Research Article

Economic Losses Due to Trypanosomiasis of Camels in Balochistan

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Abstract | The present study was designed to evaluate the present status of Trypanosomiasis in Province Balochistan of Pakistan. The two districts Musa Khail and Jhal Magsi with thick populations of camels and have different climate and geographical distribution were selected. The questionnaire was developed for survey of Camel farmers and information regarding the age of respondent, experience, type of community, feeding/watering pattern of camels, prevailing camel diseases in the area, treatment facilities, traditional remedies used by them against various diseases in camels and economic losses were collected. A total of one thousand and forty (n=1040) camel owners/respondents from three groups viz settled, transhumants and nomads were interviewed in Districts, Musa Khail and Jhal Magsi during the year 2011. The direct as well as indirect economic losses due to camel Trypanosomiasis based on the prevalence of Trypanosomiasis, mortality rate, abortion and perceptions of the respondents were recorded. The camel dies due to Trypanosomiasis in direct visible losses and invisible losses include reduced fertility, meat loss, low quality of hide, loss of draught power and traction force and change in herd. While, indirect losses include additional costs of drugs, veterinarian fee, preventive medicine and quarantine. Moreover, the present study demonstrates that the respondents above the age of 50 years were more experienced in disease diagnosis and use of traditional veterinary practices.

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1. Introduction

Balochistan is area-wise largest and southwestern province of Pakistan. It has an area of 3, 48,000 Sq km, which is about 43 percent of the total area of Pakistan. The climate of the province is arid and semi-arid (Nagy et al., 1989). The province has been divided into various ecological Zones i.e. Tropical Thorn forest, Sub Tropical Broad leaves Evergreen forest, Dry Temperate Forest and Arid Desert. Furthermore, only four percent of the area is cultivable land while rest is comprised of arid grazing lands, rangeland mountain forests, barren rocky mountain, and deserts (Nagy et al., 1989).

The traditional livestock production system in Balochistan is broadly categorized into settled, transhumant and nomadic. The local ecological conditions make it necessary for livestock owners to migrate in search of grazing areas. The available data demonstrates that migratory livestock constitutes about 90% of the total livestock population in Balochistan Khan et al. (2018) and Khan et al. (2018). Furthermore, 60% of the migratory livestock is transhumant while remaining 30% is nomadic livestock production system (Jasra et al., 2001). However, the animals raised on farm are either for household consumption or for sale near religious festivals, when the prices are high. This supplementary

livestock production accounts for major portion of household income and helps to improve farm productivity.

The camel is the most efficient domesticated animal of Balochistan which is used for work, transport, and production of milk and meat. Camel belongs to family *Camelidae*, order Artiodactyla (even toed ungulates) and suborder Tylopoda (pad-footed) comprises two species: *dromedaries* and *bacrtianu. Dromedaries* the dromedary one humped or Arabian species, while *bacrtianus* or two humped camel. The name dromedary for the one humped camel is derived from the Greek word 'dromeus' a runner, or 'dromas' running. This name originally designated only the swift Arabian camels renowned for their fleetness of foot. Later, it applied to all one humped camels. The Bacterian camel was named after the area of Bacteriana in Central Asia. The habitat of dromedary is Northern Africa, Sudan, Ethiopia and Northern Kenya the near East and West Central Asia. Dromedaries were originally domesticated in Central and Southern Arabia (Zenuer, 1963) and were lately dispersed to North Africa and eastwards to the deserts and semi deserts of the Middle East. The Roman used camels in many parts of their empire thus accounting for the presence of camels in parts of Europe and Asia (Ripinsky, 1983). The bactrainus camel occupies the colder areas of Southern Russia, Mangolia, East central Asia and china (Wilson, 1984).

Camel possess certain physiological features that enables him to thrive in extremely arid conditions (Shwartz, 1992) and necessitate to explore his more useful traits which may guarantee the survival of camel as a domestic animal. Like cattle, about 12% of the total body water is contained in the alimentary tract of fully hydrated camel. However, the camels have well adopted water conservation system which facilitates its survival in desert conditions and reduced water availability. The water conservation is controlled through a large number of endocrine cells in the epithelium of fore stomach and highly efficient renal mechanism. Water is continuously re-circulated through blood from the duodenum and colon into the fore stomach. Furthermore, the physiological system of camel is well adapted to high temperature and blood volume is maintained by partial water diversion from skin to other body tissues and organs.

Trypanosomiasis (Surra) is the highly damaging infectious disease of camels which is widespread throughout the camel rearing areas. The causative agent of camel Trypanosomiasis is *Trypanosoma evansi* which belongs to subgenus Trypanozoon. The protozoan trypanosome is monomorphic, slender and motile with an average 25 µ lengths and 1.5 µ widths. The body of trypanosome is pointed at both ends, nucleus is centrally located and a well-developed undulating membrane and flagellum are present. *Trypanosoma evansi* was discovered in infected camels and equids from District Dara Ismail Khan, Khyber Pakhtoonkhwa by Griffith Evans in 1880 (Indrakamhang, 1998). Much wider range of hosts like Bactrian camel and dromedaries, cattle, buffalo, horses and pigs are available for trypanosome in Asia.

Trypanosomiasis is transmitted from infected camels to healthy camels through the biting of various species of haemtophagous flies like *Tabanus, Stomoxys, Lyperosia* and *Haematobia*. *Trypanosoma evansi* lacks the genes necessary for mitochondrial development and is therefore unable to undergo growth and differentiation in the insect vector. The widespread of Trypanosomiasis (surra) in camels poses a major constraints and economic loses to camel productivity in different parts of the world (Elamin et al., 1999). Available information by different authors on the prevalence of surra caused by *Trypanosoma evansi* in many countries of the world as reported, are: Losos, 1980, Nigeria (27 percent), Chad (30 percent), Dia et al., 1997 Mauritania (24 percent), Pacholek et al., 2001, Niger (29 percent), Njiru et al., 2001, Kenya (28 percent), Ethiopia (21 percent), Jordan (33 percent), Pathak et al., 1999, India (22 percent) Elamin et al., 1999, Sudan (33 percent), Zarif-Fard et al., 2011. Prevalence of trypanosomiasis in province of Punjab, was recorded 4 percent while in other cities of Punjab province, such as Lahore 16.60 percent, Gujranwala 18.2 percent, Sargodha 8.8 percent, Faisal Abad 4 percent and Okara 5.5 percent (Shehzad et al., 2012). While in province of Sind Pakistan13.72 percent (Shah et al., 2004) and in other cities of Sind province such as Hyderabad 2.5, Mirpur Khas 7.5 percent Umerkot 12.5 percent, Badin 15 percent, Thatta 22.5 percent and in Larkana 7.5 percent (Bhutto et al., 2010).

The social and economic importance of Crop diseases is well-documented in the literature and had a profound and well-recognized effect on human welfare and migration patterns throughout history (Apple, 1978). However, economic impact

of livestock disease has still not been thoroughly study. The possible explanation of little knowledge about the economic impact of livestock is the longer period of even more than one year for completion of one round of livestock system, typical wealth value and/or transportation of livestock from one place to another. Furthermore, the income generation through livestock is distributed into a wide range of outputs such as milk, meat, draught/traction power, dung (for fertilizer, fuel or buildings), hides, wool, fiber and animals. Moreover, these outputs may be brought into personal use or sold to generate wealth. In many cultures, the proprietorship of livestock is essential in terms of social status and livestock owners increase the number of animals owned. Furthermore, livestock productivity and reinvestment are considered as a safer investment option in countries with long-lasting inflation problems. These terms of animal productivity and reinvestment can be applied to animals, individual farm enterprises, production systems or entire industries.

Efficiency of the livestock production system is defined as the rate of output (e.g. milk, meat, traction, and manure) divided by the rate of input (e.g. livestock, feed, labor, medicines). Moreover, the animal diseases in a given production system are known to cause reduced productivity. There are various mechanisms by which disease affects animal productivity. The reduced productivity caused by diseases can be directly witnessed by farmers in the form of death of affected animals, low milk production, loss of body condition, low weight gain, loss of body weight ultimately reduces the draught/traction force of the animal and dehydration effects on meat and hide quality. However, there may also be invisible losses such as decreased levels of fertility result in 'calves not born', which in turn alters the herd structure. In some cases herd structure is modified which limit the capacity of the farmer to maintain and improve the herd through selection. The other indirect losses caused by animal diseases may include treatment cost, vaccination and quarantine cost and denial to access better markets because of the presence of. Moreover, the cost of losing an animal because of disease is taken as the market value of that animal.

The value of animal is also lowered if it is sold after death (salvage value) or slaughtered earlier because of sickness. Nevertheless, slaughtering sick animals will reduce the mortality rates and increase off take, which may appear to increase output. Moreover, the disease has a negative effect on the performance of the survived animals in terms compromised fertility, late puberty, low production of milk and meat, decreased draught and traction power and loss of body condition. Keeping in view, the economic losses caused by animal diseases to the livestock and ultimately to national per capita income it is needed to establish and standardize the serological technique for efficient diagnosis and control of *Trypanosomiasis* and to save camel as a valuable livestock asset of Pakistan. Hence, the objective of the current study to record the economic losses due to camel Trypanosomiasis a case study of Musa Khel and Jhal Magsi. Moreover, the rest of the study is organized on the following way. The upcoming section offers methodology of the study while the subsequent section three and fourth proposed results and discussions and then finally conclusion.

2. Materials and Methods

The present study was the designed for assessment of camel Trypanosomiasis in two ecological zones i.e. medium upland cold climate (Musa Khel) and low land hot climate (Jhal Magsi) of Baluchistan, to investigate the economic losses due to camel Trypanosomiasis in Musa Khel and Jhal Magsi. The field study was conducted in districts of Musa Khail and Jhal Magsi during year 2011. A total 1040 camel owners were interviewed from both districts during the study period. The questionnaire was especially designed for the current study which includes questions regarding age of respondent, experience, type of community, feeding/watering pattern, prevailing camel diseases, treatment facilities, traditional remedies used against various diseases and economic losses in the area due to camel diseases. The questionnaire was tested in selected camel farmers to remove the ambiguities. Initially all of the animals were clinically examined for any apparent sign of Trypanosomiasis infection. The common signs of infection include high temperature, anemia, depression, dullness, emaciation, edema, abortion, nervous signs, circling movement, trembling, unusual aggressiveness and aimless movements.

The economic losses caused by camel Trypanosomiasis were determined on the basis of farmer's response, mortality and prevalence of the disease in the study area. The estimation of economic losses is presented in Figure 1.

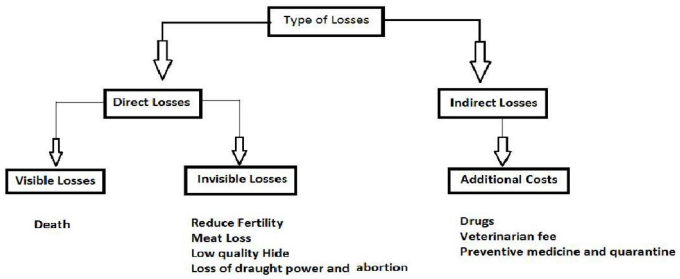

Figure 1: Economic losses due to trypanosomiasis.

2.1 Statistical analysis

The data was analyzed using computer software program "SPSS version 17" for calculation of chi square test, mean and standard Error and ANOVA. The Blood parameters for means value were analyzed using means significance difference Duncan's Multiple range test (DMRt) through Costat-2003, Co-Hort, version 6.303 software.

3. Results and Discussion

Economic losses were estimated by the prevalence rate of disease, mortality and abortion in the study area. The direct and indirect economic losses caused by camel Trypanosomiasis were investigated in the present study. The direct losses include visible and invisible losses. The mortality rate is the index of visible direct economic loss while the invisible direct economic losses include reduced fertility, meat Loss, low quality of hide, loss of draught power and traction force, change in herd and abortion. However, the indirect economic losses include expenditure of drugs, veterinarian fee and preventive medicine / quarantine.

Table 1: Approximate direct economic losses due to Trypanosomiasis in Camel in District Musa Khail during 2011.

S.No	ARHC (PKR)	Average are of diseased camel (PKR)	Average difference/ losses (PKR)	Annual losses (PKR Millon)
Live camel (Diseased)	100,000	40,000	60,000*12^	5.7
Dead camel				108
Meat	87,500**	78,750***	8750*95	0.83
Hide	1000	700	650*95	61750
Abortion			12000*9^^	0.10
Total				8.5

Note: *(Rs. 350/- per Kg Average 250 kg/animal), ***(10% reduced carcase weight). **Remarks:** ^*prevalence rate (95 out of 800) camels, ^^ 9 cases of abortion were recorded during 2011. Whereas (ARHC), Average rate of Healthy Camel, ARHC), Average are of Diseased Camel.

The average flock size comprised of 17 camels (range 15-20) and estimated mortality rate caused by Trypanosomiasis was 2 to 5 percent. The average mortality caused by Trypanosomiasis was Rs:1.8 million in district Musa Khail (Table 1) and Rs:2.5 million in district Jhal Magsi (Table 3).

Table 2: Approximate in-direct economic losses due to Trypanosomiasis in Camels in district Musa Khail during 2011.

Expenditure	Rate (PKR)	Total (PKR)
Veterinarian fee @ Rs: 500/- per day for three days	1500X95*	142500
Cost of medicine per day @ Rs: 800/- for three days	2400X95	228000
Cost of preventive medicine pour on for flys @ Rs: 3000/- per litre for 100 camels	3000X8*	24000
Total	3900	24000

According to farmers/butchers perception, the prices of camels infected with Trypanosomiasis reduced from 60 to 75 percent per animal, 10 percent for meat, 50 percent for hide. In addition, the estimated indirect economic losses were about Rs:12000/- per animal. In district Musa Khail, the economic loss caused by trypanosomiasis were Rs: 5.7 million diseased animal, 0.83 million meat losses, Rs:61750/- hide and of Rs:0.10 million due to abortion (Table 1). However, the economic losses caused by trypanomiasis in district Jhal Magsi include Rs:8.22 million diseased animals, Rs:11.9 million meat, Rs:89050 hide and Rs:0.14 million due to abortion (Table 3).

Table 3: Approximate direct economic losses due to Trypanosomiasis in Camel in district Jhal Magsi during 2011.

S. No.	ARHC	ARDC	ADL	AL (Million)
Live camel (Diseased)	100000	40000	60000X137*	8.22
Dead camel				2.5
Meat	87500^^	78750^	8750X137**	11.9
Hide	1000	700	650X137**	89050
Abortion			12000X12**	0.144

Note: (ARHC) Average Rate of Healthy Camel (PKR), (ARDC) Average Rate of Diseased Camel (PKR), (ADL) Average Difference/losses (PKR), (AL)Annual Losses Jhal Magsi (PKR, Milliom) ^(10% reducded carcase weight), kg/animal) ^^(Rs. 350/- per Kg Average 250, *prevalence rate (137 out of 800) camels, **25 camels were reported during 211, ***12 cases of abortion were recorded during 2011.

In district Musa Khail, expenditure of drugs used for diseased animal were Rs:142500/-, veterinarian fee Rs:228000/- and Preventive medicine and quarantine Rs:24000/- (Table 2) while in district Jhal Magsi drugs used for diseased animal cost Rs:205500/-, veterinarian fee Rs:328800/- and Preventive medicine and quarantine Rs:24000/- (Table 4).

Table 4: Approximate in-direct economic losses due to Trypanosomiasis in Camels in district Jhal Magsi during 2011.

Expenditure	Rate (PKR)	Total (PKR)
Veterinarian fee @ Rs: 500/- per Day for three days	1500X137*	205500
Cost of medicine per day @ Rs: 800/- for three days	2400X137*	328800
Cost of preventive medicine pour on for flys @ Rs:3000/- per litre for 100 camels	3000X137*	24000
Per litre for 100 camels	3900	558300

The economic losses has estimated by the number of camels were studied i.e. 800 90 camels in each district. The average flock size comprised of 17 camels (ranged 15-20). Previously, average 18 animals per herd were observed in 620 herds from Ethopia, Africa. In present study, the economic losses caused by camel Trypanosomiasis include the direct economic losses due to 2-4 percent mortality (Rs:4.30 million), indirect economic losses comprised of diseased animals Rs:13.92 million, hide Rs:0.15 million, meat losses Rs:12.73 million, abortion Rs:0.252 million, veterinarian fee Rs:0.348 million, medication cost Rs:0.556 million and preventive medication Rs:48000 rupees. In a previous study, economic losses due to Theileriosis in cattles were estimated to be Rs:3.39 million three districts Rawalpindi, Lahore and Multan, Punjab, Pakistan. In another study, the average live and carcass weights of healthy camel were reported 400 and 211 kg respectively (Kurtu, 2004). However, in Kenya, the estimated annual incidence rate was 15 percent and 6.9 percent and mortality rate was 9.9 percent and 5.2 percent due to trypanosomosis in adult and young camels (Mochabo et al., 2005).

The ethno-veterinary practices have been previously reported from urban and peri-urban area of Faisalabad, Pakistan Balochistan, Pakistan (Kakar, 2005), Kenya (Bett et al., 2009) and Al-Showak and Al-Obeid areas of Sudan. The participatory epidemiological techniques were used for the estimation of relative incidence and impact on livelihoods of livestock diseases amongst nomadic pastoralists.

The camel farmers/herders at two study areas i.e., Musakhail and Jhal Maghsi adopted three type of camel rearing systems i.e., Settled, Transhumant and Nomads. Same practices were also observed in four geographically distinct areas in Sudan (Salim et al., 2011) and in Balochistan, Pakistan (Kakar, 2005). The higher setteled and nomads population in Musa khail might be due to owner's own agricultural land and movement of camel flock from Afghanistan, while higher population of transhumant at Jhal Maghsi might be due to low agricultural land. Same study was conducted by in Chad.

The present study showed that settled, transhumants and nomads herders had access to camel treatment facilities from both private veterinary clinics (~42 percent) and government hospitals (33 percent). However, only 25.38 percent population was using the traditional methods for treatment of trypanosomiasis. A similar study conducted in Nigeria reported that 78.9 percent camel herders were using traditional methods of treatment (Chafe et al., 2008). In another study, it was reported that majority of the camel owners (90%) provided health care to their animals using mainly allopathic drugs, traditional healers and medicinal DFF the most common clinical signs of camel Trypanosomiasis observed in the present study included anemia, hyperthermia, edema, dullness and emaciation. A previous study conducted in Sudan also reported the history of intermittent fever, emaciation, oedema, and poor body condition, which were significantly correlated with positive serological status in CATT and trypanosome DNA detection through PCR (Kurtu et al., 2004). Furthermore, in another study showed signs of inappetence, lethargy, going down in condition, urticarial swellings, edema of pads and occasional shivering in effected camels.

Conclusion

This study was developed to evaluate the current status of Trypanosomiasis in Balochistan, Pakistan. The two districts Musa Khail and Jhal Magsi with thick populations of camels and have different climate and geographical distribution were selected. The settled and transhumants communities had easy access to government hospitals and private veterinary clinics while nomads mostly rely on the use of traditional

veterinary practices. The most common prevailing diseases of camel according to respondents were pneumonia, indigestion, parasitic infestation, mange, lameness, Trypanosomiasis, vector fly and nervous disorders. The most common clinical signs of camel Trypanosomias is hyperthermia, anemia, depression, dullness, emaciation, edema (in dependent parts of body), abortion, nervous signs, circling movements, trembling, unusual aggressiveness and aimless running were recorded. A total of one thousand and forty (n=1040) camel owners/respondents from three groups viz settled, transhumants and nomads were interviewed in Districts, Musa khail and Jhal Magsi during the year 2011. The direct and indirect economic losses according to the prevalence of trypanosomiasis are recognized as mortality, abortions and a camel trypanosomiasis. Furthermore, the current study exhibits that the respondents above the age of 50 years were more experienced in disease diagnosis and use of traditional veterinary practices.

Authors Contribution

Dr. Ihsanullah Kakar and Dr. Sarwar Khan have designed, analysed, and organised the manuscript. While Khalid Khan and Sajjad helped in estimation, data collection and edited of the manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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