

Supplementary Material

Institutional fragility and climatic exposure drive biocultural vulnerability
in traditional agricultural knowledge systems

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1 PRISMA flow diagram

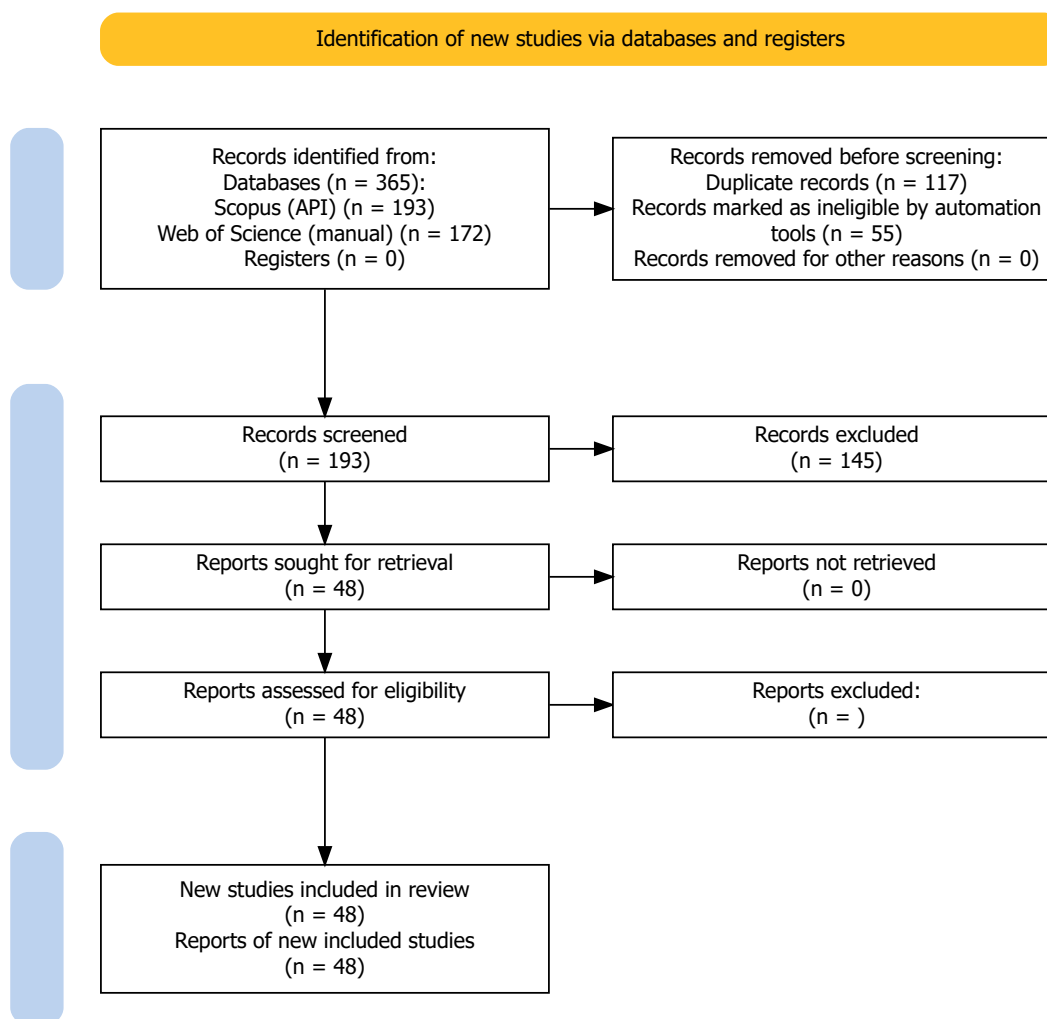


Figure 1: PRISMA 2020 flow diagram mapping the systematic search in the Scopus and Web of Science Core Collection databases, screening restrictions, and deduplication across databases.

2 Meta-analysis results by dimension

Table 1: Meta-analysis results by biocultural vulnerability dimension ($k = 37$ studies per dimension, `rma.mv` model with REML and RVE-CR2, $\rho = 0.8$).

Dimension	$\overline{\ln RR}$	SE	95% CI	τ^2	I^2 (%)	Var. %
V_1 Intergenerational Erosion	-0.017	0.108	[-0.24; 0.21]	0.169	14.8	-1.7
V_2 Biocultural Complexity	+0.045	0.051	[-0.07; 0.16]	0.021	2.4	+4.6
V_3 Territorial Uniqueness	+0.072	0.074	[-0.09; 0.23]	0.028	6.1	+7.4
V_4 Documentation Status	+0.007	0.102	[-0.21; 0.22]	0.093	7.6	+0.7
V_5 Legal Vulnerability	-0.279	0.105	[-0.49; -0.06]	0.171	30.7	-24.3
V_6 Social Organization	+0.172	0.106	[-0.05; 0.40]	0.101	8.4	+18.7

Notes: SE = robust standard error (CR2). Var. % = $(e^{\ln RR} - 1) \times 100$. CI in bold indicates $p < 0.05$.

3 Indicator-to-dimension mapping

Table 2: Mapping between meta-analytic indicators and functional dimensions of biocultural vulnerability.

Dim.	Designation	Meta-analytic indicator ($\ln RR$)	Functional variable	Evidence status
V_1	Intergener. Erosion	$\overline{\ln RR}_{V_1}$, 95% CI	Risk of transmission discontinuity	Confirmatory ($k = 37$)
V_2	Complexity	$\overline{\ln RR}_{V_2}$, 95% CI	Biocultural density	Confirmatory ($k = 37$)
V_3	Uniqueness	$\overline{\ln RR}_{V_3}$, 95% CI	Territorial exclusivity	Confirmatory ($k = 37$); restricted Tier 1 base
V_4	Documentation	$\overline{\ln RR}_{V_4}$, 95% CI	Degree of formal registration	Confirmatory ($k = 37$); contextual moderators
V_5	Legal Vuln.	$\overline{\ln RR}_{V_5}$, 95% CI	Exposure to misappropriation	Confirmatory ($k = 37$); restricted Tier 1 base
V_6	Social Org.	$\overline{\ln RR}_{V_6}$, 95% CI	Organizational vitality	Confirmatory ($k = 37$)

4 Evidence availability diagnosis

Table 3: Evidence availability diagnosis and analytical strategy by vulnerability dimension.

Dim.	Designation	k	Status	Analytical strategy
V_1	Intergener. Erosion	37	Confirmatory	Full meta-analysis (forest plot, meta-regression, publication bias)
V_2	Complexity	37	Confirmatory	Full meta-analysis
V_3	Uniqueness	37	Confirmatory	Full meta-analysis; restricted Tier 1 base, interpret with caution
V_4	Documentation	37	Confirmatory	Full meta-analysis; meta-regression with moderators
V_5	Legal Vuln.	37	Confirmatory	Full meta-analysis; restricted Tier 1 base, interpret with caution
V_6	Social Org.	37	Confirmatory	Full meta-analysis; meta-regression with moderators