*An Assessment of
Natural Resources of the Indian Desert*

Madhu Publications

WORK POTENTIAL OF CAMEL UNDER ARID ECO-SYSTEM AND ITS MANAGEMENT

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In India, arid zone covers about 12% of country's geographical area and occupies over 0.3 million km², hot desert located in parts of Rajasthan (61%), Gujarat (20%), Punjab and Haryana (9%) and Andhra Pradesh and Karnataka (10%) (Shankaranarayan, 1987). Animal husbandry under such degraded land can be successful only if the live stock are basically a stable protective resource having long term viability, employment absorbing capability and income generating capacity. The livestock should be compatible with crop cultivation and natural vegetal resources available instead of competing with it for land and water resource. Camel rearing enterprise suits well with such conditions. The abbreviation of 'CAMEL' may be expanded as 'C'- carrier, 'A'- Arid Zone, 'M'- multipurpose, 'E'- Eco-friendly and 'L'- Livestock. Their ability to survive long period under hot dry climate without water is legendary. Through ages, the anatomy and physiology of camel has evolved mechanisms to combat the hostile environment of the desert, to thrive on scanty food, to dissipate body heat and to survive without water for long periods. Modified structure of the four stomachs, ability to digest coarse vegetation, rise in body temperature, passing of concentrate urine and nearly dry faeces are some fine examples (Yagil, 1985 and Rai *et al.*, 1995).

The total world population is estimated to be 19.6 million of which India has third highest camel population of 1.52 million (FAO, 1998) after Somalia and Sudan. Indian camel population is mainly confined to north-western states viz.: Rajasthan, Gujarat, Haryana and Punjab (93.12% of total Indian camel population) with density of camel in eleven arid district of Rajasthan (70.13% of total Indian camel population) (Khanna *et al.*, 1990).

CAMEL WORK POTENTIAL

The camel is a very versatile working animal suitable for variety of functions including cart pulling, drawing wheels, ploughing, sugar cane crushers, oil mills, carrying water, transport of man and in agricultural operations under arid and semi-arid zones. The camel as provider of economic resource of bio-energy is very widely utilized and is not only cast effective for short distance transportation but also profitable and remunerable. Camel work potential is influenced by various factors viz. breed, age, sex, body conformation, training, season, terrain, pay-load, harness and implements and riders/driver.

PUBLISHED IN BOOK "AN ASSESSMENT OF NATURAL RESOURCES OF THE INDIAN DESERT" (MADHU PUBLICATION)

DRAUGHT CAPACITY

Podberezkin (1951) reported that two bactrian camels when yoked together could pull 1400 kg while Matharu (1996) studied that the Indian camel could produce draught power equal to 2 ponies and could pull cart with 1 tone load. An Indian camel could pull 816 kg weight using properly harnessed cart (Singh, 1963), Knoess (1976) studied that camels have better working potential than cattle. Dong Wie (1979) reported that the bactrian camel can pull one tone load which is equivalent to the capacity of Chinese ponies or 2 oxen. Rai and Raghvendar (1994) studied that Indian camel could haul 1.5 to 2 tons for 4-6 hour covering a distance of 30-40 km on two and four wheel cart without showing signs of distress. It can work for 4 hr at a stretch and 6 hr with 2 hr rest in between. The speed, draught force, work performance and power output reduces with the increase in distance covered. The Indian camel could have 1.5 to 2 tonnes for 4 hours covering distance of 20 to 30 Km on 2 and 4 wheel carts without showing signs of distress. The draught force generated by a camel ranges from 90-125 kg amounting to 17-22% of body weight. The tractive force (N) and work done (KJ/Kg) at 2.8 kg/kg body weight pay load upto distance of 22 km was 586 to 791 and 1.54 to 1.70 respectively. The horse power (hp) was generated from 0.93 to 1.27. On the basis of blood physiological and biochemical fatigue indicators, it was observed that four wheel cart is better than two wheel cart. Bikaneri camels are better than Jaisalmeri and Kachchhi for endurance for draught, whereas Jaisalmeri breed perform better for riding/race. Heart girth, height at wither and body weight and length of camel are positively correlated with horse power and draught. The work rest cycle indicated 2 hr. rest to be sufficient after 4-5 hours continuous work. The indices for formulating a fatigue index cart has been identified.

A pilot survey was carried out on comparative study of camel used for draught purpose in Bikaner city and surrounding village area. The major uses of camel is in carting along with agricultural operation, water carrying and breeding etc. depending upon season and requirement. The people engaged in this vocation were mainly land less or marginal farmers. The camel carts are used to transport variety of items viz. water, sand, gas cylinder, food grains and building material within the city. Maximum male camels were used for carting. The income from camel carting is estimated to be higher (approx. Rs. 6000-7000 per month) in the city as compared to village area (approx. Rs. 4000-5000 per month).

PLOUGHING CAPACITY

Nanda (1975) studied that camel is capable of ploughing of approximately 2.5 km/hr and has been recommended not to work for longer than 6 hours at stretch. Camel can produce up to 1 hp energy during plough covering 1 ha in 11 hours and could plough 500 M²/hour at a depth of 16" (Knoess, 1976). Rai and Khanna (1991) showed that dromedary camels could plough continuously for 4.25 ± 0.27 hr and covered an area of 3136 ± 168 M². The draught produced was 1.1% of body weight the horse power generated was 1.1 and the average plough capacity per 100 kg body weight was found to be 523 ± 0.37 sqm.

RIDING AND BAGGAGE POTENTIAL

The characteristics of good riding camel are long legs, display boldness, alert expression, symmetrical hump, broad muscular full thighs, small-sized foot-pads and strong knees joint. Matharu (1966) recommended that animals carrying load of 180 kg should be worked for 8 hours only at the speed of 3.2 to 4.8 km/hr and distance covered should not exceed 32 km while load.

163 kg/camel were recommended by the Sudanese military (Wilson, 1978). The slowest riding camel can cover up to 100 km/day at an average speed of 15-20 km/hr over long period and stocky pack dromedary can cover 20 to 25 km/day at an average speed of about 5 km/hr and can carry burden of 200 kg on its back (Burgemeister, 1978). Dina and Klinteberg (1977) studied that African camel is capable on traveling @ 10 km/hr and may cover about 48 km in a day with pack load of 54 kg along with rider. Williamson and Payne (1978) studied that a load of 159 to 295 kg could be carried by a baggage camel on its back over an indefinite period while about 544 kg may be carried for shorter distance. Khanna and Rai (1994) reported that the camels traveled 950 km in 29 days and covered distance ranging from 24 to 70 km/day at an average of 43.2 km/day in a camel safari across the desert of Rajasthan, India. Raghvendar et al. (1998) studied that the riding camels were targeted to complete 15 km at a stretch at the speed of 8-9 km/hr. The level of lactate and cortisol in the riding camels indicated better riding endurance in females than male Indian camels.

RACING POTENTIAL

Since ancient times, camels have been recorded as playing an integral role in the daily life of the people of Asia and Africa. Camel racing in the Gulf and certain Arabian countries is an important cultural event which emphasize the Bedouin traditions of animal husbandry skills, hospitality and competitions. Yousef et al. (1989) observed that camels had a lower than expected oxygen uptake (VO_2) during both rest and walking exercise (1 m/sec). The camel with its low VO_2 max but with a capacity to exercise at relatively high speed (9.0-10.0 m/sec) for prolonged periods, similar to the horse. The maximum values of 55-56 ml/kg/min have recorded in the current study are the same as those in the steer (Jones et al., 1989). The maximal O_2 -pulse normalized for body weight is above 0.6 ml/beat/kg in the horse and dog but only 0.3 ml/beat/kg in the camel. Evans and Rose (1988) reported that with maximal heart rates (HR max), the maximum stroke volume in the camel which is a slightly lower maximum stroke volume than found in horses. The oxygen cost of transport per km traveled in 50% of the cost compared to the horse. The long limb length enabled the pacing gait to be maintained even at high speeds. This gait would therefore appear to allow greater mechanical efficiency and therefore speeds around 9-10 M/Sec to be maintained despite relatively low oxygen availability. Raghvendar and Sahani (1999) reported better race potential in Jaisalmeri than Bikaneri female camels. Average race speed (km/hr) for 1, 2 and 3 km distances were ranged from 29 ± 2.6 to 37 ± 3.2 and 25 ± 3.2 to 30 ± 1.8 for Jaisalmeri and Bikaneri Indian female camels respectively. The maximum race speed of female and male Jaisalmeri and Bikaneri during 3 km race was recorded as 29.4, 28.4, 24.4 and 27.9 km/hr respectively.

USE IN DEFENCE

The role of camel in defence is very well evidenced from the ancient and during the first second world war by camel battalion in arid region. The camels formed important component of army during Maurya period (AC 322-232 BC) and continued through middle ages (Mughal period 1200-1700 AD) to the present times. The famous Ganga-Risala of the erstwhile Bikaner state was accepted and as Imperial service troop and participated in world war I and II. In independent India, the Ganga Jaisalmer Risala was constituted in 1948. In 1954, this corps formed part of 13, Grenadiers Regiment. Presently the camel corps constitutes an important wing of the border security force of the Indian Para Military services and used for petrolling purpose in desert boarder belt.

CAMEL MANAGEMENT PRACTICES

The camel was domesticated more recently than other animals. The most probable period of domestication of camel is prior to 1800 BC. The methods of camel keeping are now changing world wide because the grazing land is decreasing as more land is put under cultivation reducing the free grazing land. Camels which are largely maintained under extensive system are now facing problem and their management needed a better alternate system which is socially acceptable and economically viable.

CAMEL MANAGEMENT BY RAIKAS

The recent camel management by Raikas are extremely diverse, varying from free ranging for most of the year at one extreme to continuous closely supervised herding at the other. The ecological setting and the degree of competition from other land use strategies determine which particular herding system is adhered to it. In the extremely arid sparsely populated most western parts of Rajasthan, where hardly any agriculture is practiced, camels can be left to themselves for most of the year. Many of them return at regular intervals to the villages for water, but they can also range several hundred km from their owners home. The Raikas are able to keep track of their movements because they can identify the footprints of each of their camels.

CAMEL MANAGEMENT BY EXTENSIVE SYSTEM

In this system camels are allowed to graze freely and reproduces freely. All the camels are collected once every usually in the spring season for wool shearing treatment against mange, branding etc. The animals are released for free grazing again after above operations. It is usually necessary to collect camel herds during the 3 months of the rainy season (July to September) to prevent them from damaging crops. Most, but not all herders also like to supervise their camels during the breeding season which traditionally falls between the two Hindu festivals of Diwali (around November) and Holi (around March) in order to prevent fights between competing males.

CAMEL MANAGEMENT BY SEMI-EXTENSIVE SYSTEM

In this system camels are maintained around cities and villages in the marginal area and feeding is practiced. During severe drought period camels have been fed special feed lots for 2-4 months, during this period daily gain are expected to be satisfactory.

FEEDING MANAGEMENT

Camel mostly get feed from trees bushes and rarely from grasses. In stall feeding conditions the average feed consumption is maximum in the initial 2 hrs which decreased subsequently. The camel continued to consume feed during nights hrs and eat 38.5% of total feed consumption during night along.

The average daily feed consumption during day time ranged from 5.92 ± 0.46 kg to 7.25 ± 0.11 kg per day. The average feed consumption during night ranged from 5.00 ± 0.10 kg to 6.00 ± 0.29 kg per day. The average period of pasture grazing varied from 6.25 ± 0.43 to 10.54 ± 0.31 hour per day. The frequency of watering is twice in summer and once daily during winter and rainy season.

Age (Months)	Fodder and Concentrate
Upto 12 month of Age	2.5 kg fodder + 0.5 kg Conc. Mix
1-2 Year	5 kg fodder + 1 kg Conc. Mix + 30 gm Salt.
2-3 Year	8 kg fodder + 1.5 kg Conc. Mix + 90 gm Salt
About 3 Year	12 kg fodder + 2.5 kg Conc. Mix
Studs	14 kg fodder + 3 kg Conc. Mix

FEEDING BEHAVIOUR OF CAMEL

The grazing and feeding behaviour reveal that animals eat fodder for 5 to 20 min at stretch and then poused for regurgitation for 10-15 min and resume eating. The rate of fodder eating and regurgitation decreased as the day progress. In general camels eat minimum fodder between 6.0 to 8.0 P.M. when they preferred to lie down taking occasional rest by prostrating, squatting or simple standing. The animal should be fed twice in a day if kept in farm. The working animals should be fed thrice a day and animal which go daily for outside browsing may be fed once in a day in the evening.

GRAZING BEHAVIOUR

Grazing is highest in the morning time and become reduced to minimum during evening time. Camel prefers such species of plants that are high in moisture like Khejri (*Prosopis cineraria*), Pala (*Zizyphus nummularia*), Phog (*Callygonum polygonoids*) during summer and plants high in oxalate contents like Ker (*Capparis decidua*) and Sewan grass (*Lasiurus indicus*) during rainy season. Camel can eat off 9 to 11 ft tall trees. The shorted and younger animals follow the leader who is tall and has a trick to catch the high top branches and bring them down by giving a jerk so that the other animals can apprehend the foliage.

HOUSING MANAGEMENT

The open type shed is provided with 1.5 meter high barbed wire fencing. Studs and those experimental animals which required individual feeding are kept under separate roofed shed. Each animal is provided with 30-35 M² space and a manger of 75x75x40 cm internal dimension. Pregnant and recently calved animals should be kept in a separate open type shed. Sick animals were housed in a sick box off 6x6 M dimension. The soiled sand of the floor is replaced with new sand.

In army, arrangement for housing camel are tow kinds :

- (i) Single row
- (ii) Double row- camel are accommodate either tail to tail or the length, height and width of a face to face position. The ideal shed for a single camel should be kept 61 to 122 cm more than the camel's length, height and width.

MANGER

A manger about 90-120 cm high is constructed. A square pillare about 92 cm height is erected and over it, a platform of about 70 cm x 70 cm is constructed and a wall of 15 cm thickness is built on all the four sides of it from 30 to 45 cm height. This is box like manger without lid.

OTHER TYPES OF MANGER

The cheapest type is constructed by i) digging a pit in the ground of about 50-70 cm diameter and 50 cm deep, ii) the manger is made up of kachcha bricks or mud and cow dung or pucca bricks.

CAMEL HEALTH MANAGEMENT

There is a large body of ethno-veterinary knowledge on the camel derived from generations of interaction and interdependence with this animals. Even, today camel keepers rarely have access to modern veterinary core. They continue to rely on their own system of disease prophylaxis, diagnosis and treatment.

INDIGENOUS KNOWLEDGE OF CAMEL HEALTH

Camel farmers have long recognized the Effectiveness of many range plant substance in treatment of disease. These includes several herbs, roots, seeds etc. which are commonly used in Indian medicine for treatment of human being. They have identified plants which detoxify the venomous action of biting insects and animals live scorpions, snakes and flying insects. Some plants which have hormone like activities are used a glactogogues for lacto stimulation and anthelmintics. They recognise vegetation and plant products for antibacterial and antifungal characteristics in treatment of infections, cytogenic parasites, fungal skin diseases, oral diseases, antiviral and antiprotozoal activities. Along the same times plants extracts active for phagocytosis and hematic parasites e.g. trypanosomiasis are used. In addition, camel keepers have detailed knowledge of poisonous plants and their antitodes which include drenching of infusions of plant preparations and solution of salts. The ethno-veterinary medicines are low cost, adaptive and accessible to the camel keepers.

In an organised farm (NRRC), the camel are provided both prophylactic and curative measure to control ecto-parasite and internal parasites. The calves and pregnant females are given vitamins-A. A course of antibiotics is given to check diarrhoea. Mange can be brought under control with traditional concoctions, even if these methods are time consuming and labour intensive. However, trypanosomiasis is a disease which defeats indigenous methods. A variety of additional treatment are in use, but none of them is really efficient.

CONCLUSION

Camel is a wonderful animal to sustain high temperature and is equipped with the mechanism to retain and dissipate heat without affecting the vital systems. Camel can also withstand dehydration by mobilizing internal body water resources, conserving body water, avoiding water losses as far as possible and replenishing water loss by consuming huge quantity of water within minutes. Following rehydration, excess water is not excreted immediately but

slowly in 3 to 4 days to keep it as reserve for future needs. It is infact an ideal draught animal having strength and ability to cover long distance with minimum of food and water in arid zone and has enormous power endurance and hardiness. The training of young camel for riding, cart pulling or agricultural operations should be imparted by camel herd men who are specialized in this trade. Camel (*Camelus dromedarius*) constitute an important component of the desert ecosystem because of its adaptation in an anatomical, behavioral and physiological functions. Rapid change in agro-ecological conditions and industrialization in recent past has its negative impact on camel traditional management practices. It is essential in future to adopt scientific management practices to get efficient utilization of camel work potential round the year for different operations.

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