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- February 2019

(SIMPLIFIED SOLUTION! MAGNIFIED OPPORTUNITY!)

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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.

We would like to express sincere everlasting gratitude to honourable Deputy Director-General (Animal Science) for his constant encouragement and guidance.

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Furthermore, we would also like to acknowledge with much appreciation, the crucial role of Scientists Dr. M. Nagalingam and Dr. Siju Susan Jacob and SRF/YP Dheeraj R, Rashmi R. Kurli, Mainak mondal, Kiran Kumar S and Charitha J. in preparation of this report.

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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 ($^{\circ}$C), maximum temperature($^{\circ}$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 above 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.	Black quarter	94.32
2.	Foot and mouth disease	84.66
3.	Haemorrhagic septicaemia	92.05
4.	Peste des petits ruminants	94.32

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

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

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

Internal Accuracy was performed using 10 years of data. Accuracy obtained was > 90% except foot and mouth disease (84.66%)

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

i) Taluk/Block wise Livestock Disease Forewarning

KARNATAKA TALUK/BLOCK LEVEL FOREWARNING: FEBRUARY 2019					
DISTRICT	**Taluk/Block**	**Black quarter**	**Foot and mouth disease**	**Haemorrhagic septicaemia**	**Peste des petits ruminants**
BAGALKOT	Badami	NR	LR	VLR	NR
BAGALKOT	Bagalkot	NR	VLR	VLR	VLR
BAGALKOT	Bilgi	VLR	VLR	VLR	NR
BAGALKOT	Hungund	VLR	VLR	VLR	NR
BAGALKOT	Jamkhandi	NR	VLR	VLR	NR
BAGALKOT	Mudhol	VLR	VLR	VLR	VLR
BANGALORE	Anekal	VLR	VLR	VLR	VLR
BANGALORE	Bangalore North	VLR	VLR	NR	VLR
BANGALORE	Bangalore South	VLR	VLR	VLR	VLR
BANGALORE RURAL	Devanahalli	VLR	VLR	VLR	VLR
BANGALORE RURAL	DodBallapur	VLR	LR	VLR	VLR
BANGALORE RURAL	Hosakote	VLR	VLR	VLR	NR
BANGALORE RURAL	Nelamangala	NR	VLR	VLR	NR
BELGAUM	Athni	VLR	VLR	LR	NR
BELGAUM	Belgaum	VLR	VLR	VLR	NR
BELGAUM	Chikodi	VLR	VLR	NR	NR
BELGAUM	Gokak	VLR	VLR	VLR	NR
BELGAUM	Hukeri	VLR	MR	VLR	NR
BELGAUM	Khanapur	NR	LR	NR	MR
BELGAUM	Parasgad	NR	VLR	VLR	VLR
BELGAUM	Ramdurg	VLR	VLR	VLR	VLR
BELGAUM	Raybag	VLR	VLR	VLR	NR
BELGAUM	Sampgaon	MR	VLR	MR	NR
BELLARY	Bellary	NR	VLR	VLR	NR
BELLARY	Hadagalli	NR	VLR	VLR	NR
BELLARY	Hagaribommanahalli	NR	VLR	NR	NR

BELLARY	Hospet	NR	VLR	VLR	NR
BELLARY	Kudligi	NR	VLR	VLR	VLR
BELLARY	Sandur	NR	VLR	VLR	VLR
BELLARY	Siruguppa	NR	VLR	VLR	NR
BIDAR	Aurad	VLR	VLR	VLR	NR
BIDAR	Basavakalyan	VLR	VLR	VLR	VLR
BIDAR	Bhalki	LR	VLR	VLR	VLR
BIDAR	Bidar	NR	VLR	VLR	VLR
BIDAR	Homnabad	VLR	VLR	VLR	VLR
BIJAPUR	BasavanaBagevadi	VLR	LR	VLR	VLR
BIJAPUR	Bijapur	VLR	VLR	VLR	NR
BIJAPUR	Indi	VLR	VLR	VLR	NR
BIJAPUR	Muddebihal	NR	VLR	VLR	NR
BIJAPUR	Sindgi	NR	VLR	VLR	VLR
CHAMARAJANAGAR	Chamarajanagar	VLR	VLR	VLR	VLR
CHAMARAJANAGAR	Gundlupet	VLR	VLR	VLR	NR
CHAMARAJANAGAR	Kollegal	VLR	VLR	VLR	VLR
CHAMARAJANAGAR	Yelandur	VLR	VLR	NR	NR
CHIKKABALLAPURA	Bagepalli	NR	VLR	VLR	VLR
CHIKKABALLAPURA	Chikkaballapura	VLR	VLR	VLR	VLR
CHIKKABALLAPURA	Chintamani	NR	VLR	VLR	VLR
CHIKKABALLAPURA	Gauribidanur	NR	VLR	HR	VLR
CHIKKABALLAPURA	Gudibanda	NR	LR	VLR	VLR
CHIKKABALLAPURA	Sidlaghatta	VLR	VLR	VLR	VLR
CHIKMAGALUR	Chikmagalur	VLR	MR	NR	VLR
CHIKMAGALUR	Kadur	VLR	MR	MR	NR
CHIKMAGALUR	Koppa	VLR	VLR	VLR	NR
CHIKMAGALUR	Mudigere	VLR	VLR	VLR	NR
CHIKMAGALUR	Narasimharajapura	VLR	VLR	NR	VLR
CHIKMAGALUR	Sringeri	VLR	VLR	VLR	NR

CHIKMAGALUR	Tarikere	VLR	VLR	VLR	VLR
CHITRADURGA	Challakere	NR	VLR	VLR	HR
CHITRADURGA	Chitradurga	NR	VLR	VLR	NR
CHITRADURGA	Hiriyur	VLR	VLR	VLR	VLR
CHITRADURGA	Holalkere	NR	VLR	VLR	NR
CHITRADURGA	Hosdurga	NR	VLR	VLR	VLR
CHITRADURGA	Molakalmuru	NR	VLR	VLR	VLR
DAKSHINA KANNADA	Bantval	VLR	VLR	NR	VLR
DAKSHINA KANNADA	Beltangadi	NR	VLR	VLR	VLR
DAKSHINA KANNADA	Mangalore	NR	VLR	NR	VLR
DAKSHINA KANNADA	Puttur	VLR	VLR	VLR	NR
DAKSHINA KANNADA	Sulya	NR	VLR	NR	VLR
DAVANAGERE	Channagiri	VLR	VLR	VLR	VLR
DAVANAGERE	Davanagere	NR	VLR	VLR	VLR
DAVANAGERE	Harapanahalli	VLR	VLR	VLR	NR
DAVANAGERE	Harihar	NR	VLR	VLR	NR
DAVANAGERE	Honnali	VLR	VLR	VLR	NR
DAVANAGERE	Jagalur	NR	VLR	VLR	VLR
DHARWAD	Dharwad	NR	VLR	NR	NR
DHARWAD	Hubli	VLR	MR	VLR	NR
DHARWAD	Hubli city	NR	VLR	VLR	VLR
DHARWAD	Kalghatgi	VLR	VLR	VLR	NR
DHARWAD	Kundgol	NR	LR	VLR	NR
DHARWAD	Navalgund	NR	VLR	VLR	VLR
GADAG	Gadag	NR	LR	VLR	NR
GADAG	Mundargi	NR	VLR	VLR	NR
GADAG	Nargund	NR	VLR	VLR	NR
GADAG	Ron	VLR	VLR	LR	NR
GADAG	Shirhatti	NR	VLR	VLR	NR
GULBARGA	Afzalpur	VLR	VLR	VLR	VLR

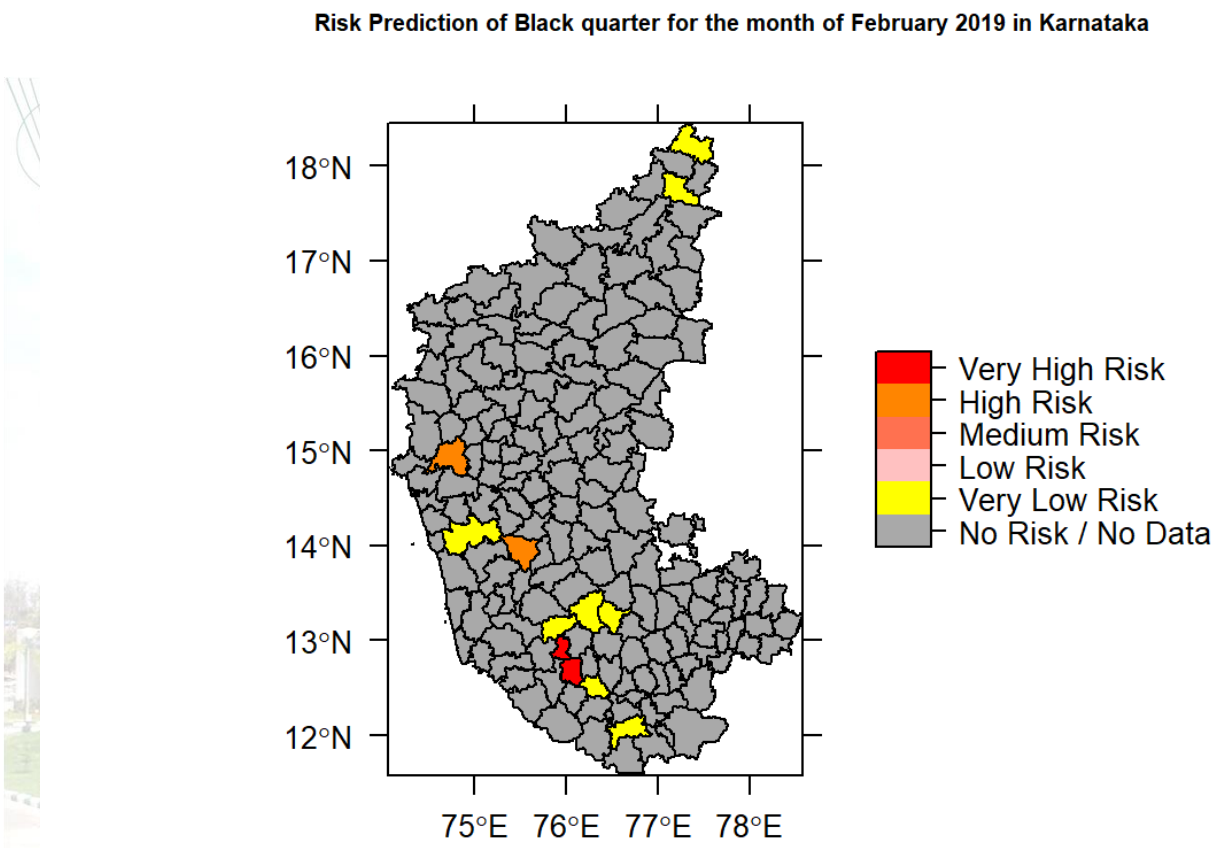
GULBARGA	Aland	NR	VLR	VLR	VLR
GULBARGA	Chincholi	VLR	LR	VLR	NR
GULBARGA	Chitapur	LR	VLR	HR	NR
GULBARGA	Gulbarga	NR	VLR	VLR	NR
GULBARGA	Jevargi	NR	VLR	VLR	NR
GULBARGA	Sedam	NR	VLR	VLR	VLR
HASSAN	Alur	VHR	VLR	VLR	HR
HASSAN	Arkalgud	VHR	LR	VHR	NR
HASSAN	Arsikere	VLR	MR	VLR	NR
HASSAN	Belur	VLR	VLR	VLR	NR
HASSAN	Channarayapatna	LR	MR	VLR	NR
HASSAN	Hassan	VLR	LR	VLR	VLR
HASSAN	Hole Narsipur	NR	VLR	VLR	NR
HASSAN	Sakleshpur	VLR	LR	NR	NR
HAVERI	Byadgi	VLR	VLR	VLR	NR
HAVERI	Hangal	NR	VLR	NR	NR
HAVERI	Haveri	NR	VLR	VLR	NR
HAVERI	Hirekerur	VLR	VLR	VLR	NR
HAVERI	Ranibennur	NR	VLR	VLR	NR
HAVERI	Savanur	NR	VLR	VLR	NR
HAVERI	Shiggaon	VLR	VLR	VLR	NR
KODAGU	Madikeri	NR	LR	VLR	NR
KODAGU	Somvarpet	VLR	VLR	VLR	NR
KODAGU	Virajpet	NR	VLR	NR	NR
KOLAR	Bangarapet	NR	VLR	VLR	NR
KOLAR	Kolar	VLR	VLR	VLR	MR
KOLAR	Malur	NR	VLR	NR	VLR
KOLAR	Mulbagal	NR	VLR	VLR	LR
KOLAR	Srinivaspur	NR	VLR	VLR	VLR
KOPPAL	Gangawati	VLR	VLR	VLR	NR

KOPPAL	Koppal	NR	VLR	VLR	NR
KOPPAL	Kushtagi	VLR	VLR	LR	VLR
KOPPAL	Yelbarga	VLR	VLR	VLR	VLR
MANDYA	Krishnarajpet	NR	VLR	VLR	NR
MANDYA	Maddur	NR	VLR	VLR	VLR
MANDYA	Malavalli	NR	VLR	VLR	NR
MANDYA	Mandya	VLR	VLR	NR	NR
MANDYA	Nagamangala	LR	MR	VLR	VLR
MANDYA	Pandavapura	VLR	VLR	VLR	VLR
MANDYA	Shrirangapattana	NR	VLR	VLR	VLR
MYSORE	Heggadadevankote	VLR	VLR	VLR	VLR
MYSORE	Hunsur	VLR	VLR	VLR	NR
MYSORE	Krishnarajanagara	VLR	VLR	VLR	VLR
MYSORE	Mysore	NR	LR	NR	NR
MYSORE	Nanjangud	VLR	VLR	VLR	VLR
MYSORE	Piriyapatna	HR	LR	VLR	NR
MYSORE	Tirumakudal - Narsipur	VLR	VLR	VLR	NR
RAICHUR	Devadurga	VLR	VLR	VLR	VLR
RAICHUR	Lingsugur	VLR	VLR	VLR	VLR
RAICHUR	Manvi	NR	VLR	VLR	VLR
RAICHUR	Raichur	NR	VLR	VLR	NR
RAICHUR	Sindhnur	NR	VLR	VLR	NR
RAMANAGARA	Channapatna	NR	VLR	VLR	VLR
RAMANAGARA	Kanakapura	NR	VLR	VLR	NR
RAMANAGARA	Magadi	VLR	LR	VLR	VLR
RAMANAGARA	Ramanagara	NR	VLR	NR	VLR
SHIMOGA	Bhadravati	VLR	VLR	VLR	NR
SHIMOGA	Hosanagara	VLR	VLR	NR	VLR
SHIMOGA	Sagar	VLR	VLR	NR	NR
SHIMOGA	Shikarpur	VLR	VLR	VLR	NR

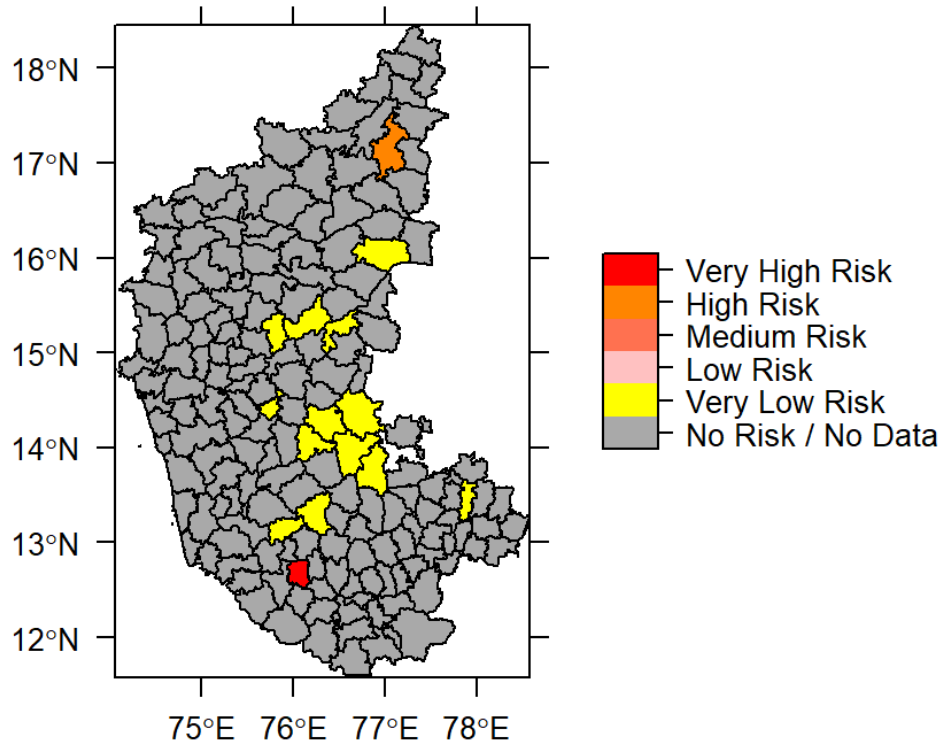
SHIMOGA	Shimoga	HR	VLR	NR	NR
SHIMOGA	Sorab	VLR	VLR	VLR	NR
SHIMOGA	Tirthahalli	VLR	VLR	NR	NR
TUMKUR	Chiknayakanhalli	NR	MR	VLR	NR
TUMKUR	Gubbi	VLR	VLR	VLR	NR
TUMKUR	Koratagere	NR	LR	VLR	NR
TUMKUR	Kunigal	VLR	VLR	NR	NR
TUMKUR	Madhugiri	NR	VLR	VLR	NR
TUMKUR	Pavagada	NR	VLR	LR	VLR
TUMKUR	Sira	VLR	LR	VLR	VLR
TUMKUR	Tiptur	VLR	LR	VLR	NR
TUMKUR	Tumkur	NR	LR	VLR	VLR
TUMKUR	Turuvekere	VLR	VLR	VLR	LR
UDUPI	Karkal	NR	VLR	VLR	NR
UDUPI	Kundapura	NR	VLR	NR	NR
UDUPI	Udupi	NR	VLR	NR	NR
UTTARA KANNADA	Ankola	VLR	VLR	VLR	NR
UTTARA KANNADA	Bhatkal	NR	VLR	VLR	NR
UTTARA KANNADA	Haliyal	VLR	VLR	NR	NR
UTTARA KANNADA	Honavar	NR	VLR	NR	NR
UTTARA KANNADA	Karwar	NR	VLR	NR	VLR
UTTARA KANNADA	Kumta	NR	VLR	VLR	VLR
UTTARA KANNADA	Mundgod	VLR	VLR	NR	NR
UTTARA KANNADA	Siddapur	VLR	VLR	NR	VLR
UTTARA KANNADA	Sirsi	VLR	VLR	NR	NR
UTTARA KANNADA	Supa	VLR	VLR	NR	VLR
UTTARA KANNADA	Yellapur	HR	VLR	NR	NR
YADGIR	Shahpur	VLR	VLR	VLR	NR
YADGIR	Shorapur	VLR	VLR	VLR	NR
YADGIR	Yadgir	NR	VLR	VLR	VLR

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

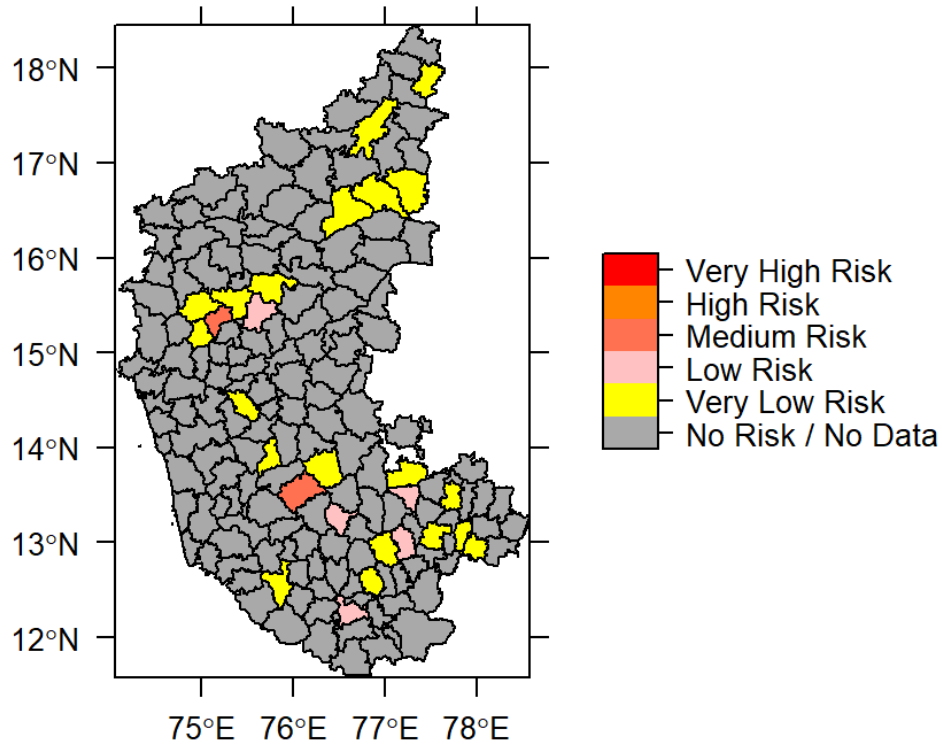
ii) Livestock Risk Prediction – Taluk wise Disease forewarning Maps



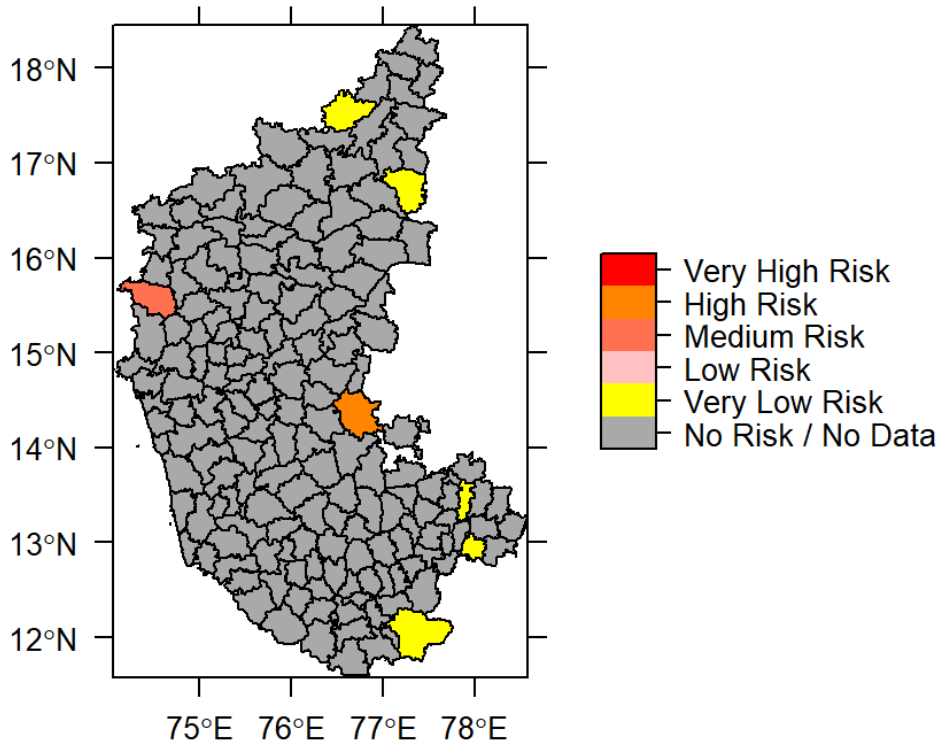
Risk Prediction of Haemorrhagic septicaemia for the month of February 2019 in Karnataka



Risk Prediction of Foot and mouth disease for the month of February 2019 in Karnataka



Risk Prediction of Peste des petits ruminants for the month of February 2019 in Karnataka



5. **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

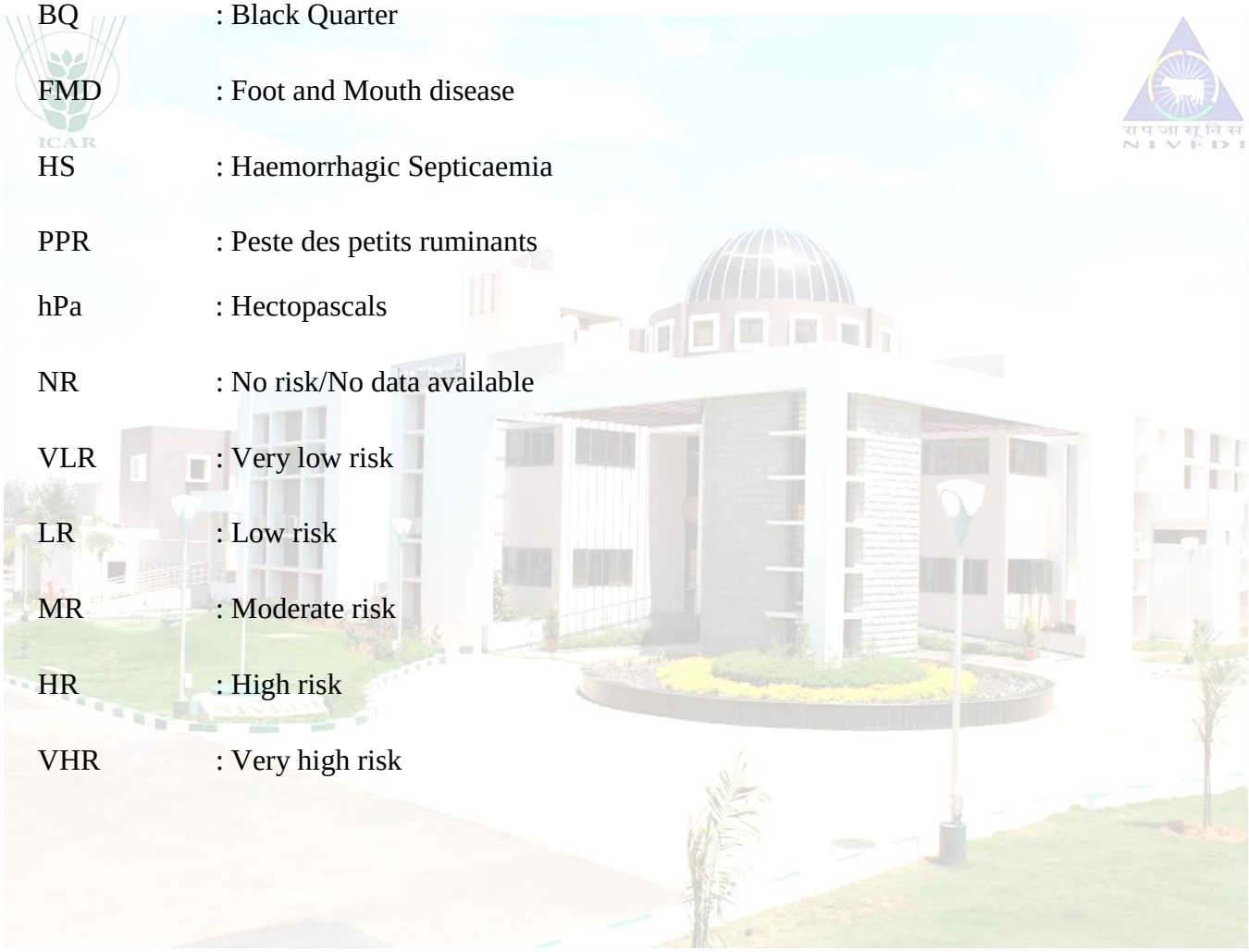
VLR : Very low risk

LR : Low risk

MR : Moderate risk

HR : High risk

VHR : Very high risk



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