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Literature database GrassCOPS* (Grassland Conference Paper Search): making better use of the potential of conference literature

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1 Introduction

The demands placed on agriculture have steadily increased over the past decades: a substantially growing demand for agricultural goods has to be met while, simultaneously, adverse environmental effects, climate-damaging emissions and a further loss of biodiversity need to be prevented. Also, society expects progress in animal welfare and wants farms' economic viability to be ensured (3; 7; 16).

The challenges agriculture is faced with represent a series of global challenges which require an increasingly urgent alternative to the ruling economic model. Hence the search for innovative solutions. Given the current situation, a call for the reorientation of science came up a few years ago. Science should become more "transformative" and play an active and creative role in solving sustainability issues. This includes i. a.

- the elaboration of concrete suggestions for solutions, of technical and social innovations as well as their dissemination and
- the accelerated implementation of solutions in the relevant sectors (16).

Transdisciplinarity is a central element of transformative research and is seen as an equal exchange both across disciplines and among academia and practice or academics and non-academics (i. a. from the economy, administration and civil society) (6; 10; 12; 16). The involvement of actors from different backgrounds is considered necessary to fully understand the complex issues involved, to agree on shared values, norms and visions, and to increase stakeholders' awareness and accountability. Also,

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involving as many affected groups of people as possible, increases the legitimacy of the solutions developed (10).

Regarding the agricultural sector, this means that applied research is called for, to offer concrete solutions that can be put into practice. The results of such research should be available and accessible. A thematic connection to the sustainability challenges faced by the agricultural sector should be clearly visible. In addition, research should not be dominated by science but should also include stakeholders such as practitioners, the industry, politics and administration. These could involve agricultural chambers, private consultancies, NGOs, government authorities, companies concerned with agricultural technology, fertilisers or seeds, as well as farmers, among others. Studies whose results can be transferred to other contexts, e.g. studies taking different spatial conditions into account, are of particular interest.

As part of the EU project Inno4Grass (2017-2019, Horizon 2020, http://www.inno4grass.eu), the grassland research represented in conference proceedings from the past decades is classified according to these criteria. Respective results are being transferred to a database and simplify the targeted search for practice-relevant research results. The literature database GrassCOPS - Grassland Conference Proceedings Paper Search - was designed for this purpose.

GrassCOPS pursues three primary goals:

a. **Better accessibility of "grey literature"**
   Essential parts of agricultural research, especially applied and practice-oriented science, are only accessible as so-called "grey literature". This means that research results are presented at conferences, for instance, but are not published in international scientific journals. However, research that has only been published in conference proceedings is either not covered at all - or covered only to a limited degree - by the common bibliographic search databases for scientific literature (e.g. Web of Science, Scopus, CAB direct). Hence, it cannot be discovered easily, and less so by international users. Even via Google Scholar, which automatically lists conference proceedings available online if they meet specific formal criteria (5), conference literature is hard to find, if the search language is not the same as the language an article was written in.
   In the German-speaking countries, the annual meetings of the “Grünland und Futterbau der Gesellschaft für Pflanzenbauwissenschaften e.V” (AGGF) working group serve as a central exchange platform for practically oriented, agricultural grassland and forage research. Similar grassland meetings are held in other countries (e.g. Journée de Printemps de l 'AFPF in France, Vallkonferens in Sweden, Dairy Conference in Ireland). In a random sample of 25 AGGF articles published between 1998 and 2017, the results of three studies only could also be retrieved from the Web of Science (Web of Science Core Collection). The reason for the low publication rate of "grey literature" is the rather low incentive for many authors to go through a labour-intensive and time-consuming review process. This particularly applies to authors who do not

work in purely scientific institutions and where a high publication rate signifies reputation. In addition, many of the studies presented at conferences are prepared for regional clients and therefore of interest only at the local level. While many international scientific journals are not interested in catering to local concerns, that does not automatically make results from such research irrelevant for other regions or situations. GrassCOPS inventories articles from conference proceedings at a central location and is fully operable in English language.

b. **Detailed filter criteria for targeted search**
   In contrast to traditional literature databases, GrassCOPS also offers detailed content filtering options, which enable a targeted article search. It is not only possible to search for keywords, but also for explanatory and output variables, for spatial focuses and scales, for the participation of specific actors and for different types of innovations.

c. **Critical reflection of grassland science**
   Based on the analysis of the articles already stored in GrassCOPS, a first critical reflection of practice-near grassland research in the German-speaking countries is possible. This will give indications towards answering the question regarding the extent to which current grassland research meets the requirements of a transformative science. Furthermore, it will help to evaluate how research results presented in conference proceedings can be valuable for tackling the current challenges in grassland management. In our analysis, we primarily looked at how grassland research has changed over the past 20 years, with a focus on thematic priorities, stakeholder involvement/transdisciplinarity), spatial scales and the practical relevance of the presented results (innovations).

Currently, GrassCOPS is being tested by the international Inno4Grass project partners as a tool for improved discussion and evaluation of innovative grassland practices with the help of scientific information.

2 Material and methods

The inventory and categorisation of conference papers for transfer into the literature database GrassCOPS follow a questionnaire-like scheme, which was developed in advance and considers the input from the Inno4Grass project partners. Besides bibliographic information (title, author, year, keywords, conference, weblink to the respective conference proceeding), content-related and formal-structural characteristics are also recorded categorically for each article (see Tab. 1).

Tab. 1: Overview of the inventoried article characteristics

Characteristic	Explanation	Concrete category example
Function of involved institutions	Which functions can be assigned to the institutions involved in the publication of the article?	Science
Number of involved institutions	How many institutions are involved in the publication of the article?	2
Type of article/study	How is the type of article/study described best?	Experiment
Grassland production system	Which grassland production system does the article refer to?	Animal husbandry > Dairy cows
Type of use	How are the addressed grasslands managed?	Grazing
Grassland	Which types of grasslands are addressed?	Permanent grassland > semi-natural
Study region	Which is the study region (country, partly also federal state, biogeographical region)?	Germany > Lower Saxony - maritime region
Spatial scale	On which spatial scale was the study conducted?	Local
Explanatory variables	The influence of which factors was investigated?	Site management > Mowing > time of mowing
Outcome variables	The development of which target value was investigated?	Biomass quality
Innovativeness	Does the article contain innovations for practitioners in grassland management?	Yes - potentially
Type of innovation	Which type of innovation can be derived from the article? Is it an innovation in the agricultural end product or one that optimised the production process, for instance?	Production technique > Process innovation

Depending on the type of the article to be inventoried, not all sections and categories are relevant. For example, for reviews, it is usually not possible to define explanatory and target variables. Multiple answers are possible in most cases. The sections "production system", "grassland", "region",

"explanatory variables", "target variables" and "type of innovation" include main categories as well as subcategories for further differentiation (e.g. grassland management> fertilisation> time of fertilisation).

Regarding the assessment of the innovation content of the individual conference articles, a pragmatic approach is applied. Innovations are usually associated with novelties (8). In addition, literature often distinguishes between invention and innovation: an invention precedes an innovation. The latter is the practical implementation of the idea or discovery (4).

A conference article is classified as innovative if the implementation and transfer of the presented results into grassland practice (including supply, processing, marketing) seem possible. During the inventory routine, these articles are again subdivided into "directly" and "potentially" innovative contributions. The category "directly innovative" is only chosen, if the results are obvious and the different alternatives for action clearly emerge from the article. Studies with still very vague results or basic research without any clear perspective for implementation are rated as "not innovative" for grassland practice. However, if these articles contain innovative approaches for actors outside grassland practice (e.g. politicians), the category "innovative for other stakeholders (e.g. politicians)" can be chosen.

Generally, results are assumed to be novel, as science aspires to create new knowledge. Even contributions with tested solutions that evidently do not work are classified as "innovative" since these results can be as relevant for grassland practice as successful solutions.

In addition to the categories listed above, the key statements of an article are entered in the inventory along with an English summary of the potentially innovative approaches. Unless English keywords are already given, these will also be defined.

All collected data is transferred to an online MySQL database, which is stored on the server of the University of Göttingen and can be searched via a specifically developed PHP-based query form.

In order to evaluate the development of practice-near grassland science, a quantitative statistical analysis of the AGGF database entries between 1998 and 2017 was carried out. 2010 was excluded, as there was no independent AGGF meeting during that year. The statistical evaluation was done in R (version 3.4.3) using the packages ggplot2, plyr, scales, data.table and grid.Extra.

3 Results

3.1 GrassCOPS tool

The GrassCOPS database is freely accessible and searchable at http://www.grassland.uni-goettingen.de (Fig. 1 and 2). Currently, it contains 1126 entries, including 1092 AGGF articles written between 1996 and 2017 (with the years 1998-2017 being fully inventoried).

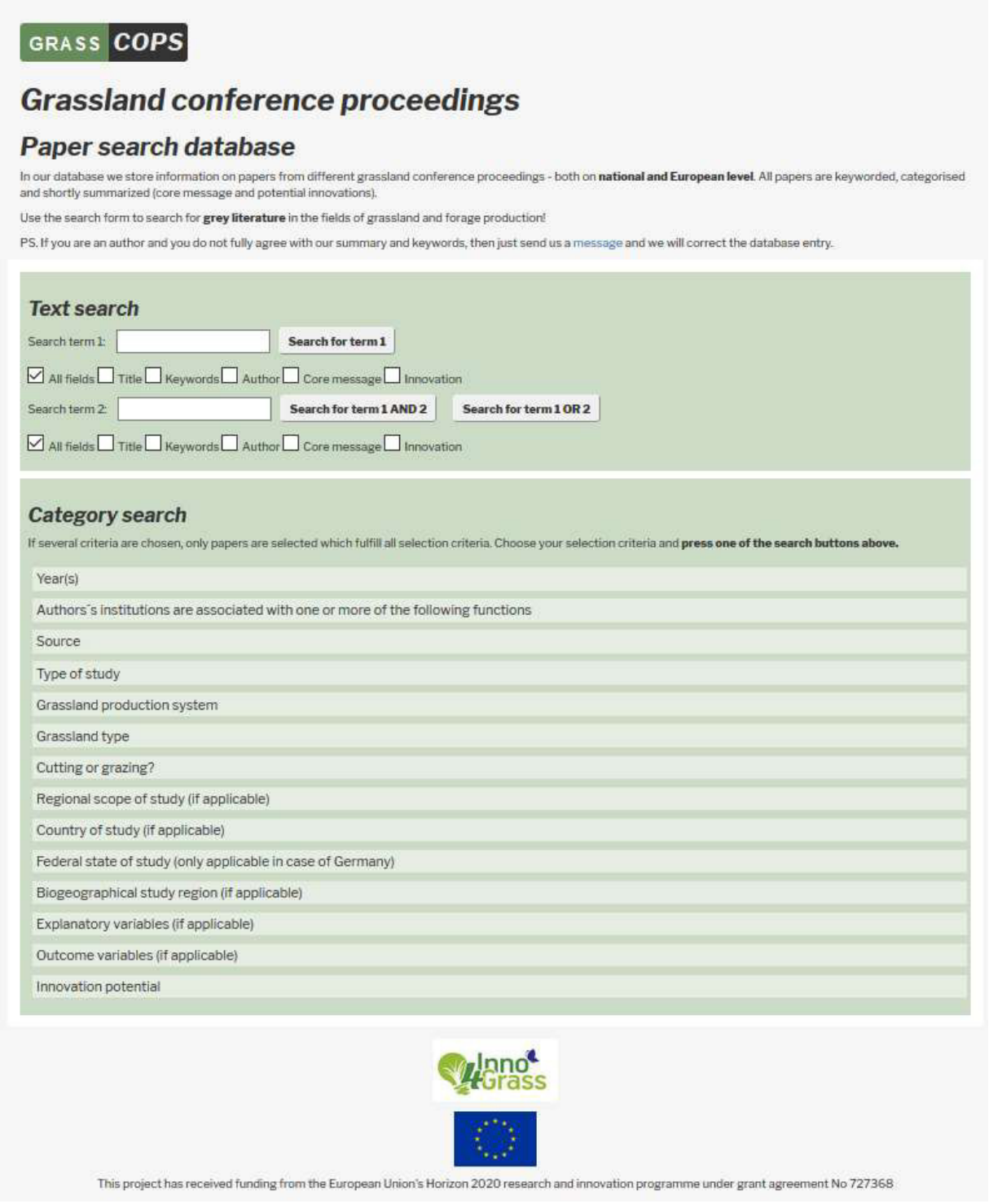
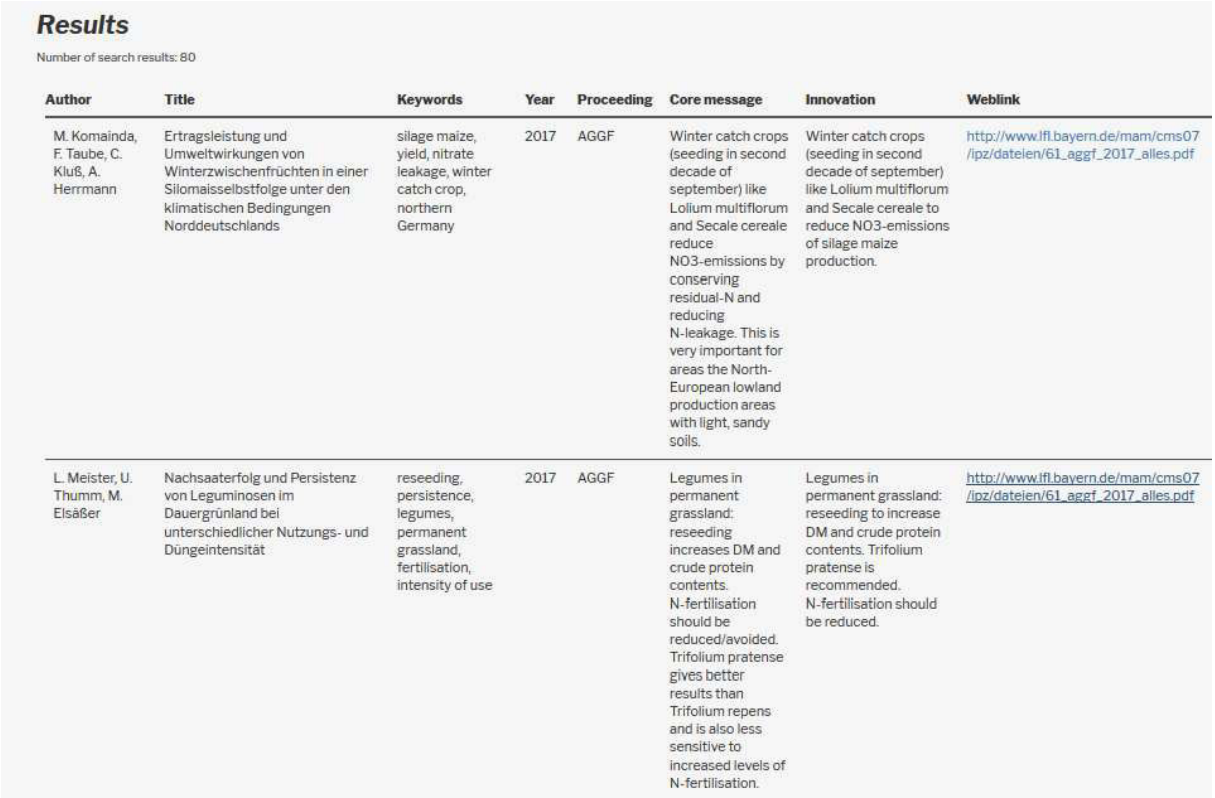


Fig. 1: Search mask with text and category-based search options, http://www.grassland.uni-goettingen.de. The individual categories for filter selection can be folded out.



Results

Number of search results: 80

Author	Title	Keywords	Year	Proceeding	Core message	Innovation	Weblink
M. Komainda, F. Taube, C. Kluß, A. Herrmann	Ertragsleistung und Umweltwirkungen von Winterzwischenfrüchten in einer Silomaisselbstfolge unter den klimatischen Bedingungen Norddeutschlands	silage maize, yield, nitrate leakage, winter catch crop, northern Germany	2017	AGGF	Winter catch crops (seeding in second decade of september) like Lolium multiflorum and Secale cereale reduce NO3-emissions by conserving residual-N and reducing N-leakage. This is very important for areas the North-European lowland production areas with light, sandy soils.	Winter catch crops (seeding in second decade of september) like Lolium multiflorum and Secale cereale to reduce NO3-emissions of silage maize production.	http://www.lfl.bayern.de/mam/cms07/ipz/dateien/61_aggf_2017_alles.pdf
L. Meister, U. Thumm, M. Elsäßer	Nachsaaterfolg und Persistenz von Leguminosen im Dauergrünland bei unterschiedlicher Nutzungs- und Düngeintensität	reseeding, persistence, legumes, permanent grassland, fertilisation, intensity of use	2017	AGGF	Legumes in permanent grassland: reseeding increases DM and crude protein contents. N-fertilisation should be reduced/avoided. Trifolium pratense gives better results than Trifolium repens and is also less sensitive to increased levels of N-fertilisation.	Legumes in permanent grassland: reseeding to increase DM and crude protein contents. Trifolium pratense is recommended. N-fertilisation should be reduced.	http://www.lfl.bayern.de/mam/cms07/ipz/dateien/61_aggf_2017_alles.pdf

Fig. 2: Example list of search results. www.grassland.uni-goettingen.de

Both text-based and category-based search options are available. The latter allows for article search based on the category options chosen during inventory. Text search and category search can also be combined with each other to narrow down results even further. The list of results includes bibliographic information, English keywords, short summaries and the direct weblink to conference proceeding in which the article was published.

Furthermore, a synonym database for English terms has been created, enabling the automatic search for synonymous terms. For example, when the search term “herbage” is entered, the terms “roughage” and “forage” are also automatically taken into account. The database of synonyms can be adapted and expanded at any time.

The database is currently being expanded by inventorising AGGF conference proceedings which date back even further. An expansion to include conference literature from other countries is possible at any time and is currently being discussed with the Inno4Grass partners.

3.2 Analysis of the development of practice-oriented grassland research using the example of the AGGF conference proceedings

Article peak in the aughts

The number of AGGF articles published between 1998 and 2017 varies considerably between individual years (Fig. 3). Most articles were submitted during the heydays from about 2000 to 2008 (a

maximum of 80 articles in 2008). Since then, the number of articles per conference volume has declined significantly (36-50 articles between 2012 and 2017). The situation is similar where the number of agricultural studies having been published in scientific journals is concerned. For Germany, an investigation by SAGAR ET AL. (11, 2013) covering the years 1993-2012, shows that annual publication figures increase until 2008. Thereafter, the number of publications decreases.

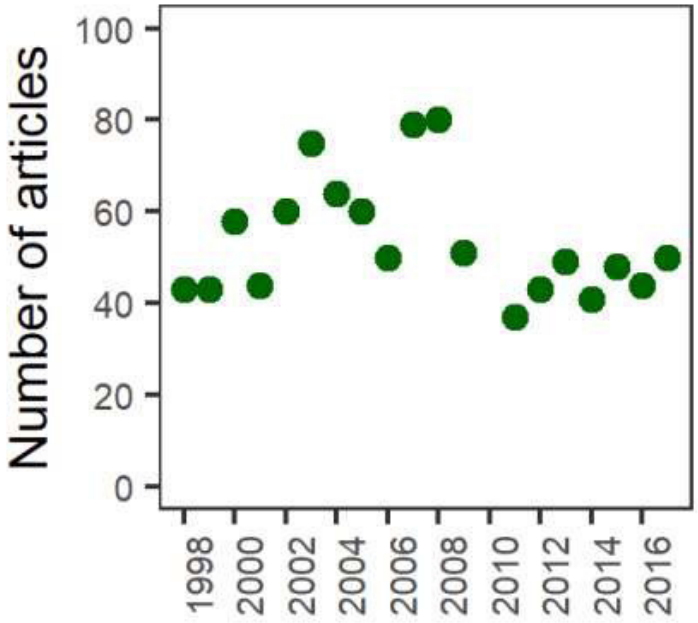


Fig. 3: Number of AGGF conference papers per year (SD=13.1)

Topical consistency

Most AGGF conference proceedings (81%) deal with the analysis of causal relationships. The effects of changes in site management (e.g. choice of plants, fertilisation, mowing) were most frequently investigated (Fig. 4 A + B). In terms of outcome variables, the harvested biomass (yield and quality) has been most important. In this context, biomass quality (usually feed quality) was examined slightly more often than yield (337 vs 302 entries). At a distance, topics such as the botanical composition of the sward, emissions and accumulations (nitrogen losses, in particular), the final animal product (milk yield and quality, primarily) and biodiversity (primarily vegetation) follow with a considerably lower number of articles (Fig. 5 A). A time series review of the years from 1998 to 2017 shows a strong constancy regarding explanatory as well as outcome variables. Looking at the six most common explanatory variables of the main category, "site management", and the six most common outcome variables, significant trends could only be identified for the variables "fertilisation" and "emissions and accumulations": The influence of fertiliser parameters has been studied with decreasing frequency over the years (Fig. 4 C). The same applies to studies dealing with the effects on emissions and accumulations (e.g. nitrogen emissions) (Fig. 5 B).

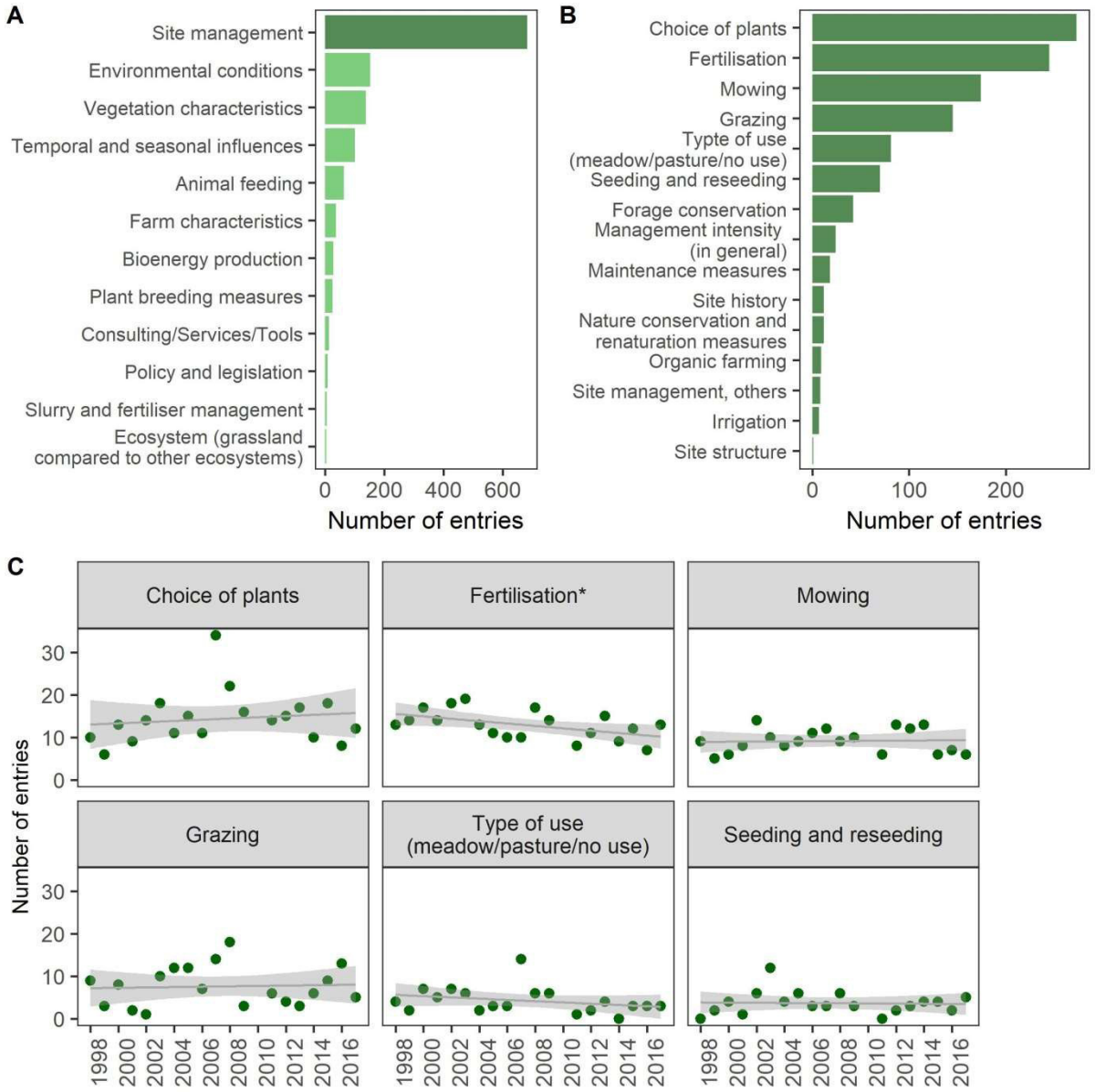


Fig. 4: Topics of explanatory variables A) main categories, B) first subcategory level of main category „Site management“, C) relationship between the six most frequent explanatory variables in the main category "Site management” and year. Variable “Fertilisation“: PEARSON-R=-0.51, p≤0.05. Other variables: ns.)

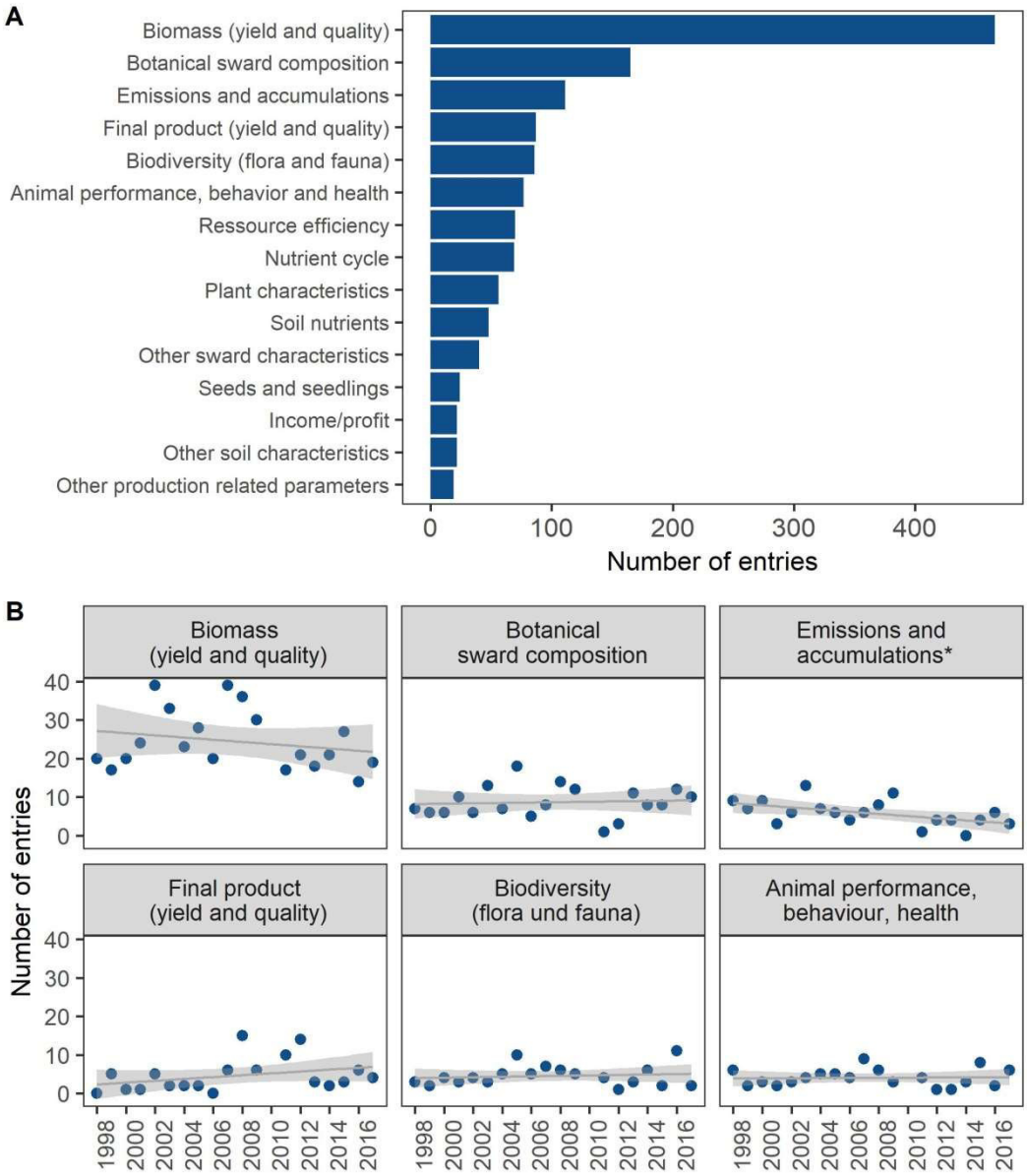


Fig. 5: Topics of outcome variables A) Top 15 outcome variables, B) Relationship between the six most frequent outcome variables and year. Variable ”Emissions and accumulations“: PEARSON-R=-0.52, p≤0.05. Other variables: ns.)

Increase in spatial scales and cooperations between scientists and non-scientists

The AGGF articles' geographic focus is on Germany, with marked differences between the federal states (Fig. 6). However, significant scale-related changes become evident over time. While in 1998, an average of 58% of all articles with an assignable spatial reference or study region had a local focus, i.e. were limited to a narrowly defined study area, this proportion decreased to a mere 38% of articles in 2017. Over the same period, the number of articles with a regional focus (at least two study sites) increased from 14% (1998) to 36% (2017). The proportion of transregional contributions (i.e. contributions with at least two study sites in non-directly adjacent regions) remained at a constantly low level (Fig. 7).

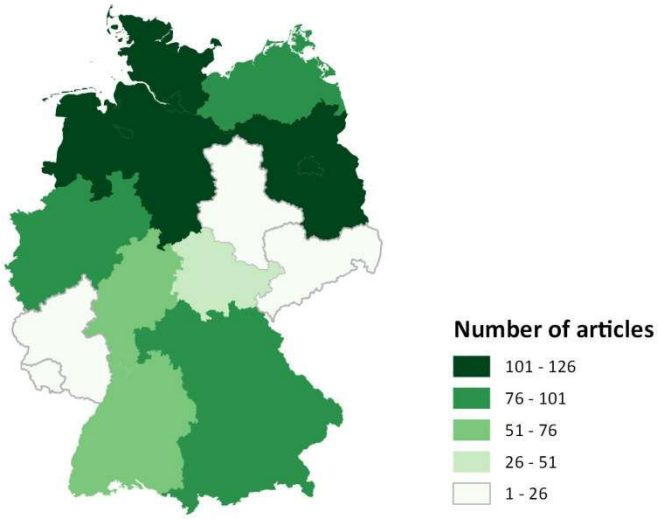


Fig. 6: The spatial focus of AGGF articles (only related to Germany)

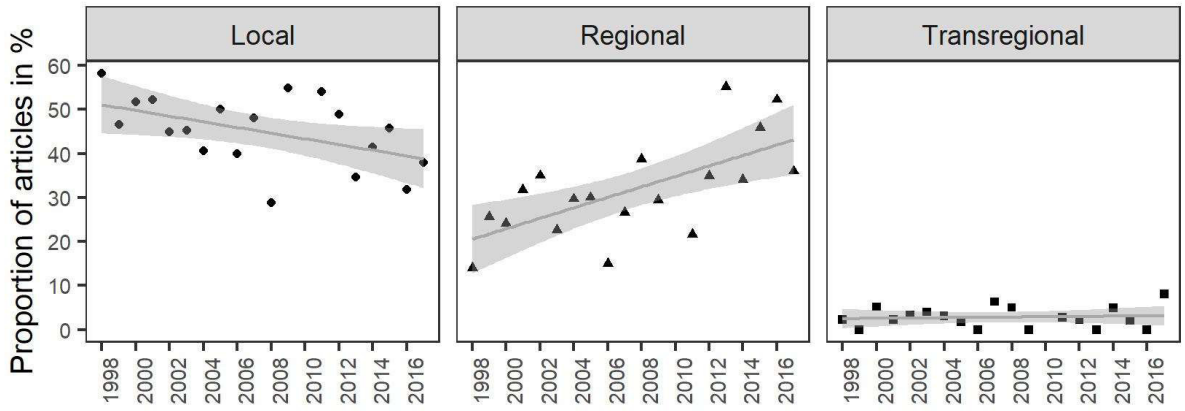


Fig. 7: Relationship between spatial scale and year (local: PEARSON=-0.48, p≤0.05; regional: PEARSON-R=0.65, p≤0.01; transregional: PEARSON-R=0.05, ns.). Only articles/studies to which a spatial focus could be assigned were taken into account.

Significant trends are also evident regarding the institutions involved in the preparation of articles. While in 1998, an average of 1.2 institutions participated in an article as authors, the figure rose to 1.7 in 2017 (Fig. 8 A). In order to investigate whether this tendency primarily points to a stronger cooperation between different scientific institutions or to a growing cooperation between scientific and non-academic institutions, we also examined how many articles per year include scientific (e.g. universities, universities of applied sciences, federal research institutes) as well as non-scientific institutions (e.g. chambers of agriculture, industry). These results also show a pronounced trend. While this criterion applied to just 9.5% of all articles in 1998, it concerned 30% already in 2107 (Fig. 8 B).

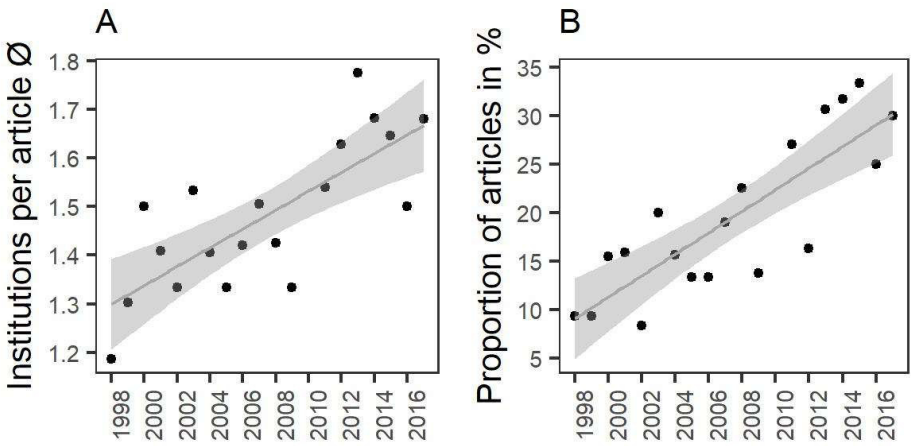


Fig. 8: **A)** Relationship between A) average number of articles per involved institution and year (PEARSON-R = 0.76, p≤0,001) and **B)** average proportion of co-productions between scientific and not purely scientific organisations and year (PEARSON-R = 0.83, p≤0.001).

Innovations for the production process

According to the criteria described in chapter 2, 35 % of all AGGF articles were evaluated as directly innovative for agricultural practice and 31% as potentially innovative. 34% of the contributions met neither category. Nearly 100% of the articles evaluated as being potentially or directly innovative address innovations that support manufacturing of agricultural products. These could be products, processes, services (e.g. calculation tools) and others. Process innovations such as changes in fertiliser application, cultivated plants or grazing/mowing are most represented with 546 entries. Innovations in final products (e.g. novel products for consumers) or innovations in marketing and corporate organisation were only discussed in rare exceptional cases (10 or 11 articles in a total of 1019 analysed contributions). The articles' innovation content remains relatively constant over the years but varies thematically. For example, the number of articles that were classified as innovative and related to the topic of environment and nature declined significantly between 1998 and 2017. We considered all articles whose outcome variables belong in the supercategory of "Environment & Nature". In 2017, only 8 % of all articles fulfilled that criterion (Fig. 9).

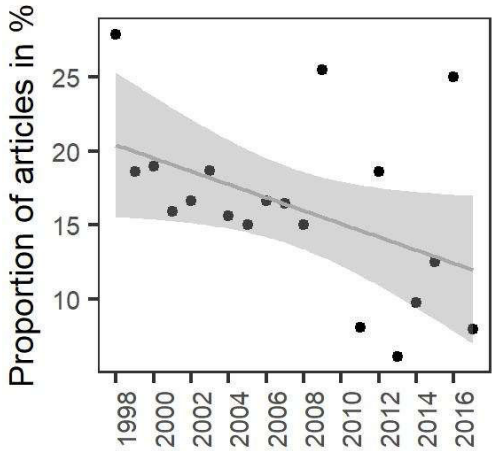


Fig. 9: Proportion of articles related to environment and nature which have been evaluated as directly or potentially innovative for practitioners (PEARSON-R = -0.46, p≤0.05).

4 Discussion

The GrassCOPS database is designed to increase the accessibility of the knowledge gathered in conference proceedings and to facilitate the international exchange, especially against the background of the enormous global demands on agriculture, which require changes in agricultural practice and innovative solutions.

The general question arises as to what extent the knowledge gathered in conference proceedings is suitable for this purpose and whether the research published there does indeed meet the increased demands science is faced with. Our analysis of the inventoried AGGF conference papers provides some hints. It has shown that at least German-speaking grassland research is characterised by an increasing cooperation between scientific and non-scientific institutions. This indicates an increase in transdisciplinarity.

However, in this respect, it should be noted that the authorship of representatives of different institutions says little about the nature of the cooperation (e.g. equality of partners). Moreover, no conclusions about the participation of farmers and other persons of the civil society are possible, since these are rarely involved when scientific articles are draughted. In a meta-analysis of scientifically published transdisciplinary articles in the sustainability sciences, Brand et al. (2) discovered that even though scientists and practitioners frequently exchange views, practitioners primarily take the role of passive sources of information and are rarely granted a say in decisions.

The observed significant trend of AGGF articles towards a larger and at least regional spatial scale suggests that, on average, the contributions have gained in spatial significance. This can facilitate the transfer of solutions to other contexts.

The topics of the outcome variables examined in the AGGF articles are generally relevant to the outlined challenges for the agricultural sector. However, it is remarkable that in the articles inventoried, the overall economic viability of measures has been given very little consideration, although this is often crucial for their practical implementation.

It is also discernible that, compared to the biomass yield, environmental issues have been examined much less frequently. The number of articles classified as innovative within the range of the topic "environment and nature" even decreased significantly during the period investigated. Given the rapid loss of species-rich grassland (1; 9) and continued nutrient surpluses (14), this development is surprising.

While there are in fact only few studies on the economics of grassland management in German-speaking countries and most of these can be assumed to have been presented at the AGGF conferences, the situation is somewhat different for issues relationg to the environment and to nature conservation. In this regard, we want to emphasise that, in addition to the AGGF, there are other scientific groups that deal with these topics in a grassland context. For instance, grassland-related

biodiversity research is also represented by the Ecological Society of Germany, Austria and Switzerland (GfÖ), including the two large-scale research projects "Jena Experiment" (see, e.g. WEISSER ET AL. (15)) and the "Biodiversity Exploratories". Here, the relationship between land use, biodiversity and ecosystem functions is examined on a fundamental level. So far, this research has not been represented by the AGGF with its focus on agriculturally oriented grassland research.

The fact that two-thirds of the recorded AGGF conference proceedings are considered directly or potentially innovative for agricultural practice indicates that conference literature can, to a significant extent, include practical solutions. However, it remains unclear whether

• the respective study meets the scientific quality criteria of objectivity, validity and profitability,

• the evaluation was carried out with scientifically appropriate methodology and whether

• the results can also be transferred to other contexts.

This insecurity is due to the fact that articles in conference proceedings usually do not have to undergo an elaborate review process which ensures sufficient quality.

Due to temporal and methodical constraints, a qualitative assessment of the articles is not envisaged within the GrassCOPS article inventory. In order to improve the general attractiveness of the articles and facilitate their international visibility, also independently from GrassCOPS, both an English summary and keywords provided by the author would be helpful. Additionally, authors of conference papers should also aim at getting the article published in reviewed Journals. We want to stress that, by improving the accessibility of conference literature, we do not mean to put into question the process of quality assurance within science. Neither do we intend to cause competition between articles in conference proceedings and reviewed professional journals.

The distinction between "potentially" or "directly" innovative contributions constituted a challenge when articles where inventoried, as this categorisation requires expertise but is also strongly influenced by the clarity of an author's writing style. Hence, in the final search database GrassCOPS, a search is only possible for types of innovations, while a specific search option for "potentially" or "directly" innovative articles has been omitted.

5 Conclusion

At http://grassland.uni-goettingen.de, the database GrassCOPS allows a targeted search for conference literature on the subject of grassland. The database can provide the international readership with a large number research results which are hard to find elsewhere, it can encourage networks of applied grassland research and can contribute to international discussions about innovative approaches. An analysis of AGGF articles already inventoried revealed that, at least in the German-speaking countries, practice-oriented grassland research is increasingly transdisciplinary, that studies are less and less locally focused and that most contributions contain practice-relevant

approaches. This underlines the relevance of conference literature also for tackling and discussing current challenges. It should be borne in mind, however, that conference literature is not subject to a strict review process and that readers are invited to critically question the qality of contributions.

Abstract

Literature database GrassCOPS (Grassland Conference Paper Search): making better use of the potential of conference book literature

As agriculture faces enormous challenges which require innovative solutions, science and research are expected to adapt to these circumstances and play a more active role regarding the solution of sustainability problems ("transformative science"). National grassland conferences provide a platform for science and practice to meet regularly, while the resulting conference proceedings are a valuable source when it comes to analysing the 'potential for transformation' inherent in the research presented. Against this background, an online search tool, named GrassCOPS, for conference literature in the fields of grassland science has been set up within the EU-project Inno4Grass. The tool is meant to improve the accessibility of practice-oriented knowledge from national grassland research and thereby to further suppport discussions on grassland innovations with scientific information. It does not evaluate research quality, which varies apparently, given that, for publications of conference proceedings, quality assurance mechanisms are less prevalent than for international scientific journals. The tool is accessible at http://www.grassland.uni-goettingen.de in English and offers detailed filter criteria for a targeted article search.

An analysis of the data currently stored in the database indicates that national grassland conference literature is gradually adapting to the societal expectations concerning science and may contain a significant amount of practice-related findings worth sharing with the international grassland community. Papers from conferences organised by the German-speaking "Arbeitsgemeinschaft Grünland und Futterbau" (AGGF), for example, show a trend towards studies with larger spatial scales and increased transdisciplinarity, which entails increased spatial explanatory power of results and a stronger involvement of affected stakeholders.

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