Key Issues Generated from the XI International Rangeland Congress 2021: Summary and Way Forward

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Key Issues Generated from the XI International Rangeland Congress 2021: Summary and Way Forward

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Abstract

The important issues, knowledge gaps, and evolving research approaches for the global rangelands are summarised in this review of submissions to the Joint XXIV International Grasslands and XI International Rangelands Congress (IGC/IRC). In the big picture, it is concluded that stand-alone studies of livestock production are becoming rare compared to that of the past International Rangelands Congresses (IRC). Rather, added effort is now being directed at understanding the fuller context of social-ecological systems (SESs) on rangelands in a quest to improve the prospects for sustainable resource management as well as the enhancement of human welfare. Although climate change is upon us, there was still a dearth of papers that dealt with broad- scaled climate-adaptation per se; opportunities to improve local drought response were the default topics here with a focus on implementing better drought early warning systems and integrating perspectives among producers and scientists. Invasive species challenges remain as prominent global concerns, and woody encroachment is viewed as a major contributor to rangeland degradation. Treatments to combat rangeland degradation can involve innovative layering methods incorporating grazing management and use of prescribed fire. While there is an important backdrop concerning ecosystem services from rangelands, research in this area is still in its infancy. Analysing trade-offs between production and conservation for services such as carbon sequestration loom large going forward. There were relatively few papers concerning wildlife, tourism, and associated issues; successes and challenges for natural resource conservancies were noted, in particular. These are topics that merit more creative research and development attention in the future. Some contributions highlighted the important issue of landscape conversion from rangelands to cultivation; in conjunction with human population growth, loss of such key resources can be very negative for wildlife and associated values. In terms of pastoralism and related sub-themes, while it was noted that the majority of studies now embrace SESs and integrated, participatory, action- oriented approaches, there is little effort to standardize methodologies. A focus on repeatable methods can help grow "sustainability science" on rangelands, and this is a challenge for research and outreach education. The volume of studies submitted overall indicated a decided numerical advantage for the Global South over the Global North. Why this is the case remains unclear, however. Disciplinary research traditions in wealthier nations may not yet provide the incentives needed to spur innovative SES work. Finally, policy makers are seen by many investigators as being ignorant of rangeland development issues. It is argued, however, that this view has not changed for 40 years. How to better engage policy makers in comprehensive SES projects is an important future goal. Policy makers themselves can then

also become human research subjects in the overall process. Based on our review the future for IRC stakeholders is clear: Continue the expansion of interdisciplinary SES and action-based approaches and increase attention to climate-change adaptation/mitigation, ecosystem services, community-based development, human empowerment, market development, poverty mitigation, and creation of effective policy frameworks.

Introduction

The rangelands component of the IGC/IRC congress was organized around six of the seven sub-themes as follows: (1) Rangeland ecology; (3) Livestock production systems; (4) Wildlife, tourism, and multi-facets of rangelands; (5) Drought management and climate change in rangelands; (6) Pastoralism, social, gender, and policy issues; and (7) Capacity, institutions, and innovations for sustainable development of rangelands. The co-authors of this summary paper were asked to review a sample of contributions and identify important issues, knowledge gaps, and evolving research approaches. This process would help identify a way forward for future congresses.

Methods

Authors were assigned different sub-themes to review. There was flexibility in what could be emphasized. Ash and Irving examined submissions for sub-themes (1) and (3) to (5) to identify key, recurrent insights, assessing 103 papers and 50 posters in total. In contrast, Coppock examined submissions for sub-themes (6) and (7) with a focus on the global distribution of work and the evolution of field methods.

Findings

Sub-theme: Rangeland Ecology

A sample of 49 submissions in this category were reviewed. As expected, the breadth of topics covered was too great to be captured in detail here. Thus, this review is limited to general observations. Although the keynote speaker for this sub-theme (Smith, 2022) noted that rangeland systems degraded from overuse by livestock comprise only a small portion of global resources, singular studies indicate that rangeland degradation remains as a serious challenge (Treydte *et al.*, 2022). One common form of rangeland degradation continues to be invasion by woody species. This ecological transformation is almost universally viewed as negative. One paper in this group, however, noted an improvement in rangeland condition associated with an increase in tree cover for an area that had endured extreme woody reduction due to cutting for fuel, building materials, and overgrazing (Nyaga *et al.*, 2022). Invasive species are commonly noted as being a significant threat to global biodiversity, possibly second only to impacts from climate change (Mutua and Chiuri, 2022). A new invasive species that has moved from South America to Kenya (*Parthenium hysterphorus*) represents a trajectory from the New World to Old World that is a contrast to patterns typically reported. Overall, land-use change continues to be a concern for ecologists, especially for places that occur on the productive interface between agriculture and rangelands (also see below). Finally, climate change has been speculated to reduce the resilience of global rangelands in response to what one paper described as system shocks (Treydte *et al.*, 2022) such as severe drought or catastrophic fire.

The compendium of papers in the ecology theme covered a wide variety of topics that were significant in expanding global science. One subset of work can best be described as descriptive studies of the physical environment. Alamin and Hassan (2022) described a new rangeland type in Sudan, while Mitchell et al. (2022) reminded us that the occurrence and germination of plants from a soil seed bank in Australia does not have the same dominance pattern as occurs in the parent sward. In other words, perennial species were poorly represented in seed banks that were dominated by ephemeral species.

There was another suite of papers dealing with livestock grazing behaviour on rangelands, many of which were focused on investigating locally adapted animals. Some studies investigated influences of novel livestock species, mostly documenting introductions of small ruminants into systems previously dominated by large ruminants (Schneider *et al.*, 2022). Other studies examined novel strains of animals within the same species that are well-adapted to local situations (Pauler *et al.*, 2022). Locally adapted strains were generally already known to local producers, but initially unknown to researchers. Novel situations were also detailed where established management practices, such as multiple cutting of brush, were deployed in new and different environments (Wedel *et al.*, 2022).

There were also descriptive studies of practices to better manage rangelands. Treatment layering—namely, the application of simultaneous or subsequent sets of treatments to help manage or solve the same rangeland problem—was commonly reported, especially for woody invasion challenges (Wedel *et al.*, 2022). Treatment layering could be comprised of repeated applications of

prescribed fire, prescribed grazing, or livestock herding in various combinations. Kreuter *et al*., (2022) described use of community-based, prescribed-burning associations to enhance the use of prescribed fire where periodic mitigation of catastrophic fire events is required. Community-based approaches can help spur adoption of prescribed fire methods by spreading the risk from a few individuals to a larger group of resource users.

Climate-change mitigation and drought readiness was a common theme amongst numerous studies (Oliva and Gaitan, 2022; Muller *et al*., 2022), with some duplication with submissions to other sub-themes (see below). The Ecology section papers mostly studied soil carbon and its response to various grazing regimes or treatment applications, information that could be used to aid predictions for a more global discussion of climate change. In general, moderate stocking is promoted as a means for rangeland managers to better survive droughts and promote soil carbon storage (Liu *et al*., 2022). Providing support for traditional grazing practices was another common research topic. Some studies promoted expansion of deferred grazing systems via the use of livestock exclosures (Abdulahi *et al*., 2022). Others investigated constraints limiting a return to traditional grazing practices based on restoration of mobility (Manzano *et al*., 2022). While the benefits of mobile pastoralism are well appreciated in many systems, it is also true that traditional grazing practices based on sedentary attributes can also be valued. Sometimes thresholds based on human population growth or intensive resource use may be crossed to a point where a return to historical practices (i.e., mobility) is no longer possible.

Sub-theme: Drought Management and Climate Change

Adapting to droughts, climate variability, and climate change with appropriate and timely management strategies is a huge challenge for rangeland managers and pastoralists. This is especially true for those managing livestock where the base forage supply is already highly variable from year to year. Materials reviewed here include a plenary talk (Howden, 2021) along with a sample of 18 oral papers and 22 posters.

Effective drought management requires early action. Whilst many such actions have been identified, Bulle (2022) argued that drought management strategies to reduce livestock mortalities—including destocking programs, supplementary feeding, provision of early warning information, water development, and veterinary services—are usually introduced too late during drought events and most have little emphasis on ecosystem sustainability. Attempts to identify early warning tipping-points in ecosystems to help inform timely actions are elusive (Klingenfuss, 2022). In developing drought management strategies, there needs to be better integration of producer expertise with science-based approaches. This was highlighted in a study by Brinkmann *et al*. (2022) who noted the challenges of differences in coping strategies, with pastoralists or farmers focused on short-term responses while scientific experts promoted longer-term management strategies.

In his plenary address, Howden (2021) highlighted changes in rainfall variability will have as much impact on rangelands as will changes in total rainfall. Further, changes in rainfall seasonality patterns will likely cause changes in plant species composition of rangelands (Zhou and Du, 2022). The most damaging trends for livestock production will occur in rangeland regions that are already the most vulnerable in terms of productivity and socio-economics (Godde *et al*., 2022).

Adapting to climate change will be crucial if livelihoods from rangelands are to remain viable. However, very few oral papers at the congress addressed climate adaptation measures. A few of the poster papers did provide some options on better managing forage supply in response to a more variable climate. A large diversity of adaptation options on- and off-farm (or ranch) have already been developed, including approaches that vary from tactical to strategic and incremental to transformational (Howden, 2021). Working with ranchers shows that positive outcomes can be achieved where there is a focus on implementing practices that increase resilience to climate change while balancing other risks (Brinkmann *et al*., 2022). Other studies highlighted the importance of understanding the limits to climate adaptation, how to remove barriers to adaptation, and how to better integrate adaptation strategies with emission-reduction strategies for greenhouse gases.

Climate change mitigation options include improved farm or ranch management, direct reductions in methane from livestock, carbon sequestration in soils and vegetation, and reducing losses and wastage in food systems. Results from Kenya (Ndung'u *et al*., 2022) showed that emissions from livestock systems are highly variable, and in a conclusion that challenges conventional wisdom, the best low-input systems can be as emission-efficient as industrial-style intensification. Increasing soil carbon in rangelands has production trade-offs, and increasing woody vegetation (i.e., *Leucaena*

hedgerows in semi-arid rangelands) doesn't always lead to significant increases in soil carbon (Banegas *et al*., 2022). Further, using rangelands for carbon sequestration needs to consider future climate change to ensure optimum landscape use for carbon abatement, but this issue is rarely considered in policy-led, carbon sequestration initiatives (Waters *et al*., 2022).

Sub-theme: Livestock Production Systems

Livestock production has been a major area of interest in past rangeland congresses. In this congress, however, there were just 18 studies submitted with only four focused on the biophysical aspects of increased livestock production. The remaining 14 contributions covered broader aspects of livestock production including grazing systems, sustainability, crop-livestock interactions, food security, livestock-wildlife interactions, socio-ecological drivers, and market interactions.

In his plenary address, Smith (2022) highlighted that despite societal concerns about environmental challenges of livestock production, in rangelands livestock help support the livelihoods for 200 million households globally. Rangeland production systems can also provide co-benefits from ecosystem services (i.e., carbon sequestration and biodiversity). A number of papers and posters were focused on how grazing management can achieve both production goals with improved environmental outcomes. Most studies suggest that balancing forage production with stocking rate is key, with the grazing system per se being of less importance for production, although rest from grazing can benefit land condition and plant species richness (McDonald *et al*., 2022).

Whilst grazing systems receive much attention in the rangelands of wealthier nations, a large global survey of producers identified feed shortages as the main constraint to improved livestock productivity in Africa and Asia. Improvements in livestock productivity require a comprehensive systems approach that addresses all constraints simultaneously i.e., nutrition, genetics, health, finance, markets (Duncan, 2022). The concept of systems approaches to achieve better outcomes in livestock production has led to the development of various frameworks to assess multiple values, benefits, and trade-offs to help decision-making where rangelands are providing multiple functions (i.e., wildlife habitat, symbiotic reciprocity among different users—Wedderburn *et al.,* 2022; Michler *et al*., 2022; Malhotra and Nandigama, 2022). Smith (2022) concluded that for livestock systems in rangelands to be sustained, rangeland managers and pastoralists need to embrace change, harness diversity, and engage widely with different stakeholders.

Sub-theme: Wildlife, Tourism, and Multi-Facets of Rangelands

This is another relatively small category with only 18 papers submitted. Key issues, however, are apparent. In general, it is almost universally accepted that any practice, policy, or application that maintains open spaces on grasslands and rangelands will be good for wildlife and other non-agricultural goods and services (Reid, 2022). Community-based tourism—where local communities are intricately involved in the management of local resources, including large wildlife species—is a research topic of intense interest, especially in Africa (Das, 2022).

Conservancies are a specialized form of community-based tourism. Conservancies are relatively common in Africa and specific examples are provided by Parmisa and Kitengela (2022). There have been successes in adding value for large wildlife species for local communities so that systems can better tolerate negative effects of livestock on natural ecosystems. There is cause for concern, however, as some conservancies in dry lands are also being transformed to towns and croplands as human populations grow. For example, local herding groups can become villages, villages can become towns, and there is a general tendency for agriculture to expand—all of which can result in a reversal of conservancy benefits for wildlife (Galvin, 2022).

The challenge of rangeland cultivation and land-use conversion to annual crops was also noted as a rapidly developing problem in the Pampas of Brazil, where highly productive native grasslands are being converted to soybean plantations (Moreira *et al*., 2022). The dynamic challenges of such land conversions are apparent in this example, as cultivation of soybean destroys natural vegetation, raises land prices, and changes the landscape and habits of producers. In addition, the conversion process diversifies production and generates more income for ranchers, who then become mixed farmers who need to create marketing and fodder alternatives for cattle (Moreira *et al*., 2022). Local wildlife (some of which are migratory) then absorb the loss of resources while the local economy receives the gains. This may be a situation that is playing out on a global scale.

Papers that document problems associated with the conversion of rangelands to cultivated fields may be the most consequential for this congress. They collectively point to incremental changes

that might be indicative of much larger challenges to come. Perhaps one statistic can summarize where rangelands and the associated wildlife are at on a global scale, namely that an incredible 96% of all mammalian biomass on the planet is now comprised by either humans or their livestock (Treydte *et al*., 2022). That fact should make us wonder where large wildlife populations and associated suites of other natural life forms is headed, given that human populations continue to grow, requiring that range landscapes be converted to farming.

Sub-themes: Pastoralism, Social Issues, Institutions, and Innovations

The focus in this sub-theme shifts to an analysis of the global origins of papers as well as an overview of evolving research approaches.

The 62 papers reviewed for these sub-themes were unevenly distributed around the globe. There were considerably more submissions overall from the Global South when compared to that for the Global North. Only 11 percent originated from North America and Europe, while over half (54 percent) originated from Africa, Latin America, the Middle East, and central or southern Asia. There were no submissions from Australia **(Fig. 1)**.

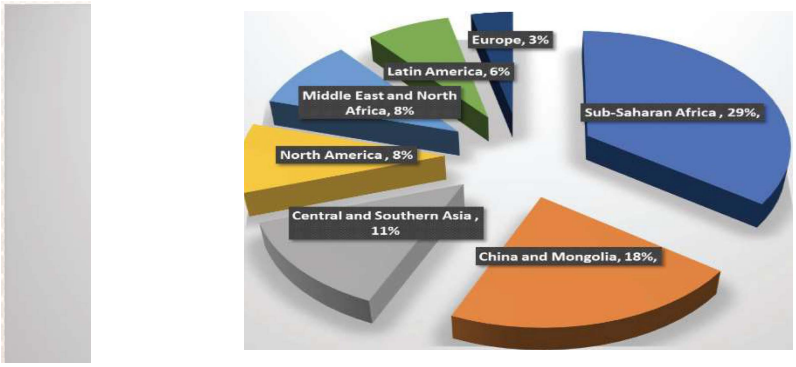

Figure 1. Global distribution of 62 paper submissions by region for pastoralism and related topics, Joint XXIV IGC and XI IRC, October 2021.

Sixteen percent of papers offered a global perspective, while the rest were specific to regions, nations, or localities. Overall, the attention given to different biomes was fairly well balanced considering temperate, tropical, or subtropical situations. For example, temperate settings were well-represented by China, Mongolia, Central Asia, North America, Europe, and parts of the Middle East. The tropics and subtropics were well-represented by Africa, Latin America, and southern Asia.

In terms of research approaches, 73 percent of papers were based on mixed methods (i.e., social and environmental sciences). Twenty-five percent of papers were only based on social science. Two percent were only based on environmental science (i.e., ecology, biology, climate, etc.).

Social science questions and methodologies thus dominated these submissions overall. Examples of common social-science perspectives included a focus on livelihoods, policy constraints, gender, co-production of knowledge, participatory research, governance, valuation of ecosystem services, political constraints, and creation of human and social capital. Research methods relied heavily on social surveys, interviews, focus groups, participatory engagement, action research, land-use planning, and role playing among project stakeholders. In seven percent of cases research involved use of simulation models to organize research and illustrate support for recommendations.

Discussion

A significant number of papers in the Ecology stream (Theme 1) is an extension of current knowledge into new regions. Some specific examples are new description of seed bank responses, new examinations of locally adapted species and strains of livestock, and applications of established methods such as prescribed fire or targeted grazing to new areas for woody control, rangeland use enhancement, or improved livestock production. Climate change mitigation and adaptation is perhaps a new theme to an old challenge of drought preparedness. There was a recurring observation, evident in several papers, that moderate stocking rates by livestock improved sustainability as reported in new research (enhanced carbon sequestration) and to manage old challenges (ability to withstand drought). There is also a resurgent interest in practitioner knowledge and a return or maintenance of

locally sustainable management practices as a way forward for many rangeland management challenges.

Although livestock production remains a critical output from the global rangelands, research on how to improve animal performance was only a minor component of this IRC. This reinforces a trend of placing range livestock production in a broader ecological and social context. This pattern has its origins following the II IRC (Adelaide) with a plea from Box (1986) who noted:

'It (this congress) did not adequately address rangeland products other than livestock. To focus on commercial pastoralism, a human lifestyle of developed nations, is to further marginalize the people issues of rangelands."

Some traditional livestock or grazing issues, however, continue to receive attention after many decades of research and debate. For example, quantifying the advantages and disadvantages of different grazing systems still provokes considerable interest (di Virgilio *et al.*, 2019), and this was also addressed at this IRC. This will likely remain as an important topic of future study, despite that livestock production in general may be receiving less attention.

Despite a clear appreciation of the emerging implications of global climate change (i.e., Howden, 2021; Godde *et al.*, 2022), it was surprising that very few papers explicitly addressed climate adaptation options for pastoralists and other rangeland users. It is difficult to explain this anomaly, as there is an increasing number of studies in the wider literature on climate-adaptation for agriculture, including rangelands. A few papers here examined drought preparedness, raising the question: Does the lack of specific papers on climate-adaptation reflect a view that options for simply dealing with weather variability (i.e., droughts, floods, heat, etc.) are sufficient? It would be disturbing if this is the case because the wider literature is quite clear about the urgent need for transformational change to address climate change in agroecosystems. Hopefully, there will be a stronger contribution on climate-change adaptation at the next IRC.

Overall, it is clear the vast majority of research approaches reviewed under the pastoralism and related sub-themes involved a robust mix of social science with environmental science. This makes sense given that most projects had a goal to improve resource management and/or livelihoods, and thus there is a need to better understand stakeholders and encourage long-term buy-in for sustainable problem-solving. This philosophy embodies a 'social-ecological systems" (SESs) perspective (Ostrom, 2009; Partelow, 2018). In the big picture, this shift from traditional, descriptive, and disciplinary biophysical research (Box, 1986) to complex interdisciplinary work that tackles real-world problems is both necessary and remarkable. This indicates that the cadre of rangeland professionals attending the IRC has collectively embraced "research *for* development," a new way of working advocated by Ashby (2003).

The SES approaches employed by congress participants, however, are "organic" with respect to genesis and very diverse. This is understandable given the high diversity of investigators including researchers, practitioners, community members, etc. In most cases, there appears to be no reliance on a unifying scholarly SES framework (i.e., SESF; Ostrom 2009) that can be used to more efficiently to integrate social and environmental research components. The pattern for most studies at this IRC, rather, seems to be idiosyncratic as social science research is used to characterize the human dimensions of a certain situation, while environmental research is used to characterize the natural resource concerns. Cross-links between social and environmental spheres can thus be lost without a standard approach. One exception, however, is work carried out by Huber-Saanwald and colleagues (2019) where different research sites (i.e., "participatory observatories") are studied using the same set of integrated research questions. There have been other attempts to distil a comprehensive SESF that can accommodate many types of natural-resource management situations and generate comparable sustainability indicators (Partelow, 2018). It may be useful if investigators study ideas embodied in the analysis by Partelow (2018) or adopt concepts from Ashby (2003) and use a more standardized SESF approach in the future. This can help grow "sustainability science" in the drylands (Ashby, 2003). Similarly, foundational approaches for "action research" (Whyte, 1989), participatory rural appraisal (Chambers, 1994), or innovation systems (Röling, 2009) are also uncited by IRC investigators. Embracing a standardized knowledge base and refining ways of working among peers is more likely to happen if there are incentives to do so. Incentives in this case can be facilitated by more education on SES and action-oriented methods for researchers, change agents, and community members.

Policy concerns are important in 61 percent of the papers in the subthemes covering pastoralism and related topics. And although policy concerns are a common backdrop for projects, "hard" policy analysis is very rare. Authors often contend that

policy makers do not understand or adequately value pastoralism or rangelands when making important decisions. This can lead to situations, for example, where key resources (i.e., water, land) are annexed from rangelands by external actors, resulting in the destabilization of pastoral production systems. That variable rangeland ecology requires producers to manage risk via mobility and household diversification appears to be under appreciated. Policy makers often come from non-pastoral backgrounds and lack the necessary frame of reference for decision- making concerning rangeland management or rangeland development. One intervention often forwarded by investigators is to better inform policy makers as to why rangelands and pastoralists are important and thus deserving of more aggressive and relevant policy support. Action-oriented interactions must replace our seemingly ineffective engagement with policy makers. We need to better understand the wants and needs of policy makers with respect to decision-making that affects the world's rangelands.

The arguments about policy above make perfect sense, but such challenges have existed for many years (Galaty *et al*., 1981). We thus should ask ourselves why so little progress has been made? Alternative approaches for the next IRC (Adelaide 2025) could be to focus more attention on integrating policy makers into rangeland and pastoralism projects at the start, and make policy makers themselves another cadre of human subjects in SES investigations.

One last observation from the body of work concerning pastoralism and related sub-themes is why there is such an imbalance in the paper contributions from the Global North versus that for the Global South (**Fig.1**). Rangeland systems in the developed world (i.e., Europe, USA, Canada, Australia) matter greatly, so why are their contributions relatively limited? One impression is that scholars in the developing world may more readily recognize the IRC as a key forum for their work, leading to more innovation in terms of adopting SES approaches. There are many possible reasons why such an unbalanced pattern occurs. The simplest explanation deals with scientific traditions. It is speculated that research in the economically developed Global North is more conventional and disciplinary in response to research funding that continues to emphasize technical studies, discount the human dimensions, and limit direct involvement with systemic problem-solving. The latter is neglected because of the high transaction costs of interdisciplinary or community-based research (Coppock, 2019). Research incentives in the Global North would need to change if the playing field is to be levelled with that of the Global South (Whitmer *et al.*, 2010).

Conclusions

Based on our review, compared to the past, it appears that traditional, disciplinary studies focused on topics such as range livestock production, forage production, and grazing management have become more diminished. The trend in paper submission to the IRC is towards more social-ecological systems (SESs) research underpinned by interdisciplinary research. Social science investigation is increasingly based on community participation and action-oriented efforts to better engage stakeholders and solve problems. The reliance on SESs may, however, be strengthened as a form of "sustainability science" with more attention to methodological rigor. At the next IRC we fully expect that more attention will be given to topics such as climate-change adaptation and mitigation, ecosystem services, community-based development, human empowerment, market development, poverty mitigation, and creation of effective policy frameworks. More efforts are needed to better unite work in the Global North with that of the Global South.

Acknowledgements

The authors thank the many devoted professionals who contributed 399 papers and posters

to the XI IRC. It is regretted that more insights from this large body of work could not be highlighted in this review. The authors also appreciate the opportunity to ponder key issues, knowledge gaps, and evolving research approaches as related to global rangeland systems for 2021.

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