

Syntropic Farming: A Sustainable Method to Address Degradation and Desertification

Koku K. Tara^{1*}, Songthat William Haokip² and Babetlang Kharshiing³

¹Division of Vegetable Science, ICAR-Indian Agricultural Research Institute, New Delhi (110 012), India

²Dept. of Fruit Science, College of Horticulture and Forestry (I), Pasighat, Arunachal Pradesh (791 102), India

³Division of Environment Science, ICAR-Indian Agricultural Research Institute, New Delhi (110 012), India

[DOI:10.5281/trendsinaagri.15342667](https://doi.org/10.5281/trendsinaagri.15342667)

Abstract

Syntropic farming, an innovative agricultural approach, offers a sustainable solution to combat land degradation and desertification. By mimicking natural ecosystems, it promotes biodiversity, soil health and water conservation while enhancing crop yields and resilience. Originating from the efforts of Ernst Gotsch, syntropic farming has gained global recognition and popularity. Through principles like natural succession and stratification, syntropic farming creates dynamic ecosystems that restore degraded lands into productive landscapes. Despite challenges, successful implementations, such as the Great Green Wall project in Senegal, demonstrate its transformative potential. However, through strategic research, community engagement and financial support are essential to scale up adoption and realize its full potential.

Keywords: Biodiversity, Degradation, Desertification, Sustainability, Syntropic farming

Introduction

Soil, water and forests stand as the cornerstone of life, supporting the existence and survival of organism on earth. These natural resources govern the fundamental processes and ecosystem services essential for sustaining life on land. Land, in turn, plays a vital role in food production, biodiversity preservation, water system management and carbon storage. While land management can optimize these services, not all lands are readily cultivable, particularly drylands characterized by low rainfall, climate uncertainty and poor soil fertility. Globally, land degradation and desertification (LDD) have emerged as significant threats to environmental and human sustainability. These challenges exacerbate hunger, poverty, unemployment, forced migration and conflict, while also amplifying the risks of extreme weather events linked to climate change. Land degradation, defined as a process diminishing the current or potential capability of soil to produce goods and services, resulting from various factors including erosion, loss of soil organic matter, deforestation and desertification. Desertification, being a long-term consequence of land degradation, particularly impacts arid, semi-arid and dry subhumid areas due to climatic variations and human activities. Drylands, covering approximately 46.2% of the global land area and housing 3 billion people, are disproportionately affected by land degradation (1). With LDD impacting 3.2 billion people globally and costing nearly 10% of the annual



global gross product, urgent action is imperative (2). The UN warns that over 3.2 billion people are at risk due to land degradation, with many residing in the world's poorest regions. In India alone, land degradation has led to a significant economic loss, emphasizing the urgency of addressing this issue (3).

In the face of these challenges, high-input intensive agriculture has been a regular practice of modern agricultural practices. Its convenience and short-term gains, however, come at a significant environmental cost exacerbating issues such as soil degradation, water contamination and ultimately contributes to desertification. As concerns grow over health and sustainable food production, there is a pressing need to transition to farming systems that prioritize sustainability over input-intensive approaches. An emerging promising solution is called as syntropic farming, which is also known as syntropic agriculture. This article delves into the transformative potential of syntropic farming, a regenerative approach aimed at combating land degradation and desertification while fostering eco-friendly agricultural practices.

Syntropic Farming: History, Concept and Popularization

In 1984, a Swiss farmer named Ernst Gotsch embarked on a remarkable journey in Brazil, acquiring 1200 acres of deforested, arid and unproductive land called "*Fugidos da Terra Seca*" (Escaped from the Dry Land) (4). Motivated by a desire to breathe life into this desolate landscape, he introduced a new method of agriculture he called successional agroforestry, later renamed as syntropic farming. This approach aimed to revive the land by mimicking nature's own regenerative processes and to reforest the entire area with native plants and subsequently prune them to produce biomass and bio mulch. The primitive objective of this farming system, is the restoration of the ecosystem by actively rebuilding soil. Over time, this approach transformed the once-barren land into a healthy and biodiverse landscape (2, 5, 6).

Reflecting its core principle of syntropy, it essentially opposes the concept of entropy (dissipation) and emphasizes creating harmonious relationships within the agricultural system. The documentary film "*Life in Syntropy*" played a pivotal role in raising awareness about syntropic farming (5). Broadcast at the 2016 Nations Framework Convention on Climate Change (COP21) in Paris, the film brought Gotsch's innovative approach to a global audience. This exposure significantly increased the popularity of syntropic farming as a potential solution for sustainable agriculture and land regeneration. Ever since its success and popularization continues, this farming principles and practices are now practised in other countries like Costa Rica, Mexico, Greece, Portugal, Germany and Switzerland (4). Furthermore, interested environmental enthusiasts can watch a success story on YouTube that highlights how the World Food Programme (WFP) is combating desertification through syntropic farming in Dakar, Senegal (6).

Understanding Syntropic Farming: Principles and Practice

Syntropic farming, represents a revolutionary approach to sustainable food systems by emulating the structure and function of natural forests. Rooted in ecological principles, this method involves cultivating a diverse array of crops in "consortia" to foster mutual support and collaboration among different species. By mimicking the natural succession and stratification found in forests, syntropic farming creates dynamic, economically viable ecosystems that restore degraded soil biodiversity.



Principles guiding Syntropic Farming

At its core, syntropic farming is guided by the principles of natural succession and stratification, aiming to concentrate energy in the form of biomass within the production system to optimize photosynthesis and biomass growth. This involves selection of diverse plant species arranged in canopy layers to mimic the natural strata of forests. The dense layering from top to bottom maximizes photosynthesis and creates a temperature gradient, with cooler temperatures at the bottom. Continuous soil cover further reduces evaporation, erosion and weed pressure while enhancing nutrient cycles, soil life and biodiversity (7).

Key practices of Syntropic Farming

- a. **Pruning and plant selection for sunlight optimization:** Regular and timely pruning of branches facilitates increased sunlight penetration across different layers of the system, optimizing photosynthetic efficiency. Strategic removal of plants before maturity prevents the release of growth-inhibiting chemicals, promoting the growth of adjacent young plants. Planting indigenous species fosters thriving ecosystems, enhancing overall biomass production and energy within the system.
- b. **Soil coverage for enhanced health:** Implementing regular mulching with plant biomass improves soil health by retaining moisture, fostering soil fauna and microbes, increasing organic matter and reducing erosion. Decomposing pruned plants enrich the soil with humus, nutrients and energy, supporting plant growth and nutrient cycling within the farm system.
- c. **Species selection and spatial stratification:** Upon reaching the end of their high-yielding period, plants are pruned and/or cut down and this material is utilized as mulch to nourish the soil, making way for emergent species (succession). Careful selection of plants that do not secrete allelopathic compounds to each other fosters natural pest and disease control and enhances pollination. Stratification is achieved by considering height, canopy and lifecycle of plants. By focusing on succession and stratification together is a highly diverse and densely planted plot where each element of the environment plays a collaborative role in restoring the land, rather than as assumed competition.

Syntropic Farming tackles desertification at its roots by following points

- a. **Soil Restoration:** Syntropic farming prioritizes healthy soil by using methods like continuous regular mulching, planting diverse crops and minimal soil tillage. This approach aids to rebuild soil organic matter, improve soil structure and increase moisture retention capacity.
- b. **Ecosystem Balance:** Syntropic farming promotes biodiversity by integrating a variety of plants species like trees, shrubs, fruits and vegetables. This diversity helps to create a resilient ecosystem that can withstand environmental stresses and disruptions.
- c. **Water Management:** Syntropic farming emphasizes water conservation and management strategies, such as rainwater harvesting, drip irrigation and water-efficient planting techniques. These practices help to prevent soil erosion, reduce evaporation and optimize water use efficiency, thereby supporting vegetation growth and address desertification in dryland areas.
- d. **Regenerative Practices:** Unlike conventional agriculture, which often depletes soil nutrients and exacerbates erosion, syntropic farming employs regenerative practices that replenish soil fertility and



promote natural ecosystem functions. By mimicking the structure and function of natural forests, syntropic farming creates resilient agroecosystems that can thrive in dryland environments.

- e. **Long-Term Sustainability:** Syntropic farming is inherently sustainable, as it relies on natural processes and ecological principles to maintain productivity over the long term. By fostering soil regeneration, enhancing biodiversity and improving water management, it offers a holistic approach to tackling desertification and promoting food security in vulnerable regions.

Advantages and Disadvantages of Syntropic Farming

Advantages:

- a. Abundant crop yields are being achieved.
- b. A consistent income stream is maintained throughout the growing season, with staggered harvests planned across different stages of the year and over multiple years.
- c. Income gradually escalates as fruit and lumber trees mature.
- d. Optimal land utilization is ensured by integrating vegetable production with fruit and lumber trees.
- e. Costs are minimized as there is no requirement for pesticides, fertilizers, or mechanized farm equipment.
- f. Soil quality is enhanced, becoming more fertile, soft, aerated and manageable.
- g. Reduced reliance on frequent rainfall due to improved water retention capacity.
- h. A pleasant working environment is fostered as trees provide partial shade over time.
- i. Reduced need for weeding, as the ground is covered with mulch that suppresses grass and competing plants.
- j. Diverse species thrive as the farm environment improves.
- k. Enhanced plant health and resilience to pests and diseases are achieved through biodiversity.

Disadvantages:

- a. The full benefits may take time to materialize.
- b. The appearance of the farm may seem disorderly to those unfamiliar with syntropic farming practices.
- c. Significant time and effort are required to learn and implement syntropic farming techniques.
- d. Sun-loving cash crops have a limited lifespan on the farm, typically around four years.
- e. The practice does not assume competition for nutrients and sunlight amongst the plants.

Conclusion and Future thrusts

Amidst the pressing challenges of climate change, population growth and unsustainable land and water management practices leading to land degradation and desertification, the need for innovative solutions is urgent. Syntropic farming emerges as a promising regenerative agricultural practice, integrating ecological principles to create diverse and productive agricultural systems. By harnessing the resilience of natural ecosystems, syntropic farming offers a holistic approach to combat global challenges such as climate change and desertification, contributing to carbon sequestration and creation of forest covers. Moreover, educating the younger generation about indigenous farming practices like syntropic farming can instill a sense of responsibility and awareness about the critical issues of desertification and climate change as one of the primary sources of desertification. Teaching regenerative agricultural practices in schools empowers youth to



become stewards of the environment, fostering a culture of sustainability and resilience. However, for syntropic farming to realize its full potential, strategic research, community engagement and financial support are essential to scale up adoption and demonstrate its effectiveness in ensuring food and nutritional security. With concerted efforts at various levels, syntropic farming holds promise as a transformative solution to address the multifaceted challenges of the 21st century.

References

1. <https://www.ipcc.ch/srccl/chapter/chapter-3/>. Accessed on: 15th February, 2025.
2. Chaudhuri, S., Roy, M., McDonald, L. M., & Emendack, Y. (2023). Land degradation–desertification in relation to farming practices in India: An overview of current practices and agro-policy perspectives. *Sustainability*, 15(8), 6383.
3. <https://www.scientificamerican.com/article/as-land-degrades-india-struggles-to-save-its-farms/>. Accessed on: 15th March, 2025.
4. Nathan, A. (2023). Portugal to New Mexico: Investigating the Applicability of Syntropic Agriculture to a Semi-Arid Continental Climate.
5. <https://www.youtube.com/watch?v=gSPNRu4ZPvE>. Accessed on 10th February, 2025.
6. <https://www.youtube.com/watch?v=WCl0gyNwL0>. Accessed on 15th February, 2025.
7. Andrade, D., Pasini, F., & Scarano, F. R. (2020). Syntropy and innovation in agriculture. *Current Opinion in Environmental Sustainability*, 45, 20-24.