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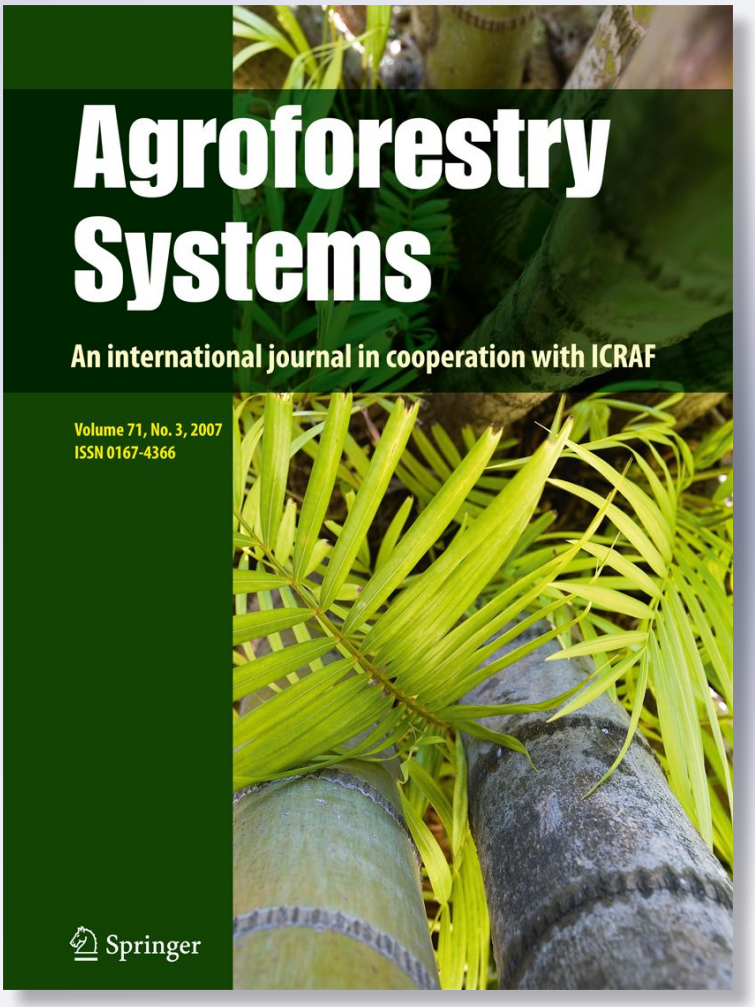

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Agroforestry for a vibrant future: connecting people, creating livelihoods, and sustaining places

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Abstract The North American Agroforestry Conference is a biennial meeting of agroforestry researchers, producers, extension and agency professionals, non-governmental organizations, investors, and policy-makers. The conference is organized and conducted with the Association for Temperate Agroforestry, a 501(c)(3) whose mission is to promote the adoption of agroforestry by landowners in temperate regions. Formed in 1991, members of the Association for Temperate Agroforestry are worldwide and constitute a longstanding network of temperate agroforestry professionals and organizations. The 15th North American Agroforestry Conference occurred at Virginia Tech University in Blacksburg, Virginia, USA in 2017 with nearly 200 agroforestry professionals from six continents representing a broad range of perspectives and interests. They shared agroforestry research, experiences, and visions, and shaped future agroforestry networking, engagement, education, and policy. Manuscripts in this special issue reflect the breadth and depth of the presentations and contribute valuable insights that cut across initiatives ranging from basic production science, applied adoption research, ecosystem services, and policy. This special issue is part of a tradition of publishing papers from the biennial conference that advance our understanding of temperate agroforestry and its role in the future of farming and forestry.

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Introduction

Agroforestry is a land use system that combines trees and crops and/or livestock in the same place (Garrett 1997). It is intensive farming and forest management shaped by intentional introduction of multiple productive species and management of their complex agroecological interactions to increase marketable yields and provision of environmental services (Gold and Garrett 2009). Some people describe agroforestry as a temporal and spatial puzzle, where species are blended and optimized based upon the vertical and horizontal space they occupy above and below ground (e.g., root depth or crown width), how and when they use light, water, nutrients, and the length of time to harvest (Buck 1986). Technically, temperate agroforestry is a relatively new land use, and researchers have made great strides in recent years studying its economic, environmental, and social benefits (Alavalapati et al. 2004; Jose 2009; Munsell et al. 2018).

The growing body of agroforestry research demonstrates that out of its characteristics arises the unique occasion to increase ecological services, while simultaneously improving the profitability of farms and forests (Gold et al. 2009). Services range from soil conservation, water quality protection, and increased biodiversity, to aesthetics and species preservation. Marketable crops range from livestock and conventional annuals, such as forages and row crops, to specialty perennial crops like fruits and nuts, and even slow-growing woodland species such as medicinal botanicals. Beyond product opportunities and provision of ecosystem services, the structure and function of agroforestry systems inherently reflect the regional and local nuances of landscapes, which largely circumscribe integrated land use (Zamora and Udawatta 2016). Indeed, Zamora and Udawatta (2016) noted as much in their introduction to the Special Issue for the 14th North American Agroforestry Conference held in 2015 in Ames, Iowa, USA. Thus similar to previous Special Issues, the manuscripts in this collection reflect the complexity, diversity, opportunities, challenges, and benefits of temperate agroforestry systems.

Conference summary

The 15th North American Agroforestry Conference was held on the campus of Virginia Tech University in Blacksburg, Virginia, USA and brought together nearly 200 researchers, extension and outreach professionals, private producers, governmental and non-governmental organizations, and a variety of other stakeholders. The biennial gathering was held June 27–29, 2017 and focused on the people, livelihoods, and places agroforestry benefits. It featured presentations on topics ranging from basic production science to advances in technology, and the relationships between permaculture and agroforestry, as well as subjects such as novel markets and education. Sizeable contingents from Canada, Mexico, and the USA attended, as did professionals from 11 other countries representing five additional continents. Together, these attendees advanced the science, practice, and policy of agroforestry, demonstrating notable gains across broad topics in the field and setting the stage for future collaboration and success (Fig. 1).

Fig. 1 Word-cloud depicting keywords submitted with presentation abstracts for the 15th North American Agroforestry Conference held on the campus of Virginia Tech University in Blacksburg, Virginia, USA from 27 to 29 June 2017. Variations in keyword size represents relative frequency among the full list accompanying abstract submissions

Keywords submitted with conference presentation abstracts included references to codified temperate agroforestry practices, such as windbreaks and silvopasture and other related techniques like organic farming and permaculture. Keywords also included prominent terms related to agroforestry applications and production such as adoption, farming, crops, and data, as well as contextual-phrasing such as urban, market, farm, forest, and field. These representations depict the classic connections (e.g., windbreaks and farm) and novel associations (e.g., permaculture and urban) presented at the 15th North American Agroforestry Conference. In keeping with agroforestry's production/conservation balance, keywords involving environmental themes and topics also were prominent. These data encompassed climate, soil, carbon, water, habitat, wild, and land and are referenced when describing and synthesizing contributions to the Special Issue in the next section.

Content summary

Special Issue manuscripts cover diverse agroforestry topics. These range from biomass management and hyrdological benefits in mid-American claypan riparian buffer soils to consumer preferences for the specialty fruit pawpaw and novel methods for integrating agroforestry topics into high school curriculum. Also addressed in the Special Issue are a study of soil carbon stocks in herbaceous biomass crops in Canada, and the effects of goat and sheep

silvopastures on soil, vegetation, and management actions in pine-oak forests of the Sierra de Las Cruces Mountains in Mexico and the pine forests of the Deep South in the USA. Many of the key words in Fig. 1 are touchstones of this Special Issue, and each manuscript covers important conference themes.

In the Midwest of the USA, Alagele et al. (2018) studied claypan soils in northeastern Missouri, USA, by comparing changes in hydraulic properties associated with agroforestry, biomass, and grass buffers to those found in conventional corn-soybean rotations. The study site used by Alagele et al. (2018) has a rich history of paired research with establishment dating back to the early 1990s. Variables in the comparative study included hydraulic conductivity (Ksat), soil water retention, bulk density, and pore size distributions. Results demonstrate that Ksat was significantly higher in agroforestry and biomass buffers compared to other treatments, particularly in shallow soil profiles. These same treatments also resulted in significantly lower bulk densities, which was accompanied by observations of larger macropores and coarse mesopores as well as improved soil water retention. Their findings further our understanding of how agroforestry affects soil moisture and its potential to decrease soil erosion.

The study conducted by Graham et al. (2018) in Ontario, Canada evaluated soil organic carbon stocks found in herbaceous agroforestry biomass species (miscanthus and swtichgrass), and compared these findings to measurements of the same variables in agricultural fields and woodlots. Woodlots surpassed field-based and miscanthus stands, but switchgrass and woodlot stocks did not differ significantly suggesting highest levels of soil carbon may be possible in agroforestry combinations. Studies by Graham et al. (2018) and Alagele et al. (2018) indicate that with market-based species selection, agroforestry systems can enhance ecosystem services, while improving conditions for annual production, and adding value and protecting natural capital over the long run.

Production-oriented silvopasture studies from Alabama, USA and the Sierra de Las Cruces Mountains in Mexico involved small ruminants (goats and sheep, respectively) and occurred in predominantly pine forests with varying species composition. Karki et al. (2018) focused on forage and animal performance and tree protection in pine silvopastures established after stand thinning. Results indicate that forages can be established successfully under loblolly and longleaf pine species and that goats perform particularly well in these systems when grazing cool-season grasses in the spring, but ruminant damage to residual stems, notably longleaf, can be substantial and require intensive management.

Ramírez et al. (2019) studied the effect of sheep on the soil and vegetation in a pine-oak forest in the temperate high altitudes of the Trans-Mexican neovolcanic belt. Sheep were enclosed within an emulated silvopasture and the researchers measured soil compaction, change in leaf litter cover and depth, along with botanical composition. The authors did not observe a significant change in compaction during the study, nor did they discern differences in leaf litter variables. Selective grazing was observed and several species were impacted, but in some cases, this stimulated growth of desirable species. In both projects (southern USA and Mexico), positive outcomes were observed but in keeping with the intensive nature of agroforestry, challenges exist that require additional management to ensure optimal yield.

Education and market research from Missouri, USA explores the human dimensions that drive adoption of agroforestry in temperate North American environments. Hemmelgarn et al. (2018) conducted novel research into the effects of high-school teacher education programs on the incorporation of agroforestry topics into classroom curriculum. Findings indicate that the potential for growth of agroforestry curriculum in high school classrooms is promising, but effectively translating teacher training into classroom delivery hinges on several factors, such as the various contexts and modes of learning and delivery. The authors reason this is particularly true because much of the agroforestry material is non-traditional and unfamiliar to both student and instructor.

Cai et al. (2018) studied consumer opinions related to the iconic native pawpaw fruit of North America. They measured preferences and uses among those most familiar with the fruit by tapping into a robust network of pawpaw enthusiasts and surveyed them to understand ideal supply chains (e.g., organic, local and place-based) and frequency and nature of consumption. From classroom content to market behavior, agroforestry researchers at the 15th North American Agroforestry Conference addressed key social and cultural questions that benefit comprehension and adoption among a broader public.

Contributions and conclusions

Studies in this Special Issue encompass many of the keyword themes reflected in Fig. 1. Ranging from particular practices and their biophysical affects and environmental services, to production and management, and ultimately aspects of communication and market growth, this set of manuscripts captures agroforestry's broad constitution. At the same time, all authors point out important needs for future agroforestry research, application, and strategy in temperate environments and beyond. One is that agroforestry studies grounded by longstanding baselines are difficult to coordinate because very few mature research sites exist. Another is that the complexity and relative obscurity of practices often complicates the social narrative and efforts to advance practices among the broader public. On one hand, production possibilities are richly promising, but the integrative nature and complexity of agroforestry requires intensive management to manage competition and enhance facilitative relationships. Perhaps the biggest challenge is addressing the gap in landscape-level studies demonstrated by Jose (2009). Only through multi-institutional collaboration, like that occurring at the biennial North American Agroforestry Conference, will capacity and momentum build toward that end.

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