



Patterns of research on food security, 2020–2022

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1 Overview

A body of submissions totalling 1,949 manuscripts over three years, 2020–2022, has been analysed. The analysis only concerns the titles of these submissions. A combination of word analytics, classification, and non-parametric multivariate methods produces a view of the mindset of Authors interested in Food Security. This view is dominated by five discriminating themes: food production, economy, socio-technological change, nutrition, and crises. This landscape of mindsets varies across regions of the world. Some of these themes are more (crises), or less (nutrition), set apart from the other dominant themes (food production, economy, and socio-technological change), and are linked through a set of eight additional themes.

The numbers of terms associated with each theme vary greatly: very few refer to biological resources and human capital, while many refer to food production. Only a small fraction of submissions address climate change (or threats over the long-term in general), whereas many deal with crises (including covid).

Food Security, as a peer-reviewed scientific journal, does not seem to exhibit a measurable bias in its publishing work on these five themes, or concerning short- or long-term threats to food security.

Concerns are however raised regarding three points:

- First is the lack of importance that Sociology (and more broadly the human capital) in current food security-related research.
- A second is the weakness of contributions of climate scientists towards food security.
- The third concerns the persistent chasm between the absolute necessity to safeguard the biosphere and the imperative to feed humanity.

A major mistake of 20th century research was to see a conflict between the emergencies of nature and of world's food: one does not have to be chosen against the other; instead, both are inherently linked; therefore, both must urgently be dealt with, equally and simultaneously. A new generation of scientists must be grown, who will be able to address both challenges jointly.

This Editorial is a summary of the report presented to the Executive Committee of the International Society for Plant Pathology in Lyon during the International Congress of Plant Pathology, August 20–26, 2023.

2 Objectives

This analysis addresses the shape and tone of submissions (not of published articles only) to Food Security over three years (2020–2022), using a sample of 1,949 submissions to the journal. The analysis wants to ask the following questions:

1. What are the broad themes addressed in submissions that reach the Editorial Office of Food Security – is there a general pattern?
2. Where is the work underpinning these submissions conducted – from which research terrain, or which country (not from which University of lab)?
3. Can a robust classification of themes, that makes justice to the incoming submissions, be developed?
4. Are there dominant themes; and why are these dominant?
5. Is such dominance of subjects (as addressed by authors) warranted by the main challenges that food security faces today globally? And, crucially:
6. What is it that the scientific community is overlooking?

Each submission is represented in the analysis by the following variables: submission code; type of submission (Original Article, Review, or Opinion); Title; Author; Country (world region) where the research is conducted; submission outcome (declined or published by Food Security).

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Typologies of themes were based on the corpus of terms used in titles. Terms were used to develop a glossary, to determine term frequencies, term associations, and terms associations with contexts. Classification methods were then used to establish a set of term-clusters (i.e., themes). Because the entire information to be analysed is qualitative and non-ordinal (i.e., cardinal), methods based on Chi-square distances were used to test associations among terms, between terms and clusters, and among clusters. Multiple correspondence analysis, a multivariate, chi-square-based method, was then used to map multidimensional associations.

3 Main results

3.1 Patterns of submissions

The origin of submissions to Food Security is global (Fig. 1A). The largest number of submissions to Food Security originate from India, Ethiopia, China, followed by the USA, Brazil, Iran, Nigeria, Bangladesh, Ghana, Pakistan, Kenya, South Africa, Turkey, Indonesia, the Netherlands, and the United Kingdom. Submissions published by Food Security (Fig. 1B) mostly come from the USA, India, the United Kingdom, Kenya, Ethiopia, China, and Brazil. Note that the origin of submission refers to the geographic area where research is conducted. Many international or global studies are undertaken from the USA and the United Kingdom, which explains in part the ranking of these two countries.

3.2 Outcome of submissions

There are wide differences in the publication ratios among submission origins (Fig. 2). Main reasons for manuscript rejections include: (1) misfit to the scope of Food Security; (2) Instructions to Authors not followed; (3) lack of novelty; (4) severe methodological issues (including statistical methods); and (5) major language issues.

3.3 Topics of submissions

Only a few topics are addressed here. Topics will be addressed again with the results of multivariate analyses. The scales at which food security is addressed greatly vary with the region where submissions are produced (Fig. 3). The rural environment is dominant in submissions from sub-Saharan Africa (SSA) and is also important in South Asia. By contrast, the urban environment is very important in East Asia, middle East and North Africa (MENA), and Western Europe. A strong national perspective prevails in East Asia, Latin America, MENA, South-East Asia, SSA, and South Asia, whereas a global perspective is distributed across several regions where submissions are produced (e.g., East Asia and South Asia, MENA, Western Europe, and North America).

There are also sharp differences among regions regarding whether submissions focus on producers or on consumers (Fig. 4). Most submissions from SSA deal with producers; this is also true for South Asia. South-East Asia and Western Europe submissions are also predominantly addressing food

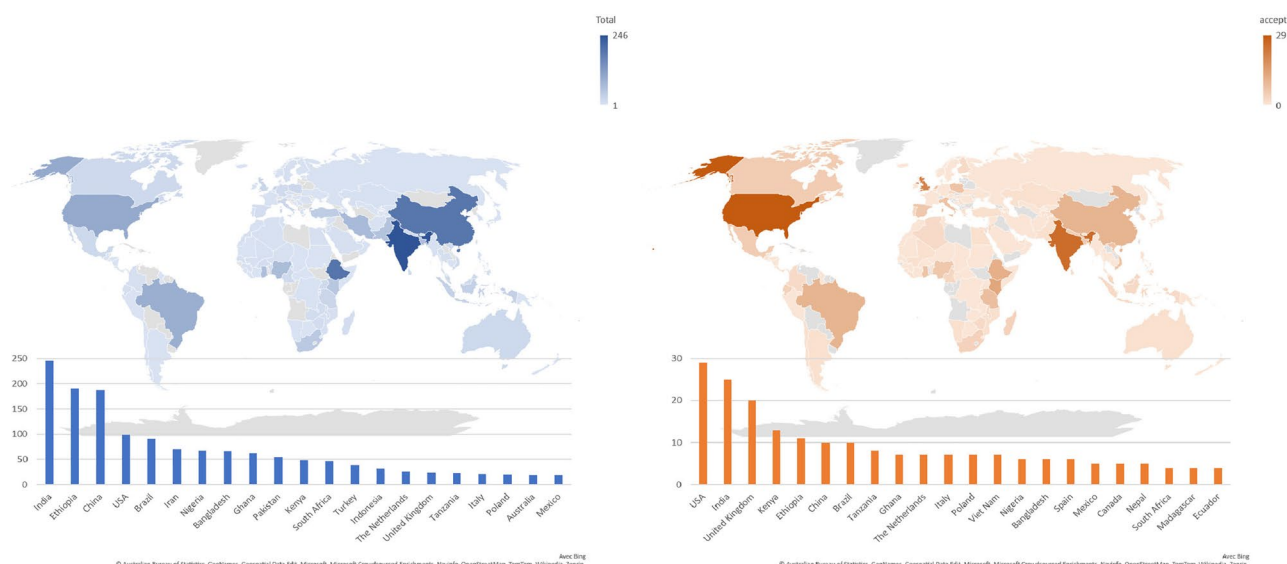
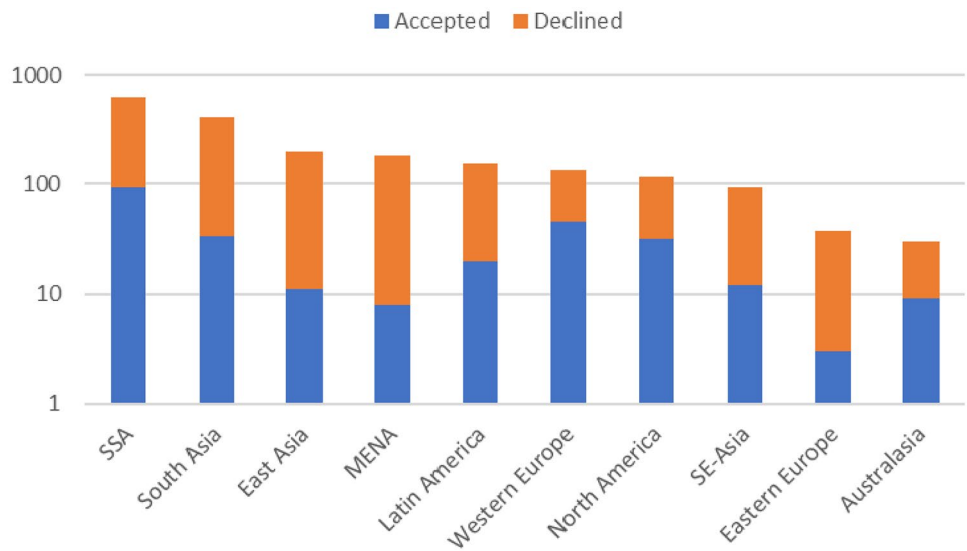


Fig. 1 Global distribution of submissions to Food Security. **A:** Submissions received; **B:** Submissions published

Fig. 2 Outcomes of submissions to Food Security, by regions



producers. By contrast, consumers are the focus of a majority of submissions from MENA. Consumers are important actors, too, in submissions from Australasia, East Asia, and North America.

The emphasis on children and women also varies across regions (Fig. 5). Women and children are equally addressed in SSA, South-East Asia, North America, and Western Europe, whereas children are the predominant theme in Australasia and East Asia. Latin America addresses solely women, and women is a dominant topic in South Asia.

3.4 Clusters of themes

Thirteen clusters of themes were found amongst Food Security submissions (Table 1). Table 1 summarises the main terms that contribute defining each cluster (with their frequency, N). In a number of cases, N smaller than 20

indicates that the term was considered critically important and added to the cluster definition.

Terms referring to key actors (“woma(e)n”, “child(ren)”, “consumer(s)”, and “producer(s)”) were not included in cluster analyses and definitions, as they were treated as variables in their own right.

3.5 Associations of theme clusters with world regions

The ten world regions considered are unevenly associated with the 13 clusters of research themes (Table 2). Food production (FOODPRO) is a main concern in submissions from East Asia, SSA, and South Asia; but less so in Australasia, MENA, North America, and Western Europe. Socio-technological change (CHANGE) is a more evenly distributed theme, but is important in SSA, and less so in Latin America and Western Europe. The economic components of food systems (ECON)

Fig. 3 Scales of studies in Food Security submissions

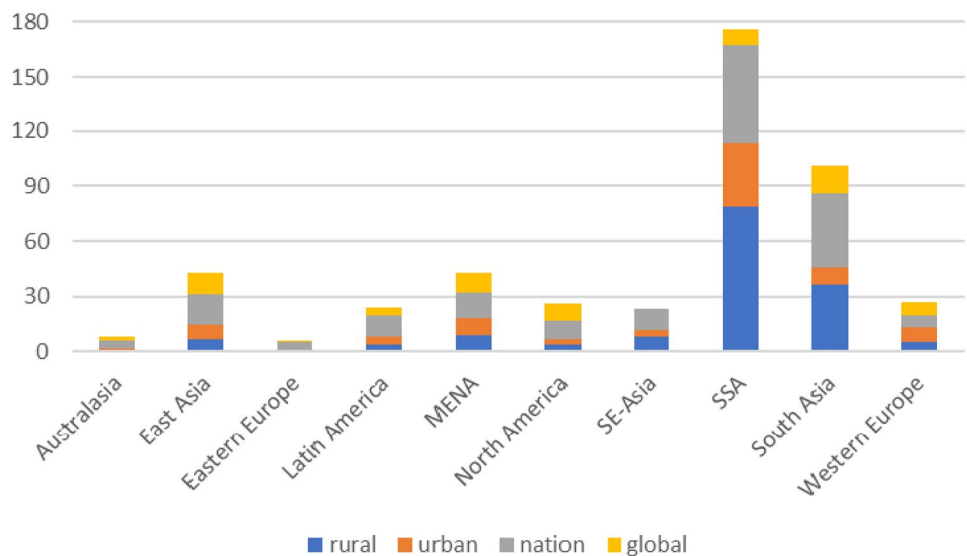
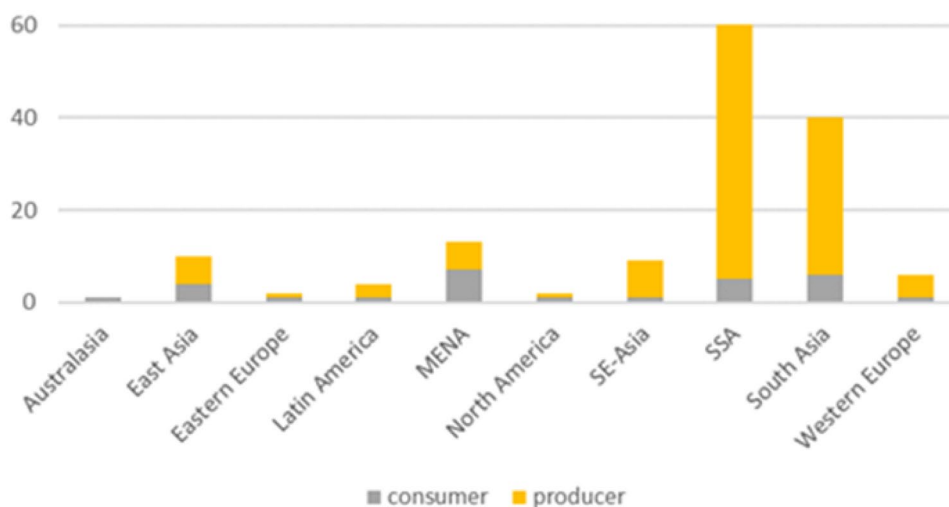


Fig. 4 Consumers vs Producers in Food Security submissions



are important subjects in South-East Asia and SSA, while they are less so in East Asia and Latin America. CRISES are strongly present in MENA, North America, South-East Asia, South Asia and Western Europe, while they are less represented in East Asia and SSA. NUTRITION is quite evenly distributed as a theme across all ten regions.

3.6 Paired associations among theme-clusters

Theme clusters are also unevenly linked with one another. Table 3 only shows linkages among five of the 13 theme clusters. Food production (FOODPRO) is strongly associated with NUTRITION, CRISES, and CHANGE, but is not with ECON ($P=0.35$). Socio-technological change (CHANGE) is dissociated from NUTRITION and CRISES. And the economic components of food systems (ECON) are dissociated from NUTRITION while associated with CRISES.

3.7 Multiple associations among theme-clusters: multiple correspondence analysis

The framework of associations and dissociations of Table 3 was used as the basis of a multiple correspondence analysis, in two stages: first, the analysis of the framework of multiple chi-squares of Table 3 (active variables), and second, the analysis of relationship between this framework and other clusters, and selected keywords from Table 1.

Figure 6A shows the multiple linkages among the five theme-clusters of Table 3, using the two first axes (which represent $23.9 + 22.0 = 45.9\%$ of the total inertia information contained in titles of Food Security submissions). Figure 6A displays five theme clusters, with CHANGE having the largest inertia of all five theme-clusters shown. CHANGE and FOODPRO are associated with axis 1 (horizontal) in the positive direction, and are opposed (by projection) to

Fig. 5 Actors: Women and Children across submissions to Food Security

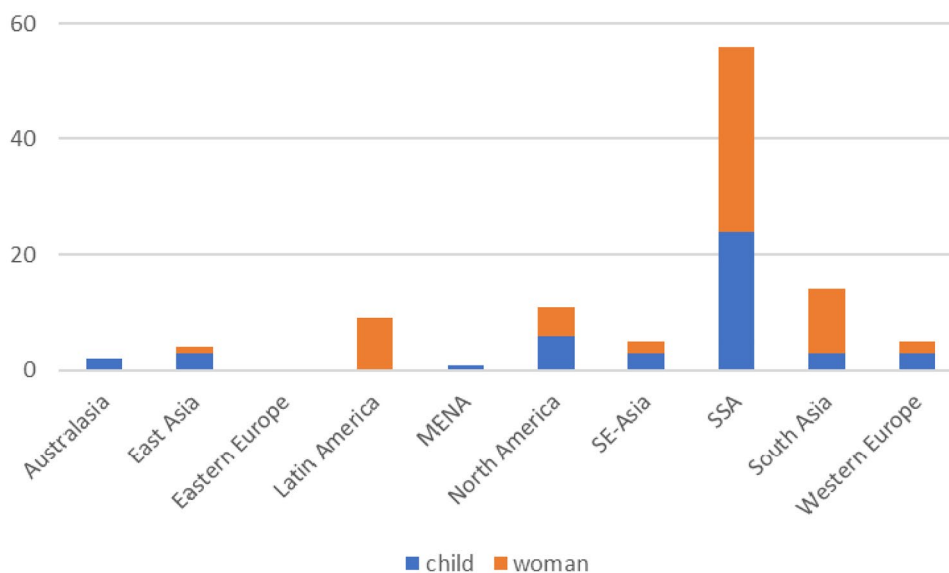


Table 1 Clusters of terms generated from the corpus of titles of submissions to Food Security

Physical resources (RESPHY)		Biological resources (RESBIO)		Human resources (RESHUM)		Food production (FOODPRO)		Production systems (SYSPRO)	
terms	N	terms	N	terms	N	terms	N	terms	N
climate change	60	seed	33	social	38	production	146	sustainable	73
climate	38	variet(-y, -al)	33	perception	26	agricultural	111	resilience	51
land	32	varieties	21	knowledge	17	rice	81	resilience	51
water	31	indigenous	16	labour-labor	8	agriculture	75	sustainability	21
environment	20	agrobiodiversity	5	education	5	crop	59	resilient	18
environmental	20	genetic diversity	3			maize	52	resilient	18
soil	17					productivity	39	vulnerability	17
resources	16					yield	37		
						wheat	35		
						crops	34		
						grain	28		
						vegetables	24		
						fish	21		
						livestock	21		
						meat	18		
						dairy	16		

Food systems' performances (SYSPERF)		Production systems' functioning (SYSFUNCT)		Policies (POLICIES)		Infrastructures of food systems (INFRA)		Socio-technical change (CHANGE)	
terms	N	terms	N	terms	N	terms	N	terms	N
access	43	farming	61	policy	55	chain	46	adoption	48
waste	23	practices	45	intervention	26	farm	41	development	43
loss	22	management	31	policies	21	supply chain	32	improved	31
efficiency	21	postharvest	20	support	18	value chain	23	adaptation	29
losses	18	decision	17	food sovereignty	6	storage	20	participation	24
food desert	10	information	14			chains	17	_technology	24
		fertilizer-fertiliser	10					application	19
		(pest-, insect-, herbi-) cide	8					changes	19
		crop diversity	4					technologies	18
		agroforestry	4						
		production diversity	3						

Economic state & performance (ECON)		Crises (CRISES)		Nutrition (NUTRITION)	
terms	N	terms	N	terms	N
income	65	covid	252	nutrition	154
consumption	54	pandemic	102	nutritional	69
supply	49	risk	41	health	64
economic	45	crisis	26	dietary	60
value	37	lockdown	22	dietary diversity	35
market	31	conflict	15	food safety	25
livelihood	28	crises	7	safety	25
poverty	24			diet	18
trade	23			heavy metal	16
welfare	23			(food) toxicity	5
poor	17			_obes*	5
livelihoods	16				

Table 2 Results of Chi-square tests of associations between clusters of themes and world regions

Theme cluster	χ^2 tests	Austra-lasia	East Asia	Eastern Europe	Latin America	MENA	North America	SE-Asia	SSA	South Asia	Western Europe
FOODPRO	observed expected	3 10.2	87 67.1	10 12.6	47 51.4	52 61.7	22 39.9	30 31.3	221 209.2	161 135.3	31 45.3
	Chi ² = 47.9 df = 9 P < 0.001	FOODPRO under-represented	FOODPRO over-represented			FOODPRO under-represented	FOODPRO under-represented		FOODPRO over-represented	FOODPRO over-represented	FOODPRO under-represented
CHANGE	observed expected	1 3.4	15 22.5	4 4.2	8 17.3	17 20.7	10 13.4	10 10.5	97 70.3	50 45.4	11 15.2
	Chi ² = 25.5 df = 9 P = 0.002				CHANGE under-represented				CHANGE over-represented		CHANGE under-represented
ECON	observed expected	7 6.3	29 41.2	4 7.7	20 31.6	38 37.9	20 24.5	26 19.3	150 128.5	81 83.1	33 27.8
	Chi ² = 22.2 df = 9 P = 0.008		ECON under-represented		ECON under-represented			ECON over-represented	ECON over-represented		
CRISES	observed expected	6 5.1	27 33.5	7 6.3	24 25.6	40 30.7	39 19.9	20 15.6	55 104.3	82 67.4	31 22.6
	Chi ² = 64.6 df = 9 P < 0.001		CRISES under-represented			CRISES over-represented	CRISES over-represented	CRISES over-represented	CRISES under-represented	CRISES over-represented	CRISES over-represented
NUTRITION	observed expected	21 23.5	162 154.6	35 29	115 118.5	149 142.1	89 91.8	74 72.2	474 482	301 311.6	110 104
	Chi ² = 14.2 df = 9 P = 0.092										

CRISES, in the negative direction. ECON and CRISES are associated with axis 2 in the positive direction, and are opposed to NUTRITION in the negative direction. Additional variables (other theme-clusters, publication decision, and world regions) can be projected on this system of axes.

All the other theme clusters (Fig. 6B) are circumscribed in the space defined by the five theme clusters of Fig. 1A and also are close to the origin of axes, indicating that these other theme clusters have little bearing on the positioning of the bulk of the information contained in the titles of the 1,949 submissions to Food Security that are analysed. ECON, CRISES, NUTRITION, FOODPRO, and CHANGE, therefore have a very strong discrimination power among the submissions to Food Security.

The two additional point-variables shown in Fig. 6C, correspond to the submissions that were either declined or published in Food Security. The two points are both very close to the origin of axes, indicating that no significant bias occurred in outcome of submissions (published, or not) with respect to the five theme clusters of Fig. 6A.

The regions from which submissions originated are shown in Fig. 6D. These point variables are mostly concentrated at the centre of the graph, suggesting no specific trend. Only a slight tendency of submissions from North America and Australasia towards CRISES, and perhaps NUTRITION, is suggested.

3.8 Associations among multiple theme-clusters and specific terms of theme-clusters

A simplified overview of the analysis is summarised in Fig. 7 where theme-clusters are represented by the approximate displays of their corresponding terms on the same system of axes (Fig. 6). Theme-clusters have different shapes and size, reflecting the extent of display of their associated terms.

NUTRITION and CRISES correspond to tightly grouped themes that are quite far apart one another, and from the other theme clusters. CHANGE, on the extreme centre right of the graph (axis 1, positive direction) is also quite a tight group, which is connected with FOODPRO

Table 3 Results of Chi-square tests of associations between clusters of themes

	FOODPRO	CHANGE	ECON	CRISES	NUTRITION
NUTRITION	Chi ² = 11.19 df = 1 P = 0.001 NUTRITION and FOODPRO often associated	Chi ² = 4.28 df = 1 P = 0.034 NUTRITION and CHANGE often dissociated	Chi ² = 7.89 df = 1 P = 0.005 NUTRITION and ECON often dis-sociated	Chi ² = 3.19 df = 1 P = 0.074 NUTRITION and CRISES are evenly distributed	Chi ² = 1
CRISES	Chi ² = 19.58 df = 1 P < 0.001 CRISES and NUTRITION often associated	Chi ² = 22.22 df = 1 P < 0.001 CRISES and CHANGE often dissociated	Chi ² = 4.13 df = 1 P = 0.042 CRISES and ECON often associated	Chi ² = 1	
ECON	Chi ² = 0.35 df = 1 P = 0.557 ECON and FOODPRO are evenly distributed	Chi ² = 0.16 df = 1 P = 0.685 ECON and CHANGE are evenly distributed	Chi ² = 1		
CHANGE	Chi ² = 8.16 df = 1 P = 0.004 CHANGE and FOODPRO often associated	Chi ² = 1			
FOODPRO	Chi ² = 1				

FOODPRO ("PRODUCTION" in Fig. 7) and several other themes. FOODPRO in turn is widely spread, mostly along axis 1, overlapping other themes (SYSFUNCT, RESPHY, and RESHUM, and others not shown in Fig. 7: RESBIO, SYSPRO, SYSPERF, and POLICIES) that are closer to the centre of the graph. Similarly, ECON, mostly accounted for by axis 2, overlaps with several other themes. Not shown on Fig. 7 are two groups of terms playing a bridging role among clusters: actors ("consumer", "public", "woman", and "child"). The infrastructure (INFRA) theme plays a similar linking role.

4 Submissions to food security: some interpretations and conclusions

The term which has been, by very far, the most used in the period of time considered in this analysis, 2020–2022, is "covid" (252 occurrence, Table 1), demonstrating the strength of the shock wave the pandemic has had on the scientific community. The weight (frequency) of the term is actually so large that it was removed from analyses lest other aspects of food security be obliterated. Despite this, the theme cluster CRISES occupies a quite unique and isolated location in Fig. 7. CRISES altogether belongs to a third axis of the analysis, which is not discussed here.

While FOODPRO is represented by the largest number of terms (the relatively close theme clusters SYSFUNCT and SYSPERF are also diverse, Table 1), POLICY and human resources (RESHUM) are poorly populated in terms. Terms such as "education", and quite surprisingly, "labour", are very sparsely used.

Regions of the world very much differ in their perceptions of what "food security" is (Table 2). Africa is very concerned with food production, technological changes, and the related (micro-)economics. South Asia also focuses on food production but on CRISES too, while East Asia, very concerned by food production, seems the least concerned with economy and crises. Western Europe and North America, both major global sources of food, have fairly similar profiles (Fig. 2), with limited emphasis on food production, and strong concerns about crises. Surprisingly, comparatively little interest is apparent in Western Europe regarding changes in food systems. Australasia's research shows limited interest in food production. The Middle-East and North Africa (MENA), a major concern for food security today, and even more so, tomorrow, strikingly shows limited interest in food production, but strong concerns about crises (in this, MENA aligns with North America and Europe, but presumably for entirely different reasons). All regions in the world exhibit a similar level of interest for NUTRITION. Here again, what

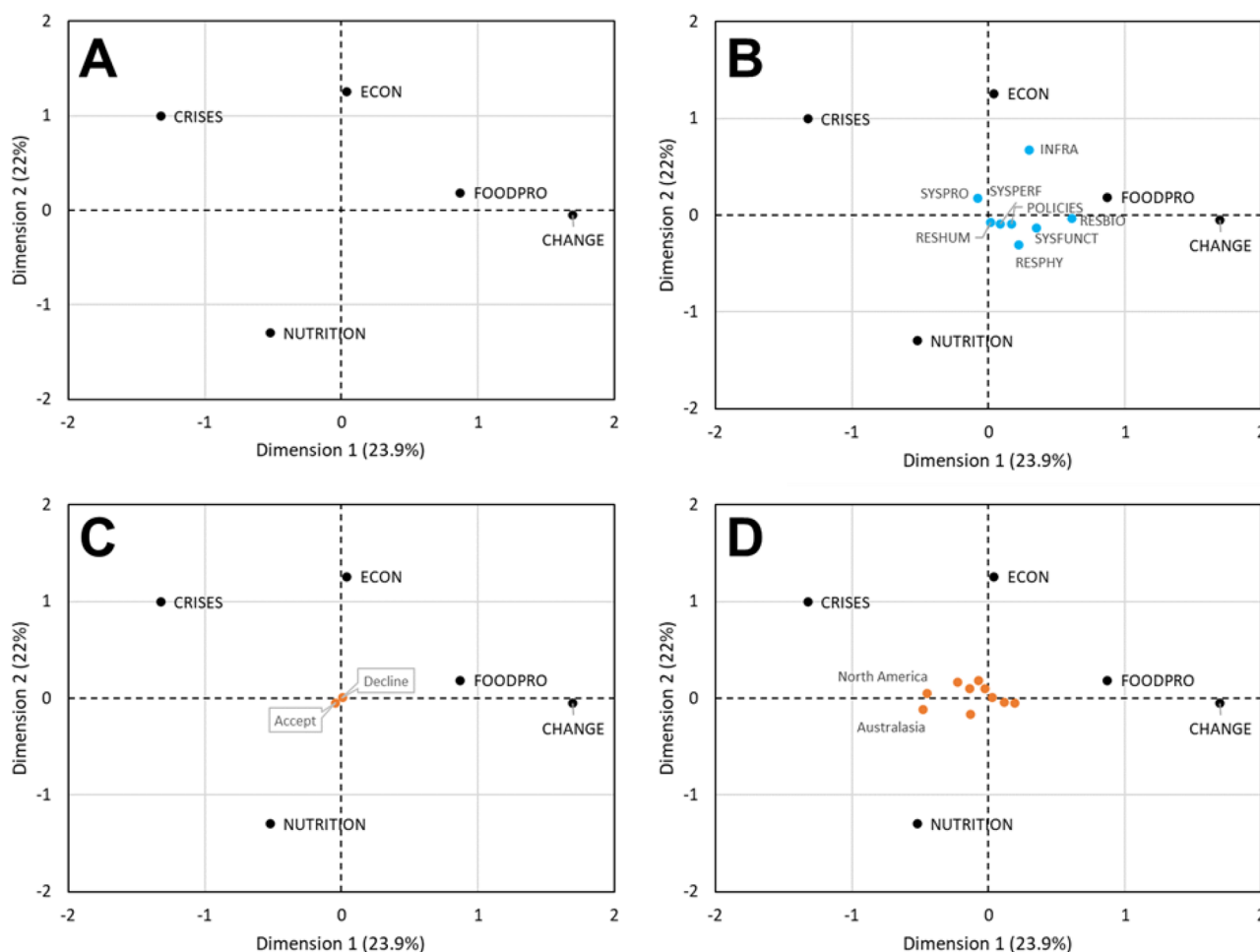


Fig. 6 Multiple correspondence analysis: theme clusters, outcomes, and world regions

is observed probably covers wide differences in what “nutrition” exactly means across the world.

The conceptual map generated by multiple correspondence analysis (Fig. 7) allows visualising patterns of associations. The axes and main cluster-themes (ECON, CHANGE, NUTRITION, FOODPRO, and CRISES) of Fig. 7 are robust (as shown by the chi-square values of Table 3 and the inertia accounted for by the two first axes (23.9 and 22.0%) of the analysis. Axis 1 (horizontal) materialises a socio-technological—production—management—resources continuum. Interpreting projected point-variables requires caution, but a key element is the (chi-square) distance between CHANGE and CRISES: much of the submissions dealing with crises merely describe or comment them without offerings pathways of change. The distance between ECONOMY and NUTRITION merely reflects the nature of submissions reaching Food Security: the two topics are significantly distinct ($P < 0.05$) in Authors’ minds: many submissions dealing with nutrition address specific, biochemical or medical (including paediatric) aspects (which are not in the scope of Food Security).

5 Perspectives for the editorial policy of food security

The mindset landscape of Authors interested in Food Security of Fig. 7 is the terrain where the journal implements its Editorial Policy. Food Security seems to have no bias regarding the many discipline-based interests (Fig. 6C), which is very reassuring. This analysis however raises concerns.

One is the weakness of Sociology in food security-related research, despite the critically important elements of actors’ behaviour in the face of food shortage and crises, of child’s education and protection, of gender fairness, and of technology implementation (or failure). One would expect to see far more terms related with human resources, or human capital.

Another is the extreme weakness of biodiversity (Table 1, RESBIO) and the weakness of climate change ($N = 60$ – less than 24% the frequency of “covid”, Table 1). Ecological science seems unaware of its role toward food security. The broad gap between the necessity to feed humanity and the imperative of a surviving biosphere again appears here. It is

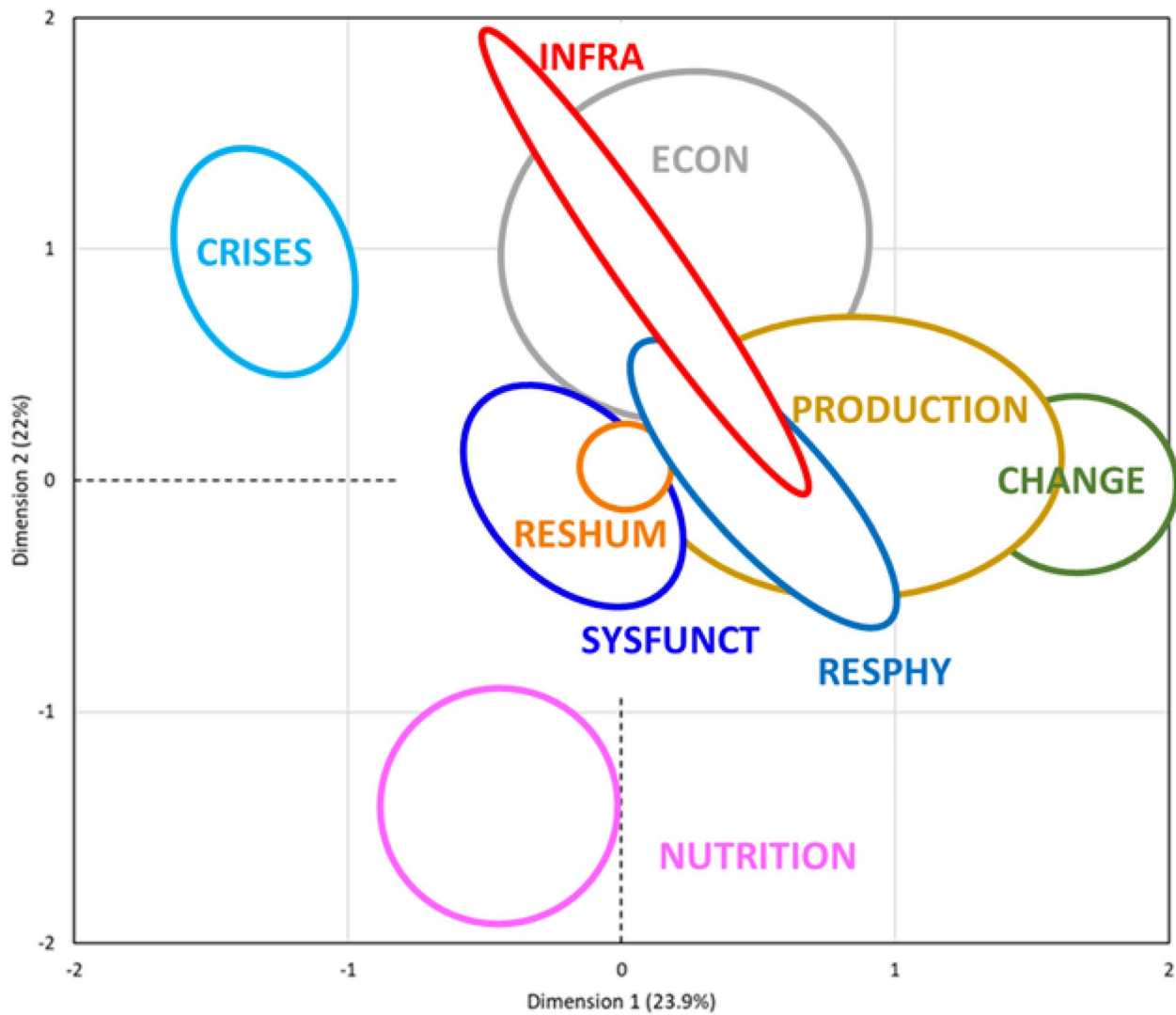


Fig. 7 Multiple correspondence of theme clusters and selected title terms

the view of the author of this analysis that seeing a conflict between the two priorities is a profound error of twentieth century science, that no dilemma exists except in the minds of some scientists and science leaders, and that addressing the two challenges simultaneously is urgently needed. Much research and excellent new science – not technology – needs to be conducted: this is why a new generation of scientists must grow away from past differences.

It is fair to say that the *problematique* of food security is quite different in this first quarter of the twenty-first century compared to the 20th, for, this author believes, three main and strongly linked reasons. One is environmental. It now is clear that planetary boundaries have been, or are about to be crossed. Another is the global

evolution of human societies. Broadly: after its beginnings in the Global North, the psychological landscape of a consumer’s society has become globally dominant. That this vision is a fantasy in the Global South (and for most of the Global North, too) is irrelevant: mass media, economic models, and urbanisation, all strengthen everywhere consumer’s society models. Third is the growing importance, in the past decades, of economy and the social sciences, and in the more recent years, of the sciences of nutrition and public health in the food security agenda, where agriculture-associated disciplines are not alone any more. Food security research has become interdisciplinary, and it now concerns both the Global South and the Global North. So should Food Security be.