



Review Article

Status of Livestock and Poultry Diseases in A & N Islands: Strategies to Make Island Disease Free

Jai Sunder

Division of Animal Science,
Central Island Agricultural Research Institute, Port Blair, A & N Islands, India- 744 101
*Corresponding author: jaisunder@rediffmail.com

ARTICLE HISTORY

Received: 2013-11-04
Revised: 2014-05-08
Accepted: 2014-05-09

Key Words: A & N Islands,
Livestock, Poultry, Incidence,
Prevalence, Diseases

ABSTRACT

The A & N Islands witnessed a tragic incidence of major earthquake followed by tsunami in the year 2004 due to which the loss of livestock was recorded as poultry (19.35%), cattle (10.3%), goat (37.75%) and pig (83.55%). The pre-tsunami disease trend indicated that the livestock and poultry of these Islands are generally free from most of the dreaded diseases of livestock which are prevalent in mainland, India. However, the incidence and prevalence of parasitic diseases are very high due to the high humidity and rainfall which favor the prevalence of parasitic diseases. The post-tsunami disease trends of the livestock and poultry indicated the outbreak of some of the diseases which were never reported from the Islands earlier. The diseases were introduced probably due to the entry of livestock, meat, meat products, egg, and poultry from mainland. The present paper describes the trend of livestock and poultry diseases in Andaman & Nicobar Islands during the pre-tsunami and post-tsunami period. A systematic survey based on the active and passive surveillance on livestock and poultry diseases in all the inhabited Islands was conducted to prepare Island wise prevalence of disease map. The study showed that parasitic diseases are most prevalent in livestock along with some of the zoonotic diseases like leptospirosis and brucellosis. The cases of infertility, repeat breeding, anestrus have also been reported mainly from the cross bred cows. Moreover, study on the mineral profile of soil, water, fodder and in blood profile suggested the deficiency of micro and macro mineral such as Ca: P imbalance in blood, deficiency of Cu, Zn, Co and others.

All copyrights reserved to Nexus® academic publishers

ARTICLE CITATION: Sunder J. (2014). Status of livestock and poultry diseases in A & N Islands: strategies to make island disease free Adv. Anim. Vet. Sci. 2 (4S): 42 – 47.

INTRODUCTION

The Andaman and Nicobar group of Islands are blessed with one of the unique and diversified ecosystem of the world. Being away from the mainland and population pressure, the area is still maintaining almost pollution free virgin environment, harboring pure and rich germplasm resources. It is situated in the Southern part of the Bay of Bengal between 92°12' E and 93°57' E longitude and between 6° 45'N and 13° 41'N latitude with 10°N channel separating Andaman group of Island from Nicobar group of Islands. It is a group of 572 Islands, Islets and rocks covering a geographical area of 8293 km² and a population of 3.80 lakhs. The average annual rainfall is 3070 mm spread over May to December. The mean temperature (24.3°-30.5°C), relative humidity (82.5%) and wind speed (5.8 km/h) is almost remaining same throughout the year. The Islands exclusive economic zone and the coast length are 1/3rd and 1/4th of India, respectively.

Animal Husbandry in A&N Islands

The island agriculture and animal husbandry activities are barely 150 years old. Till late 18th century Islands were inhabited by only native tribal and the major food animals

were pigs and birds. With the settlement of penal colony by Britishers, livestock farming came in existence to meet out the demand of meat and milk. The existence of Animal Husbandry is traced back to 1947 and became independent functioning for the first time in 1952. The farming system of the island by default is organic and the animal husbandry is practiced in integration with agriculture. The livestock sector under the Islands ecosystem enjoys the benefit of disease free status being isolated from the mainland, India. But this isolation, topography, forest reserve, transportation difficulties, natural disasters, reducing land mass, high import cost significantly hampers the progress of the livestock sector in these Islands. (Kundu et al., 2010)

The diversity of livestock genetic resources is very wide, both in variety and variability in terms of species, breeds, populations and unique genotypes. Main livestock in these Islands are cattle (45617), buffalo (7850), goat (64602), pig (35401), poultry (1080022), a few elephants and rabbits also (Table 1). Out of 36 inhabited Islands, 12 Islands have no livestock what so ever and another 4 Islands have a population less than 200 numbers. The North, South and Middle Andaman have major chunk of livestock in

Andaman group of Islands and Car Nicobar, Katchal are the centers having more concentration of livestock in Nicobar group of Islands. At the same time cattle, buffalo and goat are the predominant livestock species in Andaman group of Islands whereas pig and goat are dominant in Nicobar Islands. This distribution clearly points out the food habits of people in the two regions (Kundu et al., 2010)

Pre-Tsunami Status of diseases

The livestock and poultry of these Islands in general were free from most of the dreaded diseases which are prevalent in mainland India viz. Black Quarter, Rinder Pest, Hemorrhagic Septicaemia, Rabies, contagious Bovine Pleuropneumonia etc (Rai et al., 1992, Sunder et al., 2005). Except for three incidences of Foot and Mouth diseases (FMD) outbreak in 1985, 1989 and 2005 and three incidence of Swine fever outbreak in 1967, 1987 and 2000, no other outbreak of infectious or contagious disease has been reported so far in livestock of this territory (Sunder et al., 2005) . The diseases were introduced long back, probably at the time of settlement when the settlers brought the animals from mainland. Over the years due to entry of livestock, meat, meat products, egg, poultry from mainland the diseases like Chronic Respiratory disease, Infectious Bursal disease, Ranikhet disease in poultry have spread to this Islands.

Systematic studies on island wise prevalence of livestock and poultry diseases has been carried out and based on the active and passive surveillance, Island wise prevalence of disease map has been prepared.

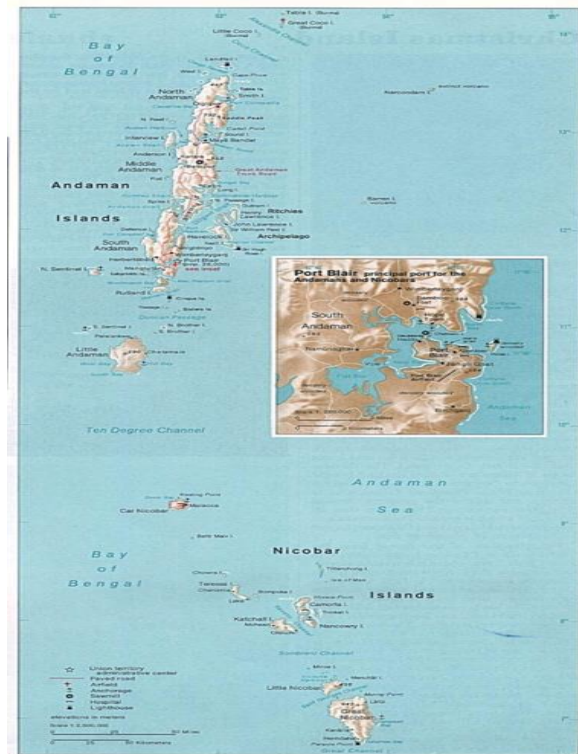
Table 1: Diseases prevalent in A & N Islands

Species	Prevalent disease	Not prevalent/reported
Cattle & Buffalo	Brucellosis, Infectious Bovine Rhinotracheitis (IBR), Bovine ephemeral fever, Leptospirosis, Mastitis, Stephanofilariasis (Hump Sore), Fascioliasis, Amphistomiasis, Schistosomiasis, Trichuris, Strongylosis, Coccidiosis, Pox, Foot and Mouth disease.	Haemorrhagic Septicaemia (HS), Black Quarter (BQ), Contagious Bovine Pleuropneumonia (CBPP), Rinder Pest, Anthrax, Bovine viral diarrhoea
Goat	Leptospirosis, Brucellosis, CCPP, Contagious ecthyma (orf), Coccidiosis, tetanus, parasitic infestation, enterotoxaemia, pox	Blue tongue
Pig	Swine fever	
Poultry	Ranikhet disease, Infectious bursal disease (IBD), Infectious laryngotracheitis (ILT), Infectious bronchitis (IB), Infectious coryza, Chronic respiratory disease (CRD), Salmonellosis (Bacillary white diarrhea), Colibacillosis, Coccidiosis, parasitic infestation.	Avian Flu

Cattle

The climatic condition of the Islands, high rainfall and high humidity favors the prevalence of parasitic and gastrointestinal parasitic diseases in cattle (Pal et al., 1987). The study revealed that the hump sore (Stephanofilariasis) is one of the most prevalent disease in cattle and buffalo caused by a filarial worm known as “*Stephanofilaria assamensis*”. The disease is endemic to these Islands and transmitted through house fly (*Musca domesticans*). Probably this disease has reached these Islands from mainland (West Bengal) and gradually spread in other Islands due to the lack of strict quarantine facilities. The prevalence of hump sore was 60% in the Islands which were brought down to less than 10% by effective treatment and control strategies. (Rai et al., 2010).

The incidence of ascariasis, strongylosis, taeniasis, trichuris and schistosomiasis were also reported in the



cattle. The overall prevalence of parasitic disease such as Strongylosis, Fascioliasis and Amphistomiasis has been found to be 23%, 10.5% and 24.5% respectively. Survey results indicated mostly parasitic diseases as major disease associated with livestock of these Islands (Jeyakumar et al., 2009).

The sero epidemiology of the cattle sera indicated the prevalence of Infectious bovine rhinotracheitis (IBR) which was highest in Rangat Tehsil (41.84%) but a few clinical cases were observed from these Islands and the sero prevalence of Brucellosis was also found to be highest in Rangat Tehsil (44.89%). The overall sero prevalence of IBR was found to be 20.58% and of Brucellosis was 12.84% (Sunder et al., 2005). Car Nicobar Tehsil was observed to be free from Brucellosis and in Nancowry Tehsil only 3.88% sero positivity of Brucellosis was observed. The overall percentage of Leptospirosis from the screened areas

was found to be 5.75%. The seroprevalence of *L. grippotyphosa*, *L. hardzo*, *L. icteohaemorrhagiae*, *L. pomonawere* reported from the cattle. (Jeyakumar et al., 2002, Sunder et al., 2005, Varma et al., 2000, 2001). The incidence of mastitis was high in crossbred cattle caused by mainly *Staphylococcus*, *Streptococcus*, *Coliform*, *Corynebacterium*, yeast and fungal pathogens. The incidence of bovine ephemeral fever was also observed in the cattle (Kundu et al., 2010)

The cases of infertility, repeat breeding, anoestrous have also been reported mainly from the cross bred cows. The majority of the cattle showing reproductive problems are anoestrous (48.6%), repeat breeder (33.38%), infectious cause such as Brucellosis and IBR (6%) and other causes viz. underdeveloped genitalia, failure of insemination etc (2%). The majorities of the cattle are affected with anoestrous and repeat breeding problem. The study on the mineral profile of soil, water, fodder and in blood profile suggested the deficiency of micro and macro mineral such as Ca: P imbalance in blood, deficiency of Cu, Zn, Co, etc. (Sunder et al., 2007c). The sera sample analysis of the cattle representing the each village suggests that the level of Mg, Na, K and Ca was found lower than normal value. The blood P level was also found low in some of the animals. Except the level of Mn, all the micro and macro minerals level was lower in nonlactating cows than in lactating cows. The level of Mn was high in nonlactating cows. The overall serum concentration of Ca (133 ppm) was lower when compared to the normal level. The level of P was also found to be lower in the infertility affected animals. Based on the preliminary findings the infertility affected cattle was selected and blood sera were analyzed for Ca: P ratio. The Ca: P ratio in the infertility affected cattle was found to be variable. The difference in Ca:P ratio also reported by Nemut-U-llah et al (1983) for non cyclic and repeat breeder. They also reported that ratio of Ca: P has adverse effect on infertility. These results are in agreement to the work of Luca et al., 1976 that Ca: P ratio close to 2:1 was required for high fertility of cattle.

Goat:

The disease pattern in the goat indicated the sero prevalence of *Brucella melitensis* (11.96 %), *Mycoplasma capri* (15.7%) and *Leptospirosis* (16.42%). The seroprevalence of *Leptospirosis* was 20.31% at Diglipur and 13.92% at Port Blair. The seroprevalence of *Mycoplasma Capri* was highest (50.63%) at Port Blair followed by Mayabunder (17.42%). The other diseases like pox virus, contagious ecthyma (orf), enterotoxaemia and gastrointestinal parasitism was also observed (Sunder et al., 2005).

Pig

The pigs are mainly susceptible to swine fever. So far three outbreaks of swine fever have been reported from these Islands. The Nicobar pigs which are mainly available in the Nicobar groups of Islands are susceptible to this disease. The sero prevalence of swine fever was 41.75%, of which Lapathy in Car-Nicobar showed highest Sero-prevalence of 21.87% followed by Diglipur (18.75%), Nancowry (14.28%) & Thamaloo (Car-Nicobar, 3.13%). The incidences of ascariasis, tape worm infestation and nutritional deficiency in the pigs have been reported (Sunder et al., 2005).

Poultry

In poultry, the incidence of Infectious bursal disease (IBD), Chronic respiratory disease (CRD), infectious bronchitis (IB) were reported mainly from the commercial birds. Ranikhet disease is prevalent in desi birds, but regular vaccination against this disease has reduced the incidence of outbreak (Sunder et al., 2007 a & d). The other diseases of poultry viz. Salmonellosis, colibacillosis, coccidiosis, lymphoid leucosis etc, has also been observed in high line chicks and desi birds. With the effective management and treatment of disease problems, the mortality amongst the birds is very less. It was found that sero prevalence of *Salmonella pullorum* was 62.19% and *Mycoplasma gallisepticum* was 13.57% in A & N Islands. The serum samples from Nancowry Tehsil showed 79.52% sero positivity for IBD (Sunder et al., 2004).

Apart from the bacterial and viral diseases the incidence of coccidiosis is very high in the backyard poultry. The Infectious coryza and infectious laryngotracheitis (ILT) was also reported from the commercial and indigenuous birds. The incidence of parasitic infestation was also observed high in the backyard rural farming and desi birds. (Rai et al., 1996, Deorani & Rao, 1989, Agarwal et al., 2003, Jeyakumar et al., 2009) The eye infections in the birds are reported to be high and for the first time the causative agent i.e. *Oxyspirura mansoni* has been isolated from the birds affected with the eye infection (Jeyakumar et al., 2011). The nutritional deficiencies due to vitamins, minerals have also been reported from the backyard poultry.

Post tsunami disease scenario:

As before the 26th December the livestock of these Islands was considered to be almost free from deadly diseases but after the Tsunami due to the major climatic changes and entry of fodder and feed resources from mainland the livestock of these Islands became prone to some new diseases. Due to the major earthquake and tsunami devastation the loss of livestock was recorded as poultry (19.35%), and cattle (10.3%), goat (37.75%) and pig (83.55%).

An outbreak of Foot and Mouth disease (FMD) in cattle, goat and pig was reported just after the episode of tsunami. Although the clinical symptoms of FMD were observed from the cattle but mortality in the adult was only 2-3%, however the morbidity was very high (90-100%). The FMD was confirmed by c-ELISA as type O and as an immediate action vaccination of all the animals were advised and quarantine of the animals were strictly followed. (Sunder et al., 2008)

In poultry eye infection was reported. The clinical signs observed were eye discharge in both the eyes, swollen head, and on later stage complete closure of the eyelids and finally death. The isolation and identification of the organisms revealed *Haemophilus*, *Staphylococcus* and *E.coli*.

The sero prevalence result revealed the presence of 55.4% salmonellosis, 69.56% infectious bronchitis and 38% infectious bursal disease in poultry and 18% brucellosis in cattle. The disease pattern post Tsunami indicated that the prevalence of brucellosis, leptospirosis, IBR still persist in the livestock of this Islands (Sunder et al., 2010), however the incidence of FMD outbreak was

recorded just after the tsunami devastation (Sunder et al., 2011).

Infertility problem in dairy Cattle:

Due to post FMD outbreak complication the problem of infertility was found to be increased in the dairy animals. The study conducted in different parts of these Islands revealed that a total of 31.62% of the surveyed cattle showed reproductive failure or infertility problems. The infertility in dairy cattle was mainly due to the anestrus (48.6%) followed by repeat breeder (33.38%), brucellosis & infectious bovine rhinotracheitis (6%), insemination failure (2%) and few cases of underdeveloped genitalia. (Sunder et al., 2007c).

The case of infertility was found to be restricted to some pockets of these villages viz. Indira nagar, Guptapara, Manjery village where almost 52.63% of cattle showed the cases of infertility. The same trend was observed in other villages like New Bimblitan, and some parts of Calicut. The results of the nutrient profile showed that infertility in this area may be due to low availability of nutrients in the soil and fodder. The Ca:P ratio was also found to be lower which suggested the cause of infertility. The level of some of the micronutrient like Co, Cu, Zn were also found to be lower. Thus it was concluded that the cause of infertility may be related to deficiency of some of the micro and macronutrient (Sunder et al., 2007 c&d)

Strategies for disease control

SWOT analysis for making the island disease free

The approach to control of a specific disease is dependent upon an understanding of its epidemiology. The control of infectious diseases is usually more difficult than non infectious diseases. An obvious disadvantage of control over eradication as a goal is that a continuing and essentially undiminished effort is required. However, in many instances control is the only scientifically realistic or economically feasible goal. In others, control may be the forerunner to an eventual disease eradication program.

Strength

The Islands as such are free from most of the dreaded diseases of livestock and poultry which are listed in the OIE list of diseases like Black Quarter, CBPP, Haemorrhagic Septicaemia, Avian Flu, Rinder Pest etc. The geographical separation of this Island from mainland prevents the trans-boundary entry of most of the pathogens. In case of any outbreak of the disease, the same can easily be contained and controlled in a particular Islands/zone without being spread to other parts of the Islands. As there is only two route i.e. air and sea, therefore the strict surveillance and quarantine of any diseases can be done on regular basis. The population of the livestock is less so all the population can easily be covered under mass vaccination programme against important diseases.

Weakness:

The high rainfall, high humidity favours the growth of pathogens mainly the parasitic diseases. Hence, the incidence and prevalence of parasitic diseases are more in the Islands. Although most of the diseases which are listed in OIE are not prevalent or not recorded but there are several diseases which poses a threat to livestock and

poultry population. Due to transportation problem between mainland and inter Islands the survey of livestock is always been a major problem. The prompt disease diagnosis facility is lacking owing to the resources, accurate status of diseases and their etiological variation, relevant epidemiological data for major diseases, nonavailability of standard diagnostic materials etc. Whenever there is any outbreak, the disease takes its full toll before the diagnosis and remedial measures are arranged.

Opportunity:

The population of livestock and poultry is very small therefore the entire population can be covered under mass vaccination programme and strict surveillance and monitoring of the diseases can be possible. The health status of the individual animals can be done by developing health report card system so that the productivity of the animals could be enhanced by effective diagnosis and preventive health care. The Islands wise health records and disease status will help in preventive and control measures of the diseases. The Islands can easily be made into disease free zone/ Islands by regular health camp/surveillance and preventive steps against the major livestock and poultry diseases which are prevalent in these Islands.

For better health package of practices the livestock can be numbered or tagged for effective vaccination and treatment, so that farmers can keep record of their animal disease history. In this way the proper diagnosis and control measures may be adopted. The state disease diagnosis facility can be created for routine surveillance and monitoring of the diseases especially the diseases which are of zoonotic importance like TB, Leptospira, Brucellosis etc.

The study of serosurveillance and epidemiology of the diseases will help in planning effective control strategies. So the will provide sufficient diagnostic material which can be used for periodic surveillance and monitoring and forecasting of the diseases.

Threat:

The Islands so far is free from the incidence of avian flu, swine flu, bovine viral diarrhoea and some of the exotic diseases of livestock and poultry but the close proximity of this Islands to the Eastern neighbour countries such as Thailand, Myanmar, Indonesia may pose a serious threat to the livestock and poultry of these Islands. Due to increase in tourist inflow, trade, market, business from mainland and lack of quarantine practices, etc there is always a threat of emerging diseases to the livestock and poultry of these Islands.

Over the last few years the trend of the disease indicated that the incidences of some emerging and exotic diseases have been reported. The outbreak of FMD after the Tsunami and regular outbreak of IBD and RD in poultry requires special attention. Therefore, screening for emerging and reemerging diseases should be done on priority.

Some of the diseases like leptospirosis, brucellosis, TB etc prevalent in the Islands is also poses a threat to the human population as these diseases are transmitted to human and causes serious consequences. Therefore, monitoring and surveillance of the zoonotic importance

diseases should be taken up. Special attention is also required on the issue of quarantine of the animals from the import of the livestock from the mainland India to Island and *vice-versa*.

Methods of disease control

Quarantine: Sick animals are physically separated from healthy ones, and restraints are placed on the movements of infected and exposed animals.

Selective slaughter: Infected animals are detected during mass surveys and separated from the population and allowed to premature slaughter.

Mass immunization: Its advantages as a method of disease control include its long lasting effects and the ability of immunized animals to move about freely. Last outbreak of Swine Fever was recorded in the year of 2000 in Nicobar group of Islands. But due to the initiation of mass vaccination programme carried out with the help of Dept. of AH&VS the disease is now under control. Under the FMDCP mass immunization of the livestock is being undertaken by the DAH&VS.

Mass treatment: This is carried out as a blanket control measure when there is high prevalence of parasitic diseases. The hump sore disease is being controlled by distributing the ointment developed, to farmers and the control of other parasitic diseases by routine deworming programmes.

Vector control: The Islands are endemic for many parasitic diseases and hot and humid climate is very conducive for vector breeding. Controlling the flies to the maximum extent by high degree of cleanliness in surrounding areas of sheds, proper dumping of garbage, kitchen waste, agricultural waste, etc. use of insecticides can be adapted to a limited extent. Preventive measures like application of Neem oil and Turpentine oil are advised to prevent the vector from transmitting the Filarial larvae while sending for grazing. For the control of Fascioliasis, Amphistomiasis and Shistosomiasis, the destruction of snail population is very important.

Reservoir host control: Control of rodent population (vector for leptospires) by poison baiting, trapping and other commonly employed techniques are very important.

Environmental measures: Disinfection, heating, vegetation clearance, and improvements in housing are should be followed strictly.

Education: This is essential to the success of disease control programs, especially where human cultural practices have to be overcome or modified. Education must precede the beginning of disease control program. The educational programs are aimed at gaining the confidence of livestock owners by demonstration regarding the importance for control of disease..

The disease control strategies which are suitable for these Islands is as follows

Strategies for improving the livestock health

The livestock and poultry of the Islands are free from most of the deadly diseases which are prevalent in the mainland India. However, the incidence of parasitic and some common diseases are reported and with an aim to develop the Islands into Disease Free State the following strategies are proposed:

- Surveillance and monitoring of prevalent and emerging diseases of livestock and poultry should be strengthened.
- Livestock health calendar should be developed for effective health management.
- The available data on disease incidence status in livestock and poultry should be compiled and utilized for development of database and decision support system for better preventive livestock health care and management
- Quarantine facility should be established at major Islands to prevent introduction of any emerging diseases of livestock and poultry from inter and intra Islands.
- Regular monitoring and surveillance of the zoonotic importance diseases like leptospirosis, tuberculosis, brucellosis etc. should be conducted for the agricultural and livestock farmers/labourers.
- Prophylactic vaccination against major diseases of livestock and poultry should be done at all Islands.
- Indigenous medicinal plants and ethno veterinary practices should be explored for better livestock health management.
- Capacity building of livestock farmers/labourers on good animal husbandry practices should be implemented to ensure quality livestock products for the consumers.

CONCLUSION

The disease trend of livestock and poultry indicated that very few deadly viral and bacterial diseases are prevalent in the A & N Islands. Except for the incidence of Foot and Mouth Disease after the Tsunami, there is not many diseases have been reported from this Islands. The prevalence of parasitic diseases is reported to be very high in almost all parts of the Islands. The seroprevalence of brucellosis and leptospirosis are reported in cattle and goat which may pose a serious threat to the human due to its zoonotic importance. Regular surveillance and monitoring of the diseases are of paramount importance due to its geographical isolation and location of the Islands from mainland, India. An understanding of the epidemiology of disease is crucial for the development and implementation of effective diagnosis, treatment, control and managerial practices. This requires sound epidemiological data of the prevailing diseases, range of host involved including intermediate host, transmitting factors etc. In case of diseases prevalent in A & N Islands information is fragmentary and composite data are practically non-existent. Due to remoteness of the Islands prompt health coverage is also a problem. Considering the changing climatic condition and to improve the health and productivity of the livestock and poultry a strict surveillance, and regular monitoring of the important diseases of livestock and poultry required to be carried out.

REFERENCES

- Agrawal M C, Jeyakumar S and Ahlawat, S P S (2003). Helminthic infection of livestock in Andaman. J. Vet. Parasitol., 17: 143-145
Annual Report (2006-07). Published by Director, CARI, Port Blair pp 78
Deorani VPS and Rao J R (1989). Control of stephanofilarial dermatitis in Andaman and Nicobar Islands. J. And. Sci. Asso., 59 : 506-509

- Jeyakumar S, Chatterjee RN, Ahlawat SPS, Senani S, Kundu A, Sunder J, SahaSK and Yadav SP (2002). Seroprevalence of Leptospirosis and brucellosis in cattle and goats of A & N Islands. *Ind. Vet. Med. J.*, 26: 351
- Jeyakumar S, Kumar BG, Roy K, Sunder J and Kundu A (2009). Incidence of parasitic infection in livestock and poultry in Andaman. *Ind. Vet. J.*, 86 (11): 1178-1179
- Jeyakumar S, Srivastava R C, Roy K, Kumar, S A, Sarmah P C, Kundu A, Damodaran T, Ravishankar N, Balakrishnan M, Ahmed S K Z, Swapna T P and George Z (2011). Prevalence of eyeworm *Oxyuris mansoni* (Cobbold, 1879) infection of domestic fowl in Andaman Islands. *J. Vet. Parasitol.*, 25(2) : 171-172
- Kundu A, Sunder J, Jeyakumar S, Verma SK and Srivastava RC (2010). Livestock and poultry production policy for Andaman and Nicobar Islands: a scientific perspective. Published by CARI, Port Blair.
- Luca L J De, Silva J H, Grimoldi R J and Capaul E G (1976). Fertility in cattle and practical application of some blood values. In proceedings of the 20th world Vet. Congress. 6-12 July. 1975. Thessaloniki, Greece. 2:972-974
- Nemat Ullah, Ali S and Ahmad K M (1983). Macro and micro mineral element in buffalo blood plasma during 90 days post partum. *Pak. Vet. J.*, 3: 176-78
- Pal RN and Balakrishnan P (1987). Incidence of gastrointestinal parasites of cattle in the Andaman. *J. And.Sci.Assoc.*, 3: 8-13
- Rai R B, Ahlawat S P S, Srivastava N and Mahto B (1992). Status of livestock diseases in Andaman and Nicobar Islands. *J. And.Sci.Assoc.*, 8: 53-58
- Rai RB, Srivastava N, Sunder J, Kundu A and Jeyakumar S (2010). Stephanofilariasis in bovines: Prevalence, control and eradication in Andaman & Nicobar Islands, India. *Ind. J. Ani. Sci.*, 80(6) : 500-505
- Sunder J, Rai RB, Kundu A and Jeyakumar S (2007a). Detection of antibodies to IBDV in poultry of Andaman and Nicobar Islands. *Ind. J. Ani. Sci.*, 77 (9) : 857-858
- Sunder J, Chatterjee RN, Rai RB, Ahlawat SPS, Kundu A, Senani S, Saha SK, Yadav SP and Bhagat D (2004). Outbreak of infectious Bursal Disease in poultry of A & N Islands. *Ind. Vet. Med. J.*, 28 : 23-25
- Sunder J, Rai RB, Kundu A and Jeyakumar S (2007b). Mineral status of infertile cattle of Andaman. *Ind. J. Ani. Sci.*, 77 (11): 1135
- Sunder J, Rai RB, Kundu A and Jeyakumar S (2008). Outbreak of FMD in livestock of A & N Islands. *Ind. Vet. J.*, 85 : 329-330
- Sunder J, Rai RB, Yasmeen J, Kundu A and Jeyakumar S (2007c). Mineral profile in soil, grass, water and cattle blood of South Andman. *Ind. J. Ani. Sci.*, 77 (11) : 1103-1107
- Sunder J, Rai RB, Kundu A, Chatterjee RN, Senani Sand Jeyakumar S (2005). Incidence and prevalence of livestock diseases of A&N Islands. *Ind. J. Anim. Sci.*, 75 (9) : 1041-1043
- Sunder J, Rai RB, Kundu A, Senani S, Chatterjee RN and Jeyakumar S (2007d). Seroprevalence of poultry diseases in Andaman and Nicobar Islands. *Ind. Vet. J.*, 84 : 95-96
- Sunder J, Rai RB, Jeyakumar S. and Kundu A (2005). Detection of leptospiral antibodies in cattle and goat of A & N Islands. IV Conference and National Symposium of Indian Association of Veterinary Public Health Specialists held on November 11-12 2005 at ICARNEH, Barapani, Shillong
- Sunder J, Jeyakumar S and Kundu A (2011). Trend of livestock diseases in changing climatic condition in Andaman and Nicobar Islands. International conference on tropical island ecosystems-issues related to livelihood, sustainable development and climate change. CARI, Port Blair pp 18
- Sunder J, Rai RB, Jeyakumar, S. and Kundu A (2005). Prevalence of Brucellosis in cattle and goats of Andamans. IV Conference and National Symposium of Indian Association of Veterinary Public Health Specialists held on November 11-12 2005 at ICARNEH, Barapani, Shillong.
- Varma A, Rai R B, Balakrishnan P and Chaube S K (2000). Seroepidemiological studies of caprine leptospirosis in A & N Islands. *Intas Polivet.*, 1: 99
- Varma A, Rai R B, Balakrishnan P and Naveen K A (2001). Seroprevalence of leptospirosis in animals of A&N Islands. *Ind. Vet. J.*, 78: 936-937