Epidemiology of Bovine Brucellosis in China and Risk Analysis of Regional Introduction in Hubei Province

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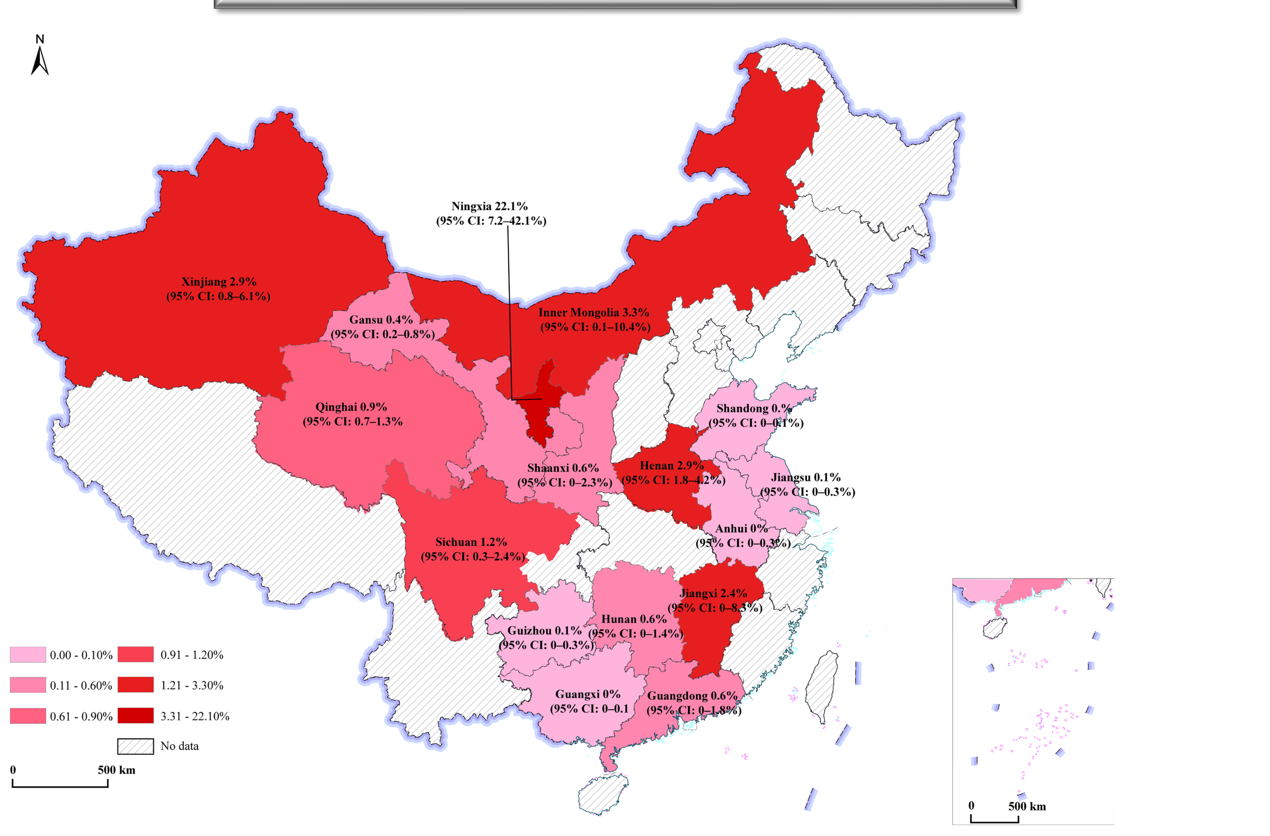
Background

- Brucellosis remains a significant zoonotic threat in China, affecting both animal and human health despite ongoing control efforts. Effective management is challenged by the disease's complex epidemiology and its economic and public health impacts.
- Comprehensive data on brucellosis prevalence, including differences across cattle breeds, production types, and the disease's temporal and spatial patterns, are crucial for designing targeted prevention and control strategies in China.
- Key points in the cattle trade chain in a county of Hubei have been identified and quantitatively assessed.

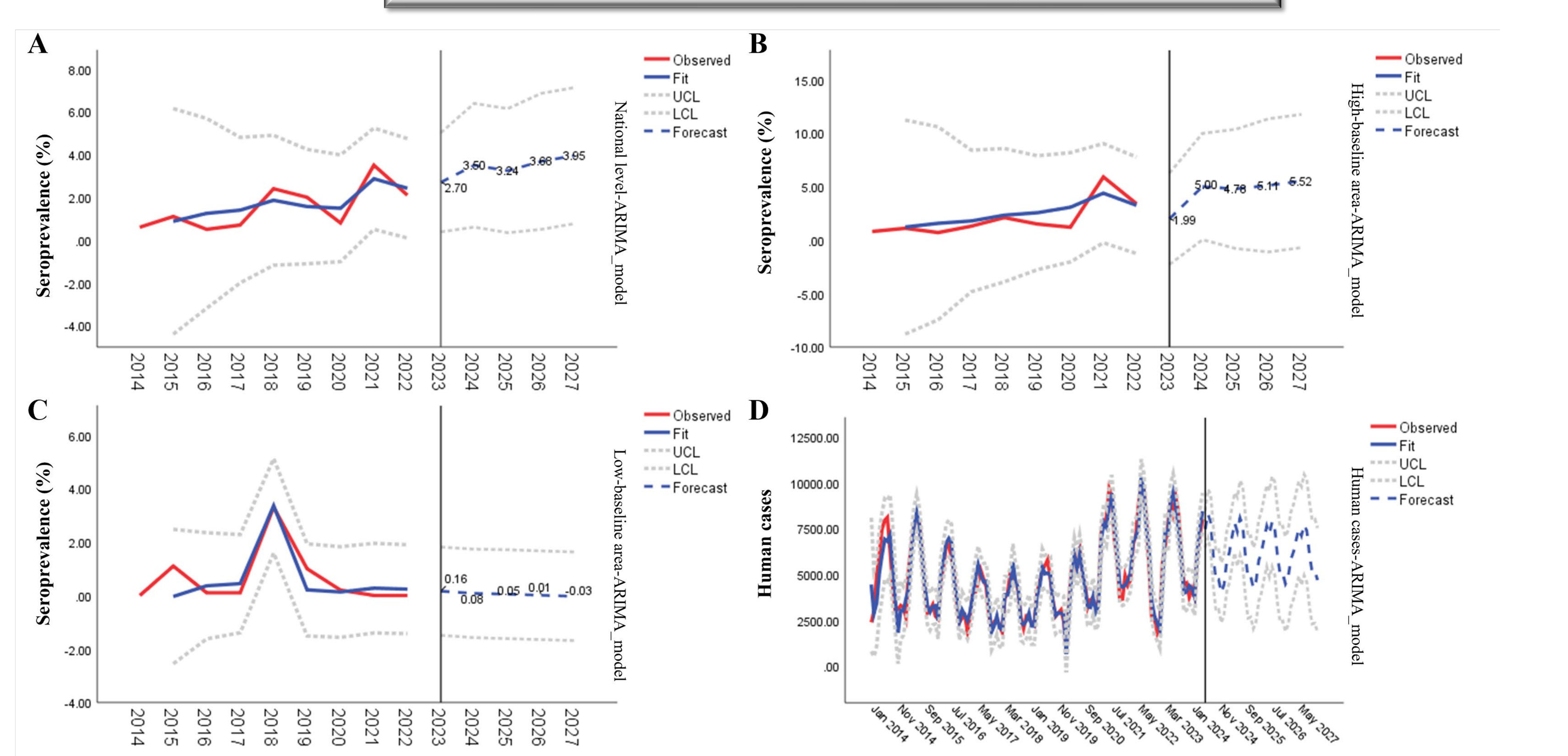
Results and Discussion

Map for Data Visualization



- Bovine brucellosis seroprevalence from 2014 to 2024 was 1.5% (95% CI: 0.6-2.6%), higher in dairy cattle (3.1%) than in beef cattle (1.3%). This poses public health risks, as rising animal infections can increase human cases, emphasizing the need for coordinated veterinary and public health surveillance.

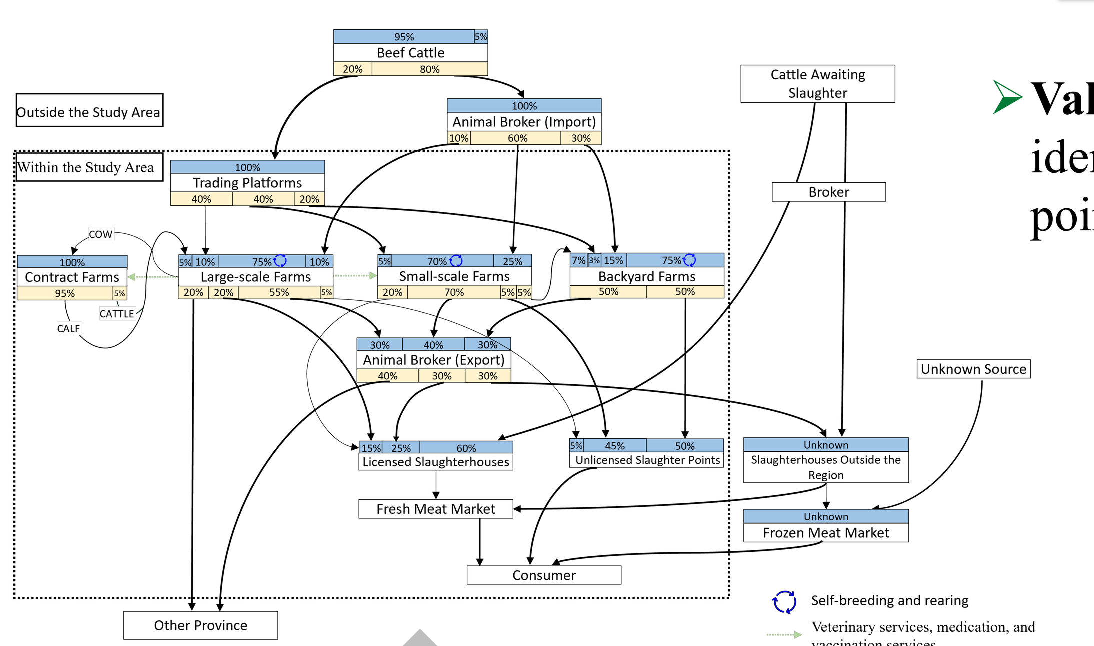
ARIMA Model Prediction (2014-2027)



- A: bovine brucellosis seroprevalence at national level. B: bovine brucellosis seroprevalence in high-baseline area, C: bovine brucellosis seroprevalence in low-baseline area. D: Human brucellosis cases in China. The ARIMA model forecasts an increase in bovine brucellosis from 2.70% to 3.95%, with human cases fluctuating between 2,500 and 12,500 annually from 2024 to 2027.

Tian Z, et al. *Emerg Microbes Infect*. 2024;13(1):2417859

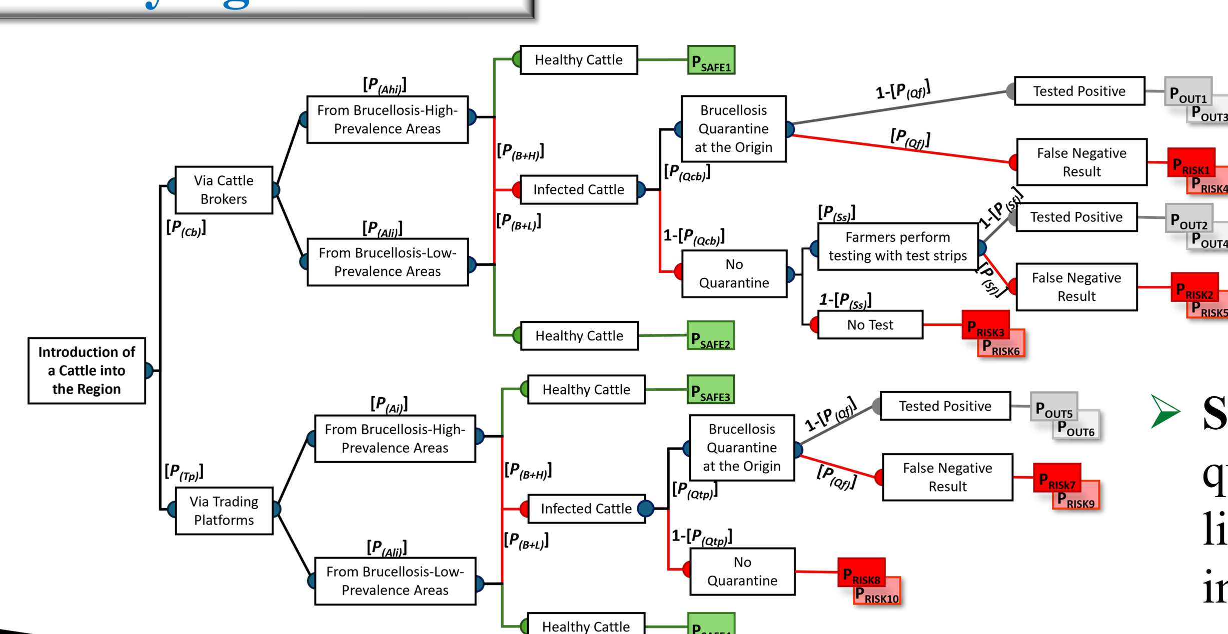
Mapping and Quantifying Risks



- **Value chain mapping** identifies key risk points and pathways

Pathways & Quota

Risk Management



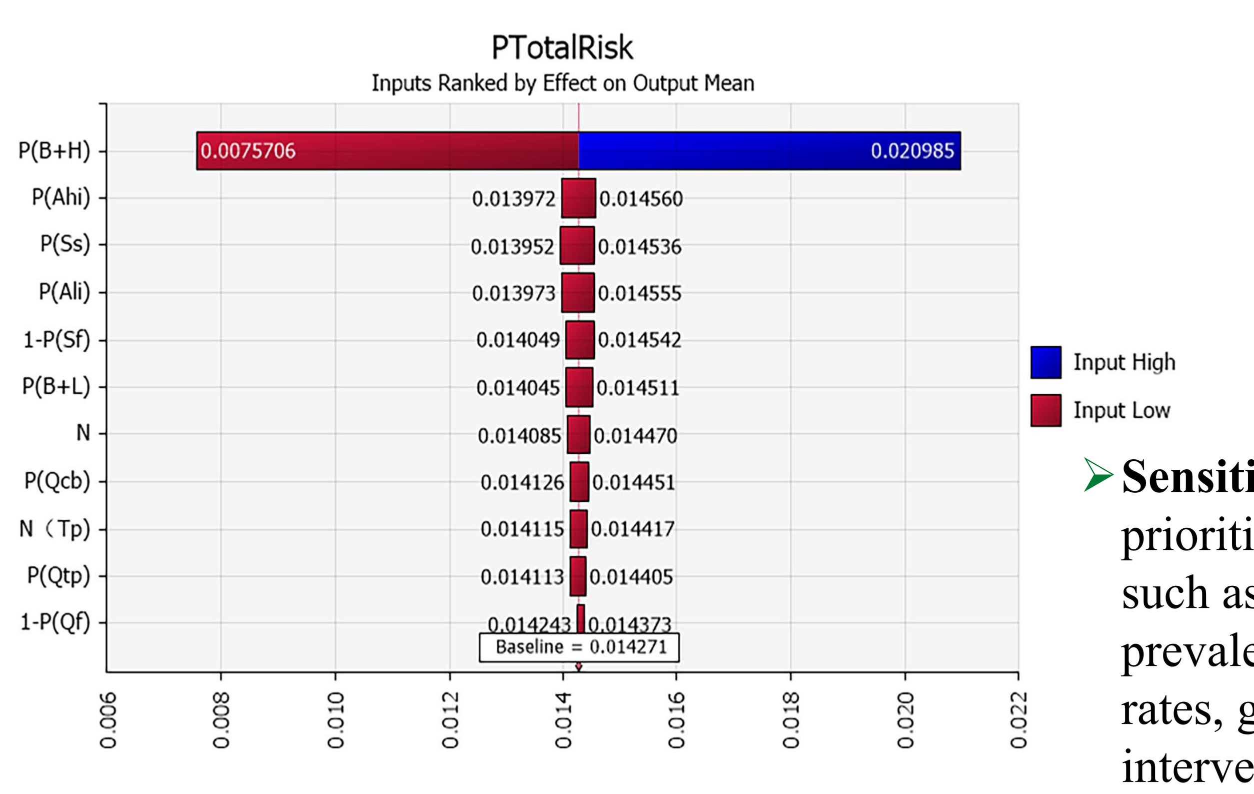
- **Scenario Tree Model** quantifies the likelihood of disease introduction

Model Framework

Name	Interpretation	Formulation	Distribution Graph	Min	Max	Mean
P_{Risk1}	Probability of brucellosis introduction through different pathways	$P_{(Cb)}*P_{(Ahi)}*P_{(B+H)}*P_{(Qtp)}*P_{(Qf)}$		-7.13E-07	4.39E-05	1.46E-05
P_{Risk2}		$P_{(Cb)}*P_{(Ahi)}*P_{(B+H)}*(1-P_{(Qcb)})*P_{(Ss)}*P_{(sf)}$		-3.46E-06	3.97E-04	6.89E-05
P_{Risk3}		$P_{(Cb)}*P_{(Ahi)}*P_{(B+H)}*(1-P_{(Qcb)})*(1-P_{(Ss)})$		-5.92E-04	2.22E-02	1.11E-02
P_{Risk4}		$P_{(Cb)}*P_{(Ali)}*P_{(B+L)}*P_{(Qcb)}*P_{(Qf)}$		1.24E-11	5.52E-07	9.85E-08
P_{Risk5}		$P_{(Cb)}* P_{(Ali)}*P_{(B+L)}*(1-P_{(Qcb)})*P_{(Ss)}*P_{(sf)}$		2.44E-11	4.16E-06	4.68E-07
P_{Risk6}		$P_{(Cb)}*P_{(Ali)}*P_{(B+L)}*(1- P_{(Qcb)})*(1-P_{(Ss)})$		8.95E-09	2.95E-04	7.55E-05
P_{Risk7}		$P_{(Tp)}*P_{(Ahi)}*P_{(B+H)}*P_{(Qtp)}*P_{(Qf)}$		-8.13E-07	4.63E-05	1.50E-05
P_{Risk8}		$P_{(Tp)}*P_{(Ahi)}*P_{(B+H)}*(1-P_{(Qtp)})$		-1.83E-04	8.15E-03	2.96E-03
P_{Risk9}		$P_{(Tp)}*P_{(Ali)}*P_{(B+L)}*P_{(Qtp)}*P_{(Qf)}$		1.16E-11	5.63E-07	1.01E-07
P_{Risk10}		$P_{(Tp)}*P_{(Ali)}*P_{(B+L)}*(1-P_{(Qtp)})$		2.16E-09	8.84E-05	2.01E-05
$P_{TotalRisk}$	Probability that any single feeder cattle introduced into the study area tests positive with brucellosis	$P_{TotalRisk}=\frac{\sum P_{Risk}}{1-\sum P_{Out}}$		-5.98E-04	3.04E-02	1.43E-02
$P_{AnnualRisk}$	Probability of introducing at least one brucellosis-positive animal through imported cattle each year	$1-(1-P_{TotalRisk})^{Unifrom(Inported)}$		-5.08E+01	1.00E+00	9.95E-01

- **Risk Assessment** refine our understanding by addressing uncertainties in risk factors

Sensitivity Analysis



- **Sensitivity analysis** prioritizes factors such as regional prevalence and testing rates, guiding targeted interventions

Conclusion

- Comprehensive Framework: This study integrates meta-analysis, value chain investigation, and quantitative risk assessment to create a comprehensive approach for brucellosis control.
- Key Risk Identification: The methods pinpoint critical risk points in the cattle trade, allowing targeted interventions at vulnerable stages of the value chain.
- Data-Driven Strategy: By quantifying disease introduction risks and prioritizing control measures, the framework provides a solid basis for preventing brucellosis spread in both cattle and humans.