ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (ICAR-NIVEDI)

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Supplementary for Karnataka (Block Level) Forewarning

LIVESTOCK DISEASE FOREWARNING BULLETIN- June 2019

(SIMPLIFIED SOLUTION! MAGNIFIED OPPORTUNITY!)

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Data compilation by: Dr. M. Nagalingam

Dr. Siju Susan Jacob

Prepared By: Dr. K. P. Suresh

Dr. Divakar Hemadri

Dr. S.S. Patil

Disclaimer

The forewarnings are based on the retrospective disease data available in the NADRES database. Hence, for those states wherein data is limited/less, the forewarning may not be realistic. Further the forewarning will not take into consideration the control measures that are *in situ*.

Acknowledgement

We would like to acknowledge the constant support and inspiration from honourable Secretary, DARE & DG, ICAR, Government of India, New Delhi.

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Dr. K. P. Suresh Dr. Divakar Hemadri Dr. S.S. Patil

(Dr. Parimal Roy)
Project Coordinator, AICRP on ADMAS
& Director, ICAR-NIVEDI.

राष्ट्रीय पशुरोग जानपदिक एवं सूचना विज्ञान संस्थान
National Institute of Veterinary Epidemiology and Disease Informatics
पोस्ट बाक्स सं-६४५० / Post Box No. 6450
रामगोंडनहल्लि / Ramagondanahalli
बैंगलुरु-५६० ०६४ / Bengaluru-560 064

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1. About the bulletin…

Livestock sector also plays a critical role in the welfare of India's rural population. This enterprise provides a flow of essential food products, draught power, manure, employment, income, and export earnings. As it is an important component in poverty alleviation programmes, continuous emphasis is being laid on this sector for enhancing the quality of the primary and secondary products in international market, which in turn demands safe animal health for better products. Therefore, livestock development programmes cannot succeed unless a well-organized animal health service is built up and protection of livestock against diseases and pests particularly against the deadly infections is assured.

India has achieved eradication of rinderpest (RP), CBPP, AHS and Dourine. However, there are several other infectious and non-infectious diseases prevailing in the country causing huge economic loss annually. Prevention, control and eradication of the animal diseases need a thorough understanding of the epidemiology as well their economic impact.

National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI) has the mandate to carry out research activities in the area of veterinary epidemiology and disease informatics. With the eradication of RP successfully, India has not only proved its ability to face the challenges, but also to succeed, despite various limitations. Similar efforts are needed to control and eradicate the diseases like FMD, PPR, Brucellosis, CSF, BT, HS etc., which cause huge economic loss annually to the livestock industry. To this end, ICAR-NIVEDI has identified 4 priority diseases, based on the past incidence patterns and has built a strong database of these diseases. The database, which is backbone of the National Animal Disease Referral Expert System (NADRES), is used for providing monthly livestock disease forewarning, which is compiled in this monthly bulletin to alert the animal husbandry departments, both at the National/state level, to take appropriate control measures. We hope users/stakeholders find this bulletin useful in their quest to control livestock diseases.

After realising the difficulties in implementing the forewarning results at district level and also considering the importance of forewarning at block level, ICAR-NIVEDI attempted to develop models for predictive analytics at block levels. Similar risk factors like Meteorological and remote sensing variables were used for forewarning at block level. We started providing the forewarning results for Karnataka state on Foot & Mouth disease, Black quarter, HS and PPR on pilot basis.

2. Forewarning Methodology

I) **Materials**

Livestock disease data

Previous 10 years livestock disease outbreak data retrieved from the NADRES database linked with Risk factors data.

Livestock population data

District wise livestock population data from 19th Livestock census (2012)

Meteorological data

Variables such as precipitation (mm/month), pressure (millibar), relative humidity(%), sea level pressure(millibar), minimum temperature (°C), maximum temperature(°C), wind speed(m/s), vapour pressure (hPa), soil moisture(%), perceptible water(mm), potential evaporation transpiration(mm/day) and cloud (%) were extracted from NCEP-National centre environmental prediction/IMD-Indian meteorological Database/NICRA-National Innovation Climate Resilient Agriculture and other sources for the past five years. Monthly average for the past five years have been calculated and used.

Remote sensing data

Remote sensing variables such as NDVI-Normalised difference vegetation index, EVI-Enhanced vegetation index and LST - Land surface temperature were calculated using MODIS LANDSAT/IRS satellite images for the past five years. Monthly average for the past five years have been calculated and used. Details of the parameters are tabulated below.

SDS Layer Name	Resolution	Description	Units	Data Type	Scaling Factor
500m_16_days_NDVI	500 sq. m	16 day NDVI average	NDVI	16-bit signed integer	0.0001
500m_16_days_EVI	500 sq. m	16 day EVI average	EVI	16-bit signed integer	0.0001
LST_Day_1km	1 sq. km	Day Land Surface Temperature	Kelvin	16-bit unsinged integer	0.02
Lai_1km	1 sq. km	Leaf Area Index	m2plant/m2ground	8-bit unsigned integer	0.1

II) **Method**

Disease outbreak was predicted by Generalised Linear Model (Logistic Regression) from the master chart containing the bove parameters using a R programme and the probability of disease outbreak was categorised in 6 risk levels- No risk (NR), Very low risk (VLR), Low risk (LR), Moderate risk (MR), High risk (HR) and Very high risk (VHR) for enabling the stake holders to take appropriate control measures by suitably allocating available resources.

Given below is the probability distribution of risk interpretations.

S. No.	Probability of risk	Interpretation
1	0	No risk/No or inadequate data
2	0-0.20	Very low risk
3	0.21-0.40	Low risk
4	0.41-0.60	Moderate risk
5	0.61-0.80	High risk
6	0.8-1.0	Very high risk

3. Accuracy of Prediction

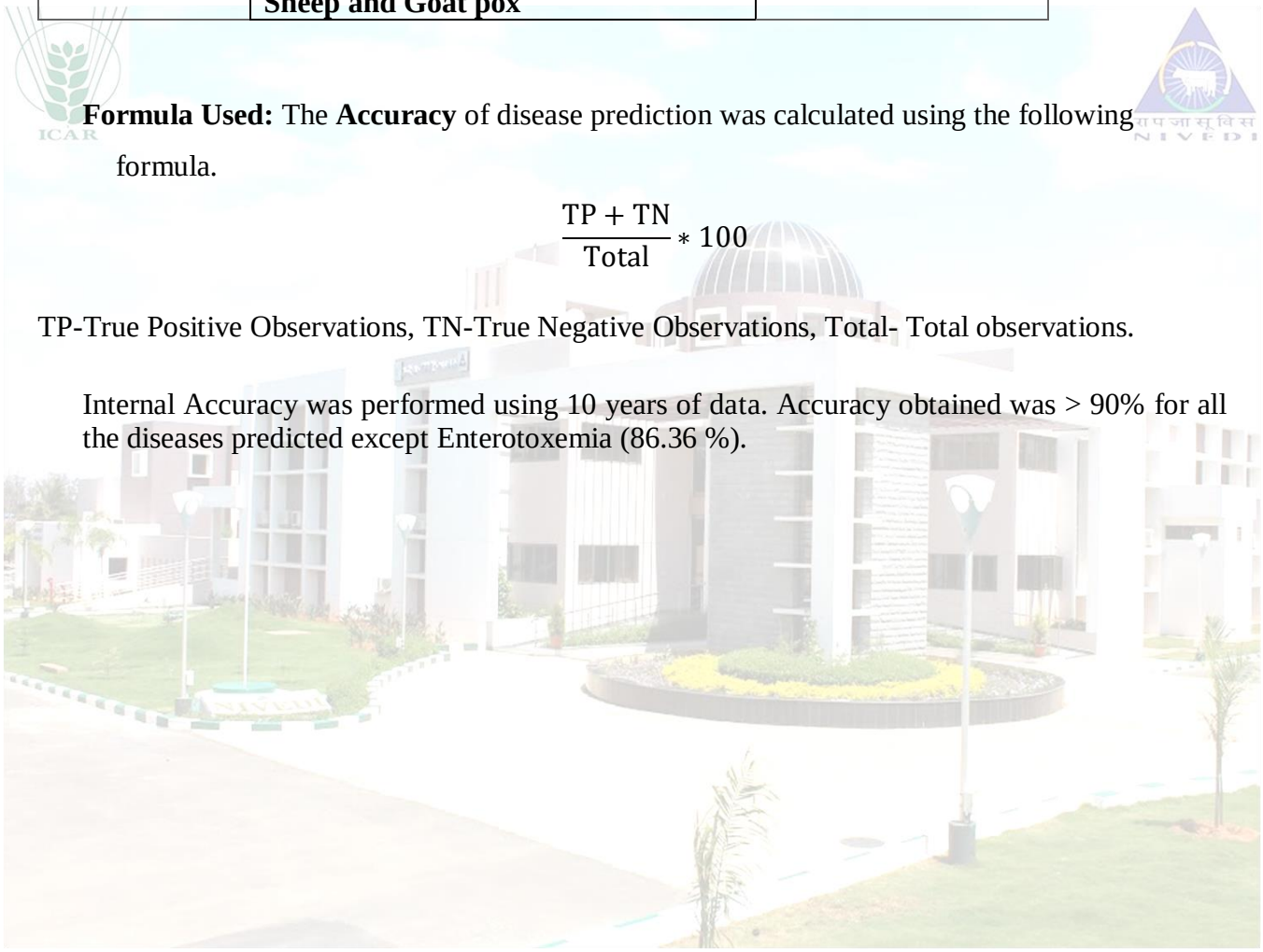
Serial No.	Diseases	Accuracy (%)
1.	**Anthrax**	96.02
2.	**Black quarter**	90.91
3.	**Enterotoxemia**	86.36
4.	**Haemorrhagic septicaemia**	96.59
5.	**Peste des petits ruminants**	92.05
6.	**Sheep and Goat pox**	100.00

Formula Used: The **Accuracy** of disease prediction was calculated using the following formula.

$$\frac{\text{TP} + \text{TN}}{\text{Total}} * 100$$

TP-True Positive Observations, TN-True Negative Observations, Total- Total observations.

Internal Accuracy was performed using 10 years of data. Accuracy obtained was > 90% for all the diseases predicted except Enterotoxemia (86.36 %).



4. Forewarning of livestock disease for the month of June 2019

(i) Taluk/Block wise Livestock Disease Forewarning

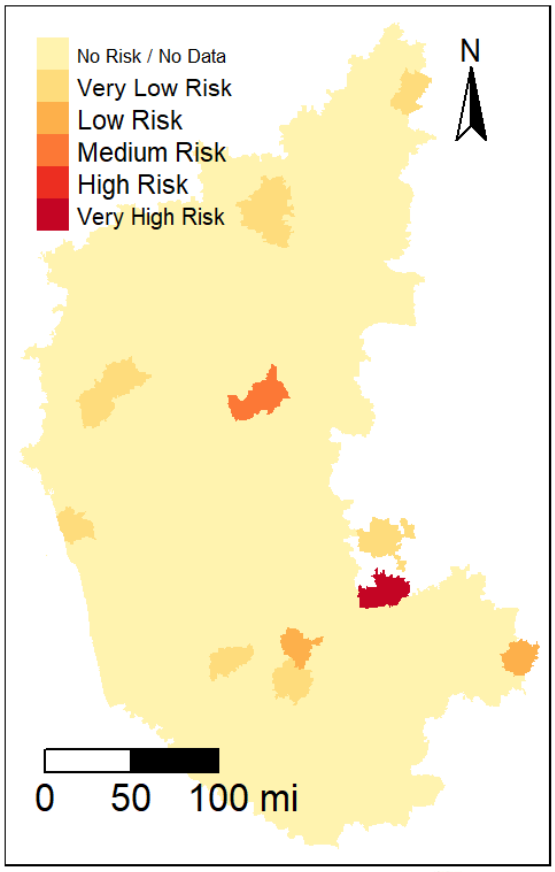
DISTRICT	TALUK/BLOCK	ANTHRAX	BLACK QUARTER	ENTEROTOXEMIA	HAEMORRHAGIC SEPTICAEMIA	PESTE DES PETITS RUMINANTS	SHEEP AND GOAT POX
	Badami	NR	VLR	VLR	NR	VLR	NR
BANGALORE	Bangalore South	NR	VLR	VLR	NR	VLR	NR
BELGAUM	Chikodi	NR	VLR	NR	NR	NR	NR
BELGAUM	Hukeri	NR	VLR	VLR	NR	NR	NR
BELGAUM	Khanapur	NR	VLR	VLR	NR	NR	NR
BELLARY	Kudligi	NR	NR	NR	NR	NR	NR
BELLARY	Sandur	NR	VLR	LR	NR	VLR	NR
BELLARY	Siruguppa	NR	VLR	VLR	NR	NR	NR
BIDAR	Bidar	VLR	VLR	VLR	NR	VLR	NR
BIJAPUR	Basavana Bagevadi	NR	VLR	VLR	NR	NR	NR
BIJAPUR	Sindgi	VLR	VLR	VLR	NR	VLR	NR
CHAMARAJANAGAR	Yelandur	NR	NR	VLR	NR	VLR	NR
CHIKKABALLAPURA	Gauribidanur	NR	NR	NR	NR	NR	NR
CHITRADURGA	Challakere	NR	MR	VLR	NR	NR	NR
CHITRADURGA	Chitradurga	NR	VLR	VLR	NR	NR	NR
CHITRADURGA	Hiriyur	NR	VLR	VLR	NR	NR	NR
CHITRADURGA	Hosdurga	NR	VLR	NR	NR	NR	NR
CHITRADURGA	Molakalmuru	NR	VLR	VLR	NR	VLR	NR
DAVANAGERE	Jagalur	NR	VLR	VLR	NR	VLR	NR
DHARWAD	Dharwad	VLR	VLR	VLR	MR	VLR	NR
DHARWAD	Kalghatgi	NR	VLR	NR	NR	NR	NR
DHARWAD	Navalgund	NR	NR	VLR	NR	VLR	NR
GADAG	Ron	NR	VLR	VLR	NR	VLR	NR
GULBARGA	Aland	NR	VLR	MR	NR	LR	NR

GULBARGA	Gulbarga	NR	LR	VLR	NR	NR	NR
HASSAN	Arkalgud	NR	VLR	VLR	NR	NR	NR
HASSAN	Belur	VLR	VLR	VLR	NR	VLR	NR
HASSAN	Channarayapatna	VLR	VLR	VLR	NR	VLR	NR
HASSAN	Hassan	NR	VLR	NR	NR	NR	NR
HAVERI	Shiggaon	NR	VLR	VLR	NR	NR	NR
KOLAR	Malur	NR	VLR	NR	NR	NR	NR
KOLAR	Mulbagal	LR	VLR	VLR	NR	VLR	NR
KOLAR	Srinivaspur	NR	VLR	VLR	NR	VLR	NR
KOPPAL	Koppal	MR	VLR	LR	NR	VLR	NR
MANDYA	Nagamangala	NR	VLR	NR	NR	NR	NR
RAMANAGARA	Ramanagara	NR	VLR	VLR	NR	NR	NR
TUMKUR	Kunigal	NR	VLR	VLR	NR	VLR	NR
TUMKUR	Madhugiri	VHR	VLR	VLR	NR	NR	VHR
TUMKUR	Pavagada	VLR	VLR	LR	NR	VHR	NR
TUMKUR	Tiptur	LR	VLR	VLR	NR	VLR	NR
TUMKUR	Turuvekere	NR	VLR	VLR	NR	NR	NR
UTTARA KANNADA	Haliyal	VLR	LR	VLR	NR	VLR	NR
UTTARA KANNADA	Honavar	VLR	VLR	VLR	NR	VLR	NR
YADGIR	Shorapur	NR	VLR	VLR	NR	VLR	NR
BAGALKOT	Badami	NR	VLR	VLR	NR	VLR	NR
BANGALORE	Bangalore South	NR	VLR	VLR	NR	VLR	NR

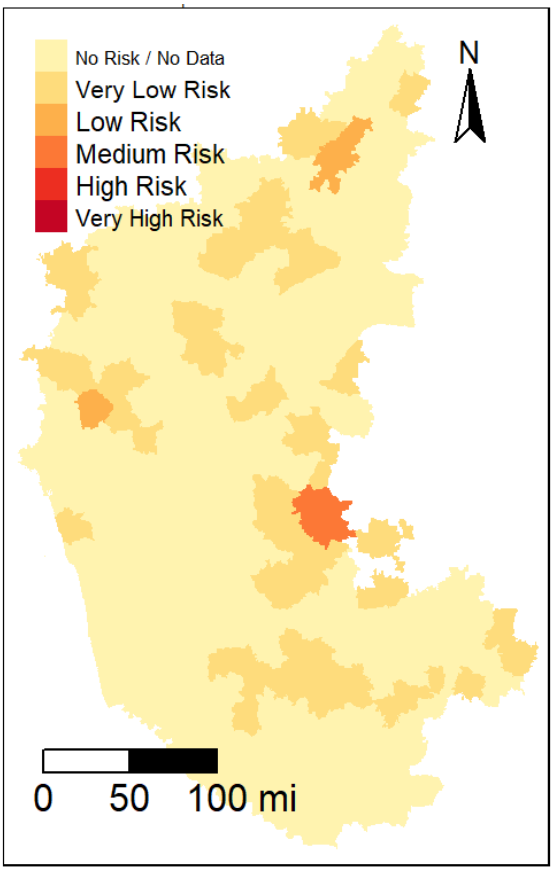
*Number of predicted disease incidence was summarised considering only High risk and Very high risk (VHR+HR

ii) Livestock Risk Prediction – Taluk-wise Disease forewarning Maps

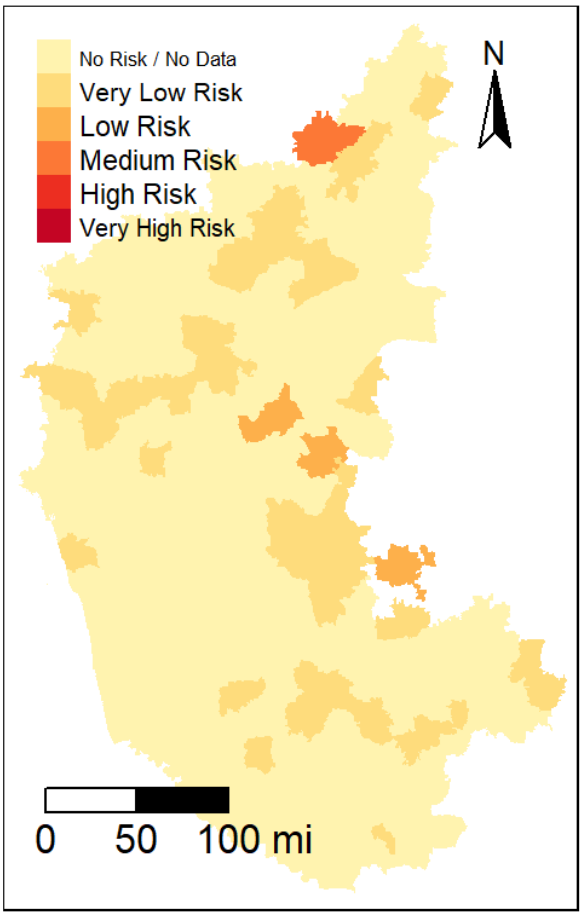
Risk prediction of Anthrax for the month of June 2019 Karnataka



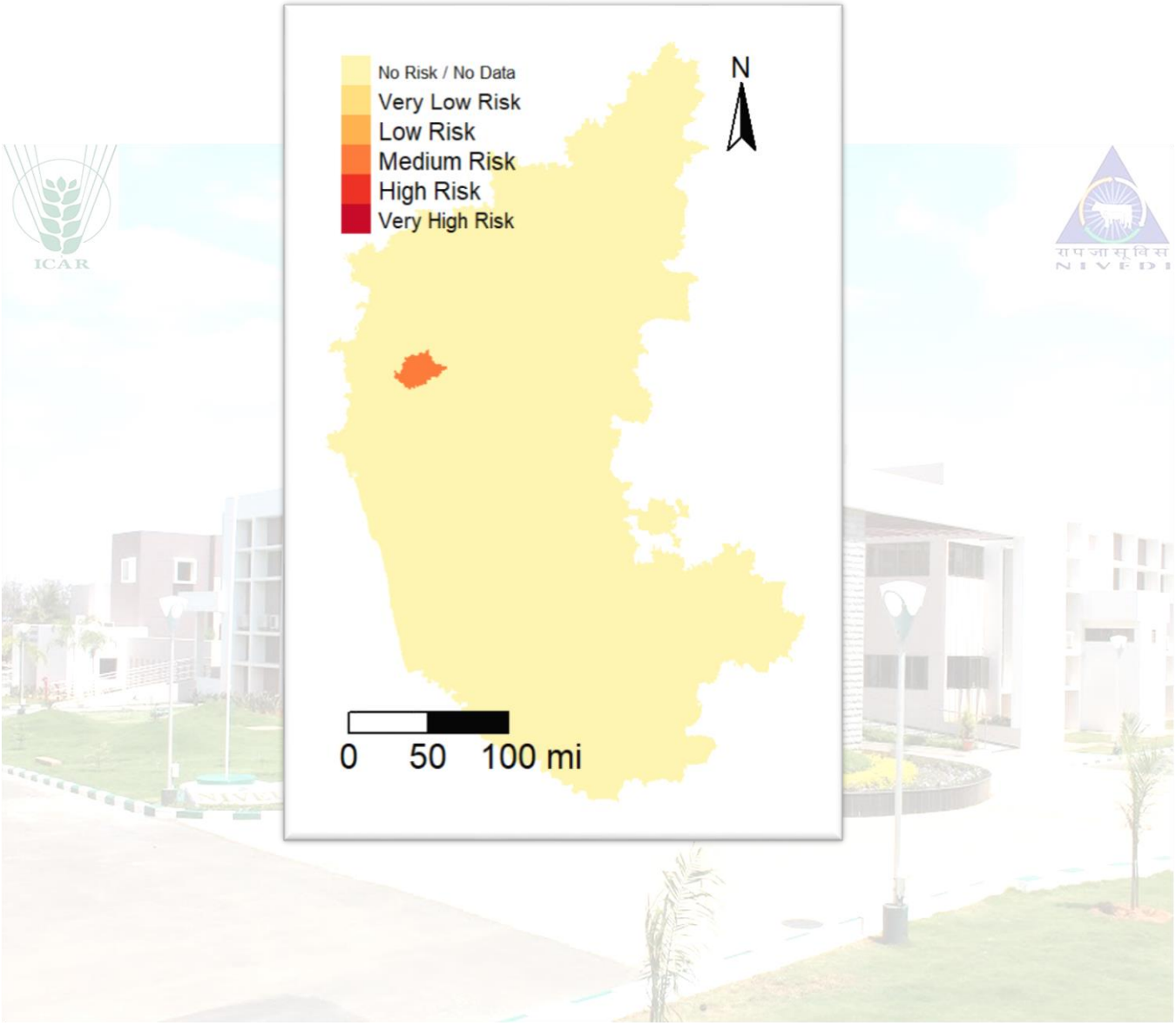
Risk prediction of Black Quarter for the month of June 2019 Karnataka



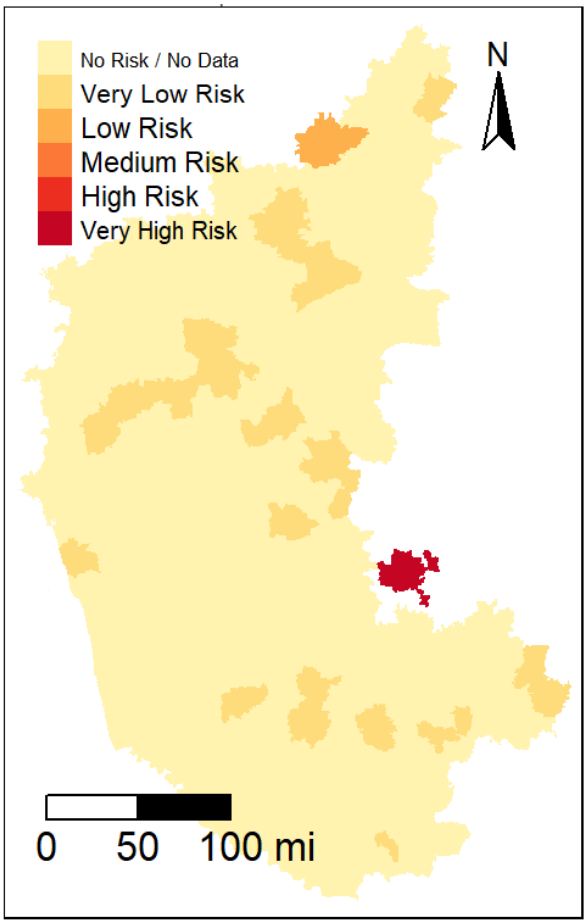
Risk prediction of Enterotoxemia for the month of June 2019 Karnataka



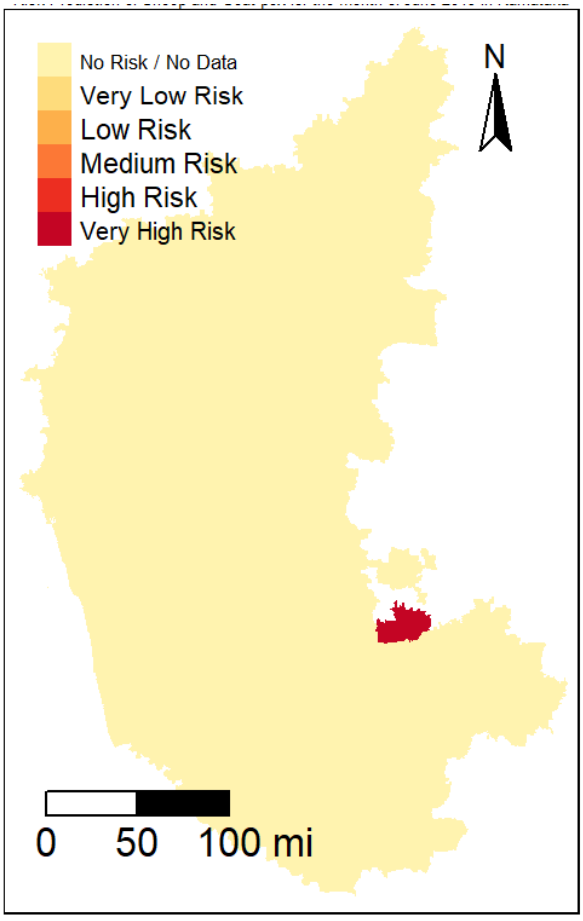
Risk prediction of Haemorrhagic septicaemia for the month of June 2019 Karnataka



Risk prediction of Peste des petits ruminants for the month of June 2019 Karnataka



Risk prediction of Sheep & Goat pox for the month of June 2019 Karnataka



7. Abbreviations

NADRES : National Animal Disease Referral Expert System

R : R environment for statistical computing

BQ : Black Quarter

FMD : Foot and Mouth disease

HS : Haemorrhagic Septicaemia

PPR : Peste des petits ruminants

hPa : Hectopascals

NR : No risk/No data available

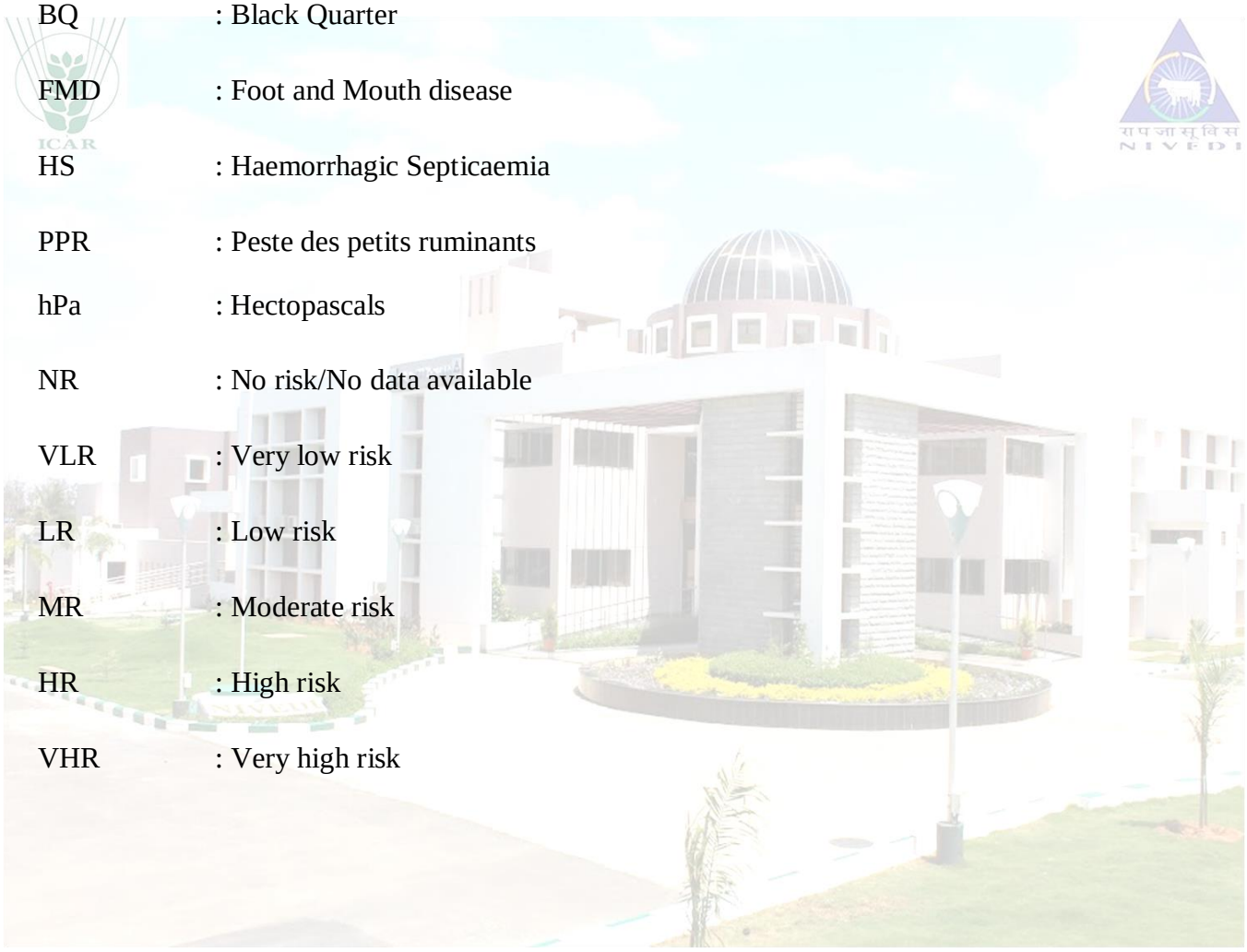
VLR : Very low risk

LR : Low risk

MR : Moderate risk

HR : High risk

VHR : Very high risk



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किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

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ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (ICAR_NIVEDI),

P. B. No.6450, Yelahanka, Bengaluru-560064

Phone: +91-80-23093111, Fax: +91-80-23093222, E-mail: director.nivedi@icar.gov.in