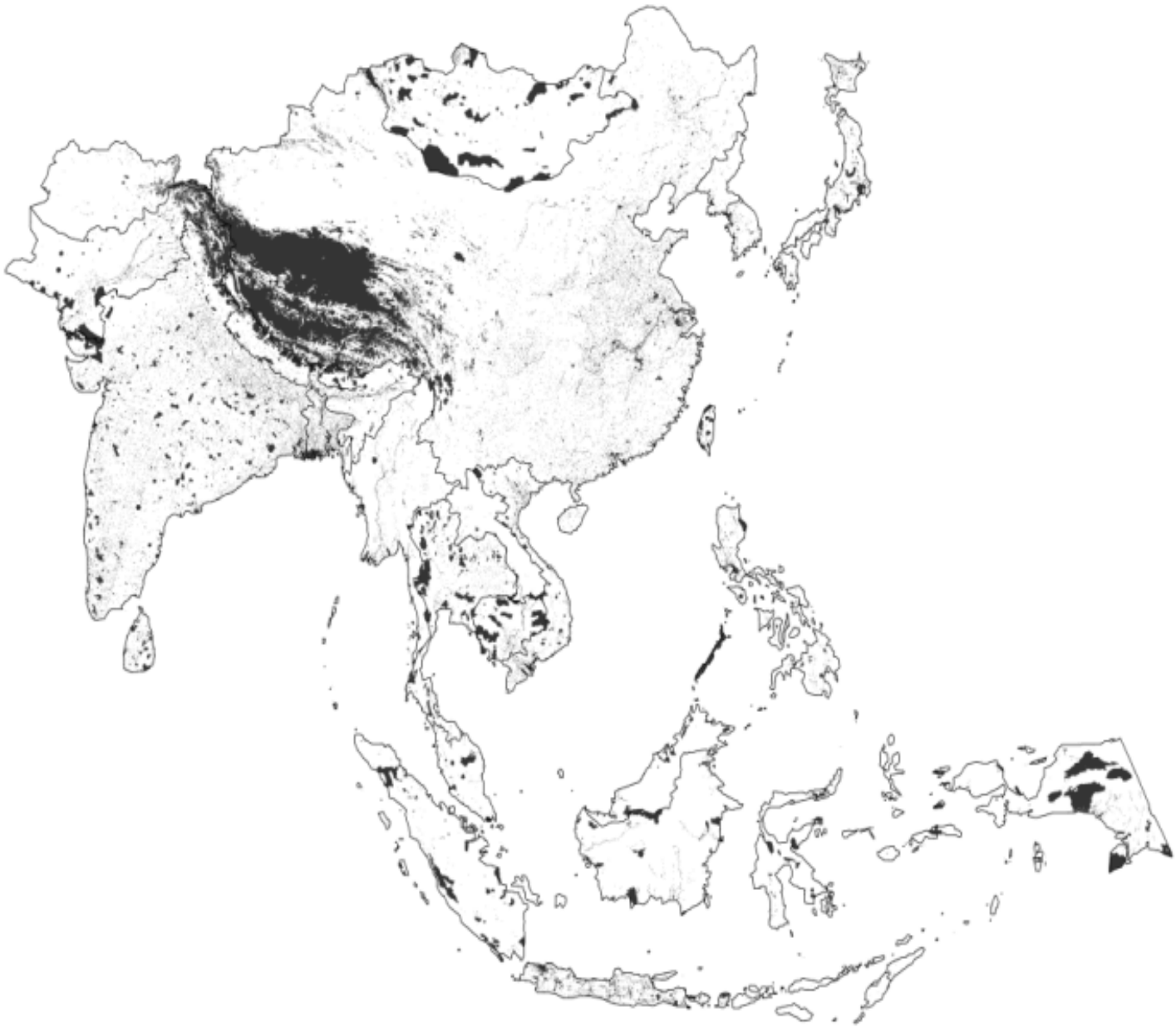
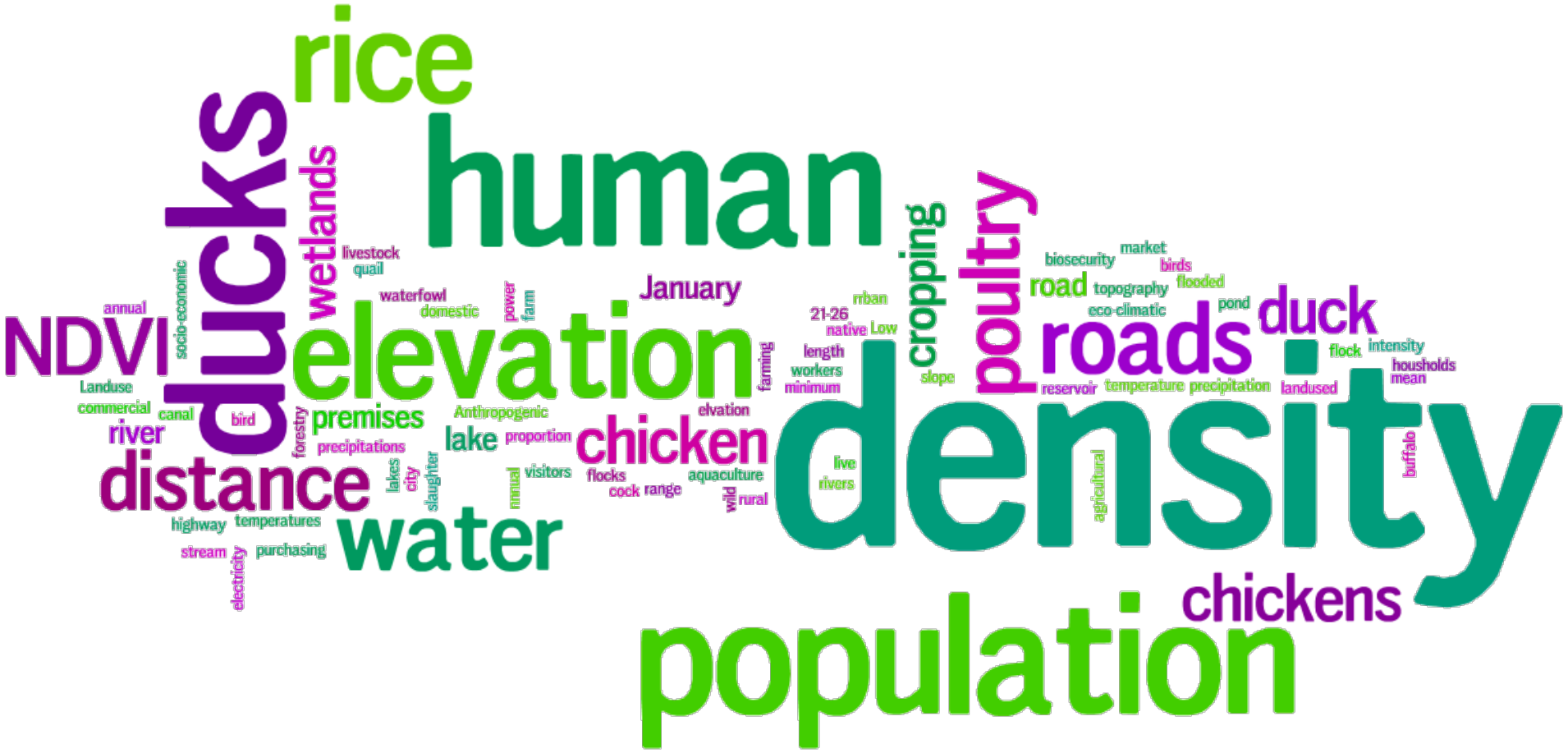
1b. To constrain or not to constrain…



2a. Identify variables associated with outcome



2b. Maps sourced from public domain

VMap0 Perennial Water Courses (Rivers) of the World

Suitability for Rain-fed and Irrigated Rice (High Input)

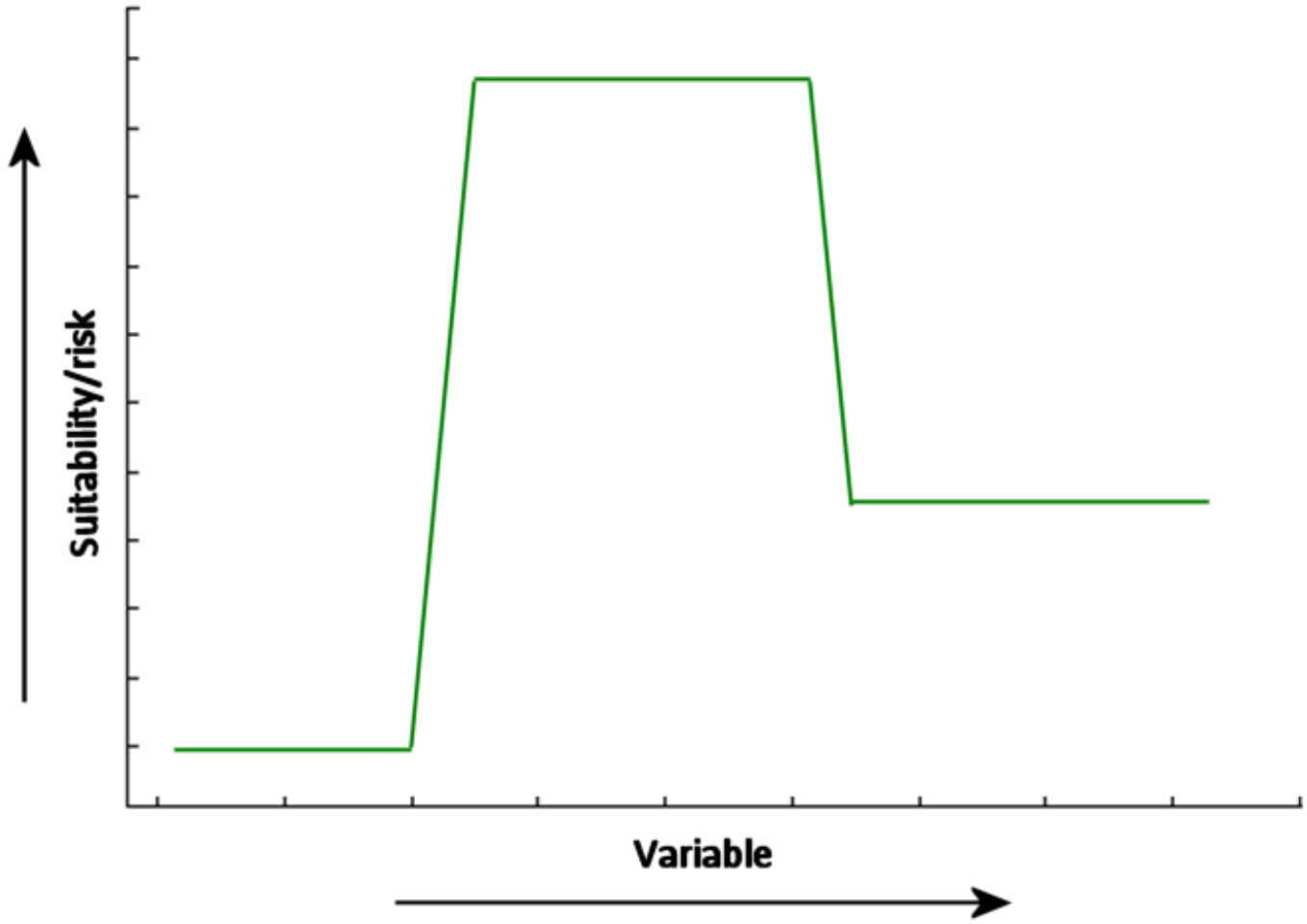
VMap0 Roads of the World

Gridded Population of the World v3

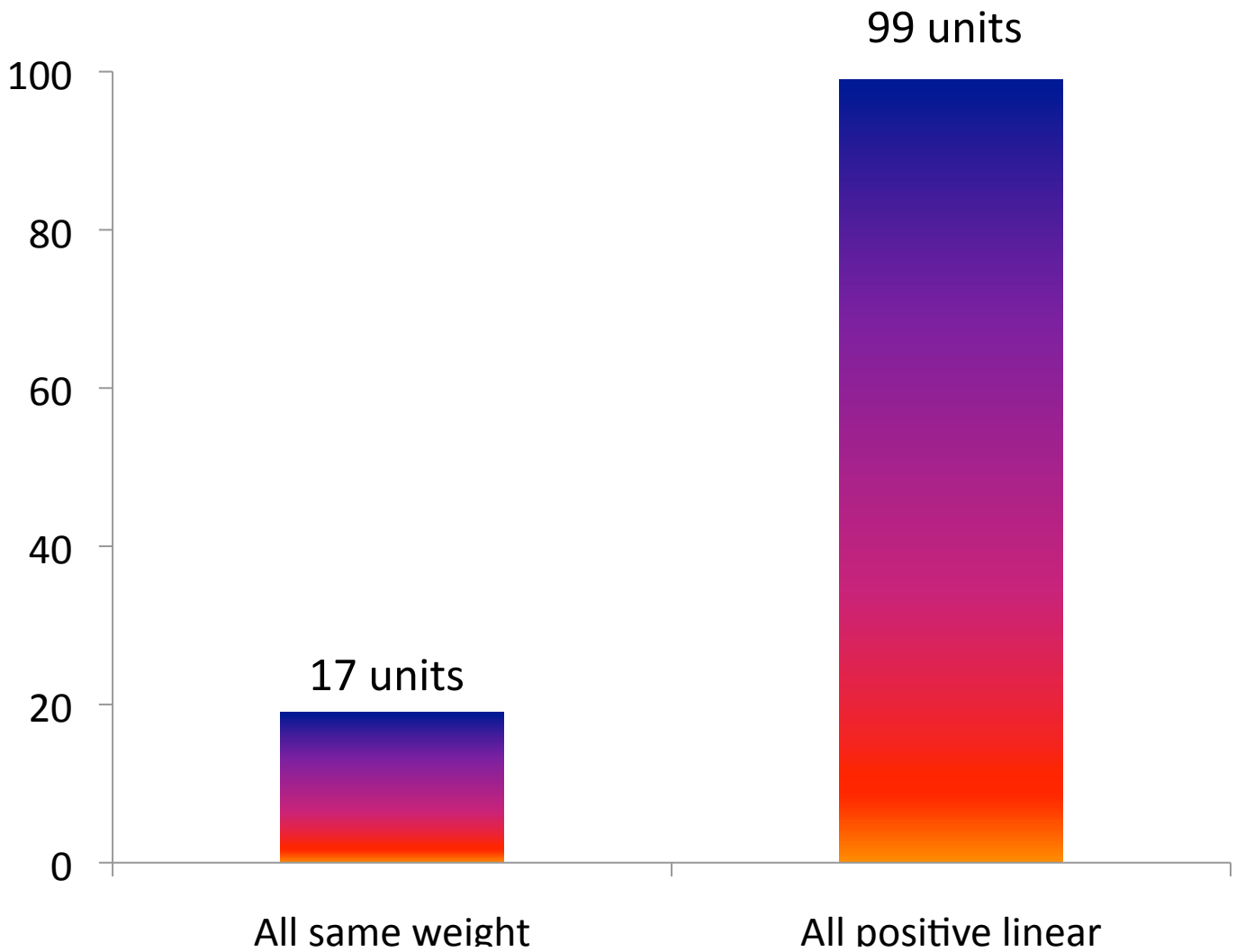
Prosser D, *et al*. (2011). Modelling the distribution of chickens, ducks, and geese in China. *Agriculture, Ecosystems and Environment*, 141:381-389

Van Boeckel M, *et al*. (2011). Modelling the distribution of domestic duck in Monsoon Asia. *Agriculture, Ecosystems and Environment*, 141:373-380

3a. Define relationship between each variable and outcome using fuzzy membership functions



3b. Correct fuzzy membership function more important than correct weights



4. Derive weight for each variable using pair-wise comparison matrix

Less important						More important		
1/9	1/7	1/5	1/3	1	3	5	7	9
extremely	very strongly	strongly	moderately	equally	moderately	strongly	very strongly	extremely

	WfowlDen	PopDen	ProxRoads	ProxWater	ChickDen	ProxRice	Weight
WfowlDen	**1**						0.3768
PopDen	**1/2**	**1**					0.2472
ProxRoads	**1/3**	**1/2**	**1**				0.1574
ProxWater	**1/4**	**1/3**	**1/2**	**1**			0.1149
ProxRice	**1/5**	**1/4**	**1/3**	**1/3**	**1**		0.0652
ChickDen	**1/6**	**1/5**	**1/4**	**1/4**	**1/3**	**1**	0.0384

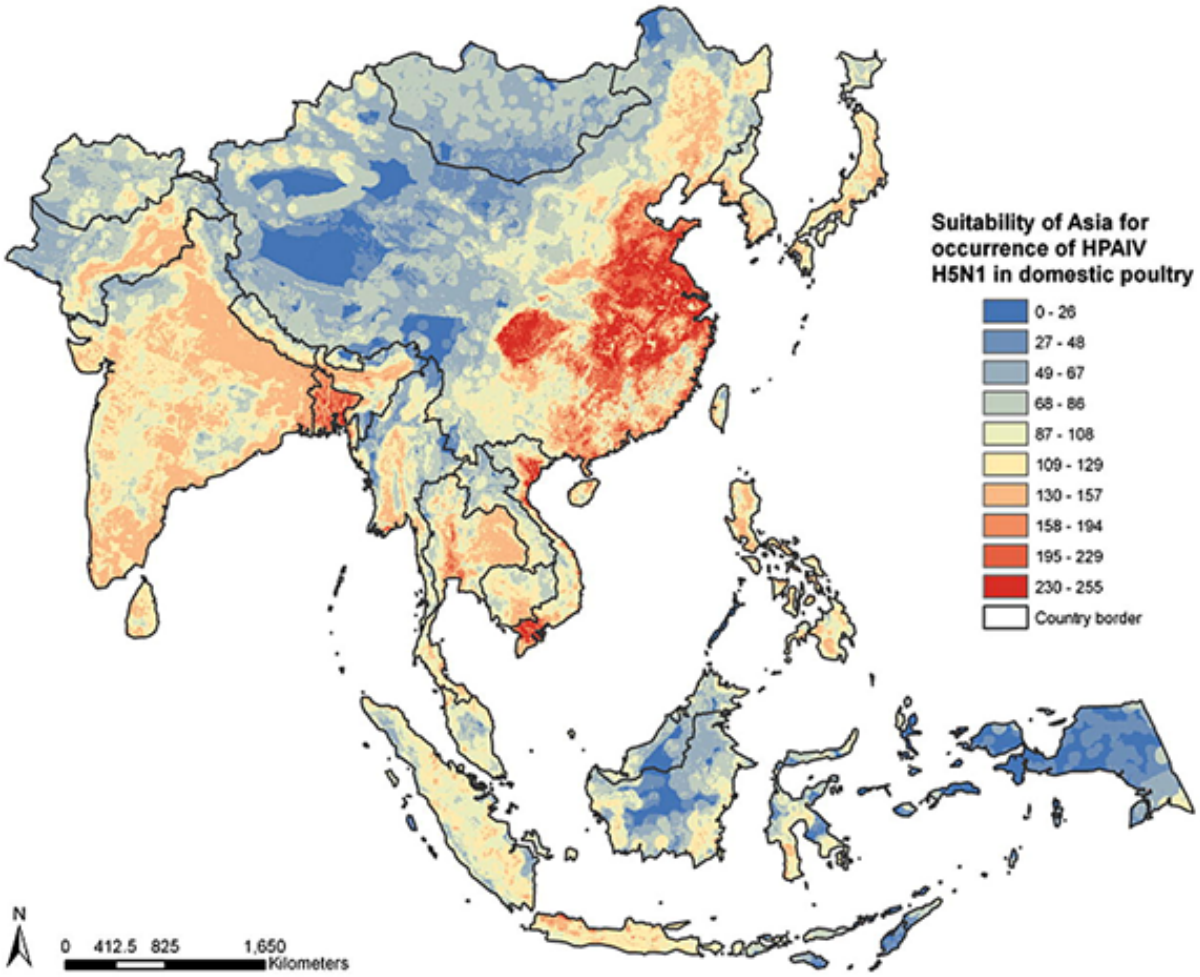
4a. Determine and account for any correlation between variables by adjusting weights

	WfowlDen	PopDen	ProxRoads	ProxWater	ProxRice	ChickDen
WfowlDen	1	0.25	-0.08	-0.03	-0.20	0.34
PopDen		1	-0.33	0.26	**-0.55**	**0.55**
ProxRoads			1	-0.09	0.27	-0.24
ProxWater				1	-0.18	0.09
ProxRice					1	**-0.47**
ChickDen						1

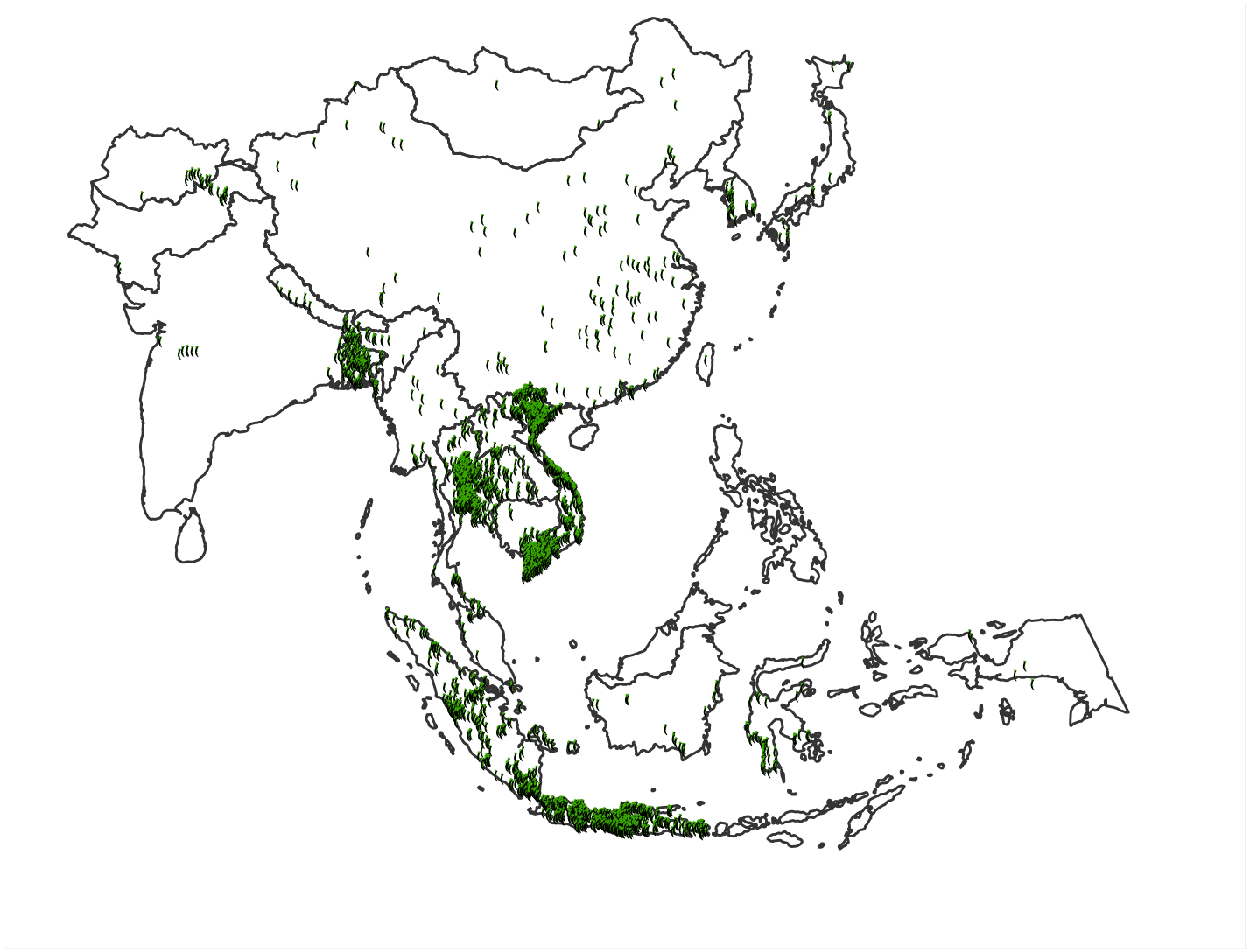
4b. Determine and account for any correlation between variables by adjusting weights

Risk factor	Weight		Adjustment
	Original	Adjusted for correlation	
WfowlDen	0.3768	0.4281	
PopDen	0.2472	0.1978	Adjusted ↓ for correlation with ProxRice (-10%) and ChickDen (-10%)
ProxRoad	0.1574	0.1767	
ProxRice	0.1149	0.0919	Adjusted ↓ for correlation with PopDen (-10%) and ChickDen (-10%)
ProxWater	0.0652	0.0748	
ChickDen	0.0384	0.0307	Adjusted ↓ for correlation with ProxRice (-10%) and PopDen (-10%)

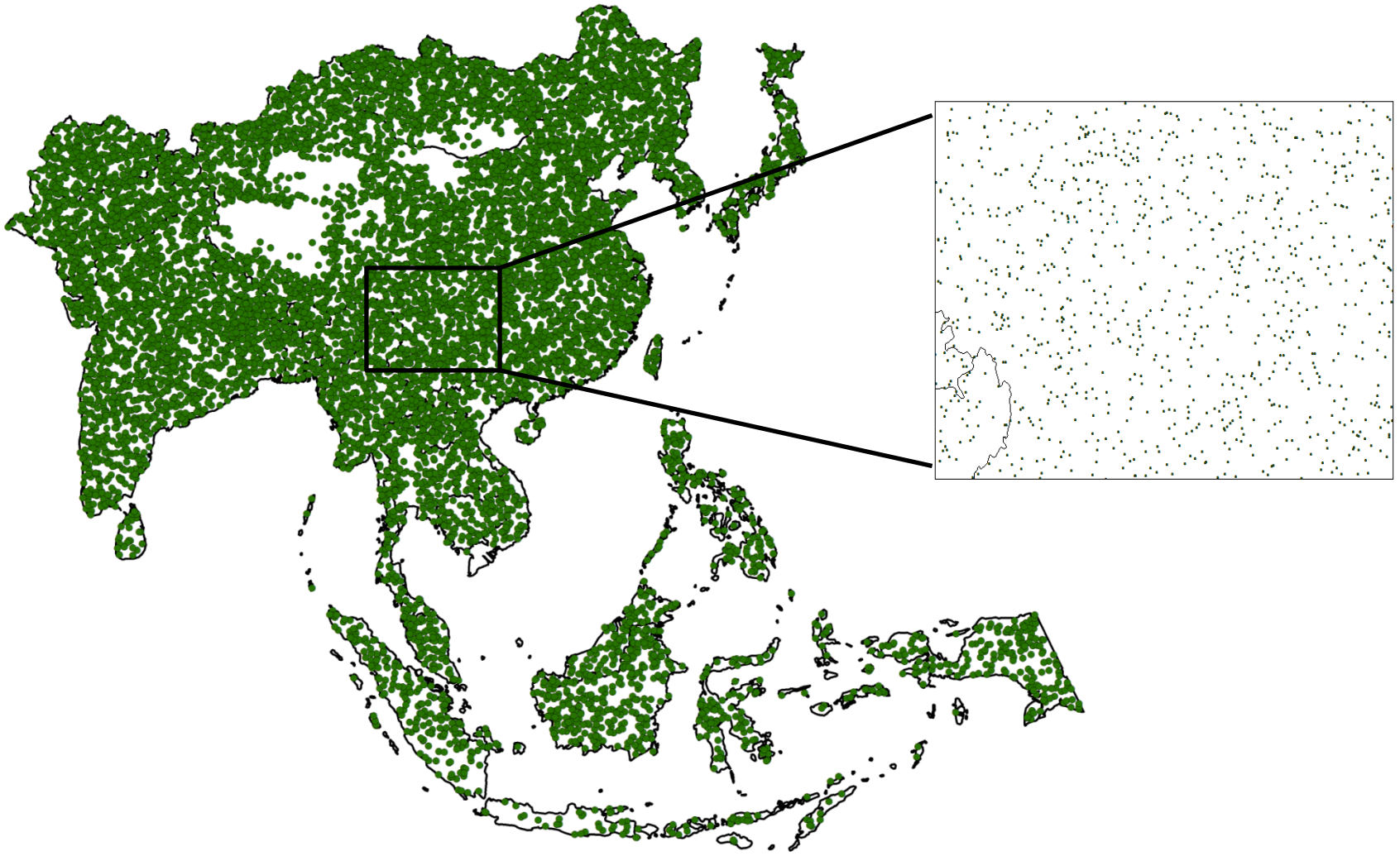
5. Combine standardised variable maps and weights using weighted linear combination to create suitability map



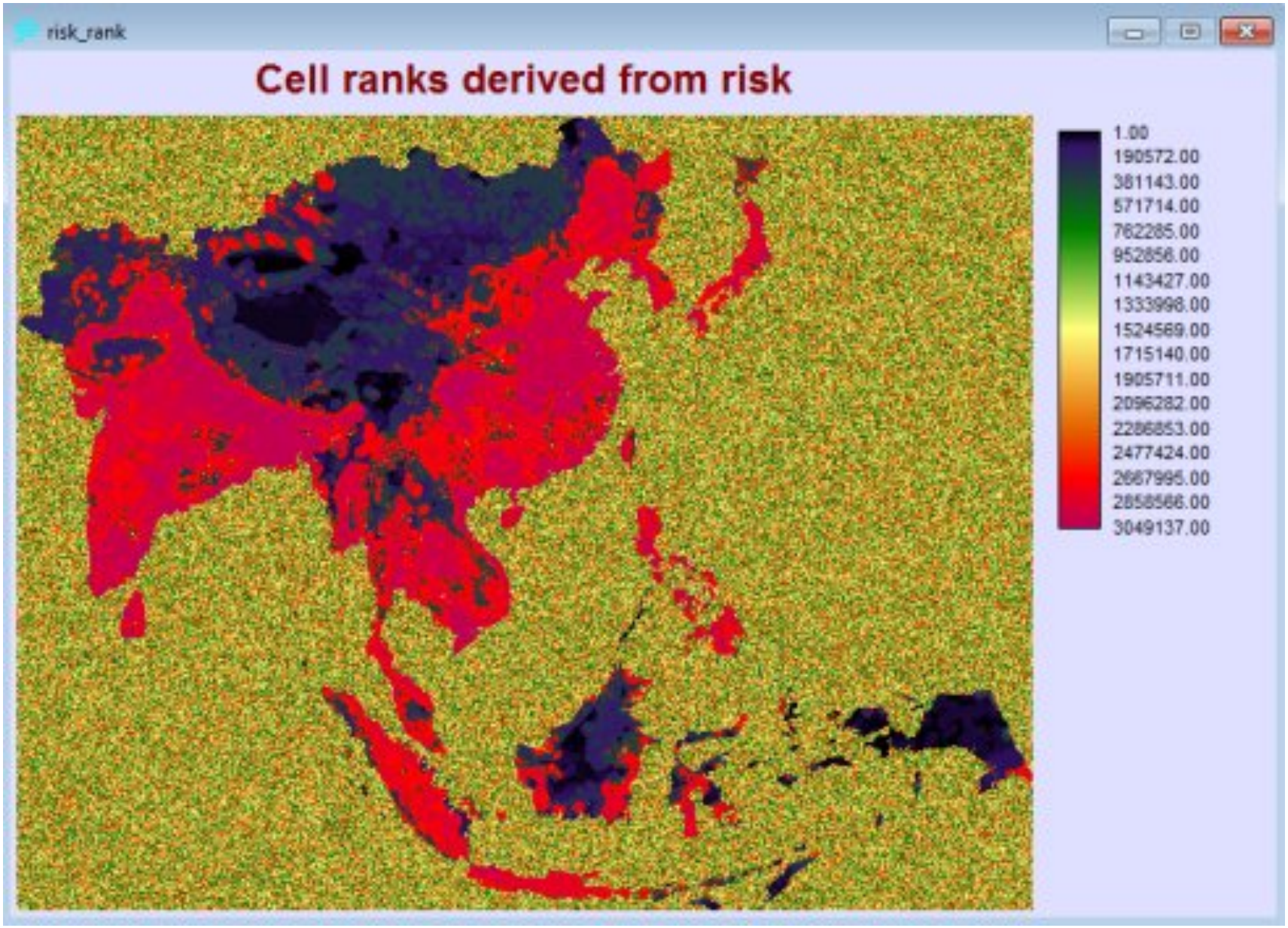
EMPRES-i database: 10 104 HPAI H5N1 outbreaks = 3690 un-duplicated points



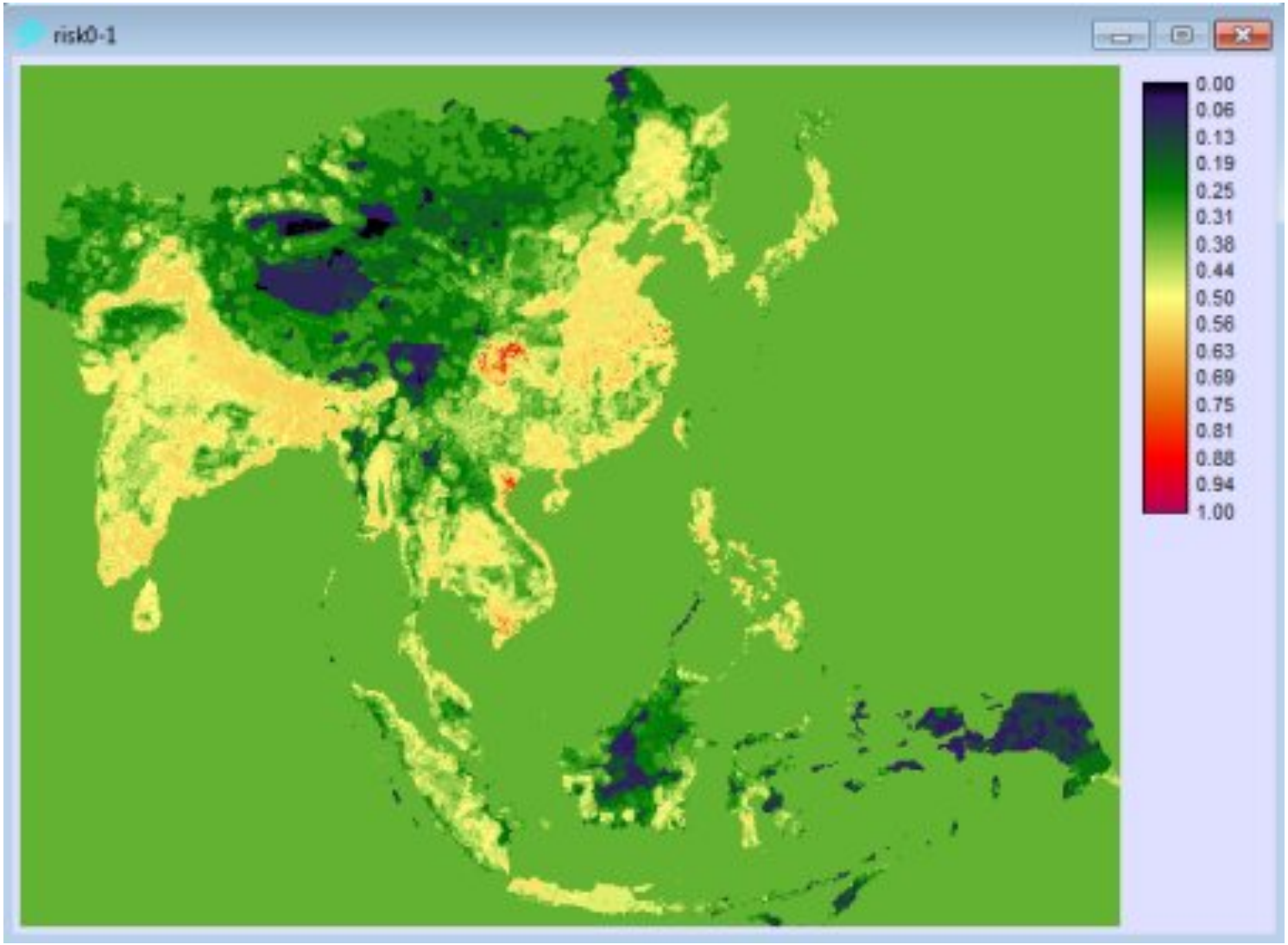
10 000 background points randomly generated – subject to three constraints



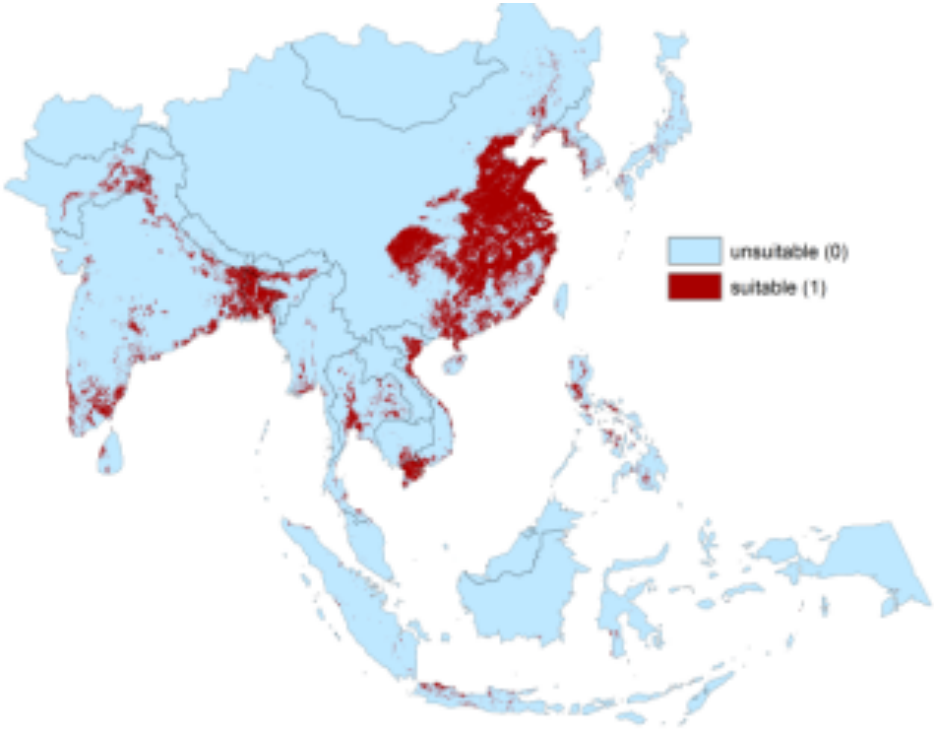
Rank order all pixels



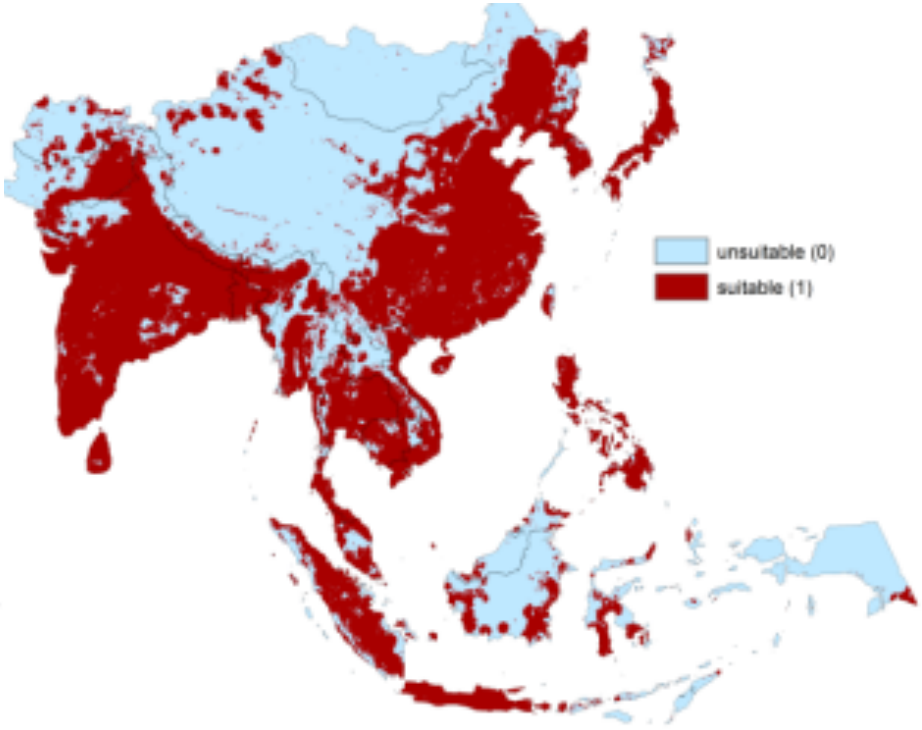
Result divided by the maximum rank to produce map of relative risk



Classify land as suitable/unsuitable using different thresholds

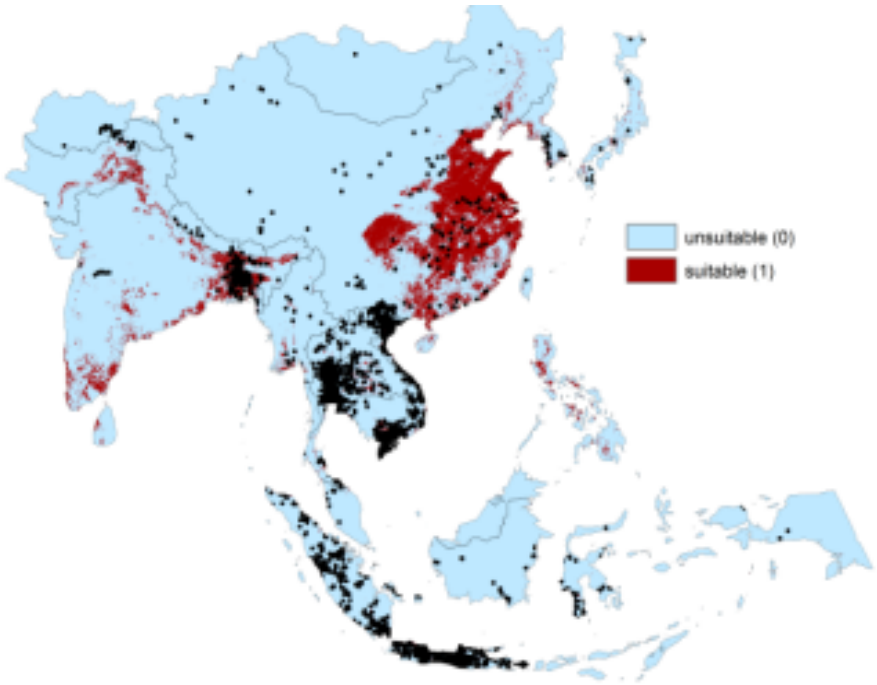


97% probability

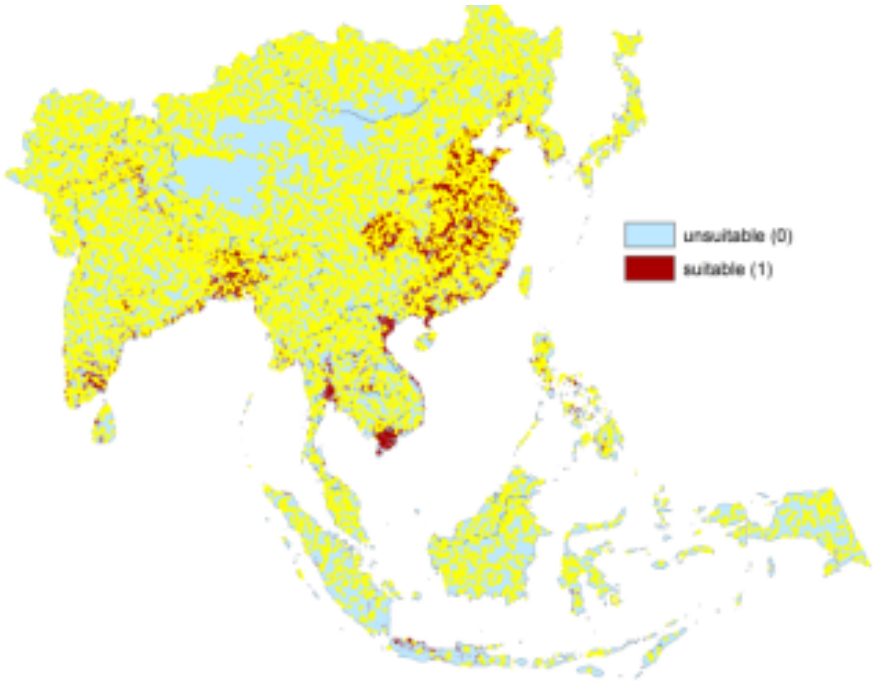


50% probability

Overlay map with outbreak & background point locations and create dataset of observed versus predicted

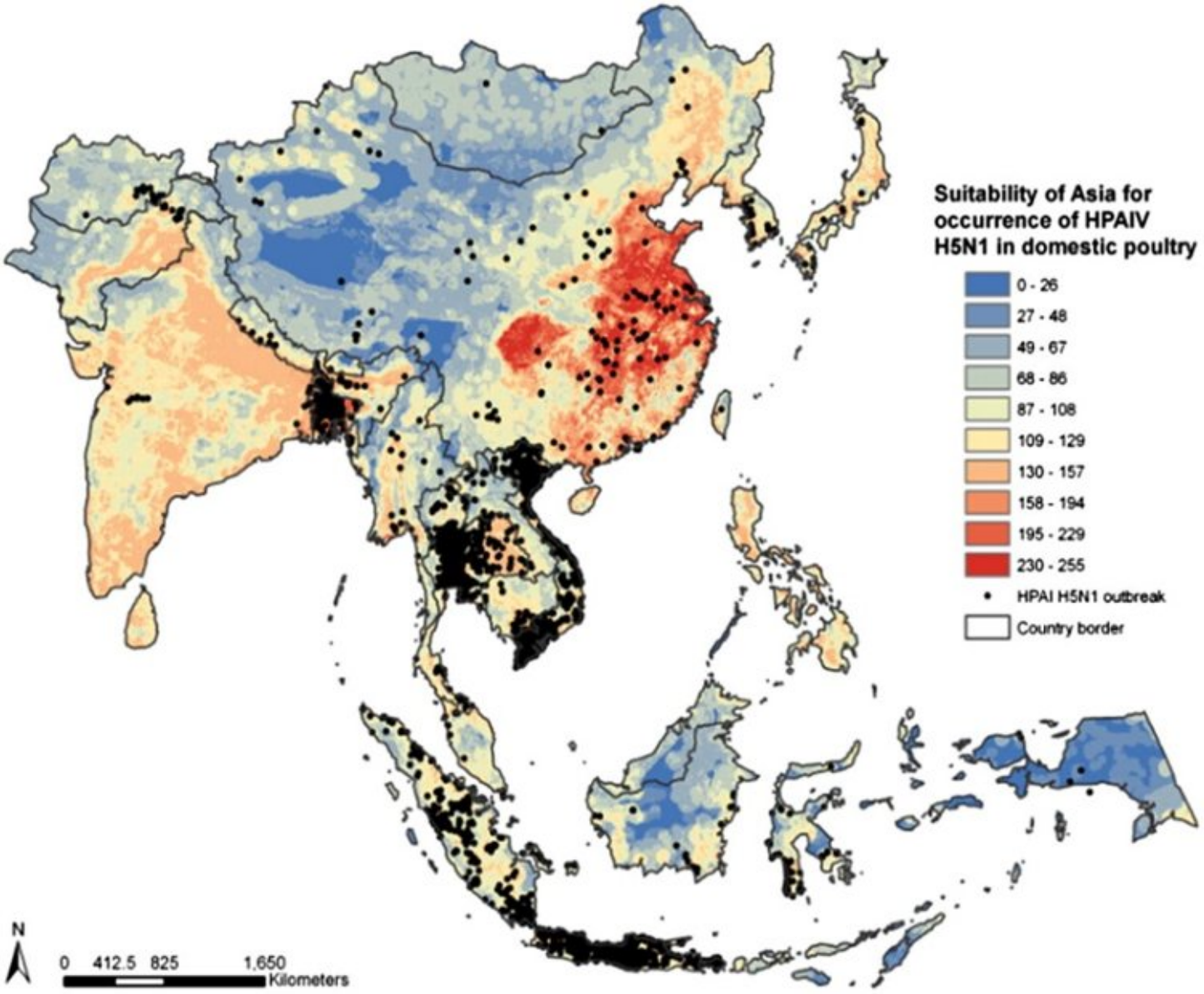


97% probability
with disease points



97% probability with
background points

Fair predictive accuracy: AUC = 0.67



‘Essentially,
all models are wrong,
but some are useful’

(Box and Draper, 1987)

Kim Stevens

'Last seen wandering vaguely, quite of her own accord…' AA Milne

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