

THE ASSOCIATION OF DISEASE WITH ANIMAL PRODUCTION SYSTEMS AND ITS SOCIO-ECONOMIC IMPACT IN DISTRICT THARPARKAR SINDH PAKISTAN

Syed Noman Ali^{1*}, Shahid Ali Khan² Afzal Mohammed³, Shahana Uroj Kazmi⁴ and Jeff Mariner⁵

¹Livestock Department, Government of Sindh Pakistan & Department of Agriculture & Agribusiness Management, University of Karachi, Karachi, Pakistan

²Food and Agriculture Organization of the United Nations, Islamabad- Pakistan (shahid.khan@fao.org)

³Food and Agriculture Organization of the United Nations, Islamabad, Pakistan (muhammadimam.afzal@fao.org)

⁴Department of Microbiology and Immunology, Dadabhoj University (DIHE) & University of Karachi, Pakistan (shahanauroj@yahoo.com)

⁵Cummings School of Veterinary Medicine-Tufts University, North Grafton, MA, USA (jeffrey.Mariner@tufts.edu)

*Corresponding author email: syednomanalivet@gmail.com

ABSTRACT

A participatory epidemiological (PE) study was carried out in the Tharparkar District of Sindh province, Pakistan, which is the only fertile desert in the world. The study was carried out to assess the association of the disease with animal production systems and its socio-economic impact. During participatory rural appraisal activities, sets of semi-structured interviews, visualization techniques, ranking and scoring techniques were applied to collect qualitative and quantitative data. The study revealed that sheep and goat are reared without systemic housing. The average herd size was 30 head with a sheep and goat ratio of 1:2. Women have an important role in sheep and goat husbandry especially for feeding, watering, milking, and management of lambing/ kidding. It was concluded from the study that most low-income landless farmers are involved in sheep and goat raising, which played a significant role in their household economy and provided the main source of income. It was also accomplished that Peste des Petits Ruminants and other prevailing sheep and goat diseases are causing momentous negative impacts on food security and child nutrition with the enduring impacts including delays in marriages, postponement of surgery and other family health interventions as well as disruption of children education.

Keywords: Socio-economic impact, PRA, PE, triangulation, Small Ruminants.

Abbreviations

PE: Participatory Epidemiology, **PRA:** Participatory rural appraisal, **PDS:** Participatory disease surveillance, **TAD:** Trans-boundary animal diseases, **SSI:** Semi-structure interview, **SC:** Seasonal Calendar, **PP:** Proportional piling, **PPMM:** Proportional piling for morbidity & Mortality, **UC:** Union council, **SA:** stock assistant, **VO:** Veterinary officer. **Pak, Rs:** Pakistani rupees, **PPR:** Peste des Petits Ruminants, **CCPP:** Contagious Caprine Pleuropneumonia, **ET:** Entero-toxemia, **FMD:** Foot & Mouth disease.

INTRODUCTION

The study was carried out in the Tharparkar District, which is the only fertile desert in the world. Administratively Tharparkar is divided into seven Taluks namely Mithi, Islamkote, Diplo, Chachro, Dahli, Nagharparkar, and Kaloi. The livelihood of the majority of rural people depends directly or indirectly on animal breeding, especially small ruminants. Sheep and goats are important ruminants offering an additional and in some cases the only source of income to the majority of landless farmers in the arid to the hyper-arid ecology of Tharparkar as found in other rural areas of the country. The involvement of women in this rural household business is the mean of success. Goat dairy products are recommended for their health value for children (Basnet *et al.*, 2010). Cow and goat milk are close in composition, however, raising goat is comparatively easier in the study area due to its dependency on natural vegetation (Mahmood and Usman, 2010). Animal diseases are causing serious socio-economic impacts, which lead to poverty, malnutrition, starvation and human health complications. Deprived veterinary coverage and the pathetic surveillance system in the country, especially in remote areas persuade authorities to clearly identify surveillance objectives and undertake strategic reviews of their animal health surveillance system. This also includes finding an appropriate combination of surveillance activities that best meet these objectives. The integration of Participatory Disease Surveillance into the passive surveillance system can enhance their effectiveness by increasing the number of cases detection for the disease investigation and the timeliness of detection (Ali *et al.*, 2006; Mariner *et al.*, 2011). Participatory epidemiology (PE) is a branch of veterinary epidemiology during which PE practitioner uses their communication skills and participatory methods to

improve the participation of animal owners in the animal disease investigation, control and formulation of appropriate eradication policies. Data obtained from PE methodology can also question traditional disease control methods and norms, nationally and internationally (Ali *et al.*, 2006; Bett *et al.*, 2009; Catley *et al.*, 2012; Singh *et al.*, 2014; Allepuz *et al.*, 2017).

Countless rural poverty alleviation programs were designed and implemented in Tharparkar, unfortunately, failed. The reason behind this failure is the gap between the farmer views regarding their requirements and the understanding of developmental agencies. This study is planned to fill this gap, especially in the small ruminant's production system and the socio-economic effect of diseases.

MATERIALS AND METHODS

Study area: Field study was carried out in the Tharparkar District of Sindh Province of Pakistan. Rural Union councils of Mithi Taluqa were selected. One village is randomly selected in each union council. Every selected village was informed of about the inclusion in the study through local animal husbandry officials.

Interviews: The village visits schedule was finalized with a local facilitator that allowed one village to be visited per day. Within each village, 03 to 04 Semi-structure interviews (SSI) were conducted with a relatively large group, followed by 03 to 04 focus group interviews involving at least 05- 10 people, key people identified from first SSI. Each interview was at least one and a half to two hours conducted by the first author. There was a total of thirty-nine semi-structured interviews conducted in large groups between forty-five to sixty-five persons of a village. Four hundred forty-two members of focus groups were identified on the basis of their relationship with small ruminant business, including the progressive farmer, traders, butchers, local traditional healers and elder of the village. Thirty-four focus group interviews were conducted during the study. At the end of the study, results were triangulated individually with forty-eight key informants, especially from the public and private organization and NGOs. Participatory rural appraisal (PRA) activities were applied for Participatory Epidemiology as earlier described and tested (Ali *et al.*, 2006; Bett *et al.*, 2009; Catley *et al.*, 2012; Singh *et al.*, 2014; Allepuz *et al.*, 2017).

The checklist for the SSI was created and pretested in two villages of the Umerkot District nearby study area on the basis of the following deliverables: Sheep and goat production systems; Husbandry conditions; The estimation of sheep & Goat population; Socio-economic value of sheep & goat; Role of women/men in sheep/goat farming business; Constraints and the possible solution of sheep and goat business in the area; the relative prevalence & importance of common diseases of sheep and goats; Veterinary facilities; awareness regarding animal disease and disease morbidity, and mortality with Socio-economic impact.

Participatory mapping exercise: Villagers were asked to draw the village map showing village boundaries and routes; Houses (Para) of different tribes' in the village with the animal population; Sheep and goat movement route and grazing areas; Water sources such as wells or reservoirs; Agriculture field; Sheep and goat gathering places for drinking water and Public and private facilities like schools, basic health units, etc.

Ranking and scoring techniques:

1. Simple ranking (SR) to rank diseases in ascending order according to their prevalence and importance.
2. Pair-wise-comparison (PWC) during which two items are compared.
3. Proportional piling (PP) for the relative prevalence and importance of diseases affecting sheep & goats.
4. Seasonal calendars (SC) for the occurrence of diseases in respect of seasons.
5. Proportional piling for mortality and morbidity (PPMM).
6. Impact matrix scoring that is the simple matrix score (SMS) and disease impact matrix Score (DIMS).

Data was gathered using PE techniques (Mariner and Paskin, 2000; Ali *et al.*, 2006; Bett *et al.*, 2009; Mariner *et al.*, 2011; Catley *et al.*, 2012; Singh *et al.*, 2014; Allepuz *et al.*, 2017) and triangulated with key informants from the study area including private and public veterinarians. During scoring exercises, 100 beans, were used as a counter. Livestock species were ranked according to number and importance to livelihoods of villagers. During the start of SSI, the list of prevalent diseases and type of livestock in the area were prepared. Participants were asked to rank disease according to a number of times occurred in the last one year as well as priorities small ruminants' disease according to their impact you socio-economically. Similarly, participants were asked to rank their livestock species according to number & value to their livelihood, during a "PP exercise". A high proportion of counters always assigned to a species that was either abundant or important for their livelihoods. The results were probed in detail before finalization.

Proportional piling for Morbidity & Mortality: A total of 100 counters were used to represent the number of goats in the village for counting scores (%age). During “PPMM exercise”, the interviewee was asked to segregate the counters into two piles; one signifies the proportion of goats that became ill in the last year and the other for remain healthy. After probing and finalization of the result, the pile contains a proportion of goat ill as overall morbidity and asked participants again to sub-divide into six piles according to the percentage of animals that got sick from each of the six diseases concluded during SSI. The results were again probed in detail before finalization. In the last step of this exercise, participants once again asked to divide all six piles correspond to the individual disease into the fraction of animals that recovered and died to establish case fatality.

Disease impact matrix scoring (DIMS) was applied to rank diseases of goat correspondent to their impact on livelihoods. The participants were first asked to list their socio-economic benefits derived from animals especially from small ruminants. After the comprehensive list had been gathered, a matrix was drawn on the paper with the prevalent diseases during first SSI. All benefits and diseases concluded during SSI were placed in matrix & interviewees asked to rank each benefit from small ruminants using 100 counters in accordance with the importance of their livelihood. The results were probed in detail. The next step involved ranking diseases impact on each benefit according to the scores given before. Each result was discussed and finalized. The scores given to benefit from each disease were added to calculate the overall impact score for each disease. All results were finalized after probing in detail.

Transect walks in each village for personal observation.

Data management and analysis: There were two types of data obtained from this study that is qualitative and semi-quantitative. Semi-quantitative data were entered into Microsoft Excel analyzed using non-parametric statistical tests while qualitative information was summarized after triangulation.

RESULT

Production systems: Study reveals two types of production systems in the study area:

1. An extensive production system for sheep and goat business with very little inputs available. In rural areas, 95 % sheep and goats are reared extensively on natural vegetation and only 5 % are kept in houses with portable feeding and drinking pots.
2. A Semi-Intensive system in an urban area with the potable managerial arrangement. In Urban areas, Sheep and goat are gathered in one place from different houses in the morning at 08.00 and then taken to natural vegetation about 3 to 4 km outside the city and brought back to their houses at 20.00 at night.

Table 3a. Demographic Data of Study area.

Name of the village	Union council	No. of House Hold**	Human population**	No. Of participants	Ethnicity Community in the village
Mithrio Bhatti	Mithrio Bhatti	380	1617	54	Rajput, Megward, Bheel Koli, Samaj, Kimber and faqir (Jogi)
Haryar	Chelhar	425	2270	55	Rajput, Megward, Bheel Koli, Samajo, Kumber
Dalen jo Tar	Vejhiar	500	2504*	54	Rajput, Megward, Bheel Koli, Samajo, Kumber
Hrothgar	Malanhore veena	250	1394	42	Rajput, Megward, Bheel
Bakuui	Bakuui	300	1855	67	Megward, Dars, Hajam, Lanja
Saghror	Jorvo	105	665*	54	Junejo, Megward & Suthar
Sainiasar	Jorvo	300	1835	8	Junejo, Megward & Suthar
Aho	Moreno	155	1197	38	Megward, Suthar & Rajput

*Data gathered during interviews and rechecked from Government officials.

Demographic Data of Study area: Study revealed that the community in each village of the study area was comprised of different Ethnicity. The highest human population was estimated in Village Dalen jo Tar, which was 2504 and lowest was recorded in village Saghror, which was 665 as presented in (Table 3a).

Livestock population: Table 3b is presenting livestock stock population estimate in the Villages of the study area. The study revealed a high population of sheep and goat around five million with an average herd size of 20 – 45, and the low population of camels in the study area. In some villages due to trading families, the sheep and goat population changes drastically, like in village Saghror Junejo, it is increased from 2100 to 4000 in a week period. These traders were purchased sheep and goat from the surrounding villages and the Chachro livestock market. They kept animals for one or two weeks in their village and then sold at big cities like Hyderabad and Karachi.

Table 3b. Estimated Livestock population of visited villages.

Name of village	Union Council	Av. Herd size	Sheep	Goat	Cattle	Buffalo	Camel	Donkey	Chicken
Haryar	Chelhar	35	4875	10000	9300	935	89	389	1129
Dalen jo Tar	Vejhiar	30	5000	10000	9910	1023	128	446	1201
Hothiar	Malanhore veena	25	2500	2750	1040	900	111	525	1501
Bakuii	Bakuii	22	2800	3800	3004	837	220	610	1700
Saghror	Jorvo	20	300	1800	898	1000	353	1012	1460
Sainiasar	Jorvo	25	2500	5000	1444	1200	350	426	2185
Aho	Mohrano	45	24750	4500	3404	935	295	737	11200

*Data gathered during interviews and rechecked from Government officials.

Animal Feeding: It was concluded that three types of feeding system prevails in the study area and 97% participants raising their animal of natural vegetation (Table 3c).

1. Grazing on natural vegetation: Nature grazing is the common practice in the study area, Bart, Baker, Curi, Moger, Cano, Bagro, Taandi, Satori, Heran Chhaper, Chamber, Satro, Tussin, plants, and trees like Kumbat, Peru, Kandi are the local name of famous natural vegetation were reported from the study area. It is a common saying among the indigenous at Tharparkar that sheep and goat eat twenty-three natural vegetation (herb, shrub & trees) while the camel eats twenty-six types.
2. Grazing on crop leftover: sheep and goat also fed on leftover after crops harvesting during the rainy season. These crops are harvested in the months of September till October and include bajra (Millet), pulses, guar, jawar, (Sorghum) maize and sesame.
3. Grazing & homemade ration: There are some sheep and goat herders who provide cotton seed cake, rice polish, vegetable, fruit waste and wheat bran to milking animals (Does, Ewes,) with natural grazing.

Table 3(c). Animal feeding system.

Total Participants	Animal fed on nature vegetation	Animal fed at a homemade ration
442	430	12

Drinking: The rains play a fundamental role in the life of the people in the study area. They store water in small ponds locally termed as Tobias and Taraies. These are the mere resource of water for animals and human in the majority part of the desert area. The underground water is obtained after dig out a very deep well; which comes out reasonably sour and undrinkable. In the study area, well and Taraie is the common means of drinking water for human as well as the animal. Well is constructed after drilling land up to 100 to 200 feet. Taraie are places built for the collection of rainwater. Each community in the village keeps 1-3 wells in their surroundings. There are also shared wells in a grazing field. Underground water is not fit for drinking. There is also the provision of water supply line from Government in the villages bordering large cities within Tharparkar District like Mithi and Nauwakote and other cities. In some village, water tanker is purchased at Pak, Rupees 4000 -5000/ each for human consumption.

Breeding: Breeding is completely natural, mating takes place after the onset of rain, most probably in June to July and kidding/ lambing is usually once a year in November and December. In a special case, when they have sufficient rainfall and lush green grazing, sheep and goat will give birth twice a year that is May - June, and November - December. Single birth is common but some time twining takes place. The pure breed is almost impossible to find because of uncontrolled breeding in the study area. The male ratio is 1:40-50.

Marketing system of sheep and goat: Three types of marketing systems were found in the study area:

1. Sale, through livestock traders: There were livestock traders, who purchase sheep and goat from herders and send to a nearby market or bring to Karachi and other big cities. For example, in the village of Sangrur, UC Jorvo, out of 105, there are twenty-two sheep and goat trader families. These traders purchase animals from surrounding villages and collect in their village for a 1-2 week and then bring to the Karachi livestock market specially Landhi Cattle Colony. They take 100 animals in one carrier (truck), which charge Pak, Rupees 30,000 to 35,000, for transportation, so it will be Rs. 300 to 350/ head transportation expenses.
2. Direct sale: livestock herders bring their animals themselves to livestock markets (locally called Piri). Nearest markets are in Mithi, Jhudo, Chachro and Islamkote cities. Livestock farmers prefer to sale animals at Piri by themselves so that they will get cash in hand, while traders who purchase their animals in the village get payments within two to three months.
3. Sale, near-religious and culture event: There were some sheep and goat herders, who plan to sell their animal near-religious events like Eid-ul-Adha and cultural events.

Historical pattern and Seasonality: As for the season is concerned, mostly farmers convinced that the seasonal occurrence is continuously changing and there is no fixed a time for the certain season as before. Rainfall has also decreased which results in a scarcity of nutrition resources for animals as well as for a human. There is also agreement that this disease can occur in any season, but mostly outbreaks were recorded last year in late spring and summer (December & March), which is in the correlation to the movement of the animal, the season of lambing and kidding and also to stress due to movement & unavailability of natural feed resources. The traditional calendar used in the study area was presented in the (Figure 3a).

Fig. 3(a). Tradition Calendar used in the study area by respondent.

Tradition month	Poh	Jhag	Phagen	Chat	Chat	Wesak	Jat	Achar	Sawan	Badu	Asu	Katie	Nahri	Katie	Nahri
Gregorian calendar	15 Dec-15 Jan	Jan-Feb	Feb-Mar	Mar-Apr	Ma-Apr	Apr-May	May-Jun	Jun-Jul	Jul-Aug	Aug-Sep	Sep-Oct	Oct-Nov	Nov-Dec	Oct-Nov	Nov-Dec
Season	Summer				Autumn / Moonsoon					Winter			Spring		

*Calendar was designed by local villagers during SSI.

Veterinary facilities in the area: During a discussion with Official from the office of Deputy Director, Livestock and Animal Husbandry, it was concluded that there is a serious shortage of Officers and officials overall in the Tharparkar district. There are only eleven Veterinarians and one hundred twenty-three Stock Assistants in the district. In the study area, there are only three Veterinarians and 23 Stock Assistants (SA). It was also found that there is non-availability of the building in few places, in the study area, local SA is running the Veterinary center in his wooden and mud made one room.

- 3.1.1. Farmer Views: The sheep and goat herders were not satisfied with the Veterinary services, according to them only vaccination is conducted free, but for treatment, they have to pay a large amount of money. They demand free treatment facilities and a regular visit from the public veterinary staff.
- 3.1.2. The researcher also feels that the contemporary technical strength was very feeble because of the work area is challenging and needs more technical manpower with four wheels drive vehicles to approach. Pastoralism is possibly the only feasible production system and access to veterinary services is difficult and sometimes impossible in the desert area likes Tharparkar district.

Movement of animals: Two types of movement were recorded in the study area:

3.1.3. Movement during the normal year: During the normal year, when there is sufficient rain and Tharparkar the desert becomes lush green, movement of sheep/ goat is not significant in the study area, but there is a backward movement of large and small ruminants place from surrounding districts to the Tharparkar district.

3.1.4. Movement during drought year: Two-way movement is common, some communities like Bheel, Kolhi, Sameja, Mangria, Faqier (Jogi) and Kimber move to interior Sindh (Umerkot, Mirpur Khas, Sanghar, Badin, Hala up to Kashmore district) for the search of labor work in rice and wheat field with their families and animals. They usually take all cattle and a few numbers of Sheep & Goat with them. The cause of moving cattle is a scarcity of feed and reason for taking sheep and goat with them is like the mobile ATM machine, whenever they need they can sell and get cash besides that their family utilizes milk from these animals for food during the journey. Only 1% to 2% sheep and goats move from Tharparkar to the irrigated area of Sindh. They started their journey before the harvesting season of the crop and make a comeback with a stock of rice or wheat grain as service charges of their work after spending 2 to 3 months. During a stay in interior Sindh, their animals graze on leftover from rice, wheat, and other crops. After reaching to their home in Tharparkar, they sell half of the stock of grains and save half for their families. It was also concluded that there is a continuous movement of animals, especially sheep and goat for marketing to big cities like Hyderabad and Karachi, etc.

Use of milk from sheep and goats in the area: It was concluded from the study, that there is no custom to sale sheep and goat milk in the study area, 96% of respondents confirmed that sheep and goat milk is utilized as food in shape of raw milk, yogurt, butter and ghee and only 4 % of milk sold at a price of Pak, Rupees. 40-50 / liter as shown in (Table 3d).

Table-3(d): Sheep and goat milk usage.

Milk Utilized at home	Milk Sold
432	10

Role of women and men: In the study area, commonly people live in the Joint family system and the family comprises three generations that are grandparents, parents and children live under one roof. The roles of men and women have generally divided as outside and domestic responsibilities among themselves in accordance with their ages and skills. Men 's duties include plowing of the fields, animal-grazing, house-construction or other money-earning activities, whereas women are responsible for bringing water from the pond, cooking, washing, cleaning, thread-making, and knitting etc. The money earned by everyone is pooled and consider as the common property of the family. Role of women is equally imperative in sheep and goat business. They are involved for watering, milking, and parturition of sheep and goat. They are also involved in feeding at home and also at the grazing area within and around their agricultural land. Women are not directly involved in livestock marketing, but they are certainly part of the marketing decision. A man's role is mainly responsible to look after sheep and goat while grazing around villages. Usually, two people are involved with one herd of 60 -100 animals. In urban UCs, on the rental basis, they charge Pak, Rupees 100 -150 per animal per month.

Farmers' knowledge about diseases: Awareness regarding diseases was very low among the sheep and goat herders. Disease cards showing disease sign were utilized to understand local perception regarding disease condition in animals. Disease reporting is also an issue both at village level as well as Veterinarian level. After probing all diseases, proportional piling exercise was carried out to rank disease according to the prevalence in their village and importance for them.

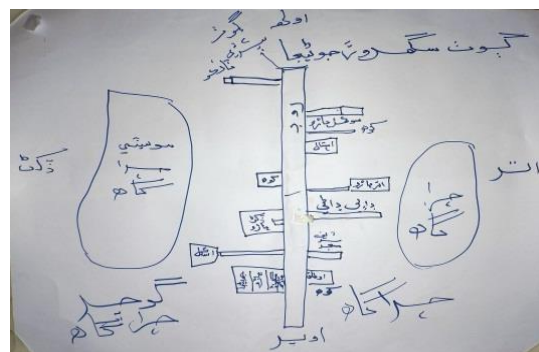
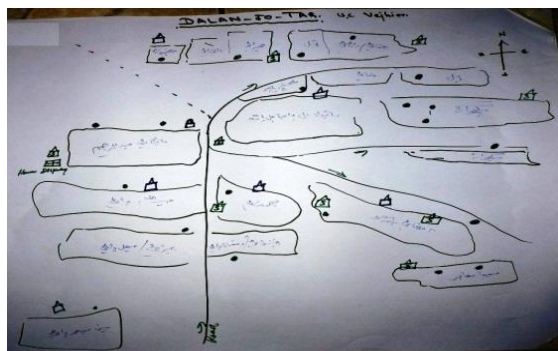


Fig. 3(b). villager prepared maps.

Mapping exercise: Through Mapping exercise, livestock movement within the village, common grazing/drinking places and other epidemiological factors were understood as shown in (Fig. 3b)

Relative Incidence & importance of small ruminant's diseases: The cumulative results of PP exercises in the study area concluded that Pox, PPR, CCPP, ET, FMD, and anthrax were identified by herders as presented in (Fig.3c). Pox and PPR diseases were ranked highest.

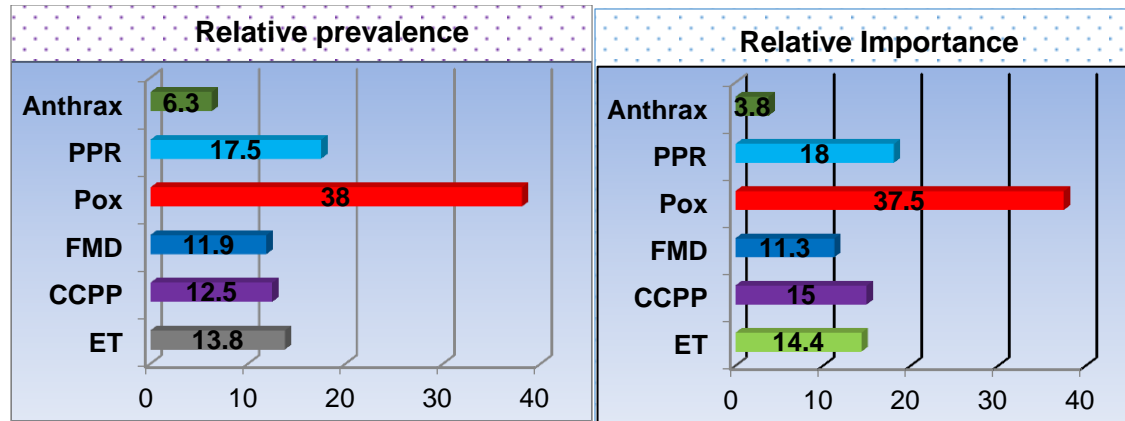


Fig. 3(c). Result of proportional pilling exercise.

*Data were finalized after probing and presented in percentages.

Importance of Livestock species to livelihoods: (Figure 3d) was explained the results from ranking exercise carried out at 68 places in all villages. Small ruminants were found relatively higher in population and also identified as important species for the livelihoods in the study area. The rationales explained for the comparatively higher population of sheep and goats compared to the other livestock species were drought resistance, easily raised on natural vegetation, bred faster and relatively require low investment. The high proportion of interviewees considered poultry keeping as unimportant because of theft and predators that reduced their numbers.

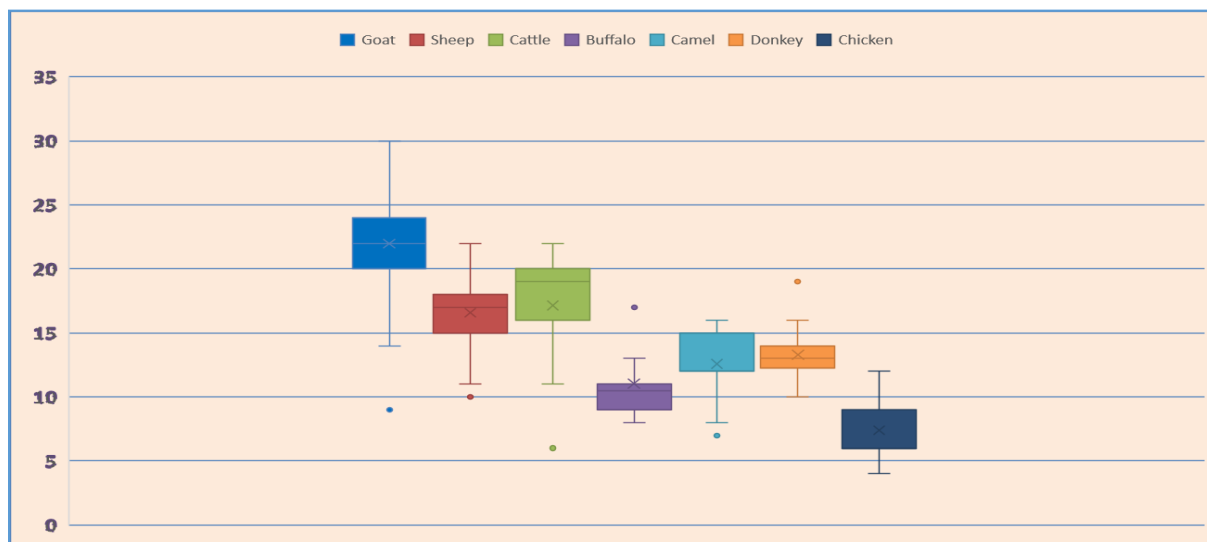


Fig. 3(d). Ranking of livestock species by number and importance to the livelihoods.

*Box plot was calculated in Excel- 2016.

Disease morbidity and mortality: It was concluded that in the study area following diseases are prevalent with variable morbidity and mortality.

4.12.1. **Sheep & goat pox** disease was causing high morbidity. The mortality was reported high in young stock (under six months).

4.12.2. **Foot & Mouth disease** was reported almost 100% in cattle, sheep, and goat, but mortality was notified only in newborn (under four months).

4.12.3. **Enterotoxemia** was also killing sheep and goat in quantity and Morbidity was also reported high.

4.12.4. **Contagious Caprine Pleuropneumonia** and **Pasteurellosis** were also suspected in the study area with variable morbidity and mortality.

4.12.5. **Peste des Petits Ruminants (PPR) disease** was initially not reported by sheep/goat herder. It was found difficult to recognize an outbreak of PPR because of lack of awareness. After describing the sign and symptom of PPR, the majority of sheep and goat herders recognize morbidity and mortality from the disease. It was notified during a meeting with the district staff of the Livestock Sindh Department that in February and March 2013, a confirmed PPR outbreak was recorded in Taluka Mithi. Since then, many outbreaks were reported by the herders.

4.12.6. **Parasitic diseases** were also common, especially in the camel. Both internal and external parasitic problems were prevalent. According to some elders, the cause of Itching in animals was due to allergy from some natural vegetation.

4.12.7. **Abortion cases** were also reported in goats with 02 to 2.5 months of pregnancy. The cause needs to be investigated in depth.

4.12.8. **Anthrax disease** outbreaks were very common 04 to 05 years before. It was communicated that cases were reported after rain every year, (locally season is termed as Waskara) when there is an ample quantity of lush green natural vegetation and crops available.

3.13. Disease impact: The impacts of the diseases were calculated through DIMS exercise as presented in (Table 3e and 3f). It was concluded that prevalent diseases were causing significant negative impacts on the livelihood of sheep and goat herders in the study area:

3.13.1. Production loss: Study reveals that the most direct economic impact of diseases is the loss of or reduced efficiency of production, which reduces family income and directly affect the livelihood of sheep and goat herders' families. There is weight loss, loss of offspring due to high mortality and abortion.

3.13.2. Expenses of treatment: Sheep and Goat herders also come in the circle financial crises, when sometimes, they have to pay the expense for treatment, which is calculated about Pak, Rs. 1500 to 3000 per animal. Sometimes, they do not have money to pay treatment cost and they have to sell another healthy animal.

4.14.3. Prices and market effects: Due to production and physical impacts induced by diseases, there was a disparity in prices. It was concluded that the distress sale price of sheep and goat is 65 % and 75 % lower. The cost of sheep and goat skin will also be reduced 45 and 55 % respectively.

4.14.4. Food Security and Nutrition: It was accomplished from the study that the families of sheep/goat herders depend on 70 to 80 % of their food requirement on animals, especially milk and meat from sheep and goat. Prevailing sheep and goat diseases are causing momentous negative impacts on food security and nutrition in the study area. Children and pregnant women critically affected by sheep and goat disease, especially PPR. They become prone to serious human disease, diseases like Tuberculosis, Hepatitis and other microbial diseases, unfortunately, surveillance and reporting system is weak both in the animal and human health. Herders also reported in abortion cases in human and mortality in newborn babies due to nutritional deficiencies.

4.14.5. Other impacts: Diseases impact is long-lasting, which delays marriages, postpone health issues (treatment and operations) and also disturb ongoing children's education.

Table 3(e). Result from Impact matrix scoring from the last year disease scenario.

Sr.	Livelihood	Rank Important-wise	Sheep / Goat Pox	CCPP	ET	FMD	Parasitic Disease	PPR	Anthrax
1	Food	24	6	4	2	5	1	3	3
2	Health	12	4	1	1	1	1	2	2
3	Education	11	3	1	1	1	1	2	2
4	Social Events	17	3	3	2	1	1	4	3
5	Saving	20	5	3	2	2	1	4	3
6	Dowry	16	4	2	2	1	0	3	4
Overall Impact of disease			25*	14	10	11	5	18*	17

*Pox and PPR were showing the high impact on their live hood benefits

**Data gathered during interviews and finalized after probing.

Table 3(f). Current Price of animal and animal products in the study area.

<i>Name of Product</i>	<i>Price (Rs)</i>	<i>Name of Product</i>	<i>Price (Rs)</i>
Live animal goat	8000-12000 each	Distress sale due to disease (Goat)*	3000-4000 each
Live animal Sheep	7000-10000 each	Distress sale due to disease (Sheep)*	1500-3000 each
Mutton	400-450/Kg	Skin (Goat)	200-250 each
Goat/Sheep milk	40 -50/Liter	Skin (Sheep)	150-200 each
Wool	100-125/Kg	Skin damage due to disease*	70-90 each

*Disease impact.

**Data gathered during interviews and finalized after probing.

DISCUSSION

This study identified the association of the disease with animal production systems and its socio-economic impact in district Tharparkar Sindh. Data obtained from the series of Participatory exercises with sundry informer groups and triangulated to conclude information. This data is mostly qualitative or subjective that can be evaluated using non-parametric statistical methods. The semi-structured interview allows interviewees to express their information independently and also priorities through scoring techniques. The use of the open-ended question also reduces related bias. During timeline exercise, the interviewees were asked to relate key social, traditional, religious events or natural disaster as indicators with outbreaks of diseases. Although findings from the current study are similar to other studies carried out with the same methodology (Mariner and Paskin, 2000; Mariner *et al.*, 2011), as far as the study area is concerned, this is the first comprehensive report.

It was concluded from the study that mostly subsistence farmers were engaged in the sheep and goat business in the study area and these species play a noteworthy role in their livelihood. Both sheep and goats are kept by low-income landless villagers and provide the main source of income (Qureshi *et al.*, 2004). The major areas known for small ruminant production are mountainous, semi-mountainous and arid lands, where cash crops and large ruminant production are not viable. In those areas, the small ruminants raising is the only option and the number of sheep and goat kept by the farmers is the indicator of their social status (Qureshi *et al.*, 2004). The rationales explained for the comparatively higher population of sheep and goats compared to the other livestock species in the study area were drought resistance, easily raised on natural vegetation, bred faster and relatively require low investment (Ahmad *et al.*, 2016; Qureshi *et al.*, 2004). The high proportion of interviewees considered poultry keeping as unimportant because of theft and predators that reduced their numbers (Papachristoforou, 2006). The primary bases of raising sheep and goats are food for the families and to produce stock meat (Farooq *et al.*, 2009; Di Cesare *et al.*, 2015; Qureshi *et al.*, 2004). The current Study was revealed two types of production systems for sheep and goat business that is the extensive production system with very little inputs in rural areas and semi-extensive in urban areas, which is also reported by other researchers (Ahmad *et al.*, 2016). The roles of the men and women in a production system are generally divided as outside work and domestic responsibilities among themselves in accordance with their ages and skills, same as reported by others (Sinn *et al.*, 1999). Three types of feeding system were concluded in the study area and 97% participants raising their animal of natural vegetation due to a shortage of feed already reported in desert areas of other provinces (Ahmad *et al.*, 2016; Ishaque, 1993). It was also notified that the contemporary technical strength is very feeble because of the challengeable working area and need to be strengthened the technical manpower with appropriate mobility. Pastoralism is possibly the only feasible production system and access to veterinary services is difficult and sometimes impossible in desert areas of the district, like in the Tharparkar district. Veterinary services can be strengthened through preparing community-based animal health workers (Mariner *et al.*, 2011). It was concluded from the study that nutritional requirements of almost 100 % sheep and goat herder's families depend on livestock, including cattle, camel, sheep, and goat. Goat milk is preferred for its nutritional value for babies (Basnet *et al.*, 2010) and was the only source of milk for poorer subsistence families who only raised small ruminant (Ahmad *et al.*, 2016).

The disease reporting and surveillance network is weak in the Sindh province. It is quite possible that many PPR outbreaks were not attended or reported. The other factor of less reporting of PPR cases is lack of awareness not only among the farmer but also Veterinarian and Para-vets. To counter this issue Participatory Disease Surveillance techniques were employed in the study area. Nevertheless, the importance of PDS is confirmed for the collection of first-hand data for early detection, reporting, and finally, control of PPR infection as already proved for Rinderpest Eradication Campaign (Ndahi *et al.*, 2012; Wachida *et al.*, 2017; Ali *et al.*, 2006). The relative prevalence and importance of sheep and goat diseases were estimated in Sindh Province during the year 2016. The

cumulative result of PP exercises concluded that Pox, PPR, CCPP, ET, FMD, and anthrax diseases were identified. Pox and PPR diseases were reported as the most prevalent diseases in the study. The almost same results were reported from the other part of the world (Garner *et al.*, 2000). Higher overall incidence 26.1% of PPR disease was also reported in Egypt (El-Rahim *et al.*, 2010). The incidence of pox disease was observed in the present study same as previous reports (Selvaraju, 2014). PPR disease was found endemic in the study area, which is in agreement with the findings of the earlier studies in the area (Abubakar *et al.*, 2011; Nizamani *et al.*, 2015). According to some elders, the cause of Itching in animals was due to allergy from some natural vegetation, which was also confirmed from another part of the country (Farooq, 2008).

The results from the disease impact study were tallies the fining of other researchers. (Bett *et al.*, 2009) (Mariner and Paskin, 2000). There is the significant negative impact of prevalent sheep and goat diseases on the livelihood of sheep and goat herders in the study area. It is accomplished from the study that families of sheep and goat herders depend on 70 to 80 % of their food requirement on animals, especially milk and meat from sheep and goat (Dossa *et al.*, 2008). Prevailing sheep and goat diseases are causing momentous negative impacts on food security and nutrition in the study area same as reported by (Peacock, 2005). Children and pregnant women critically affected by sheep and goat disease, especially PPR. They become prone to serious human disease, diseases like Tuberculosis, Hepatitis and other microbial diseases, unfortunately, surveillance and reporting system is weak both in the animal and human health. Herders also reported in abortion cases in human and mortality in newborn babies due to nutritional deficiencies (Chatterjee *et al.*, 1989). The impact of clinical and subclinical disease on production efficiency subsidies economic returns, which is a greater loss than mortality. There are many unidentified expenses, which usually ignored like the treatment cost, the reduction of production efficiency and inferior carcass quality, are the added significance economic losses. It was also revealed in the present study, that these diseases are causing economic impacts on the household in different aspects, such as savings loss, the effect on family nutrition, education and health (Ashfaq *et al.*, 2015).

Conclusion

It was concluded from the study that most low-income landless farmers are involved in sheep and goat raising, which plays a significant role in their household economy and as well as provides the main source of income. It was also deduced that PPR and other prevailing sheep and goat diseases are causing momentous negative impacts on food security and child nutrition in the study area. These diseases have enduring impacts on the lives of sheep and goat herders including delays in marriages, postponement of family health interventions (e.g., treatment and surgical operations) and also disruption of children's education.

REFERENCES

- Abubakar, M., M. Javed Arshed, M. Hussain and Q. Ali (2011). Evidence of Peste des petits ruminants in serology of sheep and goats from Sindh, Pakistan. *Transboundary and emerging diseases*, 58(2): 152-156.
- Ahmad, T, k. Ishaq M. Fiaz R. Parveen and A. Safdar (2016). Small Ruminant Production Systems: Status and Prospectus for Improvement in Potohar Region of Pakistan. *Pakistan Journal of Science*, 68.
- Ali, S., M. Asif, A. Rehman, L. Jat, Q. Ali and M. Hussain (2006). Participatory surveillance of livestock diseases in district Karachi–Pakistan. *International Journal of Agriculture and Biology*, 8: 652-656.
- Allepuz, A., K. de Balogh, R. Aguanno, M. Heilmann and D. Beltran-Alcrudo (2017). Review of Participatory Epidemiology Practices in Animal Health (1980-2015) and Future Practice Directions. *PLoS ONE*, 12(1): e0169198.
- Ashfaq, M., A. Razzaq and S. Hassan (2015). Factors affecting the economic losses due to livestock diseases: a case study of district Faisalabad. *Pakistan journal of agricultural sciences*, 52.
- Basnet, S., M. Schneider, A. Gazit, G. Mander and A. Doctor (2010). Fresh goat's milk for infants: myths and realities—A review. *Pediatrics* 125(4): e973-e977.
- Bett, B., C. Jost, R. Allport and J. Mariner (2009). Using participatory epidemiological techniques to estimate the relative incidence and impact on livelihoods of livestock diseases amongst nomadic pastoralists in Turkana South District, Kenya. *Preventive veterinary medicine*, 90: 194–203.
- Catley, A., R.G. Alders and J.L.N. Wood (2012). Participatory epidemiology: approaches, methods, experiences. *Vet J.* 191: 151–160.
- Chatterjee, M. and J. Lambert (1989). Women and nutrition: reflections from India and Pakistan. *Food and nutrition bulletin*, 11(4): 13-28.

- Di Cesare, M., Bhatti, Z., Soofi, S.B., Fortunato, L., Ezzati, M. and Bhutta, Z.A., 2015. Geographical and socioeconomic inequalities in women and children's nutritional status in Pakistan in 2011: an analysis of data from a nationally representative survey. *The Lancet Global Health*, 3(4): .e229-e239.
- Dossa, L. H., B. Rischkowsky, R. Birner and C. Wollny (2008). Socio-economic determinants of keeping goats and sheep by rural people in southern Benin. *Agriculture and human values*, 25(4): 581.
- El-Rahim, Abd, and Sharawi IH. "EM, 2010. An outbreak of peste des petits ruminants in migratory flocks of sheep and goats in Egypt in 2006." *Rev. Sci. Tech* 29.3: 655-662.
- Farooq, U., M. Ahmad and I. Saeed (2009). Enhancing livestock productivity in the desert ecologies of Pakistan: setting the development priorities. *The Pakistan Development Review*. pp.795–820.
- Farooq, Z., Z. Iqbal, S. Mushtaq, G. Muhammad, M. Z. Iqbal and M. Arshad (2008). Ethnoveterinary practices for the treatment of parasitic diseases in livestock in Cholistan desert (Pakistan). *Journal of Ethnopharmacology*, 118(2): 213-219.
- Garner, M., S. Sawarkar, E. Brett, J. Edwards, V. Kulkarni, D. Boyle and S. Singh (2000). The extent and impact of sheep pox and goat pox in the state of Maharashtra, India. *Tropical animal health and production*, 32(4): 205-223.
- Ishaque, S. M. (1993). Sheep management system. In: J. B. Mackintosh (Ed.) *Sheep production in Pakistan*. Pakistan Agricultural Research Council, Islamabad, Pakistan.
- Mahmood, A., and S. Usman (2010). A comparative study on the physicochemical parameters of milk samples collected from buffalo, cow, goat and sheep of Gujrat, Pakistan. *Pak. J. Nutr.*, 9(12): 1192-1197.
- Mariner, J.C., S. Hendrickx, D.U. Pfeiffer, S. Costard, L. Knopf, S. Okuth, D. Chibeu, J. Parmley, M. Musenero, C. Pisang, J. Zingeser, B.A. Jones, S.N. Ali, B. Bett, M. McLaws, F. Unger, A. Araba, P. Mehta & C.C. Jost (2011). Integration of participatory approaches into surveillance systems. *Rev. Sci. tech. Off. int. Epiz.*, 30 (3), 653-659.
- Mariner, J. and R. Paskin (2000). Manual on participatory epidemiology—method for the collection of action-oriented epidemiological intelligence, FAO animal health manual no. 10. Rome: Food and Agriculture Organization of the United Nation.
- Ndahi, Mwapu Dika, et al. (2012). "Detection of transboundary animal diseases using participatory disease surveillance in Plateau state, Nigeria." *World Rur. Observ* 4: 70-77.
- Nizamani, A., Z. Nizamani, A. Umrani, P. Dewani, M. Vandiar, J. Gandahi and N. Soomro (2015). Prevalence of peste des petits ruminants virus antibodies in small ruminants in Sindh, Pakistan. *The Journal of Animal and Plant Sciences* 25(6): 1515-1519.
- Papachristoforou, C. and M. Markou (2006). Overview of the economic and social importance of the livestock sector in Cyprus with particular reference to sheep and goats. *Small ruminant research* 62(3):193-199.
- Peacock, C. (2005). Goats—A pathway out of poverty. *Small Ruminant Research*, 60(1): 179-186.
- Qureshi, A. S. and M. Akhtar (2004). *Analysis of drought-coping strategies in Baluchistan and Sindh provinces of Pakistan*, IWMI.
- Selvaraju G. (2014). Epidemiological measures of disease frequency against sheep pox. *Int J Scientific Res* 3: 461-462.
- Singh, B., D. Bardhan, M.R. Verma, S. Prasad and D.K. Sinha (2014). Estimation of economic losses due to Peste des petits ruminants in small ruminants in India. *Veterinary World*, 7(4):194–9.
- Sinn, R., J. Ketzis and T. Chen (1999). The role of woman in the sheep and goat sector. *Small Ruminant Research*, 34(3): 259-269.
- Wachida, Nduhari, Terzungwe Tughgba, and Paul Hambesha (2017). "Participatory disease surveillance of transboundary animal diseases in Gboko, Konshisha and Katsina Ala Local Government areas of Benue State, Nigeria." *Epidemiology Reports* 5: 1.

(Accepted for publication March 2018)