AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly Magazine
Volume 5, Issue 12
www.agriallis.com

Article Id
AL04300

SILVOPASTORAL SYSTEMS: A SUSTAINABLE LAND USE IN DRYLANDS

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The foundation of all primary production systems is land, a non-renewable resource. Growing populations put great pressures on available land. The fact that more than 69% of our land area is classified as a dry zone by Thornthwaite adds to the demands already placed on the soil. The cattle industry is responsible for 9% of the world's anthropogenic carbon dioxide (CO2) emissions, which are mostly caused by changes in land use, particularly the expansion of pastures and arable land for feed crops and deforestation. Enteric fermentation accounts for around 40% of the greenhouse gas emissions from cattle in tropical climates, primarily from CH_4. Systems for raising cattle must strike a balance between resource use and greenhouse gas emissions. The amount of land accessible for agricultural production will decrease as climate change takes hold, which will put a lot of strain on food production systems (Dagar and Tiwari, 2016). Future reductions in the amount of arable land available may make the impoverished who reside nearby more vulnerable, which is a serious worry and sure to be a hot topic of conversation. The regrowth of woody species has been inhibited, and the overall richness of species has been restricted to a small number of important economically significant species. This makes it possible to direct nutrition and energy flows into a specific subset of plant and animal products. The farming system is expected to gain a great deal from increasing the biodiversity of grassland ecosystems through the introduction of SPS, including soil stabilisation, animal shelter and shade, revenue diversification through tree products, improved soil fertility, and increased soil water and carbon retention. They must get the utmost importance and immediate attention in order to optimise the use of drylands through tested silvopastoral systems (SPS).

Silvopastoral System (SPS)

It is a silvopastoral production unit, which is an agricultural unit that integrates woody vegetation (trees and/or shrubs) with grazing animal production.

Selection of Tree Species for SPS

- Deep-rooted to avoid competition with forage for moisture and nutrients
- Tree species must be adapted to the site to assure strong health and vigour management
- Must be compatible with planned livestock and forage species
- It should have higher rates of carbon sequestration potential
- Rows should be oriented in an east-west orientation where feasible and practical to allow maximum sunlight onto grass strips
- Resistant to pests and diseases
- Have high-value product potential
- Open-crowned to allow good forage production
- Trees should be planted at an appropriate density to allow acceptable forage production and wood products
- The invasive potential of the species must be known when selecting plant Species

Selection of Forage Species for SPS

- Suitable for the targeted livestock
- Compatible with site (soil, climate)
- Productive under partial shade and moisture stresses,
- Responsive to intensive management
- Tolerant of heavy grazing

Selection of Livestock for SPS

The choice of livestock appropriate for a given silvopastoral system will rely on the objectives and markets, in addition to the established species of trees and feed. In a silvopastoral context, some cow breeds could do better than others. Possible livestock alternatives to cattle are goats and sheep. Grazing should not begin until trees have grown to a height where the main stem terminal buds are out of reach for animals, regardless of the species chosen. Haying is advised in between young trees until they are mature enough to handle the stresses of grazing and the presence of cattle. Large ruminants, like cattle, are more prone to crush young trees, whereas browsing animals, like goats and sheep, are more likely to consume. Because there is a greater chance of tree damage during mating seasons, bulls should not be maintained in silvopasture. In general, younger animals are more prone than older, more seasoned ones to do harm to trees. If climatic change occurs, local breeds should be given precedence over hybrid breeds (Tewari *et al*., 2014).

Benefits of SPS

1. Soil Improvement

In a system of silvopastoral forests, trees shield the soil from the direct effects of wind, water, and sun. Their increased infiltration rates let them hold onto more water, lessen runoff, and help control the water cycle. In places where trees do not provide cover, soil erosion is more likely. In order to manage grasses with trees and/or shrubs, nutrients that are taken out of the soil are recycled through the addition and breakdown of fine roots and litter fall, animal dung from grazing, and tree pruning residues. Furthermore, by interacting with microorganisms found in root nodules, the preference for legume trees utilised in the silvopastoral system fixes nitrogen from the atmosphere. The higher content of organic matter in soil and the improvement of the microclimate (moisture and temperature) due to the presence of trees in silvopastoral system promote the biological activity of the macro and micro fauna, resulting in a greater mineralization and availability of soil nutrients.

2. Soil Moisture Conservation

Trees operate as barriers to minimise runoff, covers decrease the effect of raindrops, and soil improvers improve soil permeability and water retention. Increased water infiltration, interception, decreased evapotranspiration, and decreased erosion are some of the ways that silvopastoral systems help preserve water resources. In pasture-shaded systems, evaporation rates are lower than under pure pastures, particularly in windy conditions. In contrast to the open field, this results in increased soil moisture beneath the tree tops. The benefit on soil moisture may expand as trees get older (or get larger).

3. Livestock improvement

The availability of fodder, animal productivity, and animal performance are all very susceptible to the effects of climate change. Global scale modelling suggests that grazingonly farming systems, particularly those in Africa, Australia, Central America, and South Asia, would be more severely impacted. Studies indicate that the amount of edible biomass that is accessible to cattle in these areas might decrease by up to 50%. Planting trees and bushes in pastures is a suggested way to reduce the impact of sun radiation and its effect on animal thermoregulation. Trees help to regulate the surrounding temperature, which helps to disperse solar energy. Benefits include decreased metabolic rate and increased intake of dry matter since animals use less energy dispersing heat.

4. Improving socio economic status of farmer

In reaction to financial expenses, resource managers frequently decide to implement a land-use strategy that exclusively optimises financial gains. Due to asymmetric decision information and a lack of awareness of all benefits, the resource management, society, and the environment may lose out on the advantages in such circumstances. The chosen land-use strategy might not be the ideal one as a consequence. Financial indicators show advantages that the resource management values, even though they might not capture all benefits that could result from adopting a silvopasture strategy.

Conclusion

Dryland farmers have been providing their animals with the necessary feed by using traditional SPS. There is a massive disparity between the availability and demand of fodder in drylands because of the degradation caused by increased grazing pressure and energy demand on these traditional pasture lands. Improved SPS with appropriate tree species and their management techniques offers a great deal of potential to increase output, according to overwhelming data. SPS has a lot of potential to be used in drylands to address issues including biodiversity preservation, global warming mitigation, and land restoration. Farmers in arid areas might greatly benefit from the value-added goods produced by SPS.

References

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