

Improving decision-making for Rift Valley fever prevention in Senegal using knowledge-driven spatial modelling approaches

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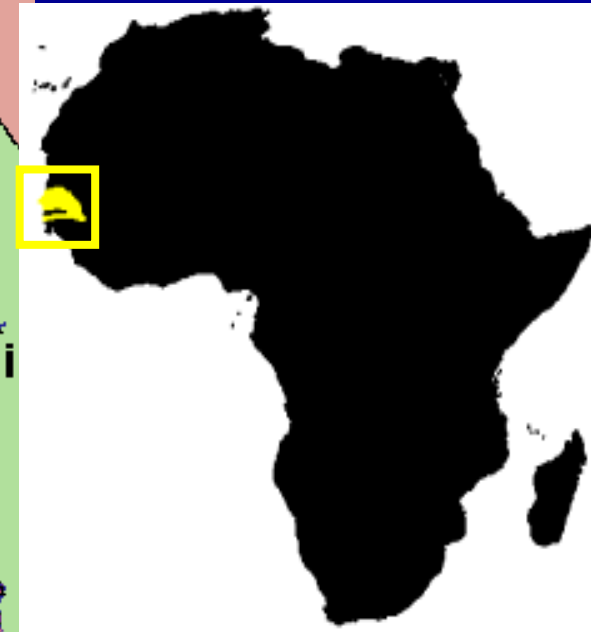
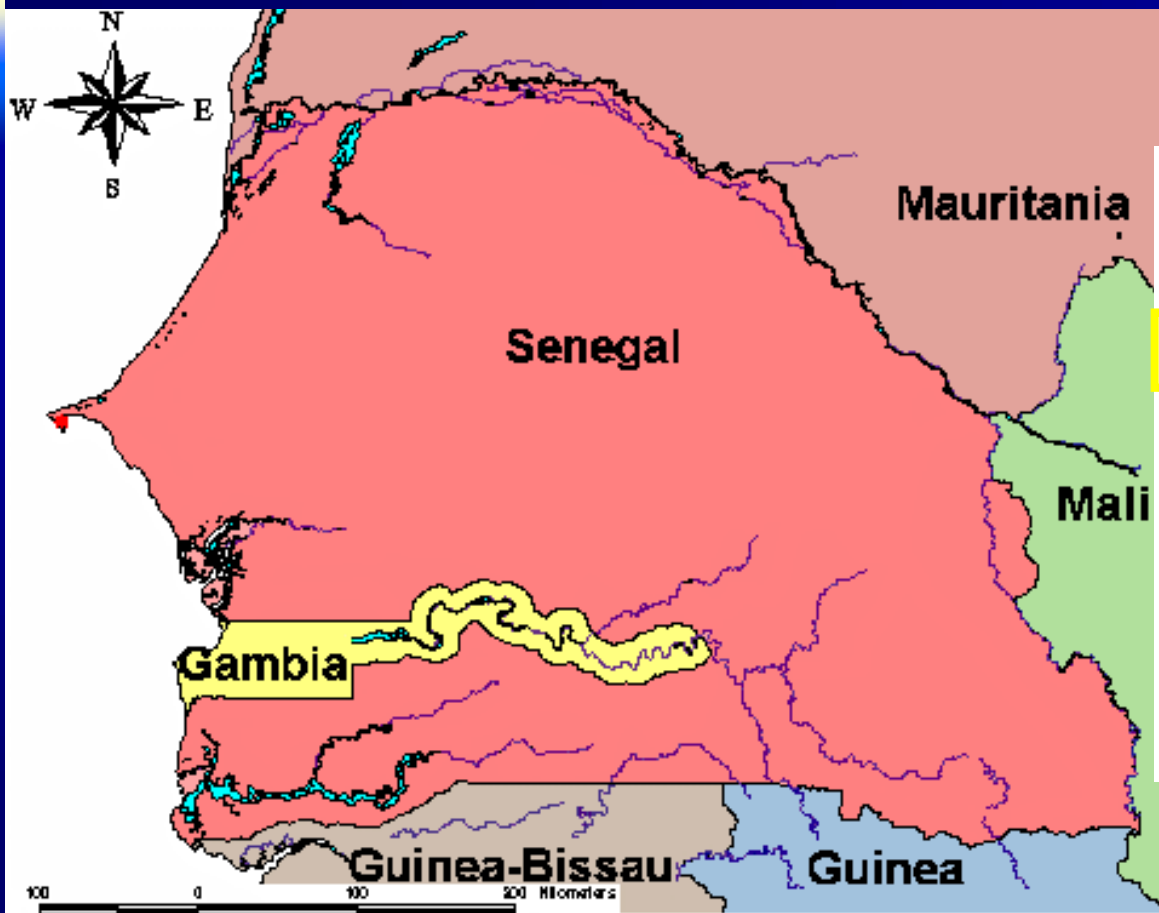
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Introduction

- RVF: arbovirus, wide range of host species
- Affects all species of domestic ruminant and man (public health concern)
- Economic consequences: mortality, abortion, movement restrictions

Geographical context



Multiple Criteria Decision Making (MCDM)

- Aim:
 - To produce maps of RVF suitability
 - To use maps to assist national policy-makers in RVF prevention
- Method: Weighted linear combination
- Software: IDRISI

Weighted linear combination

- Various factors (criteria) are considered in terms of their impact on the outcome (RVF suitability)
- Knowledge of the following is modelled:
 - Shape of the relationship between the criterion and the outcome
 - Relative weights of each criterion in terms of importance to the outcome

Sources of information

- Systematic review of the literature
- Disease reports to the OIE
- Field data
- Other unpublished data & “grey” literature
- Expert opinion

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Systematic review

- Search on CAB abstracts, PubMed, ISI Web Of Science, search engines for selected online journals
- Papers on RVF epidemiology
 - Sero-epidemiological surveys
 - Outbreak reports
 - Vector studies
 - Spatial or ecological studies

Metadata

- 98 papers were obtained

Type of Investigation	Number of Publications
Sero-epidemiological surveys:	
Cross-sectional	50
Longitudinal	9
Outbreak report	25
Vector studies	13
Spatial/ecological studies	9

Metadata cont...

Region	Number of references
West Africa	35
Egypt and Sudan	20
East Africa	19
Arabian Peninsula	10
Southern Africa & Madagascar	9
Central Africa	6

Factors for RVF suitability

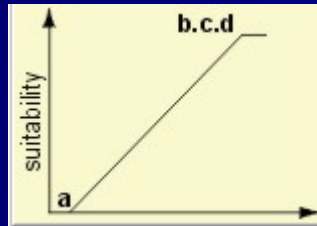
Factor	Publications
Exceptional rain or floods	26
Following rain	20
Vegetation/land-cover	14
Vector abundance	13
Human factors	12
Sheep present	9
Animal movement/importation	8
Low-lying area/floodplain	7
Proximity to swamp/small river	6
Irrigation	6
Proximity to lakes	6
Proximity to river	6

Available geographical data

- Rainfall
- Land-cover
- Cattle density
- Elevation
- Location of lakes and rivers
- Location of non-perennial streams

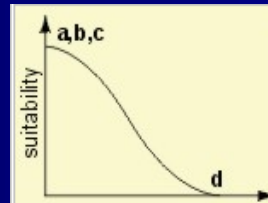
Standardisation on linear scale

Cattle density



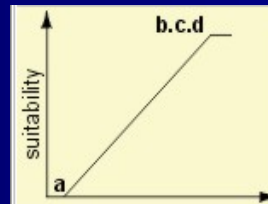
$a = 0$, $b = 80$, linear

Distance to water bodies



$c = 0$, $d = 0.05$, sigmoid

Land cover suitability

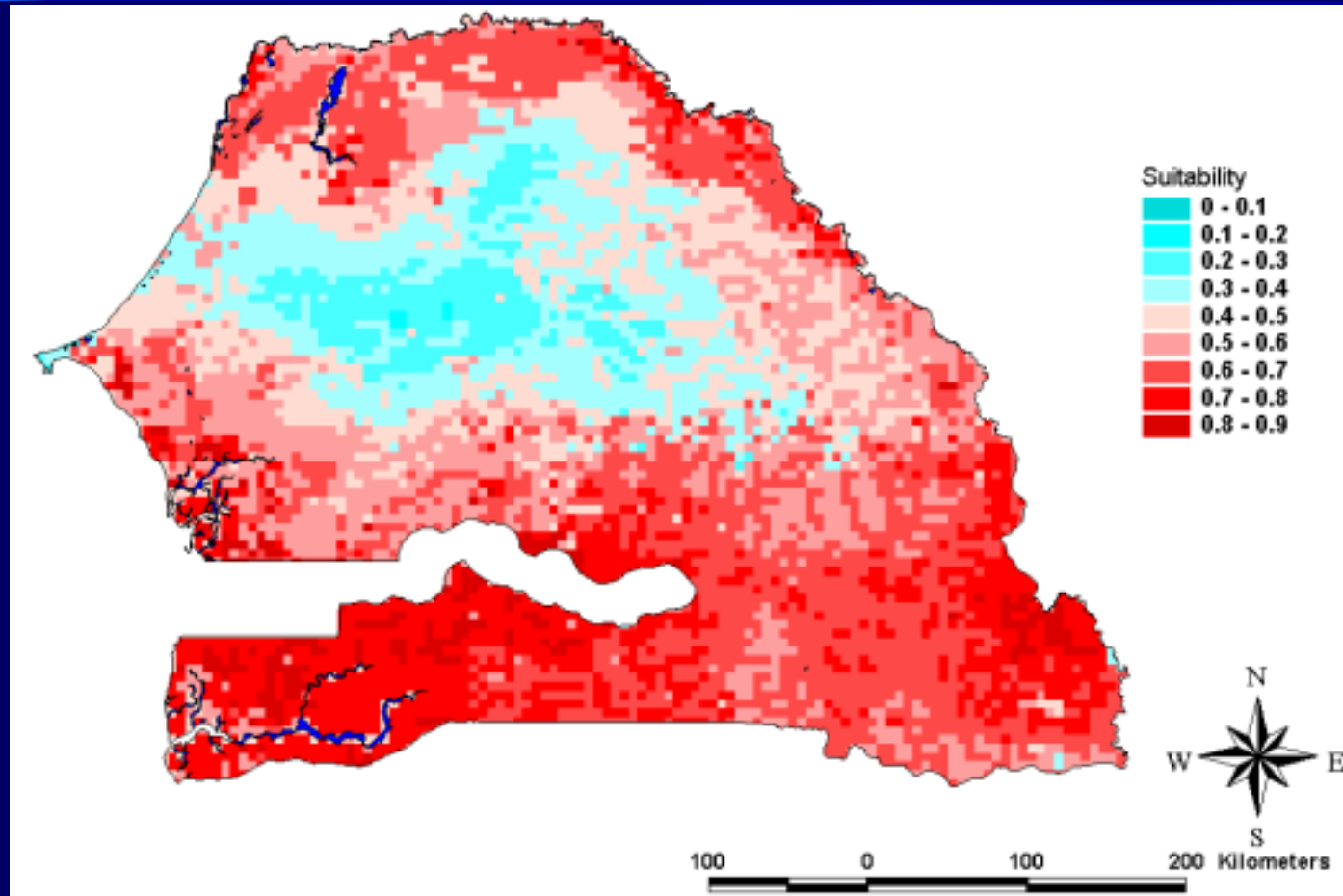


$a = 0$, $b = 1$, linear

Weight factors: Analytical hierarchy process

	Cattle density	Land cover	Distance NPR	Distance NPWB	Distance PR/PWB
Cattle density	1.00				
Land cover	1.75	1.00			
Distance NPR	0.50	0.30	1.00		
Distance NPWB	0.60	0.35	1.20	1.00	
Distance PR/PWB	1.10	0.50	1.90	1.80	1.00

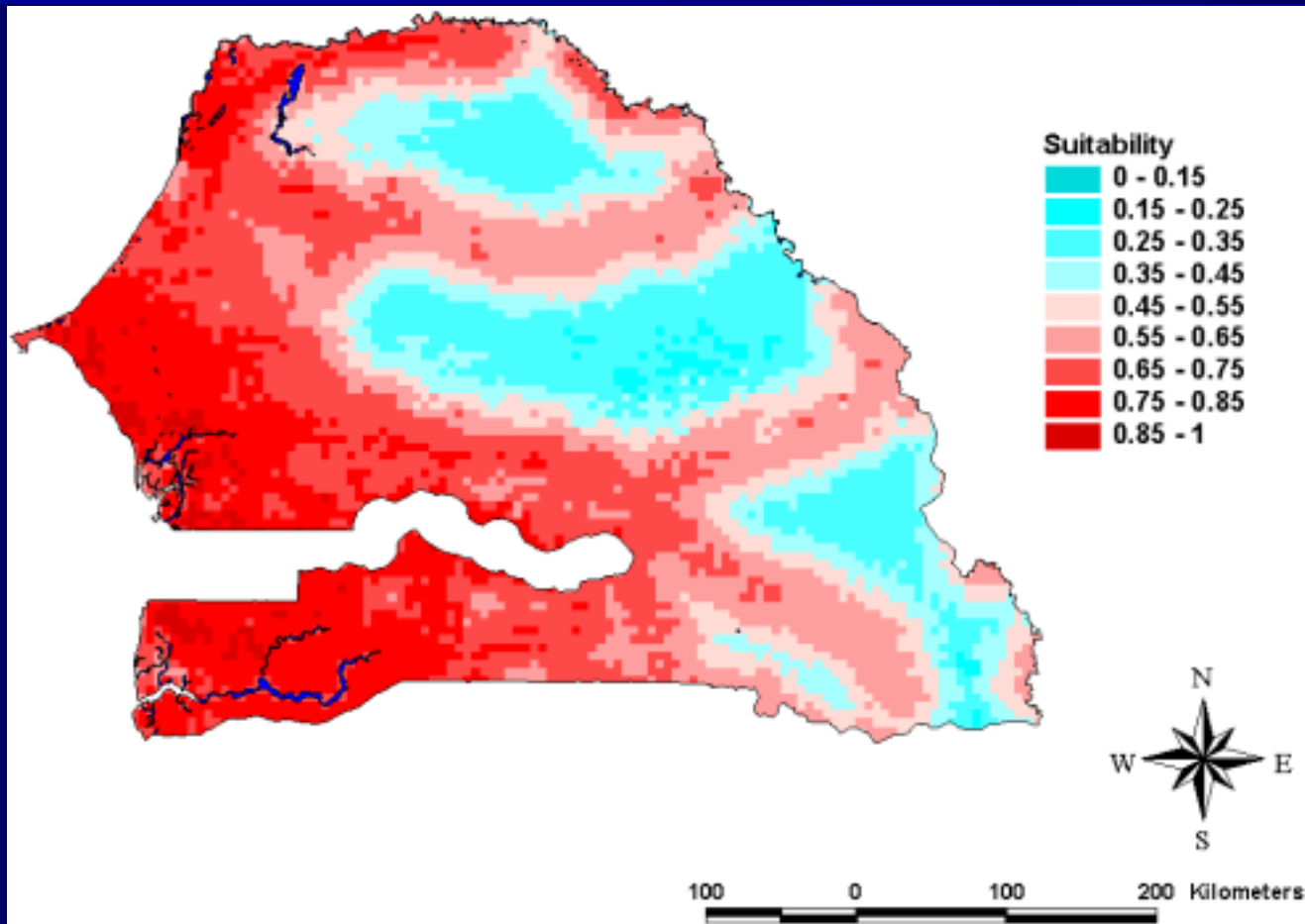
MCDM: Suitability map for RVF



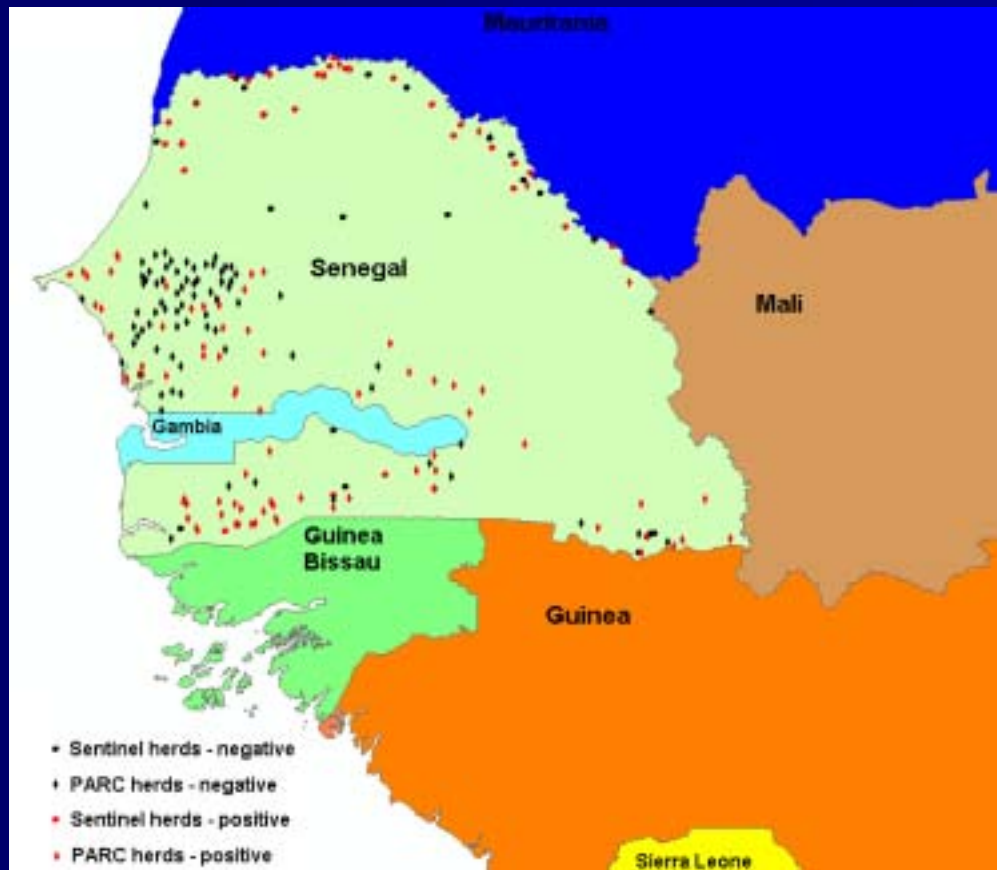
How can this information be used?

- Sentinel surveillance systems
 - Optimise the geographic selection of sentinel herds and entomological surveillance sites
- Vaccination programmes
 - Herds on the fringe of endemic areas
 - Animals moving into endemic areas

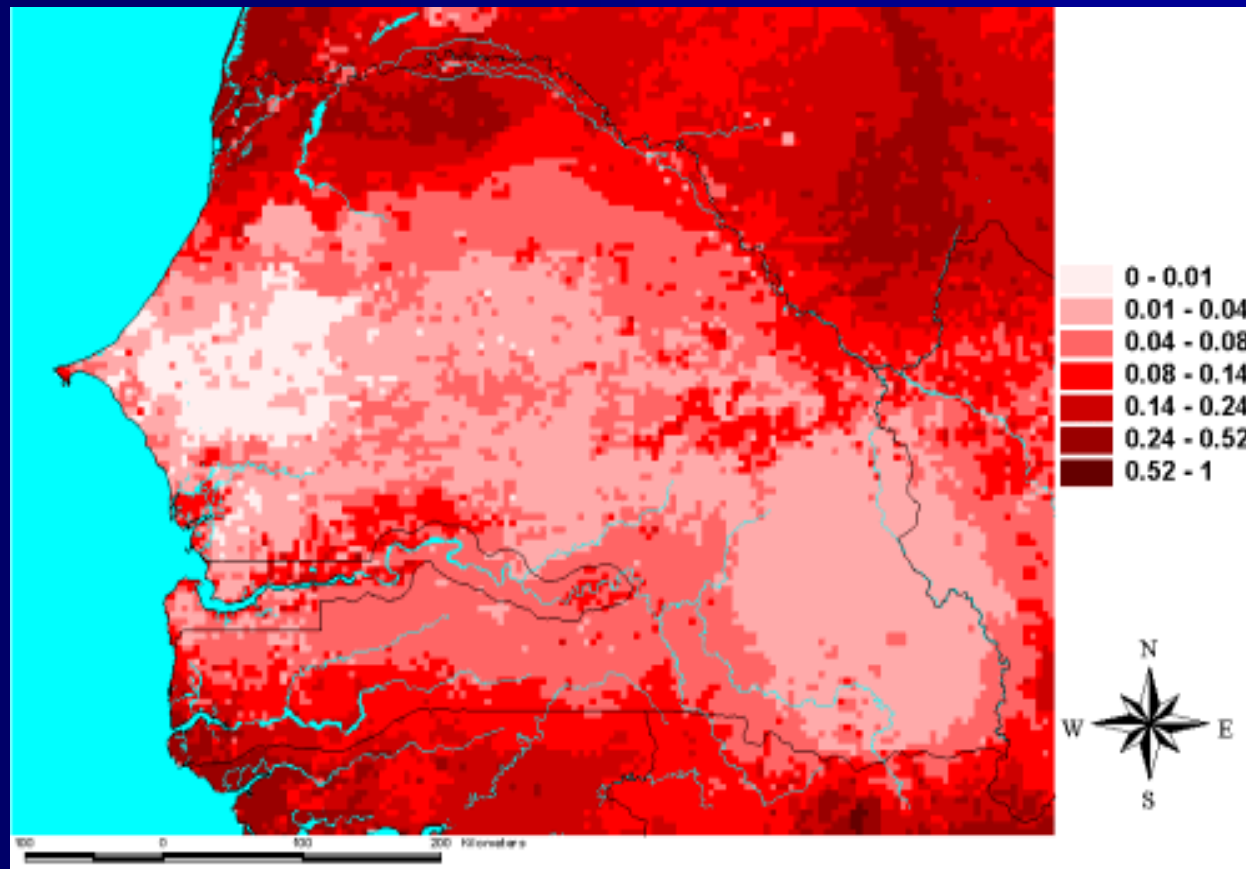
MCDM: Feasibility map for intervention



Existing serological data



Bayesian regression analysis



Dempster-Shafer theory

- Incorporates uncertainty
- Outcome for each cell is a distribution that reflects strength of the knowledge used
- Modelled using “belief functions”
- Can be implemented empirically using IDRISI but no software widely available for full implementation

Conclusion

- Range of approaches available to make use of all available information
- Knowledge driven approach enables integration of data
 - Different sources
 - Range of quality