1.2 Climate Change Adaptation

Oral presentations

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How resilient are European agroforestry systems to climate change? What experts think

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Introduction
Agriculture is the most vulnerable sector to climate change due to its strong dependency on weather parameters (Malhi et al., 2021). Predicted yield losses related to climate change range from marginal decreases up to drastic yield losses (Schlenker und Roberts, 2009). The development of future agricultural systems in the face of rising temperatures, varying precipitation and increased frequency of weather extremes must increasingly incorporate the aspect of resilience to maintain food security (Azadi et al., 2021). Agroforestry systems are seen as a promising agricultural practice for maintaining productivity while being more resilient (Smith et al., 2013).

Objectives
Quantifying agricultural benefits in agroforestry in the context of resilience to current and future climate change is a challenge. An online expert survey was conducted in 2023 to capture the experts' assessment of the resilience of agroforestry systems to climate change and to develop new approaches to enhance agricultural resilience. Are agroforestry systems in the present more resilient than their respective woodless systems or is this expected for the future? Are there differences between silvoarable and silvopastoral systems and systems with hedgerows, riparian buffer strips or windbreaks – and in different climate zones? Do the experts' backgrounds influence their assessment?

Methodology
Experts within the European agroforestry networks were invited to participate in the online survey. The online questionnaire was conducted via the Swiss platform SurveyHero (enuvo GmbH). Respondents were asked anonymous questions on the impact of climate change on yield, yield variability and the quality of saleable products, as well as on the effects of environmental services and proposals to strengthen resilience to climate change. Statistical analyses were carried out with R version 4.3.2 (2023-10-31).

Results
From 613 people viewing the survey, 60 participants completed the questionnaire, where 55% were experts for silvoarable and 27% for silvopastoral agroforestry systems, respectively, and 18% for agroforestry systems with hedgerows, riparian buffer strips and windbreaks. 50% participants were experts for Central and Eastern Europe, 23% for the Mediterranean region and 13% for Northwestern and Northern Europe, respectively. 57% of participants came from research, mostly from the Natural Sciences (53%). The second biggest group of experts came from practice (32%). Other work sectors included Advising and Administration. Concerning their field of expertise, the great majority of participants were experts for plants (83%). Nearly two-third of participants had more than 10 years of work experience in their field, a quarter up to five years.

The change in yield (defined as the amount of total saleable produce) under current climate change, averaged across all agroforestry systems and climate zones, was assessed as 0% in agroforestry as compared to -6.5% in the corresponding woodless agricultural systems. This difference was considerably higher for the assessment of expected future climatic changes, with a constant 0% for agroforestry systems and -20% for the woodless reference systems.

Experts assessed presently observed and by 2050 expected effects of climate change variables on a five-level Likert scale from -2 (severe reduction) to +2 (big increase). A severe yield reduction due to climate change in general was presently observed by 3% and 2% and by 2050 expected by 63% and 5% in non-agroforestry and agroforestry, respectively; a minor yield reduction was observed by 65% and 27% and by

2050 expected by 15% and 48%, respectively; no effect by 12% and 46% (present) and 2% and 12% (future); a small yield increase by 15% and 20% (present) and 7% and 19% (future); and a big increase by 2% (present) and 10% (future) in both non-agroforestry and agroforestry.

Work experience influenced the estimation of changes in yield. In particular participants with less than five and more than 10 years of work experience expected more severe yield reductions for non-agroforestry systems. The work sector in which the participants were active also influenced the assessment of changes in yield, though the general observation that agroforestry systems were expected to show less yield losses and more yield gains compared to non-agroforestry was reflected in most sectors. “Exclusive” practitioners, however, more often expected big yield increases for non-agroforestry systems and small increases more often for agroforestry systems. “Exclusive” natural scientists reported higher yields for agroforestry and non-agroforestry systems more or less equally frequently, and small yield increases more frequently for agroforestry systems.

42% and 28% of experts think that environmental services can buffer the effects of climate change much and very much, respectively. Compared to other measures to improve agricultural resilience to a climate, 87% of the experts rated agroforestry to be more effective.

Conclusion

Collecting assessments of the resilience of agroforestry systems to climate change from experts in science and practice allows merging knowledge from different perspectives and comparing systems, climate zones and time horizons, and understanding of experts’ opinions. Backgrounds of education and work experience may influence opinions and be an important point to consider for agricultural policy.

Keywords

Socioeconomic status, ecosystem services, climate change, agriculture, adaptation, Europe, knowledge gaps, agri-environmental system, Climate smart agriculture, buffering climatic extremes, climate resilience, Agri-Environment-Climate

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