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SCIENCE FOR A FOOD-SECURE FUTURE

Note 7

Agro-silvo-pastoralism

December 2025

Note 7: Agro-silvo-pastoralism

Summary

Type of nature loss this practice addresses

- ✓ Pollution
- ✓ Land use change
- ✓ Soil degradation
- ✓ Invasive Species

Type of agriculture this practice is most relevant for

- ✓ Smallholder farms on forest frontiers
- ✓ Agrochemical intensive monoculture
- ✓ Water extractive farming
- ✓ Intensive livestock systems

Investment bundle

Bundling agro-silvo-pastoralism rotational grazing and organic agriculture amplifies the benefits originating from agro-silvo-pastoralism. Together, these practices create a multifunctional landscape that supports sustainability goals through improved land productivity and climate adaptability.

Introduction

Agro-silvo-pastoralism is an agricultural practice combining crop cultivation (agro), forestry (silvo), and animal husbandry (pastoralism) within the same system. It is an integrated approach to land management, applicable to a wide range of ecological conditions [1] that aims to create a harmonious interconnection between its components, thereby maximizing overall system productivity, promoting production diversification and biodiversity, and ensuring sustainability [2]. Agro-silvo-pastoralism systems were already known during the Roman Empire; such systems are mentioned in works like "De Agri Cultura" by Cato (second century B.C.), "Naturalis Historia" by Pliny the Elder (first century B.C.), and "De Re Rustica" by Varro (37 B.C.) [3]. Archeological studies prove that the practice is rooted in the Bronze Age [4], [5]. In recent years, the interest in agro-silvo-pastoralism has been renewed because of its potential to sustain rural farming in marginal areas and to adapt to the challenges posed by climate change [6]. In Brazil, for example, areas under agro-silvo-pastoralism amount to 17 million hectares, with a potential to reach three times that number.

Agro-silvo-pastoralism encompasses and expands upon the concept of agroforestry [7]. Agroforestry combines the cultivation of trees or shrubs alongside agricultural crops. The trees can serve multiple purposes, such as windbreaks, soil stabilization, and habitat for wildlife. They can also provide shade or fodder for animals [7] and produce fruits, timber, building materials, and firewood; and supply fiber, honey, and medicinal products [8], [9].

Diversification is a fundamental principle of agro-silvo-pastoralism, both in terms of species and landscape composition. By diversifying crops, trees, and livestock breeds, agro-silvo-pastoral systems seek to enhance resilience to environmental stresses and improve land productivity [2]. Sustainability is also integral to agro-silvo-pastoralism, since the synergies among system components can reduce the environmental impact of human agricultural activities and enhance several aspects of crop production. For example, animals play an essential role in controlling pests and weeds, while also contributing to nutrient cycling through the recycling of organic matter and providing manure [7]. This latter aspect is

improved when agro-silvo-pastoralism is coupled with other sustainable land management practices, like rotational grazing or organic agriculture.

Pathways to Reduced Nature Loss

Assessment of impacts

The paragraphs below describe the pathways through which agro-silvo-pastoralism affects biodiversity and the subsequent pathways through which it impacts ecosystem services that support agriculture. These pathways are summarized in Figure 1.

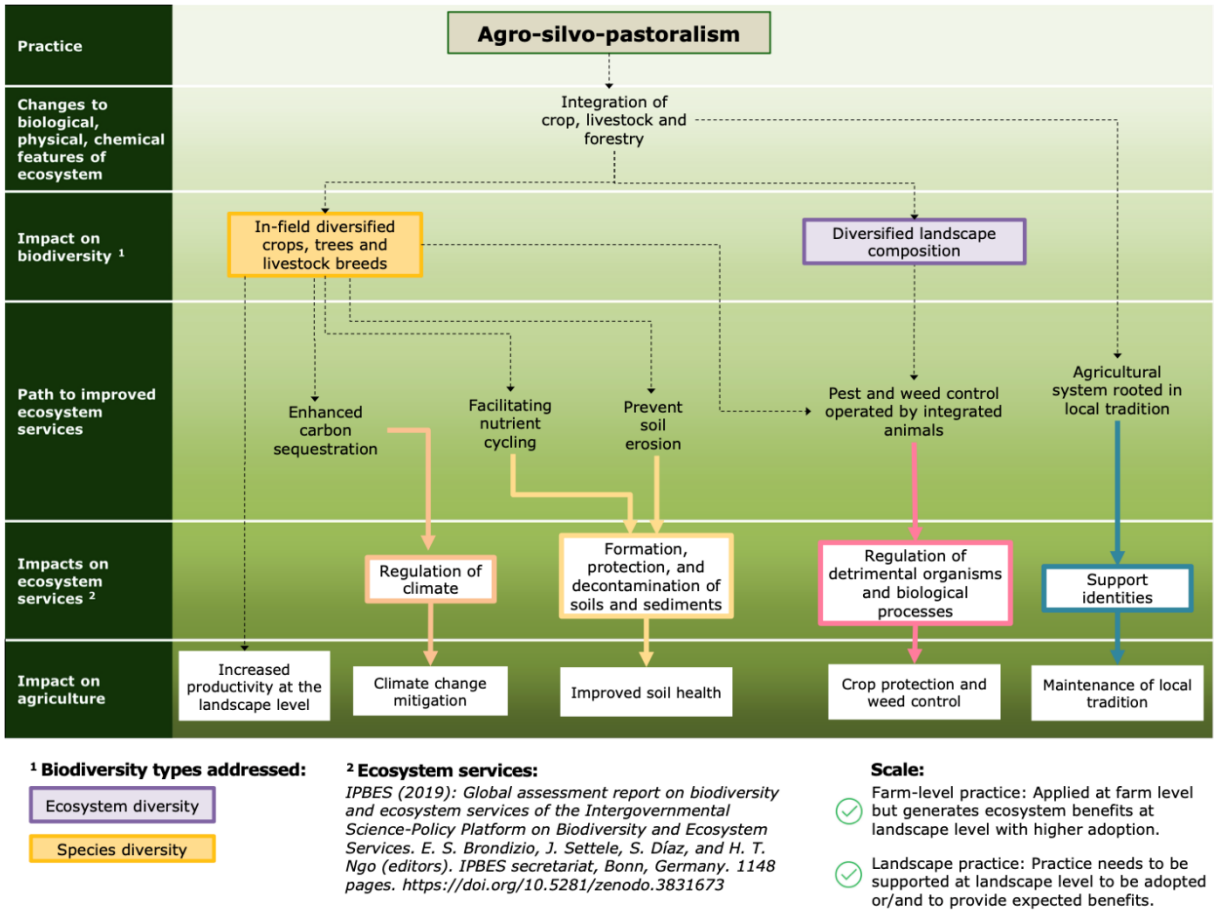

Figure 1. *Pathways through which agro-silvo-pastoralism contributes to reduced nature losses*

Source: Authors

Agro-silvo-pastoralism is a land management strategy that yields several benefits to farmers' livelihoods, their communities, and the environment. It builds around the synergies generated by the integration of its three components and the enhancement of the ecosystem services provided by them. As a direct consequence of the multiple interacting components (crops, tree, animals) agro-silvo-pastures present a more biodiverse system than monocultures [10]. The higher species diversity provided by silvo-agro-pastoralist systems improves provisioning services from agriculture, since croplands, animal grazing, and trees are all involved in the delivery of food and materials for human consumption and use. In addition, agro-silvo-pastoral systems can improve the provision of feed required for animal production

[11]. Moreover, product diversification in silvo-pastoral systems, as opposed to monocultures and intensive livestock systems, acts as a risk mitigation strategy for smallholder farmers and communities and guarantees sustainable provision of food over time. This improves the food availability aspect of contemporary definitions of the concept of food security [12].

Trees and vegetation (the agroforestry component) can regulate water flows, moderate microclimates, and improve climate resilience. On the one hand, the carbon sequestration operated by the trees mitigates climate change by directly lowering the greenhouse gases in the atmosphere [13]. On the other hand, the diverse and resilient nature of agro-silvo-pastoral systems makes them well-suited to cope with climate variability and extreme weather events.

Furthermore, agro-silvo-pastures enhance nutrient cycling through various mechanisms. First, livestock grazing redistributes nutrients and adds organic matter through dung and urine [14]. Second, trees contribute to the enhancement of soil organic matter and soil nitrogen through leaf litter and atmospheric nitrogen-fixing [15]. They also improve soil properties by mitigating the risk of soil erosion which is inherent to intensive farming systems [16], [17].

Diversified landscape in agro-silvo-pastoral systems enhances pest control by attracting and supporting natural predators and parasitoids of crop pests. This ecological complexity disrupts pest life cycles and reduces pest populations, creating a more balanced environment [18].

Finally, agro-silvo-pastoralism is deeply rooted in local traditions and cultural rites, holding significant importance in both developed and developing countries. For instance, in Italy, the practice of transhumance has been a cornerstone of rural life for centuries, with ancient routes like the Tratturi [19] serving as vital pathways for livestock movement. Similar agro-silvo-pastoral management systems exist in Brazil's northern Minas Gerais state, such as the solta and manga. These are distinct forms of livestock management within agro-silvo-pastoral systems. Solta refers to extensive cattle grazing, and manga is a more intensive livestock management practice integrated with managed agroforestry [20]. Finally, transhumance is common in the Himalayas as an adaptation of mountain people to cope with low temperatures and fodder shortages. This system is a herder's rational approach to livestock production to utilize seasonal production of pastures at different altitudes, but it currently faces pressures from various factors, including government policies, socioeconomic changes, and climate change [21].

Barriers to adoption

While the benefits of agro-silvo-pastoralism to farmers' livelihoods and agricultural systems are well documented, adoption studies until now have focused on specific components, namely agroforestry or silvo-pastoralism. For example, farmers' perception of the economic and biophysical benefits of the practice was found to be a key adoption determinant of silvo-pastoralism in the Colombian Amazon [22]. These benefits may not always be well understood, a situation which can arise from the traditional belief that pastoralism is linked to deforestation rather than reforestation [23].

Overall, there appears to be consensus in the literature about the positive role of farmers' participation in cooperatives and other groups [24], [25], [26] in promoting adoption, particularly as regards agroforestry practices. At the same time, the higher overall technical complexity compared to crop production, the existence of maintenance costs, and the high labor intensity of the silvo-pastoralist system during the initial installation phase are widely considered an important barrier to adoption [23], [27]. These findings suggest that policies and interventions should focus on addressing primarily the short-term economic trade-offs

faced by farmers through appropriate incentive schemes, while also providing the necessary technical support for the implementation of the practice, e.g., through targeted extension services.

Key knowledge and evidence gaps

While agroforestry is a key component of agro-silvo-pastoral systems, the current state of knowledge regarding agroforestry is not satisfactory. Examples of knowledge gaps include our limited understanding of what tree species are more appropriate under certain agroclimatic conditions and how agroforestry practices can be affected by climate change [28]. As regards the latter, this knowledge gap is due to limited efforts toward the development of process-based models that can simulate the impact of climate on agroforestry systems [29].

Studies about the economic and financial benefits of agro-silvo-pastoralism have also generated inconclusive results that appear to depend largely on the local context in which the study has been carried out. Hence, while authors have suggested institutional improvements to ensure the overall profitability of the practice in Sudan [30], in Colombia the financial gains from investing in agro-silvo-pastoralism are more pronounced [31]. Further research is needed to better understand the economic implications of agro-silvo-pastoralism, while also accounting for the benefits from improvements in the ecosystem services generated by the practice.

Gender differences can also be expected in use of agro-silvo-pastoralism, based on knowledge of differences in men's and women's decision-making in land use [32] and how they might benefit [33]. Women are often constrained in terms of land access [34], [35] and thus may not be able to take up the practice.

Conclusions

Agro-silvo-pastoralism emerges as a multifaceted agricultural socio-ecological system deeply interlaced with local traditions, cultural rites, and rural livelihoods worldwide. Its longstanding history, from ancient rural societies to contemporary land management, highlights its role in promoting resilient agricultural production systems. By integrating crop cultivation, forestry, and animal husbandry, agro-silvo-pastoralism offers a sustainable approach to land management, fostering biodiversity, enhancing ecosystem services, and ensuring food security. Despite its numerous benefits, challenges persist, particularly concerning the intensification of agricultural systems and barriers to adoption. Addressing these challenges requires promoting awareness, providing technical support, and incentivizing adoption.

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CGIAR Nature Notes

This note is part of a series of 15 publications on sustainable agricultural practices to mitigate agriculture-driven nature loss, particularly biodiversity. Sustainable agriculture practices are defined as technologies or approaches that mitigate selected types of nature loss or enhance positive impacts on nature, are economically viable, support livelihoods, and include diverse smallholders. The note examines agricultural drivers of biodiversity loss, impacts on ecosystem services and consequences for agriculture.

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