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SOWING THE SEEDS OF SUSTAINABILITY FROM ANCIENT TO MODERN ERA: HISTORICAL PERSPECTIVES OF SUSTAINABLE FARMING IN INDIA

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Abstract
Agriculture has played a significant role in India's history throughout its long and rich cultural heritage. A holistic approach to sustainable farming (agroecology or regenerative agriculture) strives to strike a balance between environmental stewardship, economic viability, and social equality. Organic farming is based on "The Earth has enough for everyone's need but not for everyone's greed"- Mahatma Gandhi. The origins of sustainable farming can be found in prehistoric civilisations when dependence on natural systems made conventional farming methods naturally sustainable. But as industrialisation and mechanised agriculture spread, they also brought forth practices that were dangerous for the environment and the welfare of communities. The Indian subcontinent's ancient civilisations, such as the Harappan and Vedic civilisations, were forerunners in developing sustainable farming practices that supported their societies for generations. Communities of the time relied on the land for their livelihoods and understood the need to protect it for future generations. Therefore, agricultural practices were closely tied to sustainability concepts. By examining ancient history, Mughal history, and their relevance in the context of modern sustainable farming in India, this article illuminates the knowledge of our ancestors, and it draws conclusions from both literary works and historical data.
Keywords: Agriculture, Sustainable farming, Organic Farming, Environment, Social equality

Sustainable Farming: Roots from Ancient India

The Indus Valley Civilization, which thrived between 4300 and 1300 BCE, is known for its proficient agricultural methods, which included sustainable farming practices. They created complex irrigation systems, including the "Karez" system, that allowed growing food in desert areas of India and Pakistan(M. Rahman, 1981). The Harappan civilisation also used crop rotation, numerous crops, and vegetative propagation to maintain soil fertility. These environmentally friendly methods enhanced total agricultural output while preserving soil fertility(Petrie & Bates, 2017). With these inventions' aid, the Indus Valley inhabitants could sustainably grow various crops, including cotton, wheat, barley, and rice (Fuller, 2000). Vegetative propagation is a way of reproducing plants that do not rely on seeds. Plants were propagated and cultivated using stem cuttings and root divisions(Fuller & Stevens, 2019). They employed organic matter to replenish the soil and improve its structure, such as animal manure and compost. This method aided in retaining moisture and nutrients, as well as the soil's long-term fertility(Naulakha, 2021).

The creation of the sacred text, the Rigveda, which sheds light on early Vedic agricultural practices, characterises the Vedic era(Balkrishna et al., 2022). The Vedas strongly emphasise the

value of ecological balance and sustainable land use(T. Kaur, 2014). The Rigveda refers to the practice of "Yajna" or fire ceremonies, in which sacrifices were offered to deities, and the ashes were scattered over the ground to serve as organic fertiliser (Aithal, 2022). This cyclic process has the dual goals of preserving agricultural yield and soil fertility(Aithal, 2022).

Organic farming is not a new notion; it has its origins in ancient Indian practices. 'Jivamrita,' a Sanskrit phrase, translates to 'nectar for the living.' It is a traditional organic fertiliser made from cow dung, urine, jaggery, pulse flour, and water(Somdutt et al., 2021). Similarly, as a natural insecticide and fertiliser, 'Panchagavya,' a combination of cow dung, urine, milk, curd, and ghee, was utilised. These practices demonstrate the ancient Indian awareness of the symbiotic interaction between humans, animals, and the environment(Raju et al., 2022). These practices highlight the ancient Indian understanding of the symbiotic relationship between humans, animals, and the environment(R. P. Singh et al., 2014).

The ancient Indian faith of Jainism, which strongly emphasises nonviolence (ahimsa), has substantially contributed to sustainable agriculture methods(Fergusson et al., 2018). Jains adhere to stringent dietary laws and agricultural practices that put the welfare of all living things first. There is little animal and insect harm associated with their agriculture. Jains use methods like "mulching" and "cover cropping" to increase soil fertility and stop erosion, aligning with sustainable farming techniques(R. B. P. Singh, 2008).

Tamil Sangam literature from the classical era (300 BCE–300 CE) offers essential insights into Tamil agricultural practices in the past(Sastri & Champakalakshmi, 1997). The literature describes various habitats in the 'Kurinji' (mountain), 'Mullai' (forest), 'Marutham' (cropland), 'Neithal' (coastal), and 'Palai' (desert) regions(Arul Josephine, 2022). Agroecology was practised by the ancient Tamils, who modified their farming techniques to the local environment(Udhaya Nandhini et al., 2016). This sustainable strategy guaranteed the balance between agricultural productivity and biodiversity. The Tamil rulers understood the value of irrigation well. With a wealth of resources, they carried out extremely massive irrigation works. (Srinivasan, 2016).

The ancient Indian medical system known as Ayurveda extends its ideas to farming. The gods' physician, Dhanvantari, is honoured for his contributions to medicine and for developing agricultural methods that adhered to Ayurvedic principles(Jadhav, 2018). Ayurvedic agriculture included the cultivation of medicinal plants, crop variety, and herbal pesticides, all promoting the well-being of the land and its cultivators(Desai, 2022).

Traces of Sustainable Farming in the Medieval Era

The Chera, Chola, and Pandya empires, known for their remarkable contributions to governance and agriculture, implemented sustainable water management systems. The people of the south grew a wide variety of crops, including jackfruit, coconut, palm, areca, and plantain trees, as well as rice, sugarcane, millets, black pepper, different cereals, coconuts, beans, cotton, and tamarind and sandalwood. Regular ploughing, manuring, weeding, irrigation, and crop protection were used to maintain agriculture in South India. During this time, water storage techniques were developed. One of the oldest water-regulation structures in the world that is still in use is the dam on the river Kaveri called Kallanai, built in the first and second centuries AD (Mulage, 2017). The

Grand Anicut, built by the Chola king Karikala around the 2nd century CE, is one of the oldest water-regulation structures in the world. These empires prioritised the construction of irrigation canals and tanks, enabling efficient water distribution for agriculture(Agoramoorthy et al., 2008). The ancient Indian practice of rainwater harvesting also played a crucial role in sustainable water management. The Arthashastra, attributed to Chanakya, provides insights into the management of rural areas and agricultural practices of the time(Upadhyaya, 2019). India's "Golden Age" under the Gupta Empire is frequently referred to because of the country's notable agricultural expansion(Satpathy, 2018). Evidence of increased agricultural productivity and an increase in the area under cultivation exists. The Gupta emperors maintained the Mauryas' land revenue system. Typically, taxes were paid in kind, and the state kept granaries for storage (Akter, 2020).

Mughal Era

The early-16th through the mid-19th century Mughal Empire has been recognised for its architectural wonders, cultural achievements, and economic prosperity. However, the widespread use of sustainable farming methods throughout this time is a topic that has received less attention. Recognising the value of agriculture as the foundation of their economy, the Mughals adopted several cutting-edge farming practices that were environmentally benign(Khan, 1997).

Agricultural tools and water-lifting equipment were vital for farming techniques during the Mughal era (1526–1756). These included equipment for managing water resources and crop cultivation, such as ploughs, harrows, and irrigation channels. Innovative water-raising technologies were also developed under the Mughal Empire, including a manually driven water lift that aided farmers in more effective field irrigation(S. Kaur, 2018). The farmers also employed organic fertilisers to augment soil fertility(Ali, 2023). Animal manure was a predominant organic fertiliser, specifically from cattle and sheep. (Khan, 1997).

The Mughals put in place systems of community-based water management, where residents took part in the upkeep of water sources and distribution systems(Wescoat, 1985). This decentralised strategy promoted community responsibility for sustainable resource management and equitable water delivery. The irrigation systems that the Mughal engineers built were excellent. They were well trained in water management and careful water use since they had the Persian-Transoxania traditions, which had their roots in the desert and oasis region, ingrained in their minds(Dayalan, 2017). The Mughals helped introduce new crops to India. Exchanging crops around the empire diversified crops and reduced insect and disease damage. This diversification increased the population's nutritional diversity(Spengler et al., 2021).

Mughal policies regulated agricultural markets, which included pricing controls, hoarding prevention, and fair trade. The Mughals sought to safeguard farmers and consumers by building a stable and transparent market, ensuring agricultural sustainability. However, the Zamindari class controlled agriculture and revenue throughout the Mughal dynasty. The Zamindari class inherited land pleasure. Farmers had no right to sell or mortgage the land, which caused them much hardship(Ali, 2023).

British Colonial Rule in India

The early 17th century until the middle of the 20th century witnessed British colonial rule in India, significantly impacting many facets of Indian culture, including agriculture. The British made various improvements to farming practices due to economic considerations. In the past, diversifying cropping, a wide variety of crops, and a sophisticated awareness of seasonal rhythms were all hallmarks of Indian agriculture. Our Indian Farmers used indigenous methods for managing soil fertility and depended on traditional knowledge passed down from generation to generation.

To further their economic interests, the British introduced cash crops like indigo, cotton, and opium. While these crops were profitable for the British, they frequently displaced food crops, decreasing food production. This transition had serious ramifications during famines, as food scarcity became a recurring issue(Upadhyay, 2019). During the British era, railway development made transporting agricultural products from rural areas to cities and ports easier(D'Souza, 2006). This infrastructure improvement facilitated transportation, decreased post-harvest losses, and opened up new markets for farmers. However, rather than cultivating crops essential for local sustenance, the main emphasis remained on those profitable for export(Krishna G. Karmakar, 2015).

The irrigation system was essential to British India's agricultural development (Sampatrao, 2020). The British East India Company used contemporary irrigation technologies such as canal irrigation to increase crop yields and food production (Wallach, 1985). One of the world's most significant and most intricate irrigation projects was the Indus Basin Irrigation System, which was finished in the 1930s. The system enabled the cultivation of numerous crops, including cotton, rice, and wheat, and provided irrigation to more than 6 million acres of land(Alam et al., 2007). The British government funded irrigation projects and installed canal systems in some areas of India. These initiatives sought to increase agricultural output by supplying a steady water supply(Bolding et al., 1995). While some regions benefited, others encountered ecological difficulties due to poorly thought-out irrigation plans, which caused waterlogging and salinity problems(McGinn, 2009).

British forest management regulations had a significant impact on agriculture. The British government enacted stringent forest restrictions that limited access to woodlands for farming, livestock, and other conventional uses(Guha, 1983). Due to the requirement to meet various demands, many communities were compelled to adopt agroforestry as a sustainable substitute(Nair et al., 2022).

Devastating famines struck India numerous times when the British ruled it. Famines were frequent under British rule in India, which was made worse by policies prioritising cash crops over food crops, railways, taxation system, and export/import policies (Niroula, 2021). The Bengal Famine of 1943, frequently blamed on British policies, claimed millions of lives. This terrible incident revealed the weaknesses in the agriculture system and the requirement for a sustainable strategy(Mitra, 2013).

Swadeshi and Sustainable Farming

The Swadeshi movement, a vital element of the freedom struggle, advocated using indigenous goods and resources(D.M. Diwakar, 2009). In the agricultural context, this translated into a revival of traditional and sustainable farming practices. Farmers were encouraged to rely on native seed varieties, shunning the dependence on foreign seeds and chemical inputs(Rothermund, 2003). Swadeshi began a conscious effort to reclaim agricultural self-sufficiency(D.M. Diwakar, 2009).

Sustainable Farming: Gandhian Principles

As part of his strategy for a rural economy that is self-sufficient, Mahatma Gandhi, an iconic leader in the Indian freedom movement, gave a lot of focus to sustainable agriculture. Decentralised and sustainable agriculture was encouraged by his ideology, which was encapsulated in the idea of "Sarvodaya," or the well-being of all (Krishnan, 2020). Gandhi envisioned villages as self-sufficient communities that could provide for their needs through sustainable farming and access to natural resources. Agriculture reforms were a crucial part of Gandhi's Constructive Programme, a set of projects designed to create a new social order. Gandhi exhorted farmers through his teachings to adopt practises that preserved the land and improved the socioeconomic standing of rural communities(R. Singh et al., 2019). Gandhi's initiative led to the establishment of model farms, showcasing sustainable and ethical farming practices. Promoting Khadi, a hand-spun and handwoven cloth during the freedom struggle, was inextricably tied with sustainable agriculture. The Khadi movement attempted to give rural people economic independence by emphasising village-based industries such as agriculture(Pathak et al., 2020). This supported the use of organic farming methods while discouraging the use of expensive inputs, which aligned with sustainability objectives. The Ahimsa principle was also extended to agriculture, with farmers encouraged to cultivate without harming the environment. Avoiding harmful chemicals and treating animals compassionately, crop rotation, and other non-invasive practices were essential to the Ahimsa agricultural concept(Kmar & Shankar, 2023). Women were vital to sustainable farming during the freedom movement. Women took over farming while men struggled for freedom (Pathak et al., 2020). Traditional knowledge of seed preservation, natural pest management, and sustainable farming strengthened rural communities(Sarkar & Sarkar, 2008).

Sustainable Farming in Modern India: Post-Independence

In India's changing agricultural landscape, sustainable farming practices have become paramount. With a growing population and increased environmental concerns, it is more important than ever to strike a balance between productivity and ecological well-being.

The Green Revolution and Unsustainable Practices

India went from a food grain deficit to a surplus after the Green Revolution. The Green Revolution had the most significant impact on socioeconomic progress. Over time, agriculture intensified, degrading the delicate agro-ecosystem. High production costs and declining agricultural profits hurt farmers(S. Rahman, 2015). Overadoption of agricultural technologies by farmers to make the Green Revolution successful has adverse effects on soil fertility, erosion, toxicity, water resources, underground water pollution, salinity, human and livestock diseases, and

global warming. Chemical overuse pollutes land, air, water, animal feed and fodder(Eliazer Nelson et al., 2019). The Green Revolution of the mid-20th century introduced high-yielding crop types, synthetic fertilisers, and pesticides. This revolution enhanced worldwide food production but degraded the environment, eroded soil, and destroyed biodiversity. Unsustainable irrigation practices stress water resources, threatening modern agriculture's future(Pingali, 2012).

Permaculture

In the 1970s, Bill Mollison and David Holmgren established a concept known as permaculture, which included a design framework for environmentally responsible agriculture(Janzon, 2018). It emphasises integrating agricultural components into a mutually beneficial and self-sustaining system. Permaculture concepts have seen widespread adoption to establish resilient and varied agricultural ecosystems(Fadaee, 2019). Permaculture is a science for small farmers, and India can get a lot out of it since marginal farmers own 67% of farmland. Indian farmers' traditional farming techniques, like ploughing with bullock carts, farmers' seed storage techniques, and using manual stone grinders for fodders, highlight their simplicity and sustainability. However, due to mechanisation and corporate seed control, these are tumbling. Small-scale farming in India is more favourable than in the United States, and the possibility of food self-sufficiency through permaculture is increasing in India. Permaculture emphasises self-sufficient farming practises; however, it is hampered by a lack of willingness to adopt diverse food habits(Cole, 2017).

Agroforestry

Agroforestry is widespread in India, particularly in rural regions. It entails incorporating trees into agricultural landscapes to produce a diversified and sustainable environment (V. S. Singh & Pandey, 2011). Agroforestry benefits in India include increased soil fertility, biodiversity, and ecological resilience(Kumar et al., 2017). However, it encounters obstacles such as a lack of awareness and ineffective policies. The National Agroforestry Policy of India 2014 is a comprehensive framework for policymaking to enhance agricultural lives by increasing agricultural productivity to combat climate change(Chavan et al., 2015). Agroforestry techniques, such as growing trees alongside crops, can reduce soil erosion, improve soil fertility, and preserve water. Farmers can increase their income by combining trees and regular crops(Praveen & Sharma, 2019). As carbon sinks, agroforestry systems can reduce greenhouse gas emissions. By providing a variety of nutrient-dense food sources, crop diversification improves the nutritional security of nearby people. Agroforestry can make agricultural landscapes more climate-change-resistant (Sharma et al., 2017).

Sustainable Farming Future and Beyond

In recent years, sustainable farming has emerged as a critical response to the adverse environmental impacts provided by conventional agricultural practices. The imperative need to balance food production with environmental protection drives this paradigm change. Sustainable farming practices promise a greener, more resilient agricultural landscape.

Precision Farming

Precision farming is a growing trend in India's agricultural sector. It uses cutting-edge technologies such as GPS, drones, and precision irrigation systems to increase crop yields and reduce waste(Tiwari & Jaga, 2012). Many Indian farmers are already using precision farming techniques, and the trend is projected to continue in the future years. The government's emphasis on using remote sensing GIS, ICT, drones, robotics, start-ups, and other technologies and reducing greenhouse gas (GHG) emission intensity has enabled precision agriculture(A. K. Singh, 2022).

Regenerative Agriculture

Regenerative agriculture seeks to renew ecosystem services and improve food production's environmental, social, and economic components through soil conservation. Traditional farming practices can degrade soil and decrease yield. Regenerative agriculture is promoted as a solution to these problems, focusing on soil health and carbon sequestration (Schreefel et al., 2020). The core principles of regenerative agriculture are to cover the soil, minimise soil disturbance, keep living roots in the soil all year, promote plant diversity, integrate animals, and restrict or eliminate the use of synthetic substances (such as herbicides and fertilisers). The ultimate goals are to revitalise the soil and land while providing environmental, economic, and social advantages to the larger community(Khangura et al., 2023).

Climate-Smart Agriculture

Climate-smart agriculture(CSA) assists farmers in adapting to climate change by incorporating climate-resilient practices into their operations(Abhilash et al., 2021). Climate change poses significant threats to agriculture, particularly dryland agriculture. Countries should embrace climate-friendly agricultural development strategies to reduce climate change impact by reducing greenhouse gases while preserving or growing food supply, especially in dryland agriculture(Amin et al., 2015). The scope of CSA includes improved water management, crop breeding, conservation agriculture, crop diversification planting, weather index-based insurance, integrated soil fertility management, and other cutting-edge technologies(Zhao et al., 2023).

Vertical Farming for Urban Sustainability

Growing crops vertically in a safe indoor environment is known as "vertical farming," and it mostly makes use of hydroponic or aeroponic production systems. Numerous potential advantages of vertical farming include better use of available space, less need for water, faster growing times, less need for pesticides and herbicides, and protection from harsh weather(Oh & Lu, 2023). Although "vertical farming" has been defined in several ways, it typically refers to the multilayered production of plants in carefully regulated indoor settings. Vertical farming has a long history with precedents like the Hanging Gardens of Babylon. Vertical farming seeks to boost long-term food production in the face of climate change. (Van Gerrewey et al., 2022).

Vertical farming, an eco-friendly, energy-saving, and promising alternative to conventional farming, will help feed the world's growing population in the future. Vertical farming is gaining popularity worldwide due to its capacity to manage resources and efficiently produce high-quality food(Mir et al., 2022).

Conclusion

A dynamic and continual process of adaptation and invention is shown throughout the history of sustainable agricultural practices. The Indian subcontinent has developed sustainable agricultural practices since the Harappan Civilization. Sustainable agricultural practices will continue to evolve and play a critical role in preserving the resilience and viability of our agricultural systems as the globe faces increasing problems connected to climate change, population expansion, and environmental degradation. Sustainable farming is a tribute to the timeless wisdom that remains under our guidance as the globe grapples with environmental issues.

References

Abhilash, Rani, A., Kumari, A., Singh, R. N., & Kavita. (2021). Climate Climate-Smart Agriculture: An Integrated Approach for Attaining Agricultural Sustainability. In *Climate Change and Resilient Food Systems: Issues, Challenges, and Way Forwards* (Issue August). https://doi.org/10.1007/978-981-33-4538-6

Agoramoorthy, G., Chaudhary, S., & Hsu, M. J. (2008). The check-dam route to mitigate india's water shortages. *Natural Resources Journal*, *48*(3), 565–583.

Aithal, P. K. (2022). Vedic Literature And Agriculture. *National Journal of Hindi & Sanskrit Research*, *1*(45), 130–133.

Akter, I. (2020). Economic System of Ancient India: Maurya and Gupta Empire. *American Journal of Humanities and Social Sciences Research*, *4*(9), 218–228.

Alam, U., Sahota, P., & Jeffrey, P. (2007). Irrigation in the Indus basin: A history of unsustainability? *Water Science and Technology: Water Supply*, *7*(1), 211–218. https://doi.org/10.2166/ws.2007.024

Ali, M. J. (2023). *Agriculture During the Mughal Period*. *8*(2), 147–149.

Amin, A., Mubeen, M., Mohkum Hammad, H., & Nasim Jatoi, W. (2015). Climate Smart Agriculture: an approach for sustainable food security. *Agric. Res. Commun. 2015*, *2*(3), 13–21. www.aspublisher.com

Arul Josephine, S. (2022). Tamils Land-based Thinai Theory and Economic Transformation. *International Research Journal of Tamil*, *4*(S-13), 76–83. https://doi.org/10.34256/irjt224s1311

Balkrishna, A., Sharma, G., Sharma, N., & Rawat, N. (2022). Transition of Indian Agriculture from Glorious Past to Challenging Future: A Serious Concern. *Indian Journal of Ecology*, *July*. https://doi.org/10.55362/ije/2022/3625

Bolding, A., Mollinga, P. P., & Straaten, K. Van. (1995). Modules for modernisation: Colonial irrigation in india and the technological dimension of agrarian change. *The Journal of Development Studies*, *31*(6), 805–844. https://doi.org/10.1080/00220389508422392

Chavan, S. B., Keerthika, A., Dhyani, S. K., Handa, A. K., Newaj, R., & Rajarajan, K. (2015). National Agroforestry Policy in India: A low hanging fruit. *Current Science*, *108*(10), 1826–1834.

Cole, R. (2017, September). Permaculture is growing rapidly in India. *Down to Earth*, 1–3. https://www.downtoearth.org.in/blog/agriculture/permaculture-is-growing-rapidly-in-india-58727

D.M.Diwakar. (2009). Reinventing swadeshi towards swaraj for food sovereignty in india. *Jharkhand Journal of Development and Management Studies*, *7*(1), 3391–3310.

D'Souza, R. (2006). Water in British India: The Making of a 'Colonial Hydrology.' *History Compass*, *4*(4), 621–628. https://doi.org/10.1111/j.1478-0542.2006.00336.x

Dayalan, D. (2017). *Water Management Systems during the Mughal period*.

Desai, S. (2022). Dhanvantari Vatika—A Model Herbal Garden for an Agro-Ecotourism Uni. In *Transforming Coastal Zone for Sustainable Food and Income Security* (Issue August). https://doi.org/10.1007/978-3-030-95618-9

Eliazer Nelson, A. R. L., Ravichandran, K., & Antony, U. (2019). The impact of the Green Revolution on indigenous crops of India. *Journal of Ethnic Foods*, *6*(1), 1–10. https://doi.org/10.1186/s42779-019-0011-9

Fadaee, S. (2019). The permaculture movement in India: a social movement with Southern characteristics. *Social Movement Studies*, *18*(6), 720–734. https://doi.org/10.1080/14742837.2019.1628732

Fergusson, L., Wells, G., & Kettle, D. (2018). The personal, social and environmental sustainability of Jainism in light of Maharishi Vedic Science. *Environment, Development and Sustainability*, *20*(4), 1627–1649. https://doi.org/10.1007/s10668-017-9957-1

Fuller, D. Q. (2000). Harappan seeds and agriculture : some considerations. *Antiquity*, *October*, 410–414. https://doi.org/10.1017/S0003598X00061068

Fuller, D. Q., & Stevens, C. J. (2019). Between domestication and civilization: the role of agriculture and arboriculture in the emergence of the first urban societies. *Vegetation History and Archaeobotany*, *28*(3), 263–282. https://doi.org/10.1007/s00334-019-00727-4

Guha, R. (1983). Forestry in British Post-British A Historical Analysis. *Economic and Political Weekly*, *18*(44), 1882–1896.

Jadhav, D. K. (2018). Role of Agriculture in Ayurvedic Drug Research. *Current Investigations in Agriculture and Current Research*, *4*(5), 32474. https://doi.org/10.32474/ciacr.2018.04.000200

Janzon, T. (2018). *The quest for sustainability – a critical reading of permaculture literature* [Uppsala University]. https://uu.diva-portal.org/smash/get/diva2:1218134/FULLTEXT01.pdf

Kaur, S. (2018). *Agricultural Implements and Water Lifting Devices in Medieval India*. *6*(1), 194–201.

Kaur, T. (2014). Reflection of agrarian practices in vedic literature T. *Research Journal of English Language and Literature (RJELAL*, *2*(1), 360–363.

Khan, S. U. (1997). Agricultural Statistics of Mughal India: A Reconsideration. *Studies in History*, *13*(1), 121–146. https://doi.org/10.1177/025764309701300105

Khangura, R., Ferris, D., Wagg, C., & Bowyer, J. (2023). Regenerative Agriculture—A Literature Review on the Practices and Mechanisms Used to Improve Soil Health. *Sustainability (Switzerland)*, *15*(3), 1–43. https://doi.org/10.3390/su15032338

Kmar, prof L. U., & Shankar, A. bhavani. (2023). Exploring the Intersection of Buddhism and

Ahimsa in Production for a Compassionate and Sustainable World. *Journal of Emerging Technologies and Innovative Research (JETIR)*, *10*(1), 107–111.

Krishna G. Karmakar. (2015). COLONIAL RULE AND ITS EFFECTS ON INDIA'S RURAL ECONOMY . *Journal of South Asian Studies*, *3*(3), 277–288. http://www.escijournals.net/JSAS

Krishnan, P. (2020). Science-led Agricultural Development : Gandhian Thoughts. In *Mahatma Gandhi's Vision of Agriculture* (Issue October, pp. 131–143).

Kumar, Y., Thakur, T. K., & Thakur, A. (2017). Socio-Cultural Paradigm of Agroforestry in India. *International Journal of Current Microbiology and Applied Sciences*, *6*(6), 1371–1377. https://doi.org/10.20546/ijcmas.2017.606.161

McGinn, P. (2009). *Capital, "Development" and Canal Irrigation in Colonial India*.

Mir, M. S., Naikoo, N. B., Kanth, R. H., Bahar, F., Bhat, M. A., Nazir, A., Mahdi, S. S., Amin, Z., Singh, L., Raja, W., Saad, A., Bhat, T. A., Palmo, T., & Ahngar, T. A. (2022). Vertical farming: The future of agriculture: A review. *The Pharma Innovation Journal*, *2*(January), 1175–1195. http://www.thepharmajournal.com

Mitra, R. (2013). The Famine in British India. *Http://Dx.Doi.Org/10.1177/0973258613501066*, *7*(1–2), 153–174. https://doi.org/10.1177/0973258613501066

Mulage, B. S. (2017). History of Agriculture System in India: A Legal Perspective. *International Journal of Humanities, Social Sciences and Education*, *4*(7), 25–30. https://doi.org/10.20431/2349-0381.0407004

Nair, P. K. R., Kumar, B. M., & Nair, V. D. (2022). An Introduction to Agroforestry. In *An Introduction to Agroforestry: Four Decades of Scientific Developments*. https://doi.org/10.1007/978-3-030-75358-0_3

Naulakha, D. J. S. (2021). Agriculture In Harappan Civilization : An Observation. *Adhigam*, *16*.

Niroula, S. (2021). *Implication of British Economic Policies on Indian Famine*.

Oh, S., & Lu, C. (2023). Vertical farming - smart urban agriculture for enhancing resilience and sustainability in food security. *Journal of Horticultural Science and Biotechnology*, *98*(2), 133–140. https://doi.org/10.1080/14620316.2022.2141666

Pathak, H., Pal, S., & Mohapatra, T. (2020). Matatma Gandhi's Vision of Agriculture: Achievement of ICAR. In *Indian Council of Agricultural Research* (Vol. 6, Issue 11).

Petrie, C. A., & Bates, J. (2017). 'Multi-cropping', Intercropping and Adaptation to Variable Environments in Indus South Asia. *Journal of World Prehistory*, *30*(2), 81–130. https://doi.org/10.1007/s10963-017-9101-z

Pingali, P. L. (2012). Green revolution: Impacts, limits, andthe path ahead. *Proceedings of the National Academy of Sciences of the United States of America*, *109*(31), 12302–12308. https://doi.org/10.1073/pnas.0912953109

Praveen, B., & Sharma, P. (2019). A review of literature on climate change and its impacts on agriculture productivity. *Journal of Public Affairs*, *19*(4), 1–16. https://doi.org/10.1002/pa.1960

Rahman, M. (1981). Ecology of Karez Irrigation : A Case of Pakistan Origin and Diffusion of

Karez Technology. *GeoJoumal*, *5*(1), 7–15.

Rahman, S. (2015). Green revolution in India: Environmental degradation and impact on livestock. *Asian Journal of Water, Environment and Pollution*, *12*(1), 77–85. https://www.researchgate.net/publication/283227979_Green_revolution_in_India_Environmental_degradation_and_impact_on_livestock

Raju, G. S. K., Nawabpet, P., & Kumar, A. (2022). Panchagavya as Soil Conditioner: Ancient Traditional Knowledge for Sustainable Agriculture. *Journal of Experimental Agriculture International*, *44*(11), 181–186. https://doi.org/10.9734/jeai/2022/v44i112065

Rothermund, D. (2003). An Economic History of India. *An Economic History of India*. https://doi.org/10.4324/9780203420584

Sampatrao, K. D. (2020). Irrigation System under the British Rule Special Reference to Kukadi Project Kakade. *Multidisciplinary Scientific Reviewer*, *07*(02), 27–30.

Sarkar, S., & Sarkar, T. (2008). *Women and Social Reform in Modern India*. Indiana University Press. https://iupress.org/9780253220493/women-and-social-reform-in-modern-india/

Sastri, N. K. A., & Champakalakshmi, R. (1997). *A History of South India: From Prehistoric Times to the Fall of Vijayanagar*. oxford University Press. https://indianculture.gov.in/ebooks/history-south-india-prehistoric-times-fall-vijayanagar

Satpathy, B. B. (2018). *Socio- Political and Administrative History of Ancient India*.

Schreefel, L., Schulte, R. P. O., de Boer, I. J. M., Schrijver, A. P., & van Zanten, H. H. E. (2020). Regenerative agriculture – the soil is the base. *Global Food Security*, *26*(June), 100404. https://doi.org/10.1016/j.gfs.2020.100404

Sharma, P., Singh, M. K., Tiwari, P., & Verma, K. (2017). Agroforestry systems: Opportunities and challenges in India. *Journal of Pharmacognosy and Phytochemistry*, *January*, 11–16. http://www.phytojournal.com/archives/2017/vol6issue6S/PartV/SP-6-6-241.pdf

Singh, A. K. (2022). Precision Agriculture in India- Challenges and Opportunities. *Indian Journal of Fertilisers*, *18*(4), 308–331. https://doi.org/10.2139/ssrn.3363092

Singh, R. B. P. (2008). *Jainism in Early Medieval Karnataka: CAD 500-1200*. https://books.google.com/books/about/Jainism_in_Early_Medieval_Karnataka.html?id=JtWGm4E4qZIC

Singh, R., Jat, N. K., Ravisankar, N., Kumar, S., Ram, T., & Yadav, R. S. (2019). Present status and future prospects of medical libraries in india. In *Sustainable Agriculture* (Vol. 3, Issue Jahresband, pp. 276–300). https://doi.org/10.1515/LIBR.1954.3.1-4.134

Singh, R. P., Singh, R. K., Singh, S. P., Srivastava, V., & Bohra, J. S. (2014). Organic Farming: A need of sustainable agriculture. *Indian Farming*, *63*(10). https://doi.org/10.13140/RG.2.1.2873.8162

Singh, V. S., & Pandey, D. N. (2011). Multifunctional agroforestry systems in India. In *Climate Change and CDM Cell Rajasthan State Pollution Control Board* (Issue 4).

Somdutt, Bhadu, K., Rathore, R. S., & Shekhawat, P. S. (2021). Jeevamrut and Panchagavya's Consequences on Growth, Quality and Productivity of Organically Grown Crops: A Review. *Agricultural Reviews*, *I*(Of), 1–9. https://doi.org/10.18805/ag.r-2239

Spengler, R. N., Stark, S., Zhou, X., Fuks, D., Tang, L., Mir-Makhamad, B., Bjørn, R., Jiang, H., Olivieri, L. M., Begmatov, A., & Boivin, N. (2021). A Journey to the West: The Ancient Dispersal of Rice Out of East Asia. *Rice*, *14*(1). https://doi.org/10.1186/s12284-021-00518-4

Srinivasan, T. M. (2016). Agricultural Practices as Gleaned from the Tamil Literature of the Sangam Age. *Indian Journal of History of Science*, *51*(2), 167–189. https://doi.org/10.16943/ijhs/2016/v51i2/48430

Tiwari, A., & Jaga, P. K. (2012). Precision farming in India-a review. *Outlook on Agriculture*, *41*(2), 139–143. https://doi.org/10.5367/oa.2012.0082

Udhaya Nandhini, D., Vimalendran, L., Sangamithra, S., Kalaiyarasan, V., & Suganthi, S. (2016). Heritage rich agricultural technologies of the Sangam Period. *Asian Agri-History*, *20*(1), 31–39.

Upadhyay, R. K. (2019). Devastating Impact of British Rule on Indian Agriculture. *SSRN Electronic Journal*, *August*, 1–7. https://doi.org/10.2139/ssrn.3442594

Upadhyaya, Y. M. (2019). A Comparative Analysis of Agriculture and Economic Development of Nepal with Kautilya Arthashastra. BİLTÜRK. *The Journal of Economics and Related Studies*, *1*(2), 131–149. https://orcid.org/0000-0003-3089-3615

Van Gerrewey, T., Boon, N., & Geelen, D. (2022). Vertical farming: The only way is up? *Agronomy*, *12*(1), 1–15. https://doi.org/10.3390/agronomy12010002

Wallach, B. (1985). British irrigation works in India's Krishna Basin. *Journal of Historical Geography*, *11*(2), 155–173. https://doi.org/10.1016/S0305-7488(85)80062-1

Wescoat, J. (1985). Early water Systems in Mughal India. *Journal of the Islamic Environmental Design Research Centre*, 50–57.

Zhao, J., Liu, D., & Huang, R. (2023). A Review of Climate-Smart Agriculture: Recent Advancements, Challenges, and Future Directions. *Sustainability (Switzerland)*, *15*(4), 1–15. https://doi.org/10.3390/su15043404