MSc thesis

Sheep husbandry and Ethnoveterinary knowledge of Raika sheep pastoralists in Rajasthan, India

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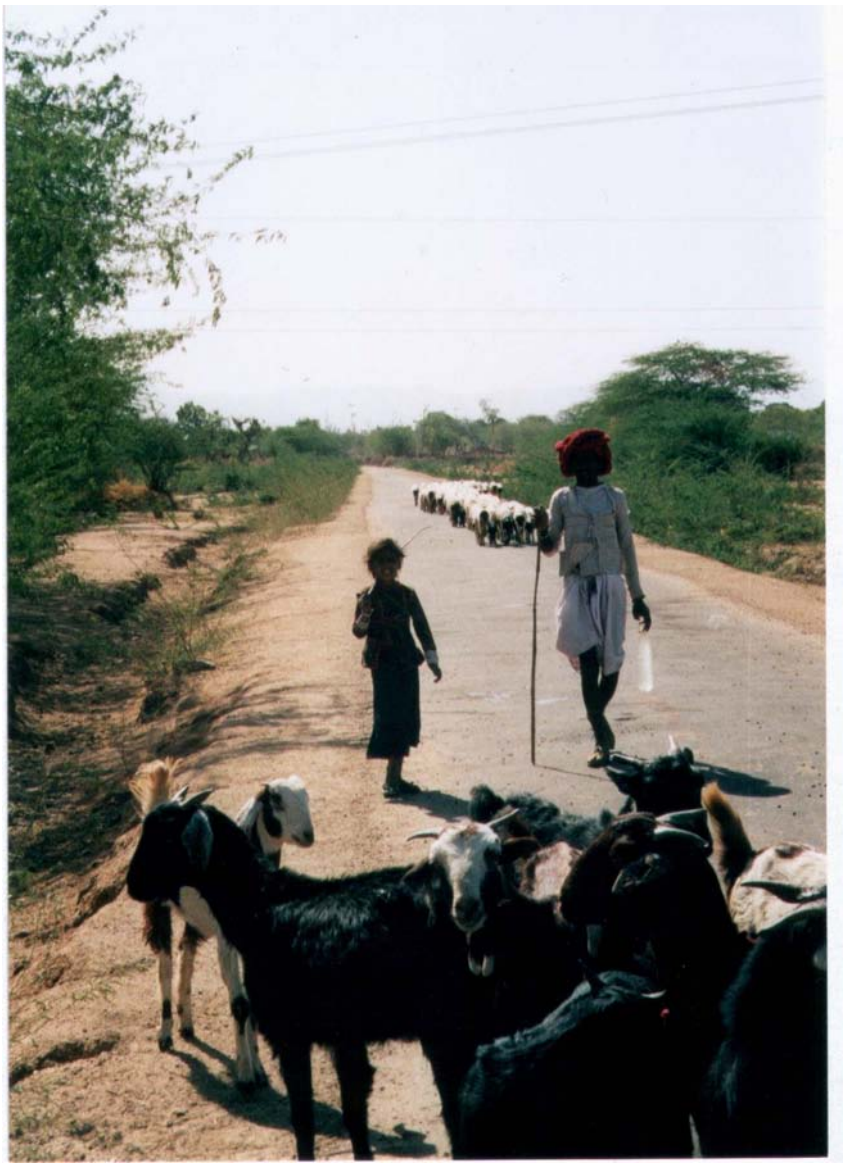

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Sheep husbandry and Ethnoveterinary knowledge of Raika sheep pastoralists in Rajasthan, India

Thesis submitted for partial fulfillment of the MSc degree in: Environmental Sciences.

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Abstract

This thesis describes the sheep husbandry and healthcare system of the Raikas in south-central Rajasthan. Aspects such as sheep breed diversity, fodder availability, disease prevalence and gender labor division are discussed. Special attention has been paid to traditional and conventional interventions and actors in sheep healthcare. Ethnoveterinary knowledge and practices are described as well as weak and strong points of both conventional and traditional institutions and actors.

Key-words: Raika, sheep husbandry, pastoralism, sheep breed diversity, gender labor division, ethnoveterinary knowledge, ethnoveterinary practices, traditional and conventional healthcare actors and institutions, medicinal plants.

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List of Abbreviations

AnGR	Animal Genetic Resources
BBC	British Broadcasting Corporation
CA	Contagious Agalactia
CBD	Convention on Biological Diversity
CBPP	Contagious Bovine Pleuropneunomia
CCPP	Contagious Caprine Pleuropneunomia
CE	Contagious Ecthyma
CHI P	Camel Husbandry Improvement Project
DAD-IS	Databank on Farm Animal Genetic Resources (FAO)
DGIS	Directoraat Generaal Internationale Samenwerking
FAO	Food and Agriculture Organization
FMD	Foot and Mouth Disease
GO	Governmental Organization
GTZ	German Agency for Cooperation
IIRR	International Institute Rural Reconstruction
IK	Indigenous Knowledge
IMF	International Monetary Fund
IUD	Intra uterine device
LPP	League for Pastoral People
LPPS	Lokhit Pashu-Palak Sansthan
NGO	Non-governmental Organization
PA	Participatory Appraisal
PLA	Participatory Learning and Action
PPR	Pests de Petit Ruminants
PRELUDE	Programme for REsearch and Link between Universities for DEvelopment
RRA	Rapid Rural Appraisal
UN	United Nations
UNEP	United Nations Environmental Program
USA	United States of America
WHO	World Health Organization
WTO	World Trade Organization

1. Background and motivation for the study

1.1. Failure of development efforts

Peasants all over the world have developed their own forms of farming to survive. Their way of farming is determined by local possibilities and limitations of ecology and within the social, economic and political structure of their countries and the whole world.

Furthermore it is estimated that a large part (three-fourths) of all farming families are scarcely in a position to buy machinery, fertilizers, insecticides, hybrid seeds or veterinary medicines. These low external input farming systems produce a large part of the total agricultural production world-wide and livestock plays an essential role in the agrarian economy of developing countries. More than half of the rural population depends at least in part on livestock for their livelihood, and 12% of the world's population is entirely dependent on livestock production. In the developing countries the role of livestock is often multi-purpose: a source of subsistence (milk, meat, wool, eggs, hides), draught power, manure, additional income (from the selling of animal products), investment, spiritual or religious functions, security and social status.

The classification of livestock production systems can be done based on the relative importance of livestock in the system (animal based, mixed crop-animal, crop based), scale of operation (large versus small), utilisation of outputs (subsistence versus commercial), and source of feed (uncultivated lands versus cultivated lands). Broadly, the systems can also be classified into migratory and sedentary systems. (de Jong *et al*., 1992). Livestock can be seen as a subsystem within a farming system. The lack of appropriate technologies being developed to match the perceptions and resources of farmers can be brought back to this lack of perception where it concerns the role of livestock in a wider perspective than livestock production in itself (Cornelissen, 2001)

In contrast with earlier development activities which were initially only involved with the most modern forms of livestock production, including supplies of livestock mainly intended for large-scale dairy farming, these traditional systems need a thorough, interdisciplinary study which consist of a socio-economic and an agro-ecological analysis, as well as analyses of livestock production and official policy. There is no shortage of examples where the actual technology to improve livestock systems in the developing countries were technically inappropriate. This is particularly the case where technologies that work in western countries were transferred to developing countries. A classic example has been the repeated attempts by Dutch government to introduce high yielding Friesian/Holstein cattle into developing countries to increase milk production. Bred for intensive (high input, high output), temperate production systems, these breeds have failed to produce under adverse climatic, disease and management conditions associated with developing countries (Geerlings, 1998).

The multi- and bilateral development institutes (incl. The World Bank) have paid much attention to the development of livestock sectors in developing countries. Set aside some exceptions, mainly in Latin America, Europe and North Africa, the results where disappointing. An internal review of World Bank lending concluded that based on the bank's own criteria of economic return, more than 37% of projects reviewed in 1991 should have been considered unsatisfactory. In the water supply and sanitation sector, 43% of projects were experiencing major problems, in the agriculture sector, 42% (Bond W. 1996).

From the analyses of literature it can be concluded that many projects have failed because of the lack of understanding of social, economic, cultural, environmental, and political factors which influence the decision making of the people for whom these development programs are supposed to benefit (Davis 1995, DGIS 1997, Fernandez 1991, Hooft van't 1995, Mathias *et al*, 1999, Perezgrovas 1992, Vijfhuizen 1992, WWVA 1994). Other important reasons for these disappointing results are; oversimplification of problems; lack of institutional capacity to conduct projects; skepticism about farmer's knowledge and potential contribution, predetermined thinking patterns and gender-blindness, i.e. that farming is a predominantly male domain and the lack of interdisciplinary research.

Livestock contribution to total food production has been growing at a faster rate than that of the agricultural sector as a whole - a trend that is expected to continue (see table 1.1). The most spectacular increases have been achieved from egg production which has increased by 330% over the last 20 years, with the meat production having increased by 127%, compared with 78% for cereals over the same period. Much of this growth has been derived largely from an increase in animal populations and stimulated, in part, by increasing income and urbanisation.

Table 1.1: Trends and projections in Food Production in developing countries

	Million tonnes			**Growth rate, %**	
Product	1996/71	1988/90	2010	1970/90	1990/10
Wheat	67	132	205	3.8	2.1
Rice	177	303	459	3.0	2.0
Milk	78.0	147.3	247.6	3.5	2.5
Meat	28.5	64.8	143	4.6	3.8
Eggs	4.6	15.3			
Fish	16.4	35.1	-	-	-

Source: After Agriculture toward 2010"

Land is becoming scarce, quantitatively as well as qualitatively, due to a more intensive use of land for crop production and subsequent loss of soil fertility, over exploitation of marginal lands and erosion. This problem is most visible in developing countries. Its solution is hampered by:

1. A lack of resources.
2. Weak government policies, at both national and international level.
3. A lack of appropriate technologies and failure of agricultural scientists to develop sustainable technologies that match the perceptions and resources of small farmers.

The problem of rising food production is, therefore, complicated because of social, political and economic constraints (Cornelissen, 2001).

In the developing countries livestock are an integral part of the local farming system, their contribution to the whole farming system is highly variable and their importance ranges from low in some systems to crucial in others such as in the agro-pastoral system described in this thesis. Several factors play a role in the functioning and production output of such a system. Some of these factors include; available resources and security of their supply, stable markets, environmental conditions (fodder availability) and disease control.

The last two mentioned seem to be of highest relevance for the described agro-pastoral system.

1.2. Animal healthcare interventions

Although several governmental and International services exist to prevent, control or eradicate major livestock diseases like rinderpest, anthrax and CBPP, small holders still have to cope with many animal diseases and low fertility and productivity of their animals. Veterinary services -on a regular bases- are out of the question for these small holders who often live to far away from cities or they can not afford to pay for veterinary services.

The third world is almost completely dependent on the import of therapeutic drugs and farmer demand for effective drugs has frequently been met by smuggled drugs with all the attendant problems of lack of consistent supply, questionable handling practices, high cost and loss of government tax revenue (Chema *et al*, n.d.). Furthermore problems associated with the use of modern veterinary drugs are: lack of knowledge of the selection of appropriate drugs, incorrect drug administration, incorrect drug doses, availability of drugs, and ignorance of disposal and withdrawal periods prior to product consumption which may be hazardous to human health. Even with increasing numbers of veterinary graduates, the delivery of veterinary services to the majority of livestock raisers is declining in many developing countries. If primary animal healthcare services are ever to reach a majority of the world's livestock, then as WHO recognised for human patients nearly two decades ago it is necessary to tap all possible practitioner resources, including traditional healers and

localised paraprofessionals. This imperative is particularly acute wherever livestock are dispersed across large and remote rural areas and/or are nomadic or transhumant, as in the case in many nations of the tropics (McCorkle 1997).

Traditionally, veterinarians [and "science" in general] have tried to discourage traditional medicines in favor of the modern medicine in which they were trained.

Scepticism about farmers knowledge and potential contribution stems from an honest appraisal on the part of many dedicated scientists. Researchers simply have not seen hard evidence to prove or disapprove its existence and value. This is partly because farmers seldom record their accomplishments in writing, rarely write papers on their discoveries and do not attach their names and patents to their inventions (Chambers *et al*, 1990).

'Modern' medicines are economically often unrealistic to those in the low income groups and those living in remote areas. Ethnoveterinary remedies on the other hand are often freely available, or have a cost in proportion to the value of the animal, or are already part of the culture, often work and are relatively easy to administer (Fielding in Lans, 2001).

On the other hand "epidemics and fatal endemic diseases are more appropriately treated with commercial drugs and more resources may need to be devoted to these large-scale concerns in the future" (Lans, 2001, p 8).

In many projects in developing countries, the way in which scientific knowledge is to be combined and interacted with local knowledge of the target-group is an underestimated aspect. Both projects with strong theoretical preferences for either scientific knowledge or indigenous face problems (Hooft van't, 1997).

With the foregoing in mind a research was conducted to gather detailed information on the sheep husbandry and healthcare system of the Raikas in Godwar area of Pali district in Rajasthan, India. Special attention has been paid to both traditional and conventional actors and institutions in animal health care, the ethnoveterinary knowledge present, problems and obstacles relating to sheep husbandry and healthcare, sheep disease prevalence in the research area and ethnoveterinary practices including medicinal plants, minerals and animal products used to cope with some of the most common diseases.

1.3. Focus and main purpose of the study

1.3.1. Research objectives

The main objective of this thesis is to document and understand the ethnoveterinary knowledge and practices of the shepherding Raikas in Godwar area and to explore whether it can usefully complement formal veterinary practices.

Other objectives of the research are:

Understanding the rationale of the sheep husbandry system of the Raikas:

Economic importance

Identify the strengths, characteristics and purpose of the sheep breeds used.

Identify the bottlenecks in sheep healthcare (main diseases, problems relating to conventional healthcare services, medicine availability, fodder deficiency etc).

Identify possible options for improvement of sheep healthcare interventions (both traditional and conventional).

Cultural and social values

Understanding women's role and contribution to sheep husbandry and healthcare.

1.3.2. Problem statement

The high rate of failure of development efforts to improve animal healthcare is evident in many publications. Main cause is the misinterpretation of peoples real needs and interests and ignorance and underestimation of local peoples knowledge and capabilities regarding animal husbandry and healthcare and in particular women's contribution and knowledge of the subject. Added to this is the problem of inadequate governmental animal healthcare services. In this study sheep rearing Raikas in central-south Rajasthan were chosen to evaluate the bottlenecks and problems they face and to evaluate the ethnoveterinary practices they employ as possible successful alternatives or complementary to the conventional healthcare delivery system.

1.3.3. Research questions

How can the sheep husbandry and management system of the Raikas be described?

Which practices can be identified as ethnoveterinary practices in the research area?

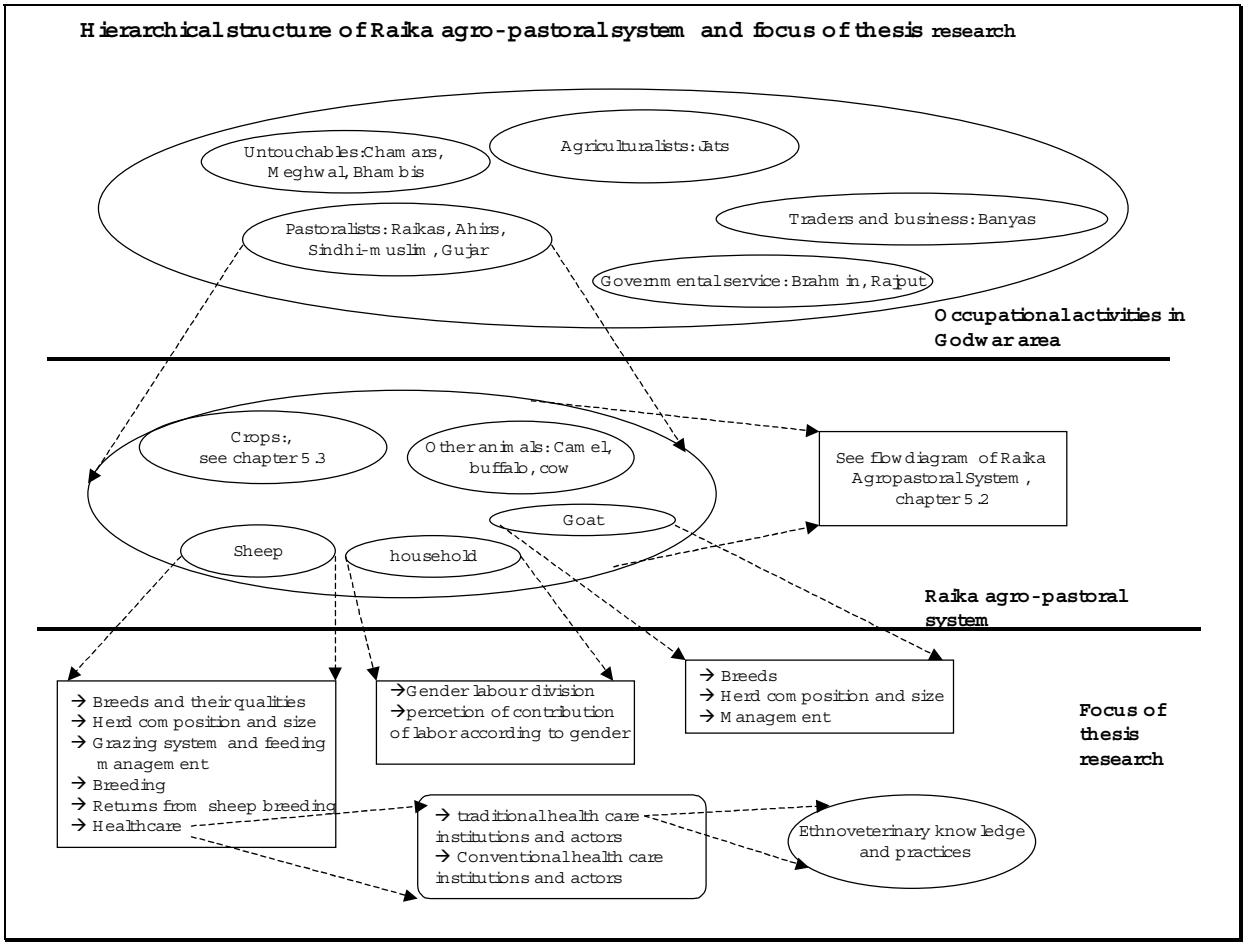
What are the main problems and bottlenecks relating to sheep husbandry and healthcare?

In what way do women contribute to sheep husbandry (in terms of labor)

What traditional treatments can be identified for the main sheep diseases and does the ethnomedical literature support the claimed uses of the medicinal plants?

What are strong and weak points of both conventional and traditional animal health care actors and institutions and how can they be improved.

The results of this study are presented in chapter 5. Chapter 2 presents a literature review on the different thesis subjects such as ethnoveterinary research, gender bias in livestock research and conventional healthcare delivery services. Chapter 4 will deal with the research design and data collecting methods and Chapter 3 will give some background information on the research area and the context of the study. The following figure will give a visual representation of the subjects and focus of the study.



2. Background information on research subjects

"I have to feed the animals, for our livelihood depends on them. We have to take more care of our animals than our children".

(Punjabi rural women, quoted in Carpenter, 1991: 70)

2.1. Ethnoveterinary research

While Western medicine strayed away from herbalism, 75%-90% of the rural population in the rest of the world still relies on herbal medicine as their only health care. The long tradition of herbal medicine continues to the present day in China, India, and many countries in Africa and South America. In many village marketplaces, medicinal herbs are sold alongside vegetables and other wares. Practitioners of herbal medicine often undergo a rigorous and extended training to learn the names, uses, and preparation of native plants. (Mc Mahon *et al*, 1994). The people's Republic of China is the leading country for incorporating traditional herbal medicine into a modern health care system. The resulting blend of herbal medicine, acupuncture, and Western medicine is China's unique answer to the health care needs of over a billion people and animals. While China melded traditional practices with Western medicine, in India traditional systems have remained quite separate from Western medicine. At Indian universities, medical students are trained in Western medicine; however much of the population puts its belief in the traditional systems. In addition to Ayurvedic medicine, which has a Hindu origin, Unani medicine with its Muslim and Greek roots is another widely practiced herbal tradition. Economics is also a factor in the reliance on indigenous cures, since the cost of manufactured pharmaceuticals is beyond reach for most of the population (Levetin *et al*, 1994).

Since the domestication of animals some 10.000 years ago, rural communities have been experimenting with and developing their own veterinary theories and techniques. The oldest known veterinary texts originate from Egypt, India and China documented as early as 269 BC. Until the early 1900's most veterinary practices could be considered traditional in the sense that they derived from long experience and underwent little fundamental change in many of their tools and techniques. With the discovery of modern chemo-therapeutics in the twentieth century, however, the First World began to abandon much of its own medical and veterinary tradition in favor of what is now viewed as conventional or modern medicine (Mc Corkle *et al,* 1996).

In all parts of the world, indigenous peoples discovered and developed medicinal uses of native plants. About 75% of the biochemical components in drugs have the same or similar forms of application in Western medicine as in traditional healing systems.

For example The National Cancer Institute in USA currently has used 50-100 per cent of its budget for research on ethno-botanical information in traditional healing methods which could be of importance for cancer and AIDS medicine.

Well-known drugs developed from tropical diversity are Vinblastine and Vincristine from *Catharanthus roseus*, Tubocurarine muscle relaxant from *Talabash curare* and Strophantin for congestive heart failure from *Strophantus gratus* (Lans, 2001). Other drugs which are commercially used in veterinary medicine and are similar to traditional plant extracts are Atropine from *Atropa belladonna*, Digoxin working as cardiotonic from *Digitalis lanata* and Adrenaline from *Ephedra sinci* (Anzuino, 1999). Not only medicinal plants form the bases of modern medicine, also ethnoveterinary practices have formed the foundation of several modern uses. For example the use of intrauterine device (I.U.D.) In human medicine originated from traditional veterinary medicine. Desert nomads placed small stones into the uteri of camels to prevent pregnancy during long caravan journeys. This was the foundation for the modern use of I.U.D. as contraceptive (Adejuwon *et al*, 1985).

Ethnopharmacological surveys provide the rationale for selection and scientific investigation of medicinal plants, since some of these indigenous remedies are already used by significant numbers of people over extended periods of time (Lans, 2001) Most pharmaceutical companies have some form of research programs investigating plants with the aim of creating allelochemicals (bioactive secondary compounds) and new marketable drugs. Their findings are often based on well funded research, it is estimated that it cost $320 million to develop a new drug over 10-15 years (Anzuino, 1999).

Historically both human and animal medicine have relied heavily on traditional treatments and plant materials. Even now in human healthcare 80 to 90 per cent of the planet's inhabitants still rely mainly on traditional treatments and practitioners. Similar figures appear to hold for animal healthcare (Mathias *et al*, 1996). The traditional theories or indigenous knowledge which is local knowledge unique to a given culture or society still forms the basis for agriculture, health care, food preparation, education, environmental conservation and a host of other activities. It is build upon and passed down from generation to generation, usually by word of mouth. Farmers and livestock raisers throughout the developing world rely on traditional practices to keep their animals healthy. Such ethnoveterinary medicine includes the use of medicinal plants, surgical techniques and management practices to prevent and treat livestock diseases. Interest in ethnoveterinary medicine has risen over the last decade. Some scientists and development professionals recognize its potential as an alternative or complement to Western-style veterinary medicine (McCorkle *et al*, 1996).

Ethnoveterinary also known as veterinary anthropology or local knowledge systems is a relatively young discipline in the sense that it got recognition only during the last 10 to 15

years. The term ethnoveterinary was invented by McCorkle in 1986. It was first used by her in her article “An introduction to ethnoveterinary research and development”.

From analysis of literature on ethnoveterinary medicine some conclusions can be drawn. Ethnoveterinary research and development is still very young, field research has mainly been done in Africa, less in Asia and very little in Latin America and elsewhere. These researches are mainly descriptive (practices, prescriptions, linguistic analyses). Few analytical studies (e.g. Bauman et al., 1989 compared the knowledge of pastoralists with epidemiological data on contagious *caprine pleuropneumonia*) have been carried out (Mathias, 1996). Major work in this field has been done by women (Evelyn Matthias and Constance McCorkle especially), a veterinarian and a sociologist, a combination which has led to a broader understanding (Van’t Hooft, 1995).

Ethno- and western veterinary medicine have much to learn from each other when it comes to their practical application. As Last (quoted in McCorkle *et al.*,1996) observes for medical systems cross-culturally, “In theory.....all systems may work; in practice, all have successes and failures, with some systems scoring much higher in particular areas of medicine depending on the social, cultural and economic context in which they are applied”. Indeed, it would be naive to think that either ethno- or Western science alone is likely to provide a sufficient solution for all development problems present today. “The aim is not to impose one medical paradigm on another but rather to create contact points between them” (Salih quoted in McCorkle *et al.,*1996).

2.2. Gender bias in livestock research

Predetermined thinking patterns and the fact that livestock research has long been dominated by male researchers has caused gender bias in social and natural sciences.

“This means that scientists take men’s behavior and predominance to be ‘ standard’ (e.g., men are the ‘farmers’, ‘foresters’, ‘leaders’, ‘shamans’ etc.) whereas women are given little importance or their behavior is seen to be ‘deviant’ in comparison with the male standards” (Howard Borjas, 2001 forthcoming).

As gender is the primary social differentiation among adult economically active members of a society, it is logical that specific spheres of activity will become the specialized domains of different genders, as they increase their knowledge and skill over time. As a result of this gender specialization, the indigenous knowledge and skills held by women often differ from those held by men (Fernandez, 2000). Thus gender-based division of labor has an effect on the ethnoveterinary knowledge of men and women. It also implicates that interventions focus on problems identified by men and thus projects neglect important human resources, for example, those receiving para-veterinary training are usually men (Davis, 1995). Research

and development efforts have often treated the household as the unit of planning, this does not necessarily deliver benefits to all members of the family. Assessments of poverty based only on household income may conceal much hidden poverty. Members of a household have different positions and different needs and can therefore not be assumed to have the same benefits from research and development efforts.

Most authors indicate that herding and the care of livestock are almost exclusively the domain of men. The unwritten implication is that women have only limited knowledge of animal health care issues. It is clear from recent publications that such perceptions have consciously or unconsciously excluded women from the design and implementation of development projects (Awa *et al.,* 1992). This implicates that women knowledge is not recorded and an important body of knowledge is being missed.

Due to male cash labor and migration, more and more women have the sole responsibility for the care of animals, which implies a shift in the use of ethnoveterinary remedies in relation to western drugs. There is then a need for ethnoveterinary info for these women. Also because of women handling small stock, dead animals, processing of milk and meat and the care of young and weak stock at home, they need to be included in any ethnoveterinary research.

Young (1993), Perezgrovas (1996), Davis (1995), and McCorkle (1996) all agree that research has neglected to examine women's knowledge on animal health. Only a handful of projects have addressed, or are addressing, women's knowledge in animal health systems specifically. These include the university of Chiapas work with the Tzotzil shepherdesses and their sheep (Perezgrovas, 1996).

2.3. Governmental animal healthcare services

Animal husbandry is the most important activity in rural Rajasthan in which sheep husbandry takes up an important part. Income from livestock accounts for 30% to 50% of the rural households income, for pastoralists this figure is much higher, ranging up to about 90%. Livestock sector tops in rural employment with 4.50% growth rate against 1.75% for all sectors and 1.10% for agriculture (Kurup, n.d.).

However India still has many animal epidemics, across all species and recurring incidence of the epidemics (most importantly Foot & Mouth Disease) which severely affect the livestock economy of the country. Livestock enterprise in India is predominantly the endeavor of the small holder. Over 70% of all households own livestock and earn supplementary incomes out of them. Though losses due to livestock diseases had not been precisely quantified, estimates are that the total annual loss is around Rs. 50 billion some 10% of the total output value of the entire livestock sector in India in 1991 (Kurup, n.d.). Figures on losses due to specific sheep diseases could not be obtained, but since sheep husbandry takes up a large

part of the livestock sector- especially in Rajasthan- these losses are substantial. Foot and Mouth disease, peste des petits ruminants sheep pox and haemorraghic septicaemia are some of the sheep diseases which cause substantial losses in Rajasthan in terms of smaller average returns to -in this case- the Raika sheep breeders and to the livestock sector in India as a whole.

Furthermore, India's inability to eradicate (or even control) animal epidemics, has compromised the country's competitive advantage in the global market place, as non-compliance to the "sanitary and phyto-sanitary regulations" of the WTO deprive Indian livestock products even the benefits under the "minimum access clause" of the world trade order, open to all countries (Kurup, n.d.)

Kurup further stated that " the institutional network of the departments have grown at the expense of the quality of the services they provide, as state governments face growing resource problems to support the system (meaning public sector livestock service network). Financial constraints have reduced State Funding for these services to barely the establishment costs. There is growing realization within Governments that they will have to pass on at least a part of the cost burden for the services to the livestock owner and of the need to evolve alternate mechanisms for service delivery, in the near future".

The current system of health care suffers from a curious dichotomy. On the one hand an impressive infrastructure has been created for the delivery of health services which includes district hospitals, block level hospitals, animal health centers etc. However the percentage of the animal population actually covered by these health services is very low, this especially counts for nomadic pastoralists. Apart from poor coverage in rural areas, many other problems exist, such as, economic sustainability of such a model which requires the pumping in of more and more financial resources to sustain it. In the light of such ground realities it has become necessary to critically review the strategy that India should adopt in order to achieve self-reliance in animal health care (Balasubramanian, 2001).

In contrast to the above scenario, there exists an indigenous model of animal healthcare, which relies on local resources, has traditions of self-help, is autonomous and is entirely community supported. It has been due to the western ethnocentric outlook of health policy makers and planners that the government has so far been ignoring the existence of these indigenous traditions of healthcare (Balasubramanian, 2001).

In this regard NGO's, community based organizations, could play an important role.

The Raikas posses a large amount of ethnoveterinary knowledge but so far little efforts were made to record information on ethnoveterinary knowledge and perception regarding sheep diseases. An evaluation report on the Camel Husbandry Improvement Project ("CHIP") made clear that the camel breeding Raikas of Pali-district in south-central Rajasthan voiced their strong discontent with the difficulties of obtaining veterinary services (Köhler-Rollefson *et*

al.,1997). The same appears to hold for sheep breeding Raikas. According to a survey conducted in Pali district, livestock keepers will much rather resort to their own resources and experience, consult a traditional healer or, if all else fails, visit a spirit medium. In the survey area, the traditional healthcare system was still functioning, with people regarded by the community as especially knowledgeable in animal diseases available in most villages (Rathore *et al*., 1997).

2.4. Domestic animal biodiversity

Every week the world loses two breeds of its valuable domestic animal diversity, the UN Food and Agriculture Organization (FAO) said in its 3rd edition of the "World Watch List for Domestic Animal Diversity". The study was co-published with the UN Environment Program (UNEP). Over the past decade, FAO has helped collect data from some 170 countries on almost 6,500 breeds of domesticated mammals and birds: cattle, goats, sheep, buffalo, yaks, pigs, horses, rabbits, chickens, turkeys, ducks, geese, pigeons, even ostriches, see Appendix 2A. One third are currently at risk of being extinct, according to Keith Hammond, Senior Officer of FAO's Animal Genetic Resources Group.

The FAO Global Databank for Farm Animal Genetic Resources contains information on 6,379 breeds of 30 mammalian and bird species. Population size data is available for 4,183 breeds of which 740 breeds are already extinct and 1,335, or 32 percent, are classified at high risk of loss and are threatened by extinction. Domestic animal diversity is unique and cannot be replaced, As much as novel biotechnology may attempt to improve breeds, it is not possible to replace lost diversity. Loss of diversity is forever. Biotechnology will not be able to regenerate diversity if it is lost (FAO, DAD_IS, 2001).

There is an additional important aspect to the indigenous knowledge system of pastoralists that has been overlooked. Pastoralists must be regarded as crucial guardians of biodiversity, because they have developed and maintain a large variety of indigenous livestock breeds. Many of these breeds are adapted to specific and often very difficult environmental conditions (Köhler-Rollefson, 2000).

Virtually every pastoral group has created a specific and pheno-typically distinct animal breed. This is a consequence of the fact that in traditional pastoral societies breeding stock is rarely if ever sold, and changes in ownership occur only within circumscribed social networks, at occasions such as births, circumcisions, marriages or other crucial stages in the life cycle. Hence, the exchange of genetic material is limited to the social network within a tribe or other endogamous unit. Redistribution of genetic material between different social groups occurred only during raids of tribal warfare which were not uncommon among such groups as the Bedouins of the Somalis. But, by and large, the genetic composition of a social

group's animals remained virtually unchanged over generations. In this respect the livestock holdings of a pastoral group resemble very closely the recognized herdbook of registered breeds of western cultures: both derive from a small original population and represent essentially closed gene pools (Köhler-Rollefson, 2000)

Local livestock breeds and minor species often represent the lifeline of rural populations. While they may not be able to compete with 'improved breeds' in terms of productivity, they fulfil a much wider range of functions and provide a larger range of products. They thrive even under low levels of inputs, thus in marginal environments, their maintenance is ecologically more sustainable. Requiring lower levels of health care and management, they entail a lower work load for women in comparison with improved breeds (IK Development Monitor, 2000).

Many of these indigenous livestock genetic resources are threatened: according to the FAO, one third of the world's estimated 5000 livestock and poultry breeds are endangered. Maintenance of livestock genetic diversity is mandated by the Convention of Biological Diversity (CBD). This legal instrument specifically calls for the conservation of agro-biodiversity in the environment that have nurtured and shaped it. It also emphasizes the need for the active involvement of indigenous communities and the role of local knowledge and institutions in conservation. But so far the groundwork for such an approach has not been laid. Indigenous knowledge and institutions that maintain domestic animal diversity are only now beginning to be explored (*ibid*).

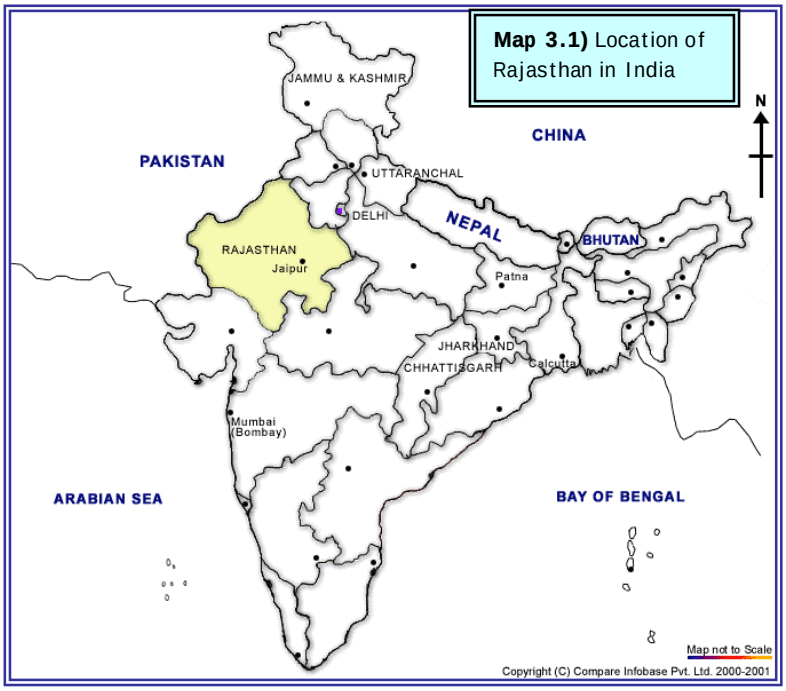
3. Background information on study area

3.1. Rajasthan

Rajasthan is a state in north-western India, see map 3.1. It covers 342,239 square kilometers and is the second largest state in the country. Only Madhya Pradesh is larger. Rajasthan means "the land of the *rajahs* (or kings)". The state has a long border with Pakistan, and contains a large area of desert. It covers 68% of the state's geographical area and represents 61% of the area covered by desert in India.

The state capital is Jaipur. Geographically Rajasthan comprises of two distinct regions divided by the Aravalli range. The Aravalli Range runs from Mount Abu in the south-west to Khetri and beyond in the north-east. They divide the state in half and rise to 5,577 feet (1,700 meters). To the north-west is the Thar desert. This region is arid, sandy, and far less productive than the land to the south-east.

Within the arid and semi-arid part of Rajasthan, annual rainfall varies from 100 mm in the Jaisalmer area in the extreme west to 450 mm at its eastern boundary which is the Aravalli mountain range. Rainfall occurs mostly during the monsoon months from July to September. With 48 persons and 80 heads of livestock per square kilometer, the Great Indian (Thar) Desert was by the 1970's supporting a higher density of human and livestock populations than any physically similar area in the world (Köhler-Rollefson, 1999).



Map 3.1) Location of Rajasthan in India

3.2. Animal husbandry in Rajasthan

The rural economy of Rajasthan has traditionally been based on livestock kept on common property resources. More than 80% of farmers own animals and livestock ownership is much more evenly distributed than that of land. While keeping of large animals (cattle and buffaloes) is usually integrated with agriculture, there are also many specialized animal herders (pastoralists) who have a large number of animals but own little land" (Köhler-Rollefson *et al*, 1999). Livestock includes sheep, cattle, goat, buffalo, camel and donkey.

According to the livestock census of 1997, Rajasthan has about 7% of the country's cattle population and contributes over 11% of the total milk production. Rajasthan has about 20% of the country's sheep and goat population of which the sheep contribute 40% of the mutton and 42% of the wool produced in India. 70% of India's camel population can be found in Rajasthan, these camels are an important means of transportation and important draught animals. Raikas own more than 90% of the camels in the area. Less then 10% of these Raika families own camels. Sheep are the second most numerous type of livestock in the state of Rajasthan. Goats are the most numerous type of livestock in Rajasthan. They are kept throughout the state, but their importance is relatively higher in the desert areas.

"Nomadic pastoralism is critically important to the economy of Rajasthan. Aridity and poor soils, especially in the western districts, where the homes of most migrant shepherds are located, make it well-suited to a combination of agriculture and livestock rearing. However, the large number of animals in these districts cannot be supported by existing fodder resources. While part of the fodder deficit in the state is met by importing fodder from the neighboring states of Punjab and Haryana, a significant proportion is met through the migration of animals, especially sheep" (Agrawal, 1992).

3.2.1. Raikas

Raika agro-pastoralists are one of several, but perhaps numerically the largest, migrant groups in India. Various estimations place their population at around half a million people. The number may well be higher since migrant populations, because of their mobility, are often underestimated. Within Rajasthan, Raikas dwell primarily in the drier western districts of Jaisalmer, Barmer, Jodhpur, Jalore, Pali and Nagaur. Depending on their access to water and fodder, the amount of cultivable land they possess, the size of their flocks, and the composition of their households, Raikas may migrate for anywhere between three to twelve months a year (Agrawal, 1999).

According to a large number of historical references, the traditional occupation of Rajasthan's Raika community was to take care of the camel breeding herds (*tolas*) belonging to the Maharajahs and other nobility. When the royal camel establishments were dissolved in the

first half of this century, many of the camels passed into ownership of the Raikas who switched to producing camels for the emerging market in draught animals. Lately the camel market for draught camels has been depressed and the severe decrease in grazing areas has turned camel production into a losing venture (Köhler-Rollefson, 1999).

While in the minds of many people, the Raikas are still mostly associated with camel breeding, it is actually only a minority that is active in this occupation. The majority are now specialized sheep breeders who may keep a handful of burden animals, if any. “The raikas are not mentioned in connection with sheep-breeding in early records and the switch to this occupation probably post-dates the middle of the 19th century since prior to this date sheep wool was not a marketable good” (Kumar quoted in Köhler-rollefson, 1999; p 310). The migratory system used by the Raikas can be described as trans-humance since they do have a permanent home to which they return every year. Some of the members of the Raika community take the majority of the flocks away from the permanent settlement. Only small flocks remain in the area of permanent settlement since returns do not outweigh the costs of migration.

3.3. NGO’s activities in the research area

Livestock related activities are an important component of NGO activities in Rajasthan. Most of these projects related to cattle and goats, there were no specific activities for sheep. Para-vet training was taken up by many NGOs in Rajasthan, however, the methods of paravet training that are used are in need of improvement. Furthermore NGO’s do not place any significant emphasis on the research and revitalization of livestock related indigenous knowledge and institutions, even though Rajasthan has a particularly strong tradition in this respect. In some cases, awareness about the value and even the existence of traditional knowledge is lacking among NGO staff. With one exception, none of the projects concerns itself with the needs of the nomadic pastoralists population. Migratory pastoralists in essence fall through the gaps in the NGO-network (Köhler-Rollefson *et al*.,1998).

In 1998 Köhler-Rollefson and Rathore made an overview and analyses of NGO strategies for livestock development focussing on western and southern Rajasthan. This study included conversations and discussions with NGO representatives, field visits and talks with beneficiaries, analyses of project proposals and reports, as well as the compilation of background information. Ten NGO’s were included in the study. Reading this paper it can be concluded that the reason for the lack of acceptance in regards to the official animal health system is to some extent the inconvenience of having to bring an animal into the hospital. But equally responsible might be the inadequate communication skills, as well as social disparity and distance, between university trained veterinarians and livestock owners. Interactions tend to be awkward with lack of respect on both sides. Adding up to this is the

inability of livestock keepers to cope with commercially produced medicines necessary for diseases which can not be cured by traditional intervention.

3.3.1. Lokhit Pashu-Palak Sansthan and League for Pastoral People

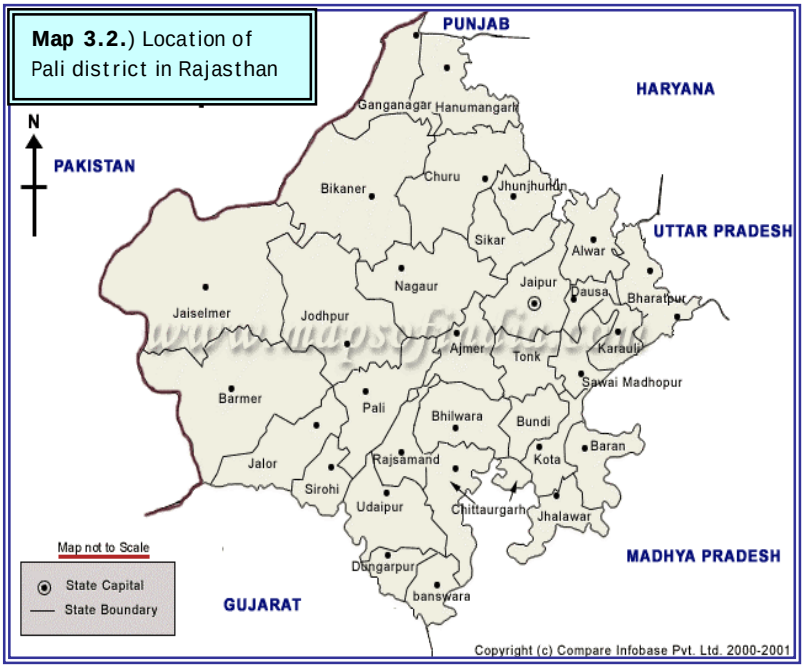
Project activities in the research area go back to a field study conducted in Rajasthan in 1990-1991 (Köhler-Rollefson 1992). This study highlighted that camel breeding communities have difficult access to grazing land and healthcare services for their animals. To address these issues, a series of projects was designed and implemented that built on or complemented each other. The first projects were the Camel Husbandry Improvement Project (1994-95) funded by the German Agency for Cooperation (GTZ). Project holder was the School of Desert Sciences in Jodhpur in collaboration with League for Pastoral People (L.P.P.). Because of difficulties of administrating the project from jodhpur, a new organization was set up with headquarters in Sadri, Pali district. At the end of 1996, it was officially registered as Lokhit Pashu-Palak Sansthan (LPPS). Since then, LPPS and LPP have implemented a number of field projects in Rajasthan (Mathias forthcoming 2001).

After undertaking an action research project documenting the traditional camel breeding system and its bottlenecks, LPP and LPPS are now involved in the promotion of camel milk marketing, breed improvement by providing male camels for breeding, organizing camel health services, researching ethnoveterinary knowledge and raising awareness about the crisis of camel pastoralism among the government and other NGO's. It is currently working together with about 50-60 families. The present research was conducted under auspices of LPPS and LPP and with logistical support of LPPS.

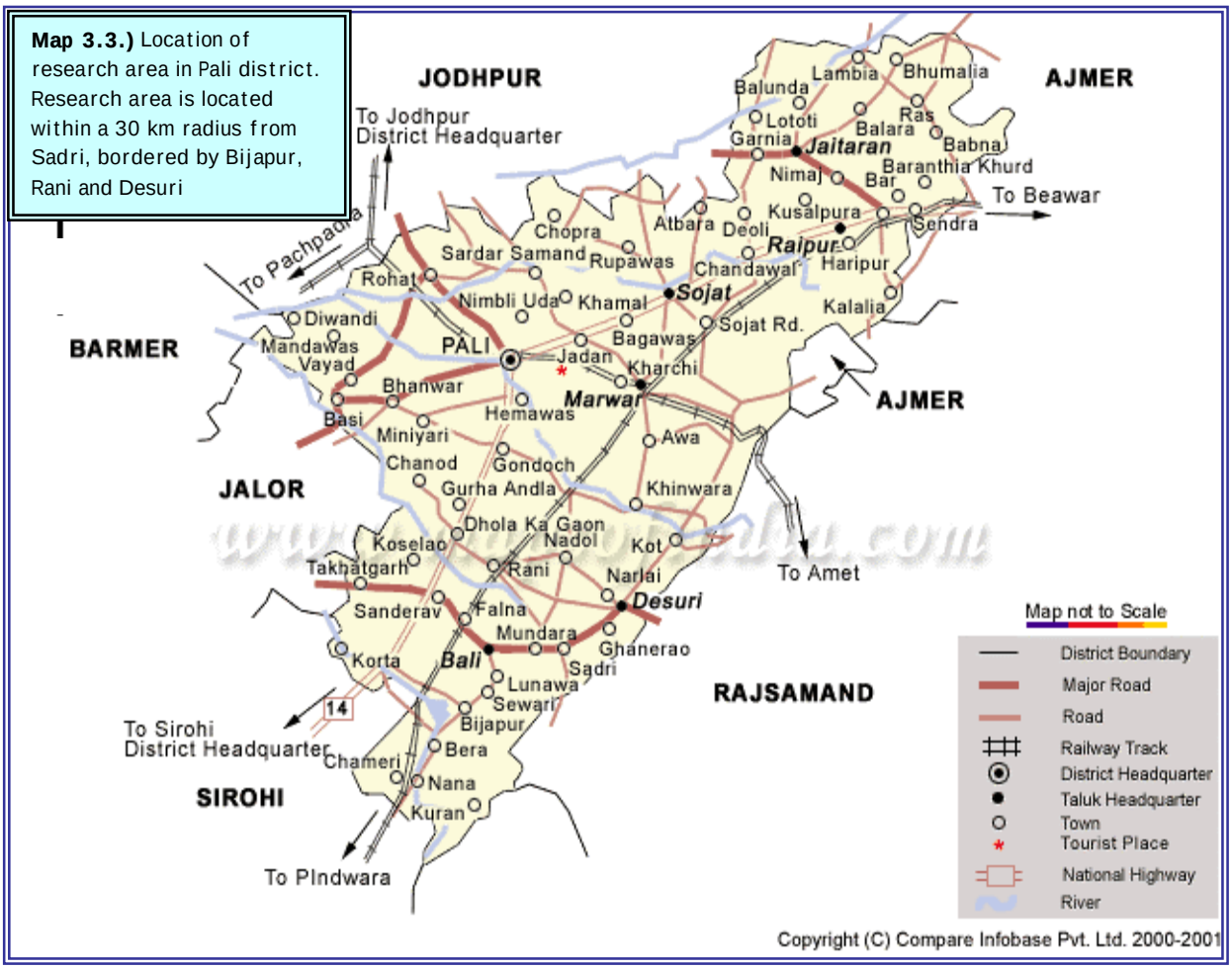
3.4. Research location

The research area is basically formed by the Godwar area of Pali District. Pali district is situated in south-central Rajasthan (see map 3.2. and 3.3.).

Godwar area is composed of Bali and Desuri *tehsils* (administrative subdivisions) that stretch along the edge of the Aravalli Hills. Bordered by Mewar in the south-east and Jalore and Sirohi in the south-west, it is a zone characterized by extreme cultural and ecological diversity. The Raikas are densely distributed in this area and form a significant part of the population. However, Godwar area is also a rather remote area that appears to be outside the zone of other NGO's other than L.P.P. and L.P.P.S. (Köhler-Rollefson, 1997).



Map 3.2.) Location of Pali district in Rajasthan



Map 3.3.) Location of research area in Pali district. Research area is located within a 30 km radius from Sadri, bordered by Bijapur, Rani and Desuri

4. Research Methodology

4.1. Introduction

Poor results in livestock development were one group of negative experiences which led to a reassessment of top down technical approaches in less developed countries and prompted discussion on alternative, more people-centered ways of working. For example Chambers (1983) noted a professional fixation among livestock workers with the promotion of exotic cattle in tropical countries in preference to research on local breeds and other types of livestock. Other notable failures were attempts to develop animal-drawn wheeled tool-carriers (Starkey, 1988) or improve pastoral production systems in dryland areas of Africa by the introduction of ranching schemes as described by Scoones, (1994) (Catley, 1999).

Until the 1980's, many livestock development initiatives in pastoral areas were based on the notion that mobile and extensive livestock production systems were wasteful and environmentally unsound. Containment of livestock on ranches and fodder improvement schemes were typically attempts to improve livestock productivity. However, more recent research showed how the opportunistic and flexible systems used by many pastoral groups were well-adapted to dynamic ecosystems with highly variable rainfall. As Scoones (1994) found, comparisons of pastoral and ranching production systems from South Africa to Mali clearly showed how pastoralists were outperforming less adaptive systems (Catley, 1999).

Social anthropologists played an important role in showing other professionals that rural people had their own, complex knowledge which had developed over many years according to local environmental and socio-cultural conditions. Rather then seeing rural people as resistant to change and irrational because they rejected the inventions of technology transfer, research on local knowledge and skills demonstrated that these resources were valuable and could contribute towards development (Catley, 1999).

This insight resulted in frustration of professionals with formal survey methods. As a result experimentation began with less formal survey methods and development approaches. Experimentation began with less formal tools such as those used in social anthropology and experience of indigenous knowledge systems began to merge with the field testing of informal interviewing, visualization and other methods (Chambers, 1994). Adding to this is the rapid pace of change occurring in many communities, short budget cycles, and the lack of funding for development projects which require faster approaches than the more time-consuming anthropological field work methods. The search for cost-effective ways to learn about the situation, needs and initiatives of rural people and to collect data relevant for planning projects led to the development of Participatory Appraisal (PA). PA encompasses Participatory Rural Appraisal (PRA), Rapid Rural Appraisal (RRA) Participatory Learning and Action (PLA) and various similar approaches and methods.

Participatory Appraisals have become increasingly popular for assessing community situations. Anthropological methods still form the basis of these approaches; however, they are modified, combined, and applied by (ideally, multidisciplinary) teams rather then single researchers (Chambers quoted in Mathias 1995; 20).

There is no blue print for the recording of IK. Many different PA methods can be used to uncover local IK, depending on the subject matter. Methods that have been used include for example the school essay method and group interviews as used by Lans 2001 for her research on ethnoveterinary knowledge in Trinidad and Tobago, use of labor calendars by gender; illustrating the division of labor for livestock tasks by Cooper and Gelezhamstin (1994) in Mongolia, use of Venn diagrams to understand institutional links between communities and agencies involved in livestock by Braganca (1994) in Mozambique and use of participatory scoring tools including “before and after” scoring for program review/evaluation as used by ActionAid Somaliland (1994).

In veterinary medicine, questionnaire surveys have been widely used to collect information from livestock owners and veterinary workers. The important features to consider when using questionnaires can be summarized as follows (adopted and modified from Catley, 1999):

Target population and sampling method: random and non-random sampling methods. Random sampling methods include simple random sampling, systematic sampling, stratified sampling and cluster sampling.

Questionnaire design: this encompasses the choice of questions to be asked, the precise wording and ordering of questions and appearance of the questionnaire. Question types are usually categorized as open, closed and semi-open-ended depending on the level of freedom offered to the informant when responding.

Administration: different ways of administrating questionnaires, e.g. by mail and personal interviews.

Quality control –reliability and validity: reliability in questionnaire design is defined as the ability of the questionnaire to produce consistent results on repeated trials. Validity is the extent to which answers reflect the true state of nature and consequently, could be checked by reference to an independent, reliable dataset.

4.2. Methods of data collection

Techniques that have been used for the present research include semi-structured open-ended interviews, observation, group interviews and talks with key informants. These techniques are widely used and are recognized as effective ways of getting valid, detailed information from "local experts." Discussions of these and other PA techniques can be found in Waters-Bayer (1994), IIRR (1996), Catley (1999) and RRA Notes (all issues). The

research design chosen was mostly qualitative but some quantitative data was also collected. Quantitative data was collected on respondent characteristics (gender, age, education), crop production, economic data of sheep production, herd size and herd composition, this was done by means of a standard questionnaire with open-ended questions. Qualitative data on ethnoveterinairy knowledge, disease perceptions, breed diversity, gender-labor division and sheep management was collected by means of a question guide with open-ended questions, observation and interviews with key informants using a list of topics to be dealt with during the interview. The emphasis of qualitative research is not on proving a causal relationship between variables but on understanding how people perceive their situation (Maas, n.d). This design is chosen because its strength lies in the collection of a great deal of "rich" information about relatively few people.

4.2.1 Workplan

Four weeks were spend on preparing the research proposal, meanwhile drafts of questionnaires for the open-ended interviews were made. The first two weeks in Pali-district were spend with a Raika family in Pachunda Kallan a village near Sojat road (see map 3.3.). This gave a good impression of day to day activities, activities relating to sheep husbandry and sheep management and women's and men's workload and responsibilities. Another advantage was that the head of the family is a governmental veterinarian. Dr. Dewasi has been working in the area for more than 10 years and his family is involved in sheep rearing. He was an important source of information during the stay in the village since he is locally known and respected, speaks Hindi and English and has both knowledge and experience with traditional and (modern)-governmental animal health services. After this stay I moved to the research area which was located approximately 100 km to the south in Desuri Tehsil of Pali-district (see map 3.3.). Eight weeks were spend on actual field research, interviewing sheep pastoralists, government vets and other key informants. A detailed outlay of the work plan for this research can be found in Table 4.1.

Table 4.1. Outlay of workplan.

WEEK	1*	2	3	4	5	6*	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Activity																				
Preparing research proposal	** **	** **	** **	** **																
Staying with Raika family						** **	** **													
Orientation on research area/Preparing field research				** **	** **	** **	** **	** **												
Conducting field research								** **	** **	** **	** **	** **	** **	** **						
Evaluation of field research												** **	** **	** **	** **					
Reporting													**	**	**	**	**	**	**	**

*Week 1 starts at the first of January 2001 * Week 6 till week 16 was spent in the research area (4 february-12 april)

4.2.2. Sampling

To draw a fairly representative sample a list was made of all villages within a 25-30 km radius from L.P.P.S. training center located in Sadri. In map 3.3. this is the area between Bijapur, Bali, Rani and Desuri. 57 villages were identified in the research area using two maps and additional information of a key informant. This list was used as the sampling frame. Since very small villages were not present on the two maps and the key informant may not know all villages or may forgotten some I choose to add another extra 10% to this number. So the estimated number of villages in the research area is 63 (57+5.7). The research area consisted of approximately 1414 square kilometers.

From the sample frame 40 villages were selected by means of a random number table. Of these 40 villages 30 villages were visited. The last 10 villages could not be visited because of time constraints. An extra 4 villages were visited at the beginning of the research to pre-test the questionnaire. Later it was decided to include the results of these four interviews (one in each village) in the overall results since the questionnaire did not change a lot and the answers were very informative. So in total 34 villages were visited, see Appendix 5A for a list of villages visited and respondents interviewed. To estimate the population size of all sheep rearing Raikas within the research area rough estimates have to be used since data was not available. Because it was impossible to make a list of all Raika sheep rearing families within each village no further selection was made. Allocation of Raika families within the village was based on pure coincidence, e.g. asking people were Raika families could be found. The unit of study originally were individual Raikas within the household both male and female, young and old. But this was practically not always possible during the actual research (see paragraph 5.1. on bias and problems in data collection).

In total 59 interviews were conducted and a total of 34 villages were visited. Per village 1 to 5 interviews were conducted, depending on number of shepherding Raika families per village, whether or not people were willing to talk, distance to village and time of visit. For more detailed information on number of interviews per village see table 4.2.

Table 4.2. Number of interviews per village

NO. OF INTERVIEWS PER VILLAGE	NO. OF VILLAGES
1	19
2	9
3	3
4	2
5	1

Of the 59 interviewees 52 were men and 7 were women. The average age of the respondents was 42 years with the youngest respondent being 13 years and the oldest respondent being 80 years. Interviews took 15 minutes to up to 2,5 hours depending on the time and enthusiasm of respondents.

5. Results and Discussion

5.1. Bias and problems in data collection

The first intention was to interview 50 men and 50 women of the Raika shepherding community in Godwar area. The total of 100 was chosen on the basis of a 90% confidence interval and a population size of about 50.000 in Godwar area (personal communication Hanwant Singh Rathore). Unfortunately due to time constraints, sickness and absence of a translator at some times no more then 59 interviews were done. In Appendix 5A a list of respondents and their age, sex, village and education is displayed. The interview guide used during the interviews can be found in Appendix 5B. For logistical and practical reasons interviews were done in a 30 km radius from Sadri. In this research area of about 1414 square kilometers the population size of shepherding Raikas is roughly estimated somewhere between 3.000 and 10.000. The results from every single interview can not be seen as individual responses of one household member, although this was the first intention of the research. Some individual interviews became group interviews and visa versa. Sometimes the interview was started of with one person and ended up with the whole family, neighbors and school children joining in. I choose not to interfere in this situation because I felt that in this way much more "rich" and important information (which otherwise would not have come up) was gathered. On the other hand, there were situations were group interviews ended up in individual interviews because people did not have the time to finish the interview or because one particular person (men) would take over the interview, this happened especially in the case were women were supposed to be the respondents.

Women and men have different responsibilities related to work, possess knowledge of different things, and have different perspectives and priorities in daily life. Therefore gender disaggregation of data was a critical method. It would have been easier or even necessary that the research interacted with local women separately from men because asking separate groups of men and women the same questions will result in information on gender differences in knowledge and perceptions and gender specific problems, needs and interests. This however posed a big problem in the present study. Apart from being interrupted by men during interviewing women sometimes felt hesitant and reluctant to talk in front of men. Since the translator was male this situation posed a problem almost every time we approached women for the interview. Raika men were surprised and could not understand that I wanted to interview their wives instead of them because "they [women] don't know about sheep, at least nothing more then we [men] know". Methods of research, interview techniques and the way to approach women need different approaches compared to that of men due to cultural and religious norms and in many cases it needs special and

careful preparation. In this research these aspects were underestimated adding to this was the fact that no female translator was found to conduct the interviews with.

This resulted in only seven interviews with Raika women. Therefore I want to stress that the data gathered during this research is generally from the viewpoint and perception of Raika men, and most probably underestimates women's knowledge and contribution to sheep rearing. This already became evident during some interviews where women were present. When men were stating for example that they were responsible for herding or treating sick animals women would sometimes tell that they also regularly take responsibility in herding or treating animals. In paragraph 5.10 the research results on gender labor division will be presented and discussed with the foregoing in mind.

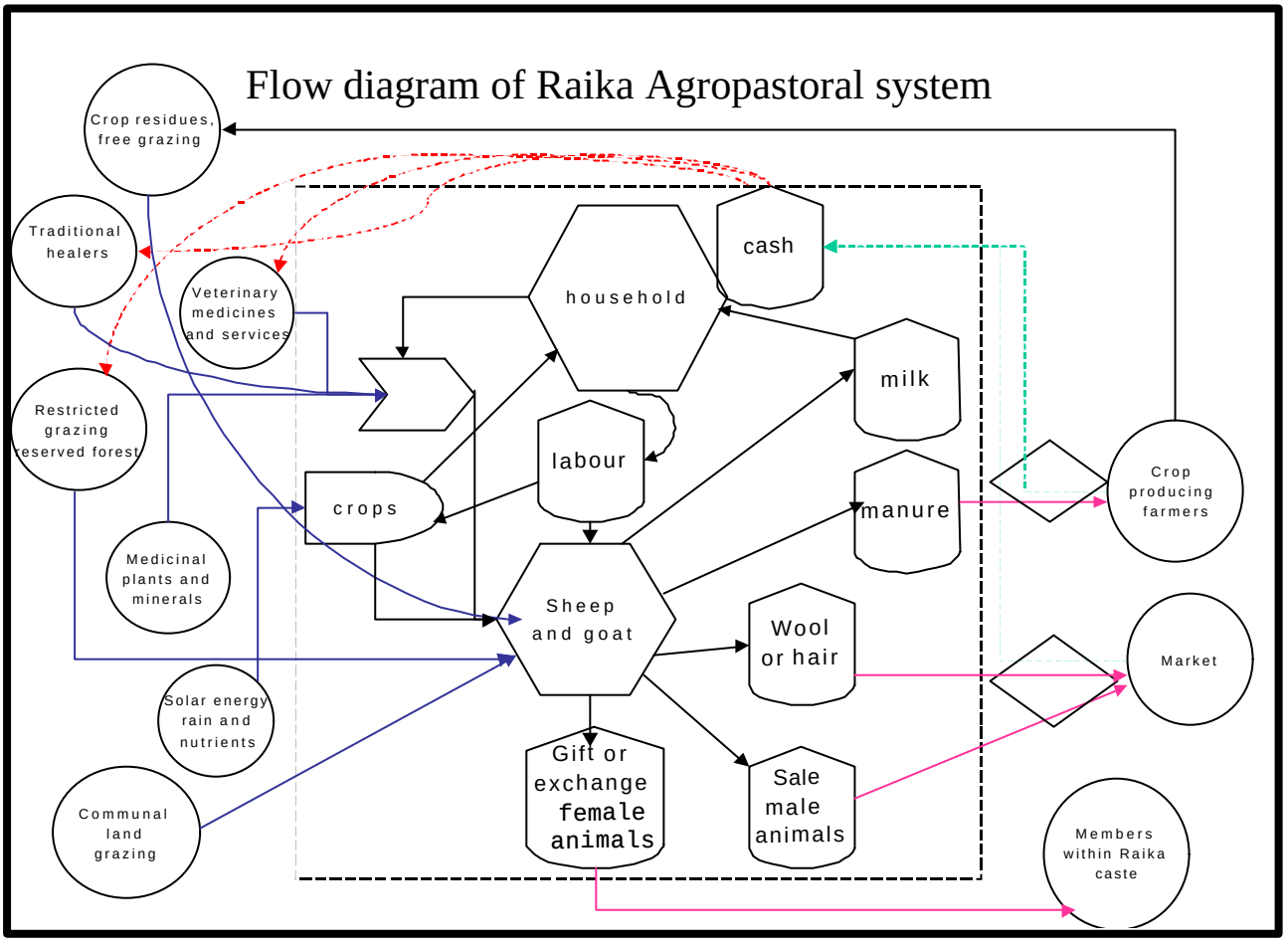
Another constraint during the interviews was that people sometimes felt hesitant to talk about such things as income and land ownership. Where possible these data have been compared with existing literature on the subject.

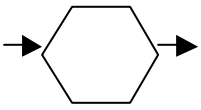
In the research proposal it was stated that a workshop was to be held as a evaluation and verification method of the research findings and as a means to analyze local problems and reach consensus about priorities for action. It was meant to include all relevant stakeholders of the research area. In this case, local NGO's, veterinarians, fieldworkers, Raika sheep pastoralists (men and women) and traditional healers. An important aspect of the workshop would have been that the Raika were able to give feedback on the research findings. This workshop would have provided an opportunity to validate ethnoveterinary practices and identify the most adequate treatments for the main sheep diseases and to establish communication between the Raikas and government veterinarians which has always been problematic. Unfortunately logistical, practical and financial constraints did not allow for such a workshop but in the future, if NGO's or GO's are aiming to improve animal health in general and animal healthcare services in Godwar area (both conventional and traditional) such a workshop would provide a useful tool. Apart from the obstacles and problems in data collection as mentioned above there were also some unplanned positive developments and opportunities during the research period. First of all the two week stay at the village of Pachunda Kalan near Sojat Road provided me with a unique opportunity of living with a Raika family, participating in daily activities and insight into cultural aspects and labor division of Raika men, women and children etc. The almost daily visits to villages and camel herds nearby to treat animals provided me with some insight into disease prevalence and the functioning of governmental hospitals and veterinarians. Furthermore the visit of Dr. Evelyn Mathias on 19 February to 8 March 2001 to Sadri in order to evaluate the projects implemented by LPP and LPPS also proved very helpful for the presented research. Among other things she provided me with comments on the questionnaire and still continues to be a rich source of information and comments.

5.2. Flow diagram of Raika agro-pastoral system

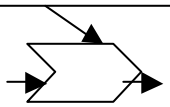
On this page a simple flow diagram of the Raika agro-pastoral system is displayed.

In the next paragraphs each of the components and flows will be discussed. In the flow diagram the household is treated as a "blackbox" ,in practice however intra-household relations, labor division and allocation of resources play a crucial role for the functioning of the system. In this thesis one of these aspects –labor division according to gender- will be discussed.

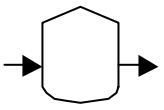




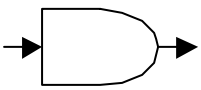
Consumer, uses, rearranges and/or decomposes converted energy



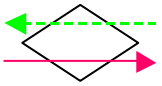
Control or management of flows of energy, matter or information



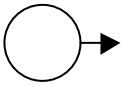
Passive storage of energy, matter or information



Producer, converts and concentrates solar energy



Price-controlled transaction



External source of energy, matter or information

5.3. Land ownership and crop production

Because sheep and camel breeding are specialized activities of the pastoral community of Raika which often keep them in migratory management systems, it is not to say that Raikas do not engage in crop production. In fact most Raika households combined crop production during the rainy season with (nomadic) pastoralism for part of the year. Of all households interviewed 45% did own a piece of land for crop production, 55% responded not to have land in ownership. This is not to say that 55% does not engage in crop production. Some Raika households rent a piece of land for part of the year or sharecrop with others.

Of all land owning Raika families the following distribution could be made, see table 5.1.

Table 5.1. Number and size of landholding in ownership (n=18)

SIZE,IN BIGHA, (1 BIGHA = 0.34 HA)	NUMBER OF LANDHOLDINGS
1-2	3
3-4	4
5-6	6
7-8	2
9-10	0
11-12	1
13-14	1
15>	1

On average land holdings are found to be around 1.8 ha per household.

Agrawal (1998) found a slightly higher figure for Patawal village in Jodhpur district. Based on 57 households he found the average landholding of Raikas to be 2.1 ha, as compared to the charans and Patels who are from higher caste and cultivate crops and have landholdings of 10.2 ha per household. The bhils and meghwals occupy the lowest position in the caste hierarchy. They hold a little more land than the Raikas do. On the other hand, they possess very few animals.

Of the different crops grown by the Raikas wheat and maize were mentioned most often, in 8 and 7 cases respectively. Furthermore Sorghum is grown to serve as animal fodder (mentioned 6 times), lentils were mentioned 4 times and finally vegetables were mentioned once.

5.4. Local breeds and their qualities

With the small holders as target population, projects have to deal with the resources available at these farm levels, including livestock. Though there is a large number of breeds in India, more then 80% of India's livestock population are of local, non-descript types.

Therefore, improving livestock resources and their management means for the small holders first of all improvement of their herds. Breeding as the improvement of a particular breed is for many farmers of second priority.

The traditional system of sheep production of the Raikas has developed in response to climatic and other aspects of the environment. The sheep kept in Rajasthan are generally hardy animals, highly adopted to extreme climatical conditions such as long drought periods and high temperatures. The majority of sheep in the Indian sub-continent are small, coarse woolled and thin-tailed. One exception is the fat-tailed Bhakarwal breed. Sheep have traditionally been given the name of the state or administrative district where they are normally raised but over the years many administrative boundaries and names have been changed. Since female sheep are usually not exchanged between castes, sheep are also caste specific, which makes classifying the breeds even a more difficult job. This already became apparent when reviewing different sources; FAO, Indian government and some literature on the classification of the different sheep breeds in Rajasthan. The Indian government uses a geographical breakdown as regards the distribution of sheep according to fleece type and productivity (Devendra *et al*, 1982) Furthermore it sees the type of sheep in Rajasthan as a breed group named bikaneri with several *varieties* such as Bagri, Chokla, Magra, Nali and Pugal. Gatenby (1991) also uses the word bikaneri to describe the type of sheep found in Rajasthan and distinguishes between Bagri, Buchi, Chokla, Jaiselmeri, Magra, Malpura, Nali, Pugal and Sonadi as different *strains* of the bikaneri breed.

The most extensive information source found was that of DAD-IS. DAD-IS is a databank on Farm Animal Genetic Resources implemented by the FAO, covering information from around the world on different animals species. DAD-IS is the key communication tool for implementing the Global Strategy for the Management of Farm Genetic resources (AnGR). It is being developed first to assist countries and country networks, and also serves as the virtual structure for the Strategy. It will increasingly provide extensive searchable databases, tools, guidelines, a library, links and contacts (FAO, DAD-IS, 2001).

Sixty sheep breeds are identified in India according to this database, 11 of which can be found in Rajasthan. An overview was made of all (known) and officially recognized (by Government) sheep breeds in Rajasthan see Appendix 5C, information was adapted and modified from the DAD-IS databank.

For the present research classification according to the various information sources mentioned above proved to be a big problem. Raikas use local names and several names are used for one specific breed and these names even differ between villages in the research area. Furthermore some sheep breeds may be caste specific, since female sheep are not sold or traded outside the caste and as stated before, more than 80% of India's livestock

population are of local, non-descript types. Resulting in the possibility that the sheep breeds as used by the Raikas in Pali-district may not have been recognized or described.

Another option would be the classification of breeds on the basis of phenotypes but as can be observed from Appendix 5C it is sometimes hard to distinguish between different breeds on the basis of color and specific visible traits. Especially the distinction between Pugal and Marwari and Jaisalmeri and Nali may be very hard in practice.

For these reasons a classification was made on the basis of local names, descriptions and qualities of breeds, and where possible national names –as used in Appendix 5C- are given.

Raikas use a classification based on phenotype and production qualities of a breed. The following local names were used for the different breeds; Boti, Bhagli, Wannermi, Tepli, Dumi, Keri, Kajeli and Jaisi. Information was gathered through interviews, observation (pointing to sheep and asking for it's breed name and characteristics) and by showing pictures of the different breeds and asking respondent to give the name used for the particular breed. In the following section the characteristics and qualities of the different breeds used by the Raikas will be summarized.

The qualities of the ***Boti*** breed lay in it's ability to cope with extreme climate conditions, low forage availability, resistance to diseases and endurance (Marwari is probably the breed name nationally used). This breed is kept mainly for its wool. In drought years this breed is said to be preferred above all the other breeds mentioned. This breed is a local breed from Godwar and Marwar area. It is a medium sized animal with black face, white body, short tail and very short ears (see picture 5.a.).

Picture 5.a) Bhagli breed (left) and Boti breed (right), Datiwara village, Bali tehsil

The ***Bhagli*** breed is kept for its milk and meat producing qualities, it is a medium to large sized animal with long, width, leaf shaped ears and dark, light brown or reddish face and white body. It's production potential is higher then that of the Boti breed but only under reasonable conditions it is able to do so. This breed is said to be more susceptible to diseases then the Boti breed especially under poor conditions therefor this breed is preferred in areas and years with better forage availability. This is a local breed originally coming from the Mewar area.

The ***Dumi*** breed is not a local breed. It's homestate is Gujarat, still it is kept in Rajasthan in reasonable quantities. It is like the Baghli breed kept for its milk and meat producing qualities. Characteristic about this breed is its round and hooked muzzle, furthermore this breed has long legs, long ears and medium sized to long tail. It's face can be a combination of brown, black, white or reddish colors according to the respondents, see picture 5.b.

Picture 5.b.) Dumi breed, Ghanerao village, Desuri tehsil

The ***Keri*** breed is a small to medium sized animal, it is a local crossbreed from Marwar area. It did not become clear which breeds are crossbred to produce this crossbreed however. It's main characteristic is it's two-colored face, mostly a combination of black and brown, reddish and brown or black and reddish (see picture 5.c. and 5.h.). Keri with small and long ears were observed as well as animals with long and small tails. This breed is not kept for one specific purpose, most probably depending on its parental breeds it is kept for wool, milk and meat or a combination of these.

Picture 5.c) Keri breed

The ***Tepli*** breed is characterized by it's very long ears and long legs. It's face is either black or white, but black is most common. This breed is kept for meat and milk production see picture 5.d.

Wannermi breed has a lot of similarities with the Boti breed, it is a local crossbreed of which one of the parents is most probably from the Boti breed. It's wool is of good quality but this breed was also mentioned to be kept for milk and meat production. This breed is well adapted to poor forage conditions.

The ***Kajeli*** breed is kept for it's meat producing qualities. It has a white, sometimes reddish face with a black colored patch around its eyes, it can have small and large ears, see picture 5.e. and 5.f.). This breed is produced by crossbreeding a local with an exotic breed. It was not clear which local and which exotic breed were meant. (Kajeli could be equivalent to Magra).

Picture 5.d) Black Tepli, Datiwara village, Bali tehsil

Picture5.e) Kajeli breed

5.4.1. Breed diversity within herds

Breed diversity per herd does not seem to depend on herd size. Small herds were observed with more then 5 different breeds and big herds would consist of only one or two breeds and visa versa. The average herd consists of 2,7 different breeds with a minimum of 1 breed and a maximum of 6 different breeds per herd. Forty three Raikas were asked how much breeds they had. This resulted in the distribution as shown in figure 5.1.

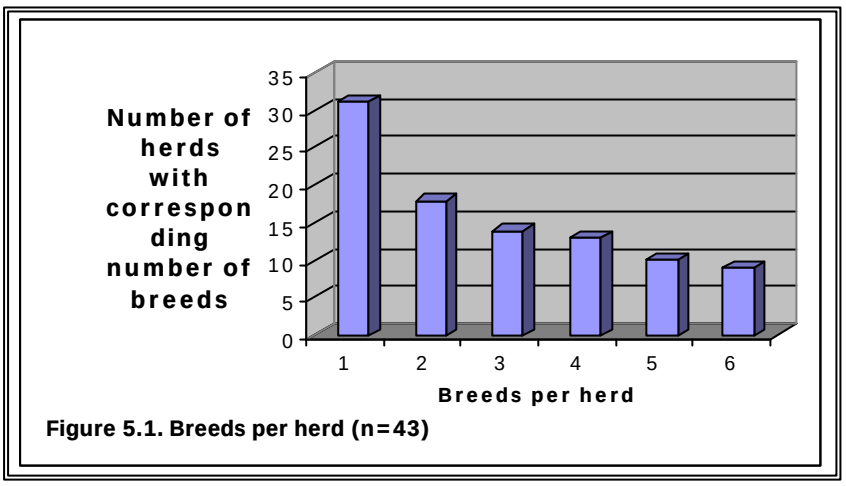


Figure 5.1. Breeds per herd (n=43)

Of all the breeds the Boti breed scored highest both in absolute number per herd as well as in presence per household, meaning that in 31 (72%) of the 43 herds the Boti breed was present, followed by the Bhagli breed which is present in 42% of all herds. The Boti breed has generally always been kept in larger quantities than the other breeds and it seems that in years of extreme drought and low fodder availability people prefer to breed or cross breed with a Boti ram, resulting in a higher percentage of Boti breed or Boti crossbreeds in a herd. On the other hand in better years people prefer (cross) breeding with Bhaghli or other breeds.

For information on the other breeds mentioned earlier see figure 5.2. Some breeds could not be identified for several reasons; some were crossbreeds and they could not be classified as a specific breed (especially if they were crossbred with an exotic breed from out of state e.g. happens while on migration) or people had different names for one breed or disagreed with each other on the breed name.

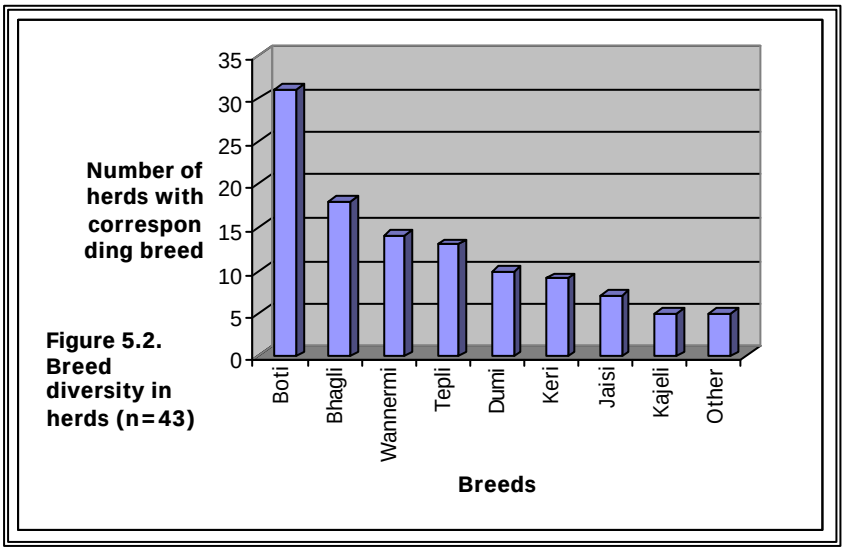


Figure 5.2. Breed diversity in herds (n=43)

There are three recognized goat breeds in Rajasthan, the Sirohi, Marwari and Parbatsari goat. The Marwari goat is black and has a good reproductive rate, but fairly low milk yields. The Sirohi and Parbatsari goats are multi-colored and produce good amounts of milk.

Earlier there were attempts to upgrade the local goat population by crossbreeding with exotic goats from Switzerland. These attempts were unsuccessful because these exotic breed proved not to be able to adapt to the extreme drought conditions in the area. Since the improved goat is not as hardy as the local breeds she needs a different approach. She needs better management and requires better forage availability. Introduction of exotic breeds can also implicate a change in (gender)-labor division, generally putting a bigger workload on women.

Traditional pastoral groups such as the Raikas are often accused of clinging to an outdated way of life and representing drains on national economies. But the contribution of pastoral societies to the maintenance of bio-diversity in domesticated animals and their role in keeping otherwise barren tracts of land habitable can not be measured in terms of money. This circumstance should be widely acknowledged on an international level and be reflected in comprehensive programs that support these traditional systems of land utilization.

The loss of hardy animal breeds, (such as the Boti breed) means a reduction of the part of the world that can be utilized by humankind. A shrinking of the human habitat is taking place just at a time when human populations are expanding at an accelerated rate and can least afford this. (IK Monitor, 1993)

The heightened public awareness about the need for conservation of biological diversity and associated knowledge system in the recent past, has largely remained restricted either to wild life or crop biodiversity conservation. Only recently has some serious notice been given to the cause of animal germplasm conservation. Even in this case, the role indigenous knowledge plays in generating incentives for conservation and utilization of germ plasm has not been appropriately appreciated (Gupta, 2001).

The government of Rajasthan is doing away with its earlier programs of cross-breeding the sheep with the exotic animals imported from Australia, the USA, New Zealand and Canada. The government's cattle breeding farms at Jaipur, Fathepur, Chittorgarh and Churu have closed down. The climatic conditions in Rajasthan are different and the off-springs (as a result of cross-breeding) have failed to withstand the heat of Rajasthan. Not one improved sheep breed such as Avivasta, Aviklin and Sardasamand was observed among the herds of the Raikas. The government seems to have changed it's policy in favor of the promotion of (improved) local breeds. In the research area some Boti rams with small eartags were observed within respondent's herds, after inquiry it became clear that these rams were freely distributed by the government.

5.5. Herd size and composition

There is a lot of difference in herd sizes between households, ranging from 10 sheep in one family to 400 in another family. In figure 5.3. the distribution of herd sizes over the different households is displayed.

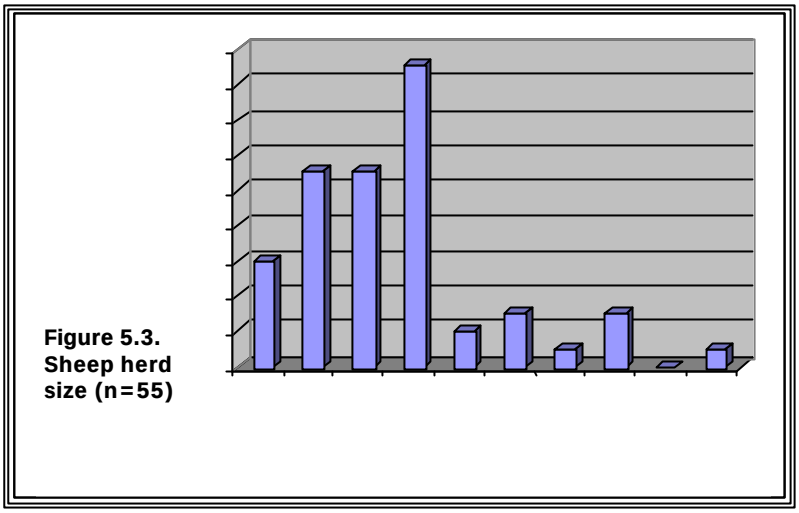


Figure 5.3. Sheep herd size (n=55)

The average herd size of the respondents (n=55) is 85 sheep with a variance of 63. Since all families interviewed also owned goats the same information could be calculated for number of goats per family. Average number of goats kept per family is 24 with a variance of 16. The smallest goat herd size consisted of 3 goats and the biggest goat herd size consisted of 60 goats.

Sixty-six percent of all households have between 1 and 25 goats in their herd, 33% of all households kept 26 to 50 goats and one respondent had 60 goats. Keeping of mixed herds of goats and sheep has several advantages. Goats can serve as wet nurses for lambs whose mothers have died. Furthermore goat milk is often used for making tea. Goats are more resistant to diseases then sheep and during the dry season goats are advantaged because trees and bushes are the only green vegetation of which goats can make better and more efficient use. During the dry season it could be observed that goats looked more healthier and had a better body condition compared to the sheep in the same herd. Since the demand for goat meat has increased and fetches higher prices then mutton the selling of kids forms an important part of the family income especially during the dry season. The lean to fat ratio in goat meat is generally wider than in mutton and goat meat has a relatively low energy and high protein content compared to mutton. Another advantage of keeping a mixed herd is that goats also lead the herd and make it easier to control the sheep. Sheep on the other hand have the advantage that they produce wool, milk, meat and dung of which the dung is of better quality and more wanted by farmers then goat dung, sheep wool get better prizes then goat hair and sheep can be shorn up to three times per year. Goat hair is only cut once a year. Keeping of mixed herds can be seen as a means of spreading risks, it produces more different products and probably also causes that income is more evenly spread throughout the year. In figure 5.4. percentages of goats related to total herd size are presented.

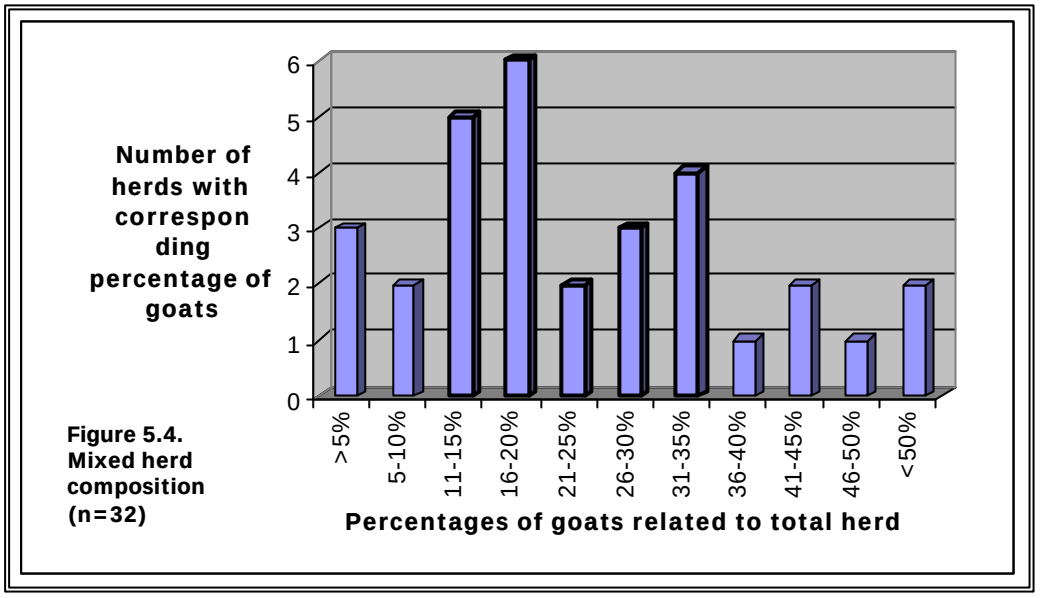


Figure 5.4. Mixed herd composition (n=32)

Raikas in the study area are more specialized sheep breeders then they are goat breeders, their herds generally consist of only a small percentage of goats, generally ranging from 11%-35%. This margin is probably the optimal margin in the given ecological and management conditions and net returns per (mixed) herd are maximized within this margin. Having more then 35% of goats in a herd can mean that net profits per herd will fall because although goats fetch higher prices for their meat compared to mutton, meat is their only tradable good (milk is used for home-consumption), along with dung but goat dung is not much wanted compared to sheep dung. In the study area ecological and management conditions are such that sheep are generally favored. Going more to the west goat are more and more favored and capable of producing given the local circumstances. Going from Jodhpur in the south-center of Rajasthan to Jaisalmer in the west of Rajasthan the rainfall is reduced (see Appendix 5D) and becomes a serious limiting factor for vegetation growth, under these circumstances goats (and camels) are generally known to survive better then any other species. Going from the study area to the west the percentage of goats related to the total herd size rose. In the more drier western desert areas herds were observed in which goats outnumbered sheep. In the Thar desert region in western Rajasthan there are generally no mixed herds kept, only goat herds are kept. One literature source was found which supports this observation. "Many of these sheep pastoralists do not live in the most arid districts of Western Rajasthan, residing instead in Pali and other districts in central Rajasthan. Goats in contrast are herded by most households in the [drier, western] area [Jaisalmer, Barmer and Jodhpur districts] " (Robbins,n.d.)

5.6. Grazing systems and feeding management

Sheep from the age of 5 to 6 months are herded daily. Shepherds will leave with their herd between 09:00h and 11:00h in the morning and return somewhere between 17:00h and 19:00h in the evening. The distance they travel with the herd basically depends on fodder and water availability in the area and herd size. Normally a distance between two and seven kilometer is traveled. Often the herding is done by the adult male member of the household sometimes accompanied by his daughter or son. A long stick of approximately 3 meter in length with on the end a saw attached is taken along. This is used to cut the branches of trees such as *Acasia nilotica* and *Azadirachta indica* of which the leaves and pods serve as animal fodder. *Azadirachta indica* or Neem tree is also used widely in Rajasthan to cure wounds and to relief animals form ecto- and endo parasites. It has antibacterial, antiseptic and anthelmintic properties. Sheep feed on these leaves and pods and the branches are taken with on the way back home to serve as fire wood.

Common Property Resources (CPR) available for grazing for the Raikas can be divided in:

Village commons or *gochers,* these are village grazing grounds used for the grazing of local livestock. Their use is being regulated by the *panchayat.*

Orans, these are grounds belonging to a temple and they are supervised by a local priest, cutting of trees within these orans is forbidden.

Waste land, not suitable for crop production.

Fallow land, for part of the year -when under crop production- this land is private property but during the fallow period land is opened up for common use.

Sometimes the Raikas make use of a reserved forest belonging to the state government, in this case they have to pay fees every time they enter the forest and for every animal that is grazed.

5.6.1. Migration

Forty households were asked if they migrate with their sheep in search for more grazing ground. 65% (26 households) responded not to go on migration. Reasons for not going on migration included; herd size is to small (64%), not enough family members to go (27%) and a combination of the two (9%). Twenty-eight percent (11 households) responded to go on migration. From these household migration would take from 2 months to up to 10 months.

The average size of herds going on migration was 136. This figure is higher then the overall average size of the herds in the research because for big flocks it is impossible to find sufficient forage in the local area and going on migration implicates that a lot of costs have to be made (transportation, consumption, bribing officials etc) therefore it is not profitable to go

with a small herd. Three households responded that they would only go on migration (7.5%) when it would be absolutely necessary (fodder scarcity or extreme droughts). Later on during the study it turned out that this figure would probably be much higher, because when people were specifically asked what survival strategies they have in years of extreme drought they would generally reply that they would go on migration.

Raikas migrate towards the east into Haryana, Uttar Pradesh, and Madhya Pradesh in herding camps each known as *dang. Dangs* comprise anywhere between 8 and 20 flocks. "While on migration, Raikas camp keeping in mind two basic requirements- fuelwood for cooking, and sufficient water for the sheep and their own needs. The particular fields in which they camp may be private, government or village land. The Raikas tend to prefer fields which have irrigation- especially from a tubewell as it can be used for sheep as well as their own drinking, cooking, and washing needs. Farmers also have a clear preference for having shepherds fold sheep in fields with irrigation because fertilization by sheep manure provide better crops" (Agrawal, 1992).

5.6.2. Fodder scarcity

The majority of constraints for production according to the respondents can be divided into two categories; high mortality and disease prevalence among sheep and fodder scarcity.

Although the Raikas have always been confronted with fodder shortages due to the harsh climate the problem seems to have gotten worse recently. Droughts are becoming more devastating. The drought now taking place in Rajasthan is India's worst drought for many years affecting some 50 million people and an equal number of livestock. During the research many wells were already beginning to dry up because of the drought.

"Though this is already the worst drought most people here can remember, they feel its effects have been exacerbated by the growing desertification of the area and the long-term disappearance of pasture" (BBC News, South Asia, May 2001).

With fodder scarcity becoming a permanent problem, farmers resort to privatization of crop residues which have traditionally been utilized as a common resource (Shanmugaratnam, n.d.). Other factors also seem to begin to play more crucial roles in the availability of fodder resources. The availability of grazing lands has considerably been reduced for several reasons. Non-livestock rearing caste are keeping more livestock. Increase in livestock has over crowded the permanent pastures and other grazing lands which results in depletion of the grazing lands and soil erosion due to trampling of livestock resulting in decreased livestock carrying capacity, this is illustrated by the picture in Appendix I.

More people are changing from traditional rain fed agriculture to irrigated agriculture due to agricultural modernization with the consequence that crops can be grown year round and the fallow period of the land is reduced considerable. So where first the land lay fallow for

several months per year for the pastoralists to graze their sheep they are now losing out on these grazing resources. Consequently groundwater is being exploited at a higher rate then the rates of recharge.

Rajasthan has also experienced population growth rates above the national average. The general trend has been one of decreasing private an common land resources per capita while the livestock population (especially goat an sheep) has been growing. The main thrust of State Intervention has been privatization of lands customarily regarded as common resources. This has led to an ever-growing scarcity of grazing resources without adequate compensation in the form of produced fodder or other substitutes (Shanmugaratnam, n.d.). The percentage of land designated as permanent pastures and other grazing lands and forests is extremely low. Rules considering grazing are unclear, to little land is opened up as should for grazing and to much money is charged by the forest department were also mentioned during the interviews. The respondents mentioned that the *Panchayats* (village committees) are closing communal grazing grounds in order to plant trees. Various studies have shown that the *Panchayats* in Rajasthan have failed to develop management systems for the pastures belonging to them. This results in insecure grazing rights, especially for lower castes, and degradation of grazing lands.

Strategies employed by the Raikas to cope with these problems are walking extra kilometers or going on migration. Buying of extra fodder was not an option for the majority of respondents. Selling of animals was seen as a last option by some of the respondents.

5.7. Breeding

The rams are generally selected in their first week of birth. Selection criteria used include; body condition (weight and strength) and general appearance. While the selection is mostly done by men the women take care of the lamb. Once a lamb is selected it is given special attention. It is allowed to drink all the milk from it's mother sometimes even supplemented with the milk of 2 or 3 other ewes. Furthermore the lamb is given oil and turmeric, in some cases ghee, eggs and extra fodder is supplied. From birth on all sheep and goat are given names. These names mostly reflect special characteristics like for example, funny shaped ears or a specific color pattern. Even in herds of more then hundred sheep every individual sheep or goat is recognized. In several occasions it was observed that animals actually recognize their names when called and respond by approaching it's caller.

Most Raika households (65%) raise their own breeding ram but sometimes other rams e.g. from the village, from within the family or from the neighbor are used, this depends mostly on the quality of the ram. Rams for breeding are used for serving at the average age of 1.9 years (22.7 months) and ewes at the age of 1.6 years (see Appendix 5E, for detailed age distribution). The age of the rams used for fist service was found to be significantly higher

than the age of the ewes at first service. Rams are used for up to 3 to 4 years and usually families have two or more breeding rams available (depending on herd size, mostly one ram for 40 - 50 sheep). These breeding rams are often of different breeds.

Forty three households were asked about the frequency of lambing per year. Number of lambing per year heavily depends on fodder availability and thus the ewes' (and rams') body condition. Since the last two years were extreme drought years ewes generally (58%) gave birth only once during the last year.

Of all herds were lambing occurred once a year 43% have their lambing season during the rainy season (July till mid-September), 33% have their lambs born during the whole year except in the dry season and 24% have their lambing season in winter (December to March). Of all herds were lambing occurs twice yearly (28%) lambs are generally born in rainy and winter season (89%). The dry season (April-June) is generally avoided for lambing since fodder availability is scarce during that period.

When interviewees were asked if they use methods to control breeding they all confirmed that they do. The method of controlled breeding is simple but effective. A rope is tied around the scrotum and sheath around the penis of a ram when he reaches sexual maturity, the rope prevents the penis from reaching erection but the ram is still able to urinate. The rope around the scrotum is probably used to keep the rope around the sheath tight and to prevent the rope from becoming lose and falling off, see picture 5.f. A similar "device" named "kunan" is used in sub-Saharan Africa to control mating (Devendra *et al*, 1982).

Picture 5.f) Kajeli ram with "device" to control mating, Dungli village, Bali tehsil

Apart from using this system rams are also separated from the ewes and kept with lambs whenever possible (e.g. at night).

The rope is generally used for 3 months per year, so it can be prevented that lambs are born during the dry season. Young animals (under 6 months) are taken care of at home where they are provided with water and fodder. Most of the households have more then one corral to separate several groups from each other, e.g. young lambs and rams are separated from the rest of the group or sick sheep are separated from healthy animals.

5.8. Returns from sheep rearing

5.8.1. Milk

Meat and wool is sold in all households (n=45), dung is either sold or traded for wheat. While on migration sheep are folded in farmers fields in return for free grazing farmers profit from the fertilization. Milk is mostly used for home consumption, only one respondent (2%) mentioned that milk is also sold occasionally, in 5% of all cases ewes were said to not produce enough extra milk for home consumption. Ghee (butter oil) is not sold but used for home consumption. It takes approximately 10 liter of milk to produce 1 kg of ghee. When sold 1 kg of ghee can fetch prices ranging from Rs 80 to Rs 100 (1 rupee = 0.021 US$). Sixty-seven percent of all respondents use ghee for home consumption, the other 33% responded not to have enough milk to produce ghee. Ghee is used on special occasions or offered to special guests. In some cases it is also offered to the gods and used for making candles which are lit at the house altar during the daily prayers. Ghee has a high nutritive value being high in protein and energy content, this makes ghee highly valued while on migration when other energy and protein sources are scarce.

5.8.2. Wool

Wool is cut 1 to 3 times per year . Seventy four percent of all interviewees (n=27) shear their sheep three times a year, 22% shear their sheep twice yearly and only in one case (3.7%) sheep are said to be shorn once a year. Wool prices have been fluctuating heavily during the last years with prices ranging from as low as Rs 2 per sheep to Rs 15 per sheep. This year wool prices were relatively low but prices fluctuated during the whole year. Twenty-one interviewees were asked what amount they earned per sheep, on average people earned Rs. 4.9 per sheep. However the spread of these responses is big, the variance of the responses is 4.6. Prices from Rs 2 to up to Rs. 10 were mentioned. For larger herds professional wool shearers are contracted, they earn between Rs. 2 to Rs. 3 per sheep. Wool buyers visit the sheep rearing families twice or three times per year to buy the wool. These wool buyers then sell the wool to larger companies in the cities fetching prices ranging

from Rs 20 to Rs. 30 per kg. (which is Rs. 10 to Rs. 21 per sheep). These companies select and clean the wool after which they sell the wool for prices ranging from Rs. 50 to Rs. 70 (which is Rs. 25 to Rs. 49 per sheep).

One sheep produces approximately 0.5 to 0.7 kg of wool. Because wool prices have been highly variable the income generated from wool sales also differ considerably per household in one household the income from wool sales accounted for only 4% of the total income while another household managed to get 24% of total income out of wool sales (see Appendix 5D).

With the overall prices of the raw carpet wool remaining almost stagnant for the last two to three years, the sheep breeders in Rajasthan, the largest producer of wool in the country, are now switching over to the production of meat in greater quantities. Meat is also being exported from Rajasthan to the Gulf countries and the prices fetched are considered much remunerative. The wool prices have remained more less at a level of Rs 20 per kg to Rs 25 per kg and what is more important to note is that the demand (of carpet wool) has not been rising. On the other hand, the meat demand all over the country is on the rise. Meat is fetching a price ranging from Rs 40 per kg to Rs 50 per kg (Jain, 1999).

The sheep breeders are at a loss in selling their produce of carpet wool due to the excessive involvement of the middlemen. The prices paid to them are much low and the situation could not be remedied as they are spread over throughout Rajasthan. ``We have tried in the past to enable the breeders get a better price but things failed to come up to our expectations" said a senior government official (Jain, 1999). The sale of wool during migration must be coordinated with the shearing since carrying the wool is burdensome. The camp leader coordinates the major tasks associated with the sale of wool. He establishes contacts with the shearers, negotiates a selling price with wool merchants, and selects a site for shearing. He often contacts wool merchants even before the shearing has been arranged (Agrawal, 1999).

5.8.3. Meat

Far out the biggest share of income is generated by the selling of male lambs.

Male lambs are sold at an age varying from 3 months to up to 12 months (5-6 months is most common), fetching prices from Rs 100 to Rs 700. Generally these lambs are kept at home and stall fed unto an age of 5 months, then they are either sold to the local slaughter house or taken with for grazing until they are sold. In times of fodder deficiency or high disease pressure lambs are sold at an young age (3-4 months). Prices depend on weight and body condition of the lambs. Mostly Raika men but also women negotiate with the slaughterer on the most appropriate price of their lambs. The following price classification can be made differentiating between qualities, see table 5.2. (source; butcher at local slaughter house in Sadri). Qualities of slaughter lambs seem to depend more on the quantity and quality of the

fodder intake during "fattening" then whether or not the lambs are of a specific meat producing breed, but not enough data was available on this. In good years when lambs can be well fed it might be that the breed of a lamb does influence the quality and thus the price the people get for their lambs. During migration the sheep are sold to Muslim traders who visit the camps at a regular times.

Table 5.2. Classification and price of mutton

QUALITY	PRICE CLASSIFICATION
Poor (3-4 kg)	Rs 100- Rs 300
Medium (5 kg)	Rs 400-Rs 500
Good (6-8 kg)	Rs 600- Rs 700

5.8.4. Dung

Income generated from the sale of sheep dung is highly variable, accounting from 7% to 33% of the total income (see Appendix F). Dung is sold per tractor trolley, fetching an average price of Rs. 800 per trolley. It was roughly estimated that one trolley contains about 400 to 800 kg of dung. If sold by the kg. dung fetches a price between Rs. 0.5 to Rs.1. Raika women are responsible for cleaning the corrals, collecting the dung and selling it to farmers. Sometimes it is traded for wheat, 80 kg of wheat is traded for 1 trolley load of dung.

From ten families sufficient financial data was gathered to roughly estimate their yearly income, see Appendix F. The data of this research have been compared with data from a household survey in Patawal village in Jodhpur district in1989-1990 by Agrawal (1999). In table 5.3. total revenues per sheep were calculated for both studies and converted to US$ to be able to compare the data (the Indian rupee at the time of this research was about half the value of that of the rupee in 1990). The average annual revenue per sheep in Patawal village in 1989-1990 was US$ 2.05 and that of Godwar area was US$ 2.56. Compared to the figures found by Agrawal ten years ago the present average revenue per sheep is 25% higher, this increase however should be set of against an increase in prices of medicine and grazing fees.

Table 5.3: Comparison of revenue per sheep In Jodhpur district and Godwar area.

Flock Number	1989-1990 Patal village, Jodhpur district		2001, Godwar area	
	Flock size	Revenue per sheep*	Flock size	Revenue per sheep**
1	95	**1.54**	60	**1.65**
2	107	**2.82**	60	**3.65**
3	110	**1.12**	60	**2.86**
4	148	**1.94**	150	**2.04**
5	212	**2.88**	200	**2.06**
6	228	**2.37**	200	**2.58**
7	255	**2.07**	100	**3.33**

8	330	**2.16**	100	**2.00**
9	350	**2.40**	50	**3.39**
10	380	**1.15**	140	**2.08**

*exchange rate of 1990 could not be found, therefore the rate was extrapolated from exchange rates in other years and was set at 0.042 Indian Rupee per US$

** exchange rate of March 2001 was 0.021 Indian Rupee per US$

The most important requirement for the survival of the enterprise –grazing for the sheep- is usually free. But shepherds incur unavoidable expenses on medicines, shearing, pay labor, and sometimes grazing (Agrawal, 1999). However in Godwar area grazing grounds are becoming scarce and higher costs are incurred nowadays on paying grazing fees to the Forest Department. In fact when asked to rank the input expenses from highest costs to lowest cost respondents would unanimously rank grazing costs to be the highest followed by sale of medicines and shearing.

A number of factors influence the returns from sheep rearing. Those that the individual shepherd can control- at least to some extent- are the direction of migration (if the herd is taken on migration); the size, and age and sex composition of the flock; the timing of sheep shearing and wool sale, and the sale of animals (Agrawal, 1992). On the other hand, there are factors over which the shepherd has little control or no control; for example, the duration and severity of a drought; the availability of water and fodder; availability of medicines; outbreak of diseases; government policies; and the prices of wool and animals.

5.9. Women in livestock production

5.9.1. Introduction

There is a lack of recognition of women's contribution to livestock production. There are several underlying reasons for this. These reasons mainly have to do with the fact that western donor-agencies and planners have been making (wrong) assumptions about rural women's place in non-industrialized countries. These misconceptions can be traced back to the colonial period (Bryceson, 1999). The model for India's earliest programs for agricultural development was the United States Agricultural Service. The heart of the agricultural program was to persuade farmers to shift from subsistence to capitalist methods of agricultural production. In brief, this program targeted men as farmers and women as housewives, thereby imposing urban middle-class gender norms on rural families. The Indian government adopted this model of development that failed to address the problems which the majority of rural women faced in their daily routines.

One of the primary shortcomings of this model is that the household was used as the unit of analysis and planning. The household approach to planning is based on the assumption that

women's reproductive labor complements men's productive labor to create a unified household set of values (Ramamuthy 1991). This approach obscures the fact that members of the household may have different needs, interests, and responsibilities.

While it is true that in many parts of the world women are engaged in the preparation of food, the picture of "the home shared by a man and a women, into which the men bring the food and women prepare it" is far from complete. The division of labor between man and women differs all over the world. It appears that forty years ago female farming (food production with little or no help from men) predominated in the whole of the Congo region, in large parts of South East and East Africa and in parts of West Africa (Bryceson 1999). Also in many Latin-American countries such as Peru, Bolivia and Guatemala women are engaged in sheep and llama production. In Chiapas, Mexico, tzotzil women are solely engaged in sheep husbandry, producing subsistence crops, collecting medicinal plants for their family and sheep and take care of their children while most of the men are working outside the villages. So the confinement of women to the domestic sphere only would be to neglect their knowledge, needs and interests in other sectors such as livestock production. It has led to a disregard for women's productive activities as farmers, irrigators and livestock breeders and has led to the assumption that they as individuals do not need access and control to and over resources, since they will indirectly benefit from their husband's rights and access.

It is only since the last 10-15 years that the critical role of women in livestock is getting recognition. It is now well accepted that most of the critical activities like cleaning, feeding, milking and more importantly care of new born and sick animals is mainly carried out by women. However there are variations in the extent to which the work is shared by men (Rangnekar, 1998). "Rural women are involved more in the animal husbandry sector than men. Studies indicate that women spend 1460 hours per year in animal husbandry which is 16.66% of their lifetime as compared to men who work for 500 hours which is 6 % of their lifetime" (Tripathi, 1998 p114). It was not clear however on which areas these figures were based and of course the extent of involvement of men and women varies between areas, regions and socio-economic groups.

A research on gender-based ethnoveterinary knowledge and labor division among Koochi Afghan nomads by Diane Davis revealed some interesting things especially given the fact that much of what has been written about the Koochi, as about many pastoral nomadic societies in the Middle East, stresses that the role of women is confined to household duties such as cooking, washing, sewing, and making and breaking camp. Their role with respect to the animals is usually described solely in terms of milking the livestock, processing milk products, spinning, weaving, and felting the fleeces (Davis, 1995). The research revealed that responsibilities included milking, caring for sick and newborn animals, and cleaning the internal organs of slaughtered livestock. Because women spend more time in close contact

with sick and newborn animals, and are also responsible for cleaning the innards of slaughtered livestock the women appear to be more knowledgeable than the men in areas such as the ability to recognize mastitis, and the care of newborns. The women also seemed to have more in-depth understanding of the relationship between parasites, symptoms and disease. It is significant that the response of the vast majority of men (94%) was that women do not know anything about animals that men do not know as well. This is not corroborated by the results of the quiz. Several authors (e.g. Davis, 1995 and Fernandez 1998) indicate that areas of livestock expertise are closely correlated with the areas for which women have most responsibility. Therefor there is enough reason to believe that this also applies to the Raika women. And although not enough data could be gathered on their eyhnoveterinary knowledge, their responsibilities relating to sheephusbandry may also indicate their area of expertise in animal health. The results of this research show that although herding is mostly done by men and/or male relatives, Raika women have responsibilities in many other significant areas. In addition to processing milk products, the women care for newborn and young animals, which are kept in corrals near the house until they are old enough to go to pasture with the herd. The women care for the animals that are ill, and these too are kept at the home. But what should be kept in mind is that the labor division as presented in the next paragraph is the result of interviews with 52 men and only 7 women. What was striking is that female respondents have very different perceptions regarding labor division and especially their contribution seems an underestimated aspect when only taken into account men's perception, this will be discussed in paragraph 5.9.3.

5.9.2. Gender-based labor division of Raika sheep patoralists

Women have shared responsibility of herding in 13% of all households whereas men are involved in 100% of all households (87% sole responsibility and 13% shared responsibility), see table 5.4.

Table 5.4. Herding (n=54)

RESPONSIBILITY	N	%
Men	33	61.1
Male relatives (brother and/or father)	11	20.4
Women/men (equally shared responsibility)	6	11.1
Men/male relatives	2	3.7
Men/son	1	1.9
Men/daughter	1	1.9

Men are involved in feeding**,** meaning cutting fodder trees and feeding it to the animals in 80% of all households (71% sole responsibility and 9% shared responsibility) whereas women are involved in 29% of all households of which 20% has sole responsibility, (table 5.5.)

Table 5.5. Feeding; cutting fodder for stall feeding (n=45)

RESPONSIBILITY	N	%
Men	23	51.1
Women	7	15.6
Son	4	8.9
Male relatives	3	6.7
Women/men	3	6.7
Daughter	1	2.2
Whole family	1	2.2
Female relatives	1	2.2
Men/son	1	2.2
Men/hired labour	1	2.2

In 58% of all households interviewed men are involved in milking. In 50% of all households women are involved of which 42% of the women has sole responsibility for milking and 8% has a shared responsibility. From next table it can be observed that men are even more involved in milking then women which is quite surprising since many authors indicate that milking is a typically women's area of responsibility.

Table 5.6. Milking (n=50)

RESPONSIBILITY	N	%
Men	20	40
Women	19	38
Women/men	4	8
Male relatives	2	4
Female relatives	2	4
Son	2	4
Men/son	1	2

Women have main responsibility in the processing of milk. In 91% of all households they are involved in the processing of milk (83% sole responsibility and 8% shared responsibility with other household members). Men are involved in processing milk (making ghee and buttermilk) in 17% of all households (8.5% sole responsibility and 8.5% shared responsibility). This figure is also surprising since generally the processing of milk –even more then milking- is seen as a typically women's job according to literature.

Table 5.7. Handling milk products (n=47)

RESPONSIBILITY	N	%
Women	35	74.5
Men	3	6.4
Women/men	3	6.4
Female relatives	3	6.4
Women/female relatives	1	2.1
Women/son	1	2.1
Male relatives	1	2.1

As can be seen from the low respondent rate (n=20) in table 5.8. ewes are not given assistance very often during labor. Often it is not necessary to help an ewe with lamming. In 20 households people keep an eye on ewes in labor and give assistance when necessary, this is done by men in most households, (70% have sole responsibility, 85% have shared responsibility). In the other 30% of all households other family members are responsible or share responsibility. Women are involved in 30% of all households of which 15% have sole responsibility and the other 15% shares her responsibility with other household members.

Table 5.8. Assisting ewes in lambing (n=20)

RESPONSIBILITY	N	%
Men	11	55
Women	3	15
Women/men	2	10
Son	2	10
Whole family	1	5
Hired labour	1	5

Women are mostly engaged in caring for the newborn, see table 5.9., in 89% of all households they are involved, in 82% of all households they have sole responsibility and in 7% of all households they share their responsibility with other household members, mostly with their daughter and other female relatives.

Table 5.9. Care for newborn lambs (n=54)

RESPONSIBILITY	N	%
Women	37	68.5
Men	5	9.3
Daughter	4	7.4
Female relatives	3	5.6
Whole family	2	3.7
Women/men	1	1.9
Women/female relatives	1	1.9
Son	1	1.9

Women have either sole responsibility or share their responsibility of caring for sick sheep in 53% of all households. Men are involved in 83% of all households, this also include hired labor, son and male relatives. However, what became evident during the research was that "taking care of sick sheep" was sometimes perceived as looking after sick sheep, feeding it and observing it and others perceived it as giving actual treatment with antibiotics, medicinal plants or other ailments. The question was not formulated clear enough and therefor the results as presented in table 5.10 only give a very rough idea of the involvement of family members in the "care of sick sheep" (thus including looking after and actual treatment).

Table 5.10. Care for sick sheep (n=53)

RESPONSIBILITY	N	%
Women/men	18	34
Men	18	34
Women	7	13.2
Male relatives	2	3.8
Hired labor	2	3.8
Son	2	3.8
Men/son	1	1.9
Men/son, daughter	1	1.9
Female relatives	1	1.9
Daughter	1	1.9

Generally women and children look after sick animals which are kept near the home. Actual treatment of sick sheep with antibiotics is done by men, whereas the responsibility of making home-remedies such as teas and oil and turmeric and the administering of these remedies seems to be shared equally among family members. There are big differences between households in the extend of involvement in taking care and treating sick sheep. There were households in which women only took responsibility in milking and making butter milk and there were families were the men's only responsibility was that of herding and even in this activity his wife was equally involved.

As for the treatment of sick sheep outside the family context, it seems that only men are involved, either governmental veterinarians, traditional healers, spirit mediums or firing healers, all were men (see paragraph 5.10). However within the village context informal networks exist of women who teach other women how to make home remedies and treat sick sheep. Ambu from Mundara village learned about sheep healthcare from her father and mother when she was a little girl, she used to have sheep but now she is 80 years old and a few years ago all the sheep of her family were either sold or given away, however she is now teaching other women of her village, about sheep diseases, how to treat sick sheep and how to make home remedies.

From these results it can be concluded that women's main responsibilities are those of taking care of new born animals and young animals and handling milk. Milking and the care of sick sheep is also taken up by women in a considerable large percentage of households. Raika men have main responsibility in herding, feeding (cutting trees) and assisting ewes in labor and to a lesser extent taking care of sick sheep. Milking is more or less equally divided between men and women.

5.9.3. Perceptions of labor division

When the data presented in paragraph 5.9.2 is split up in information given by men and information given by women it becomes clear that men and women have different perceptions of what they and especially what others (their wives, husbands or family members) contribute in terms of labour. This became clear when the information of the female respondents was compared to those of the men.

Three (50%) out of the six Raika women interviewed claimed to share equal responsibility in herding whereas only 8 Raika men (8%) acknowledged that women contribute to herding. Ambu, an 80 year old Raika women from Mundara village said that in her village it is very common for women to go herding and she claimed to know at least 10 women who go herding regularly. Four (67%) of the women claimed to be solely responsible for milking and one (17%) shares the responsibility with her husband comparing this with the information given by the men; in 34% of households women are solely responsible and 7% share their responsibility. Five out of six (83%) women state that taking care of new born animals is done either by themselves, by their daughter or other female relatives, this is exactly the percentage given by the male respondents, 40 out of 48 (83%) male respondents states that the caring of new born is done by women.

The most striking difference in opinion/perception between men and women was seen in that of taking care of sick animals, it should be mentioned however that this could also be partly the result of the wording of the question as discussed in paragraph 5.9.2.. Five out of six women (83%) claimed that taking care of sick animals was basically their responsibility, one women said that she shares the responsibility with her husband and other family members. Whereas only 4 men (9%) out of 47 said that women are responsible for taking care of sick sheep.

Although only six women were asked about the labor division in their household which is to little to draw conclusions on, their perceptions do confirm what was already suspected (through literature; Rangnekar, 1998, Davis, 1995; observation and key informants; Hanwant Singh Rathore, director LPPS), and that is that women contribute more labor in all livestock related tasks then their male household members –and others- realise.

Thus the sheep husbandry system of the Raikas should not be seen as a male dominated enterprise but more as a system dependent on labor inputs of all members of the family. As can be seen from the tables, children often help their family in all related tasks. But because most of them also go to school (in contrast to their mothers and fathers, only 3 of the 59 respondent ever went to school) their labor input is less than that of their adult family members. However, since the majority of the respondents were adult males it might be that the labor input of children is underestimated, as was the fact with female labor input.

5.10 Animal health: actors and Institutions

Various people and institutions are concerned with animal health. Each actor has his or her strength and weaknesses. In the research area the following actors and institutions could be distinguished:

1) Livestock owners;

Sheep and camel owners (mostly Raikas) have the highest degree of self-reliance and normally treat sick animals themselves. This is partly due to the fact that they have no access to specialists because they operate under migratory conditions. But it also seems that they themselves have the largest amount of knowledge and experience in this respect (LPPS, 1999). Many of them are able to distinguish between the different diseases, know the symptoms associated with the diseases and know whether diseases are contagious or not. Since the organisms which cause disease can not be seen with the naked eye, the Raikas are generally not able to name the causative agent of disease but through experience and observation they know that some diseases are transmitted from sick to healthy sheep or that some disease have to do with eating to much green fodder (enterotoxaemia) or eating “dirty grass” (liver flukes). Many of them are competent in traditional medicine and know how to make home made remedies. On the other hand the use, application and dosage of conventional drugs is problematic. Oxy-tetracycline is injected almost in all diseases and dosages vary widely between Raikas and between individual sheep in a flock. Sometimes Oxy-tetracycline is applied topically (one interviewee claimed to apply it on lesions of animals with FMD). Commercial dewormers are given in cases where worms, parasites or flukes do not seem to be the problem, or in case of flukes the wrong dewormer is given. Although regular deworming is a good practice, overuse and inconsequent dosage can cause resistance this is also the case in overuse of antibiotics. Chapter 5.11 will elaborate more on the Ethnoveterinary knowledge and practices of the Raikas.

2) Traditional Healers:

Ghuni

Ghuni's frequently belong to pastoral communities and own animals themselves. Often ghuni treat both human and animals. Ghuni prepare medicines on the spot from plant that grow near the village and other standard ingredients that are locally available, such as ghee, oil and butter milk. Their reputation and activity areas vary. Some are known only within their own village and will only be consulted occasionally. Others draw clients from great distances and operate much like a practitioner (LPPS, 1999). Their degree of specialisation varies. A few are generalised and treat humans as well as animals. Some of them are specialised in certain afflictions or certain species (LPPS, 1999). For example, Kika Ram from Mundara village in the research area is specialised in cows and buffalo's but also treats sheep and goat. He specialises in treating birth problems, afterbirth retention, fractures, poisoning, constipation, bloat and cough.

They generally do not charge for their services, except the transportation expenses, although they are often remunerated in kind. For religious reasons, cows are always treated for free.

In the research area the ghuni was rarely make use of according to the responses of the interviewees. It seems that they rely most of all on self-treatment or the firing healer and bhopa. However for the application of the sheep pox vaccine all respondents rely on special persons, and these could also be considered as ghuni's with a specialisation in sheep pox and preparation and application of the sheep pox vaccine.

Daam (firing healers)

Cauterisation (destruction of tissue by heat) is a practice with a long historical tradition common to camel herders the world over. "Often frowned upon by conventional veterinary surgeons for its apparent cruelty and futility, the Raikas swear by this method [for treatment of disease in their animals and in themselves]" (Köhler-Rollefson, 1997: 6). One thing is certain: it is a highly complex system with possible parallels with acupuncture Köhler-Rollefson, 1997: 7)

Like ghuni, firing healers frequently belong to pastoral communities and own animals themselves, they also treat both human and animals. More then half of al the respondents said to go to a firing healer in case of sickness. It is mostly applied to sheep who have sprains or bruises but abscesses, nervous problems, coughing, liver flukes, udder problems and uncoordinated movement were also mentioned as reasons to go to a firing healer. Baga Ram Dewasi from Bagri Nagar village uses firing to treat animals and humans. He did not learn the profession from his father but from other people, he does not charge money because it is a god given profession. Location of the cauterisation point is associated with the location of the disease or problem. Animals suffering from ear infection are cauterised just behind the ear, rheumatism is treated by firing on the affected joints, eye problems are treated by cauterisation around the eyes. Kidney problems in humans are treated by

cauterisation of 4 points on the lower back, and two points just above the hip bones on the front. Timpani is treated by cauterisation of the flank of an animal and lung problems are treated by firing on the chest and cauterisation of one point on the head, the last is used when animals are coughing up blood. To enhance oestrus in an animal a point just below the anus is cauterised. Cauterisation "patterns" are not only points also stripes, crosses and triangular forms are used. Instruments for cauterisation are mostly old cooking utensils or pieces of metal (see picture.5.g.).

Picture 5.g) Baga Ram Dewasi from Bagri Nagar showing firing instruments

Cauterisation is used in many cultures and countries such as the Fulani in Kenya and the Oromo stock raisers in Ethiopia. The Lozi in Zambia treat eye infections by cauterising the area around the eye (Beerling et al, 1988). In Sudan healers treat acute arthritis in camels, cattle, horses and sheep by cauterisation of the affected joints (Babiker, 1997). Cauterisation on the chest for treatment of lung problems was observed by Anzuino (1999) in sheep in Somaliland.

3) Bhopa (spirit medium)

The Bhopa is a spirit-medium, i.e. a person in whom a god becomes manifest after he has aroused himself in a state of trance. In this condition the Bhopa is endowed with supernatural

powers and can provide help and give advice in important matters. Frequently, the Bhopas also belong to the pastoral castes. They may herd animals in daily life, but hold regular trance sessions at fixed days in the lunar cycle (LPPS, 1999). The Bhopa is visited mostly in the case of sheep pox, but haematuria, liver fluke and sudden unexplained diseases are also reasons to visit the Bhopa. Some respondents visit the Bhopa for every sheep disease and consider it as part of a whole treatment complementing it with home made remedies.

4) Governmental animal health care services and veterinarians

Despite the vast network in Pali-district of 60 veterinary hospitals in which veterinary officers are posted, 43 veterinary sub-centres in which compounders are posted and 13 veterinary dispensaries in which veterinary assistants are posted (p.c. vet. Officer Sadri), this resource is rarely made use of by the Raikas. Sometimes Raika will call a veterinarian for example in case of high mortality rates among their sheep. Most respondents claimed to have bad experiences with governmental veterinarians, some stated that sheep died, presumable after treatment by a veterinarian. Others stated that “they only write recipes” and do not bother to much about establishing the right diagnose, others stated that ”veterinarians do not understand Raikas”, “do not know about sheep” and medicines given are not effective and are more expensive nowadays.

Veterinarians on the other hand have their own vision on the situation. The veterinary officer from Sadri stated that the state governmental animal health department supplies free vaccinations for sheep pox and enterotoxemia, but that Raikas are generally not aware of it or show no interest. He further states that Raikas only buy Oxy-tetracycline and Albendazole and Nilverm and complain about the fact that no other effective medicines are available while all medicine stores sell effective drugs for almost all prevalent diseases in the area. He also told that veterinary camps are organised on a regular basis. In these veterinary camps free medicines and treatment is given, but Raikas only come to veterinary camps for the free Albandazole, Oxy-tetracycline and Nilverm and do not show interest in other services or advice given by the veterinarians. Whoever is right or wrong (the “truth” is probably somewhere in between), fact is that communication between veterinarians and Raikas is very problematic and awkward with a lack of respect on both sides and that governmental animal health care services and veterinarians generally fail to improve the health status of the sheep kept by the Raikas in the research area. This might be caused by the big “gap” between the highly educated veterinarians, often from upper castes and the traditional, illiterate Raika shepherds, considered a lower caste.

One of the “solutions” generally suggested for inadequate governmental health care services is the privatization of livestock services. Privatization is the transfer of activities, functions and responsibilities which have traditionally rested with the public sector to the private sector.

It is a process whereby the state progressively reduces its involvement and sets up autonomous structures in respect of management and finances. Privatization as a general policy of structural change is a response to the generic deficiencies of public enterprises and service delivery systems: rigid bureaucratic procedures, inefficient flow of information, monopolistic position and lack of competitors, lack of managerial spirit, deficient managerial qualities, unclear, multiple, contradictory objectives and staff problems (large number of staff, inadequately trained, and with poor morale) (GTZ, 1999).

It is difficult to state to what extent the deficiencies as stated above apply to the situation in Pali-district and to what extent privatization would be a solution. A fact is however that all veterinary graduates in Rajasthan prefer working for government, because of the relative high salaries and the fact that salaries are fixed. This means that veterinarians receive a salary irrespective of how many animals they treat and to a lesser extent the quality of their service. Privatization might in this case improve efficiency and productivity of veterinarians due to concurrence and the fact that they get paid for the quality and quantity of their services. Much has been written about the privatization of livestock services and it's possible benefits (e.g. Schilhorn van Veen, 1994, Haan ,1992 , FAO, 1997) but whatever institution a veterinarian might be working for, be it a governmental veterinarian or a veterinarian working for a NGO's or working as private practicer, what seems to be of equal importance in case of Pali-district is the manner of communication and social relation between the Raikas and veterinarians.

5.11. Raika concepts of ovine disease

5.11.1. Introduction

Due to the fact that they operate under migratory conditions, Raika pastoralists have traditionally resorted to self-treatment of their sheep and camel herds. A case study conducted in 1997 by Lokhit Pashu-Palak Sansthan (L.P.P.S) and League for Pastoral People (L.P.P), showed that traditional veterinary interventions practiced in the research area were quite extensive. It included prophylactic measures through vaccination (against sheep pox and camel pox) and isolation (of mangy animals), diagnosis (sandball test for trypanosomiasis), preparation of medicines (concotions, powders, boli), fumigation, and massage (Rathore, *et al*.,1997).

In addition to the oil and turmeric which are used to improve milk yields and ease the ewe's labor, two other substances often used are salt and alum. Both are said to improve sheep's resistance to diseases. "Local ethnoveterinary knowledge represents a bewildering mixture of efficient therapies and techniques on one hand, combined with beliefs in the supernatural and potentially dangerous and harmful practices on the other" (Rathore, *et al*.,1997).

5.11.2. Ethnosemantics and ethnotaxonomy

Ethnosemantics and ethnotaxonomy refers to a local perception of a disease and its nomenclature, aetiology, pathogenesis, diagnosis and epidemiology.

The "translation" of local disease names to western equivalents is often very difficult, because modern medicine classes diseases according to etiological (causal) information, while ethno- (or folk) disease distinctions typically rely on clinical signs, epidemiological observations, or supernatural explanations (Mathias, 1989). The Raikas in the study area seem to differentiate between sheep disease brought by supernatural entities (sheep pox and FMD, although the latter is also said to be brought by "bad air") nutritional; eating dirty grass and drinking dirty water (liver flukes) or eating to much green fodder (enterotoxaemia), "hot/cold" (haematuria) and from other animals (thakla, but also sheep pox, FMD and sindura). Disease names were found to refer either to symptoms or disease cause, e.g. in the case of haldariya, which literally resembles the word "yellow" some of the symptoms were yellow urine and yellow mucus membranes, in the case of mata (sheep pox) the disease was associated with "Mataji" (Hindu goddess) who was perceived to be the causer of the disease. Sometimes it was difficult to match a local name to a specific western equivalent. In the case of Durdi mata the western equivalent could not be matched to the local name because the disease symptoms according to the different respondents varied widely, to a lesser extend this was also the case with Hindura. In other cases diseases with similar symptoms were given different names by several respondents. The key informants (one veterinarian and one veterinary assistant working in the research area) were able to match some of the local disease names and symptoms to western equivalents, but in some cases their opinions differed, this was the case in Haldariya and Thakla, the former was perceived as Hepatitis by the veterinarian and as jaundice by the veterinary assistant and thakla was perceived as rheumatism by the veterinarian and as milk fever by the veterinary assistant. Fortunately most of the names of prevalent diseases in the area could be established due to the help of these key informants and preliminary efforts of LPP and LPPS (see Köhler-Rollefson *et al*, 1999). These include; sheep pox (mata), foot and mouth disease (khurpak), entertoxemia (fatgiya) and bottleneck (gogla), Haldariya was classified as haematuria. The equivalent of "thakla" remains unclear, but efforts have been made to match the local name with possible western equivalents. During the interviews the respondents came up with other diseases apart from those already mentioned above, these included nimji, sindura and durdi mata.

According to the perceptions of the Raika, the most common sheep diseases and problems include *gogla* (bottleneck), *fatgiya* (enterotoxemia), *khurpak* (foot and mouth disease), *mata* (sheep pox), *thakla*, *haldariya* (haematuria), *Nimji* (orf), *Sindura* (pneumonia, or other respiratory diseases), diarrhea, obstipation and "durdi mata". Other important diseases

mentioned by Dr. Dewasi of the Veterinary Hospital in Pali District are Haemorrhagic septicaemia and worms.

Raika shepherds were asked which disease(s) affect their sheep most frequently, one or two answers could be given. The results are presented in table 5.11.

Table 5.11. Most common diseases among traditionally raised sheep in research area, as identified by Raika shepherds (n=59).

RAIKA NAME	ENGLISH NAME	N	% OF SAMPLE CITING
Gogla	Bottleneck	26	44
Sindura	Respiratory disease	23	39
Khurpak	FMD	8	14
Mata	Sheep pox	8	14
Diarrhea	Diarrhea	4	7
Durdi mata	?	4	7
Haldariya	Haematuria	3	5
Nimji	Skin disease (Orf)	1	2
Obstipation	Obstipation	1	2

Apart from the diseases mentioned in table 5.11. which occur most often (meaning that these disease occur most frequently affecting most of the herd) there are other diseases which affected the sheep. Interviewees were asked what other diseases occurred in their herd during the last two years. Sheep pox were mentioned most often (29 %) followed by durdi mata (17%), FMD (15%), sindura (12%), thakla, haldariya and gogla (8%), fatgiya and diarrhea respectively in 2% and 1% of all responses. More than one answers per interviewee possible. Finally interviewees were asked to name the one disease which causes the highest mortality rate in their herd. Almost 70% pointed out that Sheep pox caused the highest death rates in their herds, in several cases reducing the herd by half or even more. Bottleneck (associated with fasciolosis) caused the highest death rates in 14% of all herds followed by durdi mata (7%) diarrhea (5%), hindura and FMD, both cited in 3% of all responses.

In the following section the results of the interviews concerning ethnoveterinary knowledge and disease perception of the Raikas will be summarized and discussed. A complete list of respondents replies to the ethnoveterinary question guide can be found in Appendix 5G.

For information on etiology, pathogenesis, diagnosis and epidemiology of the mentioned diseases I have drawn upon several sources of information namely: literature: the merck veterinary manual by Amstutz *et al* (1986), Animal health, Vol 2 by Hunter (1996) and Where there is no vet by Forse (1999), and key informants: Evelyn Mathias and the veterinarian working in the research area. I will be referring to the respondents perception and knowledge when the local disease name is used and when it's western equivalent is used I will be referring to conventional literature or key informants.

Gogla (bottleneck)

Edema under the jaw is often a sign that an animal has worms or liver fluke but oedema can also be caused by protein shortage in an animals diet or abnormalities in blood pressure (personal communication Evelyn Mathias). In the research area bottleneck is most probably caused by liver flukes, this was confirmed by the veterinarian and by the respondents of which the majority associated the disease with “eating dirty grass and drinking dirty water”

The parasite causing the edema requires moisture and certain snail species for its development. These snails live on grasses and other plants in humid environments often near water sources, this explains the Raikas perception as to what is the cause of the gogla. Liver fluke or fasciolosis is an infection of the liver of grazing animals, mainly ruminants, with leaf shaped trematodes (flukes), *Fasciola hepatica* and *F. gigantica.* In India *F. gigantica* predominates since *F. gigantica* only occurs in warm climates and *F. hepatica* are only found in cooler and high altitude areas of the world.

The Raikas consider it a specific sheep disease rather than a non-specific symptom.

The three most important symptoms as cited by the respondents were swollen jaw (100% of respondents cited this symptom), diarrhea (43%) and fever (29%). on photo 5.h. a sheep of the local Keri breed can be observed with a “bottle-neck” (edema caused by fasiolosis).

According to several sources (Merck veterinary Manual 1986, Hunter 1996 and Forse 1999) a swollen jaw and diarrhea are indeed the main symptoms of the disease but fever is usually not seen in fasciolosis. The fact that some respondents did indicate that sheep with Gogla have fever could mean that sheep have a secondary infection which is causing the fever such as pneumonia. The severity of clinical signs depends on the number of parasites ingested and the length of time over which infection takes place. The disease can be acute or chronic. With acute fasciolosis animals die quickly within one or two days, this form is mostly seen in young sheep. However the fasciolosis in the research area was most commonly of the chronical form since the majority of respondents stated that the disease took about a month from first clinical signs to death and adult sheep-especially ewes- are more severely affected. Sixty-seven percent of respondents stated that the disease causes high death rates somewhere between 50% to 100% of all sheep infected die of Gogla. Comparing these figures with literature the mortality rate of sheep infected with fasciolosis in the research area seems very high. In the dry season animals were weak and malnourished therefore the high dead rate could probably be attributed to the poor condition of sheep at the time of research. Constant re-infestation (through grazing at wells, open water sources or humid grasslands) causing sheep to ingest a large amount of parasites over a longer period could also be a explanation of the high mortality rates.

Picture 5.h) Bottle-neck in local Keri breed

Mata (Sheep pox)

Sheep pox is a viral infection of sheep and goats characterized by lesions in the skin and internal organs. When asked for the cause of the disease the majority (85%) of respondents replied that the disease is caused by “Mataji”, which is a local Hindu goddess. However most of the respondents did add that healthy sheep could also get the disease from sick sheep.

According to literature the mode of transmission is by direct contact with sick or recently recovered animals. The virus can survive for many months on contaminated hair and wool as well as in the environment. The three main symptoms as cited by the respondents are; small lesions/wounds on body and face, fever before lesions appear and weakness and lack of appetite. These symptoms are also described in the literature as being the main symptoms. All respondents claimed that within a few weeks the whole herd would have the disease, this is no surprise since the disease is highly contagious. Animals of all ages can be infected but the disease is worst in lambs and kids according to the literature. The responses of the Raikas were more divers, 40% did claim that lambs were more severely affected by the disease, the other 60% claimed that all animals are equally affected or that adult sheep get more affected. In photo 5.i. small lesions on the head -the beginning stage of sheep pox- can be seen, also notice the mucus discharge from the nose.

Picture 5.i) Sheep with "mata" (sheep pox)

The lesions become nodules, then pustules which erupt and eventually scab over. The lesions vary in number and if numerous they join up with each other; they are intensively irritant. Lesions in the mucous membrane ulcerate, and in many animals lesions also develop in the lungs and cause respiratory distress. Severely affected animals become emaciated and death can occur at any stage of the disease. Pregnant animals abort. Where the disease is endemic there is a high level of natural immunity and outbreaks are confined to sporadic cases in kids and lambs. Furthermore Hunter (1996) states that if infection is introduced into a new area by transhumant herds or flocks, outbreaks can be severe with heavy mortalities. However this could also work the other way round, Raikas could pass through endemic areas on their way back from migration and in this way infect flocks in the home area. This situation has actually been described by one respondent. This might be one of the

explanations of the incredible high mortality rates as claimed by the respondents another explanation could be the poor body condition of the sheep. From 60% to 100% of all infected animals die according to 67% of all responses. Sheep pox is the number one cause of death among the traditionally kept sheep in the research area.

Sindura (respiratory disease)

Sindura most probably represents several respiratory diseases and problems. The overall symptoms cited by the respondents were mucus discharge from the nose, coughing, weakness and lack of appetite. Bloody discharge from the nose and sneezing larvae out onto the ground were also mentioned. Possible diseases representing Sindura are: Pneumonia, Contagious caprine pleuropneumonia (CCPP), nasal bots (in the case when sheep sneeze larvae out onto the ground) and pasteurellosis. Peste des petits ruminants (PPR) also occurs occasionally in India and the symptoms also resemble those cited by the respondents . But the symptoms of sindura might also be side effects of sheep pox and FMD or other severe diseases.

During the interviews people gave several explanations as to what could be the cause of the disease(s). Some stated that the eating of a tree would cause the disease (43%), in this case it was difficult to unravel the explanation. Others stated that when sheep with a high body temperature (e.g. by standing in sun all day or when standing in an overcrowded flock or by running for a long time) drink cold water they get this disease (43%). The hot-cold concept is found in many parts of the world. Hot/cold theories are found in Asia (Ayurvedic medicine), Latin America and parts of Africa, here people interpret illness and their causation's as an imbalance between hot and cold and cures are sought to remove either the heat internally or externally by "cold" plants and visa versa. Heat comes from the sun, work, sleeping, burns and reproductive activities. Eating cold foods when the body is hot can lead to illness. Illnesses with skin changes such as chicken pox, measles, rashes, eczema and ring worm are associated with "too much heat in the body". Other illnesses linked to 'overheated are fever, pressure and headaches'. "Cold" is associated with experiencing a sudden change in temperature, drafts or getting wet. Parts of the body associated with coldness are, chest, head, back, womb, eyes, ears, discharge and arthritic pain, influenza, asthma and the common cold. (Lans, 2001).

In the case of Sindura some respondents may have been referring to pasteurellosis since sheep get pasteurellosis when they are kept close together, especially when they are kept in hot, damp environments, the disease is also stress induced. It is generally stated that healthy sheep can get the disease from sick sheep (86%) and that within a month all sheep in the herd will have contracted the disease. This is actually the case in CCPP, PPR and pasteurellosis. Mortality rate of sheep with sindura varied widely among respondents.

Fourteen percent of respondents stated that animals do not die from the disease (e.g. nasal bot seldom causes death) while 29% stated that all animals will die, this is actually the case with pasteurellosis when it remains untreated. Very few animals die is stated by 43% of respondents. Sindura is said to affect all types of sheep (rams, ewes and lambs). The diseases suggested to be the western equivalents of Sindura were solely identified by the descriptions (symptoms, aetiology, epidemiology) of the respondents. Without laboratory analyses and/or diagnoses of a qualified veterinarian, none of these suggestions can be confirmed.

Khurpak (Foot and Mouth disease)

Foot and mouth disease (FMD) is a very important and extremely infectious viral disease of cloven hoofed animals and occasionally man. European breeds of cattle get foot and mouth disease much more severe than Zebu and other local breeds.

Sheep and goat get an mild form of the disease. The virus is extremely infectious and susceptible animals may be infected by inhalation or ingestion of the virus by various means, e.g. from nearby infected animals, virus contaminated environment or in feed. Animals also get infection from people or things that infected animals have touched. People carry infection for about 24 hours after they have been with infected animals. When asked for symptoms of Khurpak the respondents named; small lesions on feet, difficulty walking, no appetite, fever and lesions in mouth. Less often excessive saliva from mouth, reduction in milk production and pregnant animals abort was cited. These symptoms are also mentioned in the literature.

Since the virus (*Apthovirus*, type C) responsible for FMD can not be seen with the naked eye (which is also the case in sheep pox) people can only guess as to what is the agent causing the disease. However through careful observation the majority (60%) of respondents were aware that healthy sheep can get the disease from sick sheep or that it is caused by something bad in the air. Others link the disease to more supernatural causes, 20% stated that khurpak is caused by a Brahmin (Brahmin are of the priest caste in India). Although FMD is an extremely infectious disease, less than 5% of affected animals die. The mortality rate may be much higher in young animals, however, due to heart muscle lesions causing sudden death without typical FMD symptoms.

Half of the respondents did indeed observe that young sheep were more severely affected by khurpak and 34% made a distinction between the death rate of young sheep and that of adult sheep with that of young sheep being higher. Approximately 50% of the respondents stated that death rates between 25% and 50% of all sheep were common. Comparing these figures to literature (less then 5% is said to die from FMD) the figures given by the respondents may seem very high. This may partly be explained by the poor body condition of most sheep especially in the dry season.

Haldariya (Haematuria)

Haematuria is rather a symptom then a specific disease. Haematuria means that there is blood in the urine which may be red or brown as a result. All respondents claim that the disease is caused by “hot” or “cold” (see sindura for explanation on hot/cold dichotomy) or a combination of the two (71%) and 29% of the respondents state that it is caused by a change in weather (humid weather). The main symptom cited by the respondents is that of red urine, furthermore pregnant ewes abort, sheep have yellow urine and yellow eyes and lack of appetite. Respondents unanimously cited that the disease occurred only in the rainy season which is reason to believe that it is probably caused by a tick-borne protozoa disease namely Babesioses, since its tick vector is prevalent in India *(Haemaphysalis spp and Rhipicephalus spp.)* and only becomes active in the rainy season. Symptoms as cited by the respondents are similar to those cited in literature on Babesiosis, these are; red urine (haematuria), weak and tired, lack of appetite, fever, mucous membranes become yellow (jaundice) and pregnant animals often abort. In all animals , Babesia infections can range from inapparent to acute severe cases, animals have fever for about a week and are sick for about three weeks followed by recovery which can be slow. Some animals die after 2-4 days or after a few weeks. Duration of the disease according to the respondents is somewhere between 3 to 30 days (see Appendix G for more detailed information).

Blood tests will be necessary to confirm Babesiosis, since some of the symptoms can also be caused by other diseases.

Fatgiya (Enterotoxaemia)

All respondents cited that animals with fatgiya suddenly jump and then die and that fatgiya is caused by eating to much green fodder. The disease occurs in the rainy season. Sometimes sheep get it while on migration in places where there is a lot of fodder available.

According to literature on enterotoxaemia animals throw their heads backwards and stretch their legs out. They soon have convulsions and often die in 1-2 hours (which may explain the “jump and die”” description of the respondents). Although not fully understood, improvement in nutrition is the usual factor that leads to the various types of enterotoxaemia. As a result, conditions in the intestines are suitable for the various types of *Clostridium perfringens* to multiply rapidly and secrete toxins causing a generalized poisoning, or toxaemia, of the animal. Because of the rapid multiplication of the bacteria takes place in the gut, the disease is called enterotoxaemia.

Thakla

According to the respondents the main symptoms are; swollen and painful joints (often hot), udder problems (abnormalities in milk or reduction of milk production), abortion of pregnant ewes, difficulty walking, weakness, lack of appetite and sheep get blind. Most respondents observed that lambs get sick after drinking milk from an ewe with thakla. Some said that a healthy (adult) animal can get the disease from a sick animal by direct contact. Mortality rate is high in thakla especially in lambs according to the respondents. It is most unlikely that thakla is Milk fever or Ca-deficiency as suggested by the veterinarian and veterinary assistant. Milk fever is often regarded as "modern, man-made'' disease commonly associated with livestock industries in the USA, western Europe, etc or anywhere where intensive animal husbandry is practiced, it is virtually unknown in extensively grazed livestock. Ca deficiency rarely occurs in grazing livestock in the tropics. Grazing livestock under extensive range systems in the tropics, even if grazing is deficient in minerals, are at levels of productivity which may not produce disease.

There are very few diseases which resemble the combination of symptoms mentioned above especially considering the mode of infection to young animals. Two diseases which resemble the symptoms and occur in India are: Brucellosis and Contagious agalactia (CA). The symptoms of these two diseases are very similar; abortion and inflammation of mammary gland weakness and lack of appetite, sometimes fever and lameness. Organisms are excreted in milk and lambs can be infected by suckling infected dams. With CA sheep sometimes get discharge from the eyes and the animals do not like bright sunlight. The center of the eyes becomes white then red and a few animals may become blind, this last symptom was cited by 24% of the respondents. Brucellosis is caused by bacteria (*Brucella abortus* and others). Animals get brucellosis from direct contact with infected animals or from eating grass or other food contaminated by infected animals. Most infection comes from aborted fetuses, placentas and discharges that come from the vagina soon after an infected animal aborts or gives birth. Lambs can be infected in the womb before birth from infected dams. The organism is secreted in milk and lambs can also be infected by suckling dams.

CA is caused by mycoplasmas (*Mycoplasma agalactiae*)- they are like bacteria. Animals get CA from direct contact with infected animals or their infected discharges. Sucking infected milk or colostrum is the main source of infection to young animals.

Nimji

Respondents generally described the symptoms as lesions/wounds which start from the nose and mouth and slowly infecting the muzzle and other parts of the head. Discharge from the nose, lesions in the nose, hair inside nose is gone were also mentioned. One respondent even mentioned little worms inside the nose, in this case he was probably referring to nasal

bot. Another respondent was referring to these same symptoms but did not use “Nimji” to name the disease but “Sindura” (see section on Sindura). This again demonstrates the difficulty to classify local diseases according to western science since classification and concepts of traditional medicine are different from those of western science. Clearly, local and western criteria for semantically identifying a given disease often vary. A good example is *wilsere*, a common disease designation among Fulani pastoralists in Burkina Faso. This term embraces all endemic, fatal systemic diseases –although Fulani also recognize several epidemic diseases as specific entities. In the case of *wilsere*, local definitions are much broader than those of modern medicine. Another example of traditional approaches to disease classification is that the same ill may have different names, for example, among Mauritanian Fulani, the scientifically same skin disease is termed *felno* among sheep and *tiro* among goats (Mathias, 1989).

More (multidisciplinary) research, backed up with laboratory diagnoses is needed to understand these disease classifications.

Since the symptoms of Nimji as mentioned by most of the respondents were very specific to the western equivalent of Orf (contagious ecthyma (CE), contagious pustular dermatitus), see picture 5.j., it was suggested that Nimji could be Orf. This was later confirmed by a veterinarian. Of course additional laboratory analyses should be done to confirm the diagnose because “Nimji” could very well be used to describe several diseases characterized by lesions or wounds on the muzzle. There are several other diseases which cause lesions on the muzzle, such as sheep pox, FMD and bluetongue. but the last two also cause lameness and walking difficulties and sheep pox causes fever and higher death rates and these are symptoms not associated with Nimji (Orf) according to the respondents. Very few animals die from Nimji and the disease can take up several months. According to literature most animals with Orf recover after two months. Orf is seen in virtually every place in the world. Every breed and age are susceptible, although young animals are more easily infected. Orf is caused by a virus from the pox family. Within two to three days of contracting the virus, the first signs of the disease can be seen. By eleven days, scabs are evident which may stay for a week or two. The virus may be passed directly between animals or indirectly by objects that animals contact. The virus is very hardy and live virus has been found in dried scabs up to twelve years after they have been shed. Orf is most commonly seen on the lips and mouth of infected animals, but lesions may also occur on the udder and between the toes. The disease begins with lesions that eventually become pustules. When the pustules break, raised brown scabs form over the resulting wounds. If a number of pustules are found close to each other, large scabs result. It is usually at this stage of the disease that farmers notice that they have a problem. Animals that get the disease usually develop a strong immunity and will not be re-infected for at least one year. Orf is an extremely infectious

disease with up to 90 percent of a flock showing signs. Most animals will have only mild loss of condition because of unwillingness to eat from the painful condition of their mouths. Young lambs and kids are more at risk to serious consequences. They may be abandoned by mothers when they become lame from foot lesions or refuse to drink because of their sore mouths. In very rare cases, it is possible for the lesions to extend down from the mouth into the trachea and lungs and cause death in adult animals.

Picture 5.j) Nimji

5.11.3. Ethnoveterinary practices and pharmacology

Also referred to as ethnobotany or medical botany, ethnopharmacology studies how people of a particular culture or region use indigenous plants and other substances to treat sick animals. This forms only a part of ethnoveterinary since such things as surgery, magico-religious rituals, and prevention of disease among others are also part of the broad "discipline of ethnoveterinary'.

For the evaluation of treatments several sources were consulted such as literature (Forse, 1999, Amstutz, 1986 and Hunter, 1996) and medicinal plant databases on the internet (see bibliography). One of the sources used was the information kit on traditional animal health care practices in Asia published by the International Institute of Rural Reconstruction (IIRR) in the Philippines. Another source was the PRELUDE data bank on traditional veterinary medicine. This data bank derives information from several sources such as scientific articles, books and papers. This data bank provides access to documentation regarding the use of traditional medicinal plants in different regions of Africa.

What became clear during the interviews was that treatments mostly consisted of enhancing a sheep's resistance by giving it edible oil mixed with turmeric or ghee or buttermilk mixed with turmeric (*Curcuma longa*, see picture on the left) and jaggery. These mixtures contain high contents of proteins and energy and help the weakened sheep to regain strength and recover from disease. Additionally most respondents regularly visit a temple to pray for their sheep's welfare and health. In some cases mantras and tantras are chanted for sick sheep and it was observed that many sheds have small niches build in the walls in which small altars were build (see photo 5.k.) in order to pray for the sheep.

Picture 5.k) Ceremony altar in sheep shed with image representing "Mataji"

Specific treatments include a.o. topical application of different oils, juice of *Calotropis procera* and *Euphorbia spp* in case of Nimji (Orf), drenching sheep with tea from the flowers of the palas tree (*Butea monosperma*) in case of Haldariya (haematuria), use of tobacco (*Nicotianum tabacum*) and chili (*Capsicum annum*) in case of Gogla and drenching sheep

with tea made from the bark of the Karava tree in case of Thakla (possibly Brucellosis or Contagious agalactia). In the following section the specific treatments of the diseases as mentioned in the foregoing section will be discussed.

Gogla

Fasciolosis is a disease of economical importance to the Raikas since it causes death rates higher than the other diseases mentioned except for sheep pox. Although as much as 26 different treatments were described by the respondents not all treatments appear to be adequate since the most used remedy is tetracycline injection (broad spectrum antibiotic) and "Nilverm" which is useful for lung worms and roundworms but not for treatment of fasciolosis. Albendazole -a conventional worm remedy used by some respondents- can successfully be used to control chronic fluke infestations but will not kill young liver flukes. Another problem appears to be the dosage of these remedies, these varied widely with different respondents.

In 27% of all the treatments mortuta or tobacco is given, mostly in combination with water. Mortuta or Copper sulfate is useful in the treatment of chronic diarrhea, dysentery and in parasitic diarrhea. Tobaco (*Nicotiana tabacum L*) is used in Zaire, Tanzania and Central Ethiopia for internal parasitism including fascioliasis. In Zaire the leaves are pounded and put in half a glass of milk, after 24 hours the mixture is filtered and given to the sheep (Byavu, 2000). Chili *(Capsicum annum*) is used by 19% of the respondents to cure liver fluke. Chilli is used worldwide for the treatment of internal parasites, in Mexico, tzotzil shepherdesses give 13 chili peppers blended with water to sheep with fasciolosis.

Mata (sheep pox)

The majority of respondents said that there is only one treatment for mata. Because mata is perceived as being caused by mataji a *bhopa* (spirit medium) is visited and sometimes mantras and tantras are being chanted.

Ninety percent of all respondents applied a traditional vaccine in order to prevent the disease. Additionally contact between healthy and sick sheep is avoided (60%), healthy sheep are taken out of the infected area for 30 days (3%) and women in their menstruation period are not allowed near sick sheep to prevent the disease from getting worse (51%). The function of the last is not really clear but the same rule applied for Hindu temples in India, women in their menstruation period are not allowed inside. Since mata is caused by a Hindu goddess there must be some sort of parallel between the two phenomenon's.

When somebody heard that in a neighboring village sheep are infected with sheep pox the sheep in the village will be vaccinated as soon as possible. The vaccination is done by specialized persons (not necessarily of the Raika community) who will either pay a visit to

individual flocks or a meeting is organized to vaccinate all the sheep in a village at once. One rupee is charged per sheep vaccinated. Respondents expressed that sometimes these persons were very hard to track down resulting in many deaths of sheep infected with sheep pox. Although respondents claimed that they themselves were not able to apply the vaccine they were very well capable of describing the methods involved.

Tissue is taken from a highly pox infested animal, either dead or alive. The tissue is taken from a place on the body where the scabs are most abundant. The size of the piece of tissue is about 3 to 4 square cm, this also appears to depend on the number of animals that have to be vaccinated. The tissue is cut in small pieces and either applied directly in a incision made in the ear or shoulder of a sheep or the tissue is cut in small pieces and put in water, then this water is inserted in the ear or shoulder by means of a syringe. Animals are said to become a little sick several days after vaccination but will recover and be immune for their entire life.

Although there is a conventional vaccine available on the market the preference is given to the traditional vaccine and even veterinarians applied the traditional vaccine in the two cases that a veterinarian was called upon (after it was found out that the special person normally applying the vaccine was not available).

Hindura

Because hindura could be representing as much as 5 different diseases according to western classification (see hindura in foregoing section) it is very difficult to evaluate exactly the treatments given by the respondents.

Since helminth infections other then lung worms -which only occurs in cool wet places- do not cause coughing and mucus discharge the most given treatment which is a broad spectrum worm remedy (Nilverm, Albendazole and Tolzan) is probably not specifically beneficial for treatment of hindura but may cure or prevent secondary infections with worms or flukes.

The second most frequent given treatment is an injection with oxy-tetracycline, a broad spectrum antibiotic. Four out of the five western equivalent diseases associated with hindura are actually successfully treated with antibiotics. According to literature CCPP can be successfully treated with antibiotics (Tylosin or tetracycline). With pneumonia antibiotics often work well. They stop infection by bacteria even when pneumonia is caused by viruses or parasites that antibiotics do not kill. Plenty of fresh air is also recommended. With pasteurellosis many antibiotics are effective. For PPR there is no treatment but it helps to give an antibiotic to stop infection with bacteria. Nasal bots can be treated with many insecticides. They can be given by injection or sprayed up in the nose. The treatment given by the respondent whose descriptions of the symptoms of hindura resembled nasal bot is a

mixture of ghee with chili this is put in the sheep's nose and causes the sheep to sneeze after which the larvae fall on the ground. This treatment does remove the larvae from the nose but it is not clear if the chili is also able to kill the larvae. However it was seen that Raikas burn or kill insects such as ticks which either fall of an animal or are deliberately removed to prevent re-infection or infection to other animals. This may also be the case with nasal bot. Addition of turmeric powder (*Curcuma longa*, see picture on the right) to castor, sesame or other oils given as a drench adds to antihistaminic effect aiding in reducing coughing and breathing distress. According to the information kit on traditional animal healthcare practices, this treatment is widely used in India and the remedy is cited in other literature where it is stated that the plant has proven pharmacological activity to treat coughing.

Khurpak

There is no treatment for FMD but animals can be helped to recover. Plenty of water, shade and extra food help the animal to recover quickly. Local antiseptic treatment of the lesions together with antibiotic treatment help to stop the blisters getting infected by bacteria.

Although only 20% claimed that khurpak is caused by something supernatural no less than 67% of respondents applied magico-religious rituals to treat khurpak, these included burning items of animal origin in the middle of the sheep's corral making sure that the smoke is spread over all the sheep. Items included; donkey hoof, dog's and jackal's feces, lizards, turtle heads and birds. Furthermore mantras and tantras are being chanted, a spirit medium is being visited and holy water collected from a temple is spread over the sheep while chanting mantras. It was very difficult to understand the meaning of these rituals and in many cases respondents replied that they were past down from their fathers but the meaning of the rituals was unclear to some of them. One explanation was that because the Brahmin (who to the perception of most respondents cause khurpak) are vegetarians the burning of animal items would "scare" them off and the disease would leave the animals. A Similar situation described in literature concerns cattle; as an FMD prophylaxis, people may drench the cattle with wine in the belief that the wine will keep the disease away, just as good Brahmins avoid alcohol (Honey bee 1991).

Lesions are treated by applying oil and turmeric, Potassium permanganate dissolved in water, oil with salt, boiled ghee and a mixture of ghee, oil, salt and charcoal. More then half of all respondents treat the wounds and lesions. Additionally 50% of the respondents drench the sheep with oil and turmeric or ghee and turmeric in order to help the animal recover more quickly.

Haldariya (Haematuria)

To cure Haldariya a tea is made from the flowers of the Palas tree (*Butea monosperma,* see picture on the left*)* and mantras are being chanted (both cited by 44% of respondents). Additionally a spirit medium is sometimes visited (21%). Fifteen percent of the respondents supplies the sheep with either jaggery or turmeric, mixed with warm water, oil or buttermilk to improve the animals general condition. Eight percent of the respondents said that they would put the sheep in open space or give it a cold bath to remove the excess heat, since they perceive the cause of the disease to be "hot". The palas tree is a sacred tree. The flowers are offered as the bloody sacrifices to the goddess Kali. It is found in greater parts of India, Burma and Sri Lanka. In the research area it was only found along the Aravalli mountain range. Respondents living far away from the mountain range did not know the tree or said not to use it since it was to difficult and time consuming to collect the flowers. Kika Ram, a traditional healer from Mundara village, collects and dries the flowers. Before the rainy season the flowers are boiled and the mixture is given to all the sheep to prevent Haldariya. All the other respondents use the flowers as curative. The main constituent from the flower is butrin (1.5%) besides butein (0.37%) and butin (0.04%). The flowers also contain flavonoids and steroids. Butrin and isobutrin has proved to have antihepatotoxic activity (work against liver toxins). Since one of the symptoms was jaundice (associated with liver problems) the tea might aid the liver recovering or strengthens the liver. Flowers are furthermore reported to possess astringent, diuretic (increase in urine production), depurative (agents that clean and purify the system (blood)), aphrodisiac and tonic properties. The Raikas said to give this tea daily until the urine regains it's normal color, the diuretic and depurative qualities of the palas flower might help in this. Although it is very hard to exactly describe how the tea of the palas flowers might help the animal recover from Haldariya, the fact that a disease characterized with blood/urine and liver problems is treated with flowers of which the active ingredients work as antihepatotoxins and as depuratives and diuretic is already promising.

Fatgiya (enterotoxaemia)

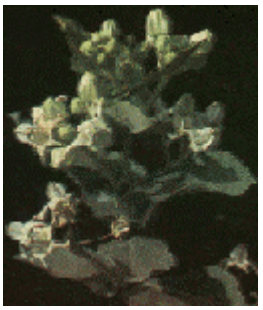
There is no treatment for an animal that already has severe disease. Moving the animals to poorer pasture may help. Vaccination for enterotoxaemia is effective. Twelve percent of the respondents did not know the disease. Of the respondents who do know the disease 40% said that they did not know a treatment for fatgiya. Some respondents (12%) use vaccination before going on migration and 16% buy medicine from the medical store to treat their flock after a sheep has died. This medicine is bought in Gujarat and the name of the medicine is Penakur . Unfortunately no information on this medicine could be found.

Nimji (Orf)

Like all diseases caused by viruses, Orf cannot be treated with antibiotics. If infected animals are kept clean, the disease will clear up in one to four weeks without treatment. However, it is possible for the sores of Orf to be infected a second time by bacteria or insects. To prevent this, many farmers will treat Orf lesions with an antibiotic spray or cream.

Vaccines are available commercially and may also be made from the lesions.

Like with FMD the respondents apply several kinds of oil on the wounds, such as diesel oil, sesame oil and castor oil. Some also use the juice of Acra (*Calotropis procera,* see picture on the left) or Thor (*Euphorbia spp*) to apply it on the lesions. Acra is very abundant in Rajasthan, it is found in waste lands and agricultural lands. In the leaves mudarine is isolated as principle active constituent. Besides a yellow bitter acid, resin and 3 toxic glycosides calotropin, uscharin and calotoxin are found. In the latex a powerful bacteriolytic enzyme and a very toxic glycoside calactin had been identified. Calotropin is one of the most violent poiseness substances known. Preparation of the latex with honey and jaggery is used in Assam (India) to cure bites from rabies dogs. The juice is sometimes used for the purpose of infanticide, sometimes taken by women to procure abortion. The plant is also used for skin diseases and wounds of cattle in Mauritanie (Niang, 1987), in Senegal by the Peul (Steur van der, 1994) and by the Borana in Ethiopia and Kenya (Heine et al, 1988). Thor is also used to treat wounds or ecthyma in cattle by the Samburu in Kenya (Politz, 1988).



Thakla

In case of Brucellosis there is no effective treatment. There are vaccines available. In case of Contagious agalactia (CA) treatment is usually not effective, but sometimes tetracycline or tylosin may work if it is given soon enough. Vaccines for CA are not always effective.

As much as 24 different treatments were identified for thakla. These treatments basically enhance the body's resistance and can be divided in 5 categories; giving water and/or ghee and/or oil mixed with turmeric and/or jaggery (45%); tea is made from the bark of a tree or the bark is put in a pot of water, this pot is burred in a dung heap for several days, there the water warms up and the bark get dissolved in the water and then the mixture is given to the sheep (39%); a fish or lizard is boiled in water and the mixture is given to sheep (13%); Ajwain (*Carum copticum*, see picture on the left) is given to the sheep (13%); people visit a spirit healer, chant mantras or pray for their animals (9%). Whereas 4 out of the 5 categories of treatment are aspecific (meaning that they work to enhance the resistance of the animal but do not necessarily combat the disease itself) ,

the tea made from the bark of the Karava tree could possible contain active ingredients which work against the disease causer or aid in relieving animals from the symptoms. Unfortunately this could not be checked since the Latin name for the Karava tree could not be found and there are many variations of the word "karava" in Rajasthan representing different trees and plants.

5.12. Concluding remarks on ethnoveterinary knowledge and pharmacology

Use and knowledge of medicinal plants depend on the ecological zone in which the Raika live. Some of the plants as described in this thesis are widespread and generally used for the same diseases and problems by Raikas in the whole of Rajasthan, e.g. *Calotropis procera.* Other plants and trees such as *Butea monosperma* can only be found in certain areas, mostly along the Aravalli mountain range, therefor it's use is limited by it's availability. What became evident is that ethnoveterinary knowledge differs greatly between Raika households. Some Raikas were able to name at least 5 different kinds of treatment, both using home remedies and conventional drugs while others would say not to know any treatment. It is not possible to differentiate between the ethnoveterinary knowledge of men and women because the sample size of women was to small to draw conclusions. However, what was surprising is that the seven women interviewed mentioned plants which are not or only sparsely mentioned by men. For example, Ambu Devi from Chowdajupa uses the bark of the Rohin tree (*Soymida ferbrifuga*) to cure Thakla (possible brucellosis or CA). *Soymida febrifuga* is generally used in India for dysentery, diarrhea, fever and debility (Tenetiga, 1997, Honey bee, 1993, Honey bee, 1992). This treatment was not mentioned by any of the male respondents. Another plant mentioned by Janu a 13 year old girl from Mundara was the use of Ajima seed (*Carum copticum*). This seed is boiled in water and then given to the sheep. Two kg. is used for 10-15 sheep. This plant is used as part of a cure for retained placenta in buffalo as described by Chahar (1997), this cure was verified by veterinarians who stated that the plant possibly has uterotonic value. This treatment was mentioned by two male respondents. The actual effect of these plants on Thakla has not been investigated, therefor it is hard to claim that women are better able to treat Thakla, however they seem to have more healthcare options since they seem to make more use of different plants .

The seven women were able to give detailed information on symptoms, epidemiology, duration and mortality of the most common diseases and their knowledge did not seem to be "inferior" to that of the male respondents. However it might very well be possible that their knowledge does differ compared to that of men because of the different labor responsibilities of Raika men and women.

It is interesting to see that the Raikas have build up a large network of traditional healers (bhopa, ghuni and daam) and make use of a large variety of plants, minerals and animal

products to cure their sheep especially given the local circumstances and the fact that sheep husbandry is a relatively young occupation for the Raika community who used to be involved in camel rearing. The switch to this occupation probably post-dates the middle of the 19th century. Therefore it might be interesting to investigate to what extent the sheep husbandry and healthcare system is linked to the camel husbandry system of the Raikas. Has the sheep husbandry system and health care developed separately from the camel rearing system with influence from outside the Raika community or have camel rearing Raika applied their knowledge of health care and livestock rearing to sheep husbandry? Some Raika families keep sheep and camels (see picture 5.L), camels are kept to serve as draught animals or transportation, others keep them for selling the bull calves.

Picture 5.L) Manglaram, 13 years old with his sister and younger brother from the village of Wara Solenkian,

Family owns 35 sheep, 12 goat and 6 camels. In the picture a crossbreed ram can be seen (possible Keri*Tepli). Notice the Neem tree in the background and the long sticks which are used to cut the branches of trees to serve as animal fodder.

6. Conclusion

Raikas rely on self treatment and traditional healers and will rarely avail to Governmental veterinary hospitals and veterinarians. This is partly due to the inconvenience of bringing animals to the hospital but the most important reason seems to be the communication problems and lack of respect on both sides. Raikas are highly dependent on their own skills and knowledge for the treatment of their sheep due to the migratory live of some and general lack of trust in governmental Institutions and veterinarians. Typically, veterinarians who are posted to remote areas are not from pastoral groups and they have different moral and social values and their language often differs from that of the Raikas, especially locally used names for diseases are often not understood or known by western trained veterinarians for reasons already mentioned in paragraph 5.11.2.

Some beliefs by the Raikas about disease etiology, epidemiology or an animals biology are not always scientifically correct. But as McCorkle (1989) emphasizes, the issue is not how closely folk knowledge and practice parallel western veterinary medicine or whether indigenous beliefs and practices are “right” or “wrong”. Rather, what is important is “…the extent to which they promote productive animal management given the resources actually or potentially and realistically available to farmers.

Most of the plants and other healing practices such as cauterization and praying used by the Raikas are also extensively used in other countries and although these are mostly frowned upon in the western world the fact remains that millions of people rely on them for their own and for their animals health.

Validation of ethnoveterinary knowledge and practices is important because it cannot be assumed that all of the practices are effective. A method of validation could for example be laboratory analysis of active ingredients. But it should be noted that this method may not be always appropriate since some plants “work” because of their synergistic effects (active ingredients working together) so plants seemingly ineffective in laboratory trials may work in the field. Another approach to evaluate medicinal plants and practices is “the workshop approach” as discussed in paragraph 5.9. to identify “best bets” (those plants that appear most promising).

This research found that the amount of ethnoveterinary knowledge differ greatly between different Raikas, certain individuals have more extensive knowledge than others. This could possible depend on herd size (the bigger the more practice and experience with diseases and generation of sheep breeders (the more generations, the more knowledge and experience is build up and past down to the next generation).

The Raikas are capable to distinguish between the different symptoms through careful observation. Their careful observations also results in a considerable good analysis as to what could be the etiology of some –not all- diseases (such as "bad" air causing FMD and the eating of "dirty grass and drinking dirty water" causing bottle-neck), especially taking into account that the bacteria and viruses causing these diseases can not be seen with the naked eye. Although most Raikas possess considerable knowledge and are skillful in the preparation and application of home-made remedies the fact is that they still have to cope with high mortality rates in their herd, especially sheep pox and liver fluke cause considerable losses. The solution partly lays in a better delivery of the sheep pox vaccine, in many cases the vaccine was applied to late or not applied at all because the person specialized in the application of the vaccine could not be found. Another problem is the inadequacy of most Raikas to deal with modern drugs. They perceive oxy-tetracycline as a cure all, resulting in over use of the medicine. The dosages used are often inappropriate resulting in resistance to antibiotics and the needles used are often dirty or bend.

Because of their illiteracy, healers and livestock keepers are not able to distinguish between the various types of industrial medicines. These medicines are regarded as a cure-all. (Köhler-Rollefson in Mathias *et al*,1999). The same basically applies to the use of anthelmintics.

Governmental health care institutions and veterinarians have the potential to assist the Raikas on these matters e.g. giving workshops and village training in the use and application of these drugs. This would certainly prevent or save a lot of sheep from death. Local NGO's such as LPPS would also be very appropriate to assist and sensitize the Raikas on the use of modern drugs, since they have already established contact and are socially more accepted by the Raika community. In the short term they seemingly would yield more promising results then Governmental healthcare services and veterinarians.

Considering their migratory and independent lives and limited resources to purchase drugs or make use of veterinary services their ethnoveterinary knowledge and practices –if effective- should be promoted and disseminated among other Raikas and "only those disease eventualities that are beyond the reach of local expertise should be combated by other means. Such a strategy is ambitious and demands a lot of thinking and research from NGO's. But it is a effort that is well worth it, because it contributes to empowerment instead of creating dependence among local people and thereby supports endogenous development" (LPPS 1999).

Summarizing, the research objective as posed in paragraph 1.3.1. could better be rephrased to "what are strong and weak points of both traditional and conventional healthcare practices and how can both be optimally used to improve the health care status of traditionally kept sheep in Godwar area".

The reliance on sheep husbandry of the Raikas coupled with their mobile lifestyle makes that planning in pastoral settings for e.g. animal healthcare projects differs from that in other agricultural development projects for the following reasons (adopted from Waters-Bayer *et al,* 1995):

pastoralists' main assets (livestock) are mobile rather than stationary;

land use in pastoral systems is large-scale so as to incorporate wet- and dry season grazing and emergency reserve areas, and it tends to be without fixed boundaries;

tenure institutions for resources used by pastoralists tend toward common property regimes rather than plots and farms clearly defined for individual use;

pastoralists often use resources that are used simultaneously or during other seasons or years by other groups, for farming as well as grazing; pastoralists therefore need to negotiate with other groups to gain access to resources, to manage their use and to improve them;

to allow for mobility and flexibility of decision making, pastoral households or informal groups of households are the basic operational units. In general, collaboration between households or groups is not rigorously institutionalized.

The results of this study suggest that future development projects should give more careful consideration to the livestock-related role of pastoral women and to their indigenous knowledge. The sheep husbandry system of the Raikas is a family enterprise and if NGO's and GO's are to collect valuable indigenous knowledge about this system they should collect gender disaggregated data. Far to often women's role in animal husbandry and healthcare is underestimated and undervalued and as a result (paravet)training and information is only directed to men. However women represent important actors in livestock keeping. They can play a crucial role in influencing the productivity of their animals (Rangnekar, 1999).

An important body of knowledge is being missed if no effort is made to collect women's knowledge. Collecting gender disaggregated data however poses a problem since there is a lack of female staff in NGO"s and GO's, and often women are reluctant to speak to male researchers for religious and/or socio-cultural reasons.

Improving female participation in animal health training may not be easy. There are some cultural and dominant gender ideologies which make women's participation difficult:

Gendered norms which limit women's range of movement and may thereby restrict their participation in management activities.

Summary

Nomadic pastoralism is critically important to the economy of Rajasthan. Aridity and poor soils, especially in the western districts, make it well-suited to a combination of agriculture and livestock rearing. Here Raika agro-pastoralists combine sheep husbandry with crop production for part of the year. The large number of animals in these districts cannot be supported by existing fodder resources. Therefor a significant number of animals migrate annually in search for grazing grounds. Because of the extreme climatic conditions Raika have developed and maintain a large variety of indigenous livestock breeds well adapted to specific and often very difficult environmental conditions.

The sheep husbandry system of the Raikas should not be seen as a male dominated enterprise but more as a system dependent on labor inputs of all members of the family. Women's main responsibilities are those of taking care of new born animals and young animals and handling milk. Milking and the care of sick sheep is also taken up by women in a considerable large percentage of households. Raika men have main responsibility in herding, feeding (cutting trees) and assisting ewes and labor and to a lesser extent taking care of sick sheep. Milking is more or less equally divided between men and women. Raika can choose between several healthcare actors and institutions such as traditional healers, spirit healers, firing healers and governmental veterinary hospitals an veterinarians. However communication between veterinarians and Raikas is very problematic and awkward with a lack of respect on both sides and governmental animal health care services and veterinarians generally fail to improve the health status of the sheep kept by the Raikas in the research area.

The Raikas will most often avail to self treatment of their animals. According to the perceptions of the Raika, the most common sheep diseases and problems include *gogla* (bottleneck), *fatgiya* (enterotoxemia), *khurpak* (foot and mouth disease), *mata* (sheep pox), *thakla*, *haldariya* (haematuria), *Nimji* (orf), *Sindura* (pneumonia, or other respiratory diseases), diarea, obstipation and "durdi mata".

The Raikas in the study area seem to differentiate between sheep disease brought by supernatural entities (sheep pox and FMD, although the latter is also said to be brought by "bad air") nutritional; eating dirty grass and drinking dirty water (liver flukes) or eating to much green fodder (enterotoxaemia), "hot/cold" (haematuria) and from other animals (thakla, but also sheep pox, FMD and sindura). Disease names were found to refer either to symptoms or disease cause, e.g. in the case of haldariya, which literally resembles the word "yellow" some of the symptoms were yellow urine and yellow mucus membranes, in the case of mata (sheep pox) the disease was associated with "Mataji" (Hindu goddess) who was perceived to be the causer of the disease.

What became clear during the interviews was that treatments mostly consisted of enhancing a sheep's resistance by giving it edible oil mixed with turmeric or ghee or buttermilk mixed with turmeric and jaggery. These mixtures contain high contents of proteins and energy and help the weakened sheep to regain strength and recover from disease. Additionally most respondents regularly visit a temple to pray for their sheep's welfare and health. In some cases mantras and tantras are chanted for sick sheep and it was observed that many sheds have small niches build in the walls in which small altars were build in order to pray for the sheep. Strong points of the traditional healthcare system can be summarized as follows:

* High variety of local resources and materials are used.
* Home remedies are effective in increasing general condition of sheep, which helps animals to recover more quickly.
* Wounds, skin infections and ectoparasites are effectively treated with plants (*Calotropis procera*, *Euphorbia spp)* different kinds of oils, salt solutions or Potassium Permanganate.
* Literature research showed that some plants have active ingredients which work against those diseases and problems for which these plants are used, or these plants are used in other parts of the world for the same diseases.

Specific treatments include a.o. topical application of different oils, juice of *Calotropis procera* and *Euphorbia spp* in case of Nimji (Orf), drenching sheep with tea from the flowers of the palas tree (*Butea monosperma*) in case of Haldariya (haematuria), use of tobacco (*Nicotianum tabacum*) and chili (*Capsicum annum*) in case of Gogla and drenching sheep with tea made from the bark of the Karava tree in case of Thakla (possibly Brucellosis or Contagious agalactia).

Weak points of the Raika healthcare system can be summarized as:

* Inadequate use of conventional drugs such as oxy-tetracycline and anthelmintics.
* Some diseases can not be cured or prevented with traditional treatments (e.g. enterotoxaemia, brucellosis)
* Traditional vacine against sheep pox seems effective but application is problematic resulting in high death rates.
* Treatment of Liver fluke (2nd highest cause of death) does not seem very effective.

Strong points of the conventional healthcare services and veterinarians are:

* Effective medicines and vaccines available for treatment and adequacy of application.
* Potential to train Raika in use of conventional drugs.

Weak points of conventional healthcare system and veterinarians are:

*Social disparity.

*veterinarians are not from pastoral groups (western trained, high caste).

*communication problems

*Lack of motivation

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Appendix 2A Global breed data

Sub-Saharan Africa,
a total of 738 breeds have been recorded. Around 15 percent of extant breeds on file are at risk. "This is believed to be a gross underestimate of the actual situation," the report said. "The trends for the African region are alarming: The number of mammalian breeds at risk of extinction has increased from 8 to 19% since 1995. The situation with bird breeds is even more serious with the total percentage of breeds at risk of being lost increasing from 20% in 1995 to 34% in 1999."

The ***Asia and Pacific region*** contains more than one-fifth of the world's animal genetic resources, with 1,251 domestic animal breeds recorded. The majority of the world's buffaloes and yaks, almost half of its muscovy ducks, pheasants and partridges, one-third of its pig breeds and one quarter of its goat breeds are found in the region. Of the 1,251 breeds recorded, around 10% are at risk. The figures also are underestimated, FAO said. Between 1995 and 1999, the proportion of mammalian breeds at risk of extinction in the Asian region has increased from 11 to 14%, of bird breeds at risk of being lost from 32 to 37%.

In ***Europe***, a large number of breeds are endangered because of their perceived lack of economic competitiveness. The poultry and pig industry are relying on only a handful of specialized breeds. Especially critical is the situation in Eastern Europe with only a few conservation programs in place. "The current uncertain political climate in the region will accelerate the loss of many breeds," FAO said. Of the 2,576 breeds recorded in Europe, almost half are considered at risk. Between 1995 and 1999, the number of mammalian breeds at risk of loss has increased from 33 to 49%; the number of bird breeds at risk of being lost has grown from 65 to 76%.
Over a quarter of the world's cattle, goat, sheep, pig, duck and turkey breeds and over a half of the world's horse, chicken and geese breeds are recorded in Europe.

In ***Latin America***, around 20% of extant breeds on file are considered at risk. The total proportion of bird breeds at risk of being lost increased dramatically from five percent in 1995 to 45% in 1999. "These figures are alarming and efforts must be made to encourage maintenance of the genetic resources at risk. We must better understand this seemingly very serious situation," FAO said.

In the ***Near East***, much of the domestic animal diversity is now under threat of extinction due to intensification and mechanization, FAO said. Current data is not available for many countries because of unrest and drought. Eight percent of extant breeds are considered at risk (44 of 571), but the real losses are probably much higher.

In ***North America***, "many breeds that were once considered quite valuable have now been confined to the genetic wastebasket," the report said. As in other regions, the continued drive towards intensification and specialization has resulted in the increased reliance on a small number of breeds to meet the demand for food. Of the 259 breeds on file, 35% are threatened by extinction.

Source: http://www.waternunc.com/gb/fao16gb.htm

Appendix 5A List of respondents

Date of interview	Name of respondent	Village	Sex (M/F)	Age	Education
16/02/2001	Bagteram Raika	Gudajata	M	55	None
17/02/2001	Nataram Raika	Rajpur	M	35	None
17/02/2001	Ambu Devi	Chowdajupa	F	35	None
17/02/2001	Baburam Raika	Khuni Bavdi	M	37	None
22/02/2001	Amboram Raika	Datiwara	M	55	none
22/02/2001	Nataji Dewasi	Bedel	M	51	None
22/02/2001	Hajiram Raika	Datiwara	M	50	None
24/02/2001	Vaktaram Raika	Kot	M	60	None
24/02/2001	Hanja	Kot	F	40	None
24/02/2001	Buraram Raika	Kot	M	50	None
24/02/2001	Hidu Raika	Kot	M	50	None
25/02/2001	Harjiram Raika	Sadalwa	M	50	None
25/02/2001	Jotaram Raika	Sadalwa	M	22	None
25/02/2001	Pimaram Raika	Sadalwa	M	30	None
26/02/2001	Malaram Raika	Datiwara	M	60	None
26/02/2001	Sita	Datiwara	F	13	None
26/02/2001	Junu	Datiwara	F	30	None
28/02/2001	Janu	Mundara	F	13	None
28/02/2001	Jagaram Raika	Mundara	M	50	None
28/02/2001	Hemaram Raika	Mundara	M	35	None
28/02/2001	Ganeshram Raika	Joba	M	30	None
28/02/2001	Punaram Raika	Joba	M	40	None
06/03/2001	Puraram Raika	Bijapur	M	35	None
06/03/2001	Pommaram Raika	Bijapur	M	68	None
06/03/2001	Sukli	Bijapur	F	22	None
07/03/2001	Bhawaram Raika	Mandigar	M	17	7th class
07/03/2001	Ambaram Raika	Mandigar	M	50	None
07/03/2001	Sewaram Raika	Mandigar	M	50	None
13/03/2001	Rhakmabhabi	Bhagibanri	M	40	None
13/03/2001	Otaram Raika	Bhagibanri	M	50	None
15/03/2001	Amararam Raika	Sinderli	M	60	None
15/03/2001	Nilaram Raika	Sinderli	M	40	None
15/03/2001	Manaram Raika	Bamania	M	45	None
15/03/2001	Juwaram Raika	Bamania	M	55	None
15/03/2001	Wennaram Raika	Malari	M	25	None
15/03/2001	Thamaram Raika	Malari	M	42	None
21/03/2001	Punaram Raika	Lartara	M	25	None
21/03/2001	Babulal Dewasi	Dungli	M	55	None
22/03/2001	Nataram Raika	Mada	M	65	None
22/03/2001	Jodaram Raika	Mada	M	70	None
22//03/2001	Kanaram Raika	Pachalwada	M	45	None
22/03/2001	Raltaram Raika	Pachalwada	M	31	None
24/03/2001	Punaram Raika	Sobawas	M	25	None
24/03/2001	Walaram	Desuri	M	45	None
24/03/2001	Sagramba Raika	Khunibavdi	M	70	None

25/03/2001	Jobiram Raika	Rhamnia	M	?	None
26/03/2001	Buwaram Raika	Bhitwara	M	40	None
26/03/2001	Beraram Raika	Muthana	M	40	None
26/03/2001	Bomaram Raika	Muthana	M	35	None
27/03/2001	Vaktaram Raika	Bilhija	M	50	None
29/03/2001	Rengaram Raika	Rangura Ki Dhani	M	32	None
30/03/2001	Ambaram Raika	Ghanerao	M	?	None
30/03/2001	Jamaram Raika	Charbuija Ki Dhani	M	40	None
01/04/2001	Selaram Raika	Sumer	M	?	None
01/04/2001	Amboram Raika	Ghanerao	M	45	2nd class
01/04/2001	Modaram Raika	Magartalab	M	60	None
02/04/2001	Manglaram Raika	Wara Solenkian	M	13	6th class
07/04/2001	Jogaram Raika	Dadai	M	35	None
12/04/2001	Ambu	Mundara	F	80	None

Appendix 5B Interview guide

Data on Respondent

1)Name of respondent:……
2) Name of village:……
3) District:……
4) Sex: Male/Female 5) Age:……..yrs
6) Other household members:……
7) Education:……..

Data on land available to household and crop production

8) What is the size of land in ownership:.....Begha
9) What crop(s) is/are grown:

General data collection of sheep husbandry and healthcare.

10) Herd composition and herd size:

	Breed*1						
	Boti	Dumi	Bhagli	Wannermi	Tepli	Keri	Other
No of ewes							
No of rams							
No of lambs							

*1 Local classification of sheep breeds: Boti, Dumi, Bhagli, Keri, Wannermi, Kajeli and Tepli.

11) How would the respondent describe all the different breeds (color, tail and ear size and shape etc)?
12) What are the specific qualities of each breed?
13) Did your herd increase or decrease over the past 10 years and why?
14)Labour division:

	Men	Women	Other family members	Children	Hired labour	Other:…… ……..
Herding						
Feeding						
Drenching						
Milking						
Handling milk						
Assisting ewes in labor						
Care for young animals						
Care for sick animals						

15) Which rams are used for service?
16) What is the age at first service (both for ewes and rams)?
17) In which season are the lambs born?
18) At what age are male lambs sold?
19) For what purposes are the sheep kept (wool, milk, dung, meat, ghee)?
20) Which products are for home-consumption and which are for selling?
21) Are sheep taken on migration, if so in which months?
22) Controlled breeding? If so, what kind of system is employed?
23) Are sheep (and goat) given names?

Data on knowledge and perceptions of sheep diseases.

24) Which disease(s) affect your sheep mostly (quantity)?
1)…… 2)……
25) What diseases did your sheep have the last 2 years?
1)..... 2).....
26) How much animals died the last year; adult....., lambs.....

Of what disease did they die?....
1)..... 2).....
27) Which disease causes the most deads in your herd?
1).....2).....
28) For what disease people go to: Bhopa:.....
Ghuni:.....
Daam:.....
29) Do people go to the veterinary hospital or cal for a veterinarian?
If so, for what diseases:……..
If not, why not:……

30)What treatment is given for:
gogla (bottleneck): ……
fatgiya (enterotoxemia): ……
khurpak (foot and mouth disease): ……
mata (sheep pox): ……
thakla (fatigue): …….
haldariya (haematuria):……..
Sindura/Hindura (?respiratory disease):.....
Nimji (?orf):.....

31) Look at 24-27 and ask details about the mentioned diseases.

Causes

1) What causes the animal to get sick?
Why does the animal get sick?
Was it caused by something the animal ate or drank, was it caused by another animal or person?

Diagnose/symptoms

2) How can you see that the animal is sick?
How does the animal look?
Does it have diarrhoea, no apitite, is it restless, mucus from nose and mouth?
3) For how much time does the disease occur?
How much days passed since you first discovered the disease until the animal cured?

Mortality

4) Do animals with this disease die?
5) Do all animals die, many or few?
How many animals who caught the disease will actually die from it?

Contagiousness

6) Do all animals catch the disease at the same time or only one or two?
7) Can healthy sheep get the disease from sick sheep?
8) Which sheep are affected (rams, ewes or lambs)?
9) Which sheep are most severely affected?
10) When was the last time a sheep was affected by this disease?
11) In which season are sheep more affected?

Treatment

12) What do you do to cure the sheep?
How do sheep cure from this disease?
Do you use medicinal plants, vaccines, medicines, prayers, surgery, other?

If other than medicinal plants are used describe treatment and materials:
……
(The following part 13 t/m 23 was only partly used during the interviews due to time constraints)
(Fill in question 13-19 if medicinal plants are used.)
13) What part of the plant is used?
Root, stem, leaves, flower, seed?
14) How is the plant prepared?
in water, fresh, dried, in boiled water, moulded, other?
15) How is the medicine administered?
Drenched, mixed in feed, injected, other?
16) What is the quantity used during every treatment?
How many leaves, flowers, plants and water is used?
17) How many times should the medicine be administered?
Once, daily, till animals cure?
18) Where do you obtain the plant?

Close to the house, during walks, near rivers and streams?

19) Can the plant be obtained year round?
In which season?

20) How did you learn this treatment?
Who taught the treatment to you?

21) Do animals cure fast after the treatment?
In how many days after treatment does the animal recover?

22) Do all animals recover after treatment?
Do animals die even if the received treatment?
Why do animals die?

23) From the different treatments which would be the most adequate?
Which treatment cures the highest number of animals?

Economics

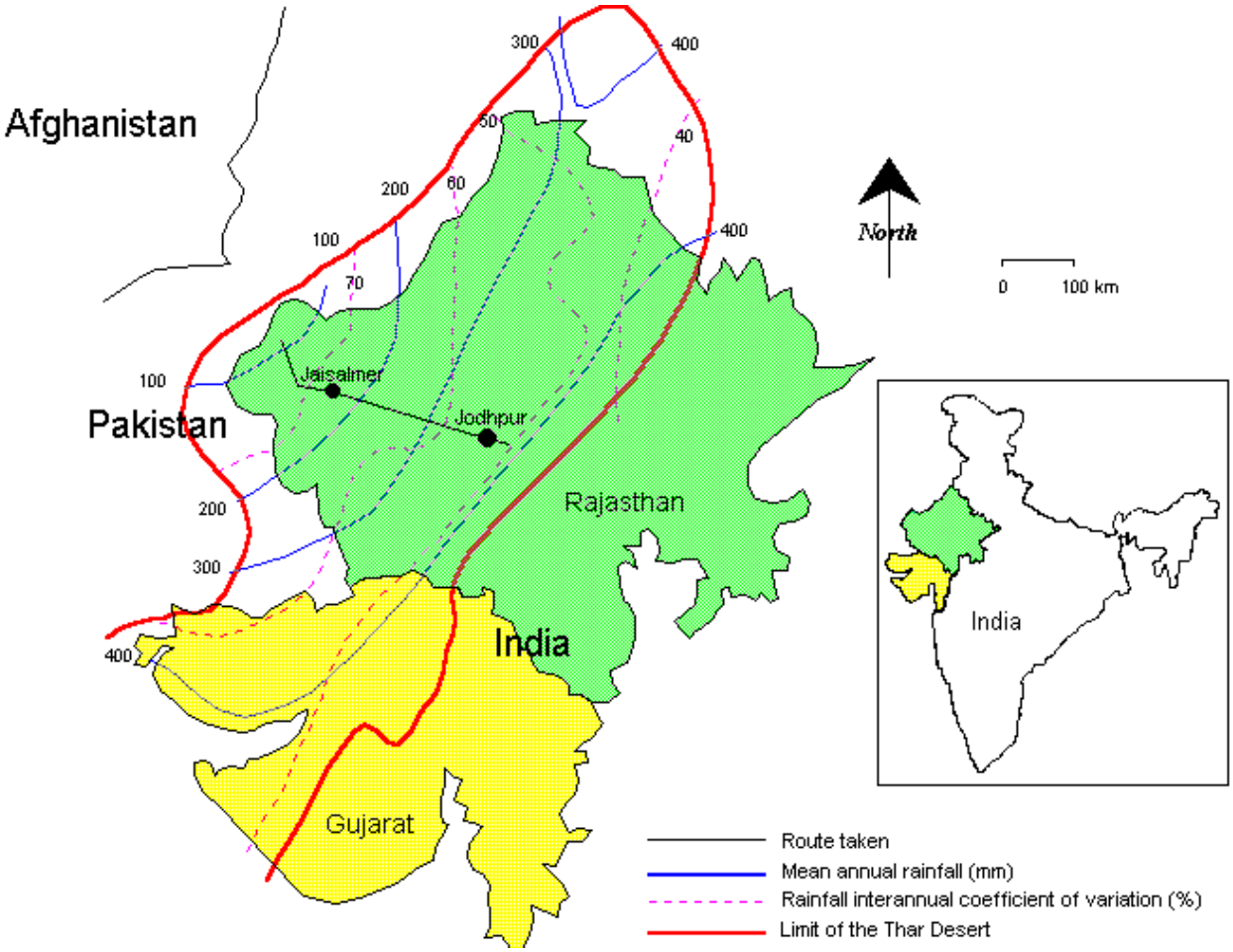
32) How much lambs did you sell last year (and of what age were the lambs sold)?
33) How much adult sheep did you sell last year?
34) How much wool did you sell last year?
35) How much dung did you sell last year?
36) How much ghee did you sell last year?

37) When there is a shortage of grazing ground what strategy is employed to overcome the fodder deficit? (e.g. buy fodder, sell animals, walk more km per day, go on migration etc)?
38) What does the respondent consider the biggest constraint/problem in sheep production (e.g. fodder deficit, lack of adequate medicines, lack of information, low prices for wool and meat etc)?
39) In what area would the respondent like assistance, advice or information or other services (e.g. assistance in disease diagnose, supply of medicines, legal help concerning grazing problems, service of superior rams etc)?

Appendix 5C Sheep breeds in Rajasthan

Common name	Other local names	Main location	Main use	Colour	Specific visible traits	Fibre type	Origin of breed
Avikalin		Rajasthan	Wool	Uni colour: white		Coarse/carpet	Developed at Research centre in Avikanagar from Rambouillet an Malpura in the 1970's
Avivastra		Rajasthan	Wool	Uni colour: white		Fine	Developed at Research Centre Avikanagar from Rambouillet and chokla
Chokla	Chapper, Shekhawati , Indi	Bikaner, Jaipur and Nagau in Rajasthan	1) Wool 2) Meat	Uni colour: white with dark brown face	Similar to Magra but smaller and finer wool	Coarse/carpet	
Jaisalmeri	Jaisalmer	Jaisalmer, Barmer and Jodhpur districtsof rajsthan	Wool	Uni colour: white With brown or black face	Long lop ears	Coarse/carpet	
Magra	Bikaneri (obselete), Bikaneri chokla, Chakri, Jangli, Mogra	East and south Bikaner, Rajasthan	1) Wool 2) Meat	Uni colour: white white face with light brown around eyes	Medium to large sized animal (approx. 63 cm)	Coarse/carpet	
Malpura	Desi	Eastern Rajasthan	1) Wool 2) Meat	Uni colour: white with light brown face	Short ears, long legs, similar to Sonadi	Coarse/carpet	
Marwari	Layda, Marwadi	Many districts of Rajasthan and Jeoria Region of Gujarat	1) Wool 2) Meat	Uni colour: white body, black face,	Medium-sized with small ears	Coarse/carpet	
Nali		Northern Rajasthan and southern Haryana	1) Wool 2) Meat	Uni colour: white light brown face	Long ears, medium-sized animals	Coarse/carpet	
Pugal		Bikaner and jaisalmer districts of Rajasthan	1) Wool 2) Meat	Uni colour :white with black face	Fairly well-built animals, short ears	Coarse/carpet	
Sardarsamand		Rajasthan	Wool				Composite of Australian Merino and Marwari, year of origin: 1935 onwards
Sonadi	Chanothar	Southern Rajasthan and northern Gujarat	1) Wool 2) Milk 3) Meat	Uni colour: brown, white with light brown face, neck and legs	Similar to malpura, but smaller with very long ears	Coarse/carpet	

Appendix 5D Distribution of rainfall in Rajasthan



Appendix 5E Age at first service for ewes and rams

Age at first service of ewes (n=32)

APPROXIMATE AGE AT FIRST SERVICE IN MONTHS	N	%
12 months, 1 year	9	27.3
15 months, 1.25 year	3	9.1
18 months, 1.5 years	4	12.1
21 months, 1.75 years	2	6.1
24 months, 2 years	12	36.4
30 months, 2.5 years	2	6.1
36 months, 3 years	1	3.0
Average age at first service is 19.7 months (1.6 years) standard deviation = 6.4		

Age at first service, rams (n=35)

APPROXIMATE AGE AT FIRST SERVICE IN MONTHS	N	%
12 months, 1 year	5	14.3
18 months, 1.5 years	6	18.2
21 months, 1.75 years	3	8.6
24 months, 2 years	16	46.4
36 months, 3 years	5	14.3
Average age at first service is 22.7 months (1.9 years) standard deviation = 6.9		

Appendix 5F Returns from sheep rearing.

FAMILY AND HERDSIZE	INCOME GENERATED IN RS. AND PERCENTAGE OF TOTAL INCOME			TOTAL INCOME	INCOME PER SHEEP PER YEAR
	MEAT	WOOL	DUNG		
Family 1, Herdsize 60	2000	1100	1500	4600	77
	43%	24%	33%		
Family 2, Herdsize 60	7500	1500	1200	10200	170
	74%	15%	12%		
Family 3, Herdsize 60	5500	480	2000	7980	133
	69%	6%	25%		
Family 4, Herdsize 150	10000	2700	1500	14200	95
	70%	19%	11%		
Family 5, Herdsize 200	12500	3600	3000	19100	96
	65%	19%	16%		
Family 6, Herdsize 200	16000	1000	7000	24000	120
	67%	4%	29%		
Family 7, Herdsize 100	11000	2000	2500	15500	155
	71%	13%	16%		
Family 8, Herdsize 100	6000	1800	1500	9300	93
	65%	19%	16%		
Family 9, Herdsize 50	5000	500	2400	7900	158
	63%	6%	30%		
Family 10, Herdsize 140	10000	2520	1000	13520	97
	74%	19%	7%		

Appendix 5G Disease characteristics as cited by respondents

Sindura

*Cause (n=7)
During the interviewees people gave several explanations as to what could be the cause of this disease. Some stated that the eating of a tree would cause this disease (43%) others stated that when sheep with a high body temperature (e.g. by standing in sun all day or by running for a long time) drink cold water they get this disease (43%). One interviewee replied not to know the cause (14%) of the disease. It is generally stated that healthy sheep can get the disease from sick sheep (86%).

*Symptoms(n=9)
-mucus discharge from nose (cited by 100% of the interviewees).
-animals are weak and have no appetite (cited by 33% of interviewees)
-coughing (33%)
-mucus discharge from nose and after some days blood discharge from nose (22%)
-mucus discharge with worms (22%)
-diarea (11%)

*Duration (n=7)
-10-20 days (43%)
-20-30 days (29%)
-1-2 months (14%)
- more than 2 months (14%)

*Mortality (n=7)
-very few (less than 5% of animals infected) die from this disease (43%)
-all sheep die from this disease (29%)
-animals do not die from this disease (14%)
-some animals die, around 20% of all animals affected (14%)

*This disease is said to affect all types of sheep, rams ewes and young stock. Furthermore it was generally stated that within a month the entire herd will have contracted the disease. One interviewee said that only 40 to 50% of the total herd will get this disease. Healthy sheep get the disease from direct contact, grazing and drinking with infected sheep.

*Seasonality (n=7)
-summer (43%)
-all year (14%)
-rainy- and winter season (14%)
-rainy and summer season (14%)
-winter season (14%)

Gogla (Bottleneck)
*Cause (n=7)
-drinking dirty water, eating dirty grass (43%)
-not known but healthy sheep get it from sick sheep by direct contact or by grazing and drinking together (14%)
-weak sheep drink cold water (14%)
-sheep eat grass in rainy season or wet grass in early morning (14%)
-not known (14%)

*Symptoms (n=7)
-swollen jaw/neck (100%)

-diarea (43%)
-fever (29%)
-weak, no appetite (14%)
-coughing (14%)
-mucus discharge from nose (14%)
-mucus discharge from mouth (14%)
-pain in neck (14%)
-difficulty breathing (14%)

*Duration (n=6)
-1 month (50%)
-10-15 days (33%)
-5-6 days (17%)

*Mortality (n=6)
-high mortality, 50% to 100% of all infected animals die (67%)
-20-25% of all infected animals die (17%)
-very few animals die (17%)

*Ewes, rams and lambs can get this disease, but 67% of the interviewees said that ewes are more severely affected, 17% said that adult sheep are most severely affected and 17% stated that ewes, rams and lambs are equally affected.
50% of the interviewees stated that this disease generally affects the whole of a herd within a short period. 17% replied that either few or a whole herd get the disease. One interviewee (17%) said that only some sheep get this disease.

*Seasonality (n=6)
-whole year (50%)
-winter and rainy (17%)
-rainy (17%)
-winter (17%)

Khurpak (FMD)
*Cause (n=10)
-causal agent not known, but healthy sheep can get it from sick sheep (50%)
-caused by some local brahman or spirit (20%)
-when sheep walk in mud (10%)
-caused by something in the air (10%)
-not known (10%)

*Symptoms (n=8)
-small lesions on feet (88%)
-animals have difficulty walking (63%)
-no appetite (50%)
-bloody discharge from feet (30%)
-fever (30%)
-lesions in mouth (30%)
-diarea (20%)
-maggots coming from lesions (20%)
-pregnant ewes abort (20%)
-excessive saliva from mouth (10%)
-bloody discharge from mouth (10%)
-lambs die (10%)
-ewes produce less milk (10%)

*Duration

-7-10 days (43%)
-15 days (29%)
-1 month (29%)

*Mortality
-few die (33%)
-around 25% of adult, and all lambs die (17%)
-around 30% of all sheep die (17%)
-50% of all sheep die (17%)
-few adult sheep die but approx. 50% of all lambs die (17%)

*All sheep get infected by the disease but in most cases young animals are more severely affected (50%), all are equally affected (25%), pregnant ewes are more severely affected (25%).

*Seasonality
-Rainy season (43%)
-Rainy and sometimes summer season (17%)
-Whole year (17%)
-winter season (17%)
-? (17%)

Haldariya
*cause (n=7)
-hot (43%)
-cold (29%)
-hot/cold, humide weather, change in weather (29%)

*symptoms (n=19)
-sheep produce red urine (79%)
-pregnant ewes abort (53%)
-sheep have yellow eyes (26%)
-sheep produce yellow urine (21%)
-sheep have no appetite (21%)
-faeses are abnormal (droppings are long in shape and look like “chewing gum”) (16%)
-fever (16%)
-diarhea (11%)
-ewes do not produce milk (11%)
-sheep appear to have pain in whole body (11%)
-sheep have a lot of gas i their stomach (5%)
-after sheep die of this disease their eyes are yellow (5%)

*duration (n=5)
-3-4 days (20%)
-6-7 days (20%)
-10 days (20%)
-15-20 days (20%)
-7-30 days (20%)

*mortality (n=6)
-some die, about 10% of all infected animals (33%)
-half of all infected animals die (33%)
-many die, over 50% of all infected animals (17%)
-sometimes all animals die, sometimes none die (17%)

*Seasonality (n=6)

-Rainy season (100%)

*(n=4)
-the whole herd gets the disease within a short timespan (50%)
-only some sheep get the disease (25%)
-sometimes only few and sometimes th whole herd get the disease (25%)

* (n=4)
-Only adult sheep get affected (50%)
-Small lambs are more severely affected (25%)
-All sheep are equally affected but adult animals get first infected (25%)

Fatgiya
*cause (n=18)
-sheep eat to much green fodder (94%) (33% of this 94% mentioned that this disease occurred during migration when there is lot's of green fodder available)
-change in diet (6%)

*symptoms (n=8)
- "sheep jump and die" (100%)

*duration
-seconds to some minutes (100%)

*mortality
-all animals die (100%)

*seasonality
-rainy season (more green fodder is available) (100%)

Mata
*cause (n=13)
-disease is caused by goddess "mataji", but also sick sheep can infect healthy sheep (54%)
-disease is caused by mataji (31%)
-cause not known but healthy sheep can get the disease from sick sheep(15%)

*symptoms (n=12)
-small lesions on body (100%)
-fever before lesions appear (58%)
-weakness, no appetite (42%)
-diarrhoea (25%)
-difficulty breathing (8%)

*duration (n=12)
-4-9 days (50%)
-7-15 days (25%)
-15-30days (17%)
-30 days (8%)

*mortality (n=12)
-90-100% dies (42%)
-30-50% dies (33%)
-60-75% dies (25%)

*Seasonality (n=12)

-all year (42%)
-winter (17%)
-summer (17%)
-rainy and winter (17%)
-rainy and summer (17%)
-rainy (17%)

*(n=10)
-mostly young sheep are affected (40%)
-all sheep get equally affected (40%)
-mostly ewes get affected (10%)
-mostly adult sheep get affected (10%)

*(n=10)
-the whole herd get this disease within a few weeks (100%)

Thakla
*cause (n=10)
-cause not known but healthy sheep can get the disease from sick sheep (20%)
-cause not known but lambs get it from drinking an infected ewes milk (42%)
-cause not known (10%)

*symptoms (n=17)
-swelling and pain in joints (100%)
-udder problems (e.g. no milk production) (65%)
-difficulty walking (47%)
-pregnant ewes abort (47%)
-ewes are weak, no appetite (35%)
-sheep get blind (24%)
-diarea (12%)
-fever (12%)
-sheep are anorexic (6%)
-mucus discharge from mouth and nose (6%)

*duration (n=4)
-5-6 days (in young animals)(25%)
-15 days (25%)
-1-2 months (25%)
-up to three months (in older animals) (25%)

*mortality (n=8)
-young animals always die (38%)
-some adult animals die (38%)
-of all sheep infected many die (25%)

*
-young animals are more severely affected (66%)
-pregnant and lactating ewes are more severely affected (33%)

-disease affects a whole herd

-lambs are first affected and die first (50%)
-adult sheep are first affected (50%)

Nimji
*cause

-? not asked

*symptoms (n=6)
-lesions on muzzle (67%)
-mucus discharge from nose (33%)
-lesions inside nose (17%)
-hair inside nose is gone (17%)
-sneezing (17%)
-small worms in nose (17%)

*duration
-several months

*mortality
-very few animals die with this disease

Appendix 5H Ethnoveterinary practices for most common sheep diseases

***Gogla (n=38)**
-"Teramacine" (Oxytetracycline injection) (29%)
-"Nilverm" Broad spectrum worm remedy for livestock and poultry (24%)
-"Elzen" dewormer for roundworms and tapeworms (24%)
-Albendazole, Broad spectrum anthelmintic for livestock and poultry (18%)
-Sheep are first given jaggery which is sweet and attracts the "disease causer" and then chili is given which kills the disease causer (16%)
-"Tolzan", liverfluke drench (13%)
-oil and turmeric is given (11%)
-mortuta is given (11%)
-hot iron is applied (8%)
-mortuta is mixed in water and given to drink (5%)
-jaggery is mixed with urine a given to drink (3%)
-Allum, turmeric and urine are mixed and given to drink (3%)
-red chili, tabacco is mixed with water and given continuously (3%)
-jaggery and turmeric is given (3%)
-allum is given (3%)
-castor oil mixed with water is given (3%)
-mustard oil, turmeric and water are mixed and given to drink (3%)
-tablets are obtained from medical store and given to sheep (3%)
-neem tree leaves are used to spread blessed water over the infected sheep (3%)
-tabacco and water are mixed and given to drink (3%)
-kira oil is mixed with water and given to drink (3%)
-tabacco, salt and water are mixed and given to drink (3%)
-ghee and boiled water are mixed and given to drink (3%)
-mortuta, tabacco and water are mixed and given to drink (3%)
-custard oil and two drops of technical oil (Carbon tetrachloride) are mixed and given to drink (3%)
-spirit medium is visited (3%)

Hindura (n=33)
-"Nilverm" broad spectrum worm remedy (42%)
-"teramacine" oxytetracycline injection (36%)
-Albendazole broad spectrum anthelmintic (18%)
-no treatment is given (12%)
-Tolzan, liver fluke drench is given (3%)
-hot iron is applied (3%)
-allum turmeric and buttermilk is mixed and given to drink (3%)
-mustard oil, boiled water and turmeric are mixed and given (3%)
-jagery and turmeric are fed (3%)
-castor oil and warm water are mixed and given to drink (3%)
-prayers/mantras (3%)
-allum, turmeric and water are mixed (3%)
-ghee and boiled water are mixed (3%)
-chili is mixed with ghee and put in nose of sheep to cause the sheep to sneeze, then worms come out (3%)
-allum powder is given (3%)
-morturta is given (3%)

FMD (n=39)
-smoke of burnt items of animal origin is spread in middle of sheep flock (33%)

-donkey hoof (31%)
-dogs' faeses (15%)
-jackal's faeses (15%)
-turtle shield is put upside down, filled with ghee and then lit (15%)
-turtles head is burnt (8%)
-lizard is burnt (8%)
-bird is burnt (8%)
-oil (ricinus or other oils) and turmeric are given to drink (26%)
-prayers/tantras (18%)
-oil is boiled and mixed with turmeric and put on wounds (18%)
-"teramacine" Oxy-tetracycline injection is given (13%)
-spirit healer is visited (13%)
-boiled oil is put on wounds (10%)
-Potassium permanganate is dissolved in water and applied on wounds (8%)
-"teramacine" Oxy-tetracycline is applied on wounds (5%)
-oil is given to drink (5%)
-kira oil is put on wounds (5%)
-ricinus oil, boiled water and turmeric are given to drink (5%)
-a tea is made from the bark of the karava tree (5%)
-mustard oil and salt are boiled and applied to wounds (3%)
-charcoal, salt, ghee and oil are mixed and applied on wounds (3%)
-boiled ghee is applied on wounds (3%)
-ghee and turmeric are given to drink (3%)
-castor oil, buttermilk and turmeric are given to drink (3%)
-ghee is given to drink (3%)
-holy water is collected from local temple and spread over sheep while saying tantras (3%)
-custard oil, water and turmeric are applied on wounds (3%)

Mata (n=39)
Treatment
-visit spirit medium (23%)
-no treatment available (10%)
-call veterinarian (8%)
-chanting mantras (3%)
-"nilverm" broad spectrum worm remedy (3%)
-small piece of tissue of infected sheep is collected and then put in ear of another infected sheep (3%)
Prevention
-Apply traditional vaccine (90%)
-avoid contact between sick and healthy sheep (60%)
-women in menstruation are not allowed near sheep (51%)
-healthy sheep are taken out of the village for 30 days when there is an outbreak (3%)

Haldariya (n=39)
-chanting of mantras and tantras (44%)
-flowers of *Butea monosperma* are used to make a tea which is given for several days (44%)
-spirit medium is visited (21%)
-"teramacine" Oxy-tetracycline is injected (8%)
-Animals are put in an open space or given a cold bath (cause of the disease is hot) (8%)
-bark of the karava tree is crashed and put in water, after boiling the mixture is filtered and given to the sheep (5%)
-jaggery is fed to the sheep (3%)
-turmeric and warm water are given to drink (3%)
-buttermilk and turmeric are given to drink (3%)
-custard oil and turmeric are given to drink(3%)

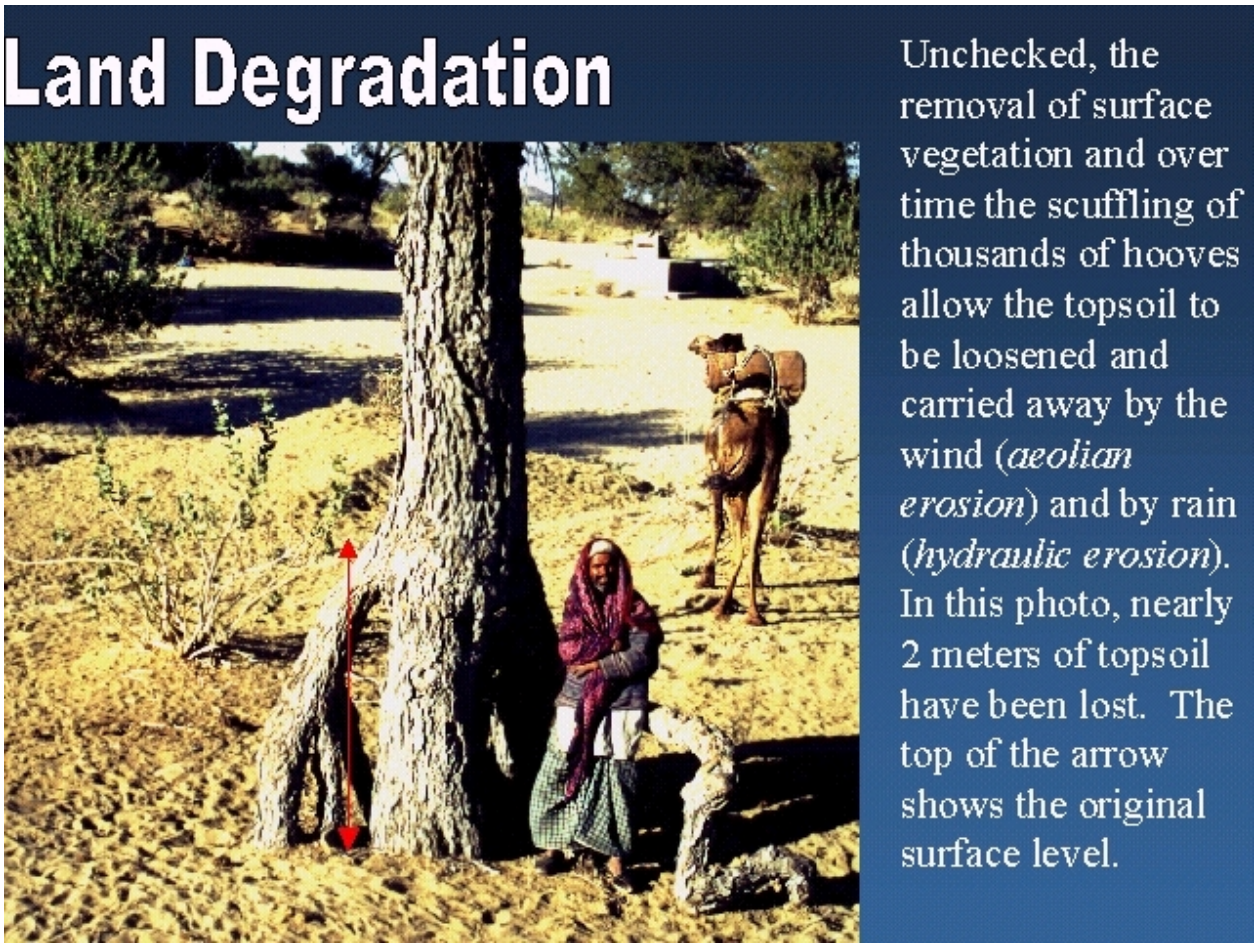
-mixture of jaggery and water is given to sheep (3%)
-obtain holy water from temple and spread on sheep (3%)
-go to temple for praying (3%)
-mortuta and water are given to sheep (3%)
-hot iron is applied (3%)
-“Nilverm” broad spectrum worm remedy is given (3%)
-neem tree leaves are used to spread blessed water on sheep (3%)
-piece of wood from “haldariya tree” is put in middle of corral (3%)

Nimji
-oil (tili, diesel, kurji) is put on wounds (92%)
-cactus milk is put on wounds (17%)
-acra leaves are crushed and liquid is used to apply on wounds (17%)
-some paste is obtained from medical store and applied on wounds (17%)
-water is mixed with kerosine and salt, this is applied on the muzzle (8%)
-ghee is put on wounds (8%)
-kurji oil and ashes are mixed and applied on muzzle (8%)
-pesticide is put on wounds (8%)

Thakla (n=39)
-bark of the karava tree is crashed and put in water, after boiling the mixture is filtered and given to the sheep (28%)
-oil and turmeric are given (26%)
-ricinus oil water and turmeric are given (10%)
-donkey dung is mixed with hot water, mixture is kept overnight than filtered and given to drink (10%)
-“teramacine” broad-spectrum worm remedy is given (8%)
-ajwain is given (8%)
-fish is boiled in water and then mixture is given to the sheep (8%)
-lizard is boiled in water ans mixture is given to sheep (5%)
-satiyanasi leaves are used to make a tea, this tea is given to drink (5%)
-bark of unidentified tree is used to make a tea from and given to sheep (5%)
-garlic is boiled in water and giveb to drink (5%)
-tabacco is mixed with water and put in a pot, this pot is berried in a dung heap for 3-4 days and then the mixture is given to the sheep (3%)
-go to temple to pray (3%)
-burning a donkey hoof in middle of sheep corral (3%)
-bark of Rohin tree is mixed with water and put in a pot, this pot is berried in a dung heap for several days and then the mixture is given to the sheep (3%)
-bark of karava tree is mixed with water and put in a pot, this pot is berried in a dung heap for 10 days and then the mixture is given to the sheep (3%)
-water, ghee and turmeric are mixed and given to sheep (3%)
-jaggery and turmeric are fed to sheep (3%)
-hot iron is applied (3%)
-Ajima powder is boiled in water and given to drink (3%)
-quarpata, boiled water and turmeric are mixed (3%)
-spirit medium is visited (3%)
-chanting mantras (3%)
-hot custard oil and turmeric is put on joints (3%)

Fatgiya (n=25)
-there is no treatment (40%)
-don’t know disease (12%)
-prevent disease by vaccinating before going on migration (12%)
-buy medicine when one sheep in flock dies of this disease (16%)
-buttermilk is given to sheep (4%)

Appendix I Land degradation



Source: http://ag.arizona.edu/~lmilich/thar/sld006.htm

Glossary of ethnominerals

Alum/alumen, local name Fitagri

Source **:** Alum earth of Nepal. Found with peroxide of iron in Silajit or Alum earth

Characteristics :Colourless, transparent, crystals with acid, sweetish astringent taste.

Action/Uses :astringent, haemostatic, antispasmodic, antiseptic.
Used in; haematuria, leucorrhoea, gastric and intestinal catarrh/diarrhoea and other haemorrhages

Charcoal (Carbo ligni)

Source **:**From burning wood.

Characteristics **:**Black moderately black lumps. Powder charcoal is black amorphous powder.

Action/Uses :Dry charcoal has the power of condensing oxygen, rapidly destroying organic Substances. Used in foul smelling diarrhoea

Copper sulphate, local name Mortuta

Source **:**prepared by roasting copper pyrites with sulphur, dissolving the roasted mass in water evaporating the solution to obtain the dark-blue crystalline sulphate**.**

Characteristics **:**Occurs as blue crystalline masses.

Action/Uses **:**In chronic diarrhoea, dysentery, and parasitic diarrhoea. In various forms of bleeding from mucus membrane, as mild lotion. To cauterise foul smelling Ulcers and footrot. It is used as a powder.

Glossary of ethno-animal products

Butter oil/ghee

Source **:**prepared by melting butter

Characteristics :white or yellowish semi liquid with aroma

Action/uses :Ghee is stomachic, nutritious. Alleviate of gas and indigestion. Generative of the secretion of semen and is beneficial in diarrhoea. Emollient soothing. Externally used on dry skin and irritability of skin. As ointment base

Butter milk, local name Chaach

Source **:**by churning curdled milk with water

Characteristics : white bluish fluid. Sour.

Action/uses **:**Rich source of calcium. Diuretic, cooling, acidic. Given as cooling agent in Diarrhoea and dysentery