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Saving the Camel and Peoples' Livelihoods

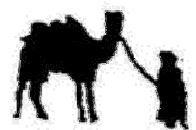
Building a Multi-Stakeholder Platform for the Conservation of the Camel in Rajasthan



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The LIFE Initiative
Local Livestock
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Lokhit Pashu-Palak
Sansthan

Saving the Camel and Peoples' Livelihoods

Building a Multi-Stakeholder Platform for the Conservation of the Camel in Rajasthan



Lakhit Pashu-Paik
Sansthan



Lokhit Pashu-Palak Sansthan

P.O. Box 1, Sadri 306702, District Pali, Rajasthan

Tel/Fax 02934-285086, email lpps@sify.com, web
www.pastoralpeoples.org/lpps.htm

Lokhit Pashu-Palak Sansthan means “Pastoralist Welfare Institute”. It is devoted to applied research and development for the benefit of people depending on animal husbandry for a living. LPPS has grown out of involvement with the camel pastoralists in the Godwar area and maintains close ties with the Raika/Rebari community. Its goal is to support and learn from pastoral communities as proponents of ecologically sound and socially just animal husbandry. LPPS has the following goals:

- Documentation of traditional knowledge
- Improvement of income from animal husbandry
- Provision of animal health care
- Creating employment opportunities for women and youth
- Breed improvement
- Pasture development.



LPPS is a member of the LIFE Network, www.lifeinitiative.net, a group of organizations and individuals who promote community-based conservation and development of indigenous livestock breeds and species.

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Misereor

Mozartstrasse 9, 52064 Aachen, Germany

www.misereor.org



Food and Agriculture Organization of the United Nations

Recommendations

Conference participants developed the following recommendations to promote camel development in Rajasthan.

Milk production

- Survey camel milk production and utilization under field conditions.
- Support changes in the dairy camel farming towards more intensive systems. Intensify production near cities, adding to (rather than replacing) traditional extensive ways of production. Increase production related to market opportunities.
- Promote hygienic practices in milking and milk handling.
- Select high milk producers for breeding, in association with camel breeders associations.
- Provide additional feed for intensive camel rearing for milk production.
- Reduce the calving interval where appropriate, e.g., by re-mating sooner after calving.
- Follow a health-management calendar. Treat diseases such as mange early.
- Establish milk marketing cooperatives, perhaps based on existing breeding organizations, to provide health and prophylaxis for milking herds.
- Promote cooperative societies for collection, processing (to produce higher-value products) and marketing.
- Work with private sector to develop collection centres with cooling facilities and generators. Work with the private sector to establish small dairy plants.

Milk policy

- One organization to coordinate the campaign for camel milk.
- Actively campaign to influence policy makers. Identify and mobilize key people and institutions to act together. Involve politicians from the beginning.
- Campaign for notification of norms and standards of camel milk under PFA Act by BIS. Campaign to include camel milk in the Dairy Act.
- Identify customer groups to plan appropriate products and advertising approaches.
- Promote camel milk as a health food through the mass media. Run an information campaign to raise improve the acceptability of camel milk and raise public awareness of its benefits. Use posters to raise awareness in schools.

- Identify important events and occasions to promote camel milk. Establish a shop for camel milk and milk products every year at Pushkar and Nagaur camel fairs.
- Ensure that the Raika and NGOs are involved in determining policy.
- Establish model dairy plants in research institutes.

Milk marketing

- Identify areas where large amounts of milk are available, based on migration patterns.
- Make clusters of 5–7 villages within a radius of 15–20 km for milk collection twice daily.
- Establish a training programme for milk processing. NRCC and field organizations to collaborate on this.
- Promote milk through free giveaways of milk.
- Link with agencies for sale of milk to big customers (hospitals, hotels).
- Develop processed products and test their market potential.
- Identify private-sector sponsors for product development and marketing.

Veterinary services

- Establish veterinary posts in key locations to provide services to camels.
- Collect and share ethnoveterinary knowledge among different camel owners.
- Organize a veterinary medicine bank through a revolving fund.
- Identify poor camel owners who need veterinary services. Train one person in each pastoralist group or village in disease control and basic treatment.
- Research specific camel medicines; don't rely on data from other species.
- Monitor camel health and return all information to the camel owners.

Information services

- Find out what information camel owners need. Mechanisms could include: camel *yatras*, surveys, fairs and social events, involving veterinary students, fellowships for journalists, and the LPPS network
- Identify gaps in existing systems, and determine how to better use what is available.
- NRCC to conduct research to fill gaps in knowledge.
- Form a communications team to make a strategy, with 1 international, 1 national and 1 regional member.
- Identify agencies and roles they should play in strategy: government, non-government, social groups and media.

- Lobby the government to conduct training for extension staff based on strategy.
- Involve KVKs in training and extension work.
- Radio is the medium of choice. Consider also pamphlets, posters, brochures, television, puppets and traditional entertainment media.

Access to grazing

- No proof that camels damage forest. Forest department and camel breeders to collaborate in testing areas to identify effects of grazing on the forest (model area for 2–3 years).
- Prevent cutting of leaves and branches by livestock owners to give plants a chance to recover.
- Reforest along roads and railway tracks with fodder trees. Such areas should be jointly managed by the Forest Department, camel breeders and village panchayats.
- Improve awareness among camel keepers of extension programmes.
- Involve camel breeders in the management of common grazing lands (*charagah*).
- Identify important fodder plants, nutritive value, maintenance and production requirements of camels. Identify vanishing fodder species, and inform Forest Department of their value species.

Participants unanimously agreed the following statement. It was named the **Mammaji-ki-dhuni Memorandum**, after a Hindu temple close to the conference venue.

Mammaji-ki-dhuni Memorandum

Camel experts from research institutions and non-government organizations in India, France, Germany, Kazakhstan, Oman, the United Arab Emirates, and the UK met at the training centre of Lokhit Pashu-Palak Sansthan near Mammaji-ki-dhuni at Sadri, District Pali, Rajasthan, India, on 23-25 November 2004. They issued the following statement.

We draw attention to the dramatic decline in Rajasthan's camel population. This has been caused primarily by the shrinking area of grazing, and the neglect of camels in policies and development programmes.

We believe that the camel is an integral part of Rajasthan's ecology, economy and culture, now and in the future. It is a significant source of employment for the state, enables the local economy to withstand drought, and is vital for Rajasthan's identity and attractiveness as a tourist destination.

We urge the following to conserve the camel in Rajasthan:

- Urgently investigate how to restore sufficient **pastureland** for camels in order to halt the decline in camel numbers.
- Make camel **health services** easily accessible to camel owners. This should include prophylactic and curative treatment of trypanosomiasis and mange.
- Identify emerging **market opportunities** for camel products (such as milk and meat), and support changes in the farming system to take advantage of these.
- Promote the value-addition and marketing of **camel products** (milk, wool, leather, dung).
- Promote and subsidize the use of **camel carts** as an eco-friendly source of transport.
- Develop an effective, comprehensive **Camel Policy**, aimed at the long-term conservation of the camel as part of Rajasthan's biodiversity. This should be developed in extensive consultation with the various stakeholders, especially camel-breeding communities.

Mammaji-ki-dhuni, Sadri, 25 November 2004

Overview

The camel in Rajasthan: Agricultural biodiversity under threat

Ilse Köhler-Rollefson

League for Pastoral Peoples

Summary

The one-humped camel is practically symbolic for Rajasthan. But over the last ten years this domestic animal has experienced a decline in its population, estimated to be about 50%. This development has grave implications for the sustainable utilization of Rajasthan's arid lands and its resilience to drought. It will also affect the several hundred thousand families below the poverty line who depend on camels for their living. These include camel-breeders who keep herds of female camels so they can sell their male offspring, camel users who own a single camel and cart, artisans who process camel products (wool, skin, and bones), and camel handlers working in the tourist business.

The people most closely associated with the camel in Rajasthan are the Raika, who earlier took care of the camel breeding herds (*to/as*) of the Maharajahs. Originally the Raika acted as guardians of the camel. They never sold female camels outside the community, and abhorred the idea of selling camels for meat. But due to severe pressures these social mechanisms are now breaking down. Thousands of female camels were sold for slaughter from the Pushkar Fair in 2003.

While the demand for camels as work animals may have fallen in some areas, the prime cause of the population decline is the disappearance of grazing grounds that can support camel breeding herds. This is evident in many parts of Rajasthan: in Pali district, where the traditional summer pastures have become part of the Kumbhalgarh Sanctuary and are therefore off-limits to grazing; around the Indira Gandhi Canal, where prime camel breeding areas have been turned into farmland; and in Sanchore, where the expansion of a *gaushala* is crowding out camel breeding herds.

Camels currently represent a typical "orphan commodity" for whose survival no public institution or agency feels responsible. The Department of Animal Husbandry of Rajasthan focuses its activities on cattle and buffaloes. The National Research Centre on Camel in Bikaner is entirely research-oriented and does not involve itself in policy making. Conservation agencies and the Forest Department seem mainly interested in wildlife and often appear antagonistic towards camels, deeming them a threat to the vegetation.

If the camel is to be saved, this situation has to change. The crisis needs to be acknowledged, discussed and acted upon at the highest level. It has to become a priority issue for the government and a question of regional pride to maintain the camel in reasonable numbers. A multi-pronged approach involving various government departments in combination with policy changes is needed to address the following main problems:

- **Shrinking grazing resources** represent the most significant problem. Lack of feed undermines the nutritional status of camel herds, making them vulnerable to diseases and negatively affecting reproductive rates.

- In many parts of Rajasthan, camel breeders have no access to **prophylactic health care and medicines**.
- There are no **organized markets** for camel milk, wool and leather; camel milk is discriminated against by the dairy cooperatives.
- **Low status and backward image** of camel breeding, lack of respect for the comprehensive traditional knowledge of the Raika community; lack of encouragement and moral support for camel breeders.

Introduction

The camel population of Rajasthan, and of India as a whole, is experiencing a steep decline. While water-intensive animals, such as buffalo, have skyrocketed in numbers, camel breeding is rapidly being abandoned. This trend, if it is allowed to continue, will make Rajasthan more vulnerable to droughts, increase dependence on non-renewable energy and have severe negative impacts on the livelihoods of many poor families depending on working camels as a source of livelihood.

This paper argues that in order to prevent a further decline and eventual near-extinction of this species in India, it is necessary, for one, to adopt participatory approaches and focus research and development efforts on the needs and worries of the people whose livelihoods depend on camels, especially the Raika camel breeding community. Equally or even more important, the government urgently needs to create a supportive policy framework by providing secure access to grazing areas and encouraging the marketing of camel products.

Camel population trend in India

India was once proud of having the third largest camel population in the world, after Somalia and Sudan, and numbering well over one million head. By 1997, the overall camel population of India had dropped to 911,000, according to the official data of the government, and it had been surpassed by Pakistan and Mauritania. In Rajasthan, camel numbers decreased from 756,088 to 668,237 head between 1992 and 1997, amounting to a decrease of 11.6% (while all other types of livestock, especially goats and buffaloes increased their numbers). The number of young camels decreased by 50% during this time period – a development that indicates a drop in camel breeding activities.

Table 1. Camel population in Bali and Desuri Tehsils of Pali District, in 1995 and 2004.

| | Desuri Tehsil | Bali Tehsil | Combined |
|------------------|---------------|-------------|----------|
| 1995 | 1026 | 783 | 1809 |
| 2004 | 556 | 396 | 952 |
| Reduction | 45.8% | 49.4% | 47.4% |

The results of the official livestock census conducted in 2003 are not yet available, but the decline seems to have accelerated since 1997 as indicated by our own

household surveys. In two Tehsils of Pali District, the camel population was reduced by almost 50% between 1995 and 2004.

Another crucial observation concerns the fact that thousands of camels (at least 50% of them female) were sold for slaughter at the Pushkar Fair in November 2003. Ten years ago, selling of camels for meat was unheard of in Rajasthan, and there were deeply ingrained social restrictions against this among the Raika, the traditional camel breeding caste, which own ca. 80% of female camels. Now the sense of custodianship that obtained in this community is rapidly breaking down, and this is probably the greatest reason for concern.

Socioeconomic significance of the camel in Rajasthan

The camel is often regarded as emblematic of Rajasthan. In Rajasthani folklore it symbolizes love, and ownership of a camel once signalled status and wealth. It was used for warfare by the Maharajahs and played an important role in desert communication, transportation and trade. Historically, camels were thus a valuable commodity used by the ruling classes and by the business community (Srivastava, 1991).

The breeding and supply of the camels required by the elite for battle and commerce was, and is, the traditional occupation of a Hindu caste known as Raika. The human-camel relationship and camel culture of Rajasthan is unique from a global perspective, since the Raika are probably the only camel pastoralists in the world who have developed a deeply ingrained prohibition against the use of camels for meat. Earlier, there was also a religious bar against the sale of milk and wool. Raika identity was traditionally based on the belief that they were created by God to take care of the camel. Therefore they regarded themselves as guardians of the camel in the true sense of the word, feeling responsible for the well-being of this animal. The community outlawed the sale of female camels, female camels were part of the dowry and for the marriage ritual the bridegroom had to be seated on a camel (Köhler-Rollefson, 1992). Due to this intimate association with the camel over the centuries, the Raika also accumulated a large body of indigenous knowledge related to camel management, breeding, disease treatment, and behaviour. For this reason, they were referred to as “native camel doctors” by colonial veterinarians (Köhler-Rollefson, 1994a).

Despite their continuing emotional linkage with the camel, it is now only a small minority of Raika for whom this animal forms the basis of subsistence. The majority of the Raika still involved in animal husbandry keep sheep and/or goats, serve as village cattle and buffalo herders, work as caretakers in *gaushalas* (cow sanctuaries) or as traditional animal healers. Although such animal related occupations are still typical for the Raikas, many of them have severed all connections with livestock and invested profits from the sale of their herds in agricultural land, in the purchase of shops, or made fixed deposits in the bank.

The majority of young men now seek wage labour outside Rajasthan, mostly in menial jobs which usually pay little more than room and board. Typically, they go to Surat, Bombay or other big towns in south India where they work in the houses of Marwari (trader) families, a caste with which they have long-standing ties.

The significance of the camel for livelihoods

Conventional analysis has attributed the decline in the camel population to a diminishing demand of these animals for work, due to their replacement by tractors and trucks. This may be true in some parts of Rajasthan, such as Ganganagar district where wealthy farmers can afford tractors. But participatory evaluation of the situation with Raika camel breeders reveals that lack of pasture and impact of disease is rendering camel breeding not only uneconomical, but almost impossible; this forces them to abandon their hereditary activity. In Pali district, continuous pressure by forest officials for bribes and abuse by landowners make camel breeding an extremely unattractive option for the younger generation. Raika camel herders in Pali district unanimously feel that they are the last generation involved in this occupation and that their children will search for employment in the cities.

Nonetheless, the significance of the camel as basis of the livelihoods of some very poor and marginal communities remains undiminished.

These camel dependent communities include:

- Around 20,000 families from the Raika caste who own herds of female camels and make a living from selling the young animals. Some of these families (in Mewar, Malva and Godwar) generate additional income by selling camel milk, alleviating the chronic milk shortages typical of many rural areas.
- An estimated 250,000 people and their families who own a male working camel plus cart and make their living from providing short and medium distance transportation in large cities, in remote desert areas and in the hilly areas of the Aravalli range.
- Entire villages in the Thar Desert depend on a camel to lift water from deep wells.
- Many Untouchable castes receive income from the processing of camel products. Although poorly documented, these secondary industries include leather and bone work.
- The population of Rajasthan as a whole benefits from the camel as an eco-friendly source of energy. In some parts of Rajasthan, such as the Godwar area, camel dung is exchanged with grain and makes an important contribution to upholding soil fertility. Most significantly, during the recent droughts camels have thrived by comparison with other livestock underscoring their superb adaptation to the local conditions. From the perspective of environmental sustainability camels with their minimal impact on vegetation and low water requirements are definitely preferable to goats and buffaloes.
- Finally, without the camel, Rajasthan would lose much of its attraction as a tourist destination.

Economic role of the camel in Rajasthan

1. Transport

Throughout much of its distribution area, the dromedary camel is an important source of food (Farah and Fischer, 2004). But in India the camel is traditionally regarded as

a draught animal and means of transportation, while its food potential is largely ignored. In the Thar desert, camel carts are still popular and remain a frequent means of transportation. They fulfil this function not only in remote rural areas, but also in the major cities. In Bikaner, Jodhpur and Jaipur, camel-drawn carts are ubiquitous. They move goods of all kinds, especially wood, fodder, gas cylinders, fabrics, bricks, etc. The typical two-wheeled carts are a relatively recent invention dating back to the 1950s.

Ownership of a camel and a cart is a solid source of income, sufficient to support a family. For this reason, development agencies (such as Heifer Project International) and regional banks support loans for the purchase of a camel cart. According to studies by the National Research Centre on Camel, the average daily income from camel carting was Rs 300 and Rs 140 in city and village areas, respectively, versus a daily expenditure of Rs 40/camel/day. The income from camel carting was estimated to be higher in city areas as compared to rural areas because camel keepers in the city area had more opportunities to transport different agricultural commodities and construction materials than those operating in the rural areas (NRCC, 2004).

In the hilly parts of the state (Aravalli range and southern Rajasthan), the camel continues to be used as beast of burden, notably for the transportation of harvested crops, such as chili peppers, *chara*, etc. It can carry loads weighing 150–300 kg over long distances and 450 kg over short distances. Other chores performed by camels include threshing, lifting of water and powering of oil mills.

The camel is used as riding animals mainly in the Jaisalmer area, where it exerts considerable draw on tourists. This is utilized by the Department of Tourism which organizes a Camel Festival in Bikaner and promotes other camel games, such as racing and polo at various festivals (Gahlot and Chada, 2000).

Finally, the camel also maintains some military significance, being used to patrol the desert border. The Border Security Force keeps 1750 camels for this purpose in Rajasthan and Gujarat.

2. Camel milk

Camel milk is a by-product of camel breeding which is consumed primarily by herdsman (especially on migration) and by their families. In Rajasthan, there are traditional cultural restrictions on the sale and processing of camel milk, and it is not marketed in the core camel breeding areas, such as Bikaner, Jodhpur and Jaisalmer. But in the late 1990s, there was a large “grey” camel market in the northern tip of Madhya Pradesh (Mandsaur, Jarwa, Ratlam, Indore, Bhopal, and Ujjain) and in parts of southern Rajasthan (Bhilwara, Chittorgarh, Udaipur, Kotah, Nimbahera) which proceeded at tea-stalls, to private households, or under the guise of cow/buffalo milk to dairies. The average daily yield of a lactating camel is around 2 kg, although some owners assert that individual yields can be as high as 6 kg or more.

The production system is extensive – camel herds are usually stationed about 10–15 km from the towns and supported exclusively on natural graze, mostly consisting of tree vegetation. Some of the trees include *Acacia nilotica*, *Prosopis cineraria*, *Capparis decidua*, *Balanites aegyptiaca*, *Zizyphus glabrata*, *Acacia leucophloea* and *Acacia senegal*. The camels are milked twice or thrice per day, usually during the night, because the milk is collected in the early morning.

The income generated from milk sales can be substantial, exceeding the returns from selling the young male offspring.

Several years ago, the Rajasthan High Court declared camel milk as hazardous to human health and sentenced a Raika camel milk vendor to a monetary fine and jail. This decision was appealed to at the Supreme Court through a Public Interest Litigation initiated by the NGO Lokhit Pashu-Palak Sansthan. The plaintive brought forward evidence about the high esteem for camel milk in other countries, and the Supreme Court decided that camel milk was fit for human consumption.

Yet, to this day, camel milk continues to be discriminated against by the Rajasthan Dairy Federation, which does not accept it. At the same time, research by Indian scientists now also supports the therapeutic value of camel milk in the treatment of several diseases, including tuberculosis. A recent study by the Medical College in Bikaner and the National Research Centre on Camel suggests that camel milk is also useful for the treatment of Type 1 diabetes (Agrawal et al., 2003).

3. Camel meat

Earlier, camels were not slaughtered in India, except in a clandestine fashion. The consumption of camel meat is not acceptable to most castes, and the Raika are unique among camel pastoralist worldwide in rejecting the use of camels for meat. In a small number of cities with large Muslim populations (for instance Tonk), there has been a tradition of sacrificing a camel at the occasion of important Muslim holidays. Within Rajasthan, eating of camel meat is therefore restricted to rare occasions and religious minorities.

However, since the last couple of years, an increasing number of camels are leaving the state to be sold for slaughter in other parts of India, especially West Bengal, but also Bangladesh and purportedly for export to the Middle East. Several thousand camels, mostly females, were sold for this purpose at the Pushkar Fair in 2002 and 2003. In February 2003, camel smuggling across the border between West Bengal and Bangladesh resulted in a shootout between Indian and Bangladeshi border troops (Daily Star, Dhaka, 28.2.2003).

4. Camel wool

Camel wool is utilized by camel breeders for the manufacture of items to be used in their own household such as rugs, blankets, *charpais* and saddle girths. Similarly to camel milk, there were earlier certain cultural restrictions on the sale of wool. Because of low wool yields and short fibre, there appears to be only limited potential for commercial use of camel wool.

5. Camel leather

The skins of camels are especially useful for manufacturing lampshades, toys, drum covers and certain types of containers. They are also used as material for shoes; according to members of the leather working community, there is no tanning facility in Rajasthan and skins have to be transported to south India for this purpose.

A regional specialty used to be the *kuppa* or *kuppi*, painted vessels for oil, ghee and perfume painted in an intricate pattern. Because of lack of demand this artisan industry has now stopped.

6. Camel bones

Similar to the bones of other animals, camel bones are processed into fertilizer (bone meal). They are also used as in lieu of ivory for the production of jewellery and

ornaments, as well as for manufacturing inlaid furniture. Logistics are complicated by the fact that the nearest facility for cleaning bones is located in Uttar Pradesh, requiring transport to and fro.

7. Camel dung

Camel dung represents an important fertilizer and plays, or played, a significant role in the relationship between camel breeders and farmers. Although the fertilizing effect of camel dung is not as high as that of goat or sheep dung, it is regarded as better than cow dung. Although its effect is retarded, since it takes longer for camel dung to decompose, it lasts for 3 years. Sedentary camel breeders sell camel dung by the cartload or exchange it for grain. Nomadic camel pastoralists receive compensation in kind from the owners of the land on which their herds stay over night. Even higher fertilizing value is attributed to camel urine.

Ecological benefits of camels

Ecologists emphasize that camel grazing has very little, if any, damaging effect on desert vegetation and does not contribute to desertification, for its foraging habits are optimally suited to areas with a low carrying capacity (Köhler-Rollefson, 1994b). Camel herds disperse over huge areas instead of clustering together like sheep. While goats often ravage a whole shrub in one extended feeding session, camels tend to take only one or two bites before moving on to the next bush or tree. In addition, their flat pad-like feet are believed to be gentle on the soil surface and not carve it up like the sharp cloven hooves of small ruminants (Gauthier-Pilters and Dagg, 1981). Camels also have a very efficient feed conversion rate and according to some calculations require only 1.9 kg of dry matter to produce 1 liter of milk, compared with 9.1 kg in cows (Stiles, 1983).

Camel breeds in India

In India, camel breeds are named after the region in which they have originated, but there is no agreement among authors which regional populations should be regarded as distinct breeds (Köhler-Rollefson, 1992b). Only the Bikaneri and Jaisalmeri camel are universally accepted as discrete, and they have their origin in the breeding herds kept by the Maharajahs of these kingdoms. Rathore (1986) referred to Mewari and Kacchi breeds, while Khanna (1988) mentions Marwari, Mewati, and Kutchi breeds, and in another paper also refers to Shekhawati, Mewari, Sindhi, and Riverine breeds and strains (Khanna and Rai, 1995). Camel breeders also list Sirohi, Jalore, and Sanchori camels as separate breeds. The Malvi camel has been described as a separate and phenotypically very distinct breed with good milk potential (Köhler-Rollefson and Rathore, 1996).

Approaches to supporting camel based livelihoods

Lokhit Pashu-Palak Sansthan, an Indian NGO based in Rajasthan's Pali District, has been working with the Raika camel breeding caste since 1996, helping them to improve economic returns from their hereditary activity, by providing camel health care, assistance with camel milk marketing and other support (Köhler-Rollefson, 1995, Köhler-Rollefson, 1997, Rathore, 2001).

The work of LPPS developed out of a research project on the socioeconomics of camel husbandry in India begun in 1990/91 (Köhler-Rollefson, 1992). At that time, the Raika from Pali district in central Rajasthan had expressed concern and complaints about the disease problems of their camel herds, mostly early and late miscarriages, as well as difficulties of finding grazing for them. These interactions resulted in an applied research project seeking to verify the information provided by the Raika, to establish data on the reproductive performance of camels under field conditions and to identify the bottlenecks in the system. The research focused on an area known as Godwar, which is composed of Bali and Desuri tehsils of Pali District and extends along the north-western face of the Aravalli Hills, but it also extended into adjacent parts of Pali district. Some of the salient results are summarized here.

Results of applied research

1. Production system and yearly cycle

The Godwar camel breeders are sedentary and engage in village-based herding, in contrast to many of the Maru Raika from outside Godwar who are usually migratory and rarely return to their village. Of 156 herds encountered during the project's survey of camel holding families in southern Pali district, 34 (22%) were sedentary and 122 (78%) were nomadic.

Often 2–5 families form herding groups. The herds are grazed on various types of lands, including fallow or harvested fields, *gauchar* (village grazing grounds), *oran* (pasture land devoted to a deity), so-called “wastelands” (uncultivated land under the jurisdiction of the state) and, during the rainy season, the forests of the Aravalli Hills. For access to the latter, grazing taxes have to be paid, frequently incremented with bribes for the forest officials.

The breeding season falls in the cold months of the year from November to March/April. This is the most work-intensive part of the year. During the rainy season from July to October, the incidence of disease is greatest. In November, the calves born during the previous winter are taken for sale to the Pushkar market, a trek that takes some 10–14 days. Traditionally, this is the time when the whole year's income is realized.

2. Herd sizes in Pali district

Herd sizes range between two and 60 head, with holdings of 11–20 camels forming the most frequent category (Table 2).

Table 2. Distribution of herd sizes in Pali district

| Herd size | 1–10 | 11–20 | 21–30 | 31–40 | 41–50 | 51–60 |
|-----------|------|-------|-------|-------|-------|-------|
| Number | 15 | 25 | 17 | 8 | 3 | 1 |

There was a definite trend for herds to become smaller. Of the 156 camel holdings surveyed in Godwar and adjoining area, 119 (76%) were said to have decreased in size over the last 20 years; only 28 (18%) had increased, whereas 9 (6%) were said to have remained about the same by their owners.

3. Income from camel breeding

The Raikas predominantly sell young male camels, which represent about 2/3 of the sold animals. About 25% of the sold camels are young female animals. The rest are adult animals – either female camels that can not be used for breeding, male riding camels, or male breeding camels.

- In 1994, the average price of 67 camels sold at Pushkar by Raika families from the village of Jojawar (District Pali) amounted to Rs 2104; male animals obtained an average price of Rs 2071, compared with Rs 1661 for females.
- In 1995, prices were slightly higher, with Rs 2209 for male and Rs 1700 for female young animals. By some this development was attributed to the project inputs.
- In 1996, prices were not recorded, but the Pushkar Fair witnessed a dramatic rise in prices for good quality camels which were also so much in demand that after the first two days practically all of them were sold.

The price range for calves of weaning age reportedly runs from a few hundred to around Rs 10,000. Camel breeders from other parts of Rajasthan where camels can range unsupervised generally prefer to sell them at the age of 4–5 years, when they fetch the highest prices – of up to Rs 20,000.

4. Profits

The average annual income of the “average” family can be calculated as follows. In an average family holding of 13 female breeding camels, 6–7 calves are born, of which 50% (3-4) are male and can be sold. At an average price of Rs 2200, this amounts to an annual income of Rs 6600–8000.

5. Disease spectrum

The two infectious diseases of greatest economic importance are trypanosomosis and mange.

Other health problems with significant impact include injuries which are often due to falls. Apparently camels fairly often slip or fall down, especially when grazing in the Aravalli Hills. Fractures occur in both young and adult animals. Poisonings from eating certain plants (*Lantana* sp., *Oleander*) also occur regularly.

6. Calf diseases

The mortality of young camels is fairly low. Of 47 camel calves whose births were recorded by the project in 1994/95, five died before weaning, i.e. before they could be sold at Pushkar, amounting to an infant mortality rate of 11%. This sample was small, but analysis of 388 births with the help of the “progeny history method” also showed that 43 (11%) had resulted in infant death.

Of 40 camel calves born to Godwar Raikas in 1995/96 only 2, equivalent to 5%, died before weaning. Causes of death are constipation, diarrhoea and accidents (for instance falling into the well), sometimes also predators (leopards).

7. Abortions

An analysis of 473 pregnancies compiled by the progeny history method showed that 18% had ended in abortions. The Raika generally attributed the abortions to infection with trypanosomosis, although causal connection was never confirmed scientifically.

Project interventions

Based on the results of the research and suggestions of the Raika, the project undertook a number of interventions aimed at making camel breeding more economically viable. These included:

- **Camel health services**, notably prophylactic treatment against trypanosomosis and curative treatment for mange.
- **Support for camel milk marketing**. In order to generate additional income, the project supported the initiation of camel milk marketing, which was against traditional social rules of the Raika community. Depending on the situation of the family (sedentary or nomadic), this can be reasonably profitable, although it requires skilled management if malnourishment of the calves is to be avoided (Köhler-Rollefson, 1997).
- **Provision of superior male breeding camels**. Because the price of camel calves depends very much on their quality, high quality male camels were made available for shared use by the community.
- **Exposure tours for camel breeders**. Linkage was established with the National Research Centre on Camel, and camel herders benefited from exposure to scientific camel breeding.
- **Solution of grazing conflicts**. The most important but also the most difficult aspect of the efforts has been pushing for access to grazing in the Aravalli Hills which constitute the traditional summer grazing grounds of the camel herds, and fighting the corruption of the Forest Department. While there have been some successes these have been temporary, and there are plans to further restrict the access of camels to this area. Lack of grazing areas is actually the most crucial and limiting factor to camel breeding.

The grazing problem

“In India the rapid development of irrigation is causing great changes in the camel-country, and, in many instances, breeds formerly famous for their good qualities have died out, and others even now are in the process of extinction as breeds...; the closure of jungles by the Forest Department in the North Punjab is another factor responsible for the loss of a good hill breed.”

This comment was made by A.S. Leese, a colonial veterinarian, in 1927. The scenario he was describing pertained to the Punjab, but it would be just as appropriate for Rajasthan today. Lack of pasture for breeding herds is unanimously cited as largest problem by camel breeders. The circumstances behind the decrease in common property resources have been described in some detail by Jodha (1986) for the period between the 1950s and the 1980s. During this time period there was a 50% increase in the land under agriculture. The incidence of double-cropping has also increased due to irrigation. In Pali district, the area under double cropping

expanded from 20,000 ha in 1956–1957 to 48,000 ha in 1977–1978 (Malhotra et al., 1983). In the almost 20 years since Jodha’s study, the situation has undoubtedly exacerbated further, although there is evidence that due to lowering of the water table, double-cropping is diminishing, at least in the Godwar area.

Conclusions

Shrinking grazing resources and lack of pasture opportunities for large camel herds represent the most significant problem and root cause for the declining camel population. Want of food undermines the nutritional status of the herds, making them vulnerable to diseases and negatively affecting reproductive rates. The situation is compounded by the fact that in many parts of Rajasthan, camel breeders have no access to prophylactic health care and medicines.

Options for increasing economic returns are reduced because of the absence of an organized market for camel milk, wool and leather. Camel milk is discriminated against by the dairy cooperatives.

Last, but by no means least, the low status and backward image of camel breeding, the absence of respect for the comprehensive traditional knowledge of the Raika community; as well as lack of encouragement and moral support for camel breeders, combine to make camel-pastoralism a very unattractive livelihood option.

If the camel is to remain part of Rajasthan’s domestic animal diversity, then it is urgently necessary for all the stakeholders, including government and non-government sectors, as well as the camel-breeders to think about remedial measures. The Raika camel breeders need to be listened to and their concerns be taken seriously. Grazing areas need to be reserved throughout the state, at least on a seasonal basis. Other countries may have valuable lessons to offer on value-addition to camel products.

Table 3. Camel population trend in Asia (according to FAO data)

| Country | Population (1993) | Population (2003) | Change |
|--------------|-------------------|-------------------|--------|
| India | 1,030,000 | 900,000 | -12.6% |
| Pakistan | 1,097,000 | 800,000 | -27.1% |
| Mongolia | 415,200 | 352,000 | -15.2% |
| China | 401,000 | 264,000 | -34.2% |
| Kazakhstan | 148,800 | 108,000 | -27.0% |
| Kyrgyzstan | 50,000 | 46,000 | -8.0% |
| Tajikistan | 50,000 | 42,000 | -16.0% |
| Turkmenistan | 40,000 | 40,000 | - |
| Uzbekistan | 23,000 | 25,000 | +8.0% |

Despite all its ecological advantages, the camel will continue to lose importance, unless solutions are found for turning camel breeding into an activity profitable enough to sustain livelihoods. The experiences of LPPS demonstrate that local activities are not enough and can not really stop the decrease and gradual extinction of the camel, unless the government also provides a supportive policy framework. Most importantly, adequate grazing areas have to be made available. If there are sanctuaries for wildlife, why can there not be some reserved grazing areas for camels? The camel represents something of an orphan commodity that neither animal scientists and veterinarians nor wildlife conservationists feel responsible for. This situation has to change. Furthermore, the stigma that has come to be associated with camel breeding as a backward activity has to be removed. Unless young people perceive camel breeding as a livelihood option that generates a certain minimum income, there is no way that the camel can be saved, except in a zoo.

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Why does the camel need to be “saved”?

Ilse Köhler-Rollefson

League for Pastoral Peoples

According to the provisional figures of the national livestock census, the camel population of Rajasthan still numbered 498,000 head in 2003, and this may lead some observers to the conclusion that calls for “saving the camel” are premature and unnecessarily alarmist. In addition, people with a modernist point of view might argue that the camel has become superfluous in this day and age anyhow. This paper recapitulates the pressing rationale for maintaining the camel as a viable component of Rajasthan’s agricultural biodiversity, and then runs through the evidence for its drastic decline in recent years. Finally, it presents the recommendations for suggested action that were compiled during a workshop of camel breeders held on 17–19 November, 2004.

Introduction

According to the provisional figures of the latest livestock census conducted in 2003, Rajasthan’s camel population numbers around 498,000 head. With still almost half a million camels around, why do we worry and claim that action is urgent in order to save the camel? Are our assertions that the camel is on the way to extinction not a wild exaggeration? And apart from that, even if our claims are right, why should we bother? For, do we really need the camel in this day and age, when tractors and other forms of transportation are available and can fulfil the functions that the camel once provided?

These are the questions I would like to address in my presentation. Let me start by giving you a point-by-point explanation of why Rajasthan still needs the camel, and then a detailed reasoning of why we at Lokhit Pashu-Palak Sansthan are so worried.

Why camels are needed

Drought resilience

Rajasthan is a drought-prone area. Average annual rainfall amounts fluctuate wildly between years and in most years. But the policy makers seem to have forgotten this and have supported and subsidized irrigation agriculture in a big way. Already this has led to a depletion of groundwater supplies in many parts of the state, including the immediate area around us. Over the last 20 years or so, the number of bore wells multiplied exponentially, and the traditional one-crop rainfed agriculture was replaced with an irrigated two- or even three-crop cycle. But since the last seven years the majority of fields has lain fallow and so once again can be put to productive use only by means of livestock.

The riots surrounding water distribution in Hanumangarh are another indication that water will become increasingly scarce rather than more abundant in the coming years. An animal, which can thrive on local vegetation that grows without irrigation, is an inestimable asset in such a scenario. It is in the interest of drought-proofing

Rajasthan that the camel should have a larger rather than a smaller share of the economy.

Livelihoods for poor people

In earlier times, camel ownership was a prerogative of the rich and powerful, and camel ownership symbolized wealth, as well as military power. But currently, it is the poor and the voiceless who own camels and for whom they form the basis of their livelihoods. Among camel owners we can distinguish two broad categories: camel breeders who keep herds of female camels, and camel users who own one or two male camels for work. We can estimate that there are about 6,000–10,000 camel breeding families and up to 200,000 families for whom working camels are an important element of their livelihood. These include the camel cart owners in Jaipur and other cities who earn a living by transporting construction materials and other goods, and for whom this business generates enough income to provide education for their children. It also includes poor farmers in the Ganganar area who can not afford tractors for carrying out agricultural activities. Thirdly, and sadly, there are some sub-sectors of Rajasthan's society for whom the camel cart affords the only means of transportation, since they are not allowed to take advantage of public transportation. One of the participants in the grazing workshop that we just concluded belonged to the Vagri community and related how his people were not allowed to use buses and therefore had to resort to camel carts to get to the hospital, etc.

This livelihood option will remain open only as long as camels are reasonably priced. If they become too scarce and too expensive, an important source of income will disappear and more people become unemployed.

Environmental protection

As a means of transporting goods, even in cities, camel carts have much to recommend them, being silent, independent of fossil energy, and non-polluting. Instead of being perceived as antiquated, camel carts should be regarded as trademark of Rajasthan and a progressive, because eco-friendly, source of energy. Lifting water is another activity that can easily be performed by camels.

Identity

Eighty percent of India's camel population is at home in Rajasthan, and the camel is practically symbolic of this state. The word Rajasthan practically conjures up images of camels in most peoples' minds, and everybody knows that camels can be found only in Rajasthan. The camel means deserts, sunsets, turbaned and moustachioed men – even love – and advertising agencies capitalize on this. From mobile phone companies to the Department of Tourism, many businesses exploit the romantic vibrations emanating from the image of a camel and use it in their advertising campaigns.

Tourism

Undoubtedly, it is the possibility of undertaking a camel safari that lures a large proportion of especially young tourists to Jaisalmer and to Rajasthan as a whole. The

significance of the camel for Rajasthan's attractiveness as a tourist destination can not be overstated. Some tourism entrepreneurs are already expressing anxiety about the shortage of camels.

Culture and indigenous knowledge

From Dhola-Maru to Moomal and Mahendra, Rajasthan's folklore abounds with references to the camel. But apart from that, there is one community for whom it is of special significance: the Raika, who believe they were created by Lord Shiva to take care of the camel and who took care of royal breeding herds. Because until today, this special sense of responsibility towards the camel is retained among the elder generation, the Raika represent the guardians of the camel, replete with an immense store of knowledge on camel management and treatment. The Raika form one of the most fascinating components of Rajasthan's ethnic mosaic, and their indigenous knowledge is a treasure that must not be squandered. Alas, few members of the young generation feel inclined towards a camel herding way of life, and this represents one of the most severe threats to the survival of the camel. The camel culture of India is precious and very distinct to that in other countries because of its Hindu foundation and the prohibition on using camels for meat.

The evidence

Various threads of evidence attest to the pressure on the camel population:

Official livestock census data

Between 1997 and 2003, the camel numbers of Rajasthan dropped from 668,000 to 498,000, which represents a decline of 24% within a time span of 5 years.

Door-to-door survey in Pali District

A door-to-door survey of camel breeding families in Bali and Desuri tehsils of Pali District even revealed a 49.4% and a 45.8% decrease respectively in the camel population between 1995 and 2004.

Oral testimonies by camel breeders

Camel breeders themselves say that camel numbers are declining.

Sale of female camels for slaughter

Ten years ago the slaughter of camels was unheard of, and abhorred by Hindus and Muslim alike. Furthermore, the Raika did not even sell female camels to anybody outside the community, well aware that this would erode the foundation of their existence. It is tragic that in recent years, these social restrictions that served to preserve Rajasthan's camel population have crumbled away. Purchase of female camels for slaughter from Pushkar began in a clandestine fashion several years ago. The authorities did not even believe this until newspaper clippings from Bangladesh provided incontrovertible evidence. Then, in 2003, thousands of female camels were openly sold for meat at Pushkar. In 2004, because of the timing of the Eid, transactions between breeders and meat purveyors took place well before the Pushkar Mela. The reason why it is mostly female camels that go for slaughter is the

fact that they are cheap by comparison with the male camels that are favoured as work animals.

If this process of a gradual, but rapid, sell-out of Rajasthan's female camel population is not brought under control, then the end of camel breeding is surely in sight, unless efforts are made to address the issue.

Reasons for the decline of the camel population

Grazing problems

The most important causal factor for the decline of the camel population is the disappearance of pastureland that can sustain camel breeding herds. For camel breeding to be reasonably profitable, a certain minimum herd size (around 20–30 female camels) is required, which in turn need to have access to sufficient pastureland. Camels are browsers and, in India, primarily depend on trees, especially various slow-growing *Acacia* species.

The causes for the disappearance of grazing opportunities are multi-factorial and include expansion of irrigation agriculture (both through deep wells and the Indira Gandhi Canal), the alienation and neglect of community grazing lands, and the establishment of wildlife sanctuaries and other reserved areas. The Indira Gandhi Canal has eaten into, and cut into half, a prime camel breeding area. Farmers reportedly shoot camels with guns, tie their mouths shut to starve them, and attach thorny shrubs to their tails. Military shooting zones also complicate camel breeding.

In Pali and Udaipur districts, the area that has been turned into the Kumbhalgarh Sanctuary has traditionally represented the rainy season pasture for several thousand camels. Access to this area has become very difficult, and now there is a total ban on grazing in all sanctuaries. In coastal Gujarat, camels have grazed in the mangrove areas, and here too they are now being barred from access. Institution of the Joint Forest Management system has also often led to the exclusion of camels, since their owners are not members of the Village Forest Protection Committees.

In Sanchore, establishment of a *gaushala* has taken away pastures and been accompanied by the destruction of *jal*, a plant that is ideal camel fodder but takes many years if not decades to grow.

Discrimination by policy makers

The significance of the camel for Rajasthan's economy is not reflected in the various livestock related laws, legal acts, and support programmes. In fact, reference to the camel is omitted in almost all of them, while cattle are given special consideration.

- Camel milk is not included in the **Rajasthan Dairy Act**. The rejection of camel milk by the government dairies to accept camel milk creates added hurdles towards the marketing of camel milk and makes it more difficult for them to support their livelihoods.
- There are no provisions for camels in the newly set up **Livestock Development Board**, which instead caters towards cattle breed improvement and *gaushalas*.
- The programmes of the central **Ministry of Agriculture** for the camel are largely inappropriate for addressing the problems of camel population decline.

- Camels, together with sheep and goats, are not included in the **Famine Code**. However, there are apparently provisions in the National Calamity Relief Fund and the Calamity Relief Fund to assist owners of draught animals with a quarter to a third of the replacement costs. However, this is not widely known.
- Funds are channelled into *gaushalas*, which compete with camels and other livestock for grazing resources.
- Livestock as a whole is not given any attention, as is reflected in the low priority and status of the Department of Animal Husbandry. This is incomprehensible and irresponsible considering the enormous competitive advantage Rajasthan has in livestock production.
- Lack of interest among non-camel specialist researchers and institutions – as is reflected in the scant participation at this conference.

Consequences for camel-dependent people

Prices for camels are up

Because of the added demand for camels by slaughterers, the demand for camels at Pushkar now by far exceeds the supply, and camel prices have risen significantly, maybe by close to 50%. This is good news for breeders obviously, but not for camel users who find it more difficult to obtain suitable animals.

Lack of interest in the young generation

Young people have lost interest in the profession of camel breeding because it does not offer the prospect of a reasonable livelihood. Within the Raika community, young women also do not want to marry men who breed livestock.

Need for action: Recommendations by camel breeders

In the grazing workshop that we held from 17–19 November, the participating camel breeders who hailed from all parts of Rajasthan, made the following recommendations to address the issue:

1. **Camel grazing areas should be identified and protected.** The responsibility for their management should be given to camel herders.
2. **Camel milk** must be included in the Rajasthan Dairy Act
3. There should be systematic **camel health care** through vaccinations
4. There should be a **ban on the slaughter** of fertile and healthy female camels
5. It must be ensured that the work of the **National Research Centre on Camels** benefits the camel breeders. For this field centres must be opened.

Additional recommendations pertained to making camel breeders once again proud of their profession so that the young generation would look at it as a viable career option.

I would like to add one recommendation from my own perspective. While the camel population will likely shrink further before the decline can come to a halt, it is

important that the process is “managed” and that loss of the most genetically valuable animal resources is avoided. There is a big degree of genetic variability within the population; for example, it seems as if the camels from Mewar and Malva have relatively high milk potential. Therefore an effort must be made to save the breeds from this region.

Conclusions

Most of you are from research institutions, from the National Research on Camel and from the Veterinary College in Bikaner. You have followed our invitation because your scientific personae are intimately linked with the camel and because, I believe your association with this animal is limited not only to the mind, but is also one of the heart. It is obvious that the few people assembled here will not be able to undertake the task of saving the camel alone, but that we have to interest the many other stakeholders as well that work only indirectly with camels.

Conservation of the camel, value addition to its products and development of a special camel policy should be crucial elements of an overall strategy to drought proof Rajasthan. I invite you to give your best in the conference’s deliberations so that we can come up with concrete recommendations and action plans and bring the magnitude of the issue to the attention of the government and other concerned actors.

Deliberations and recommendations from the National Grazing Workshop

Bagdi Ram Raika

Community leader, Mahamantri of the Akhil Bharatyia Raika Pashu Palak Sangh

Camels are found only in dry areas. Their products and services include:

- **Milk production (females).** Camel milk is known to be good for human health and to treat certain diseases. Many products can be made (curd, cheese, etc.), as demonstrated by NRCC research. Milk can be used to treat diabetes, TB, jaundice, anemia. However, camel milk is not in high demand, mainly because of superstition.
- **Hauling carts** (males), especially in Rajasthan.
- **Wool production**
- **Manure** (considered to be very fine quality) and **urine** (also used as fertilizer)
- Parasites from camels' noses are used as **medicine**.
- **Camel riding:** a tourist attraction. Camels are (or used to be) used in battle.

However, there is a worrying decline in the number of camels; increasing numbers of females are being sold for slaughter, and the availability of grazing and veterinary services are major concerns. Large numbers of young people have left camel breeding to work in the cities. Many breeders are abandoning camel breeding activities and are taking on other livestock or are moving out of the livestock sector altogether.

A meeting attended by 150 Raika and camel breeders at Ram Raika Temple on 21 November 2005 discussed these issues. The breeders came from Uttar Pradesh, Rajasthan, Haryana, Gujarat and Punjab. Many of their recommendations expand on the recommendations from the National Grazing Workshop (see the preceding paper by Ilse Köhler-Rollefson).

- **Data.** Cattle are counted every 5 years, but camels are not. So the statistics are not as detailed as for cattle. Data on camel numbers should be gathered at more frequent intervals, and in collaboration with the camel owners.
- **Marketing of milk.** Research and support from NRCC and the Veterinary College in Bikaner facilitated the recent Supreme Court decision that camel milk was fit for human consumption. This research was published in newspapers. But dairies still reject our milk. We need your support to include camel milk in the Dairy Act. We also need support from the international participants and media people at this conference. The marketing of camel milk should be promoted in Bikaner and other cities. Support from government institutions is needed for marketing milk and improving consumer acceptance. This would increase milk sales, boost camel numbers, and improve the livelihood of camel herders.
- **Slaughter.** The slaughter of camels should be banned, especially in slaughterhouses in Mumbai, Pune and Hyderabad.

- **Education.** The government should promote education to eliminate the widespread illiteracy among camel breeders.
- **Grazing.** The loss of grazing areas is a serious problem facing camel breeders. The government must find ways to reverse this trend.
- **Policy.** The government currently pays little attention to nomadic camel breeders, and offers no legal protection. The government should formulate a national policy on camels in conjunction with the camel owners.
- **Research and extension.** Research conducted by NRCC is commendable, but has not yet reached the mass of camel owners. Only one camel research centre exists, so few camel breeders are able to take advantage of it. A field centre should be established in each district to enable owners to access their services more easily. Efforts should be made to ensure that technical know-how reaches the camel owners.
- **Health services.** There is an acute shortage of veterinarians. During the foot-and-mouth disease outbreak, it was necessary to bring in veterinarians from Udaipur. This is expensive and is not possible for everyone.

Potential of camel milk

A better knowledge of milk quality parameters: A preliminary step for improving the camel milk market opportunity in a transition economy – The case of Kazakhstan

Gaukhar Konuspayeva¹ and Bernard Faye²

1. Biology faculty, Kazakh National University Al-Farabi, 71 av. Al-Farabi, 480078 Almaty, Kazakhstan

2. Animal Production Programme, CIRAD-EMVT, Campus International de Baillarguet TA 30/A, 34398 Montpellier Cedex, France

In Kazakhstan and some other countries in Central Asia, the production and consumption of traditional fermented camel milk products are common. These products are culturally very important and are typical of these countries. They play a major role in maintaining the economy of steppe zones. Traditional milk products from horses and camels are highly appreciated. Scientists and consumers attribute pro-biotic and medicinal properties to them. During the Soviet era, the collective production system included the marketing of dairy products through state shops, only in the local market. Since the collapse of the Soviet Union and the privatization of the agricultural sector, milk production has been fragmented into smaller units with limited capabilities in milk marketing. To help producers market camel milk nationally or even internationally for its dietetic and medical properties, better knowledge of the components and quality parameters of camel milk is necessary. An improved understanding of farming practices, milking conditions and general rearing conditions could help producers develop a quality approach so they can position their product favourable in the milk market.

Introduction

Fermented milk is traditional product in Central Asia, and contributes strongly to the cultural identity of those countries. Fermented milk is processed from the milk of various livestock types: horse (the product is called *koumis*), camel (*shubat* in Kazakhstan, *doïran* in Turkmenistan), yak (*kurut* in Kyrgyzstan) or even cow (*kefir*). These products depend on local resources: they respect the capabilities of the land and contribute to environment conservation. They answer to local consumers' tastes and food habits, emphasizing a "natural" taste. Popular beliefs, supported by some scientific studies, have long attributed pro-biotic and medicinal properties to these products, and they are widely used in the medical sector.

Research at universities in the Newly Independent States has focused on the biochemistry of traditional milk products. During the Soviet Union period, all collective farms (*kholkoze*, *sovkhoze*) could be considered experimental: scientific innovations were applied directly according to the objectives of the planned economy. These farms had standardized practices and methods for production, processing and marketing of products. After the collapse of the Soviet Union and the division of collective structures into small, privatized production units, local and individual know-how formerly used for home consumption became predominant. This led to a wide range of processes and variable quality of traditional milk products, along with strong

competition from “western-type” industrial products produced by modern dairy plants in sub-urban areas. This means that research has to take account of the new situation: how to characterize and manage the diversity of traditional milk product processing? How to reach the market with safe products that respond to the tastes and needs of urban consumers? These new approaches are necessary to develop products with guaranteed standard quality, suitable for international markets.

This paper focuses on camel milk. It considers knowledge of the composition of camel milk as a preliminary step to improving the market for this milk.

The place of camel farming in Kazakhstan

In Central Asia and notably in Kazakhstan, natural pastures cover more than 180 million ha. According to FAO statistics, the camel population was 98,300 in 2002; of this number, 80% were *Camelus bactrianus* (double-humped camel). The Kazakh breed has three sub-types, each prevalent in a different region of Kazakhstan (Photos 1, 2, 3). The Kazakh breed is famous for its meat and wool productivity. The Turkmen Arvana *dromedary* breed (Photo 4) originates from Turkmenistan and is reputed for its milk productivity (Faye, 2003; Cherezekov and Saparov, 2004). Some hybrids are present (Photo 5 and 6). Animals are commonly cross-bred to improve the milk productivity of Bactrian camels.

The camel population has changed markedly in the 20th century (Table 1). The population was 1 million at the beginning of the 19th century. Numbers decreased dramatically after collectivization. A further decrease occurred after the independence of Kazakhstan and the privatization of collective farms between 1991 and 2003 (Figure1). The present population is only 10% of the camel stock 100 years ago.

In spite of this decrease, the camel population in Kazakhstan remains the largest in Central Asia (Table2). However, the numbers recorded by FAO are debatable.

Table 1. Livestock population in Kazakhstan.

| | 1927 | 1941 | 1991 | 2002 | References |
|--------------|------------|------------|------------|-----------|----------------|
| Camel | 1 200 000 | 104 600 | 145 000 | 102 300 | Moussaev, 2002 |
| Horse | 3 500 000 | 869 700 | 1 700 000 | 1 010 000 | |
| Sheep | 18 000 000 | 12 000 000 | 35 000 000 | 9 207 500 | FAO |



Photo 1. Bactrian camel, Kazakh breed, Uralobukeevskii type



Photo 2. Bactrian camel, Kazakh breed, Kzylordinskii type



Photo 3. Bactrian camel, Kazakh breed, Yuzhnokazakhstanskii type



Photo 4. Dromedary camel, Turkmen breed, Arvana



Photo 5. Camel F1 hybrid Bactrian x dromedary



Photo 6. Camel F2 hybrid Bactrian x dromedary

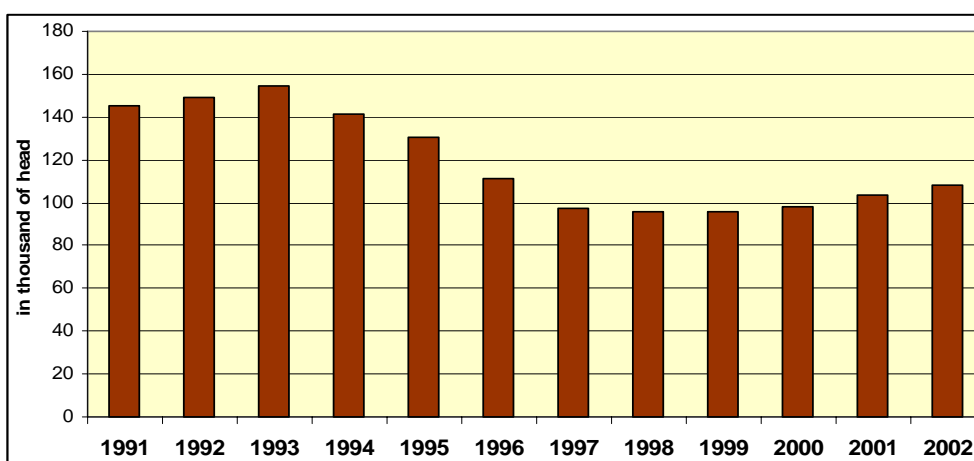


Figure 1. Population of camels in Kazakhstan, 1991–2003

Table 2. Camel population in Central Asia, 2002 (source: FAO)

| | |
|--------------|--------|
| Kazakhstan | 98 300 |
| Kyrgyzstan | 46 000 |
| Tajikistan | 42 000 |
| Turkmenistan | 40 000 |
| Uzbekistan | 25 000 |
| Russia | 12 000 |
| Azerbaijan | 200 |

As in many countries, camels are multi-purpose animals. They are used for milk (unprocessed and fermented milk), wool, meat and transport. The richest region for camel farming is Mangystau with 32,700 camels, of which 35% belong to private enterprises and collective societies, and 65% belong to smallholders. The milk productivity averages 4–6 litres per day for 12–18 months of lactation, with 2–4 milkings per day. Feeding is based on natural pasture throughout the year, with hay in the winter. With Arvana breed or crossbreeds, the daily productivity can reach more than 10 litres.

Camel milk production and use in Kazakhstan

In Kazakhstan where animals live in vast, empty spaces, there are few possibilities to keep products fresh. So, traditionally, farmers sell fermented products. Fermented camel milk is called *shubat* in Kazakhstan, *chal* and *doïran* in Turkmenistan, and *khoormog* in Mongolia. A dehydrated product similar to camel cheese is called *kourt*. A sweet product in caramel form is called *balkaimak*. These products, and especially *shubat*, are typical for the country and can be considered as “territorial products”, indicating a cultural identity. They stem from ancestral techniques and are an important part of the tradition. This rooting in traditional culture could be a strong commercial promotional factor.

At present, the most important part of *shubat* production is provided by small-scale production units, but the industrial sector is increasing (for example, the Agromerkur enterprise at Almaty) despite a lack of standardization in production and processing conditions (Konuspayeva et al., 2003).

Consumers appreciate camel milk for its medicinal properties: it is reputed to be an anti-infectious, anti-cancerous and antidiabetic. More generally, it is regarded as an energy-giving product for convalescents. Camel milk is commonly used to help treat infectious diseases such as tuberculosis in humans. *Shubat* is commonly used as a cure in sanatoriums (Urazakov and Bainazarov, 1974). Significant improvements in patients seemed to be obtained, and a restoration of blood parameters was observed, with 2 litres of *shubat* per day for 2–4 months. Similar results were reported in Libya with 1.5 l/day (Alwan and Tarhuni, 2000) and in India with 1 l/day (Mal et al., 2000).

The fermented milk contains lactic bacteria that reinforce antimicrobial activities against pathogenic agents such as *Bacillus*, *Pseudomonas*, *Mycobacterium*, *Staphylococcus*, *Salmonella* and *Escherichia* (Puzyrevskaia, et al., 2000). *Shubat* is also used to prevent diarrhoea.

Camel milk is also used in Kazakhstan as an adjunct to chemotherapy for some cancers, especially those of the digestive tract. Good results were reported in auto-immune diseases such as Crohn's disease and multiple sclerosis (Yagil and van Creveld, 2000).

The positive effect of camel milk on diabetic patients has been studied in India (Agrawal et al., 2003). With the consumption of 0.5 l of camel milk per day, the insulin demand decreased in diabetic patients and glycaemia was better balanced.

The camel milk is widely considered as an energy-giving product and can be used for convalescents or in case of severe fatigue. Some authors report that it reinforces the immune defences. However, many such observations are anecdotal rather than really scientific. Specific investigations are needed, especially to understand the link between milk composition and any true medicinal effect.

Camel milk composition

The gross composition of camel milk is similar to that of cow milk (Farah, 1996). Only fragmentary information is available on the minerals and vitamins in camel milk. The available data indicate that camel milk is rich in chloride and phosphorus, and poor in calcium. Camel milk vitamin C content is twice to ten times as high as in cow milk. The relatively large amount of vitamin C in camel milk is of relevance from a nutritional standpoint in arid areas, where fruits and vegetables containing vitamin C are scarce (Sawaya et al., 1984). This richness in vitamin C could explain the role of camel milk in energy-giving for convalescents.

Electrophoretic and ion exchange chromatographic studies reveal that proteins analogous to the α_{S1} -, α_{S2} -, κ - and β -caseins of cow milk occur in camel milk. Different whey proteins such as serumalbumin, α -lactalbumin, lactophorin, lactoperoxidase have been isolated from camel milk (Kappeler et al., 1998). Compared to cow milk fat, camel milk fat contains fewer short-chain fatty acids, but a relatively high concentration of C14:0, C16:0 and C18:0 acids and – more interesting for a dietetic point of view – unsaturated fatty acids as C18:1 and C18:2 in large amounts (Hagrass et al., 1987). Camel milk seems to be richer in lactoferrin, lactoperoxidase and lysozyme than is cow milk. Those proteins are thermo-stable in

camel milk (Elagamy, 1996) and have antibacterial activities, which can explain the anti-infectious activity described by several authors.

However, those values are variable and are affected by the breed, season, feeding system and production conditions. We have a lack of information on the true effect of the variation factors. In the Russian literature, authors gave general data or used different methods for analysing camel milk, making it difficult to make comparisons among the published papers. The production of camel milk products are not yet standardized in dairy plants, and 90% of the production results from craft processing units. The mode of preparation can differ from one region to another and by season.

Tables 3 and 4 compare different data of camel milk composition.

Table 3. Composition of camel and cow* milk (from the literature)

| References | Fat content (%) | Protein content (%) | Vitamin C mg/l | Calcium mg/l | Phosphorus mg/l | Iron mg/l |
|-----------------------|-----------------|---------------------|----------------|--------------|-----------------|-----------|
| Kappeler, 1998 | *3,8 | *2,7-4,7 | *3-23 | *1,000-1,400 | *0,650-1,100 | *0,3-0,8 |
| | 3,2-3,8 | 2,7-4,0 | 24-36 | 1,060-1,570 | 0,580-1,040 | 1,3-2,5 |
| Wangoh, 1997 | 3,55 | 3,14 | 27,18 | 1,21 | 0,85 | 3,06 |
| Elamin & Wilcox, 1992 | 3,15 | 2,81 | | 3,003 | | 0,028 |

Table 4. Mean and extreme values of camel milk components in a current survey in Kazakhstan

| | Fat content (%) | Protein content (%) | Acidity D° | Vitamin C mg/l | Calcium mg/l | Phosphorus mg/l | Iron mg/l |
|-------------|-----------------|---------------------|------------|----------------|--------------|-----------------|-----------|
| Mean | 5,80 | 5,49 | 24,20 | 148,19 | 1,22 | 1,007 | 2,12 |
| S.D | 1,46 | 0,83 | 7,00 | 80,17 | 0,23 | 0,12 | 1,04 |
| Min | 1,56 | 2,06 | 15,75 | 15,38 | 0,60 | 0,76 | 0,70 |
| Max | 17,68 | 10,82 | 33,30 | 386,76 | 1,88 | 1,43 | 5,60 |

For example, in a current survey of 4 different regions in Kazakhstan, the turner acidity in *shubat* varied from 106,50°T to 198°T, leading to very different final products. In such conditions, the content of fat, protein or minerals may vary markedly.

Table 5 shows the range of values measured for the composition of *shubat*.

Table 5. Mean and extreme values of *shubat* of camel milk components in a current survey in Kazakhstan

| | Protein content (%) | Acidity D° | Vitamin C mg/l | Calcium mg/l | Phosphorus mg/l | Iron mg/l |
|-------------|---------------------|------------|----------------|--------------|-----------------|-----------|
| Mean | 5,52 | 141,64 | 149,07 | 1,30 | 1,01 | 3,39 |
| S.D | 0,62 | 22,88 | 70,69 | 0,23 | 0,14 | 1,72 |
| Min | 4,31 | 86,40 | 35,86 | 1,05 | 0,76 | 0,80 |
| Max | 6,93 | 189,00 | 279,18 | 1,88 | 1,27 | 7,30 |

No data are available for products such as *kourt* or *balkaimak*.

Elsewhere, recent microbiological analysis of *shubat* has shown that 8 strains of bacteria belonging to 4 different lactic bacteria occurred simultaneously in camel milk fermentation process: *Lactobacillus casei*, *Leuconostoc lactis*, *Lactobacillus lactis* and *Lactobacillus plantarum*. This suggests that it is possible to drive fermentation process to get different standard products (Serikbaeva et al., 2004). The microbiological flora of *shubat* have antagonistic properties against pathogenic microorganisms (Saubenova et al., 2002).

Defining a camel milk standard

As described above, since the collapse of the Soviet Union and the privatization of agricultural sector, milk production has fragmented into smaller units with low competence in milk marketing. As producers aim to reach the national and international markets by promoting the dietetic and medical properties of camel milk, a preliminary step is a better knowledge of camel milk components and its quality parameters. A better understanding of the farming practices, milking conditions and the general environmental conditions could help producers to develop a quality approach to position their products appropriately in the milk market. In some parts of Kazakhstan, farms are located in highly polluted areas, where heavy metals and radionuclides may contaminate the environment. To reach national and international market, the products have to be safe.

For this, it is necessary to establish standard criteria for camel milk quality in different areas of Kazakhstan. The analysis of the chemical composition of raw and fermented camel milk, taking in account the variability due to the region, rearing conditions and the environment, will be the basis for proposing these standards. It is necessary to establish the physico-chemical and biochemical criteria for a proposed standard that will be submitted by authorized institutes. The methodology to achieve this objective is summarized as follows:

1. Compile and analyse data from the current survey on camel milk composition and variations in different areas.
2. Compile standards for milk elsewhere in the world.
3. Adapt the standard to the Kazakh situation.

4. Submit to official standard offices: the State Standard Organization, State Sanitary and Epidemiological Station, State Nutrition Policy Organization, Ministry of Health
5. Publish norms and technical conditions to establish further standards in the official gazette.

Conclusion

After independence, many firms in Kazakhstan's small-scale agro-food sector wished to extend their market and to improve the quality of their products. The development of small-scale agro-food processing plants was linked to the improvement of their raw materials in term of quantity and quality. For camel milk, however, the variability of composition and production conditions have been a major constraint for dairy development at both the national and international levels. As camel milk is not a well-known product, in terms of its composition, its variability and its production conditions in the new economic context, research is needed to answer such questions and transfer as soon as possible its findings to the small- and large-scale agro-food industry. The current study, conducted through French-Kazakh cooperation, is a preliminary step to this.

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Chemical and physico-chemical properties of camel milk at different stages of lactation

S. Raghvendar¹, S.K. Shukla², M.S. Sahani³ and C. Bhakat⁴

¹ Senior Scientist (Animal Biochemistry), ² Research associate and ³ Director ⁴ Scientist (Sr G), National Research Center on Camel, Post Bag No. 07, Bikaner 334001, India

Camel milk samples from early in the lactation, in the middle, and late in the lactation were collected, processed and analyzed. The composition was as follows: moisture 89–91%, total solids 8–11%, fat 1.5–3.1%, SNF 7–8%, protein 2.1–2.5%, lactose 3.8–4.3%, vitamin C 0.134–0.154%, pH 6.3–6.6. Higher acidity and lower percent fat were recorded in the milk from late in the lactation, followed by early and the middle. To assess quality of milk, samples from the mid-lactation were processed to determine the total, free and bound forms of minerals. Average values were as follows (all figures in mg/dl): Na 46 ± 0.39 , K 29 ± 0.16 , Ca 84 ± 1.99 , P 90 ± 3.15 , Mg 04 ± 1.22 , Fe 01 ± 0.12 , Zn 02 ± 0.02 , and Cu 0.44 ± 3.04 . These data will be helpful in standardizing milk product processing techniques.

Prospects for adding value to camel milk in India

S Raghvendar¹, S K Shukla² M S Sahani³ and C Bhakat⁴

¹ Senior Scientist (Animal Biochemistry), ² Research associate, ³ Director and ⁴ Scientist (Sr G), National Research Center on Camel, Post Bag No. 07, Bikaner 334001 (India)

Camels in India are primarily used for draught. However, good genetic potential to produce milk exists in indigenous breeds of camels. The average lactation period in Indian camels lasts from 14 to 16 months, depending upon the time the calf is weaned. Milk yield averages 3–4 kg/day, with a peak yield of about 6 kg/day during the 5th and 6th months. Camel milk is considered to be one of the most beneficial foods in arid and semi-arid areas. Although camel milk has been used for centuries, and its products are widely used in East Africa, camel milk products are not common in India. It is now generally accepted that a potential growth area for the Indian dairy industry is a traditional milk product that meets the changing demands of the market. In order to add value to the milk, the process of camel milk fermentation was standardized. The prepared fermented milk (*lassie*) was chemically evaluated, and the results were closely related with International Dairy Federation standards. The process of camel milk soft cheese production was standardized using different protocols. The composition of camel cheese was as follows: percent moisture 61.07 ± 4.29 , total solid 61.07 ± 4.29 , fat 9 ± 1.53 , and acidity 0.068 ± 0.012 . The process of flavoured milk was successfully standardized. The highest points for taste smell and colour were scored by the vanilla flavour with green colouring. Milk *kesar kulfee* was standardized and chemically evaluated. Test panels scored it with an overall acceptability of 81% on the scale of good, very good or excellent. Panelists aged 15–35 gave it an overall score of 96%; 36–65 year-olds gave it 86%, while dairy experts rated it at 85%.

Camel milking in Rajasthan

Carl Edward Archibald Albrecht

Georg-August University, Göttingen, Germany

As normally done in Rajasthan, camel milking is far from optimal. It could be improved through better hygiene management and more effective milking. Ways to improve hygiene include controlling diseases in the camels – and in the people who work with them; using the California Mastitis Test to check the milk; preventing calves from stimulating the udder; cleaning the udder properly; and using containers that can be closed immediately after milking.

A Raika pastoralist might own a herd of 20 camels. One animal is typically a breeding male. Twelve are calves or young animals below 4 years of age. So, they are not producing milk at the moment, and there might be some male animals in between that will be sold to other people using them for transportation purposes or agricultural work.

Eight animals are female and productive, but four of them are pregnant and do not produce any milk at the moment. Some of the animals are suffering of a disease such as surra or mange, and all animals suffer under bad feeding conditions and are undernourished. The animals that produce milk are not able to show their unknown genetic potential due to disease and malnourishment. They are milked twice a day, producing a milk yield of 3 kg per animal and day. There is no measuring what the calf will suckle, but it will be up to 10 kg per day. The pastoralist has a total daily milk yield of 12 kg. From this 12 kg he has to feed his family. If there are some leftovers, there is a taboo against the sale of camel milk. There are prejudices from the consumers against camel milk. So he cannot sell his milk everywhere.

Animals and the people who work with them are not tested for diseases. The stimulation of the udder is most times done by the calf, and milking starts very often without any cleaning of the udder. Sometimes the teat is even pulled out of the mouth of the suckling calf and milking starts with a teat full of calf's saliva! Milking is often done by only one milking person. He keeps the milk container in one hand and milks with the other hand. That way milking is much slower than if two people were to milk. As the time of milk release is very short, a lot of milk will not reach the container, but stays in the udder. The milk container is very often an open pot without any lid.

This milking process means that not all the milk that could be obtained will be produced, and there are many possibilities (calf saliva, dirty udder, open container) for germs to get into the milk and contaminate it.

Milking by hand should be done in a hygienic way. First, all animals and the people working with them have to be free of brucellosis and tuberculosis, as these diseases will be spread with the milk to human consumers and other animals. This makes control by human doctors and veterinarians necessary.

Stimulation by the calf should be stopped. It has to be done by udder massage by the hand of the milking people until the teats are swelling. This will happen after about two minutes.

The udder should be cleaned with an antiseptic solution produced especially for udder cleaning. This has to be made available to Raika at a price they can afford.

Europeans would claim for disposable tissues for cleaning. But Europeans will have a well functioning municipality at home that will carry the waste away. A Raika has no municipality access. He is moving with his herd in search of fodder plants.

Disposable tissues can last in the desert for up to 50 years! Disposable tissues would cause a severe environmental problem within a short time. A Raika will be far better off with a clean cotton towel for each animal at each milking time that is put into antiseptic solution before it is used for cleaning the udder and washed properly after milking, so it can be used again.

When the udder is clean, milking has to start immediately as the letdown of milk is for a very short time. Two people should milk all four teats as quickly as possible to gain the highest possible amount of milk.

Milking should be done regularly. That means the same number of milking times at the same times of the day, every single day, and not milking an animal eight times on one day and not at all for the next two weeks.

Milking should take place at least two times a day, once in the early morning, once in late afternoon or in the evening. A third milking time should be done only if enough milk is left over for the calf and if the additional milk repays the additional work.

The milking container should be closed immediately after milking to avoid the access for germs. It should be brought quickly to the market as no cooling facilities are available to the Raika and power failures will occur at least once a day.

Milk with high germ contents should not be sold. The California Mastitis Test works very well in camels and can be easily done.

To reach better prices of the milk a label should be founded, that includes regularly milk control. Raika will have to do some advertising for their milk themselves to improve the image of camel milk and with it, the price they receive.

A Raika will not know how to transport a heavy milking machine, because his camels are busy with carrying the things he needs for him and his animals to survive. He has no access to electric power in the middle of nowhere. He has no possibilities to clean a milking machine in a proper way, as there is always a lack of water. The water available might not be free of germs or might contain heavy metals from industrial plants, or pesticides from agricultural land. He has no money to buy a milking machine, and is not able to buy expensive spare parts that originate abroad.

So machine milking seems not to be an option for the Raika at all. Improved hand milking seems to be the only way of better milking conditions.

Other income sources

Camel hair: Its textile applications

V.K. Singh and P.C. Patni

Central Sheep & Wool Research Institute, Avikanagar, Rajasthan 304 501

Dromedaries in India produce about 0.6 m kg of hair, which is used to make carrier bags, floor coverings, blankets, etc. This study explored the potential to make better end-products from this specialty fibre. Processes included sorting by colour (darker fibre is coarser and longer), scouring to remove vegetable matter and dust, blending with various other natural and artificial fibres, carding and spinning. The following products were developed: coat fabric, blankets, rungs, hand-knotted carpets, and hand-made felts. Conclusions include the following. Hair from kids and adult camels should be kept separate, and after proper sorting, finer and coarser qualities may be mixed together. Sorting is vital to optimize the use of different grades of hair. Finer, brown hair should be used for making blankets and fabric in blends with wool and synthetic fibres. Dark brown hair may be used to make rugs and hand-knotted carpets. Wool is preferred as a blend for these purposes. The coarsest quality, black, hair may be blended with wool to make hand-made felts.

The dromedary variety of camel found in our country produces about 0.6 m kg of camel hair which is utilized domestically by camel breeders in making carrier bags, floor coverings, blankets etc.

To explore the potential of this speciality fibre for the manufacture of better end-products, efforts were made at Central Sheep and Wool Research Institute, Avikanagar. The following sequence of operations was adopted to develop different type of products.

Sorting

The fibre obtained was sorted into three categories i.e. brown, dark brown, and black. The darker the fibre, the coarser and longer it is.

This sorting is adopted for the fibres obtained from kids as well as adult camels separately, and then similar qualities are mixed together.

Sorting also helps in partial removal of dust, vegetable matter and other associated impurities.

Scouring

Since the grease content in camel hair is below 1%, scouring is not needed; however, it helps in removal of vegetable matter and associated dust. During scouring, the light vegetable matter floats on the water surface which can be easily removed by hand.

Fibre testing

Samples were drawn from the sorted lots separately, and testing was performed for fibre length and fineness. The test results are shown in Table 1.

Table 1. Results of fibre testing of camel wool

| Fibre categories | Fineness (microns) | Medullation (%) | Length (mm) |
|-------------------------|---------------------------|------------------------|--------------------|
| Brown | 30.8 | 63 | 33 |
| Dark brown | 39.3 | 71 | 43 |
| Black | 45.2 | 73 | 65 |

Blending

Blending of camel hair with wool, acrylic, viscose, silk waste, polyester staple etc. was done to prepare different types of products for different end uses.

Blending is done after opening the fibres separately by machine or hand, and heaps are prepared. According to the desired percentage, the two fibres are taken after weighing and put layer by layer. Then this heap is cut vertically and fed to the carding or utilized for hand spinning.

Carding

Before the material is carded, it is mixed thoroughly and an emulsion of oil and water is sprinkled over it uniformly. It is again opened by willow machine and left over night so that the material may absorb desired moisture to help the carding process.

Spinning

The carded material can be spun by hand or on a ring spinning frame. The fineness and uniformity of the yarn spun on machine is always better than hand-spun. Generally 2–4 Nm yarn is spun on machine and around 0.5 – 1 Nm is spun by hand. The distribution of twist in the machine spun yarn is also more uniform.

Product development

Table 2 shows various products developed from camel hair and its blends with other natural and synthetic fibres.

Conclusions

- Kid and adult camel hair should be kept separately and after proper sorting finer and coarser qualities may be mixed together.
- Sorting is a must to explore the optimum utilization of different grades according to fineness, length and colour.
- Finer fibre of brown colour should be used for making blankets/coating cloth etc. in blend with wool and synthetic fibres.

- Dark brown camel hair may be used for the preparation of *durries* and hand-knotted carpets. For blending purposes wool should be preferred.
- The coarsest quality i.e. black camel hair may be used for the preparation of hand-made felts in blend with wool.

Table 2. Products developed from blends of camel wool with other fibres

| Product | Fibre composition |
|----------------------------------|---|
| Fabric for coating | Camel hair brown + silk waste/polyester staple/wool |
| Blanket | Camel hair brown + Viscose staple fibre/wool |
| <i>Durry</i> | Camel hair dark brown + Viscose staple fibre/wool |
| Hand-knotted carpets | Camel hair dark brown + Viscose staple fibre/wool |
| Hand-made felts (<i>namda</i>) | Camel hair black + Viscose staple fibre/wool |

Plight of draft camel owners of Bikaner

T.K. Gahlot

Editor, *Journal of Camel Practice and Research*, Department of Veterinary Surgery and Radiology, College of Veterinary and Animal Sciences, Rajasthan Agricultural University, Bikaner 334001 India

A survey of one hundred draft camel owners in Bikaner revealed that camel keeping is gradually becoming non-viable as a sole source of sustenance for the family. A questionnaire was used to ascertain the daily earning and constraints faced by the owners. It revealed that 92% of the owners had one draft camel, and 5% had two, and 3% had three camels. The draft camels are primarily used to pull loaded carts. Earnings were Rs 150 per day for the 65% of the animals that hauled grain sacks between the grain market and grain stock centre; Rs 100 per day by the 20% of animals which hauled water, gas cylinders and building materials; and Rs 120 per day by the 15% of camels that transported bricks. The average income was Rs 123 per day. Some 80% of owners were satisfied with the camel cart business, but the remainder were frustrated.

All owners felt that free medicines from government veterinary hospitals were lacking. Most preferred ethnoveterinary treatments. Reasons for the waning popularity of camels included increased competition from trucks and tractors etc. – which are faster than camel carts – and the rising cost of new camels. Camel husbandry and camel carts should be promoted as a cheap, eco-friendly mode of transportation. Owners fear that the number of camels in Bikaner city may continue to fall sharply if government or non-government agencies do not initiate schemes to support health and insurance.

Introduction

Rajasthan state has about 70% of India's camels. Bikaner stands at an important place in Rajasthan because of two premier institutes working on camels: the Veterinary College and the National Research Centre on Camels. Bikaner district has about 4000 camels, but the exact number of camels in Bikaner city is not known: a rough estimate is a few hundreds. A survey conducted on one hundred draft camel owners of Bikaner revealed that camel keeping as a sole source of sustenance for the family is gradually becoming a non-viable option for them. The reasons assigned to this option are summarized in this paper.

Materials and methods

A survey was conducted to enquire about the viability of keeping a draft camel to earn livelihood from one hundred draft camel owners engaged in a variety of jobs. A questionnaire was prepared to enquire about the daily earning and constraints faced by them. The questionnaire consisted of following questions:

1. Name of the owner and literacy status
2. Number of draft camels being kept.
3. Earning out of the camel on per day basis.

4. The type of job in which camel is engaged.
5. The amount spent on feeding of camel.
6. Level of satisfaction with the job of camel husbandry.
7. Viewpoint about government welfare schemes for camels.
8. Viewpoint about the health care of camels.
9. Reasons for the fading popularity of camels as draft animal.
10. Reasons for the decreasing population of camels.
11. Reasons for popularity of camel as a draft animal in Bikaner.

Results and discussion

A summary of replies recorded according to the questionnaire revealed that 92% camel owners had one draft camel; 5% had two, and 3% had three camels each. Earning out of a draft camel which is primarily used to pull a loaded cart was Rs 150 in the 65% of camels which carried grain sacks to and fro from grain market to stock centres. Rupees 100 per day were earned by the 20% of camel owners who carried water, gas cylinder and building materials, and the 15% of camel owners who were engaged in transporting bricks earned only Rs 120 (Table 1). The average income of draft camel owners was Rs 123 per day.

Out of 100 owners about 30% were illiterate, 50% were 5th pass, 12% were 8th pass and 8% were 10th pass. The level of satisfaction with camel cart business was good in 80% of respondents, but those with 8th and 10th pass were frustrated and wanted to obtain a governmental or private job that would provide greater remuneration to them more appropriate to their education (Table 2).

Table 1. Income from draft camel on per day basis

| Type of draft work | Percent of camels involved | Income per day (Rs) |
|--|----------------------------|---------------------|
| To carry grain sacks | 65 | 150 |
| To carry water, gas cylinders and building materials | 20 | 100 |
| To carry bricks only | 15 | 120 |

Table 2. Literacy rate and level of satisfaction among the draft camel owners of Bikaner

| Education Level | Percent | Level of satisfaction |
|-----------------|---------|-----------------------|
| Illiterate | 30 | Satisfied |
| 5th pass | 50 | Satisfied |
| 8th pass | 12 | Frustrated |
| 10th pass | 08 | Frustrated |

All owners thought that there was a lack of free treatment in terms of providing medicines in governmental veterinary hospitals, even though their number has increased. Owners found a few treatments expensive e.g. eradication of mange, endoparasites, blood protozoa etc. The majority preferred the Veterinary College hospital for treating their camels because of its quick diagnosis, effective treatment and the availability of some medicines. Most owners spend only about Rs 500–1000 per year on treatment for their camel. Mostly they prefer ethnoveterinary treatments.

The camel is well adapted to this climate and usually does not suffer from serious illness – except for automobile accidents which may result in multiple fractures, incapacitating the camels. The owners stressed the need for insurance for camels; they suggested that the premium should be paid by the government or by non-governmental organizations.

All owners agreed with that camels are fading in popularity as draft animals in Bikaner. The reasons assigned for it were the fast-growing transport industry, with an abundance of trucks, tractors, etc.; camel cart being a slow mode of transportation; and the rising cost of a new camel.

Visitors entering Bikaner city by train or by road often remark on the sight of camel carts moving through all parts of the city. The heart of Bikaner has many railway crossings, whose gates remain closed for 10–15 minutes at numerous times during the day. Many camel carts can be seen in the resulting traffic jam. Camel carts are still a popular mode of transport in Bikaner because it is cheaper mode of transportation and camels can move through narrow lanes where trucks and tractors cannot reach. There is a ban on heavy vehicles during peak day hours inside the city but camel carts can ply freely during this period, so it is still a preferred mode of transportation of goods. Compared to automobile transport, camel carts are ecofriendly and pollution-free.

The present survey focuses on the need to promote camel husbandry and camel carts as a cheap and ecofriendly mode of transportation. Camel owners fear that a sharp drop in number of camels in Bikaner city may continue if government or nongovernmental agencies do not float camel welfare schemes so far its health aspect and insurance is concerned.

Management

Changing scenario of camel population and farming strategies for its sustenance

M.S. Sahani

Director, National Research Centre on Camel, Jorbeer, PB No. 07, Bikaner 334001, Rajasthan

Camels continue to be important domestic livestock in the hot arid and semi-arid northwest region of India for the 30% rural population comprising of small and marginal farmers, landless labourers and camel-rearing communities (Raikas and Rabaries). The primary utility of camels for the last 30+ years has been carting for short distances (30–40 km/day), agriculture operations, and prior to this as baggage animal for transport of fodder, water, fuelwood and other materials. The important indigenous breeds of camel are Bikaneri (good for draught and milk production), Jaisalmeri (ideal for riding and races) and Kachchi (for milk production).

Camel husbandry in this region is managed in two ways:

Camel users

They own 1 to 2 camels, mostly males, for carting and agricultural operations in sandy soils under rainfed cropping. These camels also serve as a source of income in villages/towns and nearby cities for unemployed labourers as well as poor and landless farmers during scarcity and drought conditions. These camels are reared under intensive and semi-intensive management, depending upon the place of utility.

Camel breeders

Primarily belongs to Raika and Rabari communities with little or no agricultural landholding. Camels under this system are reared under traditional grazing with zero inputs. The camel herd size may vary from small (5–15 camels), medium (15–40 camels) and large (above 40 camels). They mainly breed the camels; the young and adult camels are being sold in various state-level livestock fairs.

Camel population

Rajasthan has the largest population of camels, with 668,000 animals (Annual Report, Animal Husbandry Department 1998–99), followed by Haryana 120,000, Gujarat 58,000, Punjab 43,000, Uttar Pradesh 30,000 and Madhya Pradesh 15,000 camels.

In 1951 the camel population of India was 600,000. Numbers rose continuously up to 1972, with a growth rate ranging from 1.2 to 5.9%. Almost static trend was marked until 1987, followed by a marginal decline ranging from 0.4 to 0.6% until 1992. The livestock census of the State observed a decline of 8.5% when compared to the 1992 census. According to latest sources (2003) there appears to be further decline of around 25%.

The critical analysis of camel population scenario clearly reflects that up to 1980 sufficient rangelands were available for grazing and browsing in most districts with a large number of camels. In addition the private agricultural fields near villages were

also available for grazing camels and other livestock for nearly 8 months after the crop harvest.

Factors responsible for decrease in camel population

Continuous shrinkage of grazing resources

In order to meet the demand for food grain of the rising human population, there has been tremendous increase in the command area under both canal and tubewell irrigation in this region. In recent years there is rapid increase in the number of tubewells, ranging from 50 to 100 per village in many districts. This has further restricted the livestock grazing resource in private fields round the year by permanent fencing of agriculture lands with barbed wire or thorn fencing. The decrease in grazing land is more than 13% of the area.

Rapid mechanization in agriculture farming

The fast mechanization in agriculture and transport in recent years under rainfed cropping has caused more damage to the available natural fauna comprising of perennial pastures, *sewan* (*Lasiurus indicus*), *dachab* (*Cyperus rotundus*) and *dhaman* (*Cenchrus setigerus*), shrubs or bushes *pala* (*Ziziphus nummularia*), *phog* (*Calligonum polygonoides*) and *kheemp*, *senia* (*Crotolaria burhia*) and some important fodder trees *khejari* (*Prosopis cineraria*). The replacement rate of *khejari* tree has declined significantly in the recent past from 10% to 3%. These used to be the important source of fodder and forage during lean periods as well as during droughts for the sustainability of camel and other livestock in arid regions.

Continuous drought

More than two-thirds of the districts of Rajasthan are passing through drought situation in the last five years due to extreme low and erratic rainfall during the monsoon. This has severely affected the crop and fodder production for livestock, resulting in high mortality in camels, sheep and cattle. There is no organized programme of fodder depots for camels or sheep, or subsidy as in the case of cattle by the state government. In severely affected villages, farmers are forced to cut down all the available natural bushes and trees from rangelands to earn money by selling fuelwood in nearby cities and town.

Illegal movement of camels for slaughter

A recent trend is for camels to be purchased in large numbers from state livestock fairs by outside agents, involving local agencies/middleman. The animals are taken to other states (such as Uttar Pradesh) and a neighbouring country (Bangladesh), where they are being slaughtered for the Eid festival. Camel meat is also exported. As camels are slow reproducers, their numbers are seriously affected. There is an urgent need for intervention by state and central government ministries of animal husbandry and agriculture in order to control illegal movements.

Lack of organized grazing policy for livestock

Although livestock are an important component of hot desert ecosystem, there is no organized policy from the government, the State Forest Ministry and village panchayats to permit camels and other livestock in forest areas for specified periods

during scarcity and drought conditions. This has created serious problems for camel herders, resulting in a decrease in the number of camel herds and herd sizes.

Lack of interest among the young

Young members of camel-owning families lack interest and attachment to camels due to increased education and rapid urbanization.

Sustaining the ship of the desert

Make camel farming more remunerative

Camel farming should be made more remunerative, not only from point of short distance transport (30–40 km/day) but in other areas which remain untapped. Camel milk has a major potential, considering its composition, biological characteristics, range of potential products and therapeutic importance to treat major chronic diseases (tuberculosis, diabetes type I, liver disease and other problems). This can be of great demand in districts with high female camel population in hilly/mountain areas, and could be regular source of income for camel keepers. Other important products include hair, leather, hides and bone. They could become more important by incorporating improved technology and by special blending with other fibres.

Strengthen silvipasture programme

The silvipasture programme is important to improve agricultural productivity, soil fertility and fodder production by utilization of available wastelands with salinity problems. The major stress should be on planting trees and bushes which are well adapted and good sources of fodder. Silvipasture yields 7 times more vegetation than traditional land use patterns, ensures a longer supply of green biomass, and is a top resource for camel browsing.

There is need for intensive tree plantation programme under rainfed cropping. Farmers should be encouraged to plant fodder trees such as *khejri* (*Prosopis cineraria*) and *Acarsia tortalis* on a large scale in their fields. This will help in long run availability of feed for the camels and other livestock and help in improve the soil fertility. The State Forest Department should be given the task of providing saplings and encourage farmers to plant them. These trees will also be an additional source of forage during drought conditions.

Emphasize plantation of fodder trees on roadsides

This will ensure the increased availability of feed during lean periods. Controlled browsing should be allowed under the supervision of the forest and agriculture departments.

Utilize unconventional feed

Efforts are needed to be utilize unconventional fodder at a ratio of 20–25% with conventional fodder during scarcity by preparing feed blocks. Provision of subsidy from the government will help in promoting use of feed blocks during drought.

Stress agroforestry development

This will help in improvement of feed, fodder and fuel resources and conserve the soil. Camels are environmentally friendly: they do not cause damage to the existing vegetation under controlled grazing.

Camels offer an excellent adaptive mechanism to drought. They can survive periods of water scarcity – and are more sustainable than irrigated crop farming in arid areas, given the fast decline in groundwater levels in many areas. Camels can adapt easily to changing in agroecosystems.

There is need to strengthen the above measures by ensuring the proper participation and collaboration of farmers and government departments, especially forest and animal husbandry departments and panchayats. This will help overcome the problem of the declining camel population.

Camel production and management systems in Pali and Bikaner regions

Champak Bhakat¹ and M S Sahani²

1. Scientist (Senior Scale), email bhakat@scientist.com

2. Director, National Research Centre on Camel, Jorbeer, PB No. 07, Bikaner 334001, Rajasthan

A study was conducted on various aspects of camel production and management systems in two different agro-ecological zones of Bikaner and Pali. Statistical analysis shows there are fewer 1–4-year-old camels in herds in Pali than in Bikaner. Female camels over 4 years of age form the majority of animals in both regions.

Bikaner is dominated by camel users (79%), while in Pali camel breeders form the majority (65%). In Bikaner the main purpose of camel rearing is carting; in Pali it is trading. The purpose of camel rearing varies significantly ($p < 0.01$) between the two regions. In the irrigated parts of both regions, there are more farmers who own a single camel; in areas without irrigation, farmers with more than 5 camels are more common. In both regions, farmers with a single camel rear their animals intensively. Farmers with 2–5 camels send their animals for grazing around the village (up to 50 km away). A majority of camel keepers who have more than 5 camels send them away on migration in the charge of herders. Chi-square test shows that camel keeping patterns significantly ($p < 0.01$) influence rearing practices and feeding management. In Bikaner, seasonal migration is more common (85%), whereas in Pali prolonged migration is highest (79%). For both type of migrations, short ranges (up to 50 km) are more common in Bikaner, and longer ranges (> 50 km) are dominant in Pali. Camel rearing is the third most important source of revenue in both regions; agriculture is the main source of income, while rearing cattle, sheep and goats and other livestock apart from camels ranks second.

Management of common diseases of camel

R.K. Tanwar

Associate Professor and Head, Department of Epidemiology and Preventive Veterinary Medicine, College of Veterinary and Animal Science, Bikaner

Surra, mange and worm infestation are common health problems encountered in camels in Rajasthan. These diseases are responsible for the poor health of camels, and if not treated in a timely way, may lead to death. Regular prophylactic chemotherapy against surra, early and complete treatment of mange, and regular deworming with proper doses of anthelmintics can prevent these diseases in camels.

Feeding of indigestible coarse roughage, particularly of gaur straw, gram straw and groundnut straw and pica are responsible for the death of many camels due to impaction, perforation of the intestine and peritonitis. Feeding of good quality roughage and prevention of pica are suggested as ways to control these conditions. Sporadic outbreaks of camelpox, haemorrhagic septicaemia and enterotoxaemia also occur in camels in Rajasthan. Camels in India are currently not vaccinated against infectious diseases.

Trypanosomiasis (surra)

T. Evansi transmitted by biting flies (tabanids).

Etiology

It is more frequent in humid areas and rare in dry areas. The disease increases after rainy season because flies multiply.

- Acute course.
- Chronic course.

Signs

- Decreased appetite.
- Water intake is also reduced.
- Loss of condition i.e. animal becomes thin, emaciated and disappearance of hump.
- Intermittent fever.
- Edema under belly and neck.
- Pale mucous membranes.
- Animal become prone to infection with other disease like mange and pneumonia.
- Some animal exhibit nervous signs convulsion and blindness.
- Death takes place in 2–3 months in chronic form.

Diagnosis

- Blood smear examination, buffy coat examination wet blood film test.
- ELISA test.
- Inoculation test in mice.

Treatment

- Quinapyramin chloride and sulphate-5mg /kg b.w. s/c.
- Melarsomine, 0.25 mg/kg i/m.

Control

- Chemo-prophylaxis.

Haemorrhagic septicaemia

Etiology

- *Pasteurella multocida*.
- Organism is excreted in the saliva, nasal and mouth discharged and in faeces of infected animal. Transportation stress also plays a role.
- Sudden onset.
- High fever, 40°C.
- Painful swelling at neck region (angle of jaw), swollen painful lymph node especially in the angle of jaw.
- Off feed, off water.
- Absence of rumination.
- Grinding of teeth.
- Mucous membranes of eyes congested.
- Salivation.
- Rapid shallow breathing.
- Death in 2–5 day.

Diagnosis

Examination of heart blood smear revealed gram negative bipolar organism.

Treatment

Trimethoprim sulpha and oxytetracycline, supportive treatment.

Prevention

Vaccination.

Mange

Highly contagious skin disease of camel. Characterize by pruritis, poor growth and even death in severe cases. Cases are mostly seen in winter.

Etiology

- *Sarcoptes scabie var cameli* mites. The mites penetrate into the upper layer skin and lay their eggs. This causes an allergic reaction, leading to intense itching.
- It is transmitted by direct contact between camels or indirectly through equipment and rubbing places such as tree.
- The mites can survive outside the body for about 2 weeks. They prefer low temperature and high humidity.
- The first sign of mange appears about 2–3 weeks after the animal is infected.
- Animal rubs/scratches the affected area with its teeth or tree.
- In the early stages, the skin is covered with small bumps.
- Hairless patches develop, and the skin becomes raw from scratching and begins to weep.
- Scabs develop, and in chronic cases the skin becomes grey, thickens, becomes wrinkled and cracks like dried mud.
- The camel spends its time in scratching itself rather than eating and resting.
- It loses weight and becomes weak and anaemic.
- If the disease is not treated, secondary infections may develop and the camel may become more susceptible to trypanosomiasis and diseases such as pneumonia.

Treatment

- Treat the disease at early stage before it spread to whole body.
- If more than one animal is infected in the herd treat all the camels.
- First wet the while animal with the detergent solution and then remove the crust from the body so that the acaricide can penetrate the skin.
- Acaricide drug Butox, 50 ml in 13 litre of water spray with machine or apply on whole.
- Tactic, malathion 0.5%.
- Parental treatment: Ivermectin, according to body weight 1 ml/ 50 kg b.w. s/c.
- Supportive treatment: multivitamins, particularly vitamin A.
- Haematinic.

- Spray the area or tree stem where the camel is tied with acaricide drug also.

Prevention

Do not allow infected camel to come in contact with uninfected animals.

Contagious skin necrosis (staphylococcal dermatitis)

Etiology

Caused by bacteria and fungi:

- *Actinomyces*.
- *Corynebacterium pyogenes*.
- *Staphylococcus aureus*.
- *Streptococcus*.

Symptoms

- A circular sore, a few centimetres in diameter, appears on the skin. It begins to weep fluid. The dead skin falls off, leaving a circular ulcer that does not heal and may form a thick scab.
- The camel tries to rub and bite the sore. Lymph glands nearby may become swollen.
- After 7–14 days, the dead skin comes off and the sore opens into a wound. An ulcer may form in the centre of the sore.
- When the sore heals it leaves a star shaped scar.

Treatment

- Debride and clean the lesion and irrigate with mild antiseptic solution (0.1% potassium permanganate).
- Apply antibiotic ointment locally on the lesion.
- Injection of broad spectrum antibiotic (in oxytetracycline) daily for 7 to 10 days. Long-acting oxytetracycline can be used.

Myopathy (Kumri)

Etiology

- It occurs mainly in camels which have been raced over long distance, in animals that are tied down for long (transporting on a trunk).
- Animal recovered from long period of anaesthesia.
- Deficiency of vitamin E and selenium.

- In Rajasthan, a similar disease known as *kumri* causes a peculiar shivering of the hind legs when animal tries to sit. It affects males. Camel owners usually abandon such camels although otherwise the animals seem normal.

Signs

- Difficulty in standing up and walking. The hind legs shake from side to side.
- Shivering of the hindquarters when camel attempts to sit. When it has reached the half-sitting position, it falls down.
- The hindquarters appear weak, and the camel is not able to pull heavy loads.

Etiology

- Over-secretion.
- Prolonged movement followed by vigorous work.
- Plant poisoning.
- Vitamin E or selenium deficiency.
- Ca/P imbalance.
- Genetic defects.

Treatment

Inject dexamethazone, 40 mg i/m.

Internal parasites

Worm infestation causes weakness, poor growth, low milk production and even death.

- *Haemonchus* (stomach worm).
- *Trichuris strongyloides* (intestinal worm).

Signs

- General weakness.
- Diarrhoea or constipation.
- Colic pain.
- Pica.
- Anaemia.
- In severe cases, swelling above the eye, on the sides of the chest pad and submandibular edema.
- Inappetance, progressing wasting and death after several weeks.

Treatment

- Proper dose of anthelmitic.

- Albendazole.
- Fenbendazole.
- Inject Ivermectin.

Lung worms (verminous pneumonia, *khurak*)

Etiology

- Small white round worms (*Dictyocaulus filaria* and *D. viviparus*) that are 5–10 cm long and live in the bronchi. They infect camels, sheep, goat, buffalo and cattle.
- Sick animals cough out the worm eggs onto pasture and into drinking water.
- Camels become infected by feeding on egg infested pasture or infested water.
- It is more frequent after the rainy season from October to December.

Symptoms

- Fever.
- Anorexia.
- Loss of condition.
- Coughing.
- Open mouth breathing in later stages.
- Reluctant to move.
- Yellowish discharge from nostrils.
- The lips become itchy and camel rubs them on trees or walls.
- Death in 15–20 days.
- The eggs and worm larvae can be seen through microscope in the nasal discharge and in faeces.

Treatment

- Inject Ivermectin 1ml/50 kg b.w. s/c.
- Inject penicillin streptomycin i/m for 5–7 days for secondary infection.

Nasal bots (nasal myiasis)

- Nasal bots are fly maggots that live in the back of the camel nose. They are very common under pastoral condition and can affect many animals in a herd.
- They are most common in the winter months. The nasal bot fly (*Cephalopina titillator*) lays its larvae (maggots or bots) in the camel's nostril. The larvae

crawl up the nose into the back of the nose and mouth. They can stay there for several months causing irritation and making the animal sneeze.

- The maggots are white and about 35 mm long.
- The bot flies themselves are rarely seen.

Symptoms

- Sneezing which may expel the maggots.
- Discharge from the nose.
- Open mouth breathing.
- Shaking of the head.
- Sometimes circling.

Treatment

- Add trichlorfon (Neguvon) to the drinking water (0.03–0.05 %).
- Do not treat female camels in the last 6 weeks of pregnancy.

Prevention

If nasal bots are problem add trichlofon to the drinking water at 0.03–0.05% during the season when nasal bots occur.

Animal welfare and the veterinary profession

Devi Shankar Rajoria

Help in Suffering

There is a need for funding to do development activities. Help in Suffering (HIS), an animal-protection NGO based in Jaipur, India, can help seek funding for such activities and provide medicines to treat camels. Possibilities:

- Abortions: need to identify cause of problem and can find funds to solve it.
- HIS could help create a coalition to provide treatment for camels. NRCC, the National Veterinary College, and LPPS are interested in joining such a coalition.
- Research is needed to develop more efficient and comfortable harnesses, saddles and equipment.
- Using nose-pegs is harmful and unnecessary. If they are used, anaesthetic should be used when they are inserted.
- Camel shelters could be provided for sick camels.
- Insurance policies could cover the families dependent on camel carts if their animal dies.
- Providing reflectors on camel carts could help prevent collisions with motor vehicles. This has been found effective in Jaipur. NRCC has developed an electrified camel cart with a dynamo and battery, which can run lights and a music system. It costs Rs 2500 to electrify a cart.

HIS's publicity efforts include a puppet show that features a discussion between the owners of a thin, malnourished camel, and a well-fed, healthy camel. This entertaining show draws crowds at events such as the Pushkar Fair, and encourages owners to feed their camels appropriately and treat their health problems promptly.

Experiences from other countries

Scientific support of the camel sub-sector development project in Niger

Bernard Faye¹ and Gilles Vias²

1. Animal Production Programme, CIRAD-EMVT, Campus International de Baillarguet TA 30/A, 34398 Montpellier Cedex, France

2. NGO KARKARA, BP n°510, Niamey, Niger

Political conflicts between Touareg nomads and the central governments in the Sahelian countries of Mali and Niger in the last few decades have stimulated development projects focusing on camels. Camel rearing is the main economic activity in these areas, but rebels consider development efforts to benefit them as insufficient. In 1990 in Niger, a major camel development project began with French government support. An initial phase of research and development activities included an analysis of the main constraints in the camel farming system and the identification of camel health and production parameters. This first phase led to a second phase, in the form of a new project entitled “Institutional Support Project to Camel Sub-sector in Niger” managed by an NGO named “Karkara”. These development activities included cheese making, camel milk marketing, camel ploughing and carting, and health monitoring on camel farms. In all sectors, scientific support was provided on cheese technology, the assessment of milk productivity, technical innovations for ploughing and carting, ethnoveterinary sciences, and others. Extension approaches included technical booklets in local languages, training sessions, and the promotion of camel farmers associations and communities.

Introduction

Unlike in India, the camel population in Niger is increasing, as it is in all Sahelian countries. Official figures state that Niger has 415,000 camels (<http://apps1.fao.org/servlet>), but local estimates are higher: up to one million animals (Faye and Paris, 1995). Moreover, the distribution area of these animals is increasing because of the incidence of drought in the region. In several places where cattle had replaced camels for dairy production, the droughts of the 1970s–80s severely affected cattle numbers and showed the superiority of camels in these harsh conditions (Bonnet and Faye, 2000). Elsewhere, several regions have been affected by rebel movements in conflict with the central government. The rebellion, associated with nomadic peoples (Touareg in Niger and Mali, Toubou in Chad) demanded better development of the desert margins. Camel farming, which is the main economic activity of these peoples, appears to be an important means to contribute to local development and to help solve the political conflict. With this in mind, the bilateral cooperation between France and Niger has started a camel research and development project that includes various development activities, training and research. This paper describes research to promote camel farming development in Niger.

The Zinder Camel Project (1991–1995)

The first phase of this series of projects was implemented in the Zinder region. A rapid appraisal was performed among camel producers, who identified the following limiting factors:

- The poverty of many camel farmers after the drought in recent decades, major loss of cattle and camels, and difficulties to rebuild herds after drought.
- Deficiencies in natural resources and water management.
- Theft of camels.
- Camel diseases and the limited know-how of technical support services in camels.
- Capture of the market by a few traders.
- Lack of training of technical service staff.
- Low productivity of camels due to feeding and health constraints.

The project proposed to include three fields in order to address these constraints:

1. Development actions, involving training camel holders on health control, marketing (via cooperative), pasture management, improvement of water points, extension of feeding practices to avoid seasonal variation of feeding resources, and cheese making. These actions were to be supported by “camel units”, moving by camel from water point to water point.
2. Training of staff in technical services from the Ministry of Agriculture and Niamey University on production and health. The training also included “animal health auxiliaries” who are responsible for various primary health activities. Festivals, such as the camel festival, were organized to heighten public awareness of camel products.
3. Research, including the production of technical and economic baselines on camel production and health in the different farming systems, pasture monitoring, feeding strategy in each agro-pastoral zone, work ability, and knowledge of the camel market system. The main research activity was the monitoring of a camel farm for 3 years by collecting data on production (milk, growth), reproduction, demography and diseases.

The project aimed to use the results of the research (baselines, proposal for pasture improvement and feeding of animals, data on work ability and camel markets) to design training courses and development activities. Several training sessions were organized for technicians from the Livestock Services and for producers. However, a major problem was in obtaining enough data on the camels, with their slow reproductive cycle, during the short project period. Funding agencies sometimes have difficulties understanding that camels need long time to reproduce, and camel farmers also need a long time before they adopt innovations. However, many results were obtained and published in scientific reviews and conferences, and in booklet form during the second phase of the project (see below).

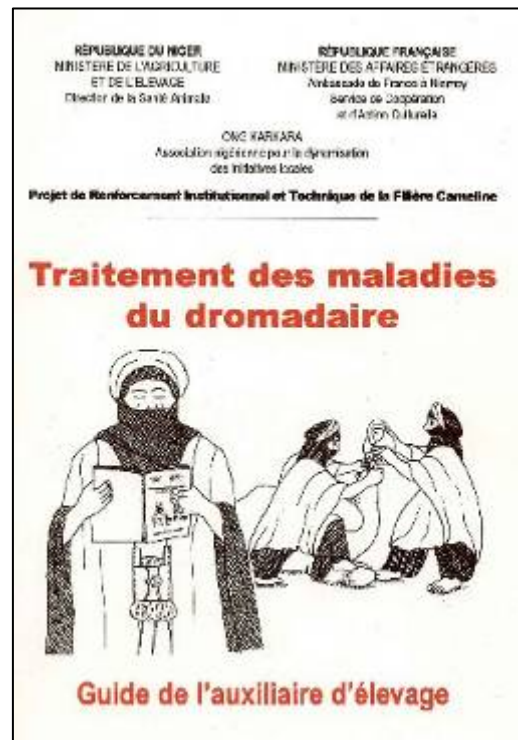
Institutional support to camel sub-sector (1996–2003)

The second phase focused mainly on supporting the camel sub-sector from a technical point of view (improving camel productivity by transferring knowledge collected in the previous stage), and by supporting institutions by training two project managers from a local NGO (KARKARA) to specialize in camel farming and to continue development activities in the camel sub-sector.

Building on the results of Phase I

Most of the results of the studies in the first phase were available after the end of that phase. These results covered health (importance of trypanosome in camel herds: Gamatché et al., 1999), technology and economics (camel cheese processing and marketing in extensive conditions (Bonfoh et al., 2003; Vias et al., 2003; Bengoumi et al., 2002) and reproductive performance. Some preliminary results were gathered on camel draught (Vias et al., 2002). This first phase ended with the publication of booklets in three languages (French, Arabic, Touareg) on different aspects:

- Zootechnical and health baselines for camel farming in Niger (Pacholek et al., 2000)
- Practical guide for camel draught: for the agriculture advisor (2000)
- The treatment of camel diseases: handbook for animal health auxiliary (1999)
- Camel cheese processing: handbook for camel producers (2002)



The cheese handbook contributed to the preparation for the first time of a local traditional camel cheese, named *tchoukou* in the Haoussa language and *tikomart* in Tamachek. This cheese is made by women. It is a dry cheese made by rennet coagulation just after milking, and drained rapidly because of its low thickness with no specific maturing technique. It is consumed in tea or in millet gruel after grinding. The processing of camel milk cheese was initiated by an FAO research project on improved processing methods. These methods have led to the availability of stabilized



Photo 1. *Tchoukou* cheese from camel milk

ferments (starters), minerals and vegetable protease of homogeneous quality, such as camifloc®. The process combines different activities: early and progressive acidification, correction of unbalanced mineral contents of camel milk, coagulation with an adapted enzyme, and fermentation through use of a lactic starter inoculum, which acts as an acidifying agent and has aromatic characteristics. These starters have been used in pastoral areas in Niger and have proven suitable for use in local methods to produce camel *tchoukou* cheese (Photo 1).

However, many problems are observed in this cheese making technology. These problems include:

- Standardization of the technique and products: the form, color and weight of cheese are extremely heterogeneous, and its yield and component recovery is very low compared to cow's milk.
- Respect of ferment dose.
- Cheese making is hindered during periods of migration.
- The hygienic quality of *tchoukou* does not allow it to be exported.
- It fetches twice the price of cow's *tchoukou*, but production is expensive because of the price of camifloc®. Camel herders tend to reduce costs by blending camel milk with cow or goat milk.

Further study is needed to improve production technically and economically.

New technical investigations

Some in-depth investigations were proposed on health problems such as trypanosoma and hydatidosis. A study has been completed on the ethnoveterinary knowledge of Touareg nomads (Antoine-Moussiaux et al., 2004).

Concerning camel draught, new studies were proposed to develop the use of camels with a wide range of agricultural equipment for ploughing, carting, sowing, harrowing, fire-lining (Photo 2) and even for carrying waste and use as ambulances in towns (Vall, 1998). Several training courses were given for local craft workers on making equipment adapted to camels, and also for farmers to use camel equipment in the field, in collaboration with various projects managed by international and local NGOs. These investigations have sometimes resulted in major innovations, especially in agropastoral zones where camels were formerly rarely used. For example, camel carting is now used in some towns in the southern part of the country for carrying waste. In a pastoral project managed by the EU, camel energy was used to make a fire-line in the Sahelian zone to control spontaneous and deliberate bush fires. In all the cases, shows were organized among camel producers using a participatory approach. Promotion of camel



Photo 2. Harrowing use trial for fire-line making

farming and camel use for draught and carting was proposed as part of traditional festivals such as the “salted cure”, where thousands camels were gathered.

The camel milk factory at Agadez

Traditionally, camel milk is not sold in Touareg culture. Camel milk is a gift for friends and visitors, or for poor people. It was very difficult for camel farmers to join the market system. Nevertheless, a private camel milk factory was created in the desert town of Agadez after a technical proposal by a CIRAD expert (Duteurtre, 1999). The factory collected camel milk from nomad camps in an area 40–50 km around the town (Photos 3 and 4). The small-scale factory is able to market pasteurized milk and cannot satisfy the whole urban demand (Photo 5). The establishment of the factory provoked the development of milk production around the town.

Preliminary studies were performed to identify the types of camel milk farms, and a PhD study is under way to assess the pastoral and milk potential and productivity in this milk production area (Chaïbou and Faye, 2003). Further studies are expected on the milk quality, to develop cheese or yoghurt-making technology. Several questions are emerging: how to maintain the sustainability of such a farming system in harsh conditions? How to ensure the quality of the milk and the durability of milk collecting with mobile producers? How to manage the feeding resources and to promote the transfer of feedstuffs from marginal areas to peri-urban areas? How to organize the collecting points during periods of migration? How to control health in the camel



Photo 3. Camel milk collecting in nomad camp



Photo 4. Camel milk collecting around Agadez town



Photo 5. Packing of pasteurized camel milk in small dairy unit

farms? How to support the role of women in a subsector traditionally managed by them, if the camel milk is going to the market? How to assess the change in livestock management with the increase of camel milk marketing?

The development of this small dairy unit is slow, and economic problems have to be solved (especially the cost of transport and the quality of milk), but there are good possibilities for development. Other small dairy plants are in progress in secondary towns in the same area (Abalak, Tahoua).

Team building

The main aim of the project is to promote the emergence of a team specialized in camel sub-sector development. This team was trained to acquire competence in three main fields:

- Project management and applied research in the camel sub-sector.
- Livestock economy and economical analysis of incomes and costs in the camel sub-sector.
- Camel draught technology.

This team has to be able to respond to tenders in camel production, and more widely in arid zone development. The team has contributed for projects other than those on camels. An operational unit, named CAPEN (English for "Support Unit for Niger Livestock). was created in the NGO KARKARA for livestock development. This unit works not only on the camel farming system but also on livestock projects in other areas of Niger, such as peri-urban livestock system, small ruminant extensive system and agro-pastoral system. It also contributes to the support of local NGOs managed by farmers associations.

Conclusion

The scientific support for the camel project has continued since the start. It has been possible to identify the constraints and to contribute to some innovations. However, the positive role of research for camel development has been possible because the association between the research institute (CIRAD) and the local NGO was clearly defined from the outset. The objectives and the demands were formalized by the farmers through the NGO, not by the scientists themselves. At the same time, it was possible for scientists to quantify some of the study results. So, the benefits were both for research and development.

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Adaptation of current biotechnology to improve camel breeding economy

B. Musa, BVSc, MVSc, Ms, PhD, Maha T. Allawati, BSc, and Mahmood S. Al Amri
BVSc

Camel Breeding Center, Royal Camel Corps, Royal Court Affairs, Sultanate of Oman

Introduction

The camel is adapted to the most rigorous environment of arid and semiarid lands. It provides people in such areas with meat, milk, traction power, mobility and high quality fiber and hides. In particular the camel produces large volume of milk with an excellent nutritional value. It must be remembered that traditional milk animals, the cow, the sheep and the goat have difficulties to survive in dry lands. The meat of the camel was also valued for its low fat content and the fat is stored mainly in the distinct hump.

In recent years the camel is helping man in many different aspects as in racing sport, music bands, ceremonial shows, circus performance, as zoo animal itself or its hybrids etc. The economical value of the animal was highly boosted recently due to these uses and raised the general appreciation of the economical value of this animal a fact that led to production of an enormous wealth of information about it.

Biotechnology in the camel

In recent years the biotechnology developed in horses, cattle, sheep, goats and swine has been adapted with variable success in the camel. However the areas of applications are still limited for few procedures such as embryo transfer and artificial insemination. In-vitro fertilization, ovum pickup, and oocytes maturation techniques are in the developmental stage in the camel. Other techniques which are under consideration in the camel include sexing of embryos and sperm, embryo splitting, guided tubular fertilization, and hybrid production with New World camelids. Procedures such as gene transfer and cloning are not expected to take off in the camel in the next one or two decades.

Limitations of techniques in camel habitat

- Most of these techniques require well-established laboratories.
- Qualified personnel are needed.
- Equipment and consumables are expensive.
- High standards of hygiene and maintenance is required.
- Understanding of beneficiaries is essential.

Dryland requirements

The carrying capacity of drylands is limited due to the scanty vegetation and poor water resources. Hence it is necessary to consider the quality of animals rather than their numbers.

- Improvement of productivity of individual animals is required.
- Avoid concentration of animals around water points in order not to overgraze.
- Distribution of water points should be well planned in relation to green cover of the land.
- Avoid soil alkalinity. Urine is alkaline. As the numbers increase urine production is increased.
- Control of disease and parasites is important.
- Extension service is a routine requirement for veterinary and agriculture work.

Possible biotechnology to improve quality of the animals

Artificial insemination

Artificial insemination has the following advantages:

- It gives more efficient use of genetically superior bulls.
- It eliminates need for transport of animals.
- It prevents diseases.
- It eliminates behavioural problems.
- Frozen semen can be used after the death of the male.

Semen collected from good sires can easily be taken to the field, where insemination can be done routinely. It is cheap way to improve quality of the progeny of the camels among nomadic and settlers as well. A laboratory in the nearest veterinary or agriculture centre is all that is needed.

Embryo transfer

This is a multifactorial procedure which requires five steps:

- Superovulation.
- Mating and induction of ovulation.
- Embryo collection and evaluation.
- Preparation of recipients.
- Transfer of embryos to the recipients.

This technique is useful in producing multiple progeny from desired sire and dam. A mother and dam of good quality can be used to produce a number of embryos. These embryos can be transferred at a well-planned programme, or can be frozen to establish a bank for good embryos on demand. More research is needed on freezing camel embryos before this becomes routine like frozen semen.

Field ultrasound

A battery-operated machine will help to:

- Improve fertility by allowing mating at optimum follicular size, since signs of heat are weak and hard to detect.
- The common cystic follicles could be spotted and eliminated readily.
- Detect pregnancy as early as 18–21 days and save breeding time.
- Good tool to diagnose and treat reproductive problems in the field.

Effect of introduction of biotechnology on camel herders

- Quick improvement of the quality of the animals is expected.
- A slow shift from subsistence husbandry to market husbandry and more cash for the herders.
- Improvement of the quality of life by extending other uses for the camel as emerging racing industry, shows, music bands, etc.
- Better conservation for the meagre resources in water and vegetation.
- Better interaction with world community interested in modern uses for camels.

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Information and advocacy

Using radio to reach your audience

Susie Emmett

WRENMedia, UK

Radio is a very powerful medium. It is cost-effective and can reach large audiences. It can be very influential: radio programmes are heard by everyone from the Prime Minister and government officials and businesspeople, to the poor: farmers, rural women and drivers.

Community radio stations are common in Africa, and are increasingly important in India.

To use the radio effectively, you must:

- Be proactive. Approach journalists, rather than wait for them to approach you.
- Know who the radio journalists are, and keep in contact with them.
- Know what programme, on what radio station, might be interested in your work.
- Do not try to interest journalists in your topic if you have nothing to say.
- Find out what is of interest to your audience.

When giving interviews:

- Use ordinary language. Avoid scientific or development jargon, but don't patronize or talk down to listeners.
- Illustrate your points; use analogies to explain ideas.
- Make what you say interesting and enjoyable. Try to have a lively conversation with the interviewer.
- Help the audience imagine pictures in their mind.
- People often say the pictures on radio are better than on television because what we see in our imagination can be crystal-clear and very memorable. When you speak on radio, you need to paint pictures, describe clearly and explain the sounds they hear, to create useful, wonderful pictures in your listeners' imaginations.
- Know what topics to cover in a radio programme. For example, don't try to teach complex techniques such as milk fermentation on the radio.
- Be concise! Practise so you can express yourself clearly in a few words.

Policy and advocacy for camels

Sopan Joshi

Down to Earth Magazine

It is difficult for scientists to communicate with rural people because they belong to different worlds and think in different ways.

The most difficult policy issue in India is the use of common land. Pastoralists currently have little input into debate on this issue because they have no effective lobbying group and do not form a political constituency (they are mobile, and few pastoralists get to vote in elections). It is necessary to build coalitions to press for pastoralists' rights. It may be possible to build such coalitions with crop farmers, who have many common interests with pastoralists (conserving water, using dung to maintain soil fertility, using camel transport services, purchasing camel milk, etc.)

In Rajasthan, 20% of the State's income comes from livestock, yet livestock receives little attention from the government.

Science has a key role to play. It produces objective information, which can be used to develop informed policies. NGOs and local organizations can research-based information to press for concrete policy changes. Research institutions should work with NGOs and community organizations to study topics that are of concern to local people.

Conference schedule

22 November

Arrival of participants

Reception

23 November

Registration and breakfast

Session 1, Opening

Opening

HS Rathore, Bernard Faye, MS Sahani

Why does the camel need to be “saved”?

Ilse Köhler-Rollefson

Summary of national grazing workshop

Bagdi Ram Raika

Lunch

Session 2, Potential of camel milk

A better knowledge of milk quality parameters

Gaukhar Konuspayeva and Bernard Faye

Camel milking techniques in the United Arab Emirates

Wernery

Chemical and physico-chemical properties of camel milk

S. Raghvendar, S.K. Shukla, M.S. Sahani and C. Bhakat

Prospects for adding value to camel milk in India

S. Raghvendar, S.K. Shukla, M.S. Sahani and C. Bhakat

Camel milking in Rajasthan

Carl Edward Archibald Albrecht

Working groups on milk production, milk policy and milk marketing

24 November

Field visit to camel herd

Session 3, Other income sources

Camel hair: Its textile applications

V.K. Singh and P.C. Patni

Plight of draft camel owners of Bikaner

T.K. Gahlot

Session 4, Management

Management of common diseases of camel in Rajasthan

R.K. Tanwar

Changing scenario of camel population and farming strategies for its sustenance

M.S. Sahani

Camel production and management systems in Pali and Bikaner regions

Champak Bhakat and M.S. Sahani

Animal welfare and the veterinary profession

Devi Shankar Rajoria

Lunch

Session 5, Experiences from other countries

Scientific support of the camel sub-sector development project in Niger

Bernard Faye and Gilles Vias

Adaptation of current biotechnology to improve camel breeding economy

B. Musa, Maha T. Allawati, and Mahmood S. Al Amri

Session 6, Information and advocacy

Using radio to reach your audience

Susie Emmett

Policy and advocacy for camels

Sopan Joshi

Evening: Cultural programme

25 November

Session 7, Action planning

Working groups on veterinary services, information services and access to grazing
Development of **conference declaration** (*Mammaji-ki-dhuni Memorandum*)

Lunch

Departure

Participants

Dr Mahmood Said Salim Al Amri

Camel Breeding Center, Box 1844 code III, Royal Court Affairs, Muscat, Oman
Tel 0968 894803 252 or 257, email Rahmani042003@yahoo.com

Carl Edward Archibald Albrecht

Trakehnerstrasse 1, D 30916 Isernhagen, Germany
Tel/fax +49 511 734138, email archiebaba@web.de

Dr Dewa Ram Dewasi

Veterinary Hospital Siyat, District Pali, Rajasthan, India
Tel 02960 230547

Susie Emmett

WRENmedia, Fressingfield, Eye, Suffolk IP21 55A, UK
Tel +44 1379 586 787, fax +44 1379 586 755, email s.emmett@wrenmedia.co.uk, web
www.wrenmedia.co.uk

Dr Bernard Faye

Centre de Coopération Internationale en Recherche Agronomique pour le Développement
(CIRAD), Département Élevage et médecine vétérinaire, Campus International de
Baillarguet TA/30A, 34398 Montpellier, France
Tel 33 467 593703, fax 33 467 593825, email Faye@cirad.fr, web
www.cirad.fr/fr/pg_recherche/elevage.php

Dr T K Gahlot

Dept of Veterinary Surgery and Radiology, College of Veterinary and Animal Science, 67,
Gandhi Nagar West, Near Lalgah Palace, Bikaner, Rajasthan, India
Tel 0151 2527029 (R), 2521282 (O), fax 0151 2204100, email tkedjcpr@datainfosys.net, web
www.bikanervetcol.org

Pranav Hatheela

V/P Setrawa, Teh Shergarh Dish, Jodhpur 342025, Rajasthan, India
Tel 02928 262303, fax 0291 2727206

Sopan Joshi

Down to Earth Magazine, Society for Environmental Communications, 41 Thughalakabad
Institutional Area, New Delhi 62, India
Tel 91 11 29955124 /5, fax 91 11 29955879, email sopan@cseindia.org, web
www.downtoearth.org.in

Dr Ilse Köhler-Rollefson

League for Pastoral Peoples, Prugelatostrasse 20, 64372 Ober-Ramstadt, Germany
Tel +49 6154 53642, fax +49 6154 53642, email gorikr@t-online.de, ilsekr@rediffmail.com,
web www.pastoralpeoples.org

Gaukhar Konuspayeva

Kazakh University Al Farabi, 242 T Ozal, 8ap. 480046 Almaty, Kazakhstan
Tel +7 3272 463501, email konuspayeva@cirad.fr, gauka@ok.kz

Dr R T Kulkarni

Centre for Community Economics and Development Consultants Society (Cecoedecon),
Swarai f-159-160, Industrial and institutional area, Tonk Road, Sitapura, 302022 Jaipur,
India
Tel 0141 2771488, 2771855, 2770812, fax 0141 2770330, email sharad-jp1@sancharnet.in,
cecoedecon@indiatimes.com, web www.cecoedecon.org

Dr Paul Mundy (facilitator)

Weizenfeld 4, 51467 Bergisch Gladbach, Germany
Tel +49 2202 932921, fax +49 2202 932922, email paul@mamud.com, web
www.mamud.com

Dr Babiker Elhag Musa

Camel Breeding Center, Royal Camel Corps, PO Box 1844 Code III, Muscat, Oman
Tel +968 893804, fax +968 893802, email bakrimusa@hotmail.com

P C Patni

Central Sheep and Wool Research Institute, Avikanagar 304501, Rajasthan, India
Tel 01437 220179, web <http://cswri.raj.nic.in>

Bagdi Ram Raika

Community leader, Mahamantri of the Akhil Bharatyia Raika Pashu Palak Sangh

Dr Devi Shankar Rajoria

Help in Suffering, Maharani Farm, Durgapura, Jaipur, India
Tel 0141 2760803, mobile 9414459745, fax 0141 2761544, email hisjpr@datainfosys.net,
devirajoria@hotmail.com, <http://his-india.com>

Hanwant Singh Rathore

Director, Lokhit Pashu-Palak Sansthan, PO Box 1, Sadri 306702, District Pali, Rajasthan,
India
Tel 02934 285086, fax 02934 285086, mobile 9829286948, email lpps@sify.com, web
www.pastoralpeoples.org/lpps.htm

Dr Jagdish Rawal

Government Veterinary Hospital, Sadri, Dist Pali, India
Tel 02934 286159

Dr M S Sahani

Director, National Research Centre on Camel, Bikaner, India
Tel 0151 2230183, fax 0151 2231213, email nrccamel@hub.nic.in, web
www.icar.org.in/nrccm/home.html

Dr R K Sawal

Central Sheep and Wool Research Institute-ARC, Bikaner, Rajasthan, India
Tel 0151 2252958, email rk_sawal@yahoo.com, web <http://cswri.raj.nic.in>

Dr Sanjay Kumar Shukla

National Research Centre on Camel, Bikaner 334002, Rajasthan, India
Tel 09414278354, email sanjayvibha@rediffmail.com, web www.icar.org.in/nrccm/home.html

Dr Raghvendar Singh

National Research Centre on Camel, Post Bag No 07, Bikaner, India
Tel 0151 2230183, 2230070, email dr_rsinghi@indiatimes.com, web
www.icar.org.in/nrccm/home.html

Dr V K Singh

Central Sheep and Wool Research Institute, Avikanagar 304501, Rajasthan, India
Tel 01437 220162, web <http://cswri.raj.nic.in>

Dr Arun Srivastava

Biodiversity Consultant, Softexel, Inc., Holmdel, NJ 07733, USA

Tel +1 732 7063339

and

President, LPPS, #34 Rajmata, Ka Nohra, Bikaner-334001, India

Tel 0151 2541976, mobile 9828313510, email Conservation@sify.com

Dr R K Tanwar

Head, Dept of Epidemiology & Preventive Medicine, Veterinary College Bikaner, Rajasthan,
India

Tel 0151 2522346, mobile 9414136821, fax 0151 2543419, email contact@bikanervetcol.org,
web www.bikanervetcol.org

Dr Sumant Vyas

National Research Centre on Camel, PB 07, Bikaner 334001, Rajasthan, India

Tel 0151 3090355, email sumantv@scientist.com, web www.icar.org.in/nrccm/home.html

Dr Ulrich Wernery

Central Veterinary Research Laboratory, PO Box 597, Dubai, UAE

Tel +971 4 3375165, fax +971 4 3368638, email cvrl@cvrl.ae

Rachel Wright

85 Lavender Hill, Battersea, London SW11 5QL, UK

Tel +44 20 79784158, email rtwright@hotmail.com

c/o Help in Suffering, Maharani Farm, Durgapura, Jaipur, Rajasthan, India