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Agroforestry Network

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AGROFORESTRY, BIODIVERSITY AND ECOSYSTEM SERVICES

Creating a resilient and sustainable future
by farming with trees

Agroforestry, integrating trees and shrubs on the same land that is used for crop production and/or animal husbandry, promotes biodiversity and produces a multitude of ecosystem services. It is not a new practice; rather, mixing trees and crops has been a common way to produce food, fodder, fibre and fuels throughout human history. Promotion and development of agroforestry for food production can help mitigate the challenges of climate change, environmental degradation and biodiversity loss.

Biodiversity, ranging from genes to species and landscapes, is vitally important to the health of our planet and humanity, and an important foundation for the production of ecosystem services (see box). Research shows that biodiversity is being degraded at an alarming pace and that the expansion and intensification of food production, including land use changes, is one of the main drivers of biodiversity loss (IPBES 2019). In order to counteract this development and build resilient food production systems, biodiversity needs to be considered both at the farm level and in surrounding landscapes (FAO 2019).

Across the globe, humans have converted natural ecosystems into simplified systems, such as monoculture croplands, forest plantations and fish farms, heavily dependent on inputs like fossil fuels, fertilisers, pesticides, antibiotics and technology. At the same time, the development of international trade and global markets have made food production systems increasingly interconnected (Nyström et al. 2019), while the environmental impacts of the production and the unsustainable use of resources might not be visible for the consumers in distant geographical locations. The simplified nature of many food production systems, and their increased inter-connectedness, is making the systems as well as the surrounding landscapes more vulnerable to disturbances and shocks, such as pest outbreaks and extreme weather events (Nyström et al. 2019). Consequently, it has become increasingly important to build the resilience of food systems and landscapes by strengthening biodiversity and multifunctionality (Gordon et al. 2017).

Agroforestry and other agroecological and regenerative farming systems have in recent years been highlighted as promising options for a more resilient food production (e.g. Wilson and Lovell 2016; HLPE 2019). A well-designed agroforestry system is self-sustaining, reducing the dependence on chemical and other agricultural inputs, while creating multiple benefits. As such, agroforestry has the potential to contribute to mitigating climate change (Zomer et al. 2016), increasing adaptation of resource-poor smallholder farmers to extreme and variable weather events, and increasing tree-related essential ecosystem services as well as the total farm productivity (Kuyah et al. 2019, Agroforestry Network 2018a).

GENDER MATTERS IN AGROFORESTRY – FOR BIODIVERSITY AND ECOSYSTEM SERVICES

Agroforestry systems are not gender-neutral. Though there are of course individual differences and both men and women hold rich knowledge and skills, some patterns

related to gender can be seen. For instance, women tend to prioritise family needs, while men often are interested in agroforestry for commercial reasons (FAO 2013). Also, women often have highly specialised knowledge of trees and forests concerning species diversity, management and different uses (FAO 2013). Their knowledge can enhance biodiversity in the agroforestry landscapes and produce a broad range of ecosystem services.

A well-designed agroforestry system is self-sustaining.

However, women's knowledge is rarely recognised in decision making. They are frequently disadvantaged compared to men, for a variety of reasons, such as access to and control over agricultural products as well as in access to financial resources and information (UN Women 2017). For instance, women are often less likely than men to own land and their access to trees and fruits are often conditioned by the relationship to men (Kiptot et al. 2014), in particular in Sub-Saharan Africa. This is important because well-known barriers to scaling up agroforestry are lack of capital, credit and secure land tenure (Agroforestry Network 2018a). The products controlled by women (such as poultry and vegetables grown for household use) are often considered secondary and far from markets, and therefore they risk being ignored in decision-making or by policy makers (Westholm and Ostwald, 2019).

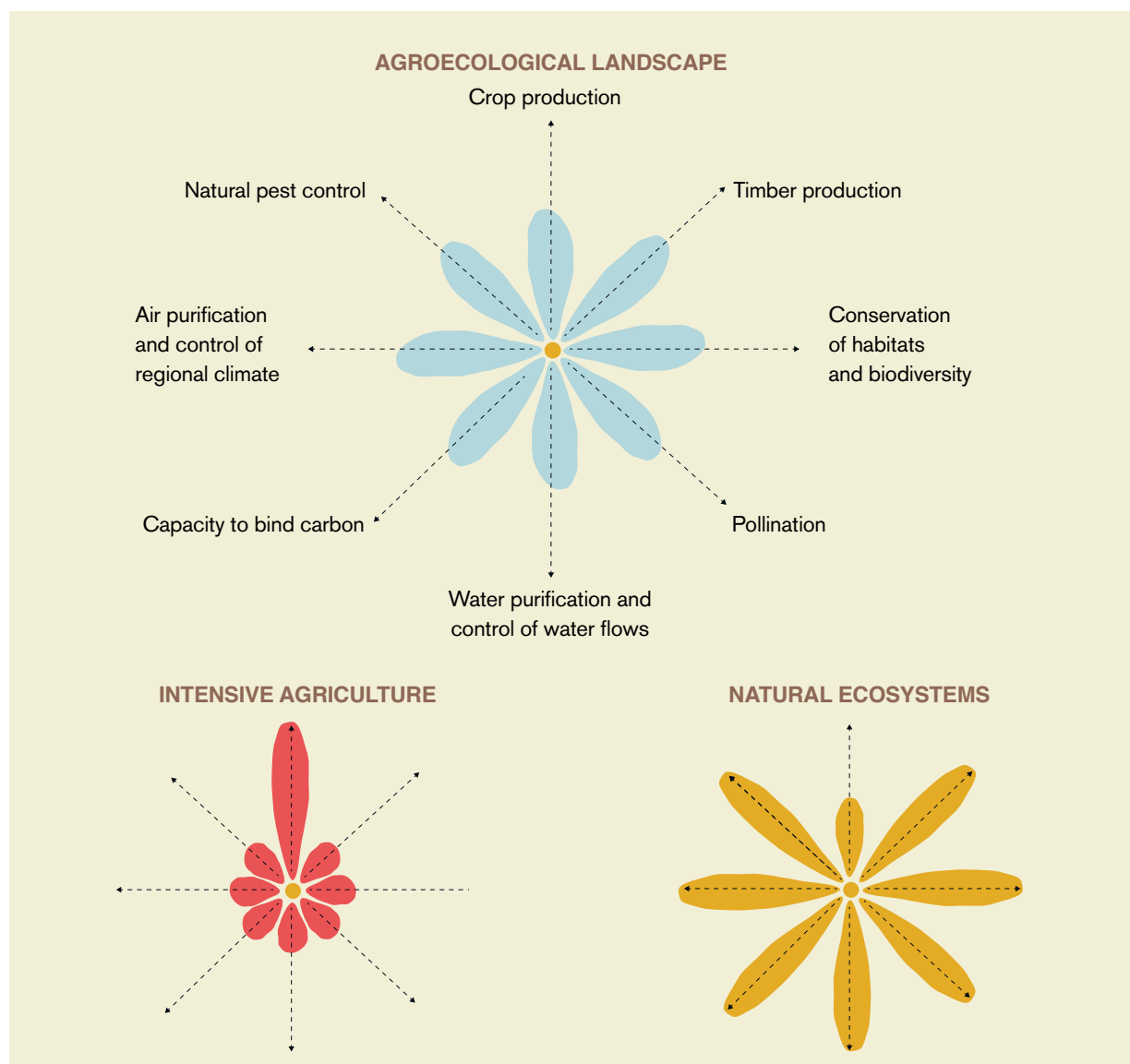
WHAT ARE ECOSYSTEM SERVICES

Ecosystem services are the goods and services that ecosystems contribute to people. Human well-being and development fundamentally depend on these services (MEA 2005; TEEB 2010). Ecosystem services are typically grouped in four categories: provisioning, e.g. production of food and fibres; regulating, e.g. erosion and pest control; supporting, e.g. soil formation and nutrient cycling; and cultural, e.g. spiritual and recreational values in biodiverse landscapes (MEA 2005). As shown in this brief, agroforestry practices contribute to all of these four types of ecosystem services, as well as to the complementing notion of "nature's contributions to people" (IPBES 2019) which places larger emphasis on culture and the inclusion of knowledge of local communities and indigenous peoples (Díaz et al. 2015). The above-mentioned agroecosystem benefits to society are dependent on maintaining the biodiversity of ecosystem service providers (Dainese et al. 2019).

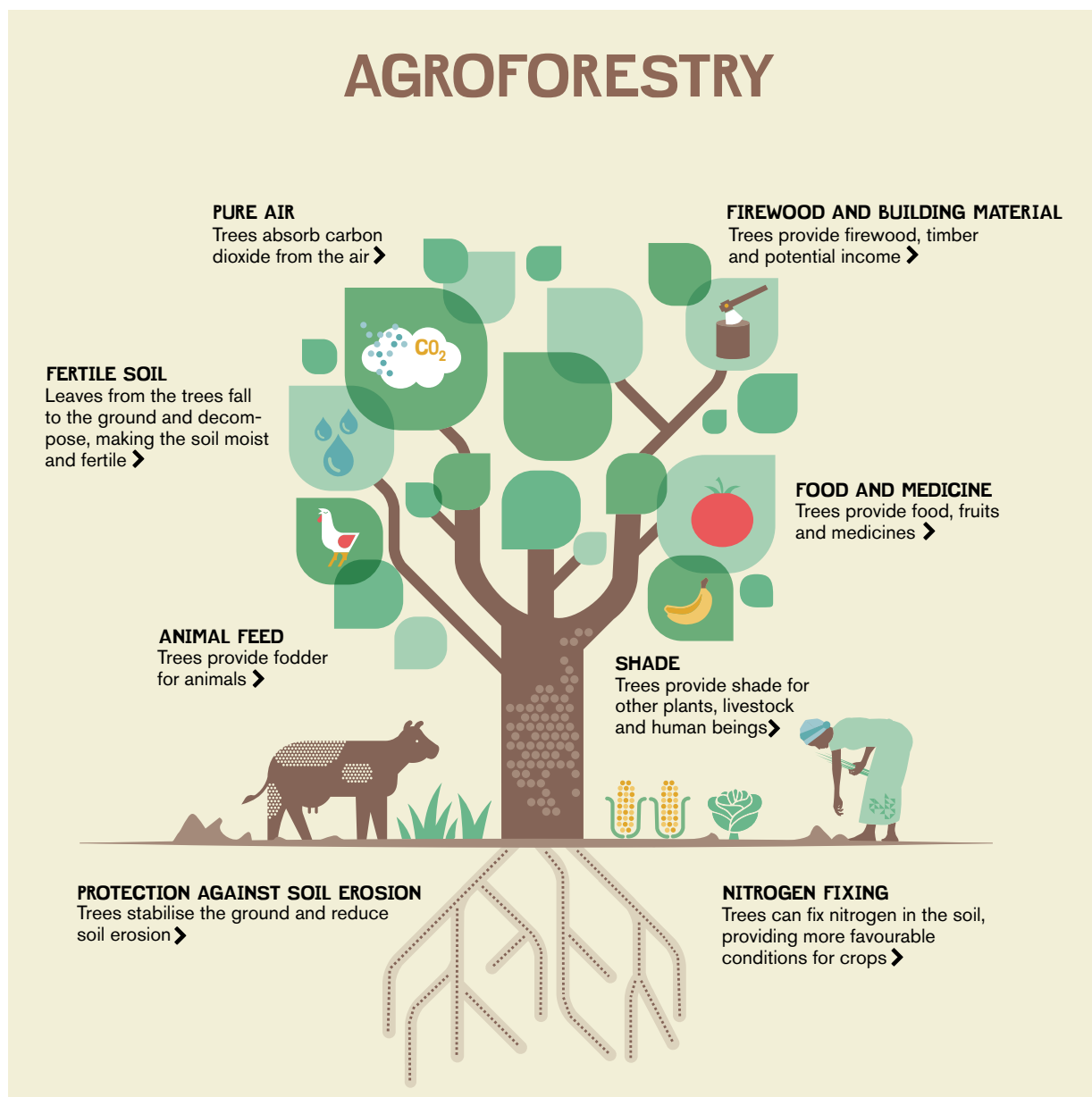
INDIGENOUS KNOWLEDGE MATTERS IN AGROFORESTRY

In general, indigenous peoples and local communities possess detailed knowledge about local settings, climate conditions, species and varieties (IPBES 2019). This knowledge is formed through their direct dependence on their local ecosystems, as well as observations and interpretations of change generated over many generations and adapted and enriched over time. Such knowledge is of particular importance for creating and managing well-designed agroforestry systems. Achieving the multiple benefits that agroforestry

can provide depends on how the system is designed. There is no blueprint, but rather, agroforestry has to be site-based and tailor-made for its local context. Studies have shown that the integration of indigenous and traditional knowledge in agroforestry systems can produce yields that are comparable with systems that have required considerable amounts of fertilisers and pesticides (e.g. Schneider et al. 2016). This is also one of the reasons why agroforestry and other agroecological land management systems should recognise indigenous and traditional knowledge as an integral resource (HLPE 2019).



These “flower diagrams” illustrate the potential ecosystem services production of different land uses. The length of each petal represents how much of a particular ecosystem service that is produced. Agroforestry systems have the potential to deliver a diversity of food together with a broad range of other ecosystem services, as illustrated in the figure “Agroecological landscape”. (Illustration from Schultz, M. 2016, adapted from Foley et al. 2005, and original illustration by C. Cliffstock).



Agroforestry is a farming system combining crops and trees, and can also include livestock. It contributes to many benefits or ecosystem services such as food and medicine, fertile soil, fire wood and carbon sequestration.

BIODIVERSITY IN AGROFORESTRY PROVIDES A RANGE OF ECOSYSTEM SERVICES

Agroforestry-related ecosystem services are many and go far beyond food production. However, most of the positive effects of agroforestry depend on sustainable management, for example choosing suitable tree species for the purpose and local circumstances. Successful agroforestry is primarily about 'the right tree for the right place', based on social, economic and ecological contexts (Sinclair and Coe 2019). By establishing biodiverse and multifunctional agroforestry

systems a multitude of ecosystem services are protected and strengthened (Kuyah et al. 2019). This creates multiple benefits both for the farmers, for example in terms of secure and diverse yields and livelihoods, and for the surrounding landscapes in terms of pollination, water infiltration and recreation (Gordon et al. 2017). Agroforestry systems are also more resilient to climate change and other disturbances than food production systems that lack trees (Castro et al. 2019).

USING AGROFORESTRY PRACTICES CAN:

- Increase biodiversity in food production systems, including soil microbial diversity (Udawatta et al. 2019; FAO 2017))
- Provide habitat for multiple species, provide a “buffer zone” against deforestation and act as “green corridors”, allowing species to migrate across landscapes (Mbow et al. 2014)
- Significantly increase crop yields (Kuyah et al. 2019)
- Provide food, fodder for animals, fuelwood, medicines and financial opportunities (FAO 2017)
- Increase several ecosystem services related to water, including flood prevention and buffering of flow in streams (van Noordwijk et al. 2019)
- Improve soil fertility and water use efficiency, e.g. by integrating trees that fix nitrogen and provide shade (Mbow et al. 2014; Moberg 2011; FAO 2017)
- Reduce the risk and consequences of crop-failure by growing a diversity of crops, and thus increase resilience to shocks and disturbances (Mbow et al. 2014; FAO 2017)
- Improve near-by availability of firewood, reducing the pressure on forests as well as time spent collecting (Mbow et al. 2014)
- Mitigate climate change by lowering emissions of greenhouse gases and sequestering carbon in trees and soils (Moberg 2011; Zomer et al. 2016)
- Contribute to soil erosion control, flood control and pest control (Mbow et al. 2014; FAO 2017)
- Improve the microclimate on farms as trees shade crops and cool the air (Mbow et al. 2014)
- Reduce vulnerability to torrential rains, heatwaves, pest infestations and diseases (Moberg 2011)



Elizabeth Kihumuro Berunga, Uganda. Photo: Elin Larsson

AGROFORESTRY CONTRIBUTES TO REACHING GLOBAL GOALS

The UN's sustainable development goals (SDGs) draw the map of Agenda 2030, a plan of action for people, planet and prosperity. The 17 goals integrate key elements of the Aichi Targets on biodiversity and ecosystem services agreed in 2010 during the UN Convention on Biological Diversity (Schultz et al. 2016). Agroforestry can contribute

to reaching at least nine of the SDGs through its contribution to more diverse and resilient production and livelihood systems, as further described in the report *Achieving the global goals through agroforestry* (Agroforestry Network 2018b). The contributions of agroforestry to all of these nine goals are related to biodiversity and the production of ecosystem services (see table on next page).

ECOSYSTEM SERVICES PROVIDED BY AGROFORESTRY CONTRIBUTES TO THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT



Diverse agroforestry practices reduce the risks of crop failure by producing a variety of crops. Combining trees, crops and animal husbandry provides farmers with a range of income sources.



Practicing agroforestry contributes to food security by producing foods that are high in nutrition and closing hunger gaps between growing seasons.



Agroforestry and its diversity of products can contribute to varied and healthy diets. The agroforestry landscapes can also offer opportunities for recreation, and shade during heat waves.



Empowering women in agroforestry is a key part of maintaining biodiversity and could increase farm yields and reduce the number of people who are under-nourished.



Trees support the hydrological cycle, and a diversity of trees can improve water use efficiency, producing “more crop per drop”.



Agroforestry improves nearby availability of firewood, reducing the pressure on forests, freeing up time spent collecting (often a chore for women and girls).



Agroforestry contributes to food production that reduces pressures on forests, strengthens ecosystem services and biodiversity. Hence, both producing and buying agroforestry products can contribute to this SDG.



Diverse agroforestry systems contribute to both climate mitigation and adaptation; supporting carbon storage in trees and soil, while improving e.g. soil fertility, water security and resistance to droughts and floods.



Agroforestry systems maintain and support biodiversity, while contributing to important processes for sustaining healthy soils and possibilities for species to migrate across landscapes.

RECOMMENDATIONS FOR POLICY AND PRACTICE:

- Increase the support from government extension to the development of agroforestry and other diverse production systems, rather than single crop systems.
- Support the conservation and sustainable use of local varieties of crops and trees, such as local fruit trees.
- Promote agroforestry policies at government level (national and county level) and policies that pave the way for agroforestry.
- Incentivise investments in agroforestry by reforming agriculture subsidies for diversification, as well as policies that give farmers access to land tenure systems.
- Support initiatives that include and empower female farmers.
- Support initiatives that include and empower indigenous peoples and local communities, and their knowledge systems.
- Promote the development of site-specific interventions informed by local knowledge, preferences, needs and constraints, optimising the benefits from the production systems.
- Invest in research towards integrated solutions that address nutritional, climate and environmental challenges combined, including participatory and farmer-led research.

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Stockholm Resilience Centre
Sustainability Science for Biosphere Stewardship



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This brief has been commissioned by the Agroforestry Network, www.agroforestrynetwork.org

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Layout: Kölare Design. Printer: Botkyrka Offset.

This product was funded by Svenska Postkodlotteriet. However, Svenska Postkodlotteriet has exerted no influence on its contents.