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Plant Cultivation and Indian Knowledge System: An Exploration of the Available Scholarly Literature

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The interest in the traditional practices of plant cultivation has gained momentum in India in the past few decades. We are witnessing a revival of ancient concepts, such as *Vrikshayurveda*. The underlying reasons of this resurgence could be attributed to the modern unsustainable cultivation practices resulting in the increasingly depleting soil quality of the farmlands, low nutritional value of the produce, indiscriminate exploitation of the forest resources, water pollution caused by chemical fertilisers and pesticides, and the consequent diseases posed to human and animal life, to name a few. Needless to say, all these disturbing issues pose a high threat to not only our food security but also to our very existence on this planet. Meanwhile, India is poised to be a completely developed nation by 2047 as envisioned by the sentiment of *Viksit Bharat*@2047. Clearly, to enable Bharat to be completely developed by that time, appropriate ground-breaking interventions need to be undertaken from today itself to mitigate the existing problems. The scientific community in India is now actively looking for solutions to these problems in the Indian Knowledge System (IKS). Lately there has been an impetus in the research carried out by universities and institutions on the feasibility of plant cultivation that is based on the IKS. The Government of India has also been supportive in this regard with several Ministries, such as the Ministry of AYUSH and Ministry of Agriculture paying special attention to the development of innovative solutions towards sustainable plant cultivation practices. In this regard, a considerable amount of work has been done by researchers and scientists in mining the knowledge available in the IKS and practicing them. However, it is felt that the information available to us regarding IKS for plant cultivation is still growing and there is a considerable scope for continued research on exploring IKS, especially that available in regional languages. This study is exploratory research on the available literature on plant cultivation practices and the IKS. This paper attempts not only to explain the various types of plant cultivation practices as mentioned in the IKS but also to highlight the available literature on the modern scientific experiments and innovations that provide the evidence of the efficacy of the IKS-based plant cultivation techniques. The collated and updated literature presented in this paper is expected to assist the researchers and policy makers to take an informed decision on the adoption of best practices in plant cultivation using IKS. The study is also expected to provide insight into the design, development and offering of customised referral services in IKS-based resources on plant cultivation by the libraries.

Keywords: Indian Knowledge System, Plant Cultivation, Crops, Agriculture, Sustainable Development, Environment, Food Security, Medicine, *Viksit Bharat*@2047, Innovation, *Vrikshayurveda*

1. Introduction

There has been a rise in the interest of the scientific community in the traditional practices of plant cultivation in the past few decades. We are witnessing a revival of the ancient concepts of sustainable cultivation practices today. The underlying reason could be attributed to the modern cultivation practices that are proving to be unsustainable. The modern practices are resulting in harmful effects on the environment and living beings, such as the increasingly depleting soil quality of the farmlands, low nutritional value of the produce, indiscriminate exploitation of the forest resources, water pollution caused by chemical fertilisers and pesticides, and the consequent diseases posed to human, plant and animal life, to name a few.

One of the main harmful consequences of unsustainable plant cultivation practices is soil degradation. Soil degradation primarily means a decline in soil quality wherein the soil becomes devoid of nutrients or is polluted by harmful chemicals. Several studies (Srivastava et.al.,2016 [1]; Bhattacharyya et.al., 2015[2]; Chaudhuri *et. al.*, 2023 [3]) have highlighted that unsustainable plant cultivation

practices over the past decades have led to soil degradation. Experts are of the opinion that 33 percent of India's soil, which comprises a huge portion of arable land is degraded (Krishna Chaitanya, 2024 [4]). The other important harmful consequence is pollution of the water bodies, such as ponds, lakes, streams, river, oceans, and groundwater. There is a large body of research that indicates the adverse effects of using chemical fertilizers, pesticides and herbicides on water bodies (Srivastav, 2020 [5], Kumar, 2021 [6]; Shukla *et. al.*, 2022 [7]). An important cause for concern is the loss of biodiversity owing to unsustainable plant cultivation practices and the resultant pollution. Obviously, the harmful effects of such pollution on human health cannot be underestimated. Yet another important point that cannot be overlooked is the use of genetically modified plants used for cultivation. The ramifications of consuming such plants on the human genome are yet to be studied. As India is poised to be a developed nation by 2047 as envisioned by the sentiment of *Viksit Bharat*@2047, appropriate ground-breaking interventions need to be undertaken from today itself to mitigate the existing environmental problems and maintaining food security. As per the Global Hunger Index-2020, India ranks 107th among 121 countries on the parameters of availability, access, utilization and stability (Ipe *et. al.*, 2020 [8], FAO, 2014 [9]). With the increasingly degrading arable lands and water bodies owing to various factors including modern agricultural methods, the situation may take a turn for the worse unless measures are taken to reclaim the soil and other degraded elements of the environment. Innovative methods need to be devised to strike a balance between bulk production of food, improved access and affordability of nutritious food, such as fresh fruits, vegetables, pulses, etc., and maintaining environmental stability and sustainability (Ipe *et. al.*, 2020 [8]). Therefore, there is an impetus on research in Universities and scientific institutions to carry out research on sustainable plant cultivation to devise innovative solutions. Clearly, there is a pressing need to find solutions to all these problems caused due to such harmful practices.

To find sustainable solutions and alternatives of plant cultivation, agricultural scientists and research communities are increasingly turning to traditional practices. The reason is the observation that traditional practices have been found to be environment-friendly and sustainable in the long run. Traditional knowledge or indigenous knowledge is considered as "a cumulative body of knowledge and beliefs handed down through generations by cultural transmission about the relationship of living beings with one another and with their environment" (Gadgil *et. al.*, 1993 [10]). Traditional knowledge has been practiced and kept alive by indigenous communities in distinct pockets across the world throughout the centuries. However, traditional knowledge gained global recognition with the upsurge of the concept of sustainable development way back in the 1980s, when the Bruntland Commission was formed in 1983 and World Commission on Environment and Development presented its report "Our Common Future" in 1984. From then onwards, traditional knowledge found its way into the policies of the governments to devise solutions for sustainable development. Research on traditional knowledge gained momentum, and many problem areas of research were identified that dealt with devising solutions for unsustainable practices.

The Government of India has also recognized the importance of traditional knowledge in sustainable development. It has popularized traditional knowledge as what we now know as the Indian Knowledge System (IKS). The IKS is being encouraged to be adopted in various sectors including plant cultivation practices. Several ministries, such as the Ministry of AYUSH and Ministry of Agriculture are paying special attention to the development of innovative solutions towards sustainable plant cultivation practices. The scientists and researchers have done a considerable amount of work in this regard. Several researchers in universities are mining the knowledge available in the IKS and devising solutions to the environmental problems and healthy food production (Chitraputhirapillai *et. al.*, 2024 [11], Ankad *et. al.*, 2021 [12], 2018 [13], 2017 [14], Narayanaswamy, 2002 [15], Chakraborty, 2019 [16], Pavithra, et.al., 2019 [17], Nene, 2017 [18], Abhang, et. al, 2015 [19]).

In this paper an attempt has been made to review the various types of plant cultivation practices as mentioned in the IKS. The paper also examines the available body of literature both on ancient IKS practices and the modern scientific experiments and innovations that provide the evidence of the efficacy of the IKS-based plant cultivation techniques. It recommends a Framework for adaptation by the

libraries for dissemination of IKS-based resources on plant cultivation.

2. Methodology

This qualitative and exploratory research was carried out using secondary data from reports, articles, research papers and books, available online and offline. In addition, electronic databases, such as Google Scholar, PubMed, ScienceDirect, Scopus, Web of Science and information at National Digital Library of India were reviewed for articles. The different search terms used were "Indian Knowledge System and Plant Cultivation", "vedic crop cultivation" and "innovative methods of plants cultivation" combined with "indigenous knowledge on the cultivation, collection, and processing of traditional medicinal plants", among others.

3. Limitations

This study is limited by the interpretations in the secondary sources of literature in which the quotes pertaining to the IKS are translated to English from Indian Languages, such as Sanskrit and Tamil. Additionally, literature pertaining to traditional plant cultivations practices in other Indian regional languages is not readily available in English or Hindi translations for ready reference, which delimits this study.

4. Plant Cultivation Practices in Ancient India

The antiquity of the IKS is still being debated. However, several experts opine that it evolved in the Vedic period around five thousand years ago. The knowledge was mostly transmitted orally but eventually recorded in the form of manuscripts (Singh and Bhardwaj, 2024 [20]; Mahadevan *et. al.*, 2022 [21]). The *Vedas*, *Upanishads*, *Brahmanas*, *Smritis*, *Samhitas*, *Upavedas*, *Puranas*, etc., are the written forms of those orally transmitted traditions. Crop cultivation was practiced through four sequential processes namely *krishanta* (tilling), *bapanta* (sowing), *lulanta* (harvesting), and *mrrinanta* (threshing)'(Roy Choudhury, 2022 [22]). Furthermore, the processes followed in each step was elaborately described in the ancient texts. The choice of crops depended on the particular region where the plant was naturally occurring. The timing of tilling and sowing was determined by the astrological observations. Before cultivation, rituals, such as *Yagna* were carried out to purify the atmosphere and soil. The use of natural and herbal products as fertilizers, pesticides, plant healing and insect repellants etc., during storage was emphasized for optimum growth of the plants. Special emphasis was put on the storage of seed so that it remained viable for the next crop. This ensured the genetic vitality and robustness of the seed for the next generation. The following sections aim to elucidate some of the important processes mentioned in the IKS for plant cultivation practices.

Type of Crops

The earliest references to plant cultivation perhaps may be found in the *Vedas*. The four *Vedas* mention more than 75 species of plants that are cultivated. In *Rigveda*, there are 24 hymns that mention agriculture (Aithal, 2022 [23]). The *Rigveda* mentions *Vrihi* or rice and *Yava* or barley as the predominant cereal crops of that period (Roy, 2009 [24]; Nene, 2012 [25]).The *Yajurveda* mentions cereals as well as other crops, such as legumes, oil seeds, fibrous plants, fruit crops and green vegetables (Roy, 2009 [24]). The *Atharvaveda* adds, in addition to the aforementioned crops, new crops, such as millets, mustard, *bhang* and hemp (Roy, 2009 [24]).The *Satapatha Brahmana* mentions over 25 species and *Charaka Samhita* mentions more than320 plants that were cultivated (Aithal,2022 [23]).The *Brihadaranyaka Upanishad* and Kashyapa's *Krishisukti* (*Kashyapiyakrishisukti*) mention the cultivation and use of chick pea known as *Khalva*.

In southern India, many neolithic sites bear testimony to permanent crop cultivation (Krishna and Morrison, 2009 [26]). Farmers grew millets, mung bean and horse gram. Some tubers were also grown. Later texts from southern regions of India mention the cultivation of many more plants and trees, such as black pepper, coconut, plantain, tamarind, ginger, garlic, cumin, coriander, jackfruit, mango, jujuba, palm, areca nut, sandalwood, teak and bamboo (Krishna and Morrison,2009 [26]; Janardhana, 2010 [27]).

In the later vedic period, the plant cultivation methods spread to more areas and more elaborate cultivation methods were devised. Texts of the later vedic period, such as *Vrikshayurveda: Upavanvinoda* by Surapala, mentioned tree cultivation. Trees were highly valued and planting of trees such as *Tulsi*, *Nimba*, *Bilva*, *Plaksha*, *Madhuka* and others were considered to be associated with merits. The ancient Bengali text *Sunyapuran* mentions about sixty varieties of flowers and forty five varieties of paddy (Ferrari, 2015 [28]).The Sanskrit text *Amarkosha* by

Amarasimha lists more than 220 plants, their classification and their uses (Boddupalli, 2019 [29]).

Some of the prominent ancient Indian texts that mention plant cultivation practices are enumerated in Table 1.

Table 1 — Prominent Ancient Indian Texts that Mention Plant Cultivation Practices

S No.	Name of the Text
1.	*Rigveda*
2.	*Yajurveda*
3.	*Atharvaveda*
4.	*Satapatha Brahmana*
5.	*BrihadaranyakaUpanishad*
6.	*Krishi-Parashara*by Parashara
7.	*Kashyapakrishisukti* by Kashyapa
8.	*Vrikshayurveda* by Surpala
9.	*Sushrut Samhita* by Sushrut
10.	*Charak Samhita* by Charak
11.	*Arthashshtra* by Kautilya
12.	*BrihatSamhita*by Varamihira
13.	*Lokopakara* by Chavundaraya
14.	*Manasollasa*by King Someshwara
15.	*Vishwaballabha*by Chakrapani Mishra
16.	*Upavanvinoda*by Sarangadhara
17.	*Shivatatvaratnakara*by King Basavaraja
18.	*Ashtanga Hridaya, Ashtanga Sangraha*by Vagbhata
19.	*Amarkosha* byAmarasimha
20.	*Vinaya Pitaka* (Buddhist Text)
21.	*Chullavagga*(Buddhist Text)
22.	*Sunyapuran* (Ancient Bengali Text)

Source: Nene, 2017, Patra, 2017,Nesari et.al., 2023., Singh and Bhardwaj, 2024, Boddupalli, 2019, Ferrari, 2015.

A variety of plants were cultivated to meet the needs of the people. These included cereals, legumes, oilseeds, sweetener, legumes, vegetables, fibre and medicine. Table 2 summarily illustrates the types of plants cultivated during the Vedic period in India, as mentioned in the *Vedas*. (Table 2).

Soil preparation for cultivating crops

Crops cannot be cultivated in just any type of land. Plant growth requires certain conducive environmental and ecological prerequisites. The most suitable land will produce the most productive crop in term of yield and nutrition. In the ancient texts, knowledge is provided on how to identify arable and unsuitable land for crop cultivation. According to Rigveda, there were two types of lands, such as fertile (*urvara*) and sterile fields (*khila* or*khilya*) (Roy Choudhury, 2022 [22]), *Usara* (Alkaline) and *Anusara* (non-alkaline or fertile) land (Roy, 2009 [24]). The text *Amarkosha (400 BC*) mentions twelve types of lands namely *urvara* (fertile), *ushara* (barren), *maru* (desert), *aprahata* (fallow), *shadvala* (grassy), *pankikala* (muddy), *jalaprayah* (watery), *kachchaha* (land contiguous to water), *sharkara* (full of pebbles and pieces of limestone), *sharkaravati*(sandy), *nadimatruka*(land watered from a river), and *devamatruka* (rainfed) (Rana, 2020). *Vrikshayurveda Upavanvinoda* mentions that the soil is classified according to the fertility and water content. Accordingly, soil is divided into *Jangama*, *Anupam*

Table 2 — Plants Cultivated during the Vedic period in India.

S no	Plant	Crop Type	Use	Ancient Texts
1.	*Vrihi* (Rice)	Cereal	Food	*Rigveda,Yajurveda,Atharvaveda*
2.	*Yava* (Barley)	Cereal	Food	*Rigveda, Yajurveda, Atharvaveda*
3.	*Godhuma* (Wheat)	Cereal	Food	*Rigveda, Yajurveda*
4.	*Anu* (Millet)	Cereal	Food	*Yajurveda, Atharvaveda*
5.	*Masa* (Urad; Black gram)	Legume	Food	*Yajurveda, Atharvaveda*
6.	*Mung* (Mung bean)	Legume	Food	*Yajurveda*
7.	*Masura* (Lentil)	Legume	Food	*Yajurveda, Atharvaveda*
8.	*Tila* (Sesame)	Oilseed	Food	*Yajurveda, Atharvaveda*
9.	*Abayu* (Mustard)	Oilseed	Food	*Atharvaveda*
10.	*Iksu* (Sugarcane)	Sweetener	Food	*Yajurveda, Atharvaveda*
11.	*Urvaruka* (Cucumber)	Vegetable	Food	*Yajurveda, Atharvaveda*
12.	*Alabu* (Bottle gourd)	Vegetable	Food	*Yajurveda, Atharvaveda*
13.	*Kharjura* (Date)	Fruit	Food	*Yajurveda, Atharvaveda*
14.	*Karpasa* (Cotton)	Seeds	Fibre	*Yajurveda, Atharvaveda*
15.	*Sana* (Hemp)	Stem	Fibre	*Atharvaveda*
16.	*Bhanga* (Cannabis)	Flowers	Medicine	*Atharvaveda*
17.	*Eranda* (Castor oil)	Seeds	Medicine	*Brahmana*
18.	*Amalaki* (Indian gooseberry)	Fruit	Medicine	*Brahmana*

Source: Roy, M. 2009. Agriculture in the Vedic Period. Indian Journal of History of Science, 44 (4), 497-520

and *Sadharana*. *Jangama* are soils that have less water and vegetation. *Anupam* are soils that are fertile with rich vegetation. *Sadharana* are ordinary soils that are neither very fertile or infertile. *Sadharana* land is recommended for crop cultivation. The soils are further classified as per their colour and taste. The colours and taste in the soil has developed due to the disintegration of the age-old rocks that contain chemicals and minerals (Nesari, *et. al.*, 2023 [30]). Accordingly, the different types of soil colours are gray, whitish, dark, red, white and yellow. The various tastes of soil are mentioned to be sweet, sour, salty, hot, bitter and astringent (Singh, *et. al.*, 2023 [31]).

The land was prepared by tilling and irrigation (wherever needed) before planting the seeds. Tilling was done using an iron plough called *langal*, as mentioned in the Rigveda, Yajurveda and *Shatapatha Brahmana*. The *Atharvaveda* mentions Indra as the lord of the plough. Oxen and bullocks were used to plough the land (Roy Choudhury, 2022 [22]). Land preparation for plant cultivation assume importance with the passage of time. Various texts, such as *Vrikshayurveda* advocated the use of *Agnihotra* or *Homa* method of farming in which the ash from the *Agnihotra* or *Homa* could be applied to the field (Nene, 2017 [18]). The smoke from *Agnihotra* reduces microbial count and toxic gases in air and thereby improves the atmosphere. The *Homa* ash contains about 94 essential elements that improve soil fertility and increases crop yield and nutritional value (Vala, 2021 [32]).

Post-vedic texts, such as Buddhist and Jain scriptures also highlight plant cultivation practices as early as the 6th century BCE. *Vinaya Pitaka*, a Buddhist text mentions that the methods of plant cultivation were known to the farmers. Another Buddhist text, the *Chullavagga*, clearly demarcates the various stages of the peasants' activities such as *kasi* (ploughing), *vapitam* (sowing), *udakamabhinetabham* (irrigation), *niddhapetabbam* (weeding), *lavapetabbam* (reaping) and *opunapetabbam* (winnowing) (Patra, 2017 [33]).

Sowing season

The nutritious value of the crops depends on their sowing season. The ancient texts advocated the sowing of crops in particular seasons to obtain maximum yield and quality of the plants. The position of the Sun or the Moon in specific *Nakshatras* or constellations were noted to begin tilling the land for sowing of the crops. The *Rigveda* mentions that rice is a water-loving plant, which means that it should be sown at a time when it encounters rain as it is growing (Roy, 2009 [24]). In India, rice is traditionally grown as a *Kharif* crop (sown in the monsoon) and wheat is grown as a *Rabi* (winter) crop. In South India, traditionally crops were grown in two seasons, *Hainu* during rainy season and *Caru* during dry season. Kautilya's *Arthashashtra* mentions that pigeon pea (*udhaarka*) is sown during early monsoons to enable the plants to have access to plenty of water (Krishna and Morrison, 2009 [26]).

For sowing, the ancient texts mention elaborate procedures that enable quick germination or sprouting. *Lokopkara*, *Vishvaballabha*, and *Vrikshayurveda* recommend certain seeds to be smeared or sprinkled with substances, such as milk, ghee, jaggery, cow dung, ashes of plants, such as *Vidanga* or mustard for better germination (Aralelimath et al , 2019 [34]). These texts also recommend appropriate heating or fumigating the seeds of certain trees to break their dormancy (Suresh, *et. al.*, 2013 [35]).

Importance of water for cultivating crops

The importance of water in crop growth is underscored by the hymns in *Vedas* that pray to Indra, Varuna and other deities to bless the earth with rains for a plentiful harvest (Aithal, 2022 [23]). There was a clear understanding of the water cycle. The seasons or *Rita* cycles were also understood by the vedic people. It was known that rainy season lasted for four months and the river waters were instrumental in increasing crop yield. It appears that rainwater was the most important mode of irrigation in the vedic times. Later on, the availability of surface and ground water was mapped and documents developed. Many traditional methods of irrigation and water management, including building canals, ponds and tanks, and rainwater harvesting, have been described in detail in many texts, including *Yajurveda, Krishi Parashara (400 BC)*, *Krishisukti*, *Vishvavallabha* and *Arthashashtra* (Sadhale, 2006 [36]). The texts, such as *Krishisukti*, and Mishra Chakrapani's *Vishvavallabha* contain detailed instructions of digging and constructing wells. Building dams was described in *Vishvavallabha*.The detection of groundwater, for example, required a study of the vegetation indicating the currents of underground water as directed in *Krishisukti*, and also described by Varahamihira in *Brihat Samhita (505-587 BC)*, Surapala in

Vrikshayurveda, and Mishra Chakrapani in *Vishvavallabha.*

Considering the importance of water for crops, the knowledge of the onset of the rainy season became important and rain forecasting, as practiced by Parashara and advanced by Varahamihira, gained importance. Observation of planets and *nakshatras* that aligned with the rainy season became important in deciding the cropping time of the plants. The *Krishi Parashara* advocates storing of water in the fields for rice during *Ashwin* (October) and *Kartika* (November). Water used for irrigation was required to be "sweet" (meaning pure), as described in the *Rigveda* and other tests. To ensure the purity of the stored water in ponds and tanks, the *Krishisukti* recommended growing *Neem* and *Kadamba* trees around the water bodies (Sadhale,2006 [36]).

Fertilisers

Fertilisers or manure are used to enhance the fertility of the soil. In the vedic times, manure was referred to as "sakan" (Roy Choudhury, 2022 [22]). The *Atharvaveda* mentions the use of cow dung as manure. The ash of the *Agnihotra* or *Homa* was also used to fertilise the soils. The *Agni Puraṇa* mentions the process of preparation of manure as 'excreta of sheep and goat and pulverized barley and sesame to be soaked in water for seven nights'(Rana, 2020 [37]). Elaborate methods of fertilization of the soil through the preparation and application of specialized manures are mentioned in the *Lokopkara*, *Vishvaballabha*, and *Vrikshayurveda.* Fumigation wit plants, such as *Vidanga*, turmeric, mustard and *Arjun* flowers were recommended for raising disease free plants. Specialised fertilisers called *Kunapjala* and *Panchagavya* were used. The ingredients of *Kunapjala* included droppings of animals, such as sheep or goat, flesh, marrow and fat of animals and fish, powder of sesame seeds and black gram, milk, honey and hot water. The mixture was fermented for a fortnight and the liquid manure was applied to the crops. The ingredients of *Panchagavya* included milk, curd, ghee, cow dung and cow urine (Suresh, *et. al.*, 2013 [35]).

Pest and Disease Management

The ancient texts describe different types of pests that damaged the crops. These pests included *Tarda* (Borer, bird or insect), *Samaka* (Insect), *Upakvasa* (noxious insect), *Patanga* (Locust) *Vyadvaras* (Rodents), *Akhu* (Rats) and Reptiles. Natural phenomenon like lightening and sunwere also identified to cause *vyadhi* (diseases) in plants (Rana, 2020 [37]). Protection from all these different varieties of pests were carried out using natural methods, such as growing specific trees around the fields that repelled pests, digging pits and fixing traps for catching wild animals, and making noise using appropriate devices to scare away birds from the fields (Narayanaswamy, 2002 [15]). Plants, which had antifeedant, contact poison and growth regulator mode of action, were used in pest control. Such plants included *Vidanga*, *Sikhandi*, *Neem*, *Kuverakshi*, *Arka*, *Ashwatha*, *Ashoka* etc. Plant- and animal-based materials, and minerals, such as rice flour, asafoetida, goat hair, ox horn, lime, salt, saw dust, river sand, mercury, etc., were used to ward off various types of pests (Narayanaswamy, 2002 [15]).

Varāhamihira in his *Brihat Samhita* explained that trees are vulnerable to disease when exposed to cold, strong winds, and hot sun. Surapala's *Vrikshayurveda* in the chapter *Taru Chikitsa*, mentions that plants are also subject to the imbalance of *tridoshas* and this is manifested as different ailments. Such ailments may be cured by using milk mixed with the paste of different types of prescribed tree barks. Other remedies for unproductiveness, dryness and oozing vital fluids are also prescribed in *Vrikshayurveda*.

Harvesting

The process of harvesting was a very well thought out process which took into consideration the physiological condition of the plants at each stage. Plants and trees are referred to as "Oushadhis" in the Ayurvedic texts, such as the *Sushruta Samhita*. The *Sushruta Samhita* mentions the plants become "enfeebled" in their properties during the rainy season, and therefore should not be harvested. The crops retain their natural properties when they grow in their natural seasons, and do not cause adverse reactions. These naturally grown crops increase the appetite, vitality, strength, and power of the human body (Bhishagratna,1907 [38]). The *Taittiriya Samhita* mentions the seasons associated with ripening, for example, barley ripens in summer, rice ripens in autumn, and beans ripen in winter. Texts, such as *Lokopkara*, *Krishi Parashara*, *Krishisukti*, and *Vrikshayurveda*, mention that the seeds should be procured in the months of *Magha* (February) or *Phalguna* (March) from naturally ripened fruits (Suresh, *et. al.*, 2013 [35]). Therefore, the recommended

harvesting seasons could be inferred from this information.

Seed storage

Seeds have been considered to be extremely important in the Indian Knowledge System. The ancient texts mention methods to store seeds is such a way that they are preserved well. These methods protect the seeds from decay or damage from insects. Further, these methods preserve the vitality of the seeds that ensures their germination in the next cropping season. It was recommended that the harvested seeds should be sun dried and stored in different pots, heaps or bowls, away from pests. Seeds that are damaged by fire, smoke, rain or mixed with inferior matter should be discarded. Traditional practices followed in South India as documented by experts show more three hundred pest control techniques during storage (Narayanaswamy, 2002 [15]).

5. Sustainability of the Ancient Plant Cultivation Practices and Recent Innovations

The plant cultivation practices mentioned in the IKS are sustainable and do not damage the environment. Age old practices, such as crop rotation, intercropping, mulching, preserving indigenous seeds and biodiversity, and the use of natural manures and pesticides have been proven to be holistic. The crop yield using the indigenous seeds can be enhanced considerably if these methods are understood and followed carefully.

The Indian Knowledge System holds a treasure of technical information that can be used to devise innovative ways of plant cultivation that could not only minimize the environmental damage caused by modern agricultural methods but also heal the environment. There has been a shift recently to the "reduced chemical" or non-chemical" farming methods. Consequently, since the 1990s, researchers and policy makers have refocused their attention to organic farming practices, which are essentially based on indigenous knowledge (Nene, 2017 [25]).

The present times are witnessing not only the increasing revival of the ancient processes of plant cultivation, but also the innovative efforts in this direction by researchers all over India. Innovations based on adaptations of the ancient practices are being carried out in various stages of plant cultivation practices, such as preparing the soil, sowing, irrigation, fertilizing, weeding, harvesting and storing the seeds and produce. In the past decades, several innovators have come forward with their novel methods of crop production. The notable innovations in farming practices proposed in India include Natueco-culture by Shripad A. Dhabolkar in 1967, *Rishi Krishi* by Mohan Shankar Deshpande in 1970, and Zero-budget Natural Farming by Subhash Palekar in 2005 (Nene, 2017 [25]). Recently, there has emerged the concept of Nature-positive farming, which employs both traditional practices and modern technological innovations. The following sections provide a brief account of the recent innovations and experiments carried out in certain cultivation processes, such as soil preparation, crop protection, *agnihotra* farming and natural fertilisers. It is hoped that the future will see innovations in the other aspects of plant cultivation, such as seed storage, seed germination, irrigation methods, etc.

5.1. Soil Preparation

The time of tilling the soil and sowing determines the crop yield. Research has been carried out to scientifically determine the correct time or season for sowing, with encouraging results. Next, recognising that the quality of the soil is degrading fast, efforts are being made by the researchers to bring the soil back to its original health. The ancient techniques of *Agnihotra* or *Homa* are being studied to determine their efficacy. Furthermore, considering the harmful effects of chemical fertilisers, herbicides, pesticides and insecticides on the soil and the ecosystem, initiatives are being taken to formulate their natural and herbal variants. The various innovative initiatives are described below.

5.1.1 Agriculture calendar

Plants, just as other life forms, are observed to be dependent on the positions of the Sun, the Moon and the twelve constellations. Accordingly, modern scientists developed timelines for sowing plants, such as root, leaf, flower and fruit crops. The moon, in particular was included, wherein its position in any of the elements (zodiac signs) of water, earth, fire or air, and the corresponding constellations, were considered for determining the time for sowing of the crops (Table 3) (Ram and Pathak, 2016 [39]).

5.1.2 Agnihotra atmosphere

Agnihotra atmosphere is created by a *Yagna or Homa*, which has been found to enhance negative ions, minimize harmful radiations, reduce pathogens

Table 3 — Time of sowing of crops determined by Moon in Constellation

S.no	Moon in Constellation	Crops
1.	Water element • Pisces • Cancer • Scorpio	Leafy crops
2.	Fire element • Aries • Leo • Sagittarius	Fruit and seed crops
3.	Earth • Taurus • Virgo • Capricorn	Root crops
4.	Air • Gemini • Libra • Aquarius	Flower crops

Source: Ram and Pathak, 2016.

in air, soil and water, thereby making the environment conducive for living beings, including crops. The soil and the environment for crops is prepared by offering brown rice mixed with cow ghee along with mantra chanting twice a day, at sunrise and sunset. Research indicates that such an *Agnihotra* purifies up to 200 acres of the atmosphere around its periphery. Studies report that application of *Agnihotra* ash results in an increase in phosphate solubilizing bacteria in soil, thereby increasing the solubility of phosphate in the water, which can be utilized by the plants. The pH levels of the soil are also suitably altered with the application of *Agnihotra* ash to obtain a good crop. The positive impact of *Agnihotra* or *Homa* farming has been reported on many crops, such as banana, pomegranate, coffee, mango and potato (Ram and Pathak, 2016 [39]; Berk, 2020 [40]).

Field Margin Vegetation

The crop fields are recommended to have a boundary of trees around them for different purposes, such as a wind-breaker or protection from sandstorms (Sarath, *et. al.*, 2023 [41]) or even ensuring purity of water while the plants are being irrigated. *Kashyapiyakrishisukti* recommended that *Nimba*, *Kadamba* and such other trees should be planted in their vicinity to ensure purity of water. Today the same concept is being adopted as "Field Margin Vegetation", wherein the importance of the vegetative buffers on the field boundaries providing a variety of ecosystem services is underscored. The plants on the field margin provide shelter for pollinators and insects that biologically control pests and control the spread of weeds. These plants also contribute to the income of the farmers in many ways (Nautiyal and Goswami, 2022 [42]).

Mulching

Mulching (*Acchadana*) is essentially the protective layering of the agricultural soil using straw, grass, peat etc. It prevents evaporation of water from the soil and protects it from weeds. It contributes to the soil humidity and reduces temperature fluctuations, along with the physical, biological and chemical properties of the soil. Studies have shown that mulching improves crop yields in plants, such as guava, mango, papaya, cauliflower, brinjal etc., (Patil *et. al.*, 2013 [43]).

Growing legumes as intercrop

Legumes contribute to the nitrogen availability in the soil and the ancient texts, such as *Vrikshayurveda* recommended growing *masha* and *tila* before sowing other seeds. Today crop rotation has been recommended highly by the scientists for the same reason.

5.2 Fertilizers and pesticides

The fertilizer and pesticide sectors have perhaps seen the most innovations in recent times. Traditional fertilisers and pesticides have been repackaged into organic manures and pesticides. Extensive research has been carried out on vedic fertilisers and pesticides, such as *Kunapjala* and *Panchagavya*, that has resulted in modern derivatives, such as *Amritjal*, *Kukkutakunapa*, *Herbal kunapa* (fertilizer) or *Indsafari* (pesticide) (Nene, 2017 [18], Okram , 2024 [44]).

6. IKS and Plant Cultivation Practices: Emerging Role of Libraries

In relation to the resources pertaining to IKS on plant cultivation practices, the available information in the libraries is still sparse and scattered. Out of whatever resource is available, a large fraction of it is inaccessible due to its oral nature or language barrier (Nadkarni, and Rajam, 2016 [45], PIBa, 2025 [46]). Considering the impetus on devising innovative methods of plant cultivation based on IKS, there is a new and emerging role of the libraries to collect, translate, document and disseminate information in this niche area.

The traditional role of a library is to serve as a repository of books and other resources and make them available to all. With the advent of information and communication technology, libraries took on the

additional role of digitizing the content available to them. With the emerging need for protecting traditional knowledge, specialized libraries, such as the TKDL that primarily has a repository of Indian systems of medicine, took on the role of customizing the available information into a patent-friendly format to serve the IPR requirements (Fredriksson, 2023 [47]). Presently, libraries are facing an increasing demand of information on IKS. In fact, some of the libraries, such as the IGNCA have initiated academic courses on IKS in collaboration with the IITs (PIB a, 2025 [48]).

The need of the hour is to disseminate IKS based information on plant cultivation practices. However, the information needs to be surveyed and collected, documented in various formats for easy dissemination, digitization, translation, and offering customised referral services in this specialized domain. Towards this, a framework is proposed, comprising the components of collection of resources on IKS-based plant cultivation, their documentation and digitization, their translation and finally offering customized translation services (Figure 1). This framework may be adapted as a component of the already existing broader Conceptual Frameworks of the libraries and the Library Management Systems to provide customized translation services. The constituents of the proposed framework are detailed below:

1. Collection of IKS Resources on Plant Cultivation

For collection, libraries will have to conduct surveys and source the resources (in audio, video and print) from across the repositories of India and abroad and from the communities. Collection could be done through mutual cooperation with other repositories as envisaged by the Gyan *Bharatam Mission* (PIBb, 2025 [48]).

2. Documentation of IKS Resources on Plant Cultivation

Documentation of IKS is a daunting task. The TKDL carried out a rigorous exercise for the documentation of indigenous medicinal formulations. The method used by TKDL is described below (Fredriksson, 2023 [47]).

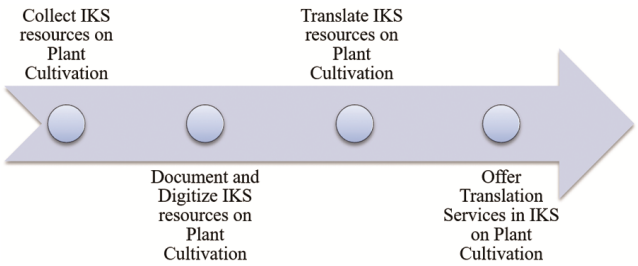

Figure 1 — A framework for offering customized translation services in IKS-based plant cultivation resources.

"*Almost 300 Vaidyas, Sanskrit scholars, and analysts were employed for two years to translate verses (Slokas) and aphorisms (Sutras) from the traditional pharmacopeia and Ayurvedic compendia (Samhitas) into structured language using a classification called the Traditional Knowledge Resource Classification; a second group isolated medicinal uses of plants from these to list them in databases; and yet another group of analysts matched these entries with original sources to compare and validate their content.*"

The above example may serve as a useful guide to design suitable mechanisms to document the resources on IKS based plant cultivation.

3. Translation of IKS Resources on Plant Cultivation

To cater to the niche area of IKS on plant cultivation, the new role of the libraries would be to translate the IKS resources on plant cultivation and provide translation services. The task of translating the information in IKS is no doubt daunting. Just as in the documentation process mentioned above, a team of scholars who are experts in several languages including Sanskrit would be needed for translating and vetting the translated resources. For this the libraries might have to take the assistance of artificial intelligence (AI) tools in the near future.

4. Offering Customised Translation Services

Apart from seeking information on routine scientific R&D studies, with the increasing trend towards innovation and startups, researchers are seeking information on prior art, patents, and innovative experiments carried out in the area of IKS-based plant cultivation methods. As the repository of translated resources in the libraries gets built, they could start offering responsive, referral and translation services that are customized based on the researcher's requirements. An indexing and abstracting facility could also be built to disseminate IKS information among researchers and other interested users. Such a repository and its associated services will not only help the researchers in the field of IKS-based plant cultivation, research and innovation, and startup development, but also help in protecting their

Intellectual Property.

7. Conclusion and Recommendations

This study reveals that there exists a great volume of information in the Indian Knowledge System about sustainable plant cultivation practices. The basic tenet of sustainable development is to live in harmony with nature. The IKS provides precisely that knowledge. The processes of growing crops in harmony with nature are explained in minute detail in the ancient Indian tests, which take into account every possible aspect of the natural cycles, air, soil, and water and the interaction of the crops with other plants and animals, in a holistic way. In today's world of environmental problems and issues of food security, efforts are underway to understand all these aspects. However, this review finds that the efforts are limited to a few specific aspects, such as fertilisers, and therefore it is recommended that more aspects need to be brought under the purview of the researchers and innovators. For example, ancient practices to preserve the seeds and to enhance the seed germination process should be studied extensively. This will reduce the dependency on the detrimental genetically modified seeds. Similarly, the judicious and recommended use of trees for natural protection of the crops and for preserving the water levels in the fields should be studied.

This study also found that the knowledge available at present are mainly in Sanskrit and a few regional languages, such as Tamil, Kannada, Marathi and Bangla. This language barrier poses a limitation to the researcher or the scientist who are not familiar with the language. Further, there are certain traditional practices in remote areas, such as the North East India, or other tribal areas of India, which are not documented and hence not available to researchers. Therefore, it is recommended that efforts should be taken by the libraries to acquire such literature and translate them into English and Hindi to make the indigenous knowledge accessible to all, as per the framework suggested in this study.

8. References

1 Srivastava P., Singh R., Tripathi S., Raghubanshi A.S.2016.An urgent need for sustainable thinking in agriculture - An Indian scenario. *Ecological Indicators*, 67 , pp. 611-622.

2 Bhattacharyya, R., Ghosh, B. N., Mishra, P. K., Mandal, B., Rao, C. S., Sarkar, D., Das, K., Anil, K. S., Lalitha, M., Hati, K. M., & Franzluebbers, A. J. 2015. Soil Degradation in India: Challenges and Potential Solutions. *Sustainability*, *7*(4), pp 3528-3570.

3 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, 6383.

4 Krishna Chaitanya, S.V. 2024. 33% of India's soil degraded. The New Indian Express. 19 Oct 2024, Available at:https://www.newindianexpress.com/xplore/2024/Oct/19/33-of-indias-soil-degraded. Accessed on 03.03. 2025.

5 Srivastav A.L. 2020. Chemical fertilizers and pesticides: Role in groundwater contamination. In: Ed: Prasad, M. N. V., *Agrochemicals Detection, Treatment and Remediation: Pesticides and Chemical Fertilizers*, Elsevier Ltd. pp. 143-159.

6 Kumar, N., Kumar, A., Marwein, B. M., Verma, D. K., Jayabalan, I., Kumar, A., and Ramamoorthy, D. 2021. Agricultural activities causing water pollution and its mitigation – A Review. *International Journal of Modern Agriculture*, Volume 10, No.1, pp 590-609.

7 Shukla, A. K., Behera,S. K., Chaudhari,S.K., Singh, G. 2022. Fertilizer Use in Indian Agriculture and its Impact on Human Health and Environment, *Indian Journal of Fertilisers*, 18 (3), pp 218-237.

8 Ipe, B. T., Shubham, S., Satyasai, K. J. S. 2022. Food and Nutritional Security in India: Charting the Way to a Robust Agri-Food System. Department of Economic Analysis and Research (DEAR), National Bank for Agriculture and Rural Development, Mumbai.

9 FAO. 2014. Global Strategic Framework for Food Security & Nutrition (GSF). Available at https://www.fao.org/fileadmin/templates/cfs/Docs1314/GSF/GSF_Version_3_EN.pdf. Accessed on 1st May, 2025

10 Gadgil, M., Berkes, F. and Folke, C. 1993. Indigenous knowledge for Biodiversity Conservation. *AMBIO*, 22 (2-3), 151-156.

11 Chitraputhirapillai, S., Palani, N., Kaliyanagounder, S., & Ramamurthy, S. 2024.Traditional Vrikshayurveda practices yielded equally to modern scientific agricultural practices in Proso millet (*Panicum miliaceum* L.). *Indian Journal of Traditional Knowledge*, 23(10), pp 948-957.

12 Ankad, G.M., Hiremath, J., Pai, S.R., Hegde, H.V. 2021. Evaluation of *Vrikshayurveda* treatments on physiological attributes and production of diterpenoids in *Andrographis paniculata* (Burm.f.) Nees. *Ayu*. 2021 Jan-Mar;42(1):45-51.

13 Ankad, G.M., Hiremath, J., Patil, R.T., Pramod, H.J., Hegde, H.V. 2018. Nutrient analysis of Kunapajala and Pancha gavya and their evaluation on germination of Ashwagandha and Kalamegha seeds: A comparative study. *J Ayurveda Integr Med*. 2018 Jan-Mar;9(1):13-19.

14 Ankad, G.M., Hiremath, J., Patil, R.T., Pramod, H.J., Hegde, H.V. 2017. Evaluation of Kunapajala and Panchagavya on plant quality, physiology, biochemistry, yield and growth attributes - A case study of *Withania somnifera* Dun. *J Ayurveda Integr Med*. 2017 Oct-Dec;8(4):247-251.

15 Narayanaswamy, P. 2002. Traditional pest control: Aretrospection, *Indian Journal of Traditional Knowledge*, 1(1), pp 40-50.

16 Chakraborty B, Sarkar I, Maitra S, Khan A., M., Bandyopadhyay S., Sinha A. K. 2019. Nutritional and microbial analytical study of Vedic liquid organic manure cum pesticide kunapajala with different storage time interval. *Int J Pharm*. 6(6):209–215.

17 Pavithra, G.V., Chhabra, D., Rajamani, R. Sharma, P.P., and Kochupillai, V. 2019. Effect of agnihotra and

tryambakam homa ash on growth of tomato plants: A novel approach for organic farming. *Asian Journal of Bio Science*, 14 (1&2), pp1-4.

18 Nene, Y. L. 2017. A Critical Discussion on the Methods Currently Recommended to Support Organic Crop Farming in India. *Asian Agri-History*, 21 (3), pp 267-285.

19 Abhang, P., Patil, M., and Moghe, P. 2015. Beneficial Effects of Agnihotra on Environment and Agriculture. *International Journal of Agricultural Science and Research (IJASR)***,** 5(2), pp 111-120.

20 Singh, A. & Bhardwaj, A. K. 2024. Roots of Wisdom: Exploring Ancient Indian Knowledge System in Botany, *IEHE The Quest*, Vol 3 (1), pp10-15.

21 Mahadevan, B., Bhat, Vinayak Rajat, Nagendra Pavana R.N. 2022. *Introduction to Indian Knowledge System: Concepts and Applications*. Delhi:PHI Learning, p 8.

22 Roy Choudhury, N. 2022. A Historical Study of Agriculture System in Vedic India. *The Journal of Archaeology and Heritage Studies (JAHS)*, 9 (II), pp 61-67.

23 Aithal, P.K.2022. Vedic Literature and Agriculture. *National Journal of Hindi & Sanskrit Research*. 1(45): pp 130-133.

24 Roy, M. 2009. Agriculture in the Vedic Period. *Indian Journal of History of Science*, 44 (4), 497-520.

25 Nene, Y. L. 2012. Rigveda has References to Rice? *Asian Agri-History*.16 (4), pp 403–409.

26 Krishna, K. R. and Morrison, K. D. 2009. History of South Indian Agriculture and Agroecosystems. in *South Indian Agroecosystems: Nutrient Dynamics and Productivity*, Brown Walker, Boca Raton, pp. 1-51.

27 Janardhana, B. 2010.Science and Technology in Ancient India. IGNTU Econtent 369570220670 BA AIHC 6. Available at https://www.igntu.ac.in/eContent/IGNTU-eContent-375577792959-BA-AIHC-6-DrJanardhanaB-ScienceandTechnologyinAncientIndia-4.pdf. Accessed on 05.03.2025.

28 Ferrari, F. 2015. Agriculture, floriculture and botanical knowledge in a Middle Bengali text. Roots of Wisdom, Branches of Devotion. Plant Life in South Asian Traditions, Edited by F. Ferrari and T.W.P. Dähnhardt (London: Equinox)., 241–269.

29 Boddupalli, K. S. 2019. Lexical Botany in Amarakośa. *Journal of South Asian Studies*. 08 (01), pp 31-37.

30 Nesari, T.M., Sanwal, C. S., Sharma, R. K., Rath, C., Mahajon, B., and Dwivedi, H. 2023. Vrikshayurveda for Farmers, Basic Concepts and Techniques. Ministry of Ayush:National Medicinal Plants Board, pp1-27

31 Singh, A., Mishra, H. S., Agrawal, A. K. 2023. A review on *Vrikshayurveda - Upavanavinoda*: Unlocking the potential of sustainable agriculture and environmental health, *Journal of Ayurveda and Integrated Medical Science*, 8 (12), pp 212-217.

32 Vala, Y. B. 2021. Agnihotra: A Vedic Touch to Modern Agriculture. *Just Agriculture: an eNewsletter*, 1 (8), April 2021.

33 Patra, B. 2017.Beginning of Agricultural Life in India. https://www.gc11.ac.in/uploads/elearning/Agrarian%20History%20of%20Ancient%20India-458789888.pdf

34 Aralelimath, G. T., Nayak, S. U., Ankad, G.M., Hegde, H. V.,Shirurmath, S. S. 2019. An Experimental Study of Vrikshayurveda Seed Treatments on Germination Rate and Active Ingredient of *Bakuchi* (*Psoralea corylifolia* Linn.) by HPLC Method. *Int. J. Ayur. Pharma Research*, 7(6):1-10.

35 Suresh, G, Haridasa, K., & Krishnamurthy, 2013. Relevance of *Vrikshayurveda* and other traditional methods of organic production of nursery seedlings of useful plants. *Ancient Science of Life*, 33 (1),pp 60-70.

36 Sadhale, N. 2006. Water Harvesting and Conservation in Ancient Agricultural Texts. *Asian Agri-History*, 10 (2), (105–120).

37 Rana, S. S. 2020. Vedic Agriculture. DOI: 10.13140/RG.2.2.13178.03526)

38 Bhishagratna, K. K. L.1907.*Sushruta Samhita*. Based on Original Sanskrit Text. Chapter VI, pp 48-51.

39 Ram, R. A., and Pathak, R. K. 2016. Organic approaches for sustainable production of horticultural crops: A review, *Progressive Horticulture*, 48 (1), 14 pp.

40 Berk, U. (2020). Impact of Homa Organic Farming in mitigating Soil, Water, and Other Environmental Crises. *International Journal of Plant and Environment*, 6(1): 56-67.

41 Sarath, S., Sandra, P.R., Nikhil, P. V. 2023. Farmland Trees in India: Perceptions, Potentials and Problems. *Authorea*. September 25, 2023.

42 Nautiyal, S., Goswami, M. 2022. Role of traditional ecological knowledge on field margin vegetation in sustainable development: A study in a rural-urban interface of Bengaluru. *Trees for People*, 8, 100-207.

43 Patil, S. S., Kelkar, T. S., and Bhalerao S. A. 2013. Mulching: A Soil and Water Conservation Practice, *Research Journal of Agriculture and Forestry Sciences*, 1(3), 26-29

44 Okram R. D., Harish B. M. Doggali, G., Laishram, B, Verma, O., Sharma, A and Ojha, N. 2024. Effect Of Liquid Fermented Organic Manure Concoctions and their Foliar Spray under Different Dose of Nutrients on Chlorophyll Content of Late Sown Wheat. Plant Archives Vol. 24, No. 1, 2024 pp. 1244-1248.

45 Nadkarni, A., and Rajam, S. 2016. Capitalising the Benefits of Traditional Knowledge Digital Library (TKDL) in Favour of Indigenous Communities. *NUJS L. Rev*. pp 183-217.

46 PIB(a). 2025. Restoration of Ancient Indian Knowledge Centres, Available at https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2109847. Accessed on 30th April, 2025.

47 Fredriksson, M. 2023. India's Traditional Knowledge Digital Library and the Politics of Patent Classifications. *Law Critique***34**, 1–19.

48 PIB(b). 2025. National Mission for Manuscripts. Available at https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2114400. Accessed on 30th April, 2025.