Hot topics in agricultural and environmental economics – a large-scale bibliometric analysis

Droste, Nils; Bartkowski, Bartosz; Finger, Robert

SCHOOL OF ECONOMICS AND MANAGEMENT

Hot topics in agricultural and environmental economics – a large-scale bibliometric analysis

Nils Droste, Bartosz Bartkowski and Robert Finger

LSR Working papers series

Paper Number: 21/04

August 2021

Lund Institute for Sustainability Impact

Hot topics in agricultural and environmental economics – a large-scale bibliometric analysis

Nils Droste[1], Bartosz Bartkowski[2], Robert Finger[3]

[1] Department of Political Science, Lund University, Sweden, nils.droste@svet.lu.se

[2] Department Economics, UFZ – Helmholtz Centre for Environmental Research, Germany, bartosz.bartkowski@ufz.de

[3] Agricultural Economics and Policy Group, ETH Zürich, Switzerland, rofinger@ethz.ch

Abstract:

Land use is at the core of today's complex sustainability challenges. Agricultural and environmental economics share a focus land and resource use but evolved in their own domains. Their specialized competencies can be complementary and thus strengthen policy analysis. We use structural topic modelling on more than 24,000 articles in the top agricultural economics and environmental economics journals to derive trending topics in both fields. We thereby identify areas where the two fields converge on hot topics. We review content and contributions from each field. Our results show that policy-oriented research on land use and agent behaviour regarding multifunctional landscapes, climate change mitigation, and biodiversity conservation are hot research avenues and thus candidates for further intensified collaboration.

Keywords: Bibliometrics, Content Analysis, Structural Topic Model, Sustainable Land Use

JEL Codes: Q1, Q2, Q5

Version 2021-07-07

Introduction

Human development is intrinsically linked to the use and appropriation of natural resources (Segerson, 2015). Classical economics considered land to be one of the main factors of production. In the process of specialization in economic theory, the study of different aspects of the human appropriation of land has diverged into two main fields of applied economics, agricultural economics (AE) and environmental and resource economics (ERE). As economic sub-disciplines, the two fields have developed specialized competencies (Cropper and Oates, 1992; Kling et al., 2010; Lybbert et al., 2018). In the face of current sustainability challenges, and the central role of land use, both sub-disciplines have important contributions to make. For example, agricultural production is considered one of the major drivers of environmental degradation, including biodiversity loss (Clark et al., 2020; IPBES, 2019). Understanding both the trade-offs faced by farm businesses and those relevant from the point of view of social welfare is crucial for comprehensive, effective and efficient policy design. Cooperation and cross-fertilization between AE and ERE thus have a high policy relevance (Swinton, 2018). To achieve ambitious and interlinked goals formulated in international policy frameworks such as the Sustainable Development Goals or the European Green Deal, we need comprehensive perspectives across disciplinary boundaries (Fresco et al., 2021; Sterner, 2019).

In this paper, we investigate fields of research in both fields and address the question where AE and ERE already complement each other for more comprehensive solutions to sustainability challenges in agricultural and environmental policy. In particular, we focus on "*hot*" topics of emergent and shared research trends, to let the publication data speak for the fields (Gentzkow et al., 2019), and identify promising avenues of intensified future collaboration. Related previous research has so far focused on authorship and collaboration in subsets of relevant journals journals (Polyakov et al., 2018, 2016), impact in terms of author's personal benefits and factors that increase them (Polyakov et al., 2017), and corresponding journal rankings (Rigby et al., 2015). Polyakov et al. (2018) use 1991–2015 data from Environmental and Resource Economics to re-estimate topic probabilities with a citation-by-year weighted linear mixed model on 1630 articles. Drupp et al. (2020) provide a content analysis of relevant contributions in sustainability economics from a random sample of 345 full texts. In one of the most extensive analyses so far, Kvamsdal et al. (2021) run a topic model on ~9.5k articles from eight selected ERE and AE journals over the 2000–2019 period, focusing on main topics addressed in this literature. We expand these approaches in three main directions: i) we use an averaged ranking for top 10 journals for each field to identify the main disciplinary outlets; ii) we expand the data base by including these top journals and increasing the temporal range, yielding a corpus of over 24,000 articles across 20 journals over the period 1993–2019; iii) we employ a recently developed content analysis method from computational political science, structural topic modelling, that allows integrating covariates directly into topic modelling (Roberts et al., 2019). The structural topic model can thereby estimate the evolution of relative prevalence across topics over time. This methodological approach allows us to identify "hot" topics in the sense of emerging research themes that have been trending over the last 5–15 years. On top of this unsupervised machine learning algorithm, we use more qualitative review techniques to balance out the semantic blindness of the machine-based learning algorithm. We analyse the content of these hot research topics qualitatively, with a focus on contributions and complementary potential for sustainable land-use policy design.

The remainder of this article is structured as follows: we first introduce the methodological approach, including an overview of data used in the analysis, the structural topic model and content analysis. Second, we provide the results in the form of descriptive bibliometrics, identified hot topics, and a qualitative content description of a subset of topics. Third, we discuss particularly promising avenues for collaboration and briefly conclude.

Method

To let the article data speak (Gentzkow et al., 2019), we use descriptive bibliometrics and structural topic modelling on abstracts from the top 10 journals from each field over the last 27 years (1993–2019) resulting in a data set of more than 24,000 articles. Bibliometric analyses are widely used, for example on natural capital research (Pan and Vira, 2019) or topics in general economics (Bowles et al., 2019). Here, we identify topics by estimating the latent, initially unobserved topics within a corpus of texts through assessing joint word occurrence probability distributions (Blei et al., 2003). The latent Dirichlet allocation algorithm has been used to analyse topics and trends within ERE (Polyakov et al., 2018) and AE (Polyakov et al., 2016), for citational impact across fields (Polyakov et al., 2017), for main topics in selected ERE and AE journals (Kvamsdal, 2021), for the content of green, circular and bio-economy (D'Amato et al., 2017) or ecosystem service literature (Droste et al., 2018; Liu et al., 2019). The structural topic modelling approach (Roberts et al., 2019) extends these earlier approaches of latent Dirichlet allocation by integrating topical content and prevalence covariates such as time and field into the topic model estimation algorithm (ibid.). This quantitative approach allows us to identify the topics with the strongest temporal trends – the "hot" topics – within each field *directly* from the topic model, instead of post-processing model estimates (as done in, e.g., Droste et al., 2018; Kvamsdal, 2021; Polyakov et al., 2018). Furthermore, it allows us to focus on trending topics rather than general and rather unspecific topics like, for example, "theory and methodology" (Kvamsdal, 2021). The quantitative analysis is subsequently complemented by a qualitative review of articles in a subset of hot topics to distil differences, similarities, and potential synergies.

Data

First, we identified the top journals in both fields and selected the top journals from each field by using the following two main criteria to increase intra-ranking robustness: (i) journals included in at least half of the below listed rankings (i.e. 3 or more), (ii) average rank to account for different indicators and preferences. In particular, we used different journal rankings for both AE and ERE journals. More specifically we used:

(1) Kalaitzidakis, Mamuneas, and Stengos (2011)
(2) Herrmann et al. (2011) (“GEWISOLA 2009” ranking; all classified as A or B)
(3) Halkos and Tzeremes (2012) (all classified as A, B or C)
(4) ISI Journal Citation Report 2017 (section “agricultural economics“ & economics journals in “environmental studies”)
(5) Elsevier CiteScore 2017 (section “economics, econometrics and finance”)
(6) RePEc aggregate rankings 2017

We focus on published rankings specific to our focus on agricultural and environmental & resource economics (1-3) as well as general journal rankings (4-5) and a bibliometric ranking of economic journals in general (6). The final result of this procedure is presented in Table 1. We checked the robustness of this selection by adding and removing rankings; while the order has changed slightly between different variants, the top 10 journals in both categories have remained the same[1]. The results of this approach are broadly consistent with results from an international study using Best-Worst Scaling to investigate researchers’ journal preferences conducted by Rigby et al. (2015), despite the slightly different focus (i.e. on most career-advancing journals) of their analysis of journal preferences. We used the Web of Science (WoS) bibliometric information

[1] The inclusion of Ecological Economics in the ERE category might not be undisputed, yet it is not exclusively our choice but a result of averaging out the indicated. It is however to be taken into account that the scope of the journal is also broader than classical AE and ERE journals and may exhibit different citation patterns for its interdisciplinary nature, see e.g. Drupp (2020) on sustainability economics in Ecological Economics.

(authors, year, title, keywords, affiliations, abstracts, etc.) for the last 27 years (1993–2019). The raw data included 33317 entries; restricting to a subset of those with non-empty abstracts, we proceeded with a data set of 24828 journal article entries from 27 years. We then removed from the abstracts stopwords, words indicating publisher copyrights, and numbers, maintained only words with a minimum length of 3 characters, transformed them to lower case, stemmed the words to their root, and dropped words that only appear once in the corpus. For the Canadian Journal of Agricultural Economics that usually has both English and French abstracts, we removed all French versions of abstracts and translated 23 abstracts only available in French. We thus proceeded with a vocabulary of 15853 unique words for which we calculated frequencies per document in the corpus. For metadata to be included in the analysis, we maintained year of publication, journal, and a classification whether the journal is AE (9772 entries) or ERE (15056 entries). In general, AE journal data entries in WoS had more incomplete observations (see also Table A1). The American Journal of Agricultural Economics had 4404 non-reported abstracts (which have an abstract-like, short introduction instead (partly conference proceedings), which is not recorded in WoS), including a set of 500 meeting briefs with no abstract.

Table 1: List of journals for content analyses.

	Agricultural Economics			***Environmental and Resource Economics***		
	ISO 4 Abbrev. Name	No. rankings	Mean rank	ISO 4 Abbrev. Name	No. rankings	Mean rank
1	*Am. J. Agric. Econ*	6	4.67	*J. Environ. Econ. Manage.*	6	2.67
2	*Food Policy*	6	8.67	*Rev. Environ. Econ. Policy*	3	3.00
3	*J. Agric. Econ*	6	9.33	*Ecolog. Econ.*	6	4.17
4	*Agr. Econ.*	6	9.67	*Energy J.*	5	5.40
5	*Europ. Rev. Agr. Econ.*	6	10.17	*Energy Econ.*	4	5.75
6	*Australian J. Agr. Resource Econ.*	6	12.83	*Land Econ.*	6	6.00
7	*J. Agr. Resource Econ.*	5	14.80	*Resource Energy Econ.*	6	9.67
8	*Appl. Econ. Perspect. Policy*	3	16.33	*Environ. Resource Econ.*	6	10.50
9	*Can. J. Agr. Econ.*	6	18.33	*Annu. Rev. Resource Econ.*	3	13.00
10	*Agribusiness*	3	19.67	*Marine Resource Econ.*	3	14.00

Source: authors' elaboration

In the following, we use these two lists of journals as proxies for publications that we assign to AE or ERE, respectively. We are aware that this is a rough proxy, given that environmental economists sometimes publish in AE journals and agricultural economists in ERE journals. However, there is no other practical method for distinguishing AE and ERE publications at hand, especially given the scope of the analyzed literature.

Topic Model

In order to derive topics from the corpus of journal abstracts from WoS, we employ an unsupervised machine learning algorithm. Topics are treated as latent variables which we estimate from word co-occurrences across documents and further covariates (Roberts et al., 2016, 2014). These so called Structural Topic Models (STM) build upon techniques such as latent Dirichlet allocation topic models (Blei et al., 2003), dynamic topic models (Blei and Lafferty, 2006), Dirichlet-Multinomial Regression topic model (Mimno and McCallum, 2012), and the Sparse Additive Generative Model (Eisenstein et al., 2011). Compared to these, STM have the advantage of flexibly incorporating document metadata covariates such as, in our case, time of publication, journal, and association with either AE or ERE. Such metadata can be modelled as covariates either influencing prevalence (the association of documents with documents), content (association with words within a topic), or both (Roberts et al., 2019). In this article, we employ both variants.

Formally, let the documents t be indexed by $d \epsilon (1, \dots D)$ and the words w by $n \epsilon (1, \dots N)$. Words w_n are unique terms from a vocabulary, and a document t_d a ‘bag of words’ with a frequency of word occurrence. Topics z are assumed to be latent, not directly observable within the overall corpus of documents and indexed by $k \epsilon (1, \dots K)$. A topic z_k is defined by a probability distribution over the frequencies of words belonging to it. The model algorithm first draws a K-dimensional Dirichlet vector θ_d for the expected proportion of words within document t_d by sampling each word per document $w_{d,n}$ to associate the words with a topic z_k.

The intuition is the higher the probability of a word for the topics of a document, $P(w_{d,n}|z_k)$, and the higher the probability of topics for a document $P(z_k|t_d)$, the more likely a word is to occur in a document (Equation 1, based on Polyakov et al. (2018). Using observed word frequencies per document, latent topics can then iteratively be estimated using non-conjugate variational expectation maximization until the model converges (Roberts et al., 2016).

$$P(w_n|t_d) = \sum_{k=1}^{K} P(w_{d,n}|z_k)P(z_k|t_d) \tag{1}$$

The covariates enter as two further design matrices, X with $D \times P$ dimensions, for P topic prevalence covariates, and Y, with $D \times A$ dimensions for A levels of topical content covariates (Roberts et al., 2016). In our case we model an interaction of the binary field variable $AEorERE$ with the $year$ of publication as prevalence covariates to estimate the topical trend by field, and a $journal$ categorical content variable to derive semantical differences across journals within topics. Observed prevalence covariates parameterize the prior distribution means through a logistic-normal generalized additive linear model; the content covariates influence the distribution of topic words through an exponential family model. We chose to employ a spectral method of moments initialization (Arora et al., 2013), as provided by Roberts et al. (2019) in the stm package in **R** (R Core Team, 2020). The spectral initialization uses approximate vertices of the multidimensional, convex hull of word occurrences as anchoring points. Since the true number of latent topics is unknown, we furthermore used the algorithm by Lee and Mimno (2017) that approximates the vertices of a convex hull of word co-occurrences by projecting the multidimensional space to lower dimensions (Roberts et al., 2019). The vertices in that lower dimensional space are used to identify an optimal number of topics. We thereby identified 53 distinct topics. A full list of all identified topics, including author provided names based on the keywords they are characterized by, can be found in the Supplementary Material.

For further analysis, we selected a subset of particularly "hot" topics, i.e. topics with a large recent increase in prevalence. To do this, we computed the absolute change in prevalence over three time spans: 5 (2014–2019), 10 (2009–2019), and 15 years (2004–2019). From each list of topics, we extracted the top 10 for agricultural and environmental economics, respectively. To increase robustness, we then selected those topics that consistently appear in the top 10 over all three periods. This approach yielded a list of 10 topics, two appearing in both fields, five only in AE and 3 only in ERE: 'energy efficiency' (AE/ERE), 'market shocks' (ERE) 'insurance' (AE) 'household incomes' (AE), 'supply chains' (AE), 'agents' behaviour' (AE/ERE), 'biodiversity conservation' (ERE), 'choice experiments' (AE), 'farm business' (AE), 'policy design' (ERE). For each of the 10 "hot" topics, we provide quantitative bibliometric information: prevalence trend, most frequent keywords per field, top 5 most cited articles and top 5 most cited new articles (2015–2019; citations per year).

As the machine-learning algorithm is unknowledgeable about semantics and cannot assess the deeper meanings within or policy-relevant linkages across topics, we combine the data-driven approach with a qualitative content analysis to tease out promising areas of work and collaboration for sustainable development research. These we then place within the wider debate in the discussion.

Content analysis

To place the resulting topics adequately within the wider debate, we use the structural topic modelling to guide a qualitative analysis of the most probable (i.e., representative for a topic) articles for each of the selected hot topics. Yet, the focus is on shedding light on content and overarching (policy) issues rather than providing a fully-fledged review of each topic.

For each of these "hot" topics we extract the abstracts of the 250 most probable articles, which we then use for a complementary qualitative analysis (see Supplementary Material). As common trends make for a promising avenue for collaboration across AE and ERE, we select the two "hot" topics that are hot in both fields ('energy efficiency', 'agents' behaviour'), as well as three topics related to currently prominent policy challenges, in which we see large prima-facie collaborative potential: 'biodiversity conservation'; 'policy design'; and 'agricultural insurance' (in its relation to climate change adaptation). We place emphasis on what the key questions and current answers within the topics are, what the contributions are, and how these relate to broader societal interest. In particular we discuss these topics with respect to issues of policy relevance. To this end, we frame them in context of policy frameworks such as Sustainable Development Goals, the EU Green Deal and the Farm-to-Fork strategy of the EU (Schebesta and Candel, 2020).

Results

In this section, we start by providing a brief descriptive bibliometric overview about the whole analysed corpus. In the second subsection, we present some quantitative information about the "hot" topics identified by means of Structural Topic Modelling. For selected hot topics, we provide more information, with a focus on potential for AE and ERE collaboration.

Descriptive bibliometrics

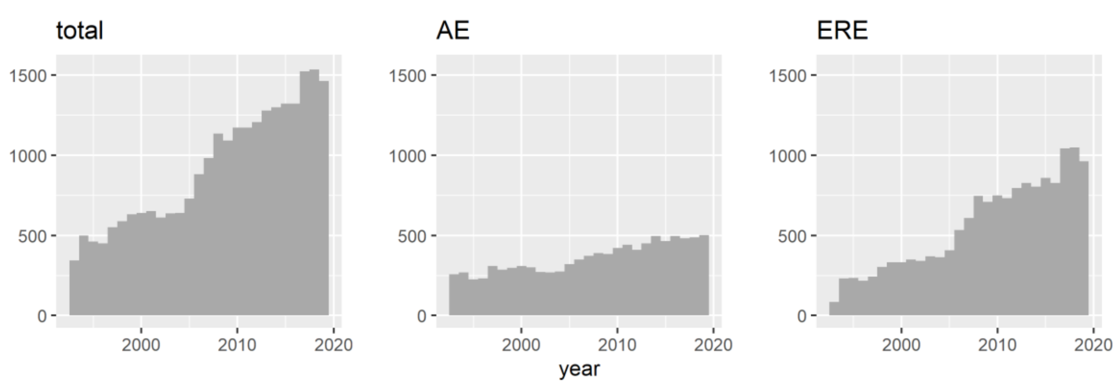


Figure 1: Article count per year, for the corpus, AE, and ERE. Source: authors' elaboration based on WoS data.

Figure 1 displays that the 10 selected journals in ERE started at about the same yearly output but has grown twice as productive as the 10 selected journals in AE during the period of analysis. This may at least partly be driven by empty abstracts in the AE corpus, especially from AJAE, and a large share of articles from Ecological Economics. Noteworthy is also the considerably steeper growth in ERE since 2005 – which is partly due to younger journals (see Appendix, Table A1).

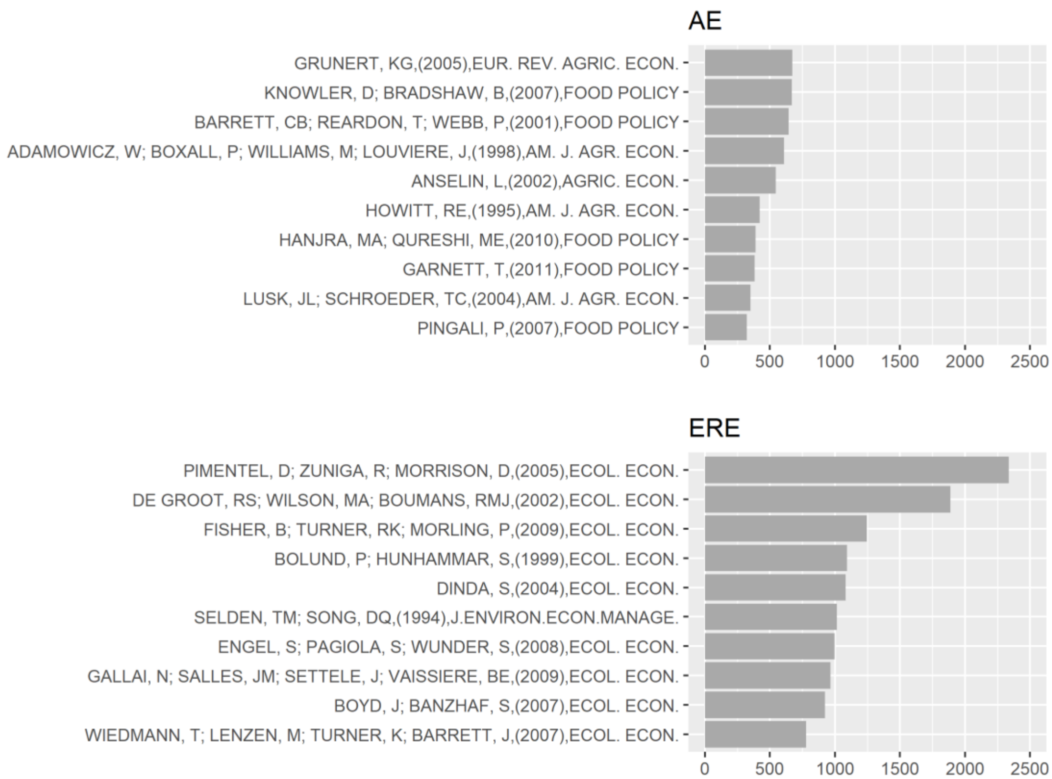


Figure 2: Top 10 most cited articles per field (1993-2019). Source: authors' elaboration based on WoS data.

Figure 2 shows that ERE has higher citation counts than AE, and the top journals of the most cited articles are Ecological Economics, and American Journal of Agricultural Economics, respectively. In fact, among the top 10 most cited ERE articles, only two were not published in Ecological Economics, while the top 10 for AE is more diverse. Wiktor Adamowicz, Michael Williams and Jordan Louviere each have one top 10 cited article in both fields. This also highlights the natural overlap between both fields and the limits of our AE/ERE proxy (see above) in identifying individual publications with either field.

Structural Topic Modelling

Here, we present a brief, mainly visual overview of all 10 hot topics, and a description of observable patterns. In the next section, we then provide some insights for a selected topics.

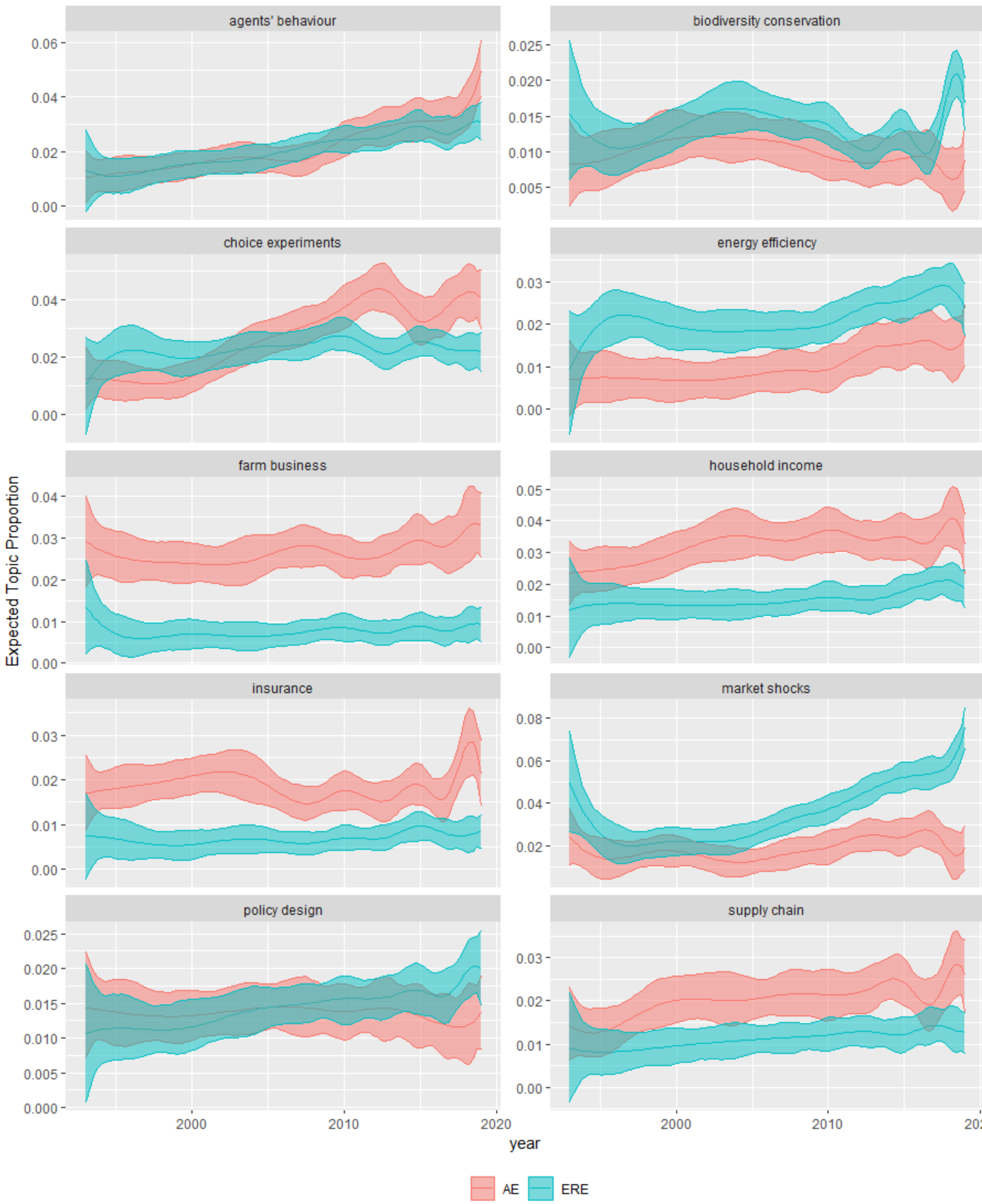


Figure 3: Time trends of structural topic models for the 10 hottest topics across AE and ERE (1993-2019). Trends are estimated for the binary AE or ERE field covariate via a spline function. The Y-axis denotes the estimated topic prevalence, or proportion of the overall corpus; note the free y-axis scales such that comparisons must be based on values. The confidence intervals display a 95% confidence level. Source: authors' elaboration based on WoS data.

Figure 3 demonstrates the prevalence trends for the 10 “hot” topics over the considered time period. Most of the topics are dominated by one of the two fields, the exceptions being especially ‘agents’ behaviour’, ‘choice experiments’, ‘biodiversity conservation’, ‘policy design’, where relative differences in prevalence are less pronounced. There are topics where the relative prevalence changes over time, e.g. choice experiments and policy design – with a reverse pattern; choice experiments have become more prominent in AE and policy designs in ERE.

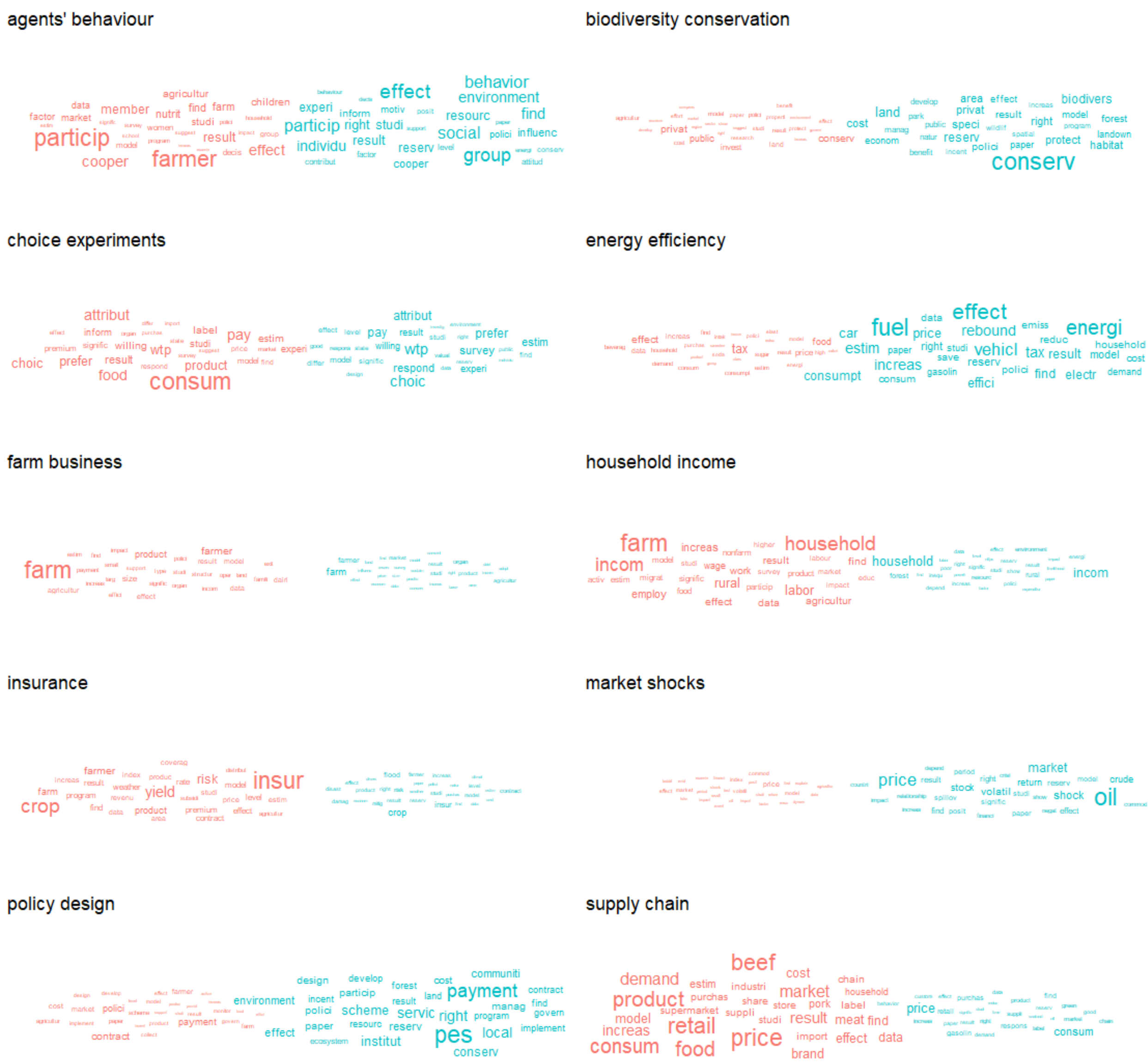


Figure 4: Word clouds for the 10 hottest topics. AE is red and ERE turquoise. Word size is determined by frequency of the 30 most frequent words from each field in the ‘250 most probable articles per topic’ corpora and is normalized within topic, making sizes relative within but not across topics. Source: authors’ elaboration based on WoS data. A high-resolution pdf file of the figure can be found in the supplementary material.

Figure 4 shows keyword clouds for each of the 10 hottest topics across both fields. Here, one gets a glance at the differences in focus within each of the topics, as well as another illustration of the relative prevalence of ERE vs AE in each topic. Even in topics that are similarly prevalent in both fields – such as, especially, 'agents' behaviour' and 'choice experiments' – one can clearly see differences in foci (to be discussed for the former in more detail in the next section).

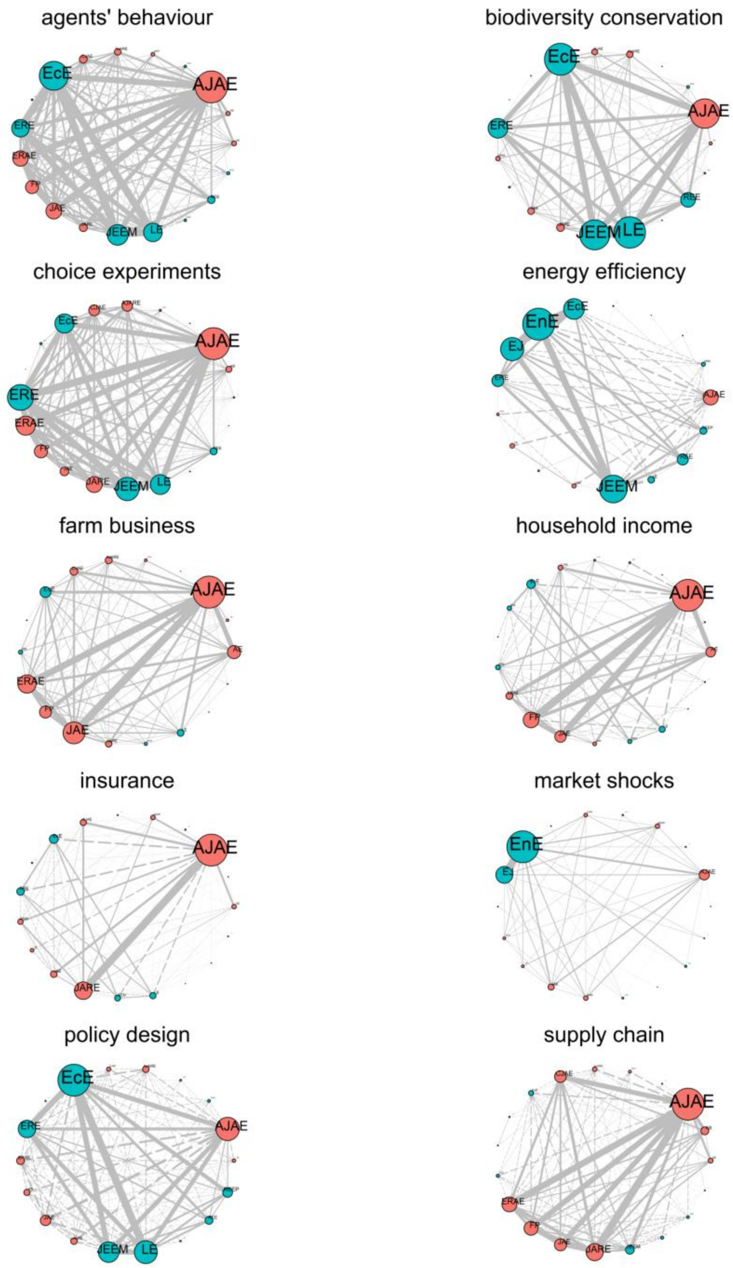


Figure 5: Bi-directional co-citation network of Journals in the 1993-2019 corpus. Vertices and edges are proportional to occurrence counts in the co-citation network. AE journals are coloured in red and ERE journals in turquois. Source: authors' elaboration based on WoS data. A high-resolution pdf file of the figure can be found in the supplementary material.

Figure 5 demonstrates co-citation patterns within each topic, i.e. articles citing each other across journals. There is quite some information to be derived from this figure. For instance, it can be seen that the topic ‘agricultural insurance’ is heavily dominated by only two journals – AJAE and JARE. Similarly, ‘market shocks’ is a topic discussed mainly in the two energy economics journals, though some AE journals are also involved and exhibit citation links to the two main journals. Other topics seemingly dominated by one of the two fields are ‘supply chains’ (primarily AE journals), ‘household income’ (AE), ’energy efficiency’ (ERE) and ‘Farm business (AE). The other four topics are much less “mono-field” – perfectly in line with the trends presented in Figure 3. However, while ‘choice experiments’ and ‘agents’ behaviour’ are spread across almost all journals, ‘policy design’ and ‘biodiversity conservation’ are less so. Specifically, in the latter topic, AJAE is the only really prominent AE journal, the other strong vertices being ERE journals. The situation is similar, though less strongly pronounced, for ‘policy design’. Overall, it seems that AJAE, ERAE, and JAE (from AE) and JEEM, EcE, LE, and EnE (from ERE) are the main topical and co-citational “exchange hubs”, at least with respect to hot topics.

Content of selected topics

Some hot topics are rather clearly related to one of the two fields (or even a subfield, such as energy economics), e.g. ‘farm business’, ‘household income’, or ‘supply chains’ to AE and ‘energy efficiency’ or, increasingly so, ‘market shocks’ to ERE. Yet, a large number of hot topics are more equally “distributed”. As stated above, we focus on the hot topics that exhibit either common trends (‘energy efficiency’ and ‘agents’ behaviour’, see Figure 3) or have a broad policy relevance across fields (‘biodiversity conservation’, ‘policy design’, and ‘agricultural insurance’), and exclude the hot but field niche topics. Table 2 gives an overview of most cited articles within selected topics from the pool of the 250 most probable articles per topic for two periods: overall (criterion: total citations) and 2015–2019 (criterion: citations per year), to show longer-term and recent patterns.

Table 2: Most cited articles per selected hot topic for two different periods (citation count for full 1993-2019 period '#' and citations per year for 2015–2019 '#/A')**.**

TOPIC	MOST CITED ARTICLES – TOTAL NUMBER (1993–2019)	#	RECENT TRENDING ARTICLES – CITATIONS PER YEAR (2015–2019)	#/A
ENERGY EFFICIENCY	1 Hidrue et al (2011), REE	353	1 Crago & Chernyakhovskiy (2017), JEEM	9.0
	2 Sorrell & Dimitropoulos (2008), EE	353	2 Barbarossa et al (2017), EE	8.7
	3 Binswanger (2001), EE	313	3 Borenstein (2015), EJ	8.4
	4 Small & van Dender (2007), EJ	303	4 Chitnis & Sorrell (2015), EnEc	8.2
	5 Gallagher & Muehlegger (2011), JEEM	280	5 Moshiri & Aliyev (2017), EE	7.7
POLICY DESIGN	1 Engel et al (2008), EE	998	1 Wunder (2015), EE	37.2
	2 Wunder et al (2008), EE	547	2 Fletcher & Buscher (2017), EE	14.7
	3 Vatn (2010), EE	371	3 Chan et al (2017), EE	12.7
	4 Pagiola (2008), EE	357	4 van Hecken et al (2015)	12.4
	5 Pattanayak et al (2010), REEP	322	5 Ezzine-de-Blas et al (2019), EE	8.0
BIODIVERSITY CONSERVATION	1 Polasky et al (2011), ERE	253	1 Norwood eet al (2019), AEPP	6.0
	2 Christie et al (2006), EE	192	2 Greiner (2016), AJARE	5.5
	3 Boersma & Parrish (1999), EE	169	3 Norden et al (2017), EE	5.3
	4 Fisher & Christopher (2007), EE	164	4 Boyd et al (2015), REEP	4.6
	5 Wunder (2000), EE	162	5 Bakhtiari et al (2018), EE	4.5
AGENTS' BEHAVIOUR	1 Vermeir & Verbeke (2008), EE	304	1 Rode et al (2015), EE	26.8
	2 Defrancesco et al (2008), JAE	173	2 Farrow et al (2017), EE	19.0
	3 Vanslembrouck et al (2002), JAE	160	3 Malapit & Quisumbing (2015), FP	11.0
	4 Rode et al (2015), EE	134	4 Kuhfuss et al (2016), ERAE	10.0
	5 Agarwal (2009), EE	121	5 Meyer (2015), EE	9.4
AGRICULTURA L INSURANCE	1 Jonkman et al (2008), EE	168	1 Jensen & Barrett (2017), AEPP	10.3
	2 Botzen et al (2009), EE	163	2 Osberghaus (2015), EE	8.2
	3 Mir&a & Glauber (1997), AJAE	134	3 Hudson et al (2016), EE	8.0
	4 Smith & Goodwin (1996), AJAE	127	4 Kousky et al (2018), JEEM	8.0
	5 Just & Weninger (1999), AJAE	125	5 Du et al (2017), AJAE	7.7

Source: WoS Data, authors' elaborations.

Energy Efficiency

The focus of this topic is on energy efficiency, particularly in the context of private transportation and against the background of the need to decarbonize the economy as a climate mitigation strategy. For instance, a common theme within this topic is rebound effects from energy or fuel efficiency gains (Santarius and Soland, 2018; Sorrell and Dimitropoulos, 2008). The topic is addressed in an increasingly broad manner, including both measurement of the extent of rebound effects in different contexts (Chitnis and Sorrell, 2015; Moshiri and Aliyev, 2017) and their explanation, also drawing from psychology (Santarius and Soland, 2018). Furthermore, another prominent area are investigations into policy instruments such as fuel taxes (Gallagher and

Muehlegger, 2011) and real-time electricity pricing (Allcott, 2011), complemented by studies of consumer preferences, especially for vehicle choice (Hidrue et al., 2011; Kahn, 2007). Given the specific focus on energy and transport questions, the topic is dominated by ERE, with the few (but rising) contributions from AE mainly focusing on taxation and policy in other areas, such as biofuels (Drabik et al., 2015). Accordingly, as can be seen in Figure 5, there is little exchange between the two fields within this topic.

Agents' behaviour

This topic brings together research into various aspects of the behaviour of agents, ranging from farmers (most AE studies in this topic) to firms, consumers, and the general population (ERE). Ultimately, the goal is understanding the determinants of agents' decisions and behaviour, often with the related aim of improving policy. For instance, within AE, there are many studies investigating participation in agri-environmental schemes (e.g. Defrancesco et al., 2008; Vanslembrouck et al., 2002) – a link to the topic Policy Design, discussed below. Among the "hot" topics, Agents' Behaviour seems to be among those where exchange between AE and ERE is rather active, according to the quantitative results. Nonetheless, a qualitative analysis of the most probable articles in this topic demonstrates some instructive differences which bear a potential for more intensive collaboration and exchange. Especially, in this topic, there is a recognizable difference regarding the use of controlled experiments to gain insights into agents' behaviour. While most studies still rely on survey and census data, in ERE, experiments are relatively common, while in AE, there are few experimental studies, most of which have been published recently, including both experimental economic approaches (e.g. Buck and Alwang, 2011; Chabé-Ferret et al., 2019; Gobien and Vollan, 2016; Kuhfuss et al., 2016; Thomas et al., 2019) and randomized control trials (Bennear et al., 2013; Pellerano et al., 2017).

Biodiversity conservation

Dealing with the conservation of biological diversity, this topic analyses various policy instruments and market-based mechanisms for both private and public lands, and in the marine environment. Generally speaking, this topic assesses public preferences and resulting (external) benefits (or costs) from private (or public) lands that require policy interventions to fix suboptimal allocations and improved biodiversity management. Representative in this regard is Pannell (2008) analysing the relation of both internal and external public and private benefits for the appropriate mechanism choice – in particular suggesting action when there are large public costs or benefits. Nevertheless, the main addressee of these instruments are private land users. In ERE these are various kinds of landowners and land uses such as forests (Wendland et al., 2010), conservation (Boersma and Parrish, 1999; Martín-López et al., 2011), or even (semi-)urban residences (Wu and Plantinga, 2003). Not surprisingly, AE within this topic mainly targets agricultural ecosystems in developed (Kline and Wichelns, 1996) but even more so in developing countries (Gebremedhin and Swinton, 2003). The public aspect is rather dealt with in terms of valuation of economic benefits (Christie et al., 2006) or in terms of protected areas (Adams et al., 2008). Across both fields, the spatial aspect of optimal allocations is prominent (Fooks et al., 2016; Parkhurst and Shogren, 2007; Polasky et al., 2011).

Policy design

This topic deals with various policy instruments for the internalization of external effects, most prominently so in the form of payments for ecosystem services (Engel et al., 2008). Accordingly, the regional focus rather lies on developing countries, where most of the payments for ecosystem services schemes can be found. payments for ecosystem services are analyzed in terms of efficiency (Wunder et al., 2008), effectiveness (Farley and Costanza, 2010), or equity (Pascual et al., 2010). Partly, at least, the debate evolves around whether payments for ecosystem services are a market-based instrument (Engel et al., 2008), a Pigouvian subsidy (Vatn, 2010), or even commodification instruments (Rico García-Amado et al., 2013). While conceptually similar (Vatn, 2010), farm subsidies for the provision of ecosystem services are rather labelled agri-environmental schemes (Falconer et al., 2001). There are, however, also programs like China's Sloping Land Conversion Program for reforestation (Bennett, 2008) or small-holder market access policies (Markelova et al., 2009). Potentially, the ecosystem service framework provides a conceptual bridge to assess policy instruments across both developed and developing countries, and various ecosystems, e.g. ranging from forests to farmland (Viaggi et al., 2021), in terms of e.g. efficiency, effectiveness, and equity considerations.

Insurance

A particular focus of research in the field of agricultural insurances is on insurance design, insurance uptake as well as policy support (e.g. subsidization) (Deng et al., 2007; Du et al., 2017; Goodwin and Smith, 2013; Miranda and Glauber, 1997). Crop insurance plays a vital role in the agricultural economic literature with a focus on both developed countries (especially in the US, e.g. Glauber, 2013) and developing countries (Carter et al., 2017; Jensen and Barrett, 2017). Risk, risk management and insurance are inherently important for various aspects agricultural production and policy (Dalhaus et al., 2020). While research in this field traditionally focusses on crop insurance, a wider focus on insurance solutions also for livestock is emerging in the literature (Bozic et al., 2014; Jensen and Barrett, 2017). Increasingly, the aspect of agricultural insurance becomes relevant also in the context of increasing risk exposure for farmers due to climate change (Du et al., 2018; Tack et al., 2018). More recently, the holistic assessment of potential environmental impacts of crop insurance (e.g. via its effects on fertilizer and pesticide use) and its subsidization are addressed, in AE and ERE journals (Weber et al., 2016). Farmer behaviour is key to design efficient insurance solutions and policies and has been studied widely. While this research traditionally is based on survey and bookkeeping data (Di Falco et al., 2014; Santeramo et al., 2016; Sherrick et al., 2004), increasingly experimental economic tools like randomized experiments are used (Elabed et al., 2013; Matsuda and Kurosaki, 2019; Tafere et al., 2019). Note that in ERE, this topic has often a slightly different focus, mainly including studies of flood insurance (Hudson et al., 2016), often looking at self-protection measures (Osberghaus, 2015) or flood protection as an ecosystem service (Watson et al., 2016, p. 201).

Discussion

Both the quantitative and the qualitative results presented in the previous section show that there are some important differences but also commonalities between AE and ERE in the topics we identified as "hot". Here, we elaborate on the contributions from each field and the synergistic potentials of cross-field collaborations, placing an emphasis on their policy relevance. Moreover, we will focus on potential combinations of perspectives – suggesting where fusing various topics into areas of further intensified collaboration and exchange seems promising and could increase the policy relevance of research.

Most prominently, 'policy design' is an obvious candidate for a hot topic with high policy relevance (for comparable results see Polyakov et al., 2018). The topic is mainly focusing on two types of policies, namely payments for ecosystem services and agri-environmental schemes. Thus, analyses in both topics deal with Pigouvian subsidy type of instruments to internalize external effects of land use in e.g. agriculture and forestry.[2] As such, this topic is clearly related to two EU policies, especially the 'Farm to Fork' strategy as part of the European Green Deal, and the forest strategy revision (European Commission, 2019). Both sectors are to be embedded within an overarching circular-bioeconomy framework that safeguards the climate, conserves biodiversity,

[2] If social and private costs are not precisely known, it would rather be a Baumol and Oates (1971) type of subsidy.

and restore natural capital by investing in for example soil or forest or carbon stocks and resilience. This approach calls for recognizing more strongly the multifunctionality of landscapes – moving away from a production-oriented focus on artificially separated systems without ecosystem linkages (e.g. forestry as independent from agriculture) or at least considering a landscape approach that considers an optimal allocation across different land uses ranging from intensive production areas to conserved or restored wilderness (Bartkowski et al., 2020; Cong et al., 2014; Sayer et al., 2013). Landscape-wide management approaches tie into ongoing debates in ecology and agronomy, namely the discourse around land-sparing and land-sharing (Law and Wilson, 2015; Luskin et al., 2018; Salles et al., 2017). Promising land use strategies in these regards include precision agriculture, organic farming, agro-ecology, and agro-forestry, as they incorporate trade-offs across ecosystems (European Commission, 2019). For a fruitful exploration of the experiences from both AE and ERE on policy instruments, meta-analysis and systematic reviews could be a possible route to cumulate knowledge (Newig and Rose, 2020).

There are also shared methodological interests across AE and ERE. In particular, experimental economics provides a set of tools that are increasingly used (not just) in AE and ERE, such as laboratory experiments (Spraggon, 2004) or randomized controlled trials (Bennear et al., 2013) to test agents' responses to policy instruments or choice experiments for valuation (Horowitz and McConnell, 2002) or program participation (Wossink and van Wenum, 2003). Policy recommendations from such evidence base are increasingly popular among economists, but may face political challenges when it comes to implementation (Head, 2010). Here, AE and ERE could well collaborate to advance the effective functioning of science-policy interfaces such as the Intergovernmental Panel on Climate Change or the Intergovernmental Platform on Biodiversity and Ecosystem Services. In particular, one potential avenue for collaboration is advancing the scientific embedding of evidence on actors' behavior in policy analysis and design. This is in line with Streletskaya et al (2020) and Viaggi et al. (2021), who called for more interaction between behavioural economic research and research on agricultural adoption – in fact, the need to understand land users' behaviour properly has been raised repeatedly in recent literature in the context of environmentally significant land management practices (e.g. Dessart et al., 2019; Pannell and Zilberman, 2020), including the need to go beyond rational choice assumptions to incorporate broader behavioural theory foundations (Bartkowski and Bartke, 2018; Cárdenas, 2016; Weersink and Fulton, 2020). This can also complement modelling approaches used for agricultural policy evaluation (Huber et al., 2021). There is a large potential by enriching toolboxes for policy evaluation and design with experimental approaches (Thoyer and Préget, 2019).

Last but not least, there are sectorial interdependencies and spill-over effects both in terms of environmental effects and policy effects. One example is the effect of crop insurance and its subsidization on environmental outcomes (Weber et al., 2016). Thus, there is need for holistic policies. A classic example is the call for a common food policy (De Schutter et al., 2020; Pe'er et al., 2019), which is also reflected in the recently proposed 'Farm to Fork' Strategy by the European Commission. Here, we see a massive collaborative potential, to devise and test policy design in terms of agents' behaviour and environmental effects across sectors and domains. Biodiversity conservation and climate change are just the most prominent examples of complex land use challenges requiring solutions that cannot stop at the border of one ecosystem or focus on only one user group. Complex interdependencies along the value chain and across socio-ecological systems need to be taken into account when designing comprehensive policy solutions. The efficiency of policy-mixes and multi-target policies is not even precisely solved from a theoretical perspective (Fesenfeld et al., 2020; Kern et al., 2017; Ring and Barton, 2015; Schader et al., 2014). There is also potential to draw from other fields of policy analysis – for instance, while rebound effects are potentially relevant in land-use contexts (Paul et al., 2019), our analysis showed that it's discussion has been largely restricted to the topic of energy efficiency. Both AE and ERE can build on existing empirical work and modelling approaches, but complex land-use challenges may only be solvable once we start collaborating. In fact, the need for collaboration may not just entail AE and ERE but several other disciplines, too.

Conclusions

In this article, we used a combination of quantitative, large-scale, machine-learning based literature analysis with more targeted and selective literature review to identify trending ("hot") topics in agricultural and environmental economics. We use this to look more closely at the collaboration (potential) and policy relevance of a subset of hot topics. We found a mixed picture as regards the collaboration and exchange between the two fields. While overall, the level of exchange is good, there are key areas in which more collaboration would be beneficial.

Our review suggests that economic research on evidence-based and effective policy design is a unifying focus and hot topic across fields. Here, trade-offs across land-uses and ecosystems and land-scape wide resource management approaches are a promising avenue for collaboration. We would argue that this holds particularly true against the background of current (global) political and societal challenges such as climate change and biodiversity loss.

From a research policy perspective, our results suggest that stronger integration across the fields of agricultural and environmental economics – both methodological and thematic – is beneficial to address global challenges of sustainability. Joint research foci and collaboration can already be observed on many topics. Agricultural and environmental policy development can thus draw upon insights from both disciplines. The use of experimental approaches in both laboratory settings and randomized control trials can contribute rigorous scientific evidence for decision makers on the behaviour of land use agents and the effectiveness of policies. Cross-sectional land-use policy (mixes) and (insurance) market solutions that facilitate optimal uses of multifunctional landscapes and trigger desired behavioural changes are yet underexplored but highly promising topics.

To address the somewhat scattered evidence across fields and topics, we recommend more dedicated efforts to synthesize evidence, e.g. by means of broader use of systematic reviews and qualitative approaches – beyond landmark works such as the Dasgupta Review on the Economics of Biodiversity (Groom and Turk, 2021). As we have analysed prevalent trends over the last 5-15 years, further emphasis on currently emerging topics at the bleeding edge in both fields would be relevant. Examples may include the role of big data, machine learning and artificial intelligence (Fresco et al., 2021; Storm et al., 2020), on-farm experimentation (Bullock et al., 2019), or living labs for nature-based solutions (Frantzeskaki et al., 2019).

Acknowledgements

We would like to thank Lea Siebert and Sergei Schaub for help retrieving the bibliographic data.

References

Adams, C., Seroa da Motta, R., Ortiz, R.A., Reid, J., Ebersbach Aznar, C., de Almeida Sinisgalli, P.A., 2008. The use of contingent valuation for evaluating protected areas in the developing world: Economic valuation of Morro do Diabo State Park, Atlantic Rainforest, São Paulo State (Brazil). Ecol. Econ. 66, 359–370. https://doi.org/10.1016/j.ecolecon.2007.09.008

Allcott, H., 2011. Rethinking real-time electricity pricing. Resour. Energy Econ. 33, 820–842. https://doi.org/10.1016/j.reseneeco.2011.06.003

Arora, S., Ge, R., Halpern, Y., Mimno, D., Moitra, A., Sontag, D., Wu, Y., Zhu, M., 2013. A practical algorithm for topic modeling with provable guarantees, in: Proceedings of the 30th International Conference on International Conference on Machine Learning. Atlanta, p. II-280-II–288.

Bartkowski, B., Bartke, S., 2018. Leverage Points for Governing Agricultural Soils: A Review of Empirical Studies of European Farmers' Decision-Making. Sustainability 10, 3179. https://doi.org/10.3390/su10093179

Bartkowski, B., Beckmann, M., Drechsler, M., Kaim, A., Liebelt, V., Müller, B., Witing, F., Strauch, M., 2020. Aligning Agent-Based Modeling With Multi-Objective Land-Use Allocation: Identification of Policy Gaps and Feasible Pathways to Biophysically Optimal Landscapes. Front. Environ. Sci. 8. https://doi.org/10.3389/fenvs.2020.00103

Baumol, W.J., Oates, W.E., 1971. The Use of Standards and Prices for Protection of the Environment. Swed. J. Econ. 73, 42. https://doi.org/10.2307/3439132

Bennear, L., Tarozzi, A., Pfaff, A., Balasubramanya, S., Matin Ahmed, K., van Geen, A., 2013. Impact of a randomized controlled trial in arsenic risk communication on household water-source choices in Bangladesh. J. Environ. Econ. Manag. 65, 225–240. https://doi.org/10.1016/j.jeem.2012.07.006

Bennett, M.T., 2008. China's sloping land conversion program: Institutional innovation or business as usual? Ecol. Econ. 65, 699–711. https://doi.org/10.1016/j.ecolecon.2007.09.017

Blei, D.M., Lafferty, J.D., 2006. Dynamic topic models, in: Proceedings of the 23rd International Conference on Machine Learning - ICML '06. ACM Press, New York, pp. 113–120. https://doi.org/10.1145/1143844.1143859

Blei, D.M., Ng, A.Y., Jordan, M.I., 2003. Latent Dirichlet Allocation. J. Mach. Learn. Res. 3, 993–1022. https://doi.org/10.1162/jmlr.2003.3.4-5.993

Boersma, P.D., Parrish, J.K., 1999. Limiting abuse: marine protected areas, a limited solution. Ecol. Econ. 31, 287–304. https://doi.org/10.1016/S0921-8009(99)00085-3

Bowles, S., Carlin, W., Halliday, S.D., Subramanyam, S., 2019. What do we think an economist should know? A machine learning investigation of research and intermediate-level textbooks. p. 60.

Bozic, M., Newton, J., Thraen, C.S., Gould, B.W., 2014. Tails Curtailed: Accounting for Nonlinear Dependence in Pricing Margin Insurance for Dairy Farmers. Am. J. Agric. Econ. 96, 1117–1135. https://doi.org/10.1093/ajae/aau033

Buck, S., Alwang, J., 2011. Agricultural extension, trust, and learning: results from economic experiments in Ecuador. Agric. Econ. 42, 685–699. https://doi.org/10.1111/j.1574-0862.2011.00547.x

Bullock, D.S., Boerngen, M., Tao, H., Maxwell, B., Luck, J.D., Shiratsuchi, L., Puntel, L., Martin, N.F., 2019. The Data-Intensive Farm Management Project: Changing Agronomic Research Through On-Farm Precision Experimentation. Agron. J. 111, 2736–2746.

Cárdenas, J.C., 2016. Human behavior and the use of experiments to understand the agricultural, resource, and environmental challenges of the XXI century. Agric. Econ. 47, 61–71. https://doi.org/10.1111/agec.12311

Carter, M., de Janvry, A., Sadoulet, E., Sarris, A., 2017. Index Insurance for Developing Country Agriculture: A Reassessment. Annu. Rev. Resour. Econ. 9, 421–438. https://doi.org/10.1146/annurev-resource-100516-053352

Chabé-Ferret, S., Le Coent, P., Reynaud, A., Subervie, J., Lepercq, D., 2019. Can we nudge farmers into saving water? Evidence from a randomised experiment. Eur. Rev. Agric. Econ. 46, 393–416. https://doi.org/10.1093/erae/jbz022

Chitnis, M., Sorrell, S., 2015. Living up to expectations: Estimating direct and indirect rebound effects for UK households. Energy Econ. 52, S100–S116. https://doi.org/10.1016/j.eneco.2015.08.026

Christie, M., Hanley, N., Warren, J., Murphy, K., Wright, R., Hyde, T., 2006. Valuing the diversity of biodiversity. Ecol. Econ. 58, 304–317. https://doi.org/10.1016/j.ecolecon.2005.07.034

Clark, M.A., Domingo, N.G.G., Colgan, K., Thakrar, S.K., Tilman, D., Lynch, J., Azevedo, I.L., Hill, J.D., 2020. Global food system emissions could preclude achieving the 1.5° and 2°C climate change targets. Science 370, 705–708. https://doi.org/10.1126/science.aba7357

Cong, R.G., Hedlund, K., Andersson, H., Brady, M., 2014. Managing soil natural capital: An effective strategy for mitigating future agricultural risks? Agric. Syst. 129, 30–39. https://doi.org/10.1016/j.agsy.2014.05.003

Cropper, M.L., Oates, W.E., 1992. Environmental economics: a survey. J. Econ. Lit. 30, 675–740.

Dalhaus, T., Barnett, B.J., Finger, R., 2020. Behavioral weather insurance: Applying cumulative prospect theory to agricultural insurance design under narrow framing. PLOS ONE 15, e0232267. https://doi.org/10.1371/journal.pone.0232267

D'Amato, D., Droste, N., Allen, B., Kettunen, M., Lähtinen, K., Korhonen, J., Leskinen, P., Matthies, B.D., Toppinen, A., 2017. Green, circular, bio economy: A comparative analysis of sustainability avenues. J. Clean. Prod. 168, 716–734. https://doi.org/10.1016/j.jclepro.2017.09.053

De Schutter, O., Jacobs, N., Clément, C., 2020. A 'Common Food Policy' for Europe: How governance reforms can spark a shift to healthy diets and sustainable food systems. Food Policy 101849. https://doi.org/10.1016/j.foodpol.2020.101849

Defrancesco, E., Gatto, P., Runge, F., Trestini, S., 2008. Factors Affecting Farmers' Participation in Agri-environmental Measures: A Northern Italian Perspective. J. Agric. Econ. 59, 114–131. https://doi.org/10.1111/j.1477-9552.2007.00134.x

Deng, X., Barnett, B.J., Vedenov, D.V., 2007. Is There a Viable Market for Area-Based Crop Insurance? Am. J. Agric. Econ. 89, 508–519. https://doi.org/10.1111/j.1467-8276.2007.00975.x

Dessart, F.J., Barreiro-Hurlé, J., van Bavel, R., 2019. Behavioural factors affecting the adoption of sustainable farming practices: a policy-oriented review. Eur. Rev. Agric. Econ. 46, 417–471. https://doi.org/10.1093/erae/jbz019

Di Falco, S., Adinolfi, F., Bozzola, M., Capitanio, F., 2014. Crop Insurance as a Strategy for Adapting to Climate Change. J. Agric. Econ. 65, 485–504. https://doi.org/10.1111/1477-9552.12053

Drabik, D., Gorter, H., Just, D.R., Timilsina, G.R., 2015. The Economics of Brazil's Ethanol-Sugar Markets, Mandates, and Tax Exemptions. Am. J. Agric. Econ. 97, 1433–1450. https://doi.org/10.1093/ajae/aau109

Droste, N., D'Amato, D., Goddard, J.J., 2018. Where communities intermingle, diversity grows – The evolution of topics in ecosystem service research. PLoS ONE 13, e0204749. https://doi.org/10.1371/journal.pone.0204749
Drupp, M.A., Baumgärtner, S., Meyer, M., Quaas, M.F., von Wehrden, H., 2020. Between Ostrom and Nordhaus: The research landscape of sustainability economics. Ecol. Econ. 172, 106620.
Du, X., Feng, H., Hennessy, D.A., 2017. Rationality of Choices in Subsidized Crop Insurance Markets. Am. J. Agric. Econ. 99, 732–756. https://doi.org/10.1093/ajae/aaw035
Du, X., Hennessy, D.A., Feng, H., Arora, G., 2018. Land Resilience and Tail Dependence among Crop Yield Distributions. Am. J. Agric. Econ. 100, 809–828. https://doi.org/10.1093/ajae/aax082
Eisenstein, J., Ahmed, A., Xing, E.P., 2011. Proceedings of the Twenty-eighth International Conference on Machine Learning, in: Proceedings of the 28th International Conference on International Conference on Machine Learning. International Machine Learning Society, Washington, pp. 1041–1048.
Elabed, G., Bellemare, M.F., Carter, M.R., Guirkinger, C., 2013. Managing basis risk with multiscale index insurance. Agric. Econ. 44, 419–431. https://doi.org/10.1111/agec.12025
Engel, S., Pagiola, S., Wunder, S., 2008. Designing payments for environmental services in theory and practice: An overview of the issues. Ecol. Econ. 65, 663–674. https://doi.org/10.1016/j.ecolecon.2008.03.011
European Commission, 2019. The European Green Deal.
Falconer, K., Dupraz, P., Whitby, M., 2001. An Investigation of Policy Administrative Costs Using Panel Data for the English Environmentally Sensitive Areas. J. Agric. Econ. 52, 83–103. https://doi.org/10.1111/j.1477-9552.2001.tb00911.x
Farley, J., Costanza, R., 2010. Payments for ecosystem services: From local to global. Ecol. Econ. 69, 2060–2068. https://doi.org/10.1016/j.ecolecon.2010.06.010
Fesenfeld, L.P., Wicki, M., Sun, Y., Bernauer, T., 2020. Policy packaging can make food system transformation feasible. Nat. Food 1, 173–182.
Fooks, J.R., Higgins, N., Messer, K.D., Duke, J.M., Hellerstein, D., Lynch, L., 2016. Conserving Spatially Explicit Benefits in Ecosystem Service Markets: Experimental Tests of Network Bonuses and Spatial Targeting. Am. J. Agric. Econ. 98, 468–488. https://doi.org/10.1093/ajae/aav061
Frantzeskaki, N., McPhearson, T., Collier, M.J., Kendal, D., Bulkeley, H., Dumitru, A., Walsh, C., Noble, K., van Wyk, E., Ordóñez, C., Oke, C., Pintér, L., 2019. Nature-Based Solutions for Urban Climate Change Adaptation: Linking Science, Policy, and Practice Communities for Evidence-Based Decision-Making. BioScience 69, 455–466. https://doi.org/10.1093/biosci/biz042
Fresco, L.O., Geerling-Eiff, F., Hoes, A.-C., van Wassenaer, L., Poppe, K.J., 2021. Sustainable food systems: do agricultural economists have a role? Eur. Rev. Agric. Econ. 25.
Gallagher, K.S., Muehlegger, E., 2011. Giving green to get green? Incentives and consumer adoption of hybrid vehicle technology. J. Environ. Econ. Manag. 61, 1–15. https://doi.org/10.1016/j.jeem.2010.05.004
Gebremedhin, B., Swinton, S.M., 2003. Investment in soil conservation in northern Ethiopia: the role of land tenure security and public programs. Agric. Econ. 29, 69–84. https://doi.org/10.1111/j.1574-0862.2003.tb00148.x
Gentzkow, M., Kelly, B., Taddy, M., 2019. Text as Data. J. Econ. Lit. 57, 535–74. https://doi.org/10.1257/jel.20181020
Glauber, J.W., 2013. The Growth Of The Federal Crop Insurance Program, 1990–2011. Am. J. Agric. Econ. 95, 482–488. https://doi.org/10.1093/ajae/aas091
Gobien, S., Vollan, B., 2016. Exchanging Land for Solidarity: Solidarity Transfers among Voluntarily Resettled and Non-resettled Land-Reform Beneficiaries. Am. J. Agric. Econ. 98, 802–818. https://doi.org/10.1093/ajae/aav043
Goodwin, B.K., Smith, V.H., 2013. What Harm Is Done By Subsidizing Crop Insurance? Am. J. Agric. Econ. 95, 489–497. https://doi.org/10.1093/ajae/aas092
Groom, B., Turk, Z., 2021. Reflections on the Dasgupta Review on the Economics of Biodiversity 23.
Halkos, G., Tzeremes, N., 2012. Ranking agricultural, environmental and natural resource economics journals: A note (No. 36233), MPRA Paper.
Head, B.W., 2010. Reconsidering evidence-based policy: Key issues and challenges. Policy Soc., EVIDENCE-BASED POLICY 29, 77–94. https://doi.org/10.1016/j.polsoc.2010.03.001
Herrmann, R., Berg, E., Dabbert, S., Pöchtrager, S., Salhofer, K., 2011. Going Beyond Impact Factors: A Survey-based Journal Ranking by Agricultural Economists. J. Agric. Econ. 62, 710–732. https://doi.org/10.1111/j.1477-9552.2011.00308.x
Hidrue, M.K., Parsons, G.R., Kempton, W., Gardner, M.P., 2011. Willingness to pay for electric vehicles and their attributes. Resour. Energy Econ. 33, 686–705. https://doi.org/10.1016/j.reseneeco.2011.02.002
Horowitz, J.K., McConnell, K.E., 2002. A Review of WTA/WTP Studies. J. Environ. Econ. Manag. 44, 426–447. https://doi.org/10.1006/jeem.2001.1215

Huber, R., Xiong, H., Keller, K., Finger, R., 2021. Bridging behavioural factors and standard bio-economic modelling in an agent-based modelling framework. J. Agric. Econ. https://doi.org/10.1111/1477-9552.12447
Hudson, P., Botzen, W.J.W., Feyen, L., Aerts, J.C.J.H., 2016. Incentivising flood risk adaptation through risk based insurance premiums: Trade-offs between affordability and risk reduction. Ecol. Econ. 125, 1–13. https://doi.org/10.1016/j.ecolecon.2016.01.015
IPBES, 2019. Summary for policymakers of the global assessment report on biodiversity and ecosystem services. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).
Jensen, N., Barrett, C., 2017. Agricultural Index Insurance for Development. Appl. Econ. Perspect. Policy 39, 199–219. https://doi.org/10.1093/aepp/ppw022
Kahn, M.E., 2007. Do greens drive Hummers or hybrids? Environmental ideology as a determinant of consumer choice. J. Environ. Econ. Manag. 54, 129–145. https://doi.org/10.1016/j.jeem.2007.05.001
Kalaitzidakis, P., Mamuneas, T.P., Stengos, T., 2011. An updated ranking of academic journals in economics. Can. J. Econ. 44, 1525–1538. https://doi.org/10.1111/j.1540-5982.2011.01683.x
Kern, F., Kivimaa, P., Martiskainen, M., 2017. Policy packaging or policy patching? The development of complex energy efficiency policy mixes. Energy Res. Soc. Sci. 23, 11–25. https://doi.org/10.1016/j.erss.2016.11.002
Kline, J., Wichelns, D., 1996. Measuring public preferences for the environmental amenities provided by farmland. Eur. Rev. Agric. Econ. 23, 421–436. https://doi.org/10.1093/erae/23.4.421
Kling, C.L., Segerson, K., Shogren, J.F., 2010. Environmental Economics: How Agricultural Economists Helped Advance the Field. Am. J. Agric. Econ. 92, 487–505. https://doi.org/10.1093/ajae/aaq012
Kuhfuss, L., Préget, R., Thoyer, S., Hanley, N., 2016. Nudging farmers to enrol land into agri-environmental schemes: the role of a collective bonus. Eur. Rev. Agric. Econ. 43, 609–636. https://doi.org/10.1093/erae/jbv031
Kvamsdal, S.F., 2021. A Machine Learning Analysis of the Recent Environmental and Resource Economics Literature 93–115.
Law, E.A., Wilson, K.A., 2015. Providing Context for the Land-Sharing and Land-Sparing Debate. Conserv. Lett. 8, 404–413. https://doi.org/10.1111/conl.12168
Lee, M., Mimno, D., 2017. Low-dimensional Embeddings for Interpretable Anchor-based Topic Inference.
Liu, W., Wang, J., Li, C., Chen, B., Sun, Y., 2019. Using Bibliometric Analysis to Understand the Recent Progress in Agroecosystem Services Research. Ecol. Econ. 156, 293–305. https://doi.org/10.1016/j.ecolecon.2018.09.001
Luskin, M.S., Lee, J.S.H.H., Edwards, D.P., Gibson, L., Potts, M.D., 2018. Study context shapes recommendations of land-sparing and sharing; a quantitative review. Glob. Food Secur. 16, 29–35. https://doi.org/10.1016/j.gfs.2017.08.002
Lybbert, T.J., Beatty, T.K.M., Hurley, T.M., Richards, T.J., 2018. American Journal of Agricultural Economics Volume 100: A Century of Publishing the Frontiers of the Profession. Am. J. Agric. Econ. 100, 1253–1274. https://doi.org/10.1093/ajae/aay081
Markelova, H., Meinzen-Dick, R., Hellin, J., Dohrn, S., 2009. Collective action for smallholder market access. Food Policy 34, 1–7. https://doi.org/10.1016/j.foodpol.2008.10.001
Martín-López, B., García-Llorente, M., Palomo, I., Montes, C., 2011. The conservation against development paradigm in protected areas: Valuation of ecosystem services in the Doñana social–ecological system (southwestern Spain). Ecol. Econ. 70, 1481–1491. https://doi.org/10.1016/j.ecolecon.2011.03.009
Matsuda, A., Kurosaki, T., 2019. Demand for temperature and rainfall index insurance in India. Agric. Econ. 50, 353–366. https://doi.org/10.1111/agec.12489
Mimno, D., McCallum, A., 2012. Topic Models Conditioned on Arbitrary Features with Dirichlet-multinomial Regression, in: Proceedings of the Twenty-Fourth Conference on Uncertainty in Artificial Intelligence (UAI2008).
Miranda, M.J., Glauber, J.W., 1997. Systemic Risk, Reinsurance, and the Failure of Crop Insurance Markets. Am. J. Agric. Econ. 79, 206–215. https://doi.org/10.2307/1243954
Moshiri, S., Aliyev, K., 2017. Rebound effect of efficiency improvement in passenger cars on gasoline consumption in Canada. Ecol. Econ. 131, 330–341. https://doi.org/10.1016/j.ecolecon.2016.09.018
Newig, J., Rose, M., 2020. Cumulating evidence in environmental governance, policy and planning research: towards a research reform agenda. J. Environ. Policy Plan. 0, 1–15. https://doi.org/10.1080/1523908X.2020.1767551
Osberghaus, D., 2015. The determinants of private flood mitigation measures in Germany — Evidence from a nationwide survey. Ecol. Econ. 110, 36–50. https://doi.org/10.1016/j.ecolecon.2014.12.010
Pan, Y., Vira, B., 2019. Exploring natural capital using bibliometrics and social media data. Ecol. Soc. 24, art5. https://doi.org/10.5751/ES-11118-240405

Pannell, D., Zilberman, D., 2020. Understanding Adoption of Innovations and Behavior Change to Improve Agricultural Policy. Appl. Econ. Perspect. Policy 42, 3–7. https://doi.org/10.1002/aepp.13013
Pannell, D.J., 2008. Public Benefits, Private Benefits, and Policy Mechanism Choice for Land-Use Change for Environmental Benefits. Land Econ. 84, 225–240. https://doi.org/10.3368/le.84.2.225
Parkhurst, G.M., Shogren, J.F., 2007. Spatial incentives to coordinate contiguous habitat. Ecol. Econ. 64, 344–355. https://doi.org/10.1016/j.ecolecon.2007.07.009
Pascual, U., Muradian, R., Rodríguez, L.C., Duraiappah, A., 2010. Exploring the links between equity and efficiency in payments for environmental services: A conceptual approach. Ecol. Econ. 69, 1237–1244. https://doi.org/10.1016/j.ecolecon.2009.11.004
Paul, C., Techen, A.-K., Robinson, J.S., Helming, K., 2019. Rebound effects in agricultural land and soil management: Review and analytical framework. J. Clean. Prod. 227, 1054–1067. https://doi.org/10.1016/j.jclepro.2019.04.115
Pe'er, G., Zinngrebe, Y., Moreira, F., Sirami, C., Schindler, S., Müller, R., Bontzorlos, V., Clough, D., Bezák, P., Bonn, A., Hansjürgens, B., Lomba, A., Möckel, S., Passoni, G., Schleyer, C., Schmidt, J., Lakner, S., 2019. A greener path for the EU Common Agricultural Policy. Science 365, 449–451. https://doi.org/10.1126/science.aax3146
Pellerano, J.A., Price, M.K., Puller, S.L., Sánchez, G.E., 2017. Do Extrinsic Incentives Undermine Social Norms? Evidence from a Field Experiment in Energy Conservation. Environ. Resour. Econ. 67, 413–428. https://doi.org/10.1007/s10640-016-0094-3
Polasky, S., Nelson, E., Pennington, D., Johnson, K.A., 2011. The Impact of Land-Use Change on Ecosystem Services, Biodiversity and Returns to Landowners: A Case Study in the State of Minnesota. Environ. Resour. Econ. 48, 219–242. https://doi.org/10.1007/s10640-010-9407-0
Polyakov, M., Chalak, M., Iftekhar, Md.S., Pandit, R., Tapsuwan, S., Zhang, F., Ma, C., 2018. Authorship, Collaboration, Topics, and Research Gaps in Environmental and Resource Economics 1991–2015. Environ. Resour. Econ. 71, 217–239. https://doi.org/10.1007/s10640-017-0147-2
Polyakov, M., Gibson, F.L., Pannell, D.J., 2016. Antipodean agricultural and resource economics at 60: Trends in topics, authorship and collaboration. Aust. J. Agric. Resour. Econ. 60, 506–515. https://doi.org/10.1111/1467-8489.12152
Polyakov, M., Polyakov, S., Iftekhar, M.S., 2017. Does academic collaboration equally benefit impact of research across topics? The case of agricultural, resource, environmental and ecological economics. Scientometrics 113, 1385–1405. https://doi.org/10.1007/s11192-017-2523-7
R Core Team, 2020. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.
Rico García-Amado, L., Ruiz Pérez, M., Barrasa García, S., 2013. Motivation for conservation: Assessing integrated conservation and development projects and payments for environmental services in La Sepultura Biosphere Reserve, Chiapas, Mexico. Ecol. Econ. 89, 92–100. https://doi.org/10.1016/j.ecolecon.2013.02.002
Rigby, D., Burton, M., Lusk, J.L., 2015. Journals, Preferences, and Publishing in Agricultural and Environmental Economics. Am. J. Agric. Econ. 97, 490–509. https://doi.org/10.1093/ajae/aau102
Ring, I., Barton, D.N., 2015. Economic instruments in policy mixes for biodiversity conservation and ecosystem governance, in: Martínez-Alier, J., Muradian, R. (Eds.), Handbook of Ecological Economics. Edward Edgar, Cheltenham, pp. 413–449.
Roberts, M.E., Stewart, B.M., Airoldi, E.M., 2016. A Model of Text for Experimentation in the Social Sciences. J. Am. Stat. Assoc. 111, 988–1003. https://doi.org/10.1080/01621459.2016.1141684
Roberts, M.E., Stewart, B.M., Tingley, D., 2019. stm: An R Package for Structural Topic Models. J. Stat. Softw. 91, 1–40. https://doi.org/10.18637/jss.v091.i02
Roberts, M.E., Stewart, B.M., Tingley, D., Lucas, C., Leder-Luis, J., Gadarian, S.K., Albertson, B., Rand, D.G., 2014. Structural Topic Models for Open-Ended Survey Responses. Am. J. Polit. Sci. 58, 1064–1082. https://doi.org/10.1111/ajps.12103
Salles, J.-M., Teillard, F., Tichit, M., Zanella, M., 2017. Land sparing versus land sharing: an economist's perspective. Reg. Environ. Change 17, 1455–1465. https://doi.org/10.1007/s10113-017-1142-4
Santarius, T., Soland, M., 2018. How Technological Efficiency Improvements Change Consumer Preferences: Towards a Psychological Theory of Rebound Effects. Ecol. Econ. 146, 414–424. https://doi.org/10.1016/j.ecolecon.2017.12.009
Santeramo, F.G., Goodwin, B.K., Adinolfi, F., Capitanio, F., 2016. Farmer Participation, Entry and Exit Decisions in the Italian Crop Insurance Programme. J. Agric. Econ. 67, 639–657. https://doi.org/10.1111/1477-9552.12155
Sayer, J., Sunderland, T., Ghazoul, J., Pfund, J.-L., Sheil, D., Meijaard, E., Venter, M., Boedhihartono, A.K., Day, M., Garcia, C., van Oosten, C., Buck, L.E., 2013. Ten principles for a landscape approach to reconciling

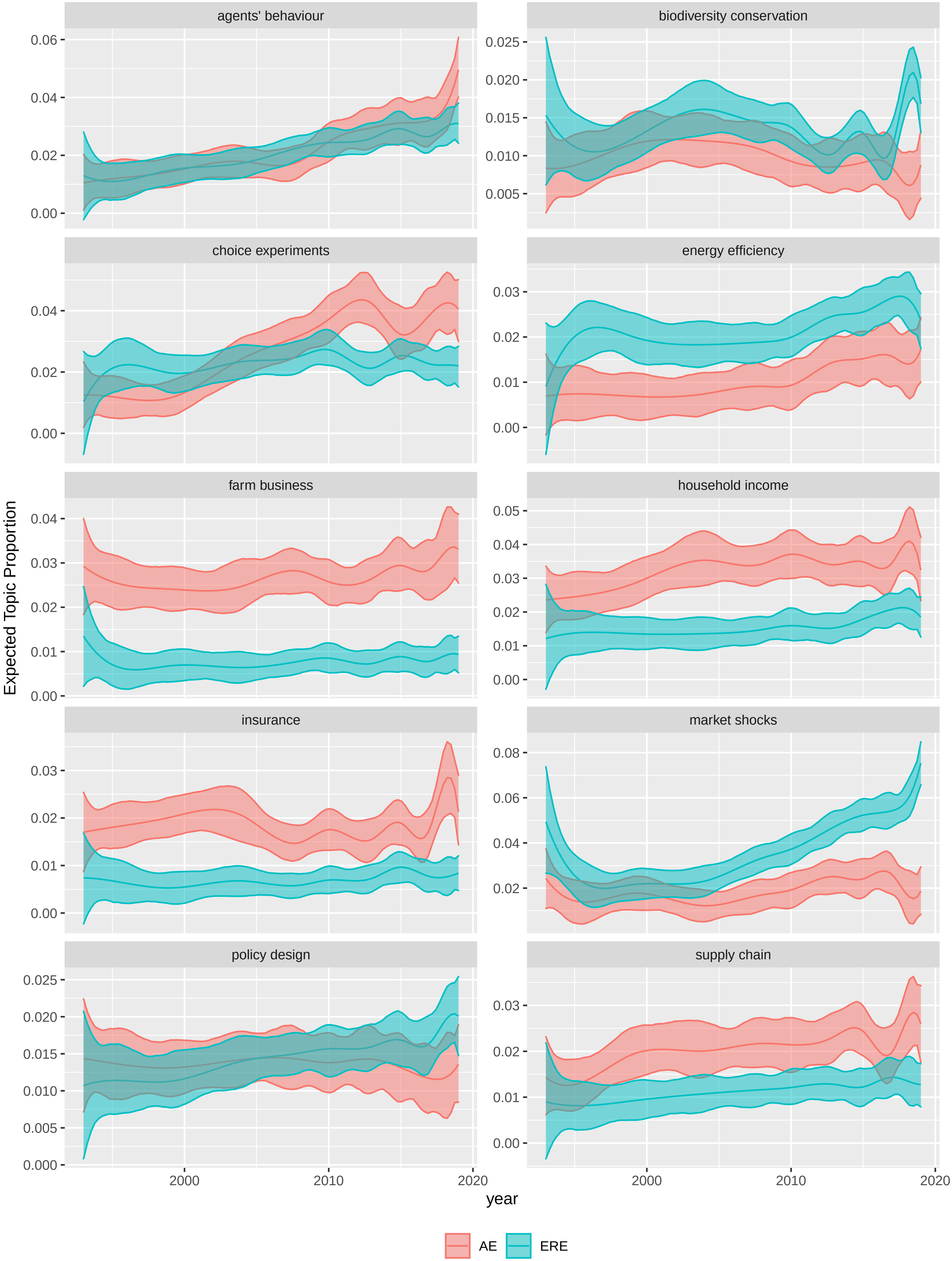
agriculture, conservation, and other competing land uses. Proc. Natl. Acad. Sci. U. S. A. 110, 8349–8356. https://doi.org/10.1073/pnas.1210595110
Schader, C., Lampkin, N., Muller, A., Stolze, M., 2014. The role of multi-target policy instruments in agri-environmental policy mixes. J. Environ. Manage. 145, 180–190. https://doi.org/10.1016/j.jenvman.2014.06.016
Schebesta, H., Candel, J.J., 2020. Game-changing potential of the EU's Farm to Fork Strategy. Nat. Food 1, 586–588.
Segerson, K., 2015. The Role of Economics in Interdisciplinary Environmental Policy Debates: Opportunities and Challenges. Am. J. Agric. Econ. 97, 374–389. https://doi.org/10.1093/ajae/aau104
Sherrick, B.J., Barry, P.J., Ellinger, P.N., Schnitkey, G.D., 2004. Factors Influencing Farmers' Crop Insurance Decisions. Am. J. Agric. Econ. 86, 103–114. https://doi.org/10.1111/j.0092-5853.2004.00565.x
Sorrell, S., Dimitropoulos, J., 2008. The rebound effect: Microeconomic definitions, limitations and extensions. Ecol. Econ. 65, 636–649. https://doi.org/10.1016/j.ecolecon.2007.08.013
Spraggon, J., 2004. Testing ambient pollution instruments with heterogeneous agents. J. Environ. Econ. Manag. 48, 837–856. https://doi.org/10.1016/j.jeem.2003.11.006
Sterner, T., 2019. Policy design for the Anthropocene. Nat. Sustain. 2, 8. https://doi.org/10.1038/s41893-018-0194-x
Storm, H., Baylis, K., Heckelei, T., 2020. Machine learning in agricultural and applied economics. Eur. Rev. Agric. Econ. 47, 849–892.
Streletskaya, N.A., Bell, S.D., Kecinski, M., Li, T., Banerjee, S., Palm-Forster, L.H., Pannell, D., 2020. Agricultural Adoption and Behavioral Economics: Bridging the Gap. Appl. Econ. Perspect. Policy 42, 54–66. https://doi.org/10.1002/aepp.13006
Swinton, S.M., 2018. Why Should I Believe Your Applied Economics? Am. J. Agric. Econ. 100, 381–391. https://doi.org/10.1093/ajae/aax096
Tack, J., Coble, K., Barnett, B., 2018. Warming temperatures will likely induce higher premium rates and government outlays for the U.S. crop insurance program. Agric. Econ. 49, 635–647.
Tafere, K., Barrett, C.B., Lentz, E., 2019. Insuring Well-Being? Buyer's Remorse and Peace of Mind Effects From Insurance. Am. J. Agric. Econ. 101, 627–650. https://doi.org/10.1093/ajae/aay087
Thomas, F., Midler, E., Lefebvre, M., Engel, S., 2019. Greening the common agricultural policy: a behavioural perspective and lab-in-the-field experiment in Germany. Eur. Rev. Agric. Econ. 46, 367–392. https://doi.org/10.1093/erae/jbz014
Thoyer, S., Préget, R., 2019. Enriching the CAP evaluation toolbox with experimental approaches: introduction to the special issue. Eur. Rev. Agric. Econ. 46, 347–366. https://doi.org/10.1093/erae/jbz024
Vanslembrouck, I., Huylenbroeck, G., Verbeke, W., 2002. Determinants of the Willingness of Belgian Farmers to Participate in Agri-environmental Measures. J. Agric. Econ. 53, 489–511. https://doi.org/10.1111/j.1477-9552.2002.tb00034.x
Vatn, A., 2010. An institutional analysis of payments for environmental services. Ecol. Econ. 69, 1245–1252. https://doi.org/10.1016/j.ecolecon.2009.11.018
Viaggi, D., Raggi, M., Villanueva, A.J., Kantelhardt, J., 2021. Provision of public goods by agriculture and forestry: Economics, policy and the way ahead. Land Use Policy 107, 105273. https://doi.org/10.1016/j.landusepol.2020.105273
Watson, K.B., Ricketts, T., Galford, G., Polasky, S., O'Niel-Dunne, J., 2016. Quantifying flood mitigation services: The economic value of Otter Creek wetlands and floodplains to Middlebury, VT. Ecol. Econ. 130, 16–24. https://doi.org/10.1016/j.ecolecon.2016.05.015
Weber, J.G., Key, N., O'Donoghue, E., 2016. Does Federal Crop Insurance Make Environmental Externalities from Agriculture Worse? J. Assoc. Environ. Resour. Econ. 3, 707–742. https://doi.org/10.1086/687549
Weersink, A., Fulton, M., 2020. Limits to Profit Maximization as a Guide to Behavior Change. Appl. Econ. Perspect. Policy 42, 67–79. https://doi.org/10.1002/aepp.13004
Wendland, K.J., Honzák, M., Portela, R., Vitale, B., Rubinoff, S., Randrianarisoa, J., 2010. Targeting and implementing payments for ecosystem services: Opportunities for bundling biodiversity conservation with carbon and water services in Madagascar. Ecol. Econ. 69, 2093–2107. https://doi.org/10.1016/j.ecolecon.2009.01.002
Wossink, G. a. A., van Wenum, J.H., 2003. Biodiversity conservation by farmers: analysis of actual and contingent participation. Eur. Rev. Agric. Econ. 30, 461–485. https://doi.org/10.1093/erae/30.4.461
Wu, J., Plantinga, A.J., 2003. The influence of public open space on urban spatial structure. J. Environ. Econ. Manag. 46, 288–309. https://doi.org/10.1016/S0095-0696(03)00023-8
Wunder, S., Engel, S., Pagiola, S., 2008. Taking stock: A comparative analysis of payments for environmental services programs in developed and developing countries. Ecol. Econ. 65, 834–852. https://doi.org/10.1016/j.ecolecon.2008.03.010

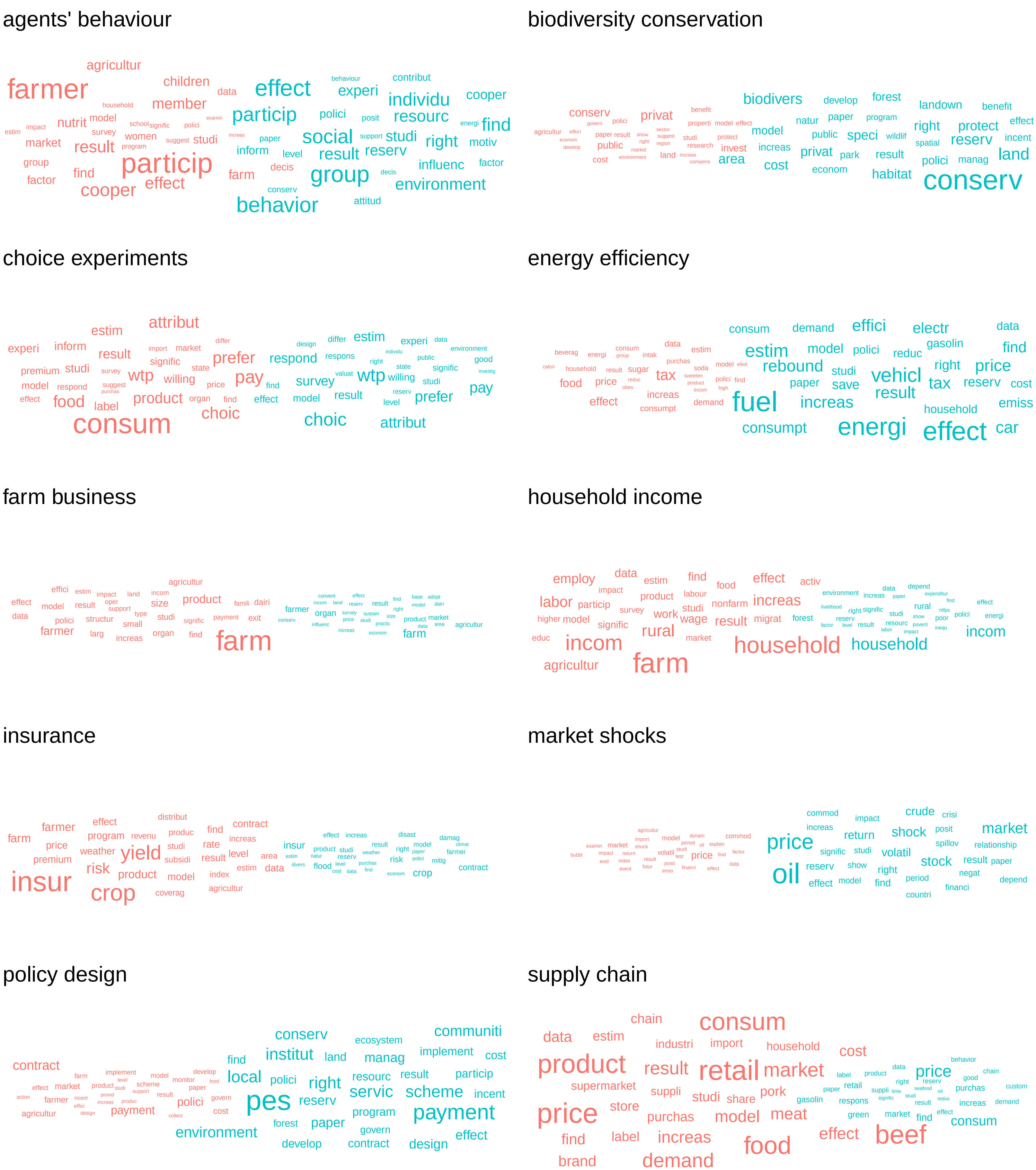
Appendix

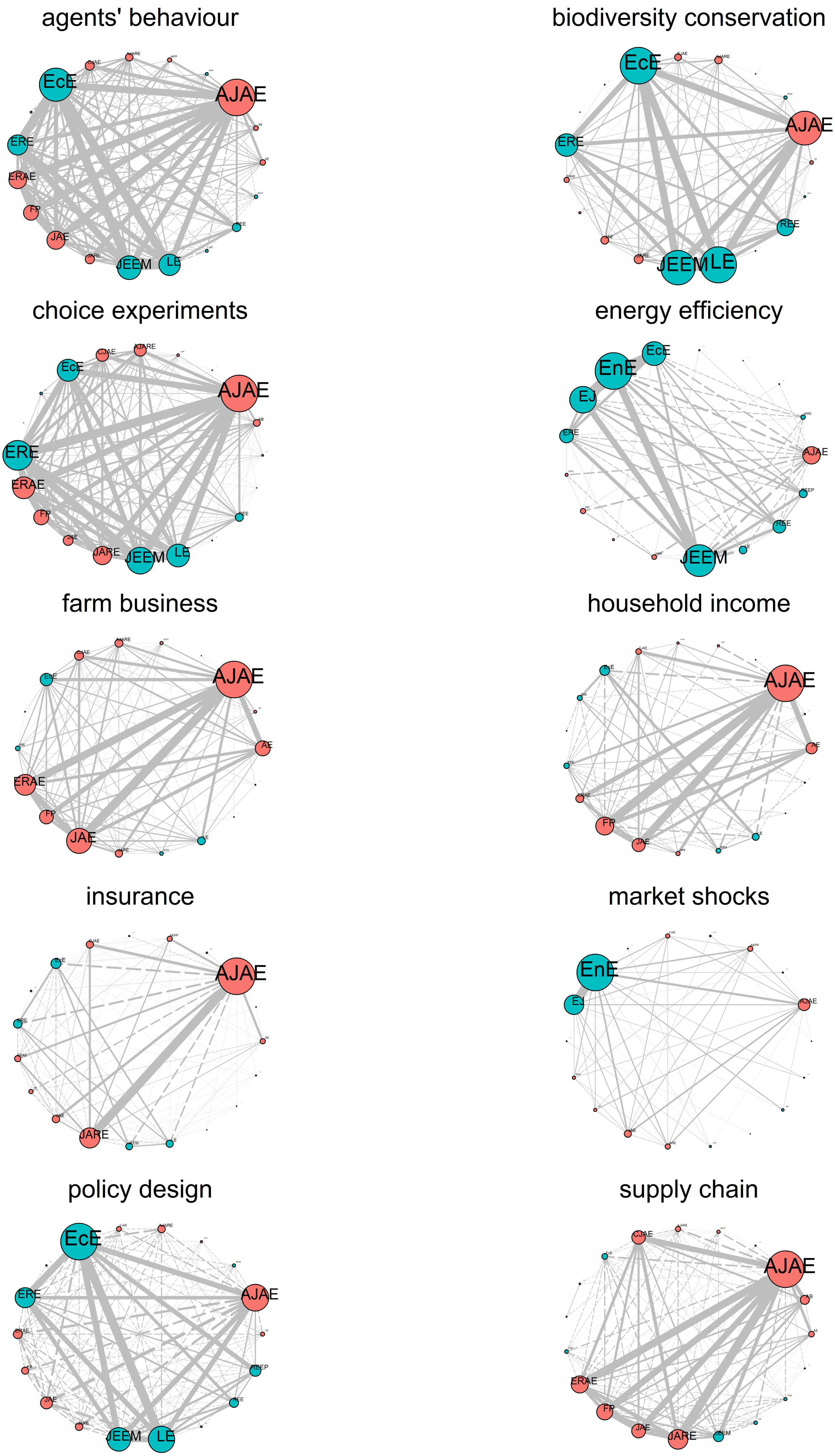
Table A1: Number of articles published per journal within analysis period and year of first publishing date

Journal	***# Publications 1993–2019***		***Journal Published since***
	Raw data	***Analyzed***	
Agricultural Economics			
American Journal of Agricultural Economics	6437	2001	1919
Food Policy	1847	1687	1975
Journal of Agricultural and Resource Economics	1624	823	1992
Journal of Agricultural Economics	1227	872	1928
Agricultural Economics	1716	1577	1954
European Review of Agricultural Economics	1126	721	1973
Australian Journal of Agricultural and Resource Economics	955	672	1957
Canadian Journal of Agricultural Economics	798	641	1952
Agribusiness	479	459	1985
Applied Economic Perspectives and Policy	335	319	1979
Environmental and Resource Economics			
Ecological Economics	5864	4993	1989
Energy Economics	3604	3547	1979
Environmental and Resource Economics	1700	1625	1991
Journal of Environmental Economics and Management	1469	1395	1974
Energy Journal	1375	1069	1980
Land Economics	1136	1033	1925
Resource and Energy Economics	794	765	(1978) 1993
Marine Resource Economics	322	280	1984
Review of Environmental Economics and Policy	253	102	2007
Annual Review of Resource Economics	256	247	2009

Source: WoS Data, journal websites


agents' behaviour
biodiversity conservation
choice experiments
energy efficiency
farm business
household income
insurance
market shocks
policy design
supply chain
Expected Topic Proportion
year
2000
2010
2020
AE
ERE


agents' behaviour
farmer
particip
cooper
result
market
nutrit
member
children
agricultur
effect
group
behavior
social
individu
resourc
environment
biodiversity conservation
conserv
land
reserv
privat
speci
area
cost
biodivers
choice experiments
consum
choic
wtp
pay
prefer
attribut
food
product
survey
energy efficiency
fuel
energi
effect
vehicl
rebound
estim
effici
tax
farm business
farm
farmer
product
size
household income
household
farm
incom
labor
rural
increas
insurance
insur
crop
yield
risk
farmer
market shocks
price
oil
shock
market
return
volatil
stock
policy design
pes
payment
scheme
servic
local
institut
right
environment
contract
supply chain
product
price
retail
consum
beef
food
market
demand
result
meat



agents' behaviour
EcE
AJAE
ERE
ERAE
FP
JAE
JARE
JEEM
LE
REE
biodiversity conservation
EcE
AJAE
ERE
REE
JEEM
LE
choice experiments
CJAE
AJARE
EcE
AJAE
ERE
ERAE
FP
JARE
JEEM
LE
energy efficiency
EcE
EnE
EJ
ERE
AJAE
REE
JEEM
farm business
AJARE
CJAE
EcE
AJAE
AE
ERAE
FP
JAE
household income
AJAE
AE
FP
JAE
insurance
AJAE
JARE
market shocks
EnE
EJ
policy design
EcE
ERE
AJAE
REEP
JAE
JEEM
LE
supply chain
CJAE
AJAE
AB
ERAE
FP
JAE
JARE

LSR Working papers series

Aims and Scopes

The Working Paper Series LUSEM Sustainability Research (LSR WPS) brings together research and policy discussions from a range of disciplinary approaches to improve social, environmental and economic sustainability and the reaching of Agenda 2030. The LSR WPS encourages manuscripts combining interdisciplinary perspectives with roots in business administration, economics, economic history, informatics and business law. In the quest of promoting a global sustainable development, the LSR WPS rests on the belief that successful transformations towards more sustainable organizations call for research and policy discussions including novel methodologies and theoretical approaches.