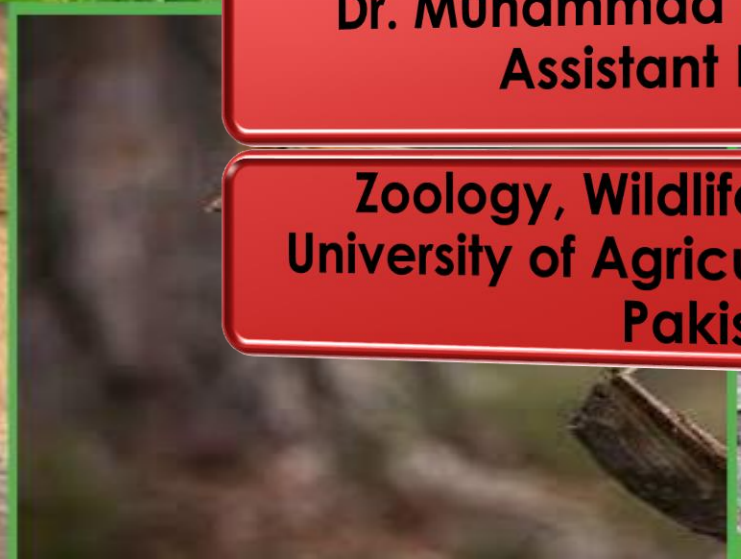
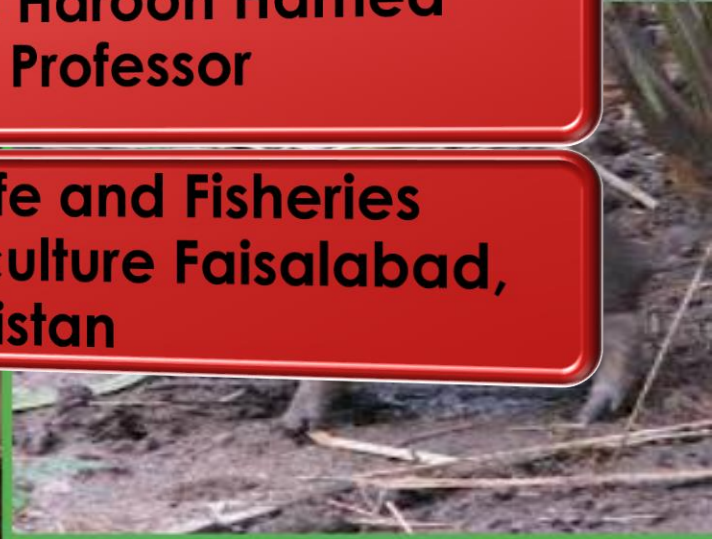
Overview of Wildlife (Zoonotic) Diseases in Pakistan





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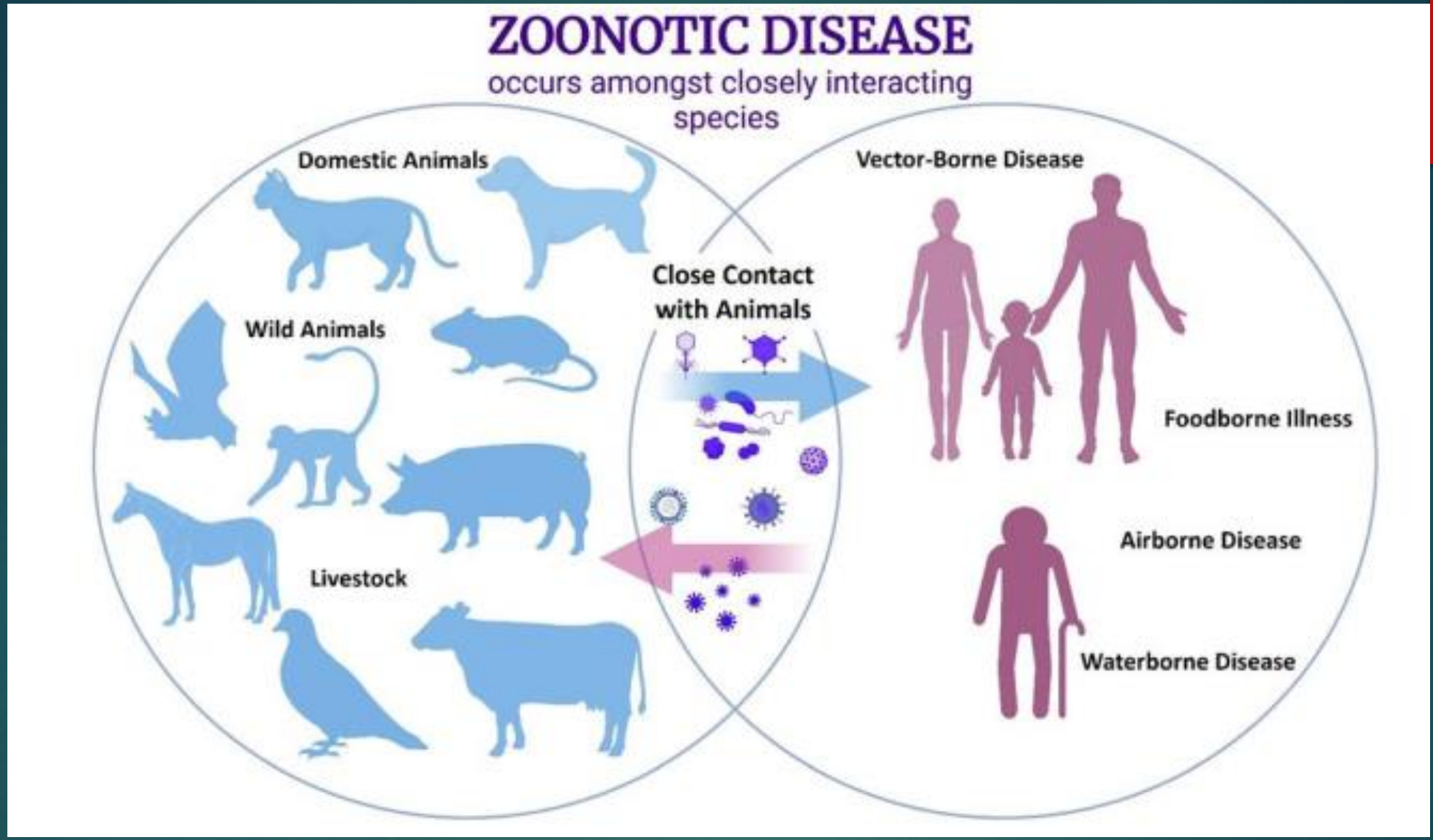
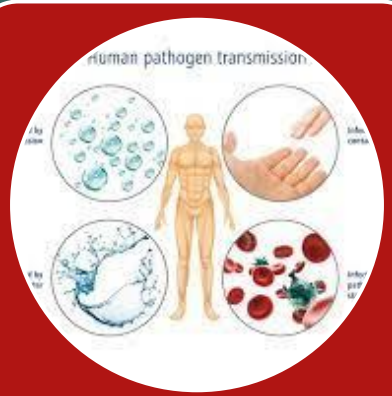


Fig1. Zoonotic transfer of pathogens occurs when close contact encourages species-jumping transmission between animals such as domestics, wildlife, or livestock—and humans. This transmission can be in the form of vector intermediates, ingestion of contaminated food or drinks, or the inhalation of droplets. (Esposito et al. 2022).

Zoonotic Wildlife diseases

Transmitted from wild animals to humans (Slingerbergh et al., 2004)

Zoonosis may be viral, bacterial, parasitic or involve unconventional agents, such as fungi and protozoans (Cleaveland et al., 2001).



About 60% of the 1,407 human pathogen species are zoonotic (Woolhouse & Gowtage-Sequeria, 2005).

Of these 72 per cent originated in wildlife (as opposed to domestic animals) (Jones et al., 2008.

Moreover, 75 per cent of the 177 emerging or re-emerging pathogens (i.e., agents of an infectious disease whose incidence is increasing) are zoonotic (Woolhouse & Dye, 2001; Taylor et al., 2001).





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These numbers may be underestimates, since new human pathogens are still being discovered at a rate of 3 to 4 species per year, with most of them being viruses (Woolhouse & Antia, 2008).

The significant threat to global public health and the economy (Parrish et al., 2008; Jones et al., 2008; Dobson et al., 2020).

Among viruses, RNA types account for 37 per cent of all emerging and re-emerging pathogens (Ferreira et al., 2021)

Many of the diseases that exist today, such as influenza, diphtheria or HIV/acquired immune deficiency syndrome (AIDS), have a zoonotic origin (Diamond, 2002).

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Zoonoses fall into two categories:

i) Pathogens of animal origin which rarely transmit to humans, but, should it occur, human-to-human transmission will maintain the infection cycle for some time –

Examples include HIV, SARS-CoV-2, certain influenza A strains, Ebola virus and SARS;

ii) Pathogens of animal origin in which direct or vector-mediated animal-tohuman transmission is the usual source of human infection

Examples include Lyssavirus infections, Zika and Dengue virus, Hantavirus, yellow fever virus, Nipah virus (Bengis et al., 2004).

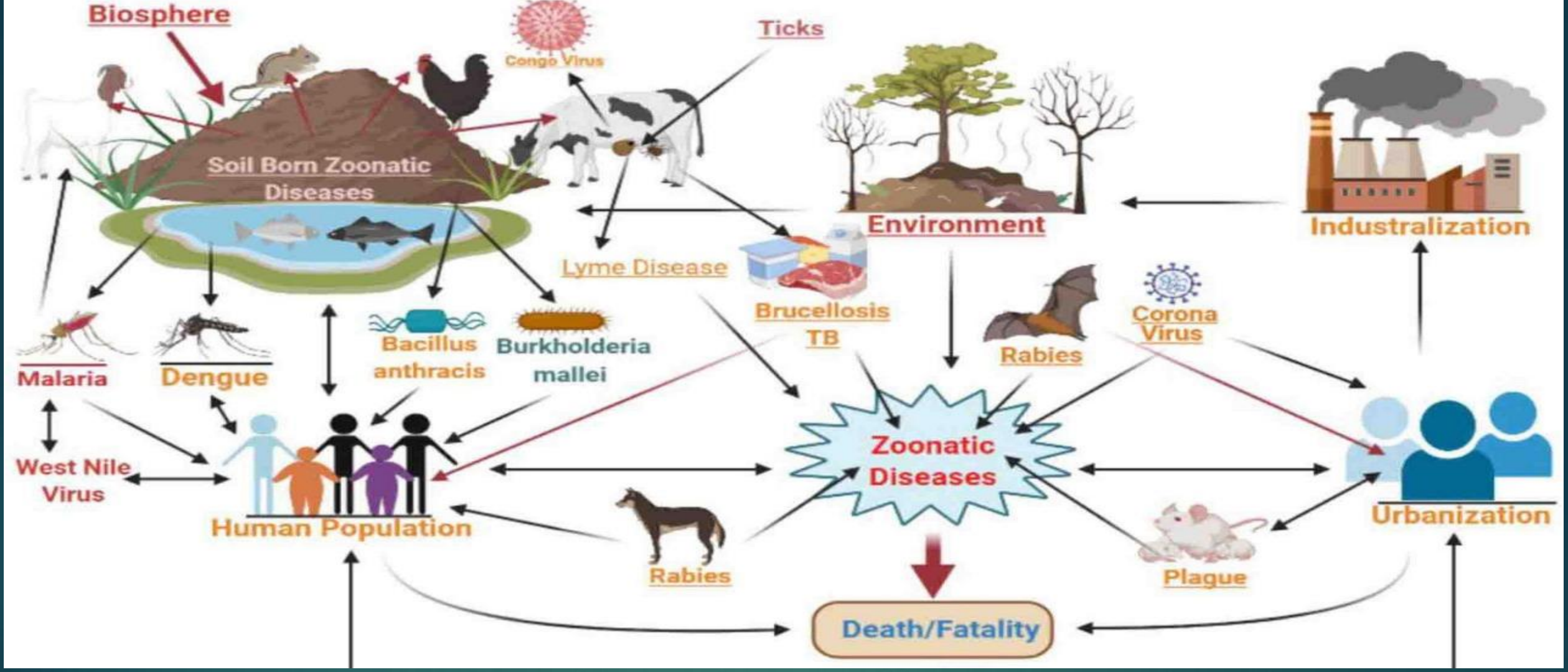

Fig2: Zoonoses, an overview

Zoonotic Diseases in Pakistan

Zoonotic Diseases	Reported
Food-borne *E. coli* infection	Ishaq et al., 2021
Leptospirosis	Ijaz et al., 2018; Sohail et al., 2018
Salmonellosis	Altaf Hussain et al., 2020; Petrin et al., 2020
Anthrax	Ahmad et al., 2004; Doganay and Demiraslan, 2015; Kim et al., 2015; Moayeri et al., 2015; Saad-Roy et al., 2017; Kolton et al., 2019
Bovine TB	Awah Ndukum et al., 2010; Jafar et al., 2014
Brucella	Akram et al, 2021
Mycobacterium spp	Akhter et al, 2023
Rift Valley Fever	Atif et al., 2012

Zoonotic Diseases in Pakistan

Zoonotic Diseases	Reported
Newcastle, Avian Influenza	Shabeer et al, 2023
Foot and Mouth Disease(FMD)	Ijaz et al, 2022
Chikungunya	Ali and Dasti, 2018
Crimean-Congo hemorrhagic fever	Yousaf et al., 2018; Hatami et al., 2019; Kasi et al., 2020
Gastrointestinal Parasitic	Safiur ullah et al, 2024
Leishmaniosis	Tiwananthagorn et al., 2012; Khan et al., 2016; Kämink et al., 2019
Parasitic in migratory birds	Ahmed et al , 2020

Epidemiosurveillance of *Brucella* Pakistan perspective

During 2000-2020 in Pakistan, Sero-prevalence of brucellosis has been reported in non-ruminants such as camels, equines, dogs and humans with the range of 0.5-21%, 16.23-62.6%, 9.2-63.8% and 2.0-70% respectively.

- Non-target species like Avian, reptiles and amphibians were also reported with the prevalence of 2.5%, 24.9% and 25% respectively.
- In Pakistan, it is considered as ignored disease in non-ruminants lacking effective policies for control and eradication

(Akram et al., 2021)

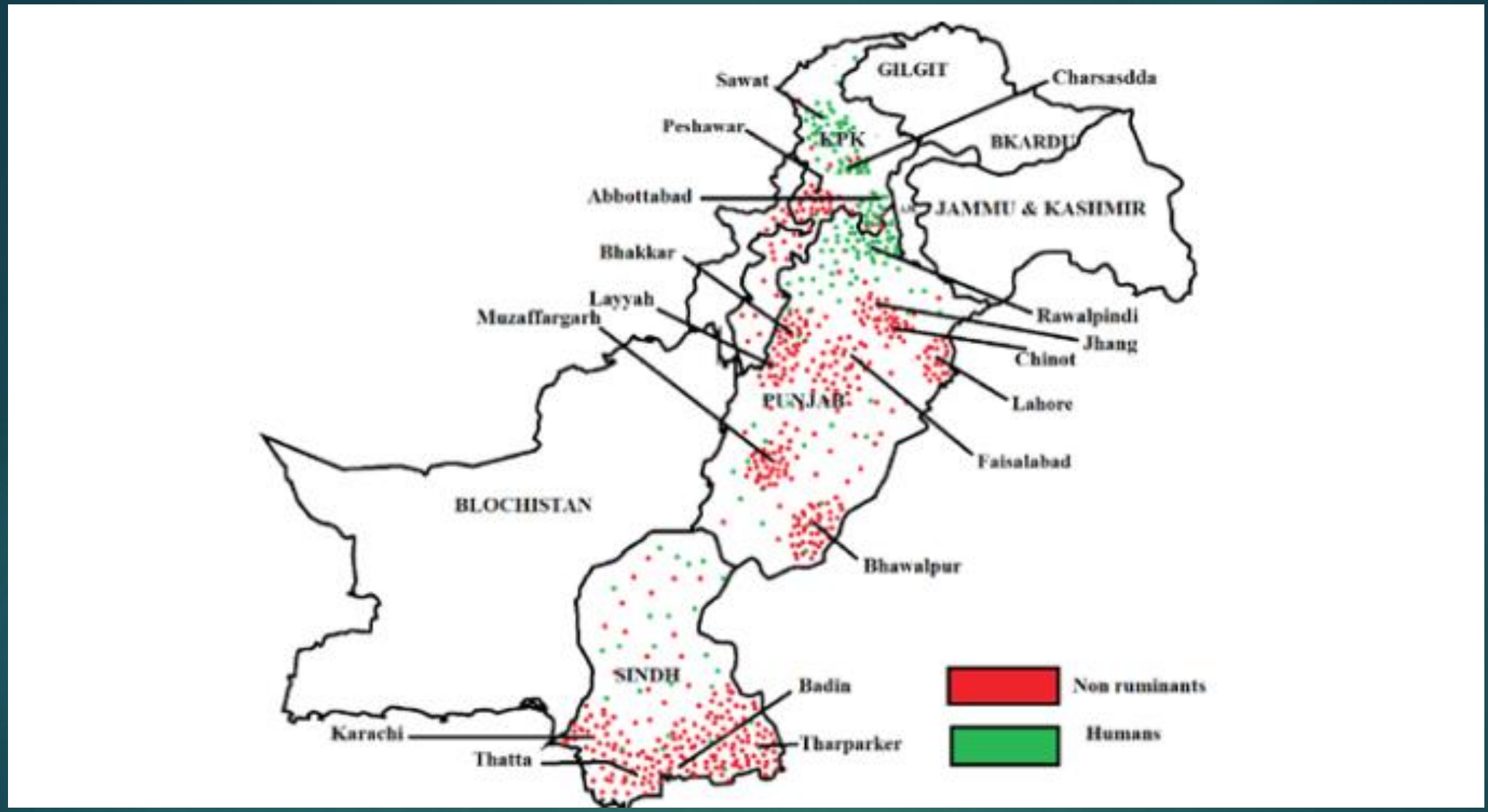

Fig3: Geographical distribution of non-ruminant and human brucellosis in Pakistan (Akram et al., 2021)

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The prevalence range of equine brucellosis in Pakistan was reported as 16.23% (Gul et al., 2013) to 62.6% (Safirullah et al., 2014).

Shahzad et al., (2018) examined 117 blood samples from birds, amphibians and reptiles collected from the Sindh (Karachi) and Punjab (Pattoki) provinces of Pakistan. They found 11.11% samples seropositive for *Brucella* antibodies.

The prevalence of brucellosis in humans may range from 2.0% (Ahmad et al., 2017) to 70% (Malik et al., 2018) in Pakistan.

Mycobacterium spp. in captive wild animals in Pakistan

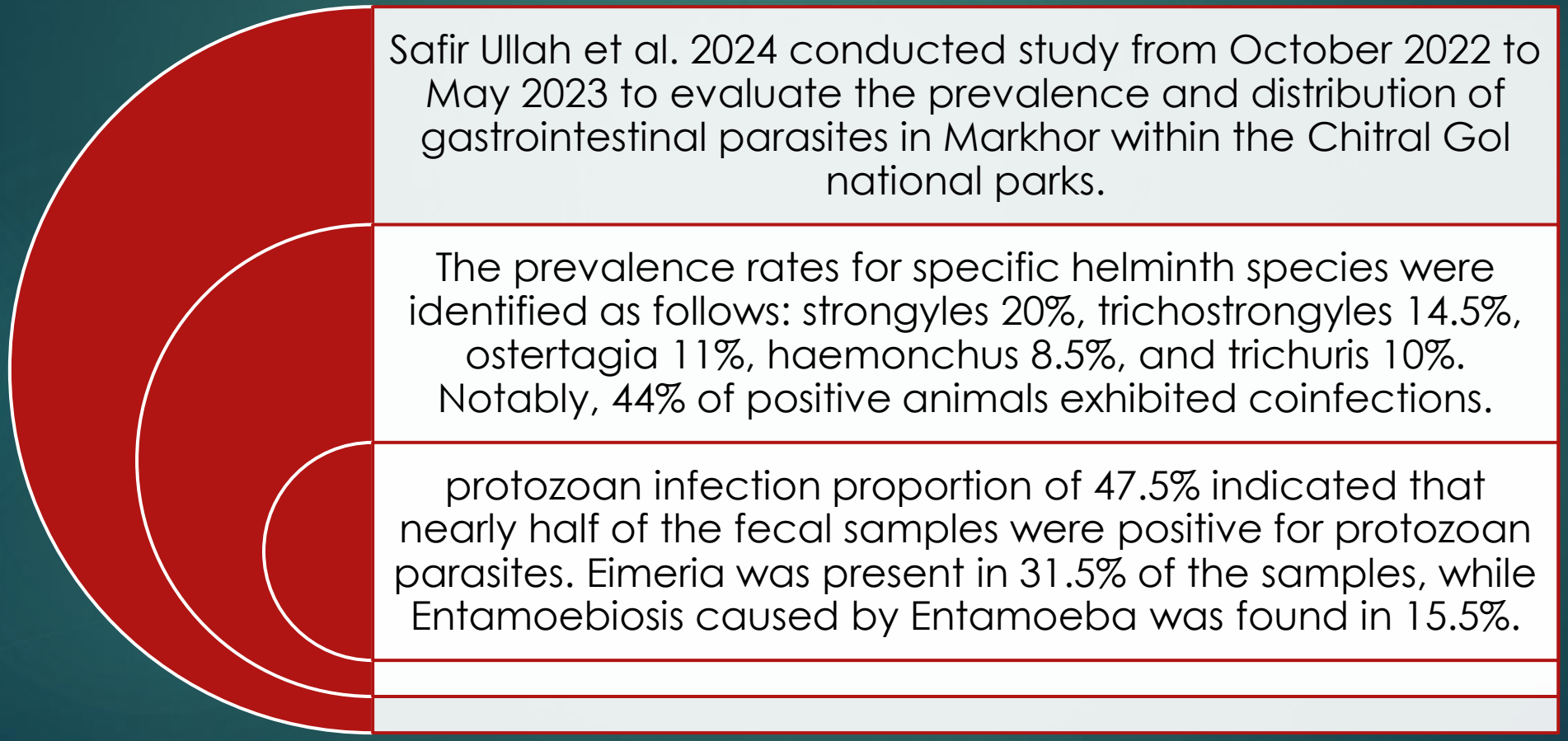
Akhter et al. 2023 reported animal tuberculosis in captive zoo animals in Pakistan.

The postmortem examination revealed that 8.1% (15/185) of animals had gross tuberculosis lesions on the lungs and lymph nodes.

The ZN staining of tissue smears showed 5.40% positivity while *M. bovis* and *M. tuberculosis* DNA was identified in 3.78 % and 1.1% of investigated animals, respectively.

The study showed that animal tuberculosis is prevalent among wildlife in Pakistan and it may pose serious public health concerns to the people visiting these zoos and wildlife parks.

Gastrointestinal Parasitic Infections in Markhor (*Capra falconeri*) at Chitral Gol National Parks, Khyber Pakhtunkhwa, Pakistan



Safir Ullah et al. 2024 conducted study from October 2022 to May 2023 to evaluate the prevalence and distribution of gastrointestinal parasites in Markhor within the Chitral Gol national parks.

The prevalence rates for specific helminth species were identified as follows: strongyles 20%, trichostrongyles 14.5%, ostertagia 11%, haemonchus 8.5%, and trichuris 10%. Notably, 44% of positive animals exhibited coinfections.

protozoan infection proportion of 47.5% indicated that nearly half of the fecal samples were positive for protozoan parasites. Eimeria was present in 31.5% of the samples, while Entamoebiosis caused by Entamoeba was found in 15.5%.

Locations	Name species	No of examination (n)	No of positive samples	Nematodes Prevalence (%)	Trematodes Prevalence (%)	Cestodes Prevalence (%)	Protozoa prevalence (%)
Chitral Goal National park	Markhor wild goat	100	65	65	0	0	48(48%)
Tooshe Shasha Conservancy area	Markhor wild goat	100	63	63	0	0	50 (50%)
Overall		**200**	**128**	**128 (64%)**	**0**	**0**	**98 (49.5)**
Parameter tested		**Chi-square test result**					
Locations vs Nematodes Prevalence		χ-squared = 0.021701, df = 1, p-value = 0.8829					
Locations vs Protozoa prevalence		χ -squared = 0.020008, df = 1,p-value = 0.8875					

Table1 : Prevalence of Nematodes, Trematodes and Cestodes in Markhor (*Capra Falconeri*) in Two Conservancy National Parks at Chitral (Safir Ullah., 2024)

ENDOPARASITIC FAUNA INFECTING MIGRATORY BIRDS VISITING WETLANDS Of PUNJAB, PAKISTAN

A study by (Ahmad et al., 2020) was designed to check the endo-parasitic prevalence in the migratory bird population of various wetlands of Punjab province, Pakistan using qualitative and quantitative microscopic examination.

Overall, highest prevalence of trematodes (41.37 %) was recorded followed in order by nematodes (36.78%) and cestodes (21.83%).

The information regarding migratory pattern and probable risk factors helped in understanding the disease distribution pattern of disease from wild birds to the livestock and humans population in the selected niches of Punjab, Pakistan.

The migratory nature of birds helps identify the threats for the countries involved in their routes of migration.

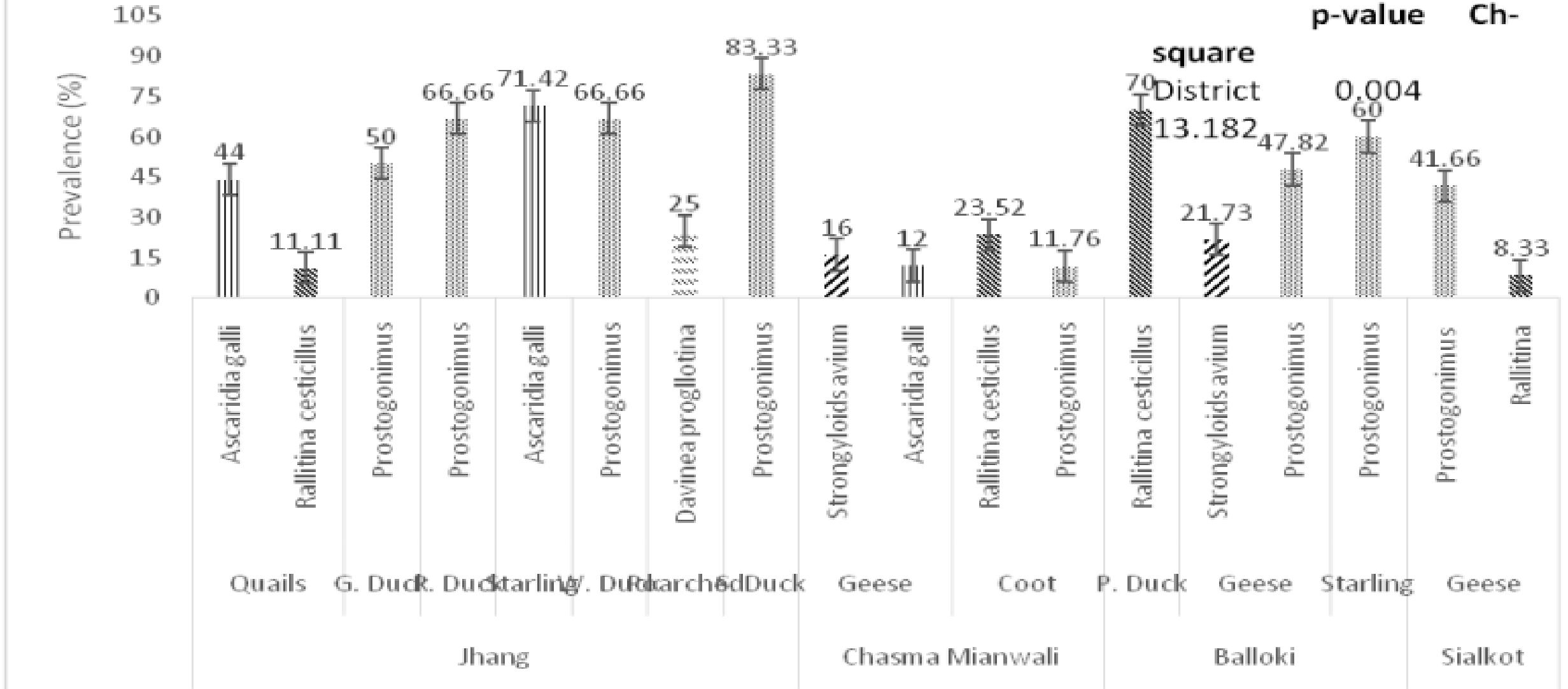


Fig4: Prevalence of parasite species prevalent in the migratory birds screened from selected wetland niches of Punjab (Ahmad et al., 2020)

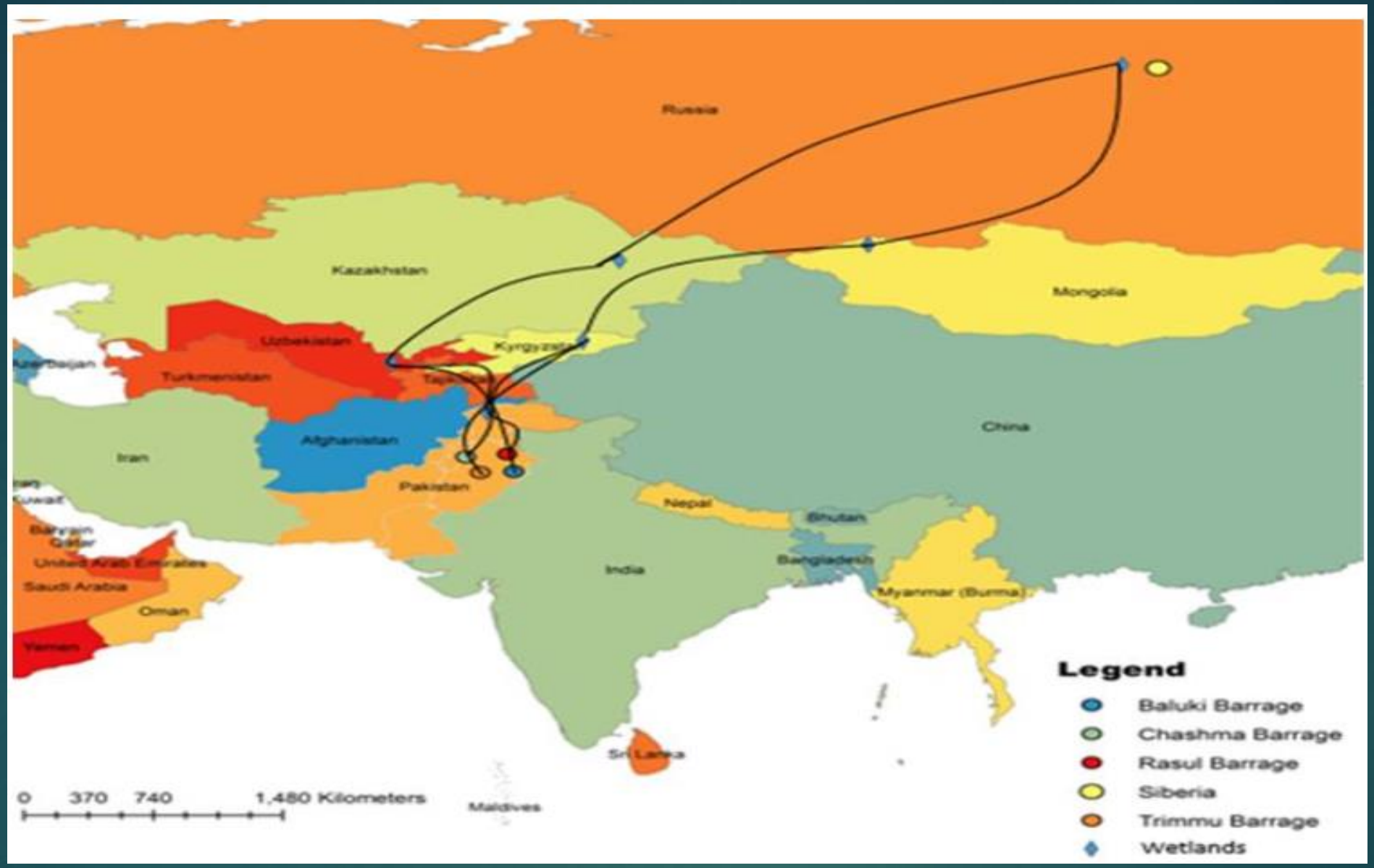


Fig5. International migratory route (# 4) for migratory birds. The route is also called as the *Green Route (Ahmad et al., 2020)*

Sarcoptes scabiei: first deadly outbreak in the Himalayan lynx from Pakistan

Although neglected, the mite Sarcoptes scabiei is an unpredictable emerging parasite, threatening human and animal health globally.

The first fatal outbreak of sarcoptic mange in the endangered Himalayan lynx (Lynx lynx) from Pakistan.

A 10-year-old male Himalayan lynx was found in a miserable condition with severe crusted lesions in Chitral District, and immediately died

This is an alarming situation for the conservation of this already threatened population, which demands surveillance for early detection and eventually rescue and treatment of the affected Himalayan lynx.

(Hameed et al., 2016)

Newcastle disease virus (NDV) and avian influenza virus (AIV)

Endemic in Pakistan

Causes large economic losses for the national poultry sector and international trade in live bird markets (Sarwar *et al.* 2013, Miller *et al.* 2015)

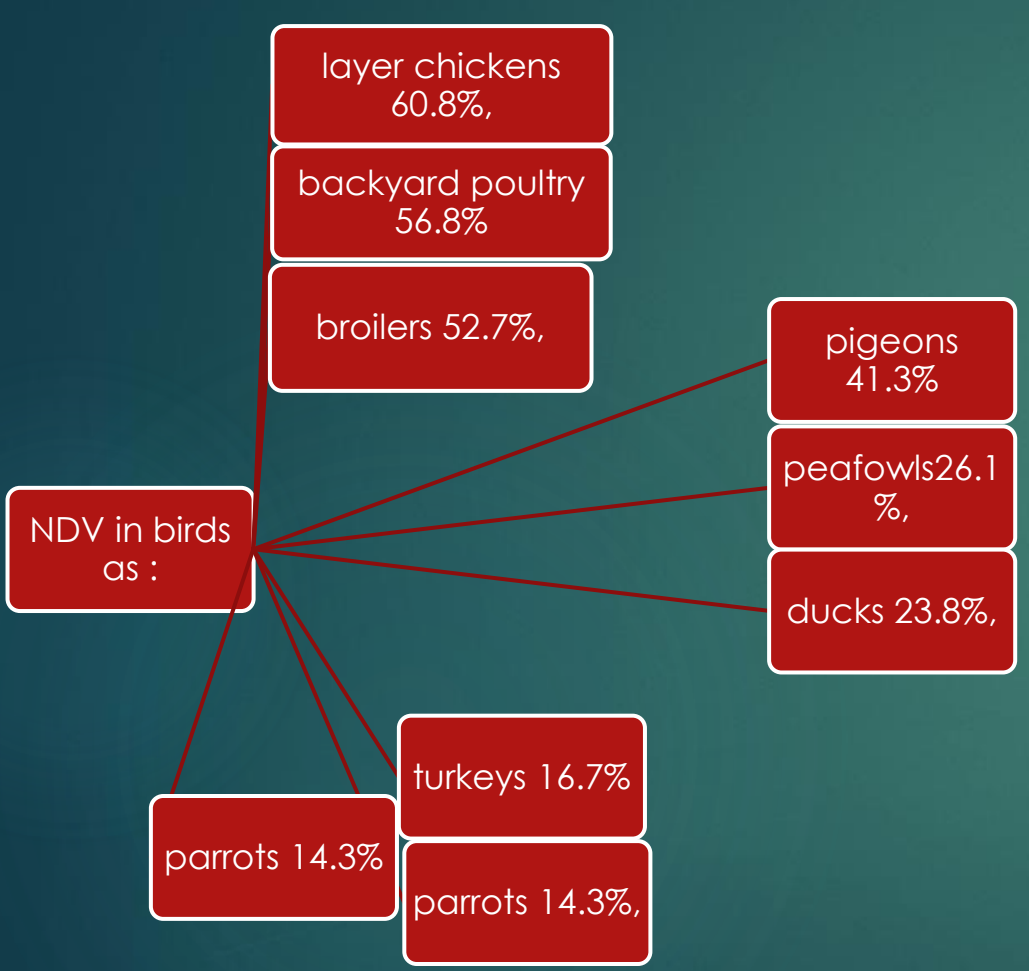
47.5% and 67.4% seroprevalence of NDV and AIV

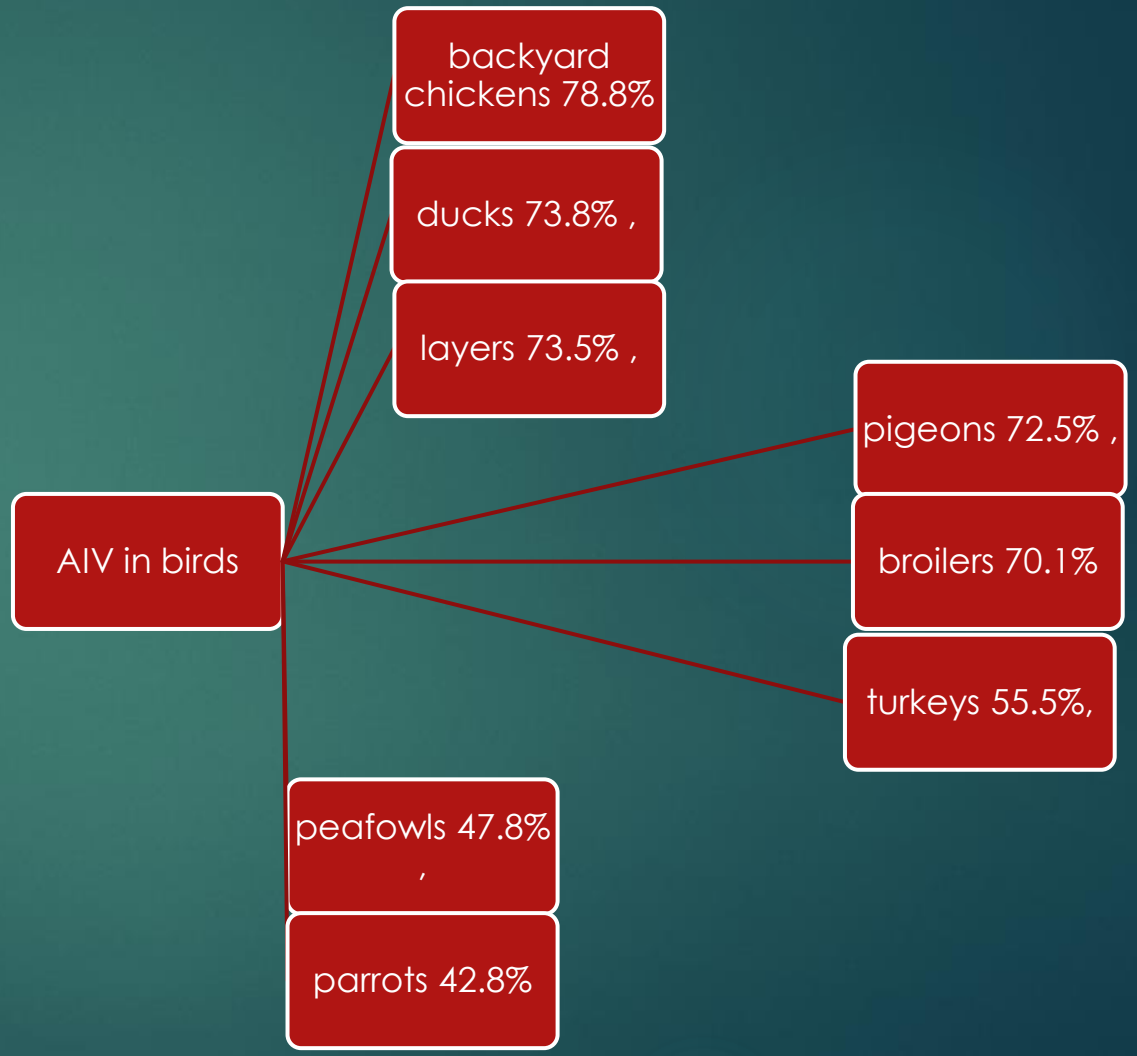
Reported Punjab, Pakistan (Aziz, Shabbir et al. 2023)

Poultry

wild birds

seroprevalance of NDV and AIV in birds





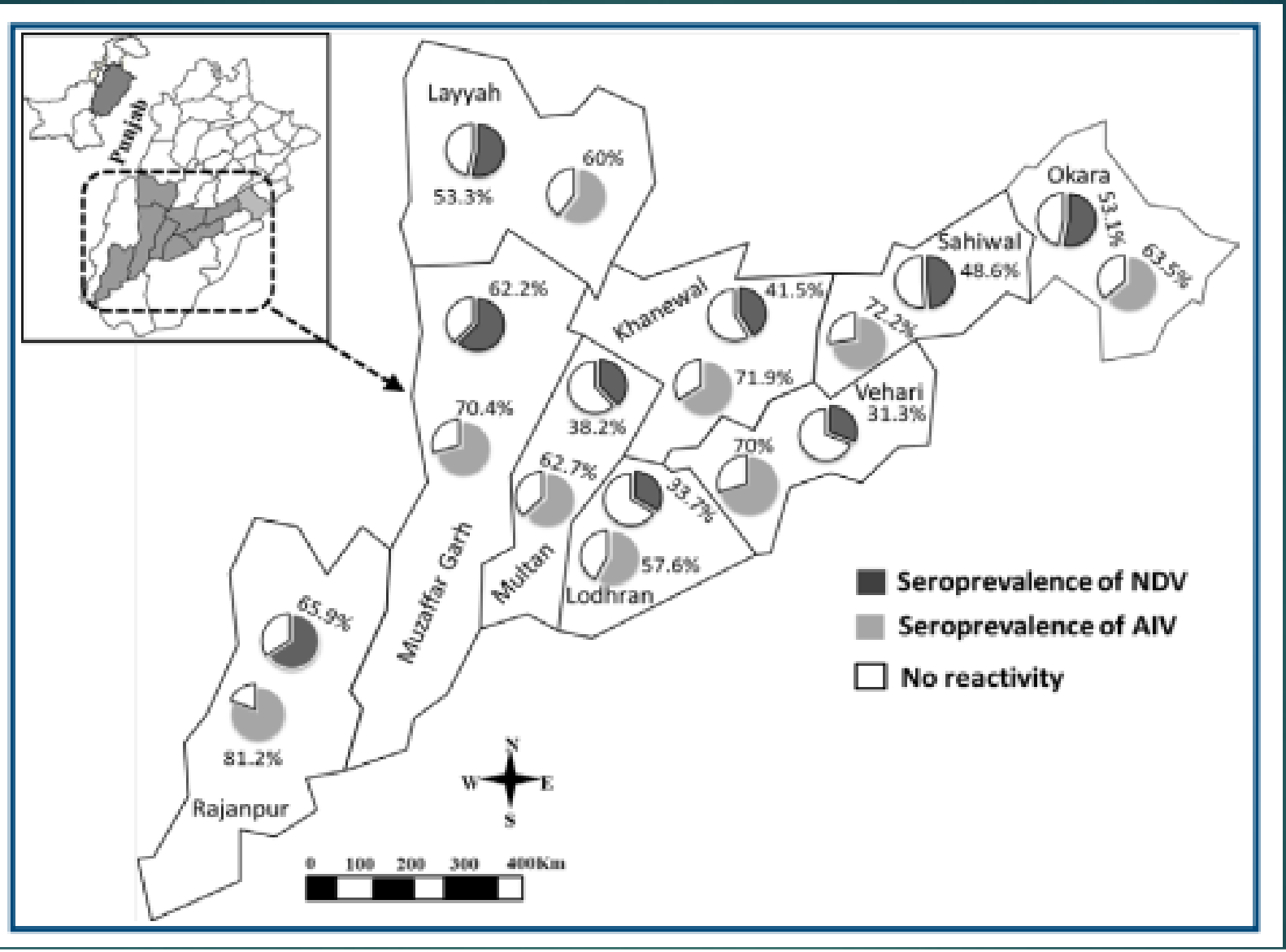


Fig6. *Geographical distribution of Newcastle disease virus (NDV) and avian influenza virus (AIV) seroprevalence in poultry and captive wild birds across selected districts of Punjab, Pakistan.* (Hameed et al., 2016)

FMD virus Breakout

Foot-and-mouth disease (FMD) is a highly contagious and notifiable transboundary animal disease (TAD) affecting the members of *order artiodactylae*, especially bovines, swine, sheep, goats, and over 70 species of wild animals (Thomson et al., 2003)

The potential spillover of foot and mouth disease (FMD) virus at the wildlife-livestock interface is mainly responsible for the outbreaks in captive wild ungulates.

study was planned to investigate an FMD outbreak in the wild ungulate species in the Jallo Wildlife Park and breeding facility, Lahore, Pakistan from Mar 2021– Jun 2021

To investigate the possible cause of FMD spillover and its pattern data revealed neither vaccination nor any FMD outbreak in the last 10 years

The morbidity rate among all the wild ungulate species was 92% and the mean mortality rate was 27%.

(Ijaz et al., 2022)

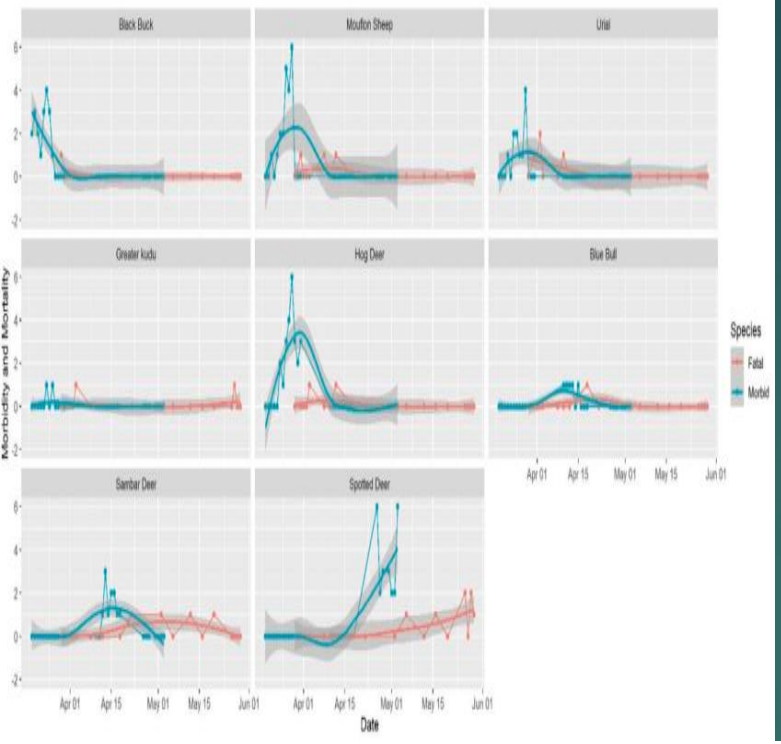


Fig7. Time series analysis of the disease occurrence among all the species present in the Jallo wild life park.

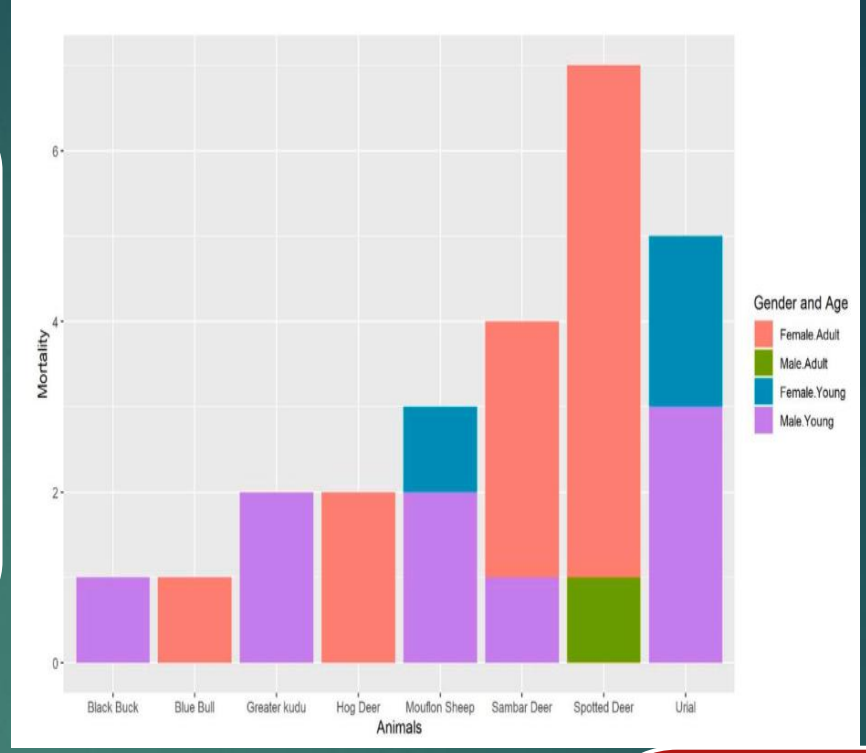
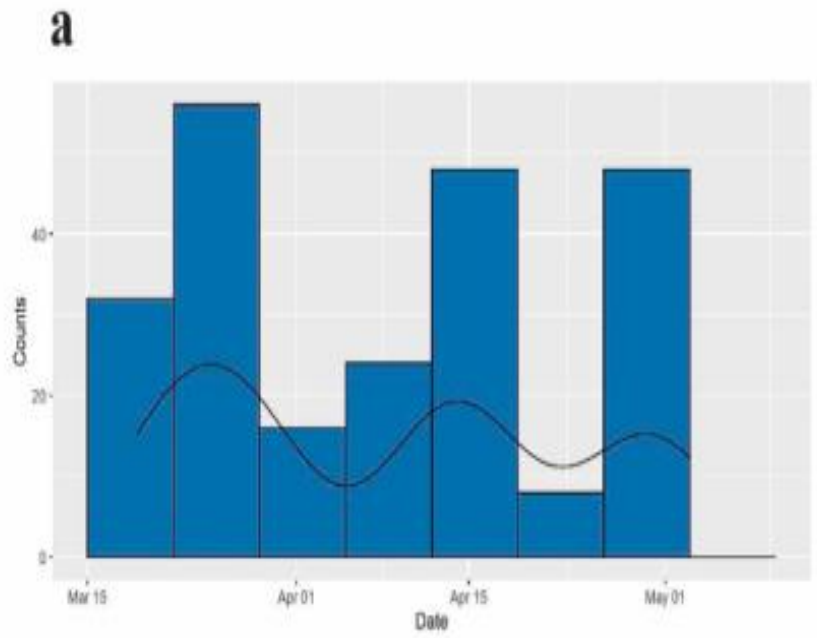


Fig8. Mortalities among the age and genders of all the species. Proportions of Genders and Age groups can be determined.



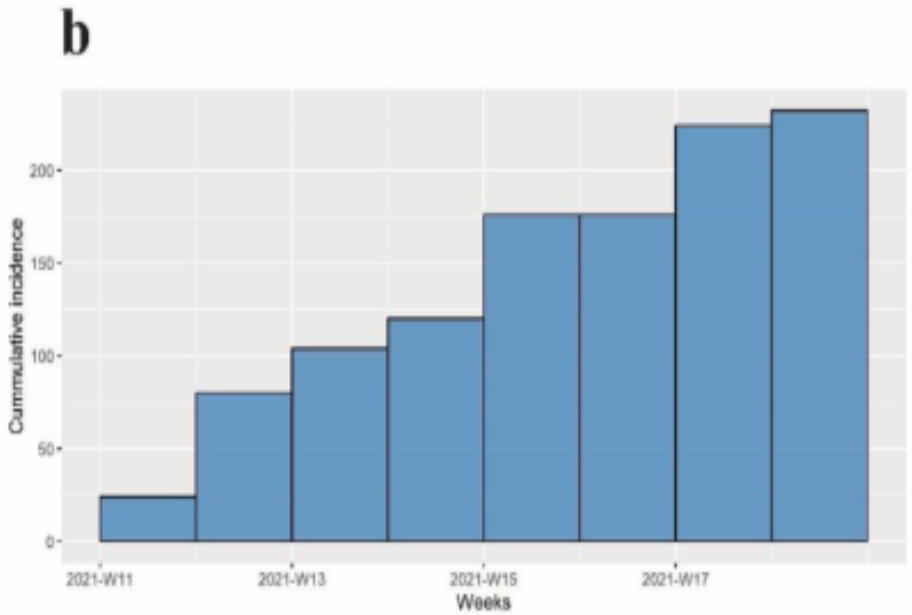


Fig9. Disease distribution and spread (a) Epidemic curve analysis that showed the intermittent rise in number of cases on weekly basis in the outbreak. (b) Calculation of Cumulative incidence during the outbreak period on weekly basis.

(Ijaz et al., 2022).

Fig10. Choropleth Map representing the spatial distribution of outbreak of FMD in Jallo wild life park, Lahore (Ijaz et al., 2022).

Nipah Virus Infection

History:

Initially isolated and identified in 1999 in Malaysia and Singapore

An outbreak of Nipah virus (NiV) with 06 laboratory confirmed cases and two (02) deaths has been reported during the September, 2023 by the State Government of Kerala, India

Bangladesh, Malaysia, Philippines, Singapore and India have also reported confirmed cases of Nipah virus in human

Root of transmission:

Emerging bat-borne zoonotic disease transmits to human through infected animals (Bats and Pigs)

contaminated food with saliva, urine and excreta of the infected animals

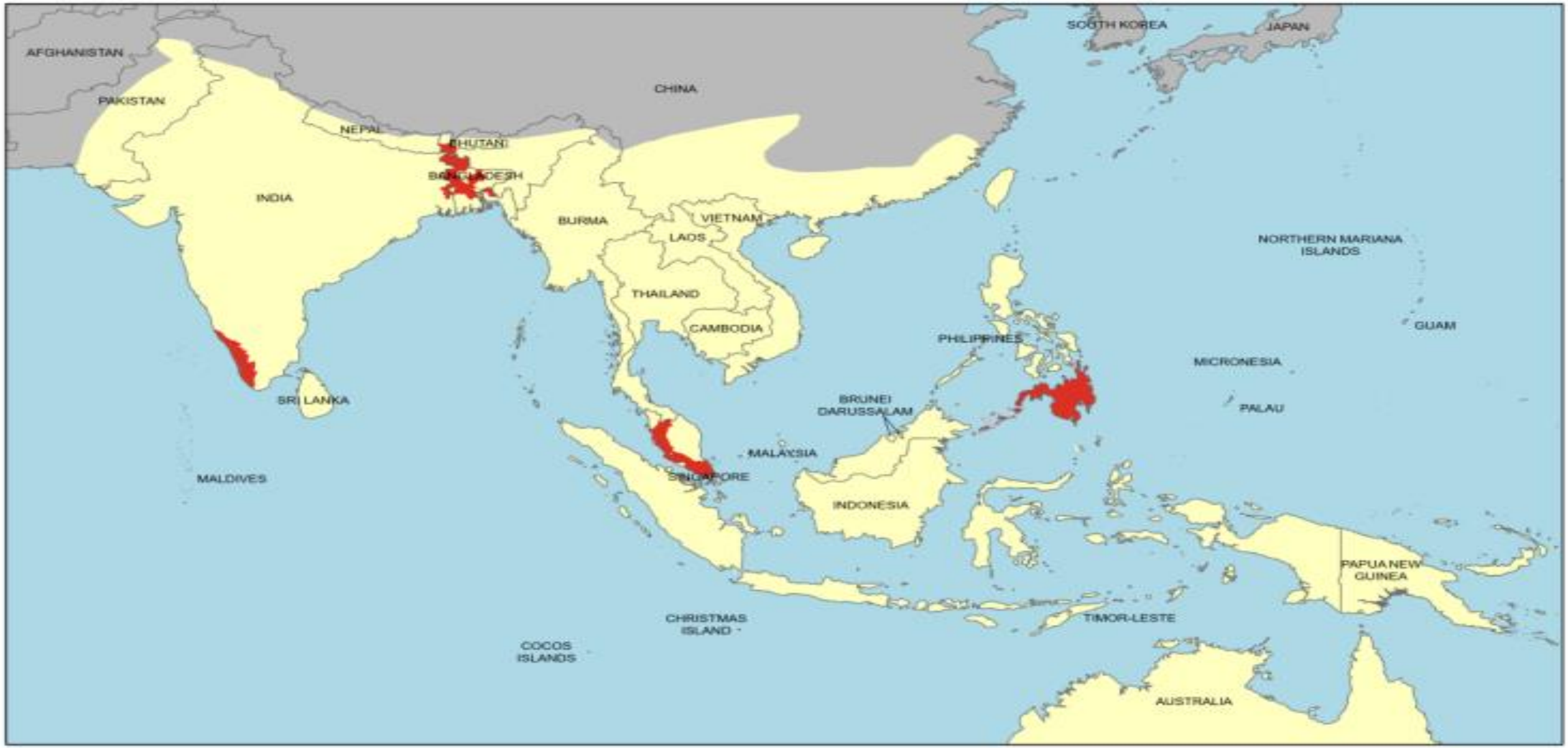
from person to person through close contact with an infected person

Risk Assessment in Pakistan

The overall risk of disease occurrence in Pakistan is low.

No report of documented animal or human cases of NiV infection in Pakistan (NIH,Govt. of Pakistan 2023)

Bats are the potential reservoir of Nipah Virus



Pteropus Bats Presence and Nipah Virus Outbreaks

CDC, Feb 2023

Nipah virus infections in people

Known or likely presence of *Pteropus* bats in the Asia, South Pacific, and Australia region

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This map shows areas where outbreaks of Nipah virus (NiV) in people have already occurred, including cases of illness and death.

It also highlights where multiple species of bats of the genus Pteropus, which can spread NiV, are known or are thought to live in the Asia, South Paciêc, and Australia region

Advisory on Nipah Virus Infection

Ministry of National Health Services Regulations and Coordination,
Government of Pakistan
National Institute of Health
(Center for Disease Control)
Phone: (92-051) 9255237 Fax: (92-051)9255099
National Focal Point for IHR

No: F.1-22/Advisory/FEDSD/2022

Islamabad, 7th October 2023

Subject: **Advisory on Nipah Virus Infection**

Nipah virus (NiV) infection is an emerging zoonosis that causes severe disease in both animals and humans and is endemic in South-East Asia. NiV was initially isolated and identified in 1999 in Malaysia and Singapore during an outbreak of encephalitis and respiratory illness among pig farmers and people with close contact with pigs. Since 2018, several outbreaks have been reported with subsequent clustering of cases in family contacts with additional reports of nosocomial transmission in health care settings. An outbreak of Nipah virus (NiV) with 06 laboratory confirmed cases and two (02) deaths has been reported during the September, 2023 by the State Government of Kerala, India. Previously countries including Bangladesh, Malaysia, Philippines, Singapore and India have also reported confirmed cases of Nipah virus in human. Although Nipah virus has caused only a few known outbreaks in Asia, it infects a wide range of animals and causes severe disease and death in people, making it a public health concern.

Acknowledgement

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- Department of Zoology, Wildlife and Fisheries University of Agriculture, Faisalabad, Pakistan
- South Asia Wildlife Health Network

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