FOOD FORWARD NDCs

Implementing silvo-pastoral systems

Overview

Silvo-pastoral systems (SPS) are a form of agroforestry that involve the combination of fodder plants (e.g. grasses and leguminous herbs) with shrubs and trees for animal nutrition and complementary uses (e.g. shade and food production). They are recognized as an integrated approach to sustainable land use. In integrated production systems, as opposed to specialized systems, products, by-products and services of one production component of the system are used as inputs to another component, or scarce or degraded natural resources are efficiently allocated. Other types of integrated production systems include agroforestry, integrated crop-livestock systems, rice-fish, rice-duck, food-energy and aquaponics.

Silvo-pastoral systems are a sustainable land use practice which allows the sustainable intensification of cattle production using natural processes. Trees on grazing land can provide multiple ecosystem services, including climate change mitigation though soil carbon sequestration.

Concrete measures to implement

Sustainable silvo-pastoral systems should be designed according to some general principles which are tailored to the specific climate, landscape and socio-economic context. Guiding principles include:

- Consider the type and initial conditions of land and balance its components:
    - Establish silvo-pasture in suitable areas. Avoid sensitive areas and intact ecosystems with high biodiversity and climate protection value,

such as wetlands and old-growth forests.

- If a silvo-pastoral system is established within existing woodlands, consider introducing forage plants (e.g. grasses; legumes or forbs) or shrubs and/or trees to be used as livestock fodder (e.g. chestnut or persimmons).
- If a silvo-pastoral system is established within existing pastureland, trees should be added while avoiding excessive canopy cover, which could suppress forage growth.

- Select appropriate livestock species and breed:
  - Select appropriate livestock species and breeds to match the condition of the land and its stage of vegetations. This is crucial in order to avoid damage to other elements of the system (e.g. by overgrazing, soil compaction or damage to vegetation and soil).
- Adopt **rotational grazing**:
  - Rotational grazing systems utilize recurring periods of grazing and recovery with animals being rotated among paddocks, or pastures management units.
  - Timing and duration of grazing, stocking rates and carrying capacity of the pasture must be carefully monitored to maintain site quality and tree seedling survival. Seedlings can be damaged through animal trampling and rubbing, overgrazing and soil compaction.
  - A comprehensive grazing management plan – including fencing or paddocking, periodic burning, rotational grazing, fertilization, placement of watering and/or supplemental feeding areas – must be implemented to maintain a silvo-pasture system.
- Select appropriate tree species:
  - In selecting trees, consider soil type, microclimate and multifunctionality of trees.
  - Micro-climate management is one of the main advantages of silvo-pastoral systems, since tree shade **reduces heat stress** of livestock and improves animal performance and well-being.
- Diversity of forage and fodder

    - A diverse range of grasses, forbs, herbaceous plants and trees gives animals a more diverse and healthy diet that is both nutritious and potentially medicinal. It also allows fodder supply to become more resilient.
- Appropriate land management
    - Management of silvo-pastoral systems are technically complex given the direct and indirect interactions among trees, livestock and forage which requires knowledge of ecological principles and skills to manage ecological complexity.

Enabling governance measures

- Secure land tenure rights: Land managers and farmers are more likely to invest in soil management measures if their land rights are sufficient and secure. Security of tenure can be improved by land registration and titling, but other measures may be more effective depending on the context. Such measures should be gender-responsive to prevent unequal land access and enable women to be effective stewards of the environment.
- Full and effective participation from local communities, Indigenous Peoples and other stakeholders which ensures their free, prior, and informed consent (FPIC) in existing government plans and programmes, as well as evaluating economic, social and environmental trade-offs during programme design.
- Specialized training for extension workers and technicians. Agricultural advisory services and sustainable inputs can provide land users with the necessary information and inputs to implement sustainable agricultural practices for soil health. Research into public agriculture and food systems, as well as other public investments in rural areas, should focus on ensuring equity.
- Dedicated credit lines and incentives such as payment for environmental services. Scaling market-based instruments (e.g. pricing CO_2 emissions with a carbon tax or Emission Trading Systems and rewarding net soil carbon sequestration with carbon price-based payment).
- Invest in decent rural farming and non-farming employment and livelihood opportunities, especially focused on women and youth, to support

entrepreneurship, enterprise, smallholders, and family farms and ensure the existence of equitable, decent and inclusive income generating opportunities.

- Reduce and remove large-scale agricultural subsidies that create perverse incentives to overproduce or move towards monocultures, both of which can degrade soil health.
- Conduct outreach campaigns to inform consumers of the benefits of silvo-pastoral systems.
- Link existing certification schemes to silvo-pastoral systems to aide market access. For example, this could be focussed on animal welfare regulations and/or nature conservation but will depend on the target markets.

Tools and MRV systems to monitor progress

Guides and handbooks

Collect Earth

Link: https://www.collect.earth/ceo-guides/

EcoSer

Link: https://www.es-partnership.org/services/guidelines-toolkits/

MRV Platform for Agriculture

Link: https://www.agmrv.org/measurment-methods/

Climate change mitigation benefits

- Greater net carbon storage above- and belowground can be achieved through the integration of trees in croplands and pastures. Silvo-pastoral systems and forest remnants store 27–163% more carbon compared to open pasturelands. Such systems have a Carbon sequestration potential of 1.1 to 6.55 Mg/ha/yr depending on geographic location and on the system age, design, and management.

    - Planting crop trees can (partially) offset GHG emissions from ruminants through carbon sequestration in biomass and soil.
- Soil properties can be improved through greater uptake of nutrients from deep soil layers, enhanced availability of nutrients from leaf-litter and increased nitrogen input by N_2-fixing trees. However, it is important to select tree species that are complementary to other crops within the system, since adding species to a system will contribute to resource competition (for example, for for water, nutrients and light). Fast growing leguminous species can provide relatively quick returns, as well as add flexibility and diversity to a system.
- Greenhouse gas emissions per unit of animal product are reduced in silvo-pastoral systems as a result of higher production efficiency.

Other environmental benefits

- Increased biodiversity in production areas and their surroundings can also provide important environmental services for the farm including pollination, pest control and water regulation.
- Silvo-pastoral systems can also have positive effects on the physical, chemical and microbiological properties of the soil. The shrubs and trees add layers of vegetation capable of transforming solar energy into biomass, which includes the formation of roots that penetrate deeper soil layers to extract nutrients and water. Silvo-pastoral systems can also allow more abundant and heterogeneous biomass to enter the soil such as leaves, branches, fruits, resins and exudates with positive impacts on nutrients, organic matter and biota.

Adaptation benefits

- Enhanced resilience of the soil to degradation, nutrient loss and climate change.
- Establishment of micro-climates that can buffer climate extremes. For example, integrating rows of trees across a field will reduce wind speed across the area, which may or may not be beneficial for the system in question. Detailed site-specific analysis can help to assess whether certain micro-climates are beneficial for the overall production system.

- Improved water holding and infiltration capacity of the soil which can contribute to the regulation of the hydrological cycle, by reducing runoff intensity.
- Preventing yield reductions during drought and flood through use of tree species that are resistant to climate stress.

Other sustainable development benefits

Food production in silvo-pastoral systems can provide a **Triple win**, supporting increased farm-level productivity and profitability, environmental improvements, and increased animal welfare, while contributing to several SDGs, including:

- SDG 1 (No poverty), SDG 2 (Zero hunger), & SDG 8 (Decent work and economic growth): beneficial ecological interactions within silvo-pastoral systems lead to increased yields per unit area, improved resource use efficiency, and enhanced provision of environmental services.
- SDG 12 (Responsible consumption and production): by making more efficient use of natural resources (producing more with less), improving animal welfare and reducing morbidity and mortality, and by enhancing nutrient cycling and other natural processes, which reduce the need for chemical fertilizers and pesticides.
- SDG 13 (Climate action): increases carbon sequestration, reduces GHG emissions per unit of product, and reduces the vulnerability of livestock production to climate change as forage availability throughout the year is stabilized through the promotion of water infiltration and soil conservation.
- SDG 15 (Life on land): the presence of shrubs and trees in silvo-pastures has positive effects on biodiversity by creating complex habitats for wild animals and plants and increases connectivity between forest fragments.

Implementation challenges and potential externalities and trade-offs

- Livestock can negatively impact a landscape if the species and breed are not matched to the land type:
    - As a result, stocking rates must be suitable for the context.

    - Pigs: could root and trample desired vegetation, damaging woodland, or pasture in a very short period. Again, sustainable stocking rates are key.
    - Sheep & Goats: depending on forage type could overgraze the landscape and/or strip the bark off young trees, killing them.
    - Poultry: could scratch or root down to bare soil, damaging roots, and plantings.
- Practicing continuous grazing instead of rotational grazing negatively impacts forage quantity and quality as well as animals' exposure to diseases.
- Higher technical complexity of managing silvo-pastoral systems, especially if implementing or piloting new practices.
- High upfront investment costs (e.g., tree planting, livestock purchase) frequently result in initial negative cash flow.

Measures to address potential externalities and trade-offs

- Appropriate selection of livestock species and breed.
- Rotational grazing.
- Appropriate management level: Farms with high management level usually reach positive cash flow more quickly during period of adoption.
- Financial risk assessment and finance plan in planning phase.
- Provision of dedicated credit lines; equitable financial support/incentives including payment for environmental services.
- Access to technical support for farmers.
- Design of appropriate equity-sensitive training programmes; specialised training for extension workers and technicians.
- Adequate provision of inputs and supplies (e.g. seedlings; advisory services).
- Access to alternative financial streams or programmes, with particular emphasis on supporting low income or marginalised populations.

Implementation costs

An average of USD 1,543 per hectare (Results from case studies from Argentina, Colombia and Mexico).

Intervention in practice

- The “Mainstreaming Sustainable Cattle Ranching in Colombia” project covers more than 2,500 farms across five regions of the country. It has introduced environmentally friendly cattle production on close to 50,000 ha, placed 51,900 ha under a Payment for Environmental Services (PES) scheme, improved stocking rates and productivity per animal by 15%, protected 50 globally endangered plant species on the farms, and sequestered 1.9 million Mg of CO_2eq above and below ground. In addition, the project has significantly contributed to the development of public policies, the training of technicians and farmers, and the development of a network of demonstration farms and service providers.

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