Renuka Jyothi. S
Shakuli Saxena

REVIEW OF AGRICULTURE AND AGRONOMY

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CONTENTS

CHAPTER 1

AN OVERVIEW OF AGRICULTURE AND AGRONOMY

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ABSTRACT:

By supplying food, clothing, shelter, medicine, and leisure activities, agriculture helps to meet the basic needs of people and their civilization. As a result, agriculture is the most significant industry in the world. It is a productive unit where the natural resources provided to humans for free, such as land, light, air, temperature, rainwater, etc., are combined into a single main unit. Animals, including cattle, birds, and insects, which are secondary production units, feed on these primary productive units and produce concentrated goods like meat, milk, wool, eggs, honey, silk and lac.

KEYWORDS:

Agriculture, Agronomy, Crops, Food, Fiber.

INTRODUCTION

Agriculture offers a free meal and a fresh atmosphere, plenty of food to drive out hunger, and supplies for and from industries. It also gives a free meal and sufficient food to drive out famine, and it favors friendship by reducing disputes. A nation's citizens appreciate peace, prosperity, harmony, health, and riches thanks to satisfactory agricultural output, which also drives away mistrust, unrest, and anarchy. It promotes the community as a whole, bringing about advancements in its social, cultural, political, and economic conditions. In terms of time and geography, agricultural growth spreads quickly and in several directions. After the green revolution, farmers started implementing new agricultural inputs and cultural practices in labor-intensive cropping systems to increase the production potential per unit of land, time, and input. It gave all of these improved genotypes the right environment to develop and show off their yield potential in fresher locales and seasons. Agriculture involves raising plants and animals for harvest and production, which contributes to the preservation of the biological balance in the natural world [1].

Elaboration of Agriculture

a. Terminology

Latin terms ager and culture are the origin of the word agriculture. Ager and Cultura both refer to a piece of land or a field. Consequently, the word "agriculture" refers to land cultivation. i.e., the science and art of raising animals and crops for commercial gain. It is also known as the science of raising animals and crops using just the earth's natural resources. Agriculture's main goal is to increase the amount of food the land can produce while also guarding against damage and exploitation. The production of food, fodder, and other industrial products is synonymous with farming.

b. Definitions

The Agriculture Act of 1947 defines agriculture as "horticulture, fruit growing, seed growing, dairy farming, and livestock breeding and keeping, as well as the use of land for grazing, meadow, osier, market gardens, nursery grounds, and woodlands when those uses are incidental to the farming of land for agricultural purposes." Additionally, it is described as "purposeful work in which natural resources are used to create plants and animals that serve human needs. It is a biological manufacturing method that relies on the expansion and maturation of certain plants and animals within the regional environment.

c. Agriculture as art, science and business of crop production

The art, science, and business of raising crops and cattle for economic gain are together referred to as agriculture [2].

It encompasses knowledge of how to carry out agricultural activities in a skilled manner as an art. The attribute of the talent is;

i. **Physical skill:**This refers to the capacity and ability to do an activity in an effective manner, such as managing agricultural equipment, animals, and crops, applying fertilizer and pesticides, etc.

ii. **Mental skill:**The farmer has the mental capacity to make decisions based on experience, such as:

   a. Time and method of ploughing,

   b. Selection of crop and cropping system to suit soil and climate,

   c. Adopting improved farm practices etc.

As a science: To maximize the yield and profit, it makes use of all contemporary technologies based on scientific principles, including crop improvement/breeding, crop production, crop protection, economics, etc. Examples include the development of novel crops and varieties via hybridization, the development of transgenic crop types resistant to pests and diseases, hybrids within each crop, varieties that respond well to fertilizer, water management, the use of herbicides to control weeds, the use of bio-control agents to battle pests and diseases, etc.

As the business: Production is ultimately tied to consumption as long as agriculture is the predominant way of life for the rural people. However, agriculture as a business strives for the highest net return by managing land, labor, water, and capital while utilising the expertise of various sciences to produce food, feed, fiber, and fuel. Through mechanization, agriculture has recently been commercialized and run as a business [3].

Scope of Agriculture in India

In India, population pressure is increasing while area under cultivation is static as shown in the land utilization statistics given below in Table 1 or even shrinking, which demand intensification of cropping and allied activities in two dimensions i.e., time and space dimension. India is endowed with tropical climate with abundant solar energy throughout the year, which favors growing crops round the year. There is a vast scope to increase irrigation potential by river projects and minor irrigation projects. In additional, India is blessed with more laborer

availability. Since agriculture is the primary sector, other sectors are dependent on agriculture.

Table 1: Illustrated the Condition of Agriculture in India.

Total geographical area	328.848 million Ha.
Total reporting area	304.300 million Ha.
Area under cultivation	143.000 million Ha.
Total cropped area	179.750 million Ha.
Area sown more than once	36.750 million Ha.
Area not available for cultivation	161.300 million Ha.
Area under forest	66.400 million Ha.

Agriculture has received a significant allocation in each of India's five-year plans. In the 8th five-year plan, agriculture and related small-scale agro-based cottage industries receive close to 23% of the national budget allocation. More than 60% of India's 1.05 billion people (60 million) rely on or are engaged in agriculture and related activities. The agriculture industry accounts for around 40% of the nation's total output. Agriculture generates around 35% of the nation's jobs, of which 75% are located either directly or indirectly in rural regions.

Through the green revolution, food grain production in India increased by almost four times, from roughly 50 million tonnes at independence to more than 220 million tonnes in 2005. The overall output of food grains increased by 2.7% year despite variations in the performance of certain crops and geographical areas, keeping pace with population growth, which was 2.2% annually. Milk output rose from 17 million tonnes at independence to 69 million tonnes via the white revolution. Fish output increased thanks to the "blue revolution" during the last fifty years, going from 0.75 million tonnes to around 5.0 million tonnes. Oil seed output has grown five times since independence thanks to the yellow revolution. Similar increases in egg production from 2 billion to 28 billion at the time of independence, sugarcane output from 57 million to 276 million tonnes, and cotton production from 3 million to 14 million bales all demonstrate our development. The world's biggest fruit grower is India. India is second in the world for both milk and vegetable production [4].

Future agricultural growth in India will be influenced by issues such as environmental preservation, sustainability, and profitability in addition to the need of enhancing food and nutritional security. Globalization of markets will necessitate competitiveness and efficiency in agriculture production by adhering to the General Agreement on Trade and Tariffs (GATT) and the liberalization process. In the years to come, agriculture will encounter difficult circumstances

on the fronts of the environment, the global climate, economic fairness, energy, and jobs.

Branches of Agriculture

There are three primary subfields of agriculture: geoponic that is earth-soil cultivation, aeroponic (air cultivation), and hydroponic (water cultivation). The scientific field that encompasses the practical applications of fundamental sciences is agriculture. The study of field crops and how they are managed (through aviculture), including soil management, is one of agricultural science's applied components.

i. Crop production:

It deals with the cultivation of numerous crops, such as those used to make food, fodder, fibre, sugar, and oil seeds, among others. Agronomy, soil science, entomology, pathology, microbiology, etc. are all included. Better food production and disease management are the goals.

ii. Horticulture:

Producing flowers, fruits, vegetables, decorative plants, spices, condiments including narcotic crops like opium and other ones with medical value and drinks is a branch of agriculture.

iii. Agricultural Engineering:

The provision of tools and implements, in particular, is crucial for agricultural production and horticulture. In order to aid effective animal husbandry and food production, it aims to manufacture customized tools, equipment, and machinery [5].

iv. Forestry:

It deals with the production of large-scale perennial tree cultivation for providing wood, rubber, and other building materials as well as raw materials for industries.

v. Animal Husbandry:

The animals that are being raised, cared for, etc. upkeep involving various cattle kinds for direct energy i.e., work energy. Animal and agricultural husbandry are both widespread practices. The goal is to create as much as possible by feeding, raising, etc. Crops are arranged to get the least amount of light or air necessary. This configuration is known as geometry. For direct and indirect energy, there is husbandry.

vi. Fishery Science:

It is for inland and marine fish, as well as prawns and prawns.

vii. Home Science:

Application and use of agricultural products should be improved. Production is increased when utilization is raised. For instance, it was discovered that a crop historically grown in the South has a wide range of current applications. All seven branches are grouped into three for crop production, two for animal management, and the final two are allied agricultural branches when it comes to integration. Agriculture is often divided into four key divisions as shown in Table 2.

Table 2: Illustrated the major categories of Agriculture.

Crop Improvement	Plant breeding and genetics
	Bio-technology
Crop Management	Agronomy
	Soil Science and Agricultural Chemistry
	Seed technology
	Agricultural Microbiology
	Crop-Physiology
	Agricultural Engineering
	Agricultural Engineering
	Environmental Sciences
	Agricultural Meteorology
Crop Protection	Agricultural Entomology
	Plant Pathology
	Nematology
Social Sciences	Agricultural Extension
	Agricultural Economics
Allied disciplines	(i) Agricultural Statistics
	English and Tamil
	Mathematics
	Bio-Chemistry etc.

Development of Scientific Agriculture

Early man relied on obtaining food, fishing, and hunting. Some communities continue to live in this modest fashion now, while others have carried on as wandering herders. However, agriculture was created as a result of deliberate wild plant and animal domestication by various groups of men. Crop cultivation, particularly the cultivation of grains like wheat, rice, barley, and millets, supported the development of permanent farm communities, some of which in

different regions of the globe eventually became towns or cities. Digging sticks, hoes, scythes, and ploughs were among the first agricultural instruments. Each invention brought about significant changes in human existence over the course of centuries. Indigenous irrigation systems were developed by men from the beginning, particularly in semi-arid regions and places with intermittent rainfall [6], [7].

Intimate ties existed between farming and political organization due to land ownership. Use of slaves and tied or semi-free labor was necessary for the expansion of vast estates. The commercial revolution and Western Europe's rapid urbanization tended to shift agriculture away from subsistence farming and towards the production of products for export, or the commercial agricultural revolution, at a time when the Middle Ages desired more communication. The development of agricultural knowledge of various crops was aided by exploration, intercontinental trade, and scientific research. The exchange of mechanical devices, such as the cotton gin and sugar mill invented by Eli Whitney, supported the system of large plantations devoted to a single crop. After the late 18th century, the industrial revolution increased the population of towns and cities and compelled agriculture to become more integrated with broader economic and financial patterns. With the development of farm machinery such the reaper, cultivator, thresher, combine harvesters, and tractors, which continued to emerge throughout the years and gave rise to a new kind of large-scale agriculture, the age of mechanized agriculture started. Food processing has been transformed by modern science. Highly specialized animal, plant, and poultry varieties have been created by breeders, greatly enhancing production efficiency. The release of new plant and animal species, along with ongoing, intensive research into fundamental and applied scientific principles related to agricultural production and economics, are all methods used by agricultural colleges and government organizations around the world to try to increase output.

DISCUSSION

The art and science of cultivating the land, producing crops, and raising animals is known as agriculture. It involves preparing plant and animal items for human consumption and distributing them to marketplaces. Most of the food and textiles in the world are produced through agriculture. Agriculture produces leather, wool, and cotton. Agriculture also produces paper and timber for building. These goods, as well as the methods of cultivation used, may differ from region to region. Agriculture's expansion throughout the years has aided in the development of civilizations. Prior to the widespread adoption of agriculture, humans devoted the majority of their time to collecting wild plants and animals for sustenance. People began to develop their knowledge of growing grain and root crops about 11,500 years ago, and they eventually adapted to a life centred on farming. A large portion of Earth's population was reliant on agriculture by 2,000 years ago. Although researchers are unsure of the exact cause, climate change may have played a role. When humans started cultivating crops, they also started domesticating and breeding wild animals. Domestication is the process of modifying wild plants and animals for human consumption [8]–[10].

CONCLUSION

Agriculture science will assist nations in converting to more wholesome food production techniques. New high-yield crop types are being created by scientists that need less herbicides and fertiliser. Such crops lessen the need for trading and expensive chemicals. Without

protecting the world's land and water, it will be impossible to address the problems of feeding the hungry. A significant loss of priceless topsoil, water, and other resources has been caused by agricultural practises. Better programmes for replanting trees are required in many nations. A rising number of farmers are being forced into areas that are too fragile to support farming due to overpopulation. Worldwide irrigation has expanded as a result of the food need. In certain places, irrigation has led to a decline in water levels, the drying up of rivers, and the depletion of wells. Chemicals used in agriculture to boost productivity often damage groundwater, soil, and food systems. Environmental damage is not always a result of agriculture. People may yet develop ways to end global hunger by preserving the land, water, and air, as well as through exchanging information and resources.

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CHAPTER 2

AN ELABORATION OF HISTORY OF THE AGRICULTURE

ABSTRACT:

Agriculture has been an integral part of human society for thousands of years, and its history is a long and complex one. From the earliest days of human civilization, people have relied on agriculture to provide food, clothing, and other basic needs. Over time, agricultural practices have evolved and changed in response to technological advancements, population growth, and shifts in economic and social structures. Additionally, it discusses the ways in which agriculture has influenced human society and the environment, including the rise of agricultural societies, the spread of diseases, and the impact of agriculture on land use and biodiversity. Finally, this abstract touches on current challenges facing agriculture, including climate change, soil degradation, and the need for sustainable and equitable farming practices.

KEYWORDS:

Cropping History, Farming Types, Natural Resources, Rural Communities, Trade Relations.

INTRODUCTION

Excavations, legends and remote sensing tests reveal that agriculture is 10,000 years old. Women by their intrinsic insight first observed that plants come up from seeds. Men concentrated on hunting and gathering during that time. Women were the pioneers for cultivating useful plants from the wild flora. They dug out edible roots and rhizomes and buried the small ones for subsequent harvests. They used animal meat as main food and their skin for clothing.

a. Shifting Cultivation

A prehistoric kind of agriculture in which individuals, using the most basic equipment, cleared a section of forest, burned the underbrush, and established new garden plots. These plots were moved to a different location after a few years, when they lost their fertility or were severely overrun by weeds or pests that are carried by the soil. In contrast to the fallow system, this is also known as the aspartate system (cultivating crops until the land is entirely worn-out). Fallow system refers to allowing land to rest without producing any crops. With different names such as jhum cultivation in Assam, podu in Andhra Pradesh and Orissa, kumari in the Western Ghats, walra in south-eastern Rajasthan, penda bewar in Madhya Pradesh, and slash-and-burn in Bihar, shifting cultivation was practiced in various Indian states [1].

b. Subsidiary Farming

primitive system of established agriculture that incorporates farming, gathering, and hunting. Although the tools, crops, and methods of cropping were primitive, people began congregating in permanent village sites near rivers and streams and began cultivating the same land more consistently.

c. Subsistence Farming

Advanced primitive agriculture, or "Grow it and eat it" agriculture, refers to agricultural production that is not done for economic gain but rather as a way of life. As a result, it is referred to as growing crops just for family consumption.

d. Mixed Farming

It is farming that consists of both crop and animal elements. Field crop-grass husbandry was popular, with the same field being utilized for both cropping and later grazing. This stage marks the transition from food collection to food production.

e. Advanced Farming

Advanced farming practices includes selection of crops and varieties, seed selection, green maturing with legumes, crop rotation, use of animal and crop refuse as manures, irrigation, pasture management, rearing of milch animals, bullocks, sheep and goat for wool and meat, rearing of birds by stall feeding etc.

f. Scientific Agriculture (19th Century)

Modern agriculture began in the 18th century with the introduction of foreign crops and animals, crop succession, organic recycling, and the use of farm equipment. Research and development (R&D) in the fundamental and basic sciences were included in the practical parts of agriculture throughout the 19th century. Agriculture evolved become a science-teaching discipline. Institutions for research, teaching, and extension (training and demonstration) were built, including laboratories, farms, research stations, and research centers. Literatures, books, periodicals, popular and scholarly articles, etc., were introduced. To reach the rural populace with fresh study results and information, new media and audio-visual aids were created [2].

g. Present Day Agriculture (21st Century)

Agriculture nowadays is more business-oriented and includes a variety of industries, including cattle (dairy), poultry, fisheries, piggery, sericulture, apiary, plantation crops, etc. Numerous advancements in agriculture's hydrological, mechanical, chemical, genetic, and technological aspects are currently being made. More of the national budget is being allocated by governments for agricultural development. Agricultural inputs are being provided on a subsidy to small and marginal farmers. Policies for exporting, importing, pricing, marketing, distribution, and consumption are becoming stronger. Small-scale agricultural businesses and crafts are expanding quickly. Planning, programming, and implementation of need-based agricultural projects are ongoing.

Global Agriculture

Agriculture, which provides food to sate hunger, is strongly tied to the development of civilization. To keep things as they are, the current food output must quadruple.

A civilized society should provide food for the almost one billion people who live in poverty, nevertheless. Increased consumption that results from rising earnings in developing nations should be allowed for the goal of the increased food production should thus be to triple it during the next century.

a. Land Resources

For crop production the basic input is land and planet earth is of 15.2 billion ha avails 3.8 ha per person. The continuing population increase will result in available cultivable land per capita world-wide from 0.3 ha in 1988 to 0.17 ha in 2050, with only 0.11 per-capita in developing countries. The nutrient losses due to soil erosion of one of good top soil in kg are 4N, 1 P_2O_5, 20K_2O and 2 CaO, besides organic matter. Only 10 to 11% of cultivated area is reasonably free from all constraints for crop production. The FAO's analysis of growth patterns in crop output in 93 developing countries shows that 63% of the growth in production must come from higher yields and 15% from higher cropping intensity. Only 22% is expected from land reserve of the total 6444 m. ha of rainfed agricultural potential, only 30% is suitable, 10% marginal and 60% unsuitable in different countries. The semiarid tropics (SAT) comprise of all or part of 50 countries in five continents of the world (Central America, SW Asia, Africa, South America and South East Asia) is the home of 700 million people who are under perpetual threat drought and occasional famine. About 65% of the arable land carries untapped potential cereals, pulses and oilseeds, the biggest gains to the food ladder of the globe would be from improvement of agriculture. India has the largest SAT area (10%) of any of the developing countries. Environmental degradation is increasing at a pace that is impairing the productivity of land and undermining the welfare of rural people [3].

Global assessment of soil degradation (GLASoD) defines soil degradation as a process that describes human induced phenomena, which lower the current and/or future capacity of the soil to support human life. The causes for degradation are:

i. Removal of vegetative cover through agricultural clearing,

ii. Decrease in soil cover through removal of vegetation for fuel wood, fencing, etc.

iii. Overgrazing by livestock leading to decrease in vegetative cover and trampling of the soil

iv. Agricultural activities like cultivation in steep slopes, farming without anti-erosion measures in arid areas, improper irrigation and use of heavy machinery,

v. Soil contamination with pollutants such as waste discharges and over use of agrochemicals.

Modern farm technologies are more productive on good soils than on poor soils. Technology may sustain yields by making the effects of soil degradation temporarily. Yield increase through technology might have been greater if the soil has not been degraded.

b. Water Resources

Of the total volume of 1400 million cubic km (M cu km) water, 97% is sea water. Of the balance 3%, 22% is ground water and 77% locked up glaciers and polar ice caps, leaving less than one% of fresh water to take part in hydrological cycle. Global water use doubled between 1940 and 1980 and is expected to double again by 2010 A.D. with two-thirds of the projected water use going to agriculture. Today one-third of the world's crops come from its 280 M ha of irrigated land. After World War II, foreign aid helped carry irrigation even to arid corners of the world. As on 1990, about 270 M ha of area, contributing to 17% of the total cropped area, was under irrigation in the world.

Salinity, inadequate drainage, and bad management pose a severe danger to the survival of the irrigated agricultural systems of the past. India 36, China 17, the USSR 18, the USA 44, and Pakistan 25 have the highest percentages of irrigated land that has been harmed by salinization since 1985. India had 0.057 ha of irrigated land per person in 1989 compared to the global average of 0.049 ha. The global cropping intensity in rainfed agriculture is 0.74. The present intensity of 1.21 might rise to 1.29 with irrigation. 300 m3 of water must be consumed per day to sustain a 2000 calorie diet, and 420 for a 3500-calorie diet.

At the FAO minimum nutritional guideline of 1600 Cal-day-1, cultivating one hectare of additional land would yield 0.9 tonnes of cereal grain, or around five people's worth of food for a year. The overall yield rises fourfold to 3.5 tonnes ha-1 if the area is irrigated. In the future, if the world's irrigated land reaches 1.0 billion hectares, there will be enough food to feed 10 billion people, which is double the FAO goal. Despite the fact that irrigation can help feed a growing population, recent attempts to expand the irrigated area have run into a number of issues that have resulted in soil degradation. Aquifer depletion, declining water tables, abandonment of waterlogged and salted land, reservoir silting, and the diverting of irrigation water for non-agricultural uses are all factors that contribute to changes in the world's irrigated area from year to year. Future food production from irrigated regions will be more dependent on improvements in water use efficiency than on new water sources.

c. Food Scenario

Cereals area grown throughout the world to provide food for the human consumption and feed and fodder for livestock. They are grown in 73.5 per cent of the world’s arable land and contribute 74.5 per cent of the global calorie production. Demand for food is growing with ever increasing world population. Compared with present production of about 1.9 billion tones, the demand for cereals is likely to go up to 2.4 billion by the year 2000 A.D. While demand for wheat and rice may be increased in the next two decades by 31 and 53 per cent, respectively, the demand for coarse grains may double. Developed nations may meet their cereal demand by increasing production at 1.8 per cent per annum. However, most of the developing countries with growth rate of 2.5 per cent per annum in cereals production fall short of this requirement, which is increasing at the rate of 3.3 per cent per annum due to high population growth rate. The FAO estimates clearly indicate the increasing shortage of cereals in 90 developing countries [4], [5].

Increase in food all over world during the decades of 1972–92 was remarkable. Productivity and production in the technologically advanced agriculture of the developed countries rose to heights that would have been unbelievable half a century ago, mainly due to introduction of high yielding varieties (HYVs) responsive to inputs of fertilities and irrigation water, besides increase in area under cultivations. Developing countries presented a different picture. Only about a third of their population lived in countries with satisfactory performance in agricultural production. Elsewhere, output was raising more slowly than population. Africa in 1970s became the striking example of production inadequacy. There were many constraints limiting agricultural productivity, particularly that of small farmers in developing countries.

i. Land remained so unequally distributed that farms were too small and steadily became smaller as rural population grew.

ii. Input supplies and services were insufficient and access to them most unequal,

iii. Resources devoted to research, training and extension were very limited,

iv. Priority was given to industry, not agriculture, and food prices were shaded in the interest of urban consumers rather than of rural producers.

The FAO aimed at doubling the agricultural production in the developing countries between 1980 and 2000. The hopeful outcome depends on achieving an ambitions transformation involving widespread modernization in technology, based primarily on massive increase in inputs to agriculture. Developed countries do not come directly into the exploration of the future as they continue to raise their farming. The strategy is:

i. Heavy investment in agricultural sector to make full use of the improved technology.

ii. Increasing crop production sources through arable land growth, cropping intensity and crop productivity.

iii. Expanding and conserving the land, based through land reforms directed at bringing underused land in to more intensive exploration and soil and water conservation to the dangers of land degradation,

iv. Intensifying land use in crop production through irrigation, fertilizers, improved cultivates, plant protection and mechanization.

d. Towards 21st Century

The global population might stabilize at just under 10 billion people by the end of the 21st century, up from 6.2 billion in 2000 A.D., according to global Bank predictions. These forecasts are significant since population is expected to increase more quickly than food demand. Today's emerging nations, which have low per capita spending levels, account for 95% of the population growth. The global demand might rise by 50% in the next 20 years, then more than double again in the first half of the following century, according to projections.

It seems difficult to double global food and agricultural output between 2000 and 2055 A.D. It will need at least suggestive global source use planning to adequately supply the food and agricultural needs of the world's roughly 10 billion inhabitants, taking into consideration non-agricultural usage of the land and oceans. It is obvious that the major driver of future production development must be a sustained, fast rise in agricultural and livestock yields. The growth of arable land over the following 20 years would result in almost all of the possible arable land being farmed by the middle of the twenty-first century. The support of agricultural research and extension has to be more focused on the issue of agriculture in developing countries.

A food and agricultural system in developing nations that is far more productive and egalitarian than it is now must be passed down to the twenty-first century. Therefore, the remainder of this century must be used to lay the groundwork for an enormous increase in output requirements in the first half of the twenty-first century. In order to improve the lives of future generations as well as those already living, it is necessary to achieve the goals set for this latter time.

While all other components are present, a deficiency or absence of the essential component renders the soil unusable for crops that require that nutrient. It is known as the "Barrle concept". The lowest stone in a barrel with stones of varying heights determines the barrel's capacity. The proportion of nitrogen, which is the least, determines the barrel's maximum capacity. The

potential for yield is thus determined by the growth factor in the lowest supply, whether it be climatic, edaphic, genetic, or biotic. Similarly, adding extra calcium or potassium to an already fertile soil that is low in nitrogen (N) won't make it grow better.

DISCUSSION

Indian agriculture was developed about 9000 BCE as a consequence of early plant domestication and crop and animal domestication. A settled existence quickly followed, and agricultural tools and methods were created. Due to two monsoons, two harvests were obtained in one year. Foreign crops were brought to India, and Indian goods quickly spread around the globe thanks to established commercial networks. The Native Americans came to worship and revere the plants and creatures they believed to be necessary for their existence. Under the patronage of Islam, irrigation channels in India reached a new level of sophistication during the Middle Ages, and Indian crops had an impact on the economies of other parts of the world. Systems for managing land and water were created with the intention of promoting uniform development. The independent Republic of India was able to create a comprehensive agricultural program despite some stalling in the later modern age [6]–[8].

CONCLUSION

In Arabic and Persian writings, the building of waterworks and many elements of water technology in India are covered. Irrigation systems were created as a result of the spread of irrigation technology from India and Persia, which fueled both economic and material culture progress. Agriculture was split into "zones" that produced rice, wheat, or millets. Gujarat's economy remained dominated by rice production, whereas northern and central India was dominated by wheat.

The several crops that were brought to India during this era of intense global debate are described in the Encyclopedia Britannica: Portuguese settlers developed tobacco cultivation quickly. Black pepper, in particular, was produced on the Malabar Coast and was the source of the earliest European forays into the East. By the end of the century, coffee had been brought from Abyssinia and was a common libation there. Even though it was growing wild in the Assamese hills, tea had yet to be identified and would eventually become a significant export and the beverage of the ordinary man. The majority of vegetable cultivation took place close to towns. The Portuguese also imported new fruit species including the cashew nut, pineapple, and papaya. Mango and citrus fruit quality has substantially increased. During the reign of Akbar, the Great, scholar-bureaucrats developed and put into practice elaborate methods for agricultural management on a sound foundation, land management was particularly strong. Cotton, sugar, and citrus fruits are examples of Indian crops that were seen in the Middle East, Islamic Spain, and North Africa. Although they may have been grown before the establishment of Islam in India, this recent wave increased their production, which had far-reaching economic effects for the regions concerned.

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CHAPTER 3

AN OVERVIEW OF AGRICULTURE IN NATIONAL ECONOMY

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ABSTRACT:

Agriculture plays a crucial role in the national economy of many countries. It is a key sector that provides food security, raw materials for industries, employment opportunities, and foreign exchange earnings through export. In this abstract, it reviews the contribution of agriculture to national economies and highlight the challenges facing the sector. We also discuss the opportunities and potential strategies for improving agricultural productivity and sustainability. Our analysis shows that the performance of agriculture in national economies is influenced by various factors, including policies, climate change, market access, infrastructure, and technology adoption. Improving the enabling environment for agriculture and investing in research, development, and extension services are essential for enhancing the sector's contribution to economic growth, poverty reduction, and sustainable development.

KEYWORDS:

Agricultural Productivity, Agriculture, Economy, Employment, Food Security, Foreign Exchange.

INTRODUCTION

The Indian economy is based on agriculture, and despite deliberate modernization over the last 40 years, agriculture still has a special place in the nation's heart. About 70% of the working population is employed in agriculture, which also accounts for a sizable portion of the nation's foreign exchange earnings and nearly 30% of the national income. It offers the food grains needed to feed the enormous 85 crore people. Additionally, it provides raw materials to numerous industries. As a result, agriculture forms the foundation of the nation's economic system. The following paragraphs examine agriculture's current place in the Indian economy.

a. Contribution to National Income

According to figures provided by the National revenue Committee and the Central Statistical Organization, agriculture generated almost 56% of the national revenue in 1950–1951 but just 22% in 2006–2007. Looking at the statistics in Table 1 indicates that during 1950–1951, the percentage of agriculture in the national income was estimated to be over 56 percent, and it stayed above 50 percent for the next 20 years. However, due to the sharp rise in the production of industrial goods and services over the past fifteen years, agriculture's contribution has decreased[1].

The importance of agriculture in the Indian economy is further shown by a comparison of India's national revenue shares with those of other nations. Only 2%, 3%, 4%, and 5% of the national income in the UK, US, Canada, and Australia in 1983 came from agriculture, respectively. It implies that the proportion of agriculture in a nation's revenue or production is less the more developed the country is. Therefore, it is impossible to classify the Indian economy as advanced.

b. Contribution to Employment

For the vast majority of people in India, agriculture continues to be their primary source of income, whether directly or indirectly. According to the decennial censuses, agriculture provides employment for 70% of the population. These censuses demonstrate that the vast majority of employees have been involved in agriculture. The working population is less dependent on other types of agriculture including cattle, fishery, forestry, etc.

i. Neither the pace nor the pattern of investment in other economic sectors has been sufficient to remove excess rural laborer and ease the burden of population on the land.

ii. Because the agriculture sector's development was so sluggish, there were not enough prospects for new jobs to be created. It has led to widespread underemployment and an increase in the number of jobless people.

A relatively tiny percentage of the working population in other nations is involved in agriculture. Only two and three percent, six percent, and seven percent, respectively, are found in the UK, the US, Australia, and France. Agriculture accounts for a significant amount of employment in poor and backward nations. As an example, it is 42% in Egypt, 52% in Indonesia, and 72% in China.

c. Contribution of Manpower to industry

The rural agricultural workforce has historically provided labor to industry. According to the Commission on Laborer's conclusions, the majority of the Indian manufacturing workers were migrants from rural regions. This migration to cities is still happening. This is brought on by both the dearth of work and income prospects in rural regions and the allure of employment, greater income, and metropolitan amenities on the other.

d. Contribution to Foreign Exchange Resources

A significant portion of the export of the nation is made up of agricultural goods, both primary production and produced from agricultural raw materials. An estimate states that in 1988–1989, agricultural products like raw cotton and jute, unprocessed tobacco, oilseeds, spices, tea, and coffee made up about 49% of the total value of exports. This contributes significantly to the nation's foreign currency reserves.

e. Interdependence between Agriculture and Industry

A tight relationship exists between industry and agriculture. This refers to the flow of inputs and raw materials from agriculture to industry and vice versa; the supply of wage goods to the industrial sector; the provision of basic consumer goods to the agricultural population; and, finally, the provision of materials for the construction of financial and social overheads in the agricultural sector. As the economy grows, the connection between agriculture and industry is intensifying. Innovations in industrial items utilized in the agricultural sector are prompted by the

use of science and technology in agriculture. Oil, sugar, jute and cotton textiles, and the tobacco industry all heavily rely on agricultural outputs such as fertilizers, pesticides, diesel oil, electric motors, diesel engines, pump sets, agricultural equipment and implements, tractors, and power tillers. Even the processing industries, which use agricultural raw materials to create goods like canned fruit, milk [2].

f. Contribution to Capital Formation

The rate at which production assets grow dictates the pace of growth in major part. Prior to independence, India's agricultural sector had low levels of capital creation. Agriculture suffered during this time due to ongoing poor yield technologies, an unfair land tenure system, and the exploitation of the rural populace. Land development, housing building, and other forms of capital production are included. Since independence, there has been a significant increase in public and private investment in agriculture. Land development, irrigation facility construction, road and communication construction, farm buildings, agricultural machinery and equipment, warehouses, cold storage facilities, market yards, etc. have all been used to create physical assets in the past. The growth of the economy as a whole, as well as agriculture, is aided by this capital accumulation.

g. Contribution to Purchasing Power of People

In addition to individuals who are directly involved in it, agriculture also benefits others who work in related businesses and services. Farmers spend more as their income rises. Hundreds of blacksmiths, carpenters, masons, weavers, potters, leather workers, utensil manufacturers, tailors, cotton ginners, oil pressers, transporters, and countless more benefit from the expansion of markets and employment opportunities [3].

As a result, there are several enterprises whose success and employment are reliant on the spending power of the rural populace. As a result, it is determined that in addition to providing raw materials for consumer businesses and food for non-agricultural employees, it has generated demand for a large number of new sectors, which in turn has produced high-quality jobs. Given that agriculture currently plays a significant role in the Indian economy and that its prosperity largely reflects that of the economy as a whole, it is imperative that Indian agriculture be developed to its full potential. The importance of agriculture stems from the fact that the growth of the agricultural sector is a prerequisite for the growth of the national economy.

Food Problem in India

a. Food Production Trends

The production of food grains has undergone several major qualitative changes recently. On the other hand, drought in the years 1987–1988 and 2002–2003 had a substantial influence on the production of food grains. The production of rice started to increase in the years 1988 and 1989 after fluctuating by roughly 60 million tonnes for five years. Government measures to increase rice productivity throughout the country, but particularly in the eastern areas, made this possible. output had been oscillating about 45 million tonnes for five years prior to a considerable rise in 1988–1989 output. The switch from wheat to oilseeds in attempt to raise crop prices, however, resulted in a fall in wheat output in 1989–1990. With the exception of a decrease during the drought year of 1987–1988, the production of pulses has also been steady at 12–13 million tonnes. While coarse grains and kharif food grains subsequently followed a similar path to rice,

rabi food grains followed the trend of wheat. The pattern in rice production through time was also seen in the generation of all other grains since rice production represented the greatest share of the production of other food grains.

b. Food Problem

India has had a food crisis even before it gained independence. In the beginning, India's food problem was one of scarcity, with a shortage of wheat and rice following the partition of the country in 1947 and the separation of Myanmar (Burma) from India, respectively. The government's first top priority was to boost local supply via either expanded production, imports, or a combination of the two. The government's primary focus turned to price regulation of food grains in the second part of the 1950s and the 1960s. In 1956, the Indian government and the United States agreed into the PL 480 agreement, which allowed for the import of wheat and rice. The PL 480 food imports were deemed by the government to be an effective measure for controlling the nation's food costs. In fact, PL 480 imports formed the cornerstone of our nation's industrial and agricultural growth. In order to reexamine the food issue, the government established the Food Grains Policy Committee in 1966. The committee concluded that India's continued reliance on food imports was unlikely to be simple. It seriously noted the fact that the food assistance was openly exploited to influence the government's domestic economic and foreign policy decisions. Production of food grains increased annually in Punjab, Haryana, and Uttar Pradesh between 1967–1968 and 1989–1990 at rates of 5.4, 4.0, and 3.4%, respectively. The foundation of our public distribution system consists of these states. These states have protected the nation from a shortage of food grains. From the initial objective of 5.0 million tonnes, there has been an increasing excess of stocks throughout the 1970s, especially after 1974; the government was successful in building up a buffer stock of more than 30 million tonnes of food grains during the 1980s. Actually, the Government's sizable reserves of food grains were what allowed it to successfully weather the three years of subpar grain production, which culminated in the severe drought of 1987–88.

The issue with food is no more one of scarcity or high pricing, but rather of how to make it so that lower income groups can buy the food grains that are readily accessible and how to utilize the vast food supplies to hasten the process of economic expansion. The food for work initiative was created in 1977–1978 with the goal of giving the rural poor, the jobless, and famine victims jobs while also building long-lasting communal assets. The government is also putting into action a plan to provide food grains to the less fortunate, particularly in tribal regions, at a cost far lower than the already subsidized price through the public distribution system. There is widespread consensus that the major causes of India's food shortage are the country's growing population (which raises food demand), a lack of food grain supply, and certain elements of the government's food policy.

c. Measures to Solve the Food Problem

Although India's food crisis predates our independence, it is regrettable that no long-term solution has been found. The efforts the Indian government has made to address the food crisis are addressed further below.

i. **Technological changes:** Technological advancements: Of all the ways to boost food grain output, technological advancements are the least contentious. In the nation kicking off the green revolution, intensive farming using enhanced varieties and abundant

irrigation and fertiliser usage is being rapidly expanded. The most recent phase is to achieve a breakthrough in dry land and rainfed agriculture.

ii. **Organizational Approach:** The second strategy for agricultural growth is organizational, or by suitable and effective organization, which comprises the complete framework of official and semi-official organizations and agencies in addition to the governmental administrative system. According to others, the fundamental reason why attempts to boost agricultural productivity via technical advancements have not been particularly successful is because the organization was insufficient and ineffectual. Bringing about institutional changes, such as via land reforms, is another strategy to boost agricultural productivity. There are no incentives for increasing productivity under the current agricultural system. Expecting the tiller to work hard to boost food production on small holdings that are dispersed across the village and in a system of landholdings where the tenant has no security of tenure is not a good idea. The Government has been pursuing a number of land reform initiatives, including as the creation of cooperative farms, the capping of holdings, the control of tenures, and the consolidation of holdings. Since there are numerous gaps in the legislation governing land reforms, the government must act immediately to close these gaps through effective legislation.

iii. **Distributional Changes:** The government has significantly extended the public distribution system (PDS) during the last several years. The public distribution system handled more than 19 million tones in 1987–88, up from more than two million tones in 1956. The PDS's coverage was expanded to 1700 blocks in remote and underserved areas in 1991, including economically depressed, drought-prone, desert, and mountainous regions. For the lean season, the PDS allocation of rice, wheat, etc. should be increased. The country's public distribution system has to be strengthened urgently.

iv. **Stabilization of food grains prices:** In recent years, the fundamental goal of food policy has been to keep food grain prices under control. The government has been implementing short-term strategies like maintaining high stock levels, expanding internal procurement, increasing government purchases of food grains for distribution through fair price shops, putting restrictions on profiteering and hoarding, and fixing maximum control prices. These actions did have some effect on price control, but historical data indicates that price stability has not yet been entirely attained. The government's buffer stock program is the solution to the issue of stabilizing both food prices and the nation's overall price level. The government made the decision to accumulate a buffer stock of 5 million tonnes of food grains by 1973–1974, but the real stock with the government starting in 1979 has been above 20 million tonnes, which is a favorable indicator. It is believed that, if handled wisely and adaptably, it would go a long way towards safeguarding both the farmer and the customer from significant price swings. A sense of confidence that the food scarcity is a thing of the past arises from the presence of vast food stores. With the development of irrigation infrastructure, the availability of fertilisers, the electrification of rural areas, etc., there is every chance that the production will increase. However, it must be understood that the highly variable monsoon and the ensuing ups and downs in food production can always indicate danger. Of course, efforts should be made to maintain population control in order to fully benefit from the rise in agricultural production [4].

An Introduction to Agronomy

The Greek words agros and nomos, which mean field and manage, respectively, are the origin of the phrase agronomy. Agronomy is defined as the "art of managing a field" in its literal sense. The "science and economics of crop production by management of farm land" is what it implies technically.

Definition: Agronomy is the art and science that underlies the production and improvement of field crops via the effective use of soil fertility, water, labour, and other crop production-related elements. The study and use of techniques for producing food, feed, and fiber crops is known as agronomy. According to Wikipedia, agronomy is "a discipline of agricultural science concerned with the concepts and practices of field crop production and management of soil for improved productivity.

Importance: Agronomy is considered as the mother branch or major branch of agriculture and has a key place among all other branches. Similar to agriculture, agronomy is a combined and applied branch of many pure scientific fields. Crop science, soil science, and environmental science are the three distinct subfields of agronomy that solely address practical issues. That is a relationship between soil, crop, and environment. Agronomy is a combination of a number of disciplines, including crop science, soil science, environmental science, and crop ecology. Crop science encompasses plant breeding, crop physiology, crop biochemistry, and other topics [5].

Basic Principles

- **i.** Planning, planning, and carrying out actions to make the best use possible of the land, labour force, capital, and other production variables.
- **ii.** Choosing crop types that are appropriate for the cropping system and can be adapted to the specific agroclimatic, land condition, soil fertility, season, and cultivation mode;
- **iii.** Proper field management via tillage, creating irrigation and drainage canals and bunds, preventing soil erosion, levelling the ground, and using other appropriate land development techniques;
- **iv.** Using mixed or intercropping techniques to assure harvest even under unfavorable climatic circumstances;
- **v.** Proper and timely crop fertilizer treatment, as well as increased soil fertility and production. through the application of green manure, farm yard manure, organic wastes, bio fertilizers, and profitable recycling of organic wastes, negative effects of soil reactions and conditions are corrected, and soil organic matter is increased;
- **vi.** Choosing high-quality seed or seed material, maintaining the required plant density per unit area, and planting seedlings that are healthy and consistent;
- **vii.** Effective water management for crops, soil, and the environment via soil moisture conservation and use, as well as through making use of surplus water and timing irrigation during crucial periods of crop development.
- **viii.** Adopting sufficient, timely, need-based, stringent plant protection measures against weeds, insect pests, diseases, and climatic dangers as well as correcting inadequacies and abnormalities;

ix. Using proper management techniques, such as cross-cultural operations, to make the most out of expensive, challenging-to-obtain, low-cost, and non-cash inputs;

x. Adoption of suitable method and time of harvesting of crop to reduce field loss and to release land for succeeding crop(s) and efficient utilization of residual moisture, plant nutrients and other management practices;

xi. Utilizing the appropriate post-harvest technologies.

xii. Agronomy was only recognized as a separate field of agricultural science about the year 1900. In 1908, the American Society of Agronomy was founded.

DISCUSSION

Scientist who researches crop production and soil management principles and practices for producing food for people and feed for his animals." In general, an agronomist's job Agronomists research crop production issues and create more efficient methods of generating food, feed, and fibre. Agronomists work to maximize productivity while minimizing costs, for example, by inventing effective and affordable field preparation techniques. They also consider things like what kind of crop to plant, when to plant it, and other factors. In addition to field issues, agronomists are responsible for any social, economic, and cultural issues that may arise for the farm's overall efficient operation. Agronomists use the information created by fundamental and related applied disciplines to increase agricultural yield. Agronomists conduct studies on the scientific cultivation of crops while considering the effects of variables such as soil, climate, and crop kinds. They also modify production methods as necessary depending on the scenario. Agronomists must also be trained in other agricultural disciplines since they collaborate and coordinate with all of the other agricultural fields. to create cultivating techniques that are effective. The procedure may change based on the germination time, the establishment of the crop, and the ideal plant population. He must recognize the various sorts of nutrients that different crops need, such as long-lasting rice and N2, P, and K for pulses. The nutritional level also changes depending on the growth technique. Nutrient application timing and technique must also be considered. The term "method" refers to dispersing or applying near the root or via leafy vegetation. An improved weed control strategy must be chosen by the agronomist. Weeds are managed using various methods. Management of irrigation: To determine the amount of water needed, it is determined whether irrigation should be continuous or interrupted periodically. What sort of crop, cropping pattern, cropping sequence, etc. should be produced during crop planning and crop sequence development by an agronomic. Agronomists are also creating harvesting techniques, harvesting schedules, etc. The right timing should be chosen for the harvest. Making decisions on agricultural management [6]–[8].

CONCLUSION

At least two-thirds of the working population in India relies on agriculture for their livelihood. Other industries in India have struggled to create enough jobs for the country's expanding working population. Food production rises quickly as a result of the high population pressure, labour surplus countries like India, and the sharp rise in food demand. The current levels of food consumption in these nations are very low, and with only a little increase in per capita income,

the demand for food rises sharply (or, to put it another way, the income elasticity of the demand for food in emerging nations is quite high). Therefore, a crisis is likely to develop unless agriculture is able to consistently increase its market surplus of food grains. Many developing nations are currently going through this phase, and agriculture has been developed in an effort to meet the growing food demands. There is broad consensus about the importance of capital formation. As the largest industry in a developing nation like India, agriculture can and must play a significant role in accelerating the rate of capital formation. The whole process of economic growth will experience a setback if it fails to do so.

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CHAPTER 4

AN ANALYSIS OF POTENTIAL PRODUCTIVITY AND CONSTRAINTS IN CROP PRODUCTION

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ABSTRACT:

Stress is an alteration of physiological condition caused by the various numbers of factors that tend to interrupt the equilibrium state. Stress in plant refers to external conditions that adversely affect growth, development and productivity of crop plants. The origin of new pathogens and insect races due to climatic and genetic factors is a major challenge for plant breeders in breeding biotic stress resistant crops. Yield losses due to biotic stresses have resulted in 800 million people underfed in the world. Reduced yield due to biotic stresses and increasing food demand put international food security at risk as 70% more food will be required in 2050.

KEYWORDS:

Agriculture, Crop Productivity, Food, Focus group Discussion, Quantification Livelihood.

INTRODUCTION

In terms of raising people's standard of living and contributing the most to global GDP, agriculture is the world's main economic engine. However, numerous biotic and abiotic restrictions have a negative impact on agricultural productivity. The poor circumstances for crop development and output brought on by biological forces are known as biotic stress. These include a lack of high yielding crop varieties, parasitic weeds, insects, diseases, and wild animals. These are the main roadblocks and contributors to the poor agricultural production productivity. The unfavorable circumstances for crop development and output brought on by environmental variables are known as abiotic stresses. For instance, inadequate or excessive nutrition, moisture, aridity, salt, acidity of the soil, light, darkness, and heat; a lack of agricultural inputs like fertilizers and herbicides; and air pollution. All of these abiotic stressors are significant ones that already result in significant and widespread yield reductions. Crop losses pose a serious danger to rural households' well-being, to the economies of businesses and governments, and to global food security. The world's agricultural output is characterized by a subsistence focus, poor productivity, a lack of infrastructure and market institutions, low technology and input levels, and a high vulnerability to rainfall variability [1].

To boost global economic prosperity, the agricultural sector's productivity performance is essential. The world's agricultural productivity is limited by a number of factors, including a lack of improved or hybrid seed, a lack of seed multiplication capacity, low fertilizer profitability and efficiency, a lack of irrigation infrastructure development, a lack of transportation infrastructure, market accessibility issues, and a high prevalence of land degradation, barren soil, excessive

grazing, deforestation, and desertification. The capacity of farmers worldwide to close the gap between present crop yields and yield potential ceilings may be crucial for future crop yields and global food security, particularly given that progress towards the latter may stall due to climate change and declining returns in breeding. There is great benefit in better quantifying and comprehending yield gaps since average crop yields play a significant role in determining food prices, food security, and the extension of cropland. In order to create crops that are resistant to climate change, it is generally necessary to understand the causes of climate change, pressures brought on by it, the effects on crops, as well as contemporary breeding techniques and biotechnological tactics to deal with it[2].

By creating transgenic plants, advances in genetic engineering methods might help overcome problems with food security in the face of harsh environmental circumstances. Overall, it is not only feasible but also urgently necessary to improve agricultural sustainability by raising yields from low-input production systems. It is possible to produce varieties with better features and adaptability by utilizing breeding techniques that are tailored to the typical constraints faced by farmers across the world. Growing the number of superior varieties developed for low-input systems using conventional or cutting-edge breeding techniques will enhance agricultural sustainability and global resource management and reduce the energy needed for food production at a crucial juncture in human history when population is at its peak and valuable finite resources are depleting.

i. **Potential Yield**: This is the highest economic yield that can be gained from a unit of land area for a crop, provided that all elements that impact crop growth and production are accessible without any restrictions. Alternatively, this is the highest yield that might be achieved under regulated conditions. Here, the crop is given access to every environmental aspect necessary for it to reach its maximum potential.

ii. **Research yield**: The output from a research station that has been properly managed and supervised by a scientist. So, in order to achieve the highest yield, scientists use all available technologies.

iii. **Potential farmers yield:** The yield attained by forward-thinking farmers adopting cutting-edge methods under the direction of scientists is shown in Figure 1 [3].

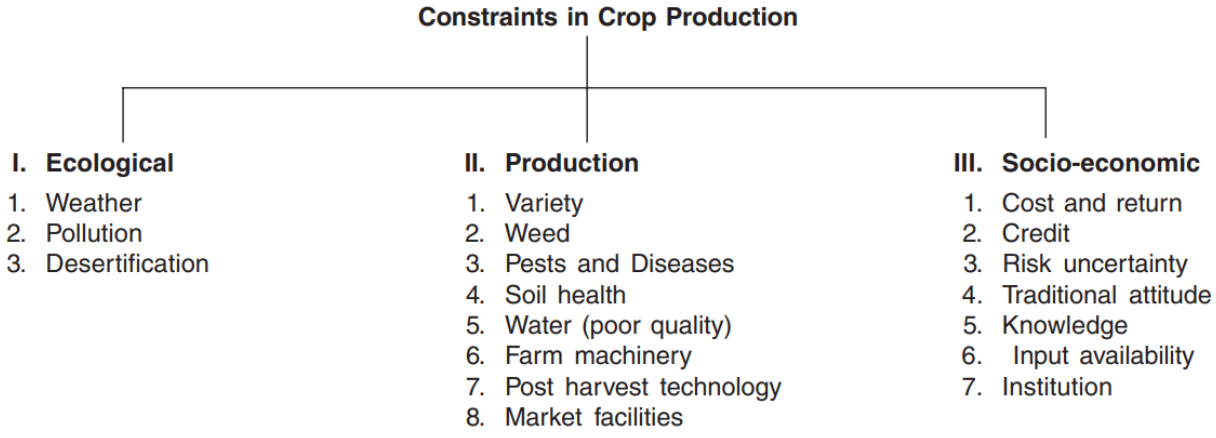

Figure 1: Illustrated the Constraints of Crop Production

Agricultural Heritage of India

i. Geology

Ancient History time scale is measured in terms of Before Christ (B.C.) or Before the Common Era (B.C.E.). The geology of Indian sub-continent is as follows:

Timeline of Mesozoic Era (~251 Ma to ~66 Ma)

a. **Triassic period**: (~251 Ma to ~204 Ma) - This period was the earliest period of the Mesozoic era, or the corresponding system of rocks, marked by the first appearance of the dinosaurs.

b. **Jurassic period:** (~204 Ma to ~136 Ma) - This period is the period of the Mesozoic era, between the Triassic and the Cretaceous or the corresponding system of rocks, marked by the presence of dinosaurs, and the first appearance of birds.

c. **Cretaceous period** (~136 Ma to ~66 Ma) - Dinosaurs, flying and marine reptiles, ammonites, ferns, and gymnosperms appeared at this time, along with angiosperms, mammals, and birds. The continents' current characteristics, forms, huge mountain systems, river courses, huge Plains, and climatic zones were gained with the collapse of Gondwanaland near the end of the Cretaceous. The Mesozoic Era was succeeded by the Cenozoic Era, which is still ongoing now. About 60 million years ago, it started.

Timeline of Cenozoic Era (~66 Ma to 10000 years)

The Cenozoic Era is divided into two periods–the Tertiary and the Quaternary. The Tertiary is subdivided into five epochs. The name of each epoch ends with the suffix one (Greek, recent) and refers to the progress of life. The Tertiary period has been studied in greater detail than any other period, partly because its flora and fauna bear close similarities to the living forms, but mainly because of economic reasons, viz., and search for petroleum, of which more than 50 per cent of the world production comes from the Tertiary rocks [4].

Pangaea, the Super-Continent

The Earth is a dynamic or constantly changing planet. The Earth’s crust is broken into many pieces, which are called plates. These plates are in constant motion causing earthquakes, mountain building, volcanism, the production of “new” crust and the destruction of “old” crust. There are three kinds of plate boundaries:

i. **Convergent boundary**: Where two plates collide to form mountains or a subduction zone.

ii. **Divergent boundary:** Where two plates are moving in opposite directions as in a mid-ocean ridge.

iii. **Transform boundary**: Where two plates are sliding past each other as in the San Andreas Fault of California.

The Earth’s plates are in constant, but very, very slow motion. They move at only 1/2–4 inches (1.3–10 cm) per year!! This does not seem like much, but over millions of years it adds up to great distances of movement. In 1912, Alfred Wagener introduced the ‘Continental Drift

Theory', which states that the continents have moved, and is still moving today. Scientists believe these plates have been moving for millions of years as mention in Figure 1. In fact, 250 million years ago the Earth's seven continents were all grouped together into a super continent called 'Pangea'. This huge super continent was surrounded by one gigantic ocean called Panthalassa.

Figure 1: Represented the position of the continents of Antarctica.

Australia slid sideways and was located far west of where it is now, the Indian subcontinent was hundreds of miles away from Asia, and Antarctica was located far south of where it is now. Figure 2 shows the location of the North American continent during a time when it was considerably further south and east than it is now. In the tropics or close by, North America was. Tropical plant and animal fossils have been discovered in freezing places like North Dakota and Greenland [5].

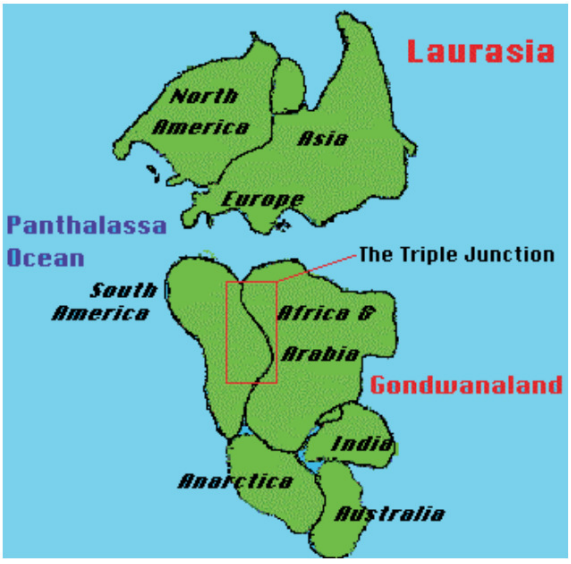

Figure 2: Illustrated the North America's Continent.

A. 180 million Years Ago

The supercontinent Pangea started to fragment 180 million years ago during the Mesozoic Era. The same reason why the plates are shifting now, according to scientists, is what caused Pangea to split apart. Convection currents that roll over in the higher zone of the mantle are to blame for the movement. The plates move slowly over the surface of the Earth as a result of this movement in the mantle. Pangea disintegrated into four halves. The split between Laurasia and Gondwanaland originally appeared in the Triassic epoch, some 200 million years ago. The modern continents of North America (Greenland), Europe, and Angara land, which included northern Russia, Siberia, and China, formed up Laurasia. The modern-day continents of South America, Africa, India, Australia, and Antarctica made up Gondwanaland. Keep in mind that India and Asia were not linked at this period. The vast Panthalassa Ocean still existed, but the Atlantic Ocean will soon be created when the North American Plate separated from the Eurasian Plate.

'The Triple Junction' as mention in Figure1, was formed because of a three-way split in the crust allowing massive lava flows in three directions and poured out lava over hundreds of square miles of Africa and South America. In terms of age and mineral composition, the rocks of the triple junction, which now includes the west central region of Africa and the east central region of South America, are exact mates. In other words, the rocks on these two continents were formed simultaneously and at the same location. This demonstrates the historical connections between South America and Africa. These two continents are now divided by the nearly 2000-mile-wide Atlantic Ocean.

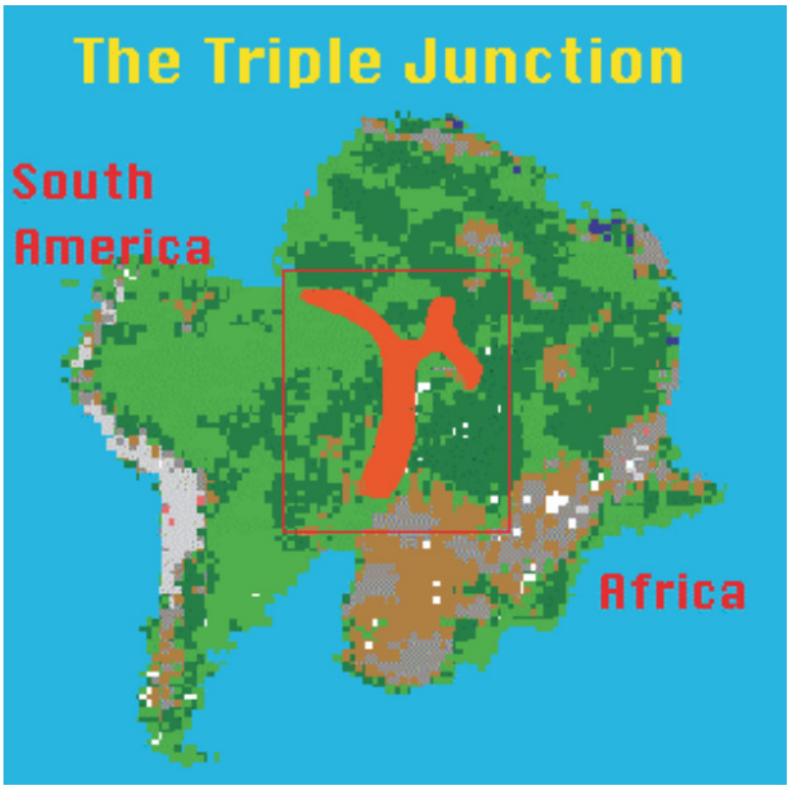

Figure 3: Illustrated the Triple Junction.

B. 135 million Years Ago

Around 135 million years ago, during the Jurassic period, Laurasia was still in motion, and as it did so, it fragmented into the continents of North America, Europe, and Asia (Eurasian plate). During the Jurassic and Cretaceous periods, the continents of the Gondwana era separated from one another. South America and Africa split apart in the late Jurassic. Another concave basin was therefore formed between these two continents. The Moroccan bulge of Africa split from the eastern coast of North America. The Atlantic and Indian Oceans became accessible with the dissolution of Gondwanaland. In stage three, the Tethys Sea, the forerunner of the Mediterranean, was sealed off on the eastern end by the Atlantic expanding northward and Eurasia rotating clockwise. In 135 million years, the Indian Subcontinent moved at a rapid rate of 4 inches per year, covering hundreds of miles. The Himalayan Mountain range was formed when the Indian plate slammed against the Eurasian plate (Asia) with such speed and power. As India neared Asia, the Tethys was being pushed out of existence east of the Alpines [6].

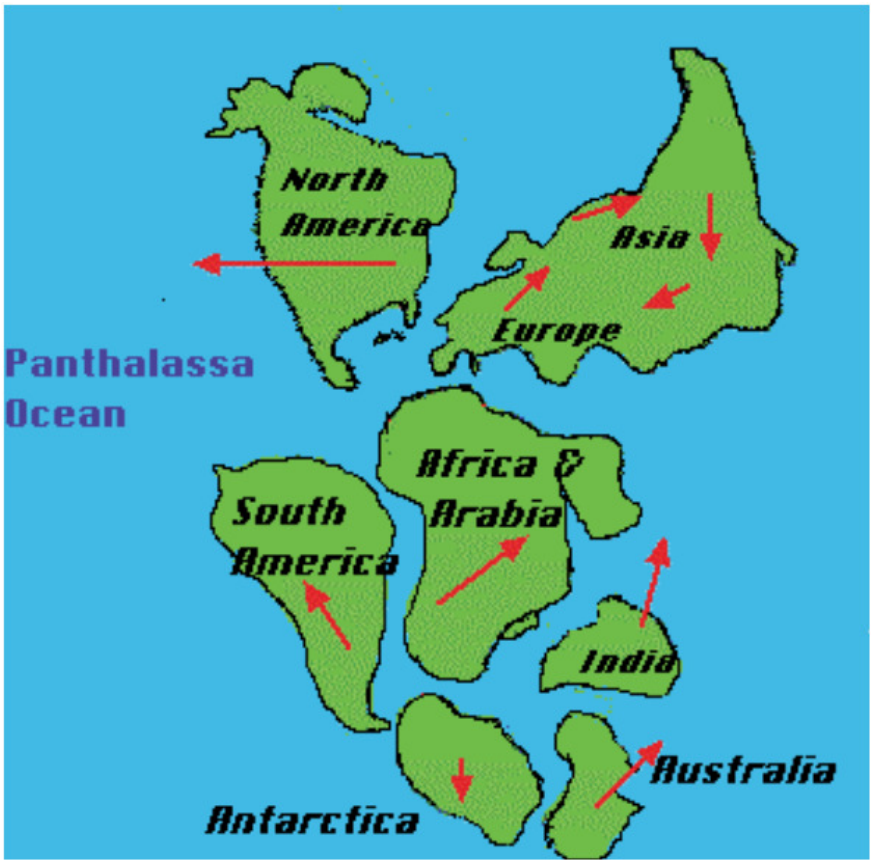

Figure 4: Illustrated the Panthalassa Ocean.

Figure 5 shows that the Himalayan Mountains and the enormous volumes of sediment they produced were so heavy that they caused the Indian-Australian Plate to sink, resulting in a zone of crystal subsidence and the formation of geosynclines into Madagascar (Madagascar) and Australia. The Permian Gondwana deposits are the primary source of Indian coal. Indian continent is regarded highly for its prospective future for mining opportunities due to its proximity to mineral-rich South Africa and West Australia. The Red Sea began to open, and Arabia began to divide from Africa. The direction of the continental motions is shown by the red

arrows. Significant portions of the Gondwanaland margins broke off and sunk into the seas as a consequence of the earth's motions. Africa and Antarctica experienced rifting, which spread northeastward to India. Australia and Antarctica split apart in the early Cenozoic. Early Cenozoic times saw Pangea's ultimate stage of fragmentation. North America and Eurasia (Europe) eventually split apart as the North Atlantic Rift moved farther north. Australia and Antarctica split apart at this time. About 45 Ma ago, the continents finally split apart. Pangea's disintegration took around 150 million years.

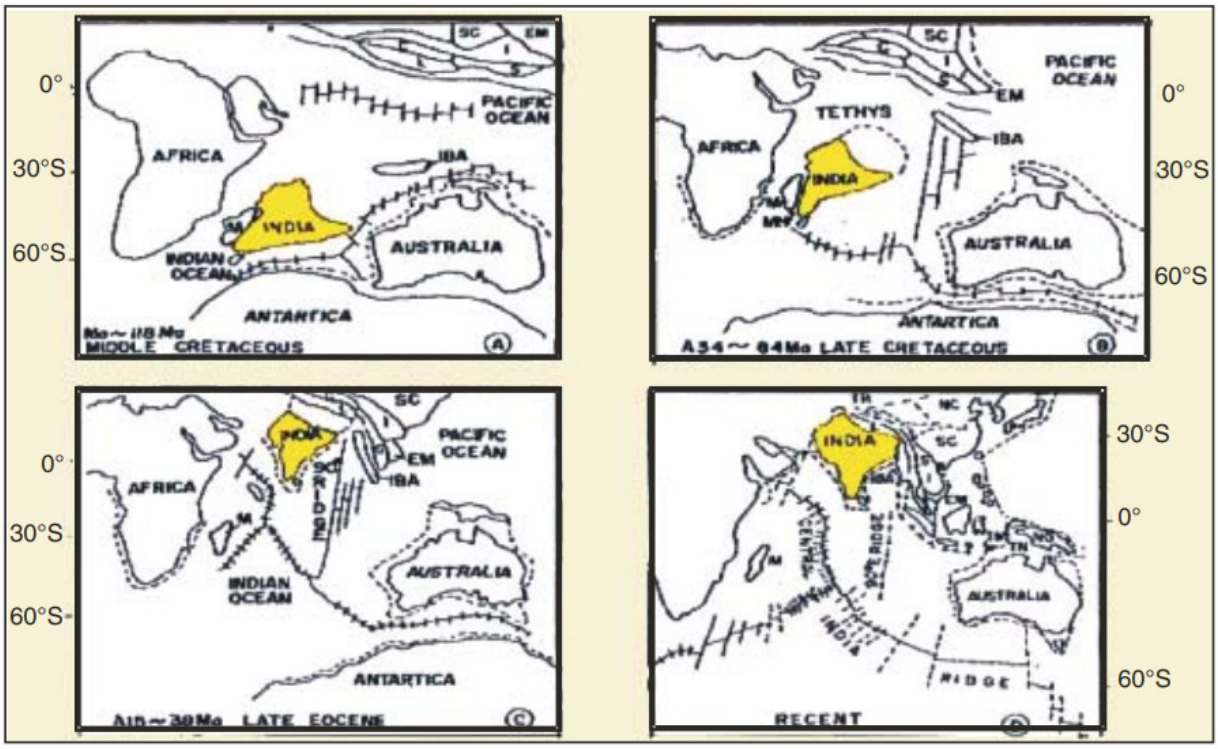

Figure 5: Illustrated the Himalayas mountain-together with vast amounts of Sediment Eroded.

DISCUSSION

Regarding the sort of limitation or opportunity and the proportionate perceived effect of these constraints and opportunities, the outcomes for the various places varied. When we combined our results with the descriptive data and observations that were accessible, we discovered that this variability was often consistent with them. Results for Inticho and Hagere Selam, for instance, indicated that demographic concerns were crucial. This was consistent with the finding that these areas had relatively low farm-size, farm-family ratio, and to some degree hiring index scores (Inticho). Unlike the other groups, the Edaga Arbi-groups did not think that better agricultural management was a key to increasing crop productivity. The increased land availability in Edaga Arbi, as shown by a comparatively high farm-family ratio, coincided with this and allowed for the extension of the area under cultivation rather than intensification. The results for three locations—Hagere Selam, Hawzen, and particularly Inticho showed that farmers strongly believed that irrigation presented a chance. This opinion was reinforced by BoARD's aggressive promotion of irrigation in these areas, as well as Inticho's particular river presence, historical connections to markets, and previous exposure to Eritrean irrigation systems. Inticho's

restricted land supply may also be a factor in the desire in intensification and the ongoing growth of small-scale irrigation operations [7], [8].

CONCLUSION

Farmers from Edaga Arbi, Hawzen, and Inticho seemed to view soil erosion as a long-term problem, similar to many other farmers in Ethiopia, as seen by the paucity of attention paid to soil and water conservation. But in Hagere Selam, soil and water conservation were seen as important, which was in line with the region's actual circumstances, where the area's relatively heavy rainfall frequently causes fatal short-term flooding. One major criticism of FGD is that its results might be impacted by chance. In our situation, for instance, the occurrence of hail or a severe drought just before the workshop may have caused a change in emphasis and, as a consequence, impacted repeatability. However, the fact that particular issues were brought up by groups showed that at that particular time, these were seen as important. Conducting FGDs clearly entails taking into account temporal context dimensions, which will inevitably have an impact on reproducibility.

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CHAPTER 5

AN OVERVIEW OF THE GEOLOGY OF INDIA FOR AGRICULTURE

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ABSTRACT:

For the use of soil for production purposes, it is essential to understand the potential of the soil resource, its constraints, current usage, and the management techniques for continued production. Due to the wide range of soils, India has earned the moniker "land of paradoxes." High mountains, snow fields, glaciers, dense forests, oceans washing long beaches on the Peninsula, a range of geological formations, a diverse temperature, a varied terrain, and a varied relief have all contributed to the development of a variety of physiographic characteristics. The country's climate ranges from arctic cold to equatorial hot, and its rainfall ranges from only a few centimeters in the driest regions to several hundred centimeters each year in certain other regions that are ultra-humid. The result is a landscape that includes lofty plateaus, stubby relic hills, shallow open valleys, rolling uplands, rich plains, marshy lowlands, and gloomy bleak deserts.

KEYWORDS:

Parent Materials, Soil-forming Factors, Soil Categories, Soil Map, Rock Formations.

INTRODUCTION

The Himalayas, a vast mountain range to the north, the Indo-Gangetic alluvial plain of northern India, which stretches from Punjab to Assam, and the Peninsula of the Deccan, to the south of the Vindhyas, a solid stable block of the earth's crust, largely composed of some sandstone, are the three distinct segments of totally different character that make up the physical geography of India stand out. Peninsular India's landmass has never been completely covered by water. While the Himalayas and the Indo-Gangetic plain are relatively young, the Western Ghats and Eastern Ghats form the western and eastern edges of the plateau, which slopes east. On the Everest's summit, there is marine sediment [1].

The Cretaceous era lasted for 50 million years and started 110 million years ago. The land regions, particularly in the Puducherry and Tiruchirappalli sector, are mostly littoral during the middle and upper Cretaceous. The fauna of this region is comparable to that of South Africa, Madagascar, and the southern edge of the Assam range. Some marine fossil ferrous beds can be found along the Narmada Valley on the west coast. These fossils are more similar to those from southern Arabia and Europe during the Cretaceous Period than they are to Assam and Tiruchirappalli. The difference suggests that there was still some form of geographical barrier separating the Arabian Sea from the Bay of Bengal. Lellluria, which covered Peninsular India and Malagasy (Madagascar), was the name given to this geographical barrier. Volcanic eruptions engulfed a sizable region during the middle and upper Cretaceous, including what is now Gujarat, Maharastra, and Madhya Pradesh. Extremely mobile lava erupted from fissures,

flooding several hundred thousand square kilometres. The Deccan traps are a group of lava-formed hills that are over 1,200 metres high in certain areas. In the Tertiary Period, the Deccan trap's formation continued. Sind, Kutch, Bihar, and the Andhra Pradesh coast are all covered by the Deccan trap.

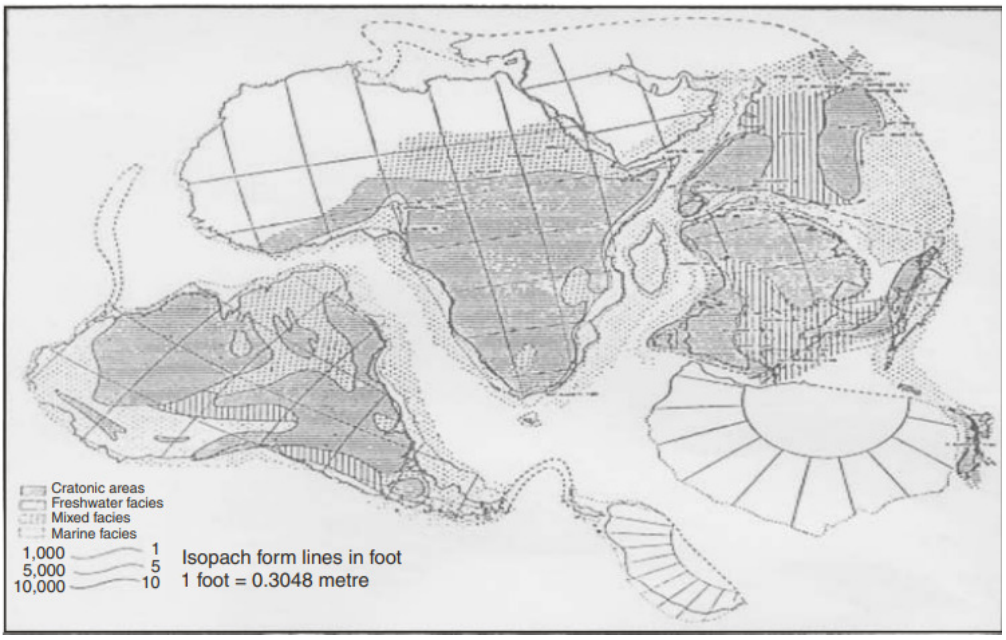

Figure 1: Illustrated the Geography of India.

As two solid continental masses on opposite sides of the Tethys Ocean moved in the direction of one another, they lifted the Himalayan system of mountain ranges. The northern border of the Indian continental mass, Gondwanaland, got down bent by the northward compressive force from the Indian Ocean, while the Central Asian continental mass, Angaraland, slowly slid from the north to the south under pressure from the bottom of the Arctic Ocean. The early Eocene is when the Himalayan component of the Tethys assumed its current pattern, gradually moving southward and becoming narrower.

The Himalayan chain's shape has been shaped by the existence of tongue-like Gondwanaland expansions, one in the Kashmir-Hazara area (the Punjab wedge) and the other in Assam's far northeastern corner (the Assam wedge).

Any relief map of India clearly shows the effects of these two wedges. You'll see that the Himalayan range spans a vast arc from Namcha Barwa in the east to Nanga Parbat in the west. The arc's convexity faces the Indian peninsula towards the south. The Siwalik Hills, which stretch from Jammu in the west to Assam in the east, are located under the Himalayas. The majority of the Siwalik Hills are river deposits from the middle Miocene to the late Pleistocene Age that have been folded into anticlines and synclines. The fault planes that plunge sharply into the hills have created sharp scarps that face the lowlands. The sub-Himalayan region, also known as the smaller Himalayas, is located directly north and next to the Siwalik Hills. It is 65 to 80 km broad and has an average elevation of around 3,000 metres. Most of the rocks in this area lack fossils. The middle Himalayan zone, which consists of high ranges with snow-capped peaks, is farther north. Mostly metamorphosed sedimentary rocks make up this structure [2].

The Indo-Gangetic plains, which extend from Hazara to Assam and are located at the base of the Himalayas, are the side of a deep basin with an estimated depth of 1,050 to 6,000 metres. This basin was formed as a consequence of the compression put on the peninsular edge by advancing crystal waves from the north. River alluvium from the plateau to the south and the rising Himalayas has filled the basin to capacity.

Lemuria Civilization: Lemuria was originally the name given to a vast hypothetical sunken continent or a land bridge or landmass stretching from Ceylon to Madagascar all the way to the central Pacific Ocean across the Indian Ocean and Indonesia. Ancient Lemuria-map of India in 30,000 B.C. is presented in following Figure 2. The lemurs derive their name from that of the Lemurs (or "Ancestors").

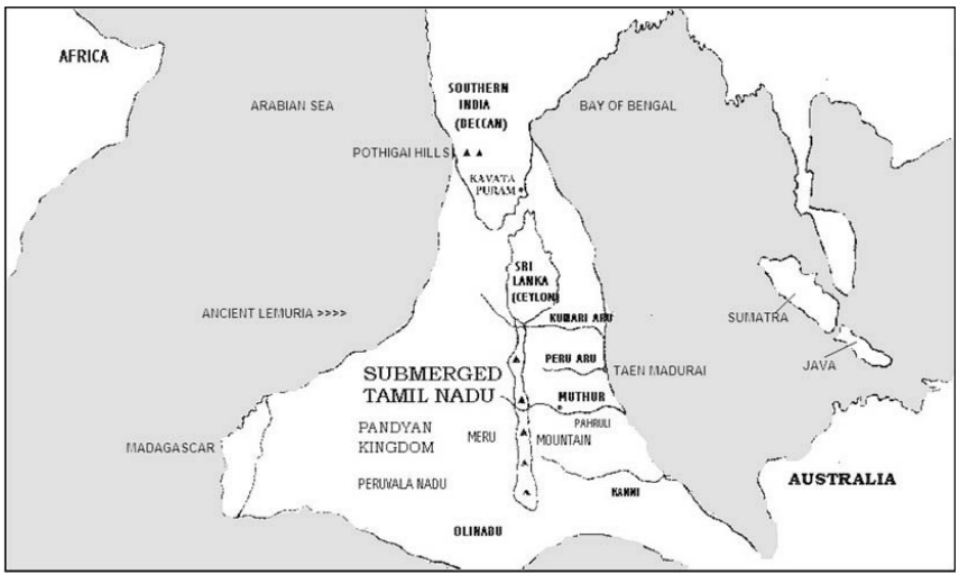

Figure 2: Illustrated the Hypothetical Sunken Continent or a Land Bridge

The ancestors of man are apes. Lemuria's name might be translated as "Land Ancestral" or "Land of the Ancestors" as a result. In the early days of Darwinism, an English zoologist named Phillip L. Schlater used the term "Lemuria" to describe the fossilized remains of lemurs that were comparable to the ones that are now exclusively found in Madagascar. There are still some "Lemurs" on Madagascar. Because of this, the ancient region that connected Australia and India and became submerged through time is known as "Lemuria." The vast Southern region of India, which formerly connected to Australia cataclysmically, is described in Tamil bark inscriptions in Southern India as gradually sinking over a long period of time. This was either Kumari Kandam or ancient Lemuria. It is said that the first Tamil Sangam took place in the so-called vanished continent known as Kumari Kandam. Since Sri Lanka, an island in the Indian Ocean, was mentioned during the Ramayana period (10,000 B.C.), the great flood would have destroyed Lemuria or Kumari Kandam before the Ramayana period [3].

Agriculture Heritage in India

In India, agriculture has existed for a very long time, going all the way back to the Neolithic period, which lasted from 7500 to 6500 B.C. It transformed early man's wandering lifestyle from

one of foraging for wild fruit and roots to one of cultivating land. Great saints' knowledge and teachings are beneficial to agriculture. Generation after generation has handed along the knowledge acquired and the practises embraced. Traditional farmers have created agricultural techniques that are favourable to the environment, such as crop rotation, mixed farming, and mixed cropping. The degree of knowledge that the older Indian farmers held is reflected in the great epics of antiquity. The value of old wisdom, which has undergone a process of refining over centuries of experience, has been overlooked by contemporary society. The rebirth of organic agriculture today is a reflection of the ecological concerns used by traditional farmers in their agricultural practises. The collection of accessible ancient literature includes the four Vedas, nine Brahnanas, Aranyakas, Sutra literature, Susruta Samhita, Charaka Samhita, Upanishads, the epics Ramayana and Mahabharata, eighteen Puranas, Buddhist and Jain literature, and texts such as Krishi-Parashara, Kautilya's, Artha-sastra, Panini's Ashtadhyahi, Sangam literature of Tamils, Manusmirit, Varahamihira's Brhat Samhita, Amarkosha, Kashyapiya-Krishisukti and Surapala's Vriskshayurveda. The most plausible period for composition of this literature is between 6000 B.C. and 1000 A.D. These works include information on agriculture (including animal husbandry) and biodiversity. India's oldest extant literary work is the Rig-Veda. It thought that among farmers, Gods were the best.

The 'Amarakosha' claims that the Aryans were farmers. Agriculture, cattle husbandry, and trade were listed by Manu and Kautilya as being key things that the monarch had to understand. According to Patanjali, agriculture and cattle raising were essential to the nation's prosperity. The 'Puranas' include a wealth of knowledge that demonstrates how well-versed the ancient Indians were in all aspects of agriculture. The "Arthashastra" by Kautilya, "Astadhyayi" by Panini, "Mahabhasya" by Patanjali, "Brahat Samhita" by Varahamihira, "Amarkosha" by Amarsimha, and "Encyclopaedic Works of Manasollasa" are a few of the well-known ancient classics of India. The knowledge and wisdom of the ancient people are attested to by these classics. Sage Parashara's 'Krishiparashara' was a technical text that dealt only with agriculture about 1000 A.D. The 500 A.D. Agni Purana and Krishi Sukti, both credited to Kashyap, are other significant writings. There is a wealth of important information on agriculture in ancient India in the Tamil and Kannada literature. India's agricultural sector achieved significant advancements in the care of sheep, goats, cows, and buffaloes, trees, bushes, spices, condiments, food and non-food crops, fruits, and vegetables, as well as the development of environmentally friendly farming techniques [4].

These customs took on social and religious overtones and were adopted by the populace as a way of life. Domestic rituals and celebrations often coincided with the four primary agricultural activities of plough, sow, reap, and harvest. Thousands of cows, horses drawn by chariots, racing tracks where chariot races were performed, camels drawn by chariots, sheep and goats presented as sacrificed victims, and the use of wool for clothing are all mentioned in the Rig-Veda. The well-known Cow Sukta shows how the cow had already evolved into the basic foundation of rural economics. She is described as the mother of the Vasus, the Rudras, and the Adityas as well as the centre of immortality in another Sukta. According to the Atharva Veda, the Vedic Aryans seem to have had access to sizable woods for obtaining timber, and they also appear to have raised plants and herbs for medical reasons. Despite the fact that agriculture exclusively relied on

the blessings of Parjanya, the rain god, farmers were respected for their work. His thunders are said to deliver nourishment. Over 75 plant species were mentioned in the four Vedas, over 25 in Satapatha Bhrahamna, and over 320 in the Charkaa Samhita, an Ayurvedic (Indian medicine) treatise from around 300 B.C.

Over 750 plant species are listed as medicinal by Susruta (circa 400 B.C.). Numerous aquatics and terrestrial, domestic and wild, poisonous and nonpoisonous animals are mentioned in the oldest book, the Rig-Veda (circa 4000 B.C.). 500 plant species are mentioned in the Puranas. In Surapala's Vrikshayurveda, the science of arbori-horticulture is well-documented and has seen significant development. In the past, forests were of great significance. Forest preservation has been emphasized for ecological harmony from the time of the Vedas. Kautilya (321-296 B.C.) indicates that the forest superintendent had to get forest goods via the forest guards in his Artha sastra. He gives a lengthy list of the plants, trees, bamboo species, creepers, fibrous plants, medications, poisons, animal skins, etc. that fall within his officer's jurisdiction. According to Manu (Manusmriti, 2nd Century B.C.), hunting was discouraged as a pastime and was seen to be harmful to the normal development of the ruler's character and personality. Particularly, the names of Shalihotra on horses and Palakapya on elephants have been found as experts in animal husbandry in the Puranas (300–750 A.D.). Aswashastra is a renowned treatise on the care of horses, while Garudapurana is a literature that deals with the treatment of animal illnesses. Agnipurana has chapters or parts devoted to treating trees and cattle, respectively [5].

Soil Map of India: New Initiative

Given the size of India, generalized soil categorization has traditionally been used. The National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), the top soil research facility of the Indian Council of Agricultural Research (ICAR), has been mapping the nation's soil resources at the sub-order association level for the last 30 years. There are 103 recognized sub-orders of soil. Large-scale mapping of soil and climatic resources was started in 1986 for sustainable resource management employing a three-tiered strategy that included picture interpretation, field mapping, and laboratory analysis. Following this, 1:250,000 scale maps of all the states and union territories were printed using cartography. To create pre-field physiography-cum-protomorphic maps, 176 false color composite (FCC) and B/W infrared imageries on a 250,000 scale were visually analyzed. Using TM FCC, 1: 50,000 scale maps of Sikkim, Goa, Lakshadweep, and the Andaman and Nicobar Islands were created. Most land use planners can understand the description of the map units. A recent study gathered and presented soil data at the family association level using the USDA taxonomy [6].

DISCUSSION

The soils around the globe experienced climatic changes as a result of the Quaternary's global climatic events, particularly during the most recent post-glacial era. Throughout the Quaternary, there have also been numerous climate changes. During the Holocene, the climate in rainfed regions of India changed from humid to semi-arid[7].Under SAT environments, it has been observed that India's major soil types are changing from sandy to calcareous and sodic, which affects the physical and chemical characteristics of soils. Regressive pedogenesis results in such alterations, which lessen the likelihood of good crop growth. Vertisols are found in weathered

Deccan basalt as well as humid tropic (HT), subhumid moist (SHm), subhumid dry (SHd), semi-arid moist (SAm), semi-arid dry (SAd), and arid environments in the Indian Peninsula, which suggests that basaltic parent materials have an influence on the formation of similar soils under various climatic conditions. Although they are all categorised under the same soil order, these soils have different morphological and chemical characteristics. But only in SAd and arid soils do cracks cut through these zones.

A decrease in mean annual rainfall (MAR) results in the creation of calcareous and alkaline soils, according to soil responses and CaCO3 concentration. These illustrations aid in identifying the traces of climate change in the tropical and subtropical soils of India and other countries. It is also useful to recognize the significance of precise soil grouping utilizing soil taxonomy to decipher climatic behavior and its change since soils have an incredible memory and meticulously preserve the events of the past [8]–[10].

CONCLUSION

The variety of soil types in India show that there is a significant amount of soil diversity due to the heterogeneity of a number of soil formation variables. In a nation with a developing agricultural system like India, it seems doubtful that the generalizations drawn thus far regarding Indian soils would be applicable more widely. In addition to paving the way for the creation of a handbook on Indian soils, this review will assist in establishing a connection between the pedology and edaphology of Indian soils and aid in the optimization of agricultural production in the twenty-first century. Realizing the inherent potential of tropical soils, Kellog predicted that eventually, the world's most productive agriculture would be concentrated in the tropics, though this will depend on how quickly institutions for research, education, and other public and private agricultural sectors develop. A huge need would be to properly manage tropical and sub-tropical soils for their restoration and maintenance during the renaissance in soil research. Even with enough rainfall, crops will perish if they are neglected.

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CHAPTER 6

AN OVERVIEW OF DEVELOPMENT OF HUMAN CULTURE

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ABSTRACT:

The world's oldest and biggest industry is still agriculture. Because it produces those goods that are necessary for human survival, it is regarded as one of the most significant economic activities worldwide. It makes a major contribution to the economic growth of a nation. Agriculture is often the only significant sector still in existence in developing nations, and an increase in agricultural production directly translates to an increase in a nation's GNP. The majority of these nations must rely heavily on the growth of the agricultural sector for their economic development in order to meet global food demand, to generate foreign exchange for overhead expenses, and to support the expansion of secondary industries to meet the rising demand for employment and to increase rural people's income.

KEYWORDS:

Agriculture, Evolution, Earth, Food, Human.

INTRODUCTION

Prehistory and recorded history are the two categories traditionally used to categories the development of human society. The latter came about with the development of writing and, therefore, of recorded historical records. The vast majority of prehistoric stone artefacts discovered in South India and the Soan Valley point to the presence of the oldest races of humans in India between 400,000 and 200,000 B.C. He developed his ability to manipulate fire, which benefited his way of life. Homo sapiens, the modern human species, first emerged around the conclusion of this era, somewhere about 36,000 B.C. [1].

Genetic History of Modern Man

At least four species of the genus Homo (man) lived on earth in the early Paleolithic:

i. **Homo Hails:** Louis S.B. Leakey found fragments of the cranium, hands, legs, and feet in Tanzania, East Africa, between 1960 and 1964. He stood four feet tall and made his own tools out of bones, tree branches, and bits of stone. The morphology of Homo habilis is too basic for it to be an ancestor of Homo erectus.

ii. **Homo erectus:** There were two groups of Homo erectus, (a) Java Man bones found in the c. 150,000–500,000 B.C. in 1891 on the island of Java. They stood 5 feet tall and engaged in group hunting. Remains of the Peking Man, who utilized fire to prepare food and stay warm approximately 500,000 B.C., as well as the earliest hand axe evidence, were discovered between 1926 and 1930.

iii. **Homo ergaster:** It resembles Homo sapiens more morphologically than H. erectus.

iv. **Homo sapiens:** The contemporary man was a 5′ 4″ tall, chiseled figure with prominent eyebrow ridges. He prepared his meals, but they were still semi-nomadic and lacked housing.

Modern humans are thought to have originated in Africa from a subset of the African population, according to certain nuclear DNA sequences (including Y-chromosome data) and mt DNA. This places Africa as the genesis of modern mankind. Africans and non-Africans had a common ancestor 59,000 years ago, and the non-African branch of humanity departed Africa about 44,000 years ago, according to a study of human Y-chromosome variance in a global sample of over 1,000 individuals. Africans and non-Africans parted around 156,000 years ago, according to other evidence. The actual migratory date falls somewhere in the middle of these two. These dates and the emergence of the modern human species as a species seem to be related in some way. It is believed that all human Y chromosomes outside of Africa had a final common ancestor approximately 40,000 years (31,000–79,000) ago. Another research of the Y-chromosome in 1,007 European males found that over 80% of the genes were linked to two Palaeolithic migrations that occurred 40,000 and 22,000 years ago, respectively. Neolithic farmers first arrived in Europe some 10,000 years ago, and their genes made up 20% of the population. Because early or primitive Homo sapiens were adaptable, they adopted a variety of lifestyles based on the local food resources. Both the Eskimo and early Europeans hunted reindeer. As migratory herds made their way from summer tundra pastures to winter forest shelters in the autumn, hunters encountered them. You could freeze this beef and utilize it all winter long. A form of spear-thrower, an early technical breakthrough, is used by modern Eskimos, Australian aborigines, and prehistoric people living in Glacial Europe. Lions, bears, bison, mammoths, woolly rhinoceroses, and wild ox were some of the animals that early Europeans had to deal with. Conifer woods provided the wood needed for cave fires. Because there was a shortage of fuel on the southern steppes, bone was used as fuel. The oldest indication of our prehuman forebears in this area is a set of Homo erectus fossils in Sunderland that date to between 600,000 and 900,000 years ago. The Negritos of Malaya and the Philippines, the Highlanders of New Guinea, and the Aborigines of Australia serve as modern-day representatives of the Australoid colonists of this region.

Development of Human Culture

A. **Stone age:** The Prehistoric Stone Age is divided into three phases based on the kind of tool-making material:

i. **The Paleolithic Period or Old/Ancient stone age (2.5 million-12,000 B.C.):**

The use of rough or chipped stone tools defined the period in human civilization. Man was basically a forager who relied on the natural world for his nourishment. He developed his ability to manipulate fire, which benefited his way of life. Homo sapiens, the modern human species, first emerged towards the conclusion of this era, somewhere about 36,000 B.C. The 2.5 million–12,000 B.C. Palaeolithic Period is also known as the Old Stone Age. beginning with the first humans who made tools and ending when mankind learnt to make better tools about 12,000 B.C. and to begin farming around 8,000 B.C. The New Stone Age, also known as the Neolithic Age (12000 to 4000 B.C.), is referred to as the "Age of Food Producers," whereas the Old Stone Age

is known as the "Age of Food Gatherers." According to this, the 'Age of Civilization' began at the end of the Neolithic Age and continued into the Bronze Age. There are three main categories of lifestyle: technological civilization, agriculture, and hunter-gatherer. Settlement in predetermined areas, the construction of towns and cities, the creation of predetermined forms of governance, and the growth of trade and commerce all contribute to or characterize civilization. Along with the first two, this social system has existed and continues to exist.

ii. Hunter gatherers:

Stone tools discovered from the 200,000–40,000-year-old Middle Palaeolithic, also known as the Middle Stone Age in Africa, are very comparable, demonstrating a global technology. Pebble tools were used in the earliest known tool site in East Africa 1.7 million years ago.

Ancient "landmarks" on the way to mankind include tools and fire. There is evidence that Homo erectus utilised fire for the first time in Ghoukoutien, China, between 300,000 and 400,000 years ago. Hunter-gatherers had a practical yet good understanding of their natural surroundings, including the plants, animals, and weather. Aborigines in Australia had access to up to 250 different food plants in fertile regions. 50 food factories were located in less wealthy communities. Up to 12,000 B.C., there was the Palaeolithic (Stone) Age. Rough stone was utilized for tools and other items by early man. Man was basically a forager who relied on the natural world for his nourishment.

iii. Ice Age (Upper Paleolithic - 35,000 to 8,000 B.C.)

Eastern Europe and Siberia were home to a mammoth hunting civilization during this time. Until recently, these nomadic hunters ate mostly meat, much as the Eskimos did. Their prey, which also included bison, horses, reindeer, birds, fish, arctic foxes, and hares, would have supplied them with all they needed. Vegetarian meals would have been a slight addition. Even houses were constructed from skin-covered mammoth bones that had been neatly linked. A typical Australian aboriginal's haul for the day would contain a few wallabies, anteaters, lizards, frogs, and grubs. The Semang people of Malaysia survive on hunting and gathering honey from the forest, along with small animals like fish, birds, rodents, squirrels, and sometimes wild pigs, tapirs, and deer. To kill certain animals, they fire a poisoned dart from a two-meter bamboo blowpipe.

iv. Beginning of Agriculture

The introduction of agricultural cultivation and animal husbandry, which gave rise to modern civilization, was likely influenced by demographic pressure. There was a greater reliance on plants as the population rose. Next, the implementation of some kind of intensive agriculture was compelled by consumer demand within a small area. Another example of this pattern may be seen in Peru, where guinea pigs and camelids were domesticated 2,000 years prior to the introduction of crops. Between 15,000 and 8,000 years ago, with the end of the last Ice Age, agriculture would have begun. People who lived a hunter-gatherer lifestyle earlier were dependent on the environment. According to historical evidence, agriculture began in the Near East approximately 8,500 years ago, spread to Britain around 6,000 years ago, and reached Spain and Portugal by 5,000 years ago. Modern-day descendants of hunter-gatherer people include the American Indians of central Brazil, known as the Kayapo. They reflect the change from a hunter-gatherer lifestyle to an agricultural one via the use of chickens, crops like maize, sweet potatoes,

sweet manioc and yams, as well as a hunting lifestyle. They had to share everything they took in when hunting, whether it was a tortoise, a deer, a fish, or a wild pig, and they opposed selfishness. Women gathered fruit, nuts, and plants in groups from the same forest where males go hunting. Ironically, when they came across a tall fruit tree, they used a metal axe to chop it down in order to harvest the ripe fruit. Food production shifts from wild animals and plants to domesticated crops and animals. Although agriculture, which only began to develop between 12,000 and 8,000 years ago, has frequently harmed the environment and brought about social changes that have made it possible for our modern civilization to develop. Agriculture was followed by the domestication of dogs and turkeys.

v. Mesolithic period or Meso stone age (12,000 to 7,500 B.C.)

The Mesolithic era started and lasted until 4000 B.C. to India. Microliths, which are very small storage objects, are its defining feature. At this time, swiftly moving animals were dispatched with the aid of pointed and sharp tools. Plant agriculture also started to take off. Around 10,000 B.C., humans discovered how to make better tools. And to begin farming around 8,000 B.C. The Old World had semi-permanent agricultural villages. The transition of societies from one based on food collecting to one based on food production. In this era, tools frequently had hooks or "barbs" that could be switched out. Plant agriculture also started to take off. Some of the various Mesolithic sites can be found on the Chotanagpur plateau, in central India, and south of the Krishna River.

vi. Neolithic or New Stone age (7500 B.C. to 6500 B.C.):

The name "lithium" derives from the Greek "lithos," which means stone, and "Neo," which means "new." The Indian subcontinent had human habitation between 7500 and 4000 B.C. Man started to tame animals and grow plants, establishing settlements to create agricultural communities. Neolithic time is when agriculture first emerged or was discovered. Western Asia has had an agricultural revolution at the same time. Tools made of polished stone have been created. The period of human civilization marked by the use of arrows, polished stone agricultural implements, pottery production, textile weaving, and basketry. In Neolithic period, two major periods were covered viz.

a. **8000-6000 B.C.**: Early agricultural settlement with domestic architecture and variety of crafts.

b. **8000-7000 B.C.**: The first phase lacked pottery; humans mostly utilized stone blades and a few hand axes made of crushed stone; they also had domesticated sheep and goats, a domesticated crop of wheat; mud-brick dwellings; and rudimentary burial customs.

c. **7000-6000 B.C.**: Between 7000 and 6000 B.C., pottery starts to develop; domestic cattle replace game animals, lambs, and goats; the appearance of granaries indicates agricultural surpluses; more complex burial rites; and clay figures of people.

d. **5000-3000 B.C.:** Around 5500 B.C., a significant earthquake, flood, or tectonic plate movement occurred, leaving the ancient site nearly entirely covered in silt. The original civilization continued, but with modifications, including increasing pottery usage, bigger and more frequent granaries, the introduction of various new crafts using copper and ivory, and a rise in population size. From 4,000 to 2,500 years B.C., there was the Chalcolithic period [2].

e. **Bronze Age (4000 to 2000 B.C.)**: The tribes employing stone tools with copper or bronze ones are referred to as Chalcolithic. Plough, wheel, and metallurgy have all been invented. Egyptian calendar's oldest known date was 4241 B.C. 3760 B.C. was the first year on the Jewish calendar. In 3500 B.C., the earliest phonetic writing appears. In the year 3000 B.C., Sumerians establish a city-state civilization. Egyptian and Sumerian usage of copper. The complex and vast Indus Valley civilization, the oldest civilization on the Indian subcontinent, flourished in what is now Pakistan. The Bronze Age, a time in prehistoric human society marked by the use of bronze, lasted between 4000 and 3000 B.C. and came to an end with the arrival of the Iron Age. Several religious traditions place the beginning of time at around 3800 B.C. was the sad banishing of "Adam and Eve" to the agricultural wasteland of Eden.

f. **Iron Age (1500 B.C. onwards)**: Starting about 1450 A.D. The Iron Age (1500 B.C.–present). A time of renewed glacial advance is referred to as "The Little Ice Age." While sea ice in the North Atlantic increased and had negative effects on the colonies of Iceland and Greenland, glaciers advanced in Europe, Asia, and North America.

Technological Civilization

Rather than a specific point in time, the rise of a technological civilization is an issue of degree. Early Egyptian cultures had advanced technology, which made it possible to build structures like the pyramids. Humans have used technology since they first used stones as tools, much as certain chimpanzee tribes do now. Due to the elimination of the need for people to travel in search of food, villages and cities were made feasible with the advent of agriculture. This sedentary lifestyle served as the foundation for modern civilization that is the term "civilization" is derived from the Latin word "civitas," which means city. By 5,000 years ago, Mesopotamia and Egypt had irrigation systems in place. By 2,600 years ago, the iron plough had been developed in China, where it had supplanted the stone and wood ploughs as a more efficient implement. By 2,100 years ago, they had also invented the mound board plough.

The use of fire, the use of metals like gold and copper, bows and arrows, the fish hook, spinning and weaving, agriculture, the domestication of animals, sailboats and ships, wells and irrigation, pottery, clothing, language, arithmetic, the alphabet, and written communication were all basic inventions made by ancient people. North Africa has the earliest evidence of the bow and arrow, which dates back 20,000 years. Seed drills, one of the most ancient agricultural innovations, were used in Mesopotamia 5,500 years ago. Over 4,600 years ago, people at Saqqara built the pyramid. Domes, for example, were created by architects and were constructed in Ancient Cyprus 5,000 years ago. The discovery and usage of "metals" had a significant role in the development of our culture. The production of a far greater variety of utensils, tools, and instruments than could be constructed with wood and bone was made possible by the malleability of metals, which allowed for inventions only limited by human imagination. The people who lived around the Euphrates and Tigris rivers in what is now Iraq were among the first to utilise metals some 10,000 years ago because copper was occasionally discovered in virtually pure form. At least 5,500 years ago, gold was in use [3].

Two thousand years ago, gold was being used as tooth fillings by Roman dentists. There were 6,000 years of silver usage. Iron, the hardest metal to extract from its source, was first created by Egypt 4,000 years ago. Iron smelting was a sophisticated technique used by the Assyrians, who

even produced steel from iron. The usage of labor-saving technologies was widespread in ancient Greece. They used the screw, the winch or windlass, the block with pulleys, the lever, and the wedge. Despite not being the inventors, scientists like Archimedes (2300 years ago) were involved in these developments. The screw, which was likely invented in ancient Egypt, was used to convey water throughout the Middle East. Prior to A.D. The rotation of crops and the Saxon wheeled and horse-drawn plough were two significant technologies that were adopted in Europe about the year 1,000. In 1066 A.D., water wheels were being used in England for a variety of tasks, including sawing and grinding wood. Johan Gutenberg, a German, created printing using moveable type towards the end of the Middle Ages and the start of the Renaissance. The earliest known printed book was his Gutenberg Bible, published in 1455. The mechanical clock and the watch with balance wheel were created in the Middle Ages around 1286.

The remainder of the globe was first discovered and explored by Europeans in the fourteenth century. In 1492, Columbus arrived in the Americas. In 1494, Bartholomew Diaz arrived at the Cape of Good Hope in Africa. In 1497, Vasco De Gama travelled from Africa to India. The Copernicus "De Revolutionibus Orbium Coelestium" published in 1543 proved that the earth orbited the sun. Marco Polo claims that between 1271 and 1292, China invented the compass, paper money, printing technology, and coal as a fuel, none of which were used in Europe. The development of the steam engine and automated regulators in the middle of the eighteenth century marked the beginning of the modern age of technology. Throughout the Industrial Revolution and up until 1830, the primary source of mechanical power in England was still water mills. In 1784, a wheat thresher was created in Scotland. In the 1830s, a horse-drawn combine harvester was in use to reap, separate the chaff, and dump the grain into bags.

Around AD, paper was created in China. 100. In 1868, a functional typewriter was patented. In 1642, French mathematician Blaise Pascal created the first automated calculator. This was evolved into Boolean algebra and Boolean Logic by mathematician George Boole. This served as the foundation for computer languages and reasoning. In 1801, J.M. mechanised the weaving of fabric. employing punched cards for jacquard. In the 1830s, Charles Babbage (1791-1871) endeavored to create a "analytical engine" a mechanical computer using punched cards. Herman Hollerith, an American inventor, created a functional computer utilizing punched cards and electricity in 1888. With the use of payroll, census, and other data, this was the first stage of automated data processing, producing tabulated results. He sold the Tabulating Machine Company in 1911, and it later changed its name to the Computing-Tabulating-Recording Company [4].

DISCUSSION

Man is said to have first appeared on Earth roughly 15 lakh years ago. The monkey that gave rise to this man began by standing upright on his feet before moving. Homo erectus Java man is the name given to such a guy. Later, Cro-Magnon evolved into modern man, and Java man into Cro-Magnon. Zoologically speaking, the modern man is referred to as Homo sapiens Homo-Continuous, Sapiens - learning habit. At first, these men lived freely, but between 8700 and 7700 BC, they began to care for sheep and goats, while the first pet was a dog that was trained for hunting. The history of agriculture and civilization is intertwined because food production allowed prehistoric man to settle down in certain locations, which in turn led to the creation of societies and the beginning of civilization. Agriculture and civilization both went through many

periods of development. The phases were first categorized by archaeologists as Stone, Bronze, and Iron Ages. The Stone Age was then divided into the Palaeolithic, Neolithic, and Mesolithic periods (sometimes known as the New and Middle Stone Ages). Each of the three eras experienced definite advancements. To assist them in daily life, the man made and developed tools out of stones, bones, wood, etc. They began raising domesticated animals including cows, sheep, goats, and dogs, among other food crops [5]–[7].

CONCLUSION

We've gathered a variety of papers in this special issue of Evolutionary Applications to give you a taste of how human selection, both consciously and unconsciously, has influenced evolution and the evolution of modern agriculture. Since agriculture's inception thousands of years ago, it has served as a catalyst for evolutionary change. This change now permeates agricultural activities at all levels of biological organization, from the individual gene to entire communities. Thus, agro-ecosystems offer one of the clearest illustrations of circumstances in which anthropogenic influences are key drivers of biotic interactions within and among species and communities, pointing to a crucial role for the application of evolutionary principles. This is especially true in light of the widespread worries about food security and production, as well as the growing expectation that increases in agricultural productivity must be made with less negative environmental effect. The transition from a nomadic hunter-gatherer lifestyle to a somewhat stable way of life in the history of human civilization was extremely significant, and it was only made possible by the invention and acceptance of early agricultural practices. The agricultural environment, and therefore the features and qualities of plants and animals that were favored both consciously and subconsciously by people, were significantly impacted by this shift in human lifestyle. In contrast, some qualities were especially favored by the more protected environment agriculture offered and rose in frequency. Very often, traits suited to species thriving without human protection/husbandry were not fit for agriculture and quickly disappeared.

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CHAPTER 7

AN OVERVIEW OF INDUS CIVILIZATION

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ABSTRACT:

One of the oldest and most sophisticated civilizations in antiquity, the Indus Civilization, also known as the Harappan Civilization, flourished in the Indus Valley from around 2600 BCE to 1900 BCE. The adoption of standardized weights and measures, sophisticated water management techniques, and urban planning all define the civilization. In addition to being adept at writing, the Indus people were also talented in metallurgy, commerce, and crafts. Their distinctive script, which has yet to be completely decoded, sheds light on their complex social structure. Despite its many accomplishments, the Indus Civilization eventually declined and vanished, leaving behind a legacy that has shaped South Asian cultures for millennia. The Indus Civilization is briefly described in this abstract, which also emphasizes its significance in the progression of human history.

KEYWORDS:

Climate Culture Linkages, Indus Civilization, Indian Summer Monsoon, Pale climate.

INTRODUCTION

Mesopotamia and ancient Egypt are the two greatest civilizations of the ancient world. Following them in a jumbled order are ancient China, Greece, Central and South America, and the Indus Valley civilization, also known as the Harappan civilization. Indian culture has a long history and has many rich cultural traditions. The Indus Valley civilization was the term given to this civilization since it was believed to have existed only in the Indus River Valley. Mohenjodaro and Harappa, two of this civilization's highly constructed urban centers, stand as the pinnacle of human habitation. Archaeological digs conducted later revealed that this civilization's boundaries extended well beyond the Indus basin and into western and northern India. As a result, the Harappan civilization is becoming a more popular name for this culture.

The main archaeological sites in India include Kalibangan in Rajasthan, Lothal in Gujarat, and Ropar in Punjab. Mohenjo-daro and Harappa are now in Pakistan. The most well-known Harappan site in Western Asia, according to recent study, is Sutkagen Dor in Baluchistan, near to Iran. The Indus Valley Civilization covered all of Gujarat, Baluchistan, Northern Rajasthan, Punjab, Sindh, and Baluchistan. One of the three major early civilizations that flourished in the late fourth and early third millennia B.C. was this one. surrounds the Tigris-Euphrates, Nile, and Indus rivers' three major alluvial systems. India placed a focus on a rich culture without ignoring

the practical world. Indian culture may be compared to that of the United States or Australia in terms of age and material accomplishments, which span two centuries [1].

A. Physical Data

With just a handful of big cities, the more than 1,500 communities that make up the Harappan civilisation are mostly tiny villages or towns. Some of the "villages" were larger than twenty hectares, while the cities, such as Mohenjo-daro, sometimes spanned between eighty and 250 hectares. The easternmost settlement as of now is Alamgirpur in Western Uttar Pradesh, and the western limits were the Arabian Sea and the entire Makran coast, almost all the way to the current Pakistan-Iran border. The southern limit was between the Tapti and the Godavari rivers, and the northern limit was about 1,400 km away in Kashmir (at Manda), though one site, Shortughai, is found even farther up, in Afghanistan. Harappa is a site on the west bank of the Ravi; Kalibangan is a site on the right bank of the Sutlej; Amri is a site on the west bank of the Indus (near the Arabian Sea); Banawali is a site situated about 120 kilometres east of Kalibangan and 15 kilometres northwest of Fatehbad; Lothal and Rangpur are sites beneath the Rann of Kutch.

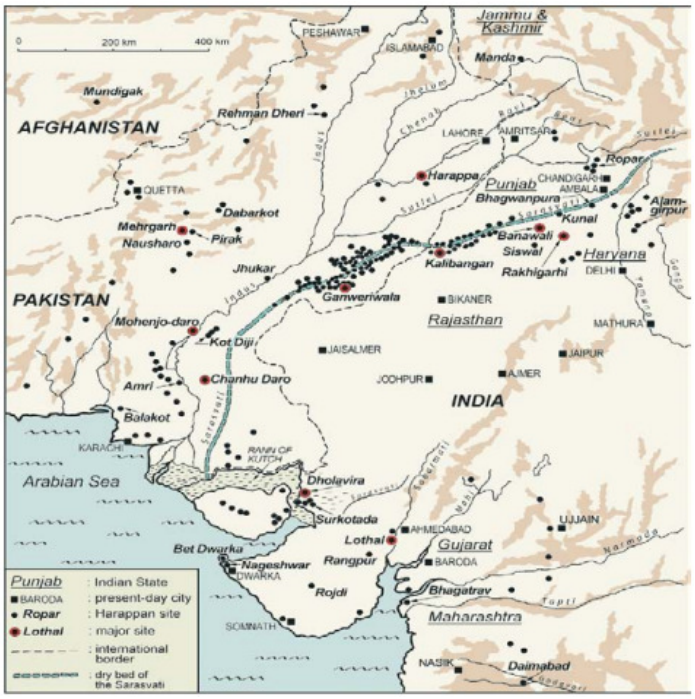

Figure 1: Illustrated theHarappan civilization along the dry bed of the Sarasvati.

Along the Ravi and its tributaries, on both sides of the Indo-Pakistan border, and along the dry bed of a sizable river called Sarasvati in the Ghaggar-Hakra valley, the Indus or "Sindhu" civilization, which included the settlements Mohenjo-daro and Harappa, was discovered. The well-known communities of Kalibangan and Banawali are located at the enormous sites of Ganweriwala and Lakhmirwala. Gujarat has several locations, including Lothal. The water that is still there underneath the dry riverbed in the Rajasthani desert has recently been radioisotope-dated. Some academics have argued that the Harappan civilization would be better known as the "Indus-Sarasvati civilization" since the sites discovered along the Sarasvati River are by far more

numerous than those in the Indus basin. The subcontinent itself is where the Indus-Sarasvati civilization had its roots. Although it undoubtedly had numerous cultural and commercial contacts with other civilizations, it retained a unique identity. Around 3000 to 1700 B.C., the Sarasvati-Sindhu civilization was at its height. On the Sarasvati and Indus River valleys. People moved from the Rann of Kutch and the Pravara River valley, along the Arabian Sea coast, southward due to the drying up of the Sarasvati River, and eastward to the Ganga-Yamuna doab. In the third to second millennia B.C., the old Sarasvati River, which originated from the Sutlej and flowed through Northern Rajasthan, Bahawalpur, and Sind before entering the Arabian Sea via the Rann of Kutch. Sarasvati's etymology translates to "abundance of lakes." Brahmi, the term given to the ancient scripts employed in Asoka's epigraphs from about 300 B.C., is a synonym of Sarasvati. 5000–2600 B.C. Indus sites have been studied by American archaeologist Jonathan Mark Kenoyer [2].

River Migrations in Western India

The main route between Hastinapur and Dwaraka could have been made up of the dried-up Sarasvati riverbed. Geographically, the Ghaggar canals are where the Sarasvati basin was first discovered. It's possible that Ghaggar was a stream that originated in the Siwalik Mountains and joined the Sarasvati. Through Sind, this network parallels the Indus. From the Himalayas to the Rann of Kutch, the river flowed. An earthquake might have dried up the river by raising the whole river-sea bed profile since the Sarasvati riverbed and the arm of the Arabian Sea into which it flowed are both on an earthquake fault. This might explain how the Thar Desert in Pakistan and on the left bank of the river were formed during prior earthquakes. Did ancient civilizations support agriculture on some stretches of the Thar Desert? There is subsurface water in certain sections, according to geological assessments.

On each side of the Indus river's path, there is a very large flood plain that may reach maximum widths of 100–120 km in the east and southeast. The Indus River has preferentially moved towards the north-west in the northern portions and towards the west in the center and southern parts, as shown by the presence of such a large flood plain on just one side. The analysis of remotely sensed data in Rajasthan's desert region reveals that there are several paleochannels with well-developed tentacles all throughout the desert. In satellite images, a well-developed network of paleochannels can be seen in the Ganganagar-Anupgarh plains, which are located on the northern border of the Thar-Great Indian desert. Originally flowing close to the Aravalli Mountain ranges and meeting the Arabian Sea in the Rann of Kutch, the Saraswati River has since moved west, northwest, and north before becoming lost in the Anupgarh plains.

The Saraswati River, which is thought to be lost in the desert, may be followed via these paleochannels as a migratory river, according to remote sensing research of the Great Indian Desert. Its first path was near to the Aravalli hills, and the next six stages made shifts to the west and northwest until they met the dry bed of the Ghaggar river. These results are additionally supported by groundwater, archaeological, and pedological evidence together with chosen ground truths. River Saraswati movement seems to be encouraged by different climate changes in the Hardwar-Delhi ridge zone, Luni-Surki lineament, Cambay Graben, and Kutch fault. Climate change - The Indus Valley Culture seen in the context of post-glacial climatic and ecological studies in North-West India: suggests that "...the significant increase in rainfall at the beginning of the third millennium B.C., attested by palaeoecological evidence, played an important role in the sudden expansion of the Neolithic-C." Yamuna River's stream piracy at a

later stage is to blame for the ultimate loss of water and drying up of the Sara According to the available data, the area first became dry approximately 1800 B.C. likely led to the Harappan culture's decline in the dry and semi-arid regions of north-western India.

Saraswati River Civilization

The civilisation came to be known as Harappan when the first archaeological site at Harappa was discovered in 1920. It was given the new name of the Indus civilisation after the discovery of another significant site at Mohenjo-daro in the same decade. Numerous new types of sites have been discovered since the 1950s. The locations of Rupar, Kalibangan, Lothal, Dholavira, and Banawali in particular. The 'lost' Sarasvati River is where these sites are located, and this is what makes their location distinctive. As a result, the civilisation needs to be renamed Indus-Sarasvati civilization. The Rigvedas sing the praises of the Sarasvati River. Despite not being as impressive as the urban Harappa, Kalibangan and Lothal are typical examples of Indus/Sarasvati civilization sites. The lost Saraswati River channel has shown that there is a river that flows from the Siwalik Ranges and that the Yamuna and Indus Rivers have changed courses. With the help of the uplifted terrain brought on by earthquakes, Sarasvati may have dried up when the Yamuna and Sutlej seized the water supplies. The remaining portion of the river has vanished in the margins of the maru-sthall or the thar desert, while a portion of it still remains as Ghaggar in Haryana.

a. **The Cities:** The most advanced town planning was found in the Harappan cities. Geometrically designed, the towns had fortifications (for defence against intruders and floods), several distinct quarters, assembly halls, and manufacturing units of various types; some bigger cities had furnaces for producing copper tools, weapons, or ornaments; public baths (probably frequently part of temples); private baths for the majority of residents; sewerage through underground drains built with precisely laid bricks; and an effective water management with n For instance, it's estimated that Mohenjo-daro had over 700 wells, some of which were fifteen metres deep and were constructed with specific trapezoid bricks (to avoid collapse due to pressure from the earth around them). The archaeologist from India, B.B. In a recent in-depth analysis of this civilization, Lal notes that "well-regulated streets [were] oriented almost always along with the cardinal directions, thus forming a gridiron pattern, and even the widths of these streets were in a set ratio, i.e., if the narrowest lane was one unit in width, the other streets were twice, three times, and so on. A town layout like that was unheard of in modern West Asia.

b. **Agriculture, Technology and Trade in Harappa during 1600 B.C.:** The Harappans had attained a high level of sophistication throughout the Chalcolithic era. They used ivory combs and copper mirrors and dressed in cotton. The ladies wore bronze and gold jewelry. They used tools fashioned of bronze and copper fishhooks, such as sickles, saws, knife blades, spears, axes, arrowheads, and daggers. These items were made by skilled craftsmen such as coppersmiths, carpenters, jewellers, goldsmiths, stone cutters, and potters, who established specialized occupations outside of agriculture. Trade with other nations, particularly Mesopotamia, prospered, and imports of rare stones, metals, and wood were made. Bread wheat, barley, sesame, pea, melon, date palm, and Brassica spp. were all grown by the Harappans. A significant crop, Gossypium arboretum, originated in the Indus Valley. With extremely significant settlements at several sites in Jammu and

Kashmir, Punjab, Haryana, Rajasthan, Gujarat, Uttar Pradesh, and Madhya Pradesh, Harappan civilization occupied a very large territory in north India. The rice grown in Harappa had long-seeded grains and may have been related to the odoriferous basmati rice. The other food crops were jowar and wheat.

c. **Neolithic (7500–6500 B.C.) and Chalcolithic (2295–1300 B.C.)**: Jowar, bajra, and ragi (Eleusine coracana) were the primary crops grown throughout these periods. Minor millets such sannuk (Echinochloa frumentacea), kundon (Paspalum milliaceum), and kangni (Setaria italica) were also grown. Kulthi (Dolichos bifiorus), mung (Vigna radiata), mash (urd; black gramme; Vigna mungo), masur (Lens culinaris), linseed (Linum usitatissimum), and castor (Ricinus communis), as well as amla (Emblica officinalis) and ber (Ziziphus nummularia) were planted as additional crops. Acacia, Albizia, Ziziphus mauritiana, and teak (Tectona grandis) wood were used to make agricultural tools and for timber. For moosal (mortar) marking, Zizphus mauritiana wood was utilised.

d. In the Neolithic period, between 8000 and 5500 B.C., in the northwestern sector, Baluchistan, Pakistan, and its borderlands with Iran and Afghanistan, full-time hunting-foraging practises were gradually replaced by the development of plants through diffusion and domestication in ancient India and the borderlands. Wheat, hulled barley, and bare barley were all grown during the early Chalcolithic era (4700-4300 B.C.). In addition to dates, cotton, jujube, and prunus fruits were introduced to the plant economy. Barley (hulled and naked) and high yielding hexaploid wheat (bread, club, and dwarf) cultivation also continued. crop remnants of hulled barley and wheat (emmer, bread, club, and dwarf) from 3500 to 3200 B.C. in addition to apricots. Barley (6 row hulled, 6 row naked, 6 row shot), lentil, chickpea, flax/linseed, jujube, grape, cotton, and dates were all produced between 3200 and 2500 B.C. The Indus-Saraswati Yamuna Ganga valleys are home to several species of minor millets, cereals, legumes, oil seed crops, fibre crops, fruits, vegetables, and other economic plant species in addition to rice. At Atranjikhera (around 2000–1500 B.C.), farmers rotated rice and barely in addition to grass pea and chickpea. In the rainy season, farmers grew rice, black gramme, green gramme, and bread and lentils in the winter. Along with cereal, vegetables, and fruit, the population also consumed fish, poultry, mutton, beef, and pork. The cultivation of cotton was perhaps the most astonishing accomplishment. There was a vast canal system for irrigation [3].

e. About 2900 B.C., the Sumerians invented the plough. It's possible that the Sumerians taught the Harappans how to utilise the plough. Wood is a perishable material, and all early ploughs were built of it. A plough model made of clay measuring 7 cm by 19.7 cm has been found at Mohenjo-daro. The Prince of Wales Museum in Bombay is where you may find this miniature plough. The plough breast culminates in a rectangular shape and there is a rather lengthy beam. There is no proof that it had a handle for the ploughman to hold (munna). The inhabitants of Kalibangan engaged in agriculture and tamed animals. A field that had been ploughed was found to the southeast of the pre-Harappan village. A grid of furrows was visible, one set of which was more tightly placed (approximately 30 cm apart) and ran east-west, while the other was more widely spread and ran north-south. This design is very similar to the way that ploughing is now done, when mustard and gramme are cultivated in separate rows in the same field.

f. S.R. Rao has published an image of a seal from Lothal that he believes resembles a seed drill in his book Lothal and the Indus Civilization. However, it has an unusual shape for a seed-drill. Around 3000 B.C., ox-drawn sledges were still in use. to transport royal bodies to their ultimate resting place at Dr. But long before that time, a discovery that transformed land transportation had also altered the sledge. The wheel was the pinnacle of early human carpentry; it is a necessary component of modern technology, and when used in transportation, it transformed the sledge into a cart or waggon. Wheeled vehicles were shown in Sumerian art as early as 3500 B.C., and maybe even earlier in northern Syria. Carts, waggons, and even chariots were widely used in Elam, Mesopotamia, and Syria by 3000 B.C. Wheeled carts were in use in the Indus Valley when the archaeological record dates back to about 2300 B.C. likewise about the same time in Turkistan. Wheeled carts may be seen in children's toys from Mohenjo-daro, Harappa, Lothal, and Chandigarh, which suggests that they were used in everyday life [4].

g. At Harappa, cart models made of bronze have also been discovered. The wooden plough was heavily used by the populace. Kalibangan even produced a field that had been ploughed with two networks of furrows that were perpendicular to one another. In this field, taller crops (like mustard) were planted in the spaced-out north-south furrows, throwing shorter shadows, while shorter crops (like gramme) occupied the continuous east-west furrows. This method is still used in the same area today. Additionally, there is proof that cats, dogs, goats, sheep, and possibly elephants were domesticated.

h. A civilization like that of the Indus civilization that is capable of town planning, shipping, fine arts and crafts, writing, and continuous commerce must obviously be well-versed in technology. Indus religious and cultural symbols were interwoven into pottery, jewellery, and commonplace objects in a manner that served to bind people together in urban areas and connect them to remote rural villages. In return for silver and other goods, cotton textiles, ivory, and copper were sent to Mesopotamia, as well as potentially China and Burma. A variety of metals, including copper, bronze, lead, and tin, were also produced. There was no iron among the Indus people. The ceramics, stone carving, and seal-making of the inhabitants showed their great artistic talent. The finding of brick-making kilns provides evidence that burned bricks were widely utilized in residential and public structures. The populace-maintained trade relations with Samaritans, Egypt, Mesopotamia, Afghanistan, and Persia. 'Barter' was the primary mode of exchange. Weights and measurements were arranged in a shrewd manner [5].

i. **Government and Social Evolution:** The link between the Indus-Saraswati civilization and the subsequent Indian civilization is still up for discussion. Dravidians were the original inhabitants of India, and their civilization had advanced to a very high level of sophistication. The Brahui tribe, which lives in Baluchistan to the west of the Indus and speaks a Dravidian language similar to South Indian Tamil, provides proof that there was a movement of people or culture. The Indus Valley civilization's language is thought to have been a form of Dravidian related to Old Tamil, which is still spoken over the southernmost region of the Indian Peninsula. The desert between the Indus and Sarasvati River basins in south Asia is known in Sanskrit as Maru. It is also known as 'thar' in India and 'thal' in Pakistan. The Indus-Sarasvati River valley's submerged region, which supported agriculture, was marsh when the "Maru" people first settled there. In Tamil, the term "maru" (which means marshland or a river valley) is used to denote agricultural

areas (or "marutam"). According to a study of India's script evolution, the Dravidian people have largely contributed to the country's development of language and literature throughout the centuries [6].

DISCUSSION

From their ancestral home in Europe or Central Asia, the Aryans moved. Semi-barbarian Aryans riding down in their horse chariots decimated the Harappan settlements. According to legend, the Aryans crossed the Khyber Pass into India and either conquered or coexisted peacefully with the inhabitants of the Indus Valley as least as early as 1600 B.C. The Aryans crossed the Sindhu River and established themselves in an area known as Saptsindu, or the "land of seven rivers" (now the "land of five rivers," the Punjab). The Aryans were Indo-European herdsmen from the Asian steppes who were warlike. Aryans used bronze weapons and were skilled horsemen. Their cavalry warfare allowed them to expand their civilization from the Punjab to northern India, paving the stage for the rise of great empires. Astronomy was regarded to be an essential component of Aryan statecraft and the Aryans possessed a sophisticated understanding of the astral sciences. Sanskrit was the language of the Aryans, who practised polytheism (one of Hinduism's fundamental tenets) and had a stratified social structure with Kshatriyas (warriors) to rule and Brahmins (priests and teachers) at the top, supported by Vaisyas (farmers) and the Sudras (outcasts) [7], [8].

CONCLUSION

To set themselves apart from the people they subjugated, the Aryans referred to themselves as the "noble ones" or the "superior ones." The Aryans were a tribal and nomadic people living in the steppe lands of EuroAsia; their name is derived from the Indo-European root word "ar," meaning "noble"; that root would also serve as the foundation of the name of the conquered Persian territories, "Iran"; this concept of nobility, in fact, seems to lie at the heart of Indo-European consciousness, for it appears in another country's name, "Ireland," They were a hardy, warlike, and violent tribe. Their way of life was centered on combat. They were controlled by a war-chief, or "raja," which has the same origin with the term "regal" in English. They ride horses for travelling, and they charge into combat on chariots. In the year 2000 B.C., they started to move southward, conquering Persia and parts of India in waves. They swarmed throughout the northern river plains of India as they swiftly swept across Persia. They migrated into India from the north-west, initially establishing themselves in the Indus Valley and then along the Ganges floodplain.

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CHAPTER 8

AN OVERVIEW OF THE STATUS OF AGRICULTURE IN DIFFERENT AGES

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ABSTRACT:

A number of distinct eras may be identified in the history of agriculture, each of which was characterized by a dramatic shift in agricultural methods and equipment. This essay gives a general summary of agriculture throughout the years, from the prehistoric period when people first started domesticating plants and animals to the ancient, mediaeval, and modern periods. Agriculture was fundamental in forming human societies, economics, and cultures throughout history. In contrast to the ancient era, which witnessed the construction of sophisticated irrigation systems and the growth of large-scale farming communities, the prehistoric era was characterized by the development of subsistence agriculture. The extension of feudalism and the expansion of feudal estates occurred during the mediaeval era, whereas the development of industrial agriculture and the emergence of world food systems occurred during the modern era. Building more resilient and sustainable food systems for the future can benefit from an understanding of the development of agriculture throughout history and the lessons that can be learnt from each period.

KEYWORDS:

Animal Husbandry, Agriculture, Environment, Farming, Vedic Period.

INTRODUCTION

Aryans' ancestral habitat during the Vedic period (1600–1000 B.C.) was in southern Russia, in the steppes between the Danube, Volga, and Urals. Another passage said that Germany was the Aryans' ancestral home. In the year 1600 B.C., the Aryans left their ancestral home and dispersed in vast numbers to the east and west. The Indus Valley was home to the early Vedic Aryans, who were predominantly pastoralists. They cleared jungles to make way for their communities, grazed their cattle there, and planted barley on the area nearby where they lived. Cows and horses were common among Vedic Aryans; buffalo, which they named gouri or govala possibly an expansion of the term gau (cow) was a novel animal. 'Saptasindhavah' is the name given to the Indus Valley, a region with seven rivers. The Sutudri (Sutlej), the Vipas (Beas), the Parushini (Ravi), and the Askini (Chenab) were among the seven rivers, while the Indus and Saraswathi made up the final two. The Punjab is known as the "land of five rivers."

As soon as the Saraswati River dried up, Aryans started to travel in quest of water. The Ganga entered the Indian plains thanks to the efforts of monarch Bhahirath, and storage cultures

emerged in the Indo-Gangetic lowlands. The Aryans were known as nomads because they were constantly on the road in search of pasturelands for their livestock. They have a met, camped, and departed way of life. This civilization is superior to the people who had previously been inhabiting India for thousands of years and had created agriculture. Strong towns and a class of artisans and craftsmen were made possible by domesticated animals. The Aryans' introduction of horses to India is one of the compelling justifications for their invasion from the Russian steppes. The horse could have been imported to India during the Chalcolithic period when trade with Mesopotamia and other cultures was taking place, when cotton textile and other goods were being exported. Horses brought by Middle Eastern traders were for sale in the bazaars even during the reign of Chandragupta Mayurya [1].

The earliest book, the Rigveda, was written approximately 3700 B.C. Ploughing was done with much pomp at the start of the agricultural season and was tied with a number of rites. Numerous hymns are dedicated to Shuna, Sita, and Shunshira. Sita has been described to as both the share of the plough and the goddess of the early. The three principal crops were sugarcane, sesame, and barley (yava). As a husbandman ploughs the ground repeatedly for barley, the barley is properly sown in the fields by the plough, and the cattle eat the barley. During harvest, prayers were said. Most of the time, a sickle was used to chop the crops at ground level or only the ear heads.

i. **Environment (Rigveda):**The phrase "the sun destroys all non-visible poisonous creatures" refers to venomous nocturnal animals like snakes and scorpions. The sun serves as a protector, a cleanser, and a source of plenty. Water is said to rise from the ground throughout the summer via evaporation, cloud formation, and then return to the earth as rain. Summertime surface water loss must have been simple to see. Grishma (May–June), Varsha (July–August), Hemant (September–October), Sharad (November–December), Shishir (January–February), and Vasant (March–April) are the six seasons that make up a year. After June 21, when the sun begins to "move south," the rainy season officially begins (obviously in Pakistan and North-West India). On the seven rivers, there were dams. Building dams across rivers must have meant denying the Vedic people access to the water they needed to cultivate their fields, supply water to people and animals after rainstorms, and hence increase food production.

ii. **Farming resources and practices (Rigveda)**: A farmer regularly ploughs his fields. The sun created six seasons that cycle back on themselves. Sutlej and Vyas rivers were crossed using bullock carts and chariots. Bullocks should be yoked to the plough, yokes should be joined, seed should be sown, enough food should be provided, and the sickle should fall on the mature crop. Sumps were built to provide irrigation from never-drying pits, leather ropes, and animal drinking water. Crop-raising activities in the fields were well established. For the Vedic Aryans, using a plough to cultivate ground and grow barley was already a "ancient practise". Different types of soils and productive and unproductive fields were identified. Multiple plowings were used to prepare the soil. Seasons were divided into six categories, which are still used today. For measuring land, a bamboo stick of a certain size was used. To make plough and sow operations easier, the soil profile was soaked with water. Although shallow wells were used for irrigation, well water was used for drinking. There was a mention of irrigation that could have come from rivers.

Undoubtedly in the post-rainy season, bovine strength was employed for plough work as well as for dragging cattle carriages and chariots over rivers like the Sutlej and Vyas. Work was available for labourers. Other farming activities included scaring birds, using a sickle to harvest, threshing, and winnowing with a titau (suba). Gains were also stored in storage bins, and trash and waste were burned. After the grain crop was harvested, barley was ratooned on the remaining moisture possibly for fodder. Other cereals were consumed besides barley. Evidently, barley was toasted to create saktu (roasted barley grain flour) [2].

iii. **Forestry (Rigveda):**There are other trees mentioned, including the peepal (pippala), khadir, shisham palasa shalmali, and urvaruka. The Pippala tree is revered. Fruits from urvaruka are edible. Even now, furniture is made from the same woods that were used to build chariots: khadir and shisham. There are many grasses listed. Some of which are still used for rope, mats, cottage roofs, religious rituals, and other purposes.

iv. **Animal husbandry (Rigveda):**In the presence of their calf, a cow gives an abundant supply of milk. Do not slaughter a cow that is the mother of Rudras, the daughter of Vasus, the sister of Aditya, and one that produces milk and is uncomplicated and innocent. In the Rigveda, various animals are mentioned, including donkeys, camels, sheep, and horses. Black and red cows are the two hues specified. It seems that long-nosed cows were prized. Horses, camels and donkeys were all utilised for transportation and probably for pulling weights. The Rigveda makes reference to cow thievery because animals were considered a symbol of riches. The enemy's cows were taken as booty. Chickpeas were utilized as horse feed because they are still regarded as a beneficial source of protein for horses when they are soaked in water. Horse cleaning was plainly preferable. Grazing in woodlands seems to have been a frequent practise while managing cows. Barley fields were open to cow grazing, and it seems that cattle owners were aware of the advantages of supplying ponds with clean, safe water for their animals. Dogs were employed to control cow herds and track down stolen cattle. The lads clearly took care of the cows as they grazed since they were calling the animals for milking while holding some grass. It is common to burn dried cow dung as firewood. Killing cows was obviously forbidden due to the innocence of the animal as well as the fact that it was crucial for human existence.

In the later Vedic period (1000-600 B.C.), agriculture implements were improved. Iron ploughshares were used.

i. **EndoftheIndusCivilization:** The Mohenjo-Daro and Harappa cultures steadily deteriorated and eventually vanished about 1750 B.C. It is difficult to pinpoint the exact reason(s) why the Indus civilization came to an end. Some attribute this to the soil's declining fertility as a result of the neighboring desert's expansion and the soil's increasing salinity. Others claim that there was some sort of land depression that contributed to the flooding. At Mohenjo-Daro, large groups of sprawling skeletons from this time period indicate a massacre or invasion. The Rig Veda was produced by the priests of the tribes whose members destroyed the Indus towns. Following the decline of Harappa and Mohenjo-Daro, the Indus Valley culture moved from the west to the east of the Ganga-Jamuna-Doab region, with sites in central and southern India

flourishing. A portion of the story of the Aryan invasion of the south was revealed in the Ramayan [3].

ii. **Status of Farmers in Society:**In India, agriculture and animal husbandry have been evolved since before the Vedic era. Thousands of cows, horses drawn by chariots, racetracks where chariot races were conducted, camels drawn by chariots, sheep and goats presented as sacrificed victims, and the use of wool for clothing are all mentioned in the Rigveda. The well-known Cow-Sukta shows how the cow had already evolved into the basic foundation of rural economics. She is deified in another Sukta as the mother of the Vasus, Rudras, and Adityas as well as the key to immortality. According to the Atharva Veda, the Vedic Aryans seem to have had access to sizable woods for obtaining timber, and they also appear to have raised plants and herbs for medical reasons. Despite the fact that agriculture solely depended on the favours of Parjanya, the rain god, farmers were respected for their work. His thunders are intended to provide nourishment. One of the fundamental tenets of Hinduism is the planting and maintenance of trees, since the Rishis' dwellings were shaded by trees where Indian civilization first developed. With considerable attention, many tree species and their significance in life for both function and beauty were investigated. Farmers were regarded as second only to Brahmans in terms of social standing, and it seems that the whole village government was under the control of prominent farmers known as "Kutumbin" (from whence the name "Kunbi" is derived). There is considerable proof that the Hindu monarchs were skilled in growing crops like wheat, gramme, lentils, barley, sugarcane, indigo, cotton, pepper, and ginger, as well as fruits like pineapple, oranges, and mangoes, even throughout the Middle Ages. Only $1/6^{th}$ to $1/12^{th}$ of the farmers' crop output was paid to the State.

iii. **Arthasastra**: uses the same slang term to describe what makes a good nation. Anecdotally, when a teacher sent a student to repair a break in the watercourse of a particular field, the student had to kneel down to halt the flow and avoid serious damage to the crops. This illustrates the advancement achieved in irrigation. A fable, the connotation of which is that guards were hired at the crucial locations of embankments, the rupture of which would create a major flood and destruction, confirms the argument. The King must use caution at danger gates and at the dam of a big water project [4].

iv. Arthasastra strongly advises that upland (sthala) and low land (kedara) be recorded separately in the gopa's field register, and it orders the tax officer to grade villages three times in the manner of Gautama and Manu (Samahartar, Sukraniti). This suggests that varied rates for various soil classifications are intended, along with a similar reference in Sukraniti. The Agnipurana once again detailed the income rates for various rice crop types. The sadbhaga was simply a traditional or average rate, not the fixed or universal rate, and as a result the land assessment fluctuated depending on the condition of the land and the kind of crop, something matching the "tithe" in European fiscal language. Manu, the Arthasastra, and the Sumaniti all mention meticulous land grading, survey and measurement, computation of our turn, as well as costs per unit of land. A set share was not always implied by the king's portion. It was chosen after taking into account the soil's fertility and the demands of the State or

the farmer. The method of measurement, survey, and differentiation of soil based on productivity also shows that the evaluation of land income was not continuous but rather subject to periodic revisions even if this was not required. The ancient Vedic irrigation devices barely ever outperformed the Buddha's inventions; water was extracted using a bullock team and a lever (tulam).

v. **Peasants under Mughal Rule:**The Arabs made significant agricultural innovations. They had upgraded irrigation systems. They penned agricultural science treatises. They were expert gardeners who knew how to graft and grow new kinds of fruits and flowers. The Traveller of Islam, Ibn Battuta: During the rule of Muhammad-bin-Tughlak, he traversed much of Asia and visited India.

vi. **Peasant economy:**The State received a sizeable portion in the shape of different perquisites and the land tax. For different groups of domestic and other labourers, a customary proportion of the remaining money was set. The remainder was held by the peasant and his family for personal use. The share of the priest and the temple was paid for in part. The washerman, carpenters, smiths, potters, scavengers, etc. were better off since they didn't have to spend money on things like feeding animals or paying agricultural labourers in cash and kind.

vii. **Trade**:
TheofficialweightsundertheSultansofDelhiwerefixedatanaverageof28.78Ib(13.05kg)to amound.

viii. **Land Revenue Cess and Taxes:**During the rule of Arab rulers, the land tax was typically calculated as follows: two-fifths of the wheat and barley production if the fields were watered by public canals; three-tenths if the fields were irrigated artificially; and one-fourth if the fields were entirely unirrigated. If cultivable land was not used, one-tenth of the estimated output must be paid. One-third of dates, grapes, and garden produce was seized, either in kind or in cash; and one-fifth (khums) of the harvest of wines, fishing, pearls, and usually of any commodity not derived from agriculture, was to be supplied in kind, or paid in value, even before the costs had been covered. The primary source of income in Mughal India was the Land-tax.

The primary goal of Akbar's income system was to accurately measure the land. The quantity of the output from each bigha of land was also determined, and the farmer was required to pay the government a set percentage of that total. Thirdly, to make a monetary equivalent for the percentage that has been determined. The primary source of income in Mughal India was the Land-tax. But once Turkish rule was established, the situation of farmers changed. Farmers should be exploited if an Empire to endure, according to Allaudin Khilji, who used to take half of their income. Except for the brief time when Akbar expanded the land reforms proposed by Sher Shah, exploiting the farmers grew to be the norm. Naturally, the farmers' standing declined, and his expertise was eventually limited to using conventional methods [5], [6].

During Aurangzeb's rule, the exodus of peasants from the countryside grew more pronounced. The assignees, the jagirdars, saw a decline in their revenue as the number of peasants increased. To make up for their loss, the jagirdars escalated their pressure on the laboring peasants. Additionally, the practice of selling provincial governments for enormous sums of cash emerged. As a result, getting back the purchase money he had borrowed at a disastrous interest rate

inevitably became the main goal of the person so designated Governor. This led to increased oppression of the farmers in turn.

StatusofFarmersinSouthernIndia

The position of the farmers in the various States of India was explored in a book named "Sons of the Soil" that was released in 1941 by the Indian Council of Agricultural Research. The forest-covered, stony, and rather arid and dry forestland of central India, presently known as Madhya Pradesh, separates the southern Indian states of Andhra Pradesh, Karnataka (Mysore), Tamil Nadu (Madras), and Kerala from the Indo-Gangetic alluvial region of North India. People from the North may not understand the natural beauty, the fertile soil, or the diverse cultural heritage of the people of South India if they haven't travelled there. This is where the ancient Hindu culture, which has largely vanished from North India, is still present and is in utterly stunning condition.

The Western and Eastern Ghats' prehistoric mountain ranges, which date back to the Archazoic era, the genesis of life itself, are the oldest mountain ranges in the world. It lacks the Himalayas' snow-capped peaks and glaciers. These deep blue-purple hills are peppered with prosperous crops of rubber, coffee, and tea. Areca palms are grown in the foothills. As you go closer to the shore, you'll pass plantations of sugarcane, paddy, plantains, and coconuts. While Tamil Nadu is appropriately referred to as the "Land of Palmyra Palm," the State of Kerala is known as the "Land of the Coconut Palm." Paddy fields in emerald green contrast well with the blue hills of the Eastern Ghats, and between them are endless rows of Palmyra palms with black trunks bearing clusters of palmate leaves. The majority of agricultural tasks, such as transplanting paddy, weeding and hoeing, excavating groundnuts, or scraping grass, were done by women. The villages in South India are often cleaner than those in North India.

Coimbatore is regarded as one of India's most forward-thinking districts. The Agricultural College has a long history of producing high-quality research, which has helped this region's agriculture advance. However, the Naidus and Gounders, who are constantly willing to adopt some useful improvements, deserve the majority of the credit. Agriculture in this region really exemplifies man's victory over challenging conditions, making it all the more admirable. They bore through the unyielding rock to create tank-like wells that provide irrigation to their farms. They are able to irrigate land at various elevations thanks to a syphon irrigation system that uses concrete towers for water storage that are distributed across their fields and are linked by cement subterranean pipelines. Application of green manures, tank mud and fertilizers is very common, and line sowing is also very common [7].

Give a Naidu a plot of unproductive land, and he will transform it via diligent soil management. The majority of prosperous farmers are also industrialists who have established modest spinning mills. They use industrial practises on their farms, which are operated on commercial principles, in addition to investing the savings from industry in agriculture. Even small farmers now practise diversified agriculture, growing rice alongside plantains, sugarcane, cotton and other crops. Many farms grow Glyricidia and Sesbania as hedge plants. In one hamlet, you may see all paddy farming activities occurring simultaneously. While a nursery is being grown in one field, another is being transplanted, and a third is being harvested. This is due to the tropical environment,

which has roughly constant temperatures throughout the year. Since the land is typically wet, paddy and millets are frequently dried on the roads. One may witness rice drying on the road in the Madurai and Ramanathapuram regions as they are travelled while a lady keeps watch.

Usually, passing cars take extra care not to step on the grain that is drying. The homes of the landowners are pucca, have red tile roofs, and are often white washed, with the exception of the cottages of the landless labourers, which are thatched with Palmyra leaves. Huge representations of horses may be found close to the village's entrance. These are the chariots of the village of Ayanar's protector god. The appreciative villagers who have benefitted from the kindness of Ayanar who has spared the suffering bullock from sickness or a youngster from a critical illness occasionally leave hundreds of baked clay pictures of horses near some of the villages. In the fields, scarecrows of hideous human races are also prevalent. They are thought to be effective against the evil eye of envious neighbours as well as protecting the crop from livestock and jackals. The festival of Pongal, when farmers clean their livestock and adorn their bullocks' horns, is the most fascinating one in Tamil Nadu. A throng of people in their finest attire making their way in groups to the village temples [8].

The coconut and arecanut crops and the many irrigation tanks dot the Karnataka landscape in a characteristic way. Bamboos and coffee gardens may be found in the Karnataka Western Ghats' evergreen woods. The people of Karnataka constructed a massive monument in honor of the Nandi bull, the mount of Shiva, while the inhabitants of Mohenjo-Daro imprinted or carved their distinctive breeds on their seals. A herd of Hallikars, a breed with long, pointed horns, encircle Krishna as He plays the flute at the well-known temple of Halalebid, enraptured by the sound of the instrument. One of India's more recent states is Andhra Pradesh. The Kammas and Reddys are knowledgeable farmers who long ago understood the benefits of fertilizers and line sowing. Tobacco, chilies, turmeric, and groundnut are all grown scientifically using all the new techniques that agricultural professionals recommend. They have such excellent soil management that they apply fertilizers, organic manures, and green manures.

In the past, people from the Andhra region known as the Naidus and Reddies moved to Karnataka and certain areas of Tamil Nadu. Wherever they landed, they improved agriculture. Their genuineness and audacity in expressing their opinions is one of their defining characteristics. In fact, in this day and age of hypocrisy, their candour is extremely refreshing. Kerala State in India has a distinctive environment and a variety of crops. Even in cities, people's residences are surrounded by a plot of land where vegetables for domestic food and coconut palms are produced. Kerala has a unique personality brought forth by its red soil and extensive cultivation of coconut trees. Beautiful temples and carefully constructed churches are scattered across the countryside as a testament to the people's culture. Punjabi farmers are among the finest in India and are responsible for creating the settlements in the canal-irrigated regions of West Punjab [9].

DISCUSSION

Lands may be taken from non-cultivators and given to others; alternatively, they may be worked on by laborer and merchants from the community, with the potential for financial penalties for non-cultivators. Cultivators may get favorable supplies of food, animals, and money if they pay their taxes without difficulty. The monarch must only grant farmers favors and concessions that will add to the coffers rather than diminish it. He will treat those who have reached the end of the tax-remission period with fatherly tenderness. He will build highways for both land-based and

maritime transportation, provide facilities for the trade and raising of cattle, and establish market towns. Additionally, he must build reservoirs that contain water that is either perennial or comes from another source. Anyone who chooses not to participate in any cooperative construction projects must send his servants and bullocks to complete the work; they will share in the costs but will not be eligible for any profits. When it comes to fishing in reservoirs or lakes, ferrying, and dealing in vegetables, the monarch must exert his ownership rights. He will defend agriculture from the abuse of harsh penalties, unpaid labor, and taxes, as well as herds of cattle from thieves, tigers, dangerous animals, and cow diseases. He will prevent thieves from destroying the cow herds. On unusable tracts, the king shall provide pastureland.

CONCLUSION

Kashyapa has emphasized several times that the king or other relevant authority must really promote agricultural activity. This would include assistance from the federal and state governments in the contemporary era. In order to identify suitable land for agriculture, build water reservoirs, plant trees along the banks of reservoirs, build canals and wells, collect water, provide seed, ensure that people have enough to eat, donate land and provide subsidies to less fortunate people, organize markets, standardize weights and measures, afforest, find mines producing the metals iron, copper, and zinc, as well as gold and silver, and collect taxes, the ruler's assistance is necessary.

Thus, Kashyapa has strongly advocated for the ruler to play a very significant role in fully supporting various agricultural activities. He has emphasized that only if there is food security will everyone feel happy. The monarch should assign people who are skilled in inspection to hunt for and purchase the best land. The selection of a piece of land is based on a scientific study of the soil. According to legend, it is the king's responsibility to hire specialists to survey the whole territory and determine which areas are best for agriculture, horticulture, and reservoir construction. The setting may be in a hamlet, another region of the nation, such as a city or town, in the highlands, or on the grounds of forts and palaces.

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CHAPTER 9

AN OVERVIEW OF KAUTILYA'S ARTHASASTRA IN AGRICULTURE

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ABSTRACT:

The Artha-Sastra of Kautilya (250 B.C.) is a comprehensive guide on ancient statecraft and science. 'Chanakya' and 'Vishnu Gupta' are other names for Kautilya. The science of politics, economics, and the art of governance in its broadest meaning, which includes the upkeep of law and order as effective administrative machinery, are all topics covered by the Arthashastra. Wealth, or artha, is one of the four highest goals outlined by Hindu tradition. Accordingly, the state or government of a nation has a crucial role to play in preserving the material status of both the nation and its citizens, according to Kautilya's Arthashastra.

KEYWORDS:

Agriculture, Argonomy, Crops, Food, Rain.

INTRODUCTION

It is necessary to establish agricultural communities of the sdra caste into villages with a minimum of 100 households and a maximum of 500 families per village, capable of defending one another, and having borders that extend no farther than a krósa (2250 yards) [1]. Boundaries must be marked by a river, a mountain, woods, bulbous plants, caves, man-made structures, or trees like the Acacia suma, the silk cotton tree, and the kshravriksha (milky trees). A sthánya (a castle of that name) should be built in the middle of 800 villages, a drónamukha in the middle of 400 villages, a khárvátika in the middle of 200 villages, and a sangrahana in the middle of a group of 10 villages.

i. Agriculture

The director of agriculture should be knowledgeable in agricultural science. In due course, one may gather seeds of cotton, cereals, flowers, fruits, vegetables, bulbous roots, and fiber-producing plants. Plant seeds in grounds that have been successfully and often tilled [2]. With the help of blacksmiths, carpenters, borers (medaka), rope makers, those who capture snakes, and others, ploughs (karshanayantra) and other essential tools or bullocks are made available. Any loss attributed to the aforementioned individuals will result in a fine equivalent to the loss.

ii. Rainfall

16 dronas of rain fall in the country of Jángala, compared to half that amount in moist countries (anpánám), 23 dronas in avant, 1312 dronas in the country of Asmakas, and enormous amounts in western countries (aparántánám), along the Himalayan border, and in places where water

channels are used for agriculture. The location, motion, and pregnancy (garbhádána) of Jupiter (Brihaspati), the rise and set and motion of Venus, and the natural or unnatural aspect of the sun may all be used to predict when such rain will fall [3]. It is possible to predict the germination of seeds from the sun, the creation of grains (stambakarita) from the location of Jupiter, and rainfall from the movements of Venus. When two-thirds of the required amount of rain falls in the centre and one-third falls at both the beginning and end of the rainy season, the rainfall is regarded as being highly even. Ploughing is feasible if rain falls three times that are not accompanied by wind or sunlight. Sow the seeds in accordance with the amount of rainfall.

iii. Seasons

a. Two months make one ritu (season)

b. Srávana and Proshthapada make the rainy season (Varshá)

c. Asvayuja and Kárthíka make the autumn (Sarad)

d. Márgasírsha and Phausha make the winter (Hemanta)

e. Mágha and Phalguna make the dewy season (Sisira)

f. Chaitra and Vaisákha make the spring (Vasanta)

g. Jyeshthámúlíya and Ashádha make the summer (Grishma)

iv. Division of Land

Lands near wells for vegetables and roots; low grounds (harin-paryantáh) for green crops; and marginal furrows between any two rows of crops are suitable for the planting of fragrant plants, medicinal herbs, cuscus roots, and lac. Lands on the banks of rivers, etc., are suitable for growing vallphala (pumpkin, gourd, and the like). It is possible to cultivate medicinal plants in pots that are suitable for swampy environments. For the king's sports, a forest with a single entrance made inaccessible by ditch construction on all sides, plantations of delectable fruit trees, bushes, bowers, and thornless trees, a large lake of water populated by friendly animals, and tigers (vyála), beasts of prey (márgáyuka), male and female elephants, young elephants, and bisons without their claws and teeth will be created [4]. Another game-forest with game-beasts, accessible to everybody, should likewise be built at the furthest point of the nation or in any other acceptable location. One or more forests must be specifically conserved in order to get all of the forest products specified above. Establishing industries to create goods from forest products is also required. Wild areas must be kept apart from timberlands. Elephant forests will be created at the very edge of the nation, isolated from natural areas.

v. Seeds and Sowing:

Sáli (a kind of rice), vríhi (rice), kodo millet (Paspalum scrobiculatum), tila (sesamum), common millet (panic seeds), and varagu (Phaseolus trilobus) are to be sown at the commencement (púrvávápah) of the rainy season. Black gram (Phaseolus mungo) and green gram (Phaseolus radiata) are to be sown in the middle of the season. Kusumbha (safflower), masúra (Ervum hirsutum), horse gram (Dolichos uniflorus), yava (barley), godhúma (wheat), kaláya (leguminous seeds), linseed, and mustard are to be sown last or seeds may be sown according to the changes of the season.

vi. Choice of Crops:

The farmer shall grow wet crops (kedára), winter crops (haimana), or summer crops (graishmika) according to the supply of workmen and water. Rice crop is the best to grow vegetables are of intermediate nature; and sugarcane is the worst and very difficult to grow as it require much care and expenditure.

vii. Seed Treatment

The seeds of grains are subsequently exposed to mist and heat for seven in total nights; the seeds of kosi undergo treatment similarly for three nights; the kernels of sugarcane have been plastered at the cut end with a combination of honey, clarified butter, the fat of livestock, and cow dung; the seeds of bulbous plant roots with honey and clarified melted butter. cotton seeds with cow-dung; and drinking water pits at the root of vegetation are to be burnt and faeces with the bones and animal dung of cows on proper occasions [5]. When the seeds sprout, they should be fertilised with a fresh catch of tiny fishes and watered with snuhi (Euphorbia antiquorum) milk. Snakes will not remain in areas where there is smoke from burning cotton seed essence and snake slough. Always plant a few seeds that have been soaked in water and include a piece of gold before reciting the following chant.:

a. "Prajapatye Kasyapaya déváya namah.

b. Sadá Sítá medhyatám dévi bíjéshu cha

c. dhanéshu cha. Chandaváta hé."

viii. Harvest:

Grains and other crops shall be collected as often as they are harvested. No wise man shall leave anything in the fields, or even chaff. Crops, when reaped, shall be heaped up in high piles or in the form of turrets. The piles of crops shall not be kept close, nor shall their tops be small or low. The threshing floors of different fields shall be situated close to each other.

ix. Post-Harvest Technology

Oils (sneha) are defined as clarified butter, oil, serum of meat, pith or sap of plants, etc. Kshára is the name for sugar-candy, jaggary granulated sugar, and decoction (phánita). Madhu refers to both the juice squeezed from grapes and bee honey. Mixture made by combining any one of the ingredients such as grape juice, sugarcane juice, jaggary and honey, the essence of jambu (Euginia jambolana) and jaka tree fruits along with the essence of meshasringa (a type of plant) and long pepper, with or without the addition of the essence of chirbhita (a type of gourd), cucumber, sugarcane, mango, and the fruit of myrobalam. The mixture is The fruits of trees that produce acidic fruits, including those from karamarda (Carissa carandas), vidalámalka (myrobalam), matulanga (citrus tree), kola (small jujuba), badara (Flacourtia cataphracta), sauvra (big jujuba), parushaka (Grewia asiatica), and similar trees, are included in this category [6]. The class of pungent substances (tiktavarga) includes long pepper, black pepper, ginger, cumin seed, kiratatikta (Agathotes chirayta), white mustard, coriander, choraka (a plant), damanaka (Artemisia indica), maruvaka (Vangueria spinosa), sigru (Hyperanthera moringa), and similar plants, along with their roots (kánda). Fruits, vegetables, dried fish, and bulbous roots (kándamla) make up the category of edibles (sakavarga). Up to one and a half of the original amount of the grains will be in the form of raw flour and cooked and pressed rice.

There will be twice as much baked barley flour and barley gruel overall. Cooking increases the amount of kodo millet (Paspalam scrobiculatum), varaka (Phaseolus trilobus), and common millet (Panicum sp.) by three times. When cooked, rice's volume increases four times. When cooked, sáli (a kind of rice) will multiply five times. When saturated, grains will multiply by two and a half, and by three times when soaked till they sprout. When grains are fried, the amount increases by one-fifth; when leguminous seeds (kaláya) are fried, the amount increases by two times; and when rice is fried, the amount increases by the same amount [7]. One-sixth of the oil from atasi (linseed), one-fifth from nimba (Azadirachta indica) and kapittha (Feronia elephantum), one-fourth from tila (sesame), kusumba (safflower), madhka (Bassia latifolia), and one-quarter from ingudi (Terminalia catappa) seeds will be extracted. One pala of threads will be produced from five palas of kárpása (cotton) and kshauma (flax).

Storehouse: On the floor, grains are piled high, jaggary (kshára) is wrapped in grass-rope (mta), oils are stored in pottery or wooden containers, and salt is piled high on the ground. Only the other half of the store will be used; the other half will be kept in reserve to fend off the people's calamities. New supply must replace the old collection.

Agricultural workers: Field laborer must always have access to water but not to fire. In accordance to the quantity of labor they do, watchmen, slaves, and labourers are paid a pana and a quarter each mensem. Wages and other benefits for artisans must be in proportion to the quantity of labour they do.

Food Requirements: An Aryan may get by with one serving of pure, unbroken rice, one-fourth of a serving of spa, and one-fourth of a serving of clarified butter or oil. One meal will consist of half the aforementioned amount of oil for low castes (avara) and one-sixth of a prastha of spa for a male. For a woman, the same rations cut in half will make one meal, and for children, the same rations cut in half will make one meal. Slaves, workers, and cooks may be fed bran and flour (kánika). The extra of the aforementioned may be offered to people who make rice cakes and cooked rice. Twenty palas of meat will need the dressing of half a kutumba of oil, one pala each of salt and sugar (kshára), two dharanas each of hot spices (katuka), and half a prastha of curd. The same chemicals may be proportionately added to adorn larger amounts of flesh [8]. The amount of the aforementioned ingredients to be added for cooking sákas (dry fish and vegetables) is one and a half times. The aforementioned items must be added twice as much when dressing dry fish. Young elephants can be fed rice prepared in such a way that five dróna of sáli yield ten ádhakas of rice; elephants with a bad temper (vyála) can be fed rice prepared in the same way that yields eleven ádhakas from five drónas; elephants trained for riding can be fed rice prepared in the same way that yields nine ádhakas; infantry can use rice prepared in the same

Taxation: The king may be paid as much as they can without putting themselves through hardship, with the exception of their own private lands which are challenging to cultivate. Fields that are left unplanted vapatiriktam, i.e., due to a lack of hands, may be brought under cultivation by employing those who cultivate for half the share in the produce. Those who irrigate their crops manually must pay a water charge equal to $1/5^{th}$ of their crop; those who lift water from rivers, lakes, tanks, and wells must pay a water rate equal to 1/3th or $1/4^{th}$ of their crop; and those who carry water on their shoulders must pay a water rate equal to $1/4^{th}$ of their crop.

Commodity Trade: The Superintendent of Commerce will determine if there is demand for, or whether there is demand for, various types of goods that may be produced on land or in water

and that may have been imported by land or water paths, as well as whether prices have increased or decreased. He must also decide when it is appropriate to distribute, centralise, buy, and sell them. Commerce includes the receipts from grain sales, grain purchases, and the collection of interest on grain loans. Bartering (parivarthana) is the profitable exchange of one grain for another. Apamityaka refers to grains borrowed with a commitment to reimburse them. Simhanika refers to the processes of crushing (for example, rice), dividing (for instance, pulses), frying (for instance, maize and beans), making beverages (suktakarma), making flour by hiring people who make their living doing these tasks, extracting oil by hiring shepherds and oil-makers, and making sugar from sugarcane juice. The supervisor is also responsible for personally overseeing any gains or losses that result from the processing of grains, including pounding (kshunna), fraying (ghrishta), turning them into flour (pishta), frying (bhrashta), and drying after soaking in water.

Forest Produce: By engaging workers who look after profitable forests, the Superintendent of Forest Produce will gather wood and other forest products. In addition to initiating productive forest activities, he must set appropriate penalties and compensations to be imposed on anybody who harms productive forests, excepting natural disasters.

Animal Husbandry

Five male animals must be present in a herd of 100 heads of asses and mules, ten in a herd of goats and sheep, and four in a herd of ten heads of either cows or buffaloes. For salaries, a certain quantity of dairy products, a tenth of the dairy products, etc., herds are kept. ‘Calves, steers, tameable cattle, draught oxen, bulls trained to yoke, bulls kept for crossing cows, cattle fit only for the supply of flesh, buffaloes and draught buffaloes, female calves, female steers, heifers, pregnant cows, milch cattle, and barren cattle-either cows or cattle-are all classified as part of the class of herds. Cowherds must provide treatments to young calves, elderly cows, and diseased cows. The herds of cows and cattle must graze in the woodlands, which are designated as distinct grazing areas. Cowherds must let their animals to enter lakes or rivers with the same depth. Both fresh and dried meat are available for sale from the cowherds.

During the rainy, autumnal, and first part of the winter (hemanta) seasons, the cowherds are required to milk the cows twice (morning and evening), but only once (i.e., only in the morning during the latter part of winter and the entirety of the spring and summer seasons). During these times, a cowherd who milks a cow a second time will have his thumb amputated. He will lose the earnings from the milk if he let the milking period to expire. The cowherds must offer buttermilk to the dogs and pigs as a drink and save a little amount in a bronze jar for their own food preparation. They may also use coagulated milk or cheese (klata) to give their oilcakes a delicious flavor (ghanapinyaka-kledartha). A quarter of the cow's rpa (worth) must be paid to the monarch by the person selling their cow from among the herds. When milk from cows is churned, it produces one drona of butter; milk from buffaloes produces one-seventh of a drona more; and milk from goats and sheep produces one-half of a drona more. Cowherds must transport their cattle either far or close, depending on their ability to guard the animals and on how far and broad they can go to graze. Sheep and other animals must have their wool sheared once every six months.

Rations for Livestock: For bullocks, one drona of green gram or one drona of barley cooked with other things, as prescribed for horses, is the requisite quantity of food, besides the special and additional provision of one tula of oilcakes or ten ádhakas of bran; twice the above quantity

for buffaloes; Half an ádhaka or one ádhaka of grain together with bran for a goat, a ram and a boar; one prastha of cooked rice for dogs; Half a prastha for a hamsa (goose), a krauncha (heron) and a peacock. For bulls which are provided with nose-rings, and which equal horses in speed and in carrying loads, half a bhára of meadow grass (yavasa), twice the above quantity of ordinary grass (trina), one tulá (100 palas) of oil cakes, 10 ádhakas of bran, 5 palas of salt (mukhalavanam), one kudumba of oil for rubbing over the nose (nasya), 1 prastha of drink (pána), one tulá of flesh, 1 ádhaka of curis, 1 drona of barley or of cooked green gram, 1 drona of milk; or half an ádhaka of surá (liquor), 1 prastha of oil or ghi (sneha) 10 palas of sugar or jaggary, 1 pala of the fruit of sringibera (ginger) may be substituted for milk (pratipána).

Remedies against National Calamities

The king shall always protect the afflicted among his people as a father his sons from eight kinds of calamities viz., fire, floods, pestilential diseases, famine, rats, tigers, serpents, and demons.

a. **Fire:** King and superintendents of villages shall protect from fire on ordinary days, but also on full-moon days.

b. **Floods:** Villagers living on the banks of rivers shall be provided protection from floods during the rainy reason. They shall provide themselves with wooden planks, bamboos, and boats. On new and full-moon days shall rivers be worshipped. Experts in sacred magic and mysticism and persons learned in the Vedas, shall perform, incantations against rain. During drought shall Indra (sachínátha), the Ganges, mountains, and Mahákachchha be worshipped.

c. **Pestilences:** Protection against epidemics with auspicious and purificatory ceremonials, milk- ing the cows on cremation or burial grounds, burning the trunk of a corpse, and spending nights in devotion to gods, worship of family-gods shall also be observed.

d. **Famines:** The king shall show favour to his people by providing them with seeds and provision during famine or the king with his subjects may emigrate to another kingdom with abundant harvest. He may cause his subjects to grow grains, vegetables, roots, and fruits wherever water is available.

e. **Rats:** Cats and mongooses may be let loose to control rats. On new and full-moon days rats may be worshipped.

f. **Snakes:** Auspicious rites may perform from Atharvaveda. On new and full moon days, (snakes) may be worshipped.

g. **Tigers:** Catch tigers by entrapping them in nets. The juice of madana and kodrava plants may be thrown in tiger living places to destroy tigers. On new and full moon days, mountains may be worshipped.

h. **Demons:** Ceremonials shall be performed with the rituals of the Atharvaveda to ward off the danger from demons. Such ascetics as are experts in magical arts, and being endowed with supernatural powers, can ward off providential visitations, shall, therefore, be honored by the king and made to live in his kingdom.

Agriculture and Sangam Literature of Tamil

i. **Sangam and its History**

'Sangam' is a Sanskrit word which means as 'association'. 'Sangam poets' is an association of poets. Tamil Sangam was a body of Tamil Scholars or poets, a literary academy, which was established by the Pandia Kings. Sangam was known as 'Avaiyam', Kudal or its variant 'Kuttu' before 700 A.D. In Purananuru, the expression of 'Kudal' was used. Kudal was also used to indicate the Madurai city.

Thirunavukarasar (Appar) in his 'Tewaram' had used the word, 'Sangam' while Thiruzhanasambandar used the word 'Togai' means a collection. This showed that the institution was known as 'Kudal' or 'Togai' during Sangam period itself. Literature/poems is said to have been compared by the members of that body of poets. A system of literary censorship was exercised in Tamil language during early days of their literary history, which is known as 'Avaiyam' and not 'Sangam'. There were three Tamil Sangam constituted one after another and were called.

a. First Sangam or Thalai Sangam;

b. Middle Sangam or Idai Sangam and

c. Last Sangam or Kadai Sangam.

DISCUSSION

Information about the social, economic, and political lives of those who live in deltaic Tamil Nadu may be found in great depth in the Sangam literature. The period known as Sanga Kaalam is regarded as Tamil literature's Golden Age. Tholkappiar was regarded as a person during the Ancient Sangam Age, which lasted from around 1000 B.C. to 200 B.C. The first Tamil text is called Tholkappiam. Our ability to trace the Tamil people's ancestry is greatly enhanced by the material provided by "Tolkappiyar," whose age is often dated to the 5th century B.C. Mountains, woods, plains, beaches, and deserts were used to represent the terrain, and the five different expressions of love union, patience, crying, separation, and sulking were used to represent the concept of love. The poet who addressed a particular facet of love limited himself to a certain place, time of day, season, and flora and fauna. Tolkappiyam explains these literary norms. The most important work from the third Sangam era is Tiruvalluvar's Tirukkural or Kural, which discusses philosophy and sage advice. With 1330 couplets (133 topics, each with 10 couplets), it is the second great work. It has been translated into various languages, including English. The Late Sangam Period, which lasted from 200 B.C. to 200 A.D., is regarded as the Thiruvalluvar period. Silappathikaram, which is set in the Ilango period approximately 200 A.D., is the third noteworthy work in ancient Tamil. Thenmadurai, a city on the coast of the Indian Ocean, served as the Pandia monarchs' capital during the middle Sangam; however, it was subsequently destroyed by a sea inundation. Later, Sangam and the capital were moved to Kapatapuram on the east coast. Kapatapuram was also overwhelmed by the sea. Then, Sangam and the capital were moved to the inland city of Madurai. Thus, the current Madurai, which is located on the Vaigai River, was chosen as the third capital and the home of the Third Sangam of Poets. Both Kalithogai and Silapathigaram had allusions.

CONCLUSION

'The Dark Age' or the Kalabhra Interoregnum period witnesses the growth of Buddhism and Jainism in the now shrinked Tamil country. The Kalabhra, of the Kannada soil, invasion during 250 A.D. alters the shape of Tamil literature and Tamil way of life. The post-Sangam period

(200–600 A.D.) is notable for the composition of five great Tamil epics - Silappadikaram, Manimekalai, Jivaka-cintamani, Valaiyapati and Kundalakesi. In 400 A.D., Ten Idylls (Pattuppattu) and the Eight Anthologies (Ettuttohai) are classified into Akam or esoteric dealing with love and Puram or exoteric dealing with war. The literature of the third Sangam period mainly comprises of poems, which are arranged in eight antholo- gies called Ettuttokoi and ten idylls called Pattuppattu. Ettuttokoi consists of Narrinai, Kuruntogai, Ainkurunuru, Padirruppattu, Paripadal, Kalittogai, Ahanuru and Purananuru. Pattuppattu consists of Tirumurugarruppadai, Porunararruppadai, Cirupanarruppadai, Pattinappalai, Kurincippattu, Nedunalvadai, Maduraikkanci, Malaipadukadam, Mullaippattu and Perumpanarruppadai.

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CHAPTER 10

AN ANALYSIS OF LANDSCAPES CLASSIFICATION OF TAMIL NADU

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ABSTRACT:

Thirupathi in the north, Cape Comorin (Kumari) in the south, and the oceans in the east and west (Kakaipadiniyar) form the borders of Tamil Nadu. Landscapes that reflect the time of day and a flower. The area was further divided into Vanpulam (Kurinchi, mullai) and Menpulam (Marutham, Neithal) by Tholkappiar. Mullai land is referred to as "Puravu" since it is situated adjacent to or beside Kurinchi land. In Mullai areas, fruit tree and cow crop agriculture were practised. The Mullai territory was known as "Kadurai Ulagam" by Tholkappiar because it is mostly covered with trees. Larger sections of it are covered with grasses. Another occupation was sheep farming and clothing weaving. In Kurinji, paddy and tenai were grown. Instead, then only being a sandy tract, "Palai" is really a bland combination or mélange of the Mullai and Kurinji tracts (Silapathigaram). It must be kept in mind that Tamil Nadu lacks a desert. The Marudam terrain is suitable for farming. The main food source in Marutham is rice.

KEYWORDS:

Agriculture, Biodiversity, Climate Change, Farming System, Sustainable Agriculture.

INTRODUCTION

The primary employment of Tamils was agriculture. The ladies of the agriculturalists were referred to as "Ulattiyar" and the males as "Ulavar." The classes of those who owned land and those who worked it were known as "Vellalas," the farmer being the superior "Vellalas" and the latter being the lower "Vellalas." Valnar was another name for Ulavar. Or Yerin, or Ulutunbar. Ulavar is known as Kalamar in Purananuru. The words Ulavar and Vellalar itself refer to the usage of the plough and the ownership of the land, respectively. While the number of ploughs was the standard of measurement for agriculturalists, the cowherd community counted the cattle as wealth. A poet in Karuntogai mentions a farmer with one ploughshare named "Orerulavar." In PART-104, Thirukural, Thiruvalluvar has emphasised the significance of agriculture. The vocation of agriculture is seen as being honourable. Valluvar has outlined the appealing quality of a region or nation. A nation should have intelligent, rich, and skilled farmers.

It must not be plagued by hunger, illness, or hostility. Famine should not be a factor in any nation. Even ascetics will become powerless if they do not cultivate the fields, regardless of what activity others may be involved in. They all ultimately rely on the farmer. Agriculture lacks the dignity of other professions, yet agriculturalists are unquestionably the backbone of the global economy. The only people who actually live productive lives are farmers; everyone else is either a parasite or a sycophant:

a. ploughtheland;

b. manureit;

c. transplant the seedlings

d. ensure an unfailing supply of channel water

e. protect thecultivatedfarmfromthestraycattle.

It warnsthefarmeragainstlethargy,helidshimbeactiveandneverdespond.Thefarmeristoguardagainstabsentee-landlordism.

Agricultural Implements

Buffaloes were used for ploughing with a wooden plough. Deep ploughing was considered superior to shallow ploughing. A labour-saving tool called parambu was used for levelling paddy fields. Tools such as amiry, keilar, and yettam were used to lift water from wells, tanks, and rivers. Tools called thattai and kavan were used for scaring birds in millet fields. Traps were used to catch wild boars in millet fields.

Land Preparation

Thiruvalluvar offers some suggestions on farming activities. There would be no need to apply even a handful of eru, or manure, to the field if an agriculturalist would let the ploughed ground to dry out until one todi (one palam) of dust dried down to one kashi (1/4 palam), or if it is reduced to one fourth (1/4) of the original amount. Ploughing was done repeatedly rather than just once. When the cultivator has his own ploughs, Iniyavainarpathu, farming may be done with ease. The term "plough" was used three times: once as "Orusal ulavu," twice as "Irusal ulavu," and several times as "Chensal ulavu." Plough the ground more deeply than widely. To plough, cattle were used. Crab holes and Cyperus weeds were removed during the levelling of wetlands (Perumpanattrupadai). In beds and channels, crops had been grown (Nanmanikaddigai) [1].

Crops and Varieties

Paddy, black gramme, horse gramme, varagu, tenai, sesame, sugarcane, banana, coconut, palmgrab, bamboo grasses, jack fruit, tamarind, and mango were all grown by the ancient Tamils. In Mullai lands (Purananuru), varagu was grown. In Kurinchi fields (Kurunthogai), field bean (Mochai) and tenai were grown together as a mixed crop. As mixed crops, Tenai and cotton were grown (Kurunthogai). In Purananuru, Pattinapalai, and Kurunthogai, rice varieties like Chennel, Vennel, Salinel, Mudandainel, Ivananel, Kulanel, Thoppinel, Pudunel, Varnel, Avianannel, and Torainel were grown. From bamboo, Mungil el or Mungil arisi are produced. At the time of king Pari (Purananuru), it was consumed as food. Marutham fields were used for the cultivation of red and black gramme. At the base of the hills (Kurunthogai), sugarcane was grown using the check basin method. During the reign of King Adiyaman (Purananuru), sugarcane of the variety Kalik karumbu was grown in the district of Thagadur. Bananas were grown. The curative qualities of its terminal loft were noted in Kurunthogai, 308. The Cauvery River Valley was home to the cultivation of rice, sugarcane, coconut, plantains, areca palm, turmeric, mango, palmyra, sembu (Colocasia antiquolam), and ginger. A 'Veli' of land produced

around 4,000 kalams of paddy. The farmer likes listening to the sound of the Cauvery flow and the eddying water cleaning the bunds (Silappadikaram) as well as watching the first freshes.

Seeds and Sowing

The first mature earheads were used to collect seed. The chosen seed was only kept for planting and was never used to make food. Such a detour was thought to be fatal to the family. Tenai seeds were also sown without being ploughed. Cyperus weeds were eliminated by feeding pigs on the area, and then seeds were sowed there without being tilled (Purananuru). The spacing between the seeds was appropriate (Narrinai). When there is enough moisture, seeds will germinate (Nanmanikadigai).

Cropping Systems

In order to practice crop rotation, black gramme (urd) was grown after rice. They also engaged in mixed cropping, such as combining cotton or foxtail millet with lablab. Intercropping ginger and turmeric were cultivated on jack fruit and coconut farms. There have been reports of fallow rice production with other crops including pulses in "Ingurunuru." 'Pathittrupattu' reported on sugarcane cultivation. Tenai and cotton mixed crops were also common. Pepper was produced in mango plantations (Inthinai) as a mixed crop [2].

Weed Management

Weeds were removed from the fields (Madurai kanchi). Tools were used for weed control (Ahananuru). Weeds hamper the growth of crops (Nanmanikadigai).

Soil Fertility

According to Thiruvalluvar, only fertile land has the right to be referred to be a region (Nadu) that produces unanticipated riches. under current literature, the fertile terrain, particularly under the Chola Kingdom, is proudly referred to. In ploughed fields, organic manures were used (Narrinai). "The land is so fertile that a tiny piece thereof, where a she-elephant might rest, can produce enough food to nourish seven bull elephants," writes Avur Mulankilar in a brief poem dedicated to Killivalavan (Purananur). The richness of the soil was such that the sesame crop was so robust and fully matured that a handful could only contain no more than seven grains of sesame (Malaipadu), even in steep locations like the Palakunrakottam (land between Tirupathi and Tiruvannamalai). Even without ploughing, mustard was still cultivated in copious amounts by just seeding it deeply into twisted sod (Malaipadu). A veli of land on a reasonably productive farm yielded a whole thousand kalams of rice (Porunnar). A significant source of fertilisation was provided by the silt brought by the floodwater, and the more water there was, the larger the silt deposit was. Some of the better-located fields were referred to as "Erikkattu," which means tank reservoir. This clever "field insurance" arrangement protected against flood danger.

Irrigation Management

Water quality depends on land type (Nanmanikadigai). Moisture stressed crops grow well on receipt of rains (Iniyavainarpathu); construction of ponds for others use is essential (Iniyavainarpathu).

a. Art of Well Divining

The Cankam artefacts describe the Tamils' practise of well-divining at wells located along roads for the benefit of tired travellers (Naririnai; Purananuru). The ethical practise of generously digging "drinking water wells" is mentioned in the didactic text Tirikatukam. Those skilled in well-divining are referred to as "ulliyar" and "calliyar," respectively, by Tivakaram and Kayatara Nikantu. Although the terms "Kuval, Acumpu, Kupam, Kuli, Puval, Keni, and Turavu" are used interchangeably to mean "well," cankam classic only refers to kuval. The wells of those days were, according to Patirrupattu and Ainkurunuru, often only shallow in depth. Two manuscripts classify rocky terrain as "Kurinchi," coarse sand terrain as "Neytal," scattered tiny rocks as "Mullai," muddy terrain as "Marutam," and the unused tract as "Palai," of which the Neytal tract is thought to contain wetness. In various places, the depths of the water source varied from the surface land. There are springs at 33 cans of depth in Kurinchi, 30 cans in Palai, 36 cans in Mullai, 35 cans in Neytal, and 22 cans in Marutam. There may be water springs at various depths in the soil that is suitable for the development of banyan, tamarind, mango, and other trees. There may be water sources in the areas where white rats, scorpions, double-tongued lizards, toads, and other creatures live. According to another text, the water in Mullai is brownish, the water in Palai is white, the water in Kurinchi is blackish, the water in Marutam is drinkable, and the water in Neytal is salty. A well that had vanished as a result of human or environmental disasters may be located by observing which types of grass wither in the winter and bloom in the summer. There would be a swarm of flies and ants in certain areas, as well as anthills emerging where certain grassy plants thrive and trees like "Vanci" and "Nocci" blossoming during the hot summer, all of which would be definite signs of the presence of wells that have since vanished.

b. Major irrigation system of ancient Tamil Nadu

Kudapula Vianar claims that a sizable irrigation system in Purananur has freed the villagers from reliance on the rain. Several irrigation tanks were built by the Pallavas, who had Tondaimandalam as their capital, and almost all of them are still in use today. In addition to building tanks, the Cholas controlled the Cauvery River, an accomplishment of which any king and his subjects may feel proud. The Pandyan Country was split between using tanks and peripheral irrigation along the rivers. The Cauvery and the Tamiraparani are Tamil Nadu's two principal rivers. There has never been a moment when the Vaigai was a significant source. The Cauvery River originates in the western ghats close to Coorg and travels approximately 500 miles before entering the Bay of Bengal, draining a region of over 31,000 square miles along the way. The construction of the Kallanai or the Grand Anicut is mentioned in the Cholamandala Satakam. Several thousand Ceylonese are said to have been employed by Karikalan for this project. The "Mahavamsa" has an elderly widow protesting to Gajabahu that her only son was among the 12,000 people Karikalan abducted for the purpose of building the Cauvery embankment. Karikalan was referred to as "Kaaverinaadan" by the Pattinathupalai for taming the turbulent river, according to them. The Malepadu plates of Punayakumara, a Telegu Choda monarch from the seventh or eighth century, recount his elevation of the flood walls of the Cauvery [3].

Farmers,theFoundersofCivilization

Thiruvalluvar has emphasised the following aspects of the agricultural profession: The best of all vocations is second only to the plough in the whole universe. Because they support everyone else who uses the plough and engages in other occupations, tillers of the soil are the pivot around which the world revolves. Only farmers who cultivate the earth and grow their own food have

the right to exist; all other creatures are parasites that depend on farmers. Many of the surrounding countries will undoubtedly feel the influence of the lush green fields that are laden with maize sheaves. Trade improves a nation's riches and prestige, but its true power and fortitude are found among the landowners. The farmers, who solely consume the products of their labour, would never beg or refuse to give charity to a man in need who knocks on their door. Even those who have given up the world will lose their calm and focus of spirit if the tillers of the land stop working. The homeowners who provide the ascetics with assistance will inevitably be impacted and lose focus if the tillers of the soil stop working. Without adding even a little amount of manure, a bountiful harvest will result from allowing the ploughed soil to dry to a fourth of its original volume. According to Valluvar, good aeration and deliberate nitrogenization are just incidental steps after the preparation of the soil. After thorough weeding, manuring is more vital than ploughing, and plant preservation is more critical than water management. The good earth would laugh mockingly at people who sit idle and ignore their fruitful land while claiming to be poor if the husband-man does not provide personal care to his land like the neglected wife.

Climate

Rain is revered as the foundation of the earth and a fundamental human need. The world cannot survive without water. Cool showers are produced by rain-bearing clouds beneath enveloping darkness with lightning, whereas heavy rains are produced by clouds that are like a pounding drum with short, thick sticks and persistent thunder. Thiruvalluvar had emphasised the need and significance of rain for the inhabitants of Thirukural's prosperity and spiritual well-being in addition to for agriculture. Valluvar gave the downpour the following praise: Rainfall must be regarded as the nectar of life or the Amuta (the drink of eternal gods), since it supports the planet. Food is created from rain, and from food comes the fourth. Rain, which is also food, causes all food to be created. Despite the fact that the planet is encircled by vast seas, if rain fails, hunger would bring about a never-ending cycle of suffering. The ploughmen will be compelled to become idle if the amount of rain decreases. Lack of rain will cause prosperity to collapse, while enough rain to water the crops will bring about fresh prosperity. Sometimes, even excessive rain and cyclonic floods result in catastrophe. Even grass blades are unable to shoot up if it does not rain. Even the richness of the waters will decrease if the clouds the sea produces fail to provide their harvest. The absence of rain throughout the summer months might harm pearl creation. Coral spawning would be impacted if there is a rain failure in October or November. There won't be any celebrations or God-specific rites if the rain fails. Alms to the poor and penance for spiritual elevation cannot be maintained if the skies refuse to forgo their bounty to provide rain to our planet. In the same way that life on earth cannot exist without water, virtue also ultimately relies on rain [4], [5].

Seasons

Seasons were broadly classified into Ilavenil (Chitrai-Vaigasi); Mudhuvenil (Aani-Adi); Karkalam (Avani-Puratassi); Kuuthgirkalam (Ipachi-Karthigai); Munpanikalam (Marghali-Thai) and Pinpanikalam (Masi-Panguni). In the spring (early summer), Vengai flowers bloom with loosened petals, and the falling petals enhance the black sand locks of the river bank. The delta's agricultural was divided into two types: a double crop economy and a single crop economy. In the former, rice was first grown in a brief crop and then again in a longer crop. Tamil Nadu has several rice producing seasons depending on the location. The short crop itself was divided into

two varieties: the 'Kar' variety, which lasted four months, and the 'Kuruvai' variety, which lasted one hundred days. The former was limited to the delta's first reaches. where the seedlings could be cultivated prior to the freshes and in a good amount of anticipation of its certainty, the latter of which was the most prevalent kind. On double crop land, the second crop was called as "Thaladi," as opposed to the first crop, "Mudladi." 'Samba' is a five-month crop that is the main crop economy. June through October was the first harvest season. From October until February, the second harvest. The one crop season spanned the months of June through January.

Agricultural Implements

To plough with a wooden plough, buffaloes were used. Shallow ploughing was seen as inferior to deep ploughing. For levelling paddy fields, parambu, a labor-saving device, was utilised. Water was lifted from wells, tanks, and rivers using implements such the amiry, keilar, and yettam. Bird scare devices called thattai and kavan were used in millet fields. In millet fields, wild boars were captured using traps.

Land Preparation

Thiruvalluvar offers some suggestions on farming activities. There would be no need to apply even a handful of eru, or manure, to the soil if an agriculturalist would leave the ploughed ground to dry out until one todi (one palam) of dust dried down to one kashi, or if it was reduced to one fourth of the original amount. Ploughing was done repeatedly rather than just once. When the cultivator has his own ploughs, Iniyavainarpathu, farming may be done with ease. The term "plough" was used three times: once as "Orusal ulavu," twice as "Irusal ulavu," and several times as "Chensal ulavu." Plough the ground more deeply than widely. To plough, cattle were used. Crab holes and Cyperus weeds were removed during the levelling of wetlands (Perumpanattrupadai). (Nanmanikaddigai) Crops had been grown on beds and canals. On the Tamiraparani, distinct anaicuts are seen. There were seven anaicuts built across the Tamiraparani. They were not built on certain dates that are known. Around every one of them have emerged the customary local folklore. But it is clear that they are old. Kodaimelalagiyan, Nadiyunni, Kannadiyan, Ariyanayakapuram, Palavur, Suttamalli, and Marudur are listed in that sequence [6].

DISCUSSION

The Tamils built two different kinds of tanks: big ones, like the ones mentioned in the introduction of this study, and countless smaller ones that were dispersed across the undulating core of the Tamil nation. The maintenance of both types of tanks was mostly handled by the inhabitants. Some of the tanks have inscriptions that refer to this obligation. The main concern of the village assemblies was to clear the sludge from the tanks they were in charge of in order to ensure that they had the right depth to hold the whole year's worth of supplies. Special endowments were often established, or local administrations suffered from poverty. In other cases, 'Eriayan', a cess, was gathered from the communities for this purpose. The Sangam literature makes it clear that the Cauvery system is very old. Karikalan built the Grand Anicut in the first century, and it is still in use today [7], [8].

CONCLUSION

The deposition of silt by rivers results in the formation of alluvial soils. Since it is rich in minerals like lime, potassium, magnesium, nitrogen, and phosphoric acid but lacking in nitrogen

and phosphoric acid, it is extremely fertile. It is loamy and permeable. The supporting crops include turmeric, sugarcane, paddy, and banana. Basically, it may be found throughout Tamil Nadu's coastal plains and river valleys. It may be found in the Kanyakumari, Thanjavur, Tiruvarur, Nagapattinam, Villupuram, Cuddalore, and river valleys in a few more interior districts. The proportion of alluvial soil should be anywhere between 3 and 6%, however the Tamil Nadu Agriculture University website does not indicate that.

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CHAPTER 11

AN INTRODUCTION OF HARVESTING AND THRESHING IN AGRICULTURE

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ABSTRACT:

In order for farmers to collect and process crops effectively, harvesting and threshing are crucial operations. Harvesting's main objective is to gather ripe harvests from the fields, while threshing's aim is to separate the grain from the chaff. The kind of crop, the temperature, and the farmer's preferences all affect when and how to harvest and thresh. There are many different kinds of harvesting and threshing instruments available, including mechanical and manual tools, which may have a big influence on how effective these procedures are. This summary will provide a general overview of the key components of harvesting and threshing in agriculture, including the guiding principles, necessary tools, best practices, and difficulties encountered. It will also emphasize how crucial it is to control and time these processes correctly in order to maximize crop output and quality.

KEYWORDS:

Agriculture, Chaff, Crop Yield, Crops, Equipment, Farming, Grain, Harvesting.

INTRODUCTION

Threshing and harvesting are significant agricultural tasks. This may be carried out manually or with the use of powered equipment. One of the most labor-intensive processes in the agricultural production system is still harvesting field crops. One hectare of rice crop requires between 170 and 200 man-hours to manually harvest using various hand equipment. Due to the high labour demand during harvest season, the operation lasts for weeks at a time, which causes over drying of the crops in the field, which leads in grain losses of between 5 and 15 percent, and even results in crop loss due to unexpected rain during harvest. Crops including wheat, barley, and gramme are more susceptible to shattering losses when harvested under very dry circumstances. Crops including maize, sorghum, and arhar are harvested when the moisture content is relatively low. The hand sickle is a suitable instrument for harvesting the thick and woody crop stacks. A hand chopper may also be used in various situations. These crops are now harvested using mechanised harvesting tools like reapers, combine harvesters, etc. It is a sickle with a serrated blade that may be used to harvest wheat, rice, and grasses. The back of the hardwood handle is curved for improved grip and to prevent hand injuries when using it. It costs Rs. 60, and the operating cost per hectare is Rs. 2000. Sickle has a field capacity of 0.018 ha/h and requires 80 man-h/ha of manpower [1].

Power Tiller Operated Vertical Conveyor Reaper

It is a front-mounted, walk-behind motorized tiller that may be used to harvest and windrow upright rice crops. The crop row separators, cutter bar, two crop conveyor belts and star wheels make up the reaping attachment. Through a belt-pulley and safety clutch, the engine drives a cutter bar and conveyor belts. The actual field capacity ranges from 0.16 to 0.20 ha/h. The cost of operating per hectare is Rs. 1400, while the unit price is Rs. 40,000.

Self-Propelled Vertical Conveyor Reaper

It is a walk-behind harvester with an engine that may be used to harvest and windrow crops like oilseeds and cereals like wheat and rice. The crop row separators, cutter bar, lugged wheels, star wheels, operator controls and a robust frame make up the reaper. It also has a conveyor belt with lugs. Through belt-pulleys, the engine's power is transferred to the cutter bar and conveyor belts. harvest row dividers split the harvest as the reaper moves ahead, whereupon the crop stems are sheared as they come into contact with the cutter bar. The conveyor belt equipped with lugs moves the chopped crop to one side of the machine. The produce is physically packaged and carried to the threshing yard. The machine has a field capacity of 0.15 to 0.17 ha/h. The gadget costs about Rs. 80,000. With this machine, operation costs are Rs. 1150/ha as opposed to Rs. 3200/ha when using the conventional method. When compared to the traditional method, there are labour and time savings of 90–95% and a 63% reduction in operating costs.

Self-propelled Fodder Harvester

Forage harvesting used the self-propelled cutter bar type (CBT) forage harvesters extensively. The appropriate engine (7.6 kW, air cooled) drives the cutting bar. The reaper-binder machine is equipped with the cutting bar as an accessory. The device is used to harvest fodder plants like Lucerne and Berseem. For berseem crop, the width of cut is 1.2 m, and the height of cut is 50–100 mm. At a forward speed of 4 km/h, the harvester has a field capacity of 0.4 ha/h.

Self-propelled Platform Type Fruits Harvesting System

It takes a lot of work and difficulty to manage orchard operations including harvesting, trimming, spraying, and other canopy management techniques in fruit trees like mango, citrus, and sapota. In India, handpicking is the sole way to gather fruit. In order to improve orchard harvesting and pruning efficiency, a self-propelled hydraulic multi-purpose system has been created at ICAR-CIAE, Bhopal for medium height fruit trees. With a load carrying capacity of 200 kg and a top ground speed of 3 km/h, it has a maximum vertical reach of 6 m. With dimensions of 2.20 x 6.32 x 1.89 metres, this device may be used as a platform to easily access fruits on trees. An 8.7 kW petrol engine provides hydraulic power for this machine. An operator sits on the platform and operates the machine by raising and lowering the platform, moving it forward and backward, and directing it. The device is simple to use and needs little upkeep. It can be securely operated on both flat fields and mountainous terrain with lateral and longitudinal slopes of up to 5o. Depending on the fruit density on the tree, the operator may pick between 700 to 1100 mangoes every hour. The machine should cost about Rs. 7.50 lakh. 2 l/h of gasoline were used during the mango harvest [2].

Tractor Front Mounted Vertical Conveyor Reaper

Harvesting of cereal crops like wheat and paddy is done with the help of the equipment. A

reciprocating cutter bar assembly with a 76 mm pitch, seven crop row separators, and two vertical conveyor belts with lugs, pressure springs, pulleys and a gearbox for the power transmission system make up this apparatus. The star wheels are positioned on top of the crop row dividers, which are mounted in front of the cutter bar assembly. The apparatus is positioned in front of the tractor, and the tractor's PTO provides power to it. Utilising pulleys and steel ropes, the tractor hydraulic system regulates the machine's height above the ground. The crop is chopped by the cutter bar, held vertically, supplied to one side of the machine by lugged belt conveyors, and then dropped in the shape of a windrow on the ground perpendicular to the machine's motion. The machine has a field capacity of 0.4 ha/h at a forward speed of 2.5–3.5 km/h. As opposed to the typical method's cost of Rs. 3200/ha, the cost of operation is around Rs. 1600.

Tractor Mounted Fodder Harvester

To enable simultaneous harvesting, chopping, and loading activities, a tractor-operated flail type harvester, cum-chopper, and cum-loader was built. Successful harvesting is possible for the crops bajra, sorghum, maize, barseem and oats, which range in height from 1 to 2.50 metres and have a stalk density of 20 to 80 plants per square metre. The equipment comprises of an auger for moving the cut crop, a rotating shaft equipped with flails to harvest the crop, cutters to chop the crop and an outlet for moving the chopped fodder into the trailer. On a horizontal axis perpendicular to the direction of motion, there are three rows of 13 blades each on the rotating shaft. Crop is chopped using blades, and an auger transports it to the chopper unit. Crops are sliced into bits by the four-bladed cutting mechanism, which is flung out at high speed and loaded into the machine's attached trailer. It also easily gathered produce that was stuck and beyond its prime. The machine can produce 0.20 hectares per hour at a forward speed of 2.5 to 4.0 km/h. The machine's operating costs are Rs. 1500/ha as opposed to Rs. 3200/ha when using the traditional approach.

Marketing

Products were traded according to weight. There was a food grains mart at Madurai, the home of the Sangam poets, where 18 different types of cereals, millets, and pulses could be purchased. Each store had a banner stating the grains sold that was raised high enough to be seen from a distance. On both imports and exports, customs duties were collected [3].

a. Revenue from Agriculture

The 'irai' or 'karai' (land tax), tolls, and customs fees were all collected by Tamil rulers. 'Ulgu' and 'Sungam' were terms used to describe revenue collecting. The king's portion of the tasks was referred to as "Kadamai," "Paduvadu," or "Padu." Vari was a general word for revenue, or income. 'Iravu' was the term for excessive demands or forced fits. "Vari" stands for tax, "Variam" for the organisation that collects taxes, and "Variyar" for a tax collector. The rulers received one-sixth of the production from the land as land income. The king grants certain people or organisations access to tax-exempt territories. These areas were known as "Puravu" or "iraiyili nilam." Due to unexpectedly weak crops brought on by a lack of rain, revenue relief was granted. Twelve years of failure were described by the poet Iraiyanar Ahapporul for the Pandia kingdom. The farmer survived during such periods of great starvation by eating the seeds that were usually meant for planting.

AnnualRainfallandCropYields

As seen in Table 1, the Sun, the yearly ruler, predicts average precipitation, the Moon, heavy precipitation, Mars, sparse precipitation, and Mercury, excellent precipitation. Venus predicts abundant rainfall, but Saturn as a king leaves the ground dry and dusty. Rainfall is sufficient when Jupiter is the king of the year. A year with the Sun as its ruling planet is marked by eye illnesses, the danger of fever, several other tragedies, little rainfall, and persistent winds. The planet will benefit from abundant harvests and people will enjoy excellent health throughout the lunar year. Crops suffer damage and illnesses spread among people in the year when Mars rules. Crops start to help the world. Earth is disease-free while Mercury is the ruling planet. There is a lot of harvest and transportation is simple. All of the many types of crops are a blessing to the environment. When Jupiter governs the year, the Dharma rules the world, people are at peace, and there is abundant rainfall. The whole planet is prosperous. The rulers always flourish under Venus, the preceptor of devils, who rules the year. Plenty and prosperity follow. There are many different types of cereal grains on the world. Stormy rains and an outbreak of illnesses are certain to occur in the year when Saturn controls war. Rare rain is scant, and there are persistent winds.

Table 1: Illustrated the AnnualRainfallandCropYieldsDependingontheRulingPlanetsoftheYear

Nameoftherulingplanetoftheyear	**Estimatedrainfallfortheyear**	**Cropyieldduringtheyear**
Sun	Averageorscanty	Poorcropyield*
Moon	Heavy	Goodharvest
Mars	Scanty	Damagetocrops
Mercury Jupiter	Good Satisfactory	Plentyofharvest Goodharvest*
Venus	Excellent	Varietyoffoodgrains
Saturn*	Scanty	Pooryield

AModelforForecastingSeasonalRainfallRecordedinBrhatSamhita

Varahamihira(600 A.D.) evolved or adapted a technique based on science. This technique lays down that after theoccurrence of the full-moon day of the month of Jyestha (approximately coinciding with June ofGregorian calendar) the asterism or lunar mansion or naksatra of the day on which the first rainfall ofthat year rainy season is received should be noted. This asterism provided the basic for the forecast ofseasonal rains. The predicted amount of the season's total rainfall for each nakshatra or lunar mansionif it happens to be the nakshatra on the first rainfall of the season is listed (Table 2.6). The first rainfallof the season that occurred after the full-moon day of the month of Jyestha (approximately June) istaken into account for forecasting the seasonal rainfall, but the amount of rainfall recorded on that day has not been indicated. Modernmeteorology define sarainy day as a day on which arain fall of 2.5mm or more has been

recorded[4].

The Method of Ascertaining the type of Cloud of the Year

Add the types of fire (which isthree) to the number denoting the Saka year. Divide the sum by the number of vedas (which is four). Theremainderofthedivision indicates the type of cloud, *viz*., Aavarta, etc., according to their order which is mention in Table 2.

Table 2: Illustrate the Varahamihira'sTechniqueforForecastingSeasonalRains

LunarMansion	Zodiac sign		Predictedtotalseasonalrainfall	
	Sanskrit	English	Inancientunits(drones)	Inmodernunits(cm)
Hasta	Kanya	Virgo	16	102.4
Purvashadha	Dhanu	Sagittarius	16	102.4
Mrigashirsha	Vrushabha	Taurus	16	102.4
Chitra	Kanya	Virgo	16	102.4
Revati	Meena	Pisces	16	102.4
Dhantishtha	Makara	Capricorn	16	102.4
Shatabhisha	Kumbha	Aquarius	4	25.6
Jyeshtha	Vrushchika	Scorpio	4	25.6
Swati	Tula	Libra	4	25.6
Kritika	Vrushabha	Taurus	10	64.0
Shravana	Makara	Capricorn	14	89.6
Magha	Simla	Leo	14	89.6
Anuradha	Vrushchika	Scorpio	14	89.6
Bharani	Mesha	Aries	14	89.6
Mula	Dhanu	Sagittarius	14	89.6
Purvaphalguni	Simla	Leo	25	160.0
Punarvasa	Mithun	Gemini	20	128.0
Vishakha	Vrushchika	Scorpio	20	128.0
Uttarashadha	Makara	Capricorn	20	128.0
Aaslesha	Karka	Cancer	13	83.2
Uttarabhadrapada	Meena	Pisces	25	160.0
Uttaraphalguni	Kanya	Virgo	25	160.0
Rohini	Vrushabha	Taurus	25	160.0

Purvabhadrapada	Kumbha	Aquarius	15	96.0
Pushya	Karka	Cancer	15	96.0
Ashwini	Mesha	Aries	12	76.8
Aradra	Mithun	Gemini	18	115.2

It is a consequence of its unique configuration in the sky, which includes a base that is around 2500–3000 feet (750–900 metres) above sea level and a vertical rise that is approximately 25,000–30,000 feet (7-9 kilometres) beyond that base. The altostratus cloud type, which is widely dispersed in the sky and lies between 2.5 km and 6.0 km above sea level, is indicated by the second form of cloud, samvarta, which showers everywhere. When the Sun is spreading across the sky, a sheet cloud can be quite thick, making the Sun invisible. Pushkara is the third form of cloud, and the year it occurs is notable for having little rainfall. Due to the fact that its building is a transient phenomenon or a disruption in the regular atmosphere, the term Pushkara or Pushkal denotes that it is a cloud of brief duration. According to the sage Prarasha, the last variety, Drona, causes the world to be covered in water. It is a stratocumulus cloud, a sheet-shaped cloud that is found at a height of around 2 km. This kind likewise produces constant, steady rain. According to Varahamihira and other scholars, the development of clouds, also known as cloud pregnancy or Garbha Dharana, occurs 195 days before to the fall, birth, or delivery of clouds, also known as "Garbha Prasava"[5]–[7].

DISCUSSION

With a total size of 329 million hectares, India is a sizable nation. About 166 million hectares of land are cultivated, and 142 million hectares of net area were sown. The country's output of food grains is growing far more quickly than its population.

Improved agricultural tools will be required to boost the output of the nation's farming operations in order to feed such a large population. Scientific farming, which includes the introduction of high yielding varieties, construction of irrigation systems, effective use of pesticides, fertilizers, insecticides, etc., along with agricultural mechanization, is required to supply the demand for food grain. Along with removing the drudgery of labor, agricultural mechanization has improved timeliness of operation, increased land productivity, and increased the return on investment for farmers. Tractors and related agricultural equipment including tillers, disc harrows, seed drills, threshers, and greater use of combine harvesters in the nation are major components of agriculture mechanization, in addition to lift irrigation [8]–[10].

CONCLUSION

Systems for harvest mechanization with a training-education component to give training to operate newer mechanized harvest equipment and systems may need to be put in place in order to prevent losses caused by delayed harvest. Due to the paucity of physical labour, it is therefore advised that the combine harvester be used to successfully harvest crops, since multi-crop threshers are perfect for threshing main cereals, oilseeds, and pulses. Farmers urgently need a rapid and effective technique of harvesting. By properly timing the threshing process and making necessary machine adjustments, these devices aid in reducing losses and preserving the quality of the yield.

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CHAPTER 12

AN ANALYSIS OF VARAHAMIHIRA'S TECHNIQUE FOR FORECASTING SEASONAL RAINS

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ABSTRACT:

Modern forecasting methods have emerged as a result of recent scientific advancements. But only our country possesses ancient indigenous knowledge. Science and technology have a long history in India. Weather was well studied by our ancient astronomers and astrologers. Even today, a startlingly high percentage of astrological forecasts from rural pandits (astrologers) are correct. The majority of people believe that meteorology is a modern discipline of study. Although it may be new to the west, India has been using this science for a very long time. The astronomers and astrologers of our ancestors meticulously researched this topic. Simple requirements must be met; costly equipment is not required. Through years of experience and observation, meteorology has evolved.

KEYWORDS:

Agriculture, Crops, Rainfall, Rain Forecast, Vedas.

INTRODUCTION

Varahamihira devotes eight portions of the Brihat Samhita to the science of predicting rain. Only by closely monitoring solar processes, which are linked to certain planetary alignments, can weather predictions be achieved with a high degree of precision. Under specific planetary configurations, the Sun, Moon, and other planets can act alone or together to cause changes in the weather. The sunspots and their consequences on Earth had been dealt with by Varahamihira. Sunspot maxima also correlate with times of very severe rainfall (flooding). When these spots appeared, earthquakes, thunderbolts, and other strange phenomena that portended disaster would occur. There are significant spurts of solar activity every 11 years or so. The "earth's heartbeats" accelerate at the maximum periods, increasing the frequency of earthquakes. The eruption of ferocious winds from sunspots also releases charged corpuscles that result in terrestrial magnetic storms. There will be starvation because of the wedge-shaped disc spot on the sun. When solar activity is at its peak, the solar wind is "gustier." The solar wind comprises more high-speed streams when the Sun is more active and creating flares and spots. And there is a good chance that the weather on Earth will be impacted by these fast streams. Records of the frequency of storms and lightning strikes provide direct evidence between sunspots and the weather. The mean sunspot index is closely followed by the annual lightning incidence, which counts the amount of lightning strikes in a certain location each year [1].

PrinciplesofAstro-meteorology

Hindu astrology rain forecasting is a scientific process that involves stage-by-stage monitoring over a minimum of six months. To anticipate rain during the Indian monsoon, it is necessary to observe the garbhadharan (impregnation) of the clouds towards the end of Dakshninayan (July 17 to January 13) on the specific day when the moon reaches a certain constellation (or nakshatra). The garbha dharan is to be followed for winter rains during the Uttarayana season (January 14 to July 16). For predicting rainfall, the following guidelines are given:

Step 1: According to Varahamihira, clouds grow or get pregnant (Garbha Dharana) 195 days before they are born (Garbha Prasava) or fall (Garbha Prasava). For astro-meteorology, there are really twenty-seven nakshatras (constellations). In addition to these, 'abhijit', the twenty-eighth nakshatra, is given a spot at the conclusion of Uttarashadha. according to Table 1.

Table 1: Illustrated the Seven Nadis in Varahamihira Method.

SevenNadis	NakshatraorAsterismorConstellation	EffectonWeather
Chandanadi,Prachand,	Krittika(3),Vishakha(16),	Brightsunshine,Norainfall
(Fierce)	Anuradha(17),Bharani(2)	
Dahananadi or VatanadiorPaman(windy)	Rohini(4),Swati(15),Jyeshta(18), Ashivini(1)	Sunshineandwind,Normalrainfall
Vayunadi,Vanhinadi,Dahan(hot)	Mrigashira(5),Chitra(14),Mula(19), Revati(27)	Stronghotwind(Westerlies)
Soumyanadi(weatherchanges)	Ardra(6),Hasta(13),Poorvashadha(20), Uttaraproshthapada(26)	Normalrainfall
Neeranadi(goodrain)	Punarvasu(7),Uttarphalguni(12), Uttarashadha(21),Poovaproshthapada(25)	Verygoodrainfall
Jalanadi(betterrain)	Pushya(8),Poovaphalguni(11),Abhijit, Satabhisha(24)	Abundantrainfall
Amritanadi(bestrain)	Ashlesha(9),Magha(10),Sravana(22), Dhanista(23)	Heavytoveryheavyrainfallcausingflood

Planets And Nadi's Impact on Rain During Winter Solstice (Dakshinayana)

As seen in Table 2, there are really 27 nakshatras (constellations) used in astroneteorology. In

addition to these, 'abhijit', the twenty-eighth nakshatra, is given a spot at the conclusion of Uttarashadha.

Table 2: Represented the Effects of Nadis on Weather Mood.

Planets	Nadi	Effectsonweather
Sun,Mars,Saturn	Saumya	Ordinaryrain
Jupiter,Venus,Mercury,Moon	Saumya	Goodrain
Jupiter,Venus,Mercury,Moon	Vayu,Chada,Dhana	Ordinaryshowers
Sun,Mars,Saturn	Vayu,Chada,Dhana	Norain

Aswini,Krittika,Rohini,Purvabhadra,Uttarabhadra,Anuradha, Sravana, Punarvasu, Pushya are masculine; Bharani, Hasta, Chitta, Swati, Visakha, Pubba, Uttara, Aslesha, Makha, Jyeshta,Aridra,Dhanishta,PurvashadhaandRevatiarefeminine;Satabhisha,Mrigasira and Moola are neutral. When the Sun and the Moon are in neutral asterisms there will be winds; whentheyareinfemininеasterismstherewillbelightningandphosphorescence;andwhentheSunoccupiesafemininеasterism,andtheMoonamasculineasterism,orvice-versatherewillberains.

Step 2: The weather is impacted when many planets are in one Rashi, ideally in one nakshatra. Even though it is not the typical monsoon season, there may be a severe deluge when multiple planets congregate in one rashi with Mars and Sun joining together with Mars conjunct Rahu. when the planets are concentrated in a single rashi.

When a new moon joins them, the weather starts to change, and it will pour heavily. Full water signs are Cancer, Pisces, and Capricorn; half water signs are Taurus, Leo, and Aquarius; quarter water signs are Aries, Libra, and Scorpio; and not water signs are Gemini, Virgo, and Sagittarius. Venus and the Moon both have significant water content. Malefic planets (Saturn, Sun, and Mars) transiting through the Amrita, Jala, and Neeranadis on the Winter Solstice (Dakshinayana) would cause typical rains.

There will be a lot of rain if the benevolent planets pass across the aforementioned constellations [2].

Step 3: When the Moon joins Venus or when it is fifth or ninth from Venus in the rainy season, it produces favorable rain unless there are elements blocking rainfall, regardless of the season.

Step 4: In the rainy season, there must be a good amount of precipitation when Mars transits from one Rashi into another in less than two days. The planet Mars is the one that causes the greatest precipitation.

Step 5: Similar to this, significant events occur when a major planet, like Jupiter, Saturn, Rahu, or Ketu, enters a fire, earth, water, or air sign and changes a Rashi. It must result in a highly visible shift in the weather in the case of weather.

Step 6: There is a shift in temperature, humidity, and what the meteorologists refer to as "disturbance" that causes rainfall, etc., when planets retrograde and on the days they direct.

PrinciplesareUsedtoPredicttheDates/OccurrenceofRainfallinIndia

i. The south-west monsoon starts to hit the Kerala coast once the sun enters Mrigshira nakshatra near the end of May. Every year, the monsoon advances towards northern India when the sun approaches Ardra.

ii. On September 26, when the sun reaches and passes six degrees in Gemini, the monsoon comes in North India, and it starts to retreat when it reaches ten degrees in Virgo.

iii. The sun creates rain in Bihar as it enters the Hasta nakshatra, which is referred to by the common farmer in Bihar as Hathiya rain. However, by that point, the monsoon has left the rest of northern India.

iv. The sun continues to provide rain to Bihar, especially in north-east India, as it enters Chitra.

v. Upon the sun's entry into Swati. In Indian folklore, there is mention of the bird named Chatak, which is said to wait for the raindrop of Swati. If it doesn't rain sometimes, the south-west monsoon completely withdraws.

vi. Rain may be induced or prevented by the moon depending on its alignment with other planets or when it forms specific 'nakshatras' constellations or stars. In the Sapta Nadi Chakra, planets will be positioned in the nakshatras listed above.

vii. After August 3, when Mercury enters Cancer and joins Venus in the north of India, there will be rain.

viii. A tremendous downpour of rain is predicted by the conjunction of Jupiter and Venus in the Rohini star.

ix. When Mars and Rahu are combined and examined by Saturn, lightning and cloud explosions occur.

x. On the coast of Andhra Pradesh, cyclones are more prone to arise when Jupiter, Saturn, Rahu (Ketu), and Uranus make even loose Kendra (square) and Samagama (conjunction) aspects between them. When either Virgo or the 12th from it is affected, these signs are amplified [3].

Rain Gauging

Varahamihira advised that rainwater be collected in a container with an adhaka-sized capacity. The amount of rain that fills a 20-inch-diameter, 8-inch-deep vessel to the brim is referred to as an adhaka.

A drona is made up of four of these adhakas. According to Varahamihira, if all five of the following circumstances exist at the same time wind, rain, lightning, thunder, and clouds then one drona of rain will fall across a 400 square mile region. Three adhakas of rain will fall as a consequence if the wind was the only factor in the formation of the clouds. Nine adhakas of rain are forecast if lightning is to blame. Twelve adhakas if the rain is the result of thunder and other rain-related elements.

i. If it rains on a day when the Moon asterism is Hastha, Poorvasshadha, Mirgasira, Chittra, Revathi, or Dhanistha, there will be 16 dronas of rain on the corresponding days of the next lunar month.

ii. If it rains on a day when the Moon asterism is Sravana, Makha, Anuradha, Bharani, or Moola, there will be 14 dronas of rain the next lunar month on the corresponding days.

iii. There would be four dronas of precipitation on the days associated with the rainy seasons if the Moon were to be in either Satbhistha, Jyestha, or Swathi. 10 dronas if in Krittika; 25 dronas if in Poorvaphalguni; 20 dronas if in Vishakha or Uttarashadha; 13 dronas if in Ayslesha; 25 dronas if in Uttarabhadrapada; 13 dronas if in Aswini; and 18 dronas if in Aridra.

iv. Neither rain nor prosperity will fall on the land if the moon in the aforementioned asterism is under the influence of a malefic aspect or conjunction. Rainfall would be beneficial if the benefic planets passed over the asterism above or if the moon was not impacted by malefic planets.

Hour of Rainfall

According to Varahamihira, clouds that are "conceiving" during the day will deliver at night, while clouds that are "conceiving" at night will deliver during the day. Clouds that are "conceiving" in the twilight of the evening deliver during the morning twilight, and vice versa. Again, if clouds were present at the time of conception, they would have been present at the time of birth in the west, and so on for the other hemispheres. Similar to this, if the wind was blowing from the east at the time of conception, it will blow from the opposite direction when it rains [4].

RainintheImmediateFuture

While ancient meteorology can predict rain long in advance, is it no difficult thing to forecast rain in the immediate future. During the rainy season, immediate rainfall is indicated: If the sun at the time of rising is exceptionally bright and red, or If the taste of water is insipid, or the color of the sky or sunset rainbow is seen in the sky, or If salt begins to sweat, or If fish in tanks jump from water on the bank, or If metal vessels emit a fishy smell, or If ants, with their eggs, move from one place to another.

Forecasting Rainfall, Floods and Weather Vagaries

The several methods recommended byclassical writers for forecasting rainfall, floods and weather Vagaries, the most important onesare:

a. The lunar new year chart,

b. Time of pregnancy of clouds,

c. Entry of the Sun into theconstellation of Aridra,

d. Sun’s entry into Capricorn,

e. Rohini, Swati, and Ashadha Yogas,

f. Mutualdispositionsofplanetsatagiventime.

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RainintheImmediateFuture

It is not difficult to anticipate rain in the near future, even if ancient meteorology could predict rain for a very long time. Immediate rainfall during the rainy season is indicated: If the sun is particularly bright and red at sunrise, if water tastes bland, if the sky is a certain colour or there is a rainbow at sunset, if salt starts to sweat, if fish in tanks jump out of the water on the bank, if metal containers give off a fishy odor, or if ants move from one place to another while carrying their eggs [5].

Forecasting Rainfall, Floods and Weather Vagaries

Of the several methods recommended byclassical writers for forecasting rainfall, floods and weather Vagaries, the most important onesare:

- **i.** The lunar new year chart,
- **ii.** Time of pregnancy of clouds,
- **iii.** Entry of the Sun into theconstellation of Aridra,
- **iv.** Sun’s entry into Capricorn,
- **v.** Rohini, Swati, and Ashadha Yogas,
- **vi.** mutualdispositionsofplanetsatagiventime [6].

DISCUSSION

Since 1993, these projections have been published in Gujarati daily newspapers in Saurashtra, including Akila, Sandesh, Fulchhab, and Gujarat Samachar. Additionally, the Agricultural Department of Maharashtra and CASAM receive this forecast. In practise, the aforementioned prediction is most useful for scheduling agricultural activities, water storage in reservoirs, and predicted severe rainfall. The scientific community has also praised the study's efforts and findings. The Agricultural Meteorological Section highlighted the development of his approach of rainfall prediction and brought this to the attention of the scientists present at the 87th Indian Science Congress Convention on January 7, 2000, at the College of Agriculture in Pune [7]–[9].

CONCLUSION

We've gone through the several approaches of predicting precipitation. It will be vital to learn about each technique's limits. The medium-range forecast made for Pune using a supercomputer has an average accuracy of 69.9%. the average prediction accuracy using the created model, i.e., less than the actual rainfall. According to Sri Shah's findings for Pune and Saurashtra, the

average accuracy is 67%. Farmers seem to benefit more from planetary-based forecasts. The planetary technique offers value from a research perspective, despite the fact that several methodologies are being studied globally to increase prediction accuracy. The inference made is that it is crucial and extremely vital to provide farmers, who are the end consumers, with accurate predictions as soon as possible. This precision in rainfall forecasting is crucial for increasing agricultural output, which would ultimately enhance Indian agriculture and bring the country wealth.

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CHAPTER 13

AN ANALYSIS OF THE EFFECT OF PLANETSONWEATHERPARAMETERS

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ABSTRACT

A challenging and exciting area of study that studies the possible impact of celestial bodies on the Earth's atmosphere is the study of how planets affect meteorological characteristics. The purpose of this study is to establish a link between planetary locations and variations in meteorological parameters such as temperature, precipitation, and atmospheric pressure. In order to find connections and possible causal linkages, the research entails analyzing data from numerous sources, including meteorological records and planetary locations, using statistical and mathematical modelling approaches. The findings of this study may advance our knowledge of the fundamental processes that control weather patterns and the potential impact of planetary motions on Earth's weather. The relevance of investigating how planets affect weather parameters is emphasised in this work, as is the value of continued research in this area.

KEYWORDS:

Climate Change, Earth, Environment, Planets, Weather.

INTRODUCTION

Mercury and the Sun make windy contact, causing spells. In a similar vein, Sun + Venus causes rain or snow; Sun + Mars causes warmer climate in accordance with the season; Sun + Jupiter causes dryness or drought; Sun + Saturn causes colder than usual in the season; Sun + Rahu causes local storms; and Sun + Ketu causes a climate that is extremely changing in a short period of time. Garga and other sages claim that the clouds begin to ovulate on the day the Moon enters the constellation of Poorvashadha in the brilliant half of the lunar month Mirgasira, which occurs during the third week of November every year.

While the Moon's changing distance from the sun, or lunar day or tithi, is a significant contributor to weather changes, there is abundant proof that the major planets have a significant impact on atmospheric outcomes. On the three days centred at the new Moon and full moon, numerous tropical storms intensified into hurricanes. Heavy downpours were most common four days after the full moon and peaked four days following the new moon. In other words, the most precipitation occurred when the Moon was 45 or 225 degrees from the Sun. The Moon's motion continues to be in perfect agreement with changes in rainfall rates. The northern hemisphere's weather is more affected when a planet enters the sign of Cancer, but the southern hemisphere's weather is more affected when planets enter the sign of Capricorn. Mars and arid conditions: When it come to the planet Mars, it boosts the temperature and makes the air dry, particularly when it is in the sign of Aries. Rain and thunder storms happen throughout the rainy season as a

result of the disruptive influence Mars and Jupiter have on the weather. Saturn-Mars effects lead to thunderstorms, lightning, and floods [1].

Typically, rainy and windy weather occurs when Mercury and Venus pass the Sun. The observer may get a hint about the sort of weather to expect during a certain time period by looking at the Sun's location during new moon and season transitions. A blizzard or cold wave happens throughout the winter when Mercury and the Sun are in conjunction. A swiftly moving cold wave might occur when Mercury and the Sun are in superior conjunction, followed by Mercury's conjunction with or opposition to Mars, and Rahu is conjunct the Sun. Temperatures might drop quickly. A shared aspect between Mercury and Saturn may restrict the region of increasing temperatures. Venus's aspects might bring warm, humid air with the possibility of storms, tornadoes, or moderate to heavy rain. Unless additional planets are present, Venus's retrogression or direct motion has little effect on the weather on its own. Rains benefit from Jupiter being retrograde. Rains are harmed by a retrograde Saturn. How external factors affect wind: Mars causes vigorous watery breezes and exceptionally hot summers, while Mercury creates acute, sharp, and whipping winds, Venus creates weather that is consistent with the season, and Saturn's influence often results in persistent cloud cover and unusual rains. At the time of the full Moon, the most fires were seen. When Jupiter is in perihelion, there is a severe drought, and when it is in aphelion, there is unusually high humidity and low temperatures. Due to their slower motion and greater mass over a longer period of time, the slower moving planets especially Jupiter and Saturn exert a telling influence [2].

RoleofPlanetsonOccurrenceofRainorFloodorDroughtorFamine

a) WhensunisbetweenVenusandMercurythereisabreakinmonsooninthesensethatforsomedays thereisdryspell.

b) Sun being behind Mars in the rainy season, there will be poor rain or rain is delayed or willcreate dry spells. When the Sun was overtaking Mars, there will be heavy downpour of rains,causingfloodinrivers.

c) Rainwillnotbetimelywhenallquadrantsbeingoccupiedbymalefic.

d) Mars,affectedbyothermalefic,willcreatedryspellstillAugust.

e) IfJupiterandMarsarewithin30degrees(thirtydegrees)ofeachotheritpreventsrains.

f) If theMoonisinthe 7thfromVenusand withinviewofbeneficplanets, orbeinthe5th,7th or9thhousefromSaturntherewillbeimmediaterain.

g) When Venus is in constellations of Swathi, Vishakha and Anusha, unprecedent rainfall resultsinheavyfloods.

h) FaminewillbreakoutforwantofrainswhenVenusisinoneofconstellationsfromJyesthatoSravana.

i) TherewillbedroughtconditionwhenVenussetsinorretrogradesinMakhaorUttarashadha.

j) Clouds become scattered and rainfall disturbed, when the sun, Mars and Venus transit the samesign.IfJupiterjoinstheabovecombinations,cloudswilldeliverrainsinplenty.

k) WhenJupiterretrogradesinRohini,theyearwillhavelessrainfall.

l) HeavyrainresultswhenJupiterisinPisceswhileVenusisinCancer.

m) DroughtsarenoticedwhenSaturnisunaspectedinAries,LeoorSagittarius.

n) WhenMarsandSaturnareinconjunction,rainfallwillbeverylow.

GeneralSignsthatBringRain

a) Soft,white,deephaloroundtheMoonortheSun.

b) Dark colored sky, dark as the crow's egg.

c) Sky overcast with huge, bright, dense clouds.

d) Needle-shaped clouds.

e) Blood-red clouds.

f) Rainbow in the morning or in the evening.

g) Low, rumbling roar of thunder.

h) Lightning.

i) The appearance of the mock-sun; and

j) Planets shine in full form and with soft light.

AnimalBehaviortomakeMediumRangeForecasts

The plants, birds and animal behavior are used to predict medium and short-range forecasts.

a) In the rainy season when the sky is cloudy try to take your pet dog outdoor. If the dog shows a disinclination, it is a sign of coming rain.

b) Seeifkitesinflockareflyingataheightofabout400ft.Itisanindicationofrainorstorm.

c) Seeifanyspiderhasstartedweavingitsweboutdoors.Itindicatesthedepartureofthemonsoon.

d) Thosewhoareluckytohavesomefrogsaliveandcroakingcangettheindicationfromtheircroaking.

e) Theexultantcryofthepeacockisanindicationofcloudformation.

f) Earlyfloweringofthegulmohurandamaltaswasanindicationofagoodmonsoon.

g) Rain bird; if the rain bird gives eggs at the ground level then there will be less rain however ifthe indication of more rains the local people assume that eggs of rain bird are laid on such aheight that in case of more or less rains, the eggs will not be submerged in rainwater. Similarly,if the narrow ends of all the four eggs of rain bird are downwards, and then it is the indicationofgoodrainfallthoughtouttheseason [3].

h) When the adventitious roots of the banyan tree (Ficus bangalensis) start spouting (tillering),thenthelocalpeopleassumethattherainswillappearwithin2to4days.

i) Whenthebudsstartspoutingincastorandber,thenrainswillappearwithin10to15days.

j) Therainswillappearafter10–15daysofflowinginbabultree(Acacianilotica).

k) As soon as the neem kernels ripen and start falling, it is expected that there will be rains after10–15days.

Almanac,PanchangandKrishi-Panchang

An Almanac is a book or table containing a calendar of the days, weeks, and months of the year, a register of ecclesiastical festivals and saint's days and a record of various astronomical phenomena, often with weather prognostications and seasonal suggestions for the countrymen". In India, the classical Hindu astrological almanac is known as 'Panchang'. Panchang has been prepared for public use from Vedang Jyotish period 1400-1300 B.C. The word 'Panchang' has derived from the Sanskrit words viz., 'panch' and 'ang', which mean 'five' and body part/limb' respectively. These parts are:

i. Tithi or lunar day;

ii. Vara or week day;

iii. Nakshatra or asterism orconstellation;

iv. Yoga or time during which the joint motion of the sun and the moon covers the space ofanakshatra

v. Karanaorhalfofalunardayorhalf-tithi.

Tithi

The fifteenth day of the bright half is called Purnima, Paurnima, or Paurnamasi. It is generally considered an auspicious day. The fifteenth day of the dark half is called Amavasya. It is called 'Kuhu' when the Moon is totally absent and 'Sinivali' when the moon is partially absent. It is generally considered an inauspicious day. The fourth, ninth, and the fourteenth days are called 'Rikta', i.e., empty days and are not recommended for commencing any new project[4].

Vara

There are seven days in a week named after the seven principal 'planets' (old concept) viz., Sun, Moon, Mars, Mercury, Jupiter, Venus and Saturn and they are believed generally to possess the characteristics of the respective planets.

Nakshatra

Nakshatra are constellations of stars. There are twenty-seven (or twenty-eight) nakshatras enumerated in a fixed order marking the Moon's heavenly path. Each nakshatra is divided into four padas, or charanas, i.e., quarters. Nine consecutive padas fall in one rashi, i.e., the zodiacal sign.

Rashi

Rashis are the twelve zodiacal signs that mark the imaginary or the apparent path of the sun through space. e.g., Mesha (Aries) and Vrishaba (Taurus). The sun takes approximately one month to pass through one sign (and takes thirteen to fourteen days to pass through one nakshatra)[5].

RainForecastinginIndianAlmanacs(Panchangs)

According to the Encyclopedia Britannica (1969), "An almanac is a book or table containing a calendar of the days, weeks and months of the year, a register of ecclesiastical festivals and saint's days and a record of various astronomical phenomena, often with weather prognostications and seasonal sugges- tions for the countrymen". In India, the classical Hindu almanac is known as 'Panchang'. It is a very important book published yearly, and is the basic book of the society giving calenderical information on daily basis and is extensively used by the people all over India. For astrologers, it is one of basic books for making astrological calculations, casting horoscopes, and for making predictions. For farmers, it is an astrological guide to start any farming activity. Hence, it is a fundamental book, which is referred to by a large section of the people in this country for various purposes. The word 'Panchang' has its roots in two Sanskrit words, viz., 'panch' and 'ang', which mean 'five' and 'body part/limb' respectively. These parts are:

i. **Tithi or lunar day**: There are a total of thirty tithes in a lunar month, fifteen in each fortnight;

ii. **Vara or week day:** There are seven varas, namely, Ravivara (Sunday), Somavara (Monday), Mangalavara (Tuesday), Budhavara (Wednesday), Guruvara (Thursday), Shukravara (Friday), and Shanivara (Saturday);

iii. **Nakshatra or asterism or constellation**: There are a total of twenty seven nakshtras named according to the yogataras or identifying stars of each of the twenty seven equal parts of the ecliptic or solar path;

iv. Yoga or time during which the joint motion of the Sun and the Moon covers the space of a nakshatra (there are twenty-seven yoga)

v. Karana or half of a lunar day or half-tithi.

Krishi-Panchang

Krishi-Panchang or Agro-almanac or Agro-panchang may be defined as "basic astro-agricultural guide book/calendar published annually, giving calendrical information on various aspects of agriculture and allied activities, basically suggesting region-wise, season-wise and crop-wise crop strategy based on astro-meteorological predictions, giving auspicious/inauspicious time for undertaking/avoiding various farm related operations, along with a list of performing religious rites, festivals, observing fasts and some non-astrological guidance, primarily useful for the farming communities and person having interest in agricultural development".

Making of Krishi-Panchang

A Krishi-Panchang may be defined as "basic astro-agricultural guide book/calendar that needs to

be published annually, giving calendrical information on various aspects of agricultural and allied activities, basically suggesting region-wise, season-wise, and crop-wise crop strategy based on astro-meteorological predictions, giving auspicious or inauspicious time for undertaking/avoiding various farm-related operations, along with a list for performing religious rites, festivals, observing fasts, and some non-astrological agricultural guidance, primarily useful for the farming communities and persons having interest in agricultural development"[6].

Content and Coverage proposed

The Krishi-Panchang should be basically different from the present-day panchangs in its content and coverage, method and approach of writing, composition of editorial boards, publication, and circulation. The Krishi-Panchang, being meant for meeting agricultural purposes, majority of its contents should relate to agricultural information. In addition to this, basic information such as annual date calendar, list of holidays, auspicious day of the coming year should be given for the benefit of farming communities.

DISCUSSION

In this section the author discussed the study of how planets and other celestial bodies affect weather patterns on Earth has been a subject of interest for centuries. Although the effects of planets on Earth's weather are not yet fully understood, there is some evidence that suggests that certain planets can have an impact on weather parameters such as temperature, precipitation, and atmospheric pressure. One of the most significant ways in which planets can affect weather on Earth is through their gravitational pull. The gravitational forces exerted by the sun, moon, and other planets can cause tides and ocean currents, which in turn can affect weather patterns. For example, the gravitational pull of the moon causes the tides to rise and fall, which can lead to changes in ocean currents and sea surface temperatures. These changes can, in turn, affect the atmosphere and lead to changes in weather patterns. Another way in which planets can affect weather on Earth is through the solar wind.

The solar wind is a stream of charged particles that is constantly flowing out from the sun. When the solar wind interacts with Earth's magnetic field, it can cause disturbances in the atmosphere, including changes in temperature and atmospheric pressure. These disturbances can lead to changes in weather patterns, including the formation of storms and other severe weather events. The position of planets in relation to Earth can also affect weather patterns. For example, when the planet Jupiter is in opposition to Earth, it can cause an increase in the number of lightning strikes on our planet. This is because Jupiter's strong magnetic field can cause disturbances in the ionosphere, which in turn can lead to an increase in lightning activity. However, it's important to note that the effects of planets on weather parameters are still not fully understood and are subject to ongoing research. While there is some evidence to suggest that planets can have an impact on weather patterns, the extent of this impact and the mechanisms behind it are still being studied. It's also important to consider that weather is a complex system with many different factors at play, and the effects of planets on weather are likely to be just one piece of a much larger puzzle. In conclusion, while there is some evidence to suggest that planets can have an impact on weather parameters such as temperature, precipitation, and atmospheric pressure, the full extent of this impact is still being studied. As our understanding of the relationship between planets and weather continues to evolve, we may gain new insights into the workings of our planet's climate and weather systems [7]–[9].

CONCLUSION

In conclusion, there is still much to learn and dispute about in regards to how planets and other celestial bodies effect Earth's weather patterns. The degree to which planets may affect meteorological variables like temperature, precipitation, and atmospheric pressure is currently unknown, despite some evidence to the contrary. Weather patterns may be influenced by the solar wind, the planets' gravitational pull, and their positions in regard to Earth. The impacts of planets on weather are likely to be only one part of a much greater puzzle, since weather is a complicated system with many distinct forces at play. We may learn new things about how the climate and weather systems of our planet function as our knowledge of the interaction between planets and weather continues to advance. To completely comprehend the principles behind how planets affect weather and how we might utilize this knowledge to forecast and prepare for severe weather occurrences, further study is required.

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CHAPTER 14

AN ANALYSIS OF THE DIFFERENT METHODS FOR RAINFALL FORECASTS

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ABSTRACT

Forecasting rainfall is a crucial problem for meteorology, hydrology, and agriculture. Various techniques have been developed in recent years to increase the precision and dependability of rainfall forecasts. This article offers a summary of some of the most popular statistical, numerical, and machine learning algorithms for predicting rainfall. Time series analysis, regression analysis, and correlation analysis are examples of statistical procedures. The Global Forecast System (GFS), the European Centre for Medium-Range Weather Forecasts (ECMWF), and the Weather Research and Forecasting (WRF) model are three examples of numerical models used in numerical approaches. Artificial neural networks, decision trees, support vector machines, and random forests are a few examples of machine learning techniques. Each approach has advantages and disadvantages, and the best one to use will depend on a number of variables, including the forecast's time horizon, the data's accessibility, and the degree of precision that is required. The report finishes with a discussion of the possibility for merging various methodologies to increase prediction accuracy as well as the future directions of rainfall forecasting.

KEYWORDS:

Agriculture, Food, Crops, Rainfall, Weather.

INTRODUCTION

India is primarily an agricultural nation; hence the harvest's success or failure and water shortages are constantly viewed with the utmost worry. Either the Malayan monsin or the Arabic mausin seem to be the source of the word monsoon. The term's original usage was in reference to southern Asia and the surrounding waterways, where it described the seasonal surface air streams that in this region change direction between summer and winter, moving southwest in summer and north east in winter. The continent warms up in the summer, which causes increasing motion and decreased pressure. Low-elevation air is forced to move from the sea to the land by this. At the regional and national levels, weather forecasting uses a variety of techniques to predict rainfall. There are essentially two methods for predicting rainfall. Empirical and dynamical approaches are them[1].

The empirical method is based on examination of historical rainfall data and its correlation with various oceanic and atmospheric factors across various regions of the planet. Regression, artificial neural networks, fuzzy logic, and group data processing techniques are the most often

used empirical methods for predicting climate. A dynamical method uses physical models that are based on equation systems to provide predictions about how the global climate system will change in response to the initial atmospheric conditions. The numerical rainfall forecasting technique is used to execute the dynamical methods[2]. In order to create a short-term prediction of rainfalls over a specific area in our state, the empirical method methodology described in this work, which is a part of the regression approach, is used. Because these months are our state's winter season, the objective analyses three months' worth of rainfall data for a specific region over a period of five years[3]. Utilizing data from the corresponding time period from the previous year, multiple linear regressions are used to forecast the rainfall.

i. Short-range predictions predict changes in monsoon rainfall a few hours to 48 or 72 hours in advance.

ii. Medium-range predictions are "the preparation of scatter diagrams illustrating the dispersion of rainfall classified as abnormal, normal, or subnormal during the five-day period immediately following the period to which the pressure height of a pair of selected stations refer."

iii. Two times a year, long-range forecasts are released, once for the full four-month period from June to September and once for the second half of the monsoon season from August to September.

ArtificialRain-makingVersusYagna

The process of creating rain artificially involves manipulating an existing cloud to produce rain. Rain is also brought about using the antiquated Vedic yagna method from India. Certain combinations of wood and other materials burned during the "Yagna" could release ash gases that could cause ice-nucleating hygroscopic particulate matter. The ash from the materials in the yagna experiment was said to have qualities comparable to the ordinary salt used in sowing. In contrast to the yagna experiments, where it is said that clouds are first generated and then seeded by nuclei in the ash, scientists do not think seeding can be done without the existence of cloud initially. Red-Indians do rain-making dances and use bishops to sprinkle water on crops in the United States.

Chemical cloud-seeding is a technique for creating rain, destroying hail, or removing fog. By spraying silver iodide or sodium chloride over the clouds from an aircraft, cloud seeding is accomplished. There are two forms of chemical cloud seeding: warm clouding and cold clouding. While cold cloud-seeding occurs in hills like Kerala, warm clouding occurs in tropical regions. A decent cloud with a thickness of at least one km is required for cloud seeding. Hygroscopic nuclei, or water-vapour-attracting particles, are present in clouds, although smaller nuclei move more quickly than larger ones. The smaller nuclei currently present in the cloud will be absorbed if larger nuclei are added. The goal of seeding is to "excite" the larger nuclei already present, causing them to expand more quickly and fall to the ground as raindrops.

In heated seeding, a coagulation procedure, soapstone powder and common salt (NaCl) are seeded into the cloud to stop coagulation. The hygroscopic quality of the common salt

molecules, which are larger than huge nuclei, causes them to initiate precipitation and enhance a cloud's effectiveness of precipitation from the typical 10% to a significantly higher count. Radar may be used to detect the growth and compare it to the control cloud. The cold cloud used in cold-seeding via sublimating is already below zero degrees Celsius. Even in that form, there are two nuclei, one under pressure in the ice state and the other under pressure in the water state. The ice nucleus is passed by the water nucleus, which is under more pressure. Thus, by seeding with silver iodide in a liquid state, ice nucleus is here introduced.

CROPS

With the help of farmers who have tamed, imported, and genetically altered a wide variety of species to harness maximum output, Indian agriculture is among the oldest in the world. Over many generations, farmers have preserved seeds and related knowledge, resulting in conservation. Rice was a cultivated grain that was farmed along the banks of the Ganges in the sixth millennium B.C., according to archaeological discoveries[4]. Later, it spread to other locations. Before the sixth millennium B.C., several species of winter cereals, including barley, oats, and wheat, as well as legumes like lentil and chickpea domesticated in Southwest Asia, were grown in Northwest India. Other millets that had previously been domesticated in Africa, like sorghum, pearl millet, and finger millet, made their way to the Indian subcontinent more than 4,000 years ago. Also cultivated in India since the Neolithic era are smaller millets such the Panicum, Setaria, Echinochloa, and Paspalum species. Archaeological study has also shown that a variety of different crops were cultivated between 6000 and 3000 years ago. These include fibre crops like cotton and fruits like jujube, grape, date, jakfruit, mango, mulberry, and black plum; oil seeds like sesame, linseed, safflower, mustards, and castor; and legumes like mung bean, black gramme, horse gramme, pigeon pea, field pea, and grass pea. Sheep, goats, asses, dogs, pigs, and horses are examples of domesticated animals. The ancient Neolithic cultures cultivated plants for food, as well as legumes, tubers, fruits, fibres, and luxury crops. Table 1 provides a categorization of the crops that were grown in the early stages of human history [5], [6].

Table 1: Illustrated the Categories of Crops Cultivated during the Prehistoric Period

Foodcrops	Legumes	Roots/Tubers	Fruit	Fibres	Luxury
Wheat	Peas	Turnips	Nuts	Flax	Cocoa
Barley	Beans	Carrots	Apples	Cotton	Tea
Rice	Lentils	Garlic	Figs	Hemp	Opium
Maize	–	Potatoes	Oranges	–	Tobacco
Millets	–	–	Dates	–	–

OriginofCropPlants

Russian biogeographer Vavilov's (1949) classification of origin and approximate dates for the most common domestic plants as mention in Table 2. Domestication of plants and animals or the origin of agriculture is quite recent in the annals of mankind. The more recent investigations

show that agriculture began around 10000 years BP (before present) or 8000 B.C. during the Sumerian times in south-west Asia [7].

Table 2: Represented the Classification of Plant Species and Origin

PlantsSpecies	**Regionoforigin**	**DateinthousandyearsBP (BP=beforepresent)**
Emmerwheat	NearEast(SouthwestAsia)	9-10
EinkornWheat	NearEast(SouthwestAsia)	9.5-8.5
Barley	NearEast(SouthwestAsia)	9.5-8.5
Pea	NearEast(SouthwestAsia)	9.5-8.5
Lentil	NearEast(SouthwestAsia)	9.5-8.5
Vetch	NearEast(SouthwestAsia)	9.5-8.5
Flax	NearEast(SouthwestAsia)	9.5-8.5
Nakedwheat	NearEast(SouthwestAsia)	9.5-8.5
Rice	SoutheastAsia	7-5
Sugarcane	SoutheastAsia	7-5
Sorghumandmulberry	NorthChina	KoreaandJapan
Soybean	NorthChina	7-5
Almond,walnut,melon	CentralAsia	6-5
Olive,fig,vine	MediterraneanEurope	6-5
Sorghumandcotton	Africa	6-5
Cucurbit	TropicalAmerica	9-8
Capsicum,maize(corn)	TropicalAmerica	8.5-7.5
Commonbean,cotton,arrow-root,	TropicalAmerica	7.7
groundnut,tomato		
Limabean	TropicalAmerica	7.7

DISCUSSION

In this part, the author spoke about this study and how it relates to the many rainfall forecast techniques that have been widely employed over the last 20 years. According to the report, the majority of researchers utilised artificial neural networks to forecast rainfall and achieved meaningful findings. The survey also reaches the conclusion that forecasting methods using

MLP, BPN, RBFN, SOM, and SVM are more suited to predicting rainfall than approaches using statistical and numerical methods. However, all of the methods of rainfall prediction discussed in this survey paper have some obvious limitations. Researchers should find it very helpful to choose the approach that will best answer the issue they will be experiencing in their suggested prediction model thanks to the comprehensive references in this study that support the various advances of the methods [8].

CONCLUSION

Time series of rainfall may not be accurate. The subject of monsoon-rainfall data series is quite complicated; the function that multiple linear regressions could play in this issue is one for future study; nonetheless, the evidence presented here suggests that the model is not effective as a predictive one. It needs to be seen whether it will be beneficial in providing an approximation of future monsoon rainfall. We also need to anticipate rainfall for our state using this regression algorithm. Rainfall is crucial to our existence. Therefore, we forecast that it will rain during that time. As a result, we prevent floods, cyclones, forest fires, global warming, etc. In the future, we'll use artificial intelligence, neural networks, fuzzy sets, and other technologies to anticipate the weather. In order to rescue the planet, we do study on public sectors.

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CHAPTER 15

AN ANALYSIS OF DIFFERENT TYPES OF CROPS

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ABSTRACT:

By relying on technical solutions that disregarded indigenous and customary food crop systems, strategies developed to tackle persistent food insecurity, malnutrition, and malnutrition, especially in developing countries, reduce the food supply base. Consumers refer to these harvests as "food for the poor". The issue that comes is whether this taxonomy is appropriate and what must be done in order to realize these crops' potential for enhancing household food security. The ingestion habits of many traditional and native food crops were examined using survey data collected from 600 families in the different Region of the earth. The results indicate that there is a more complex relationship between income and the utilization of variety of food crops.

KEYWORDS:

Agriculture, Food, Food Security, Indigenous Crops, Traditional Crops.

INTRODUCTION

Archaeological findings have revealed that rice was a domesticated crop grown along the banks of the Ganges in the sixth millennium B.C. Later, it extended to other areas. Several species of winter cereals, oats, and wheat and legumes lentil and chickpea domesticated in South-west Asia, were grown in North-west India before the sixth millennium B.C. Some other millets, such as sorghum Pearl millet R. Br. and finger millet Gaertn. Which were earlier domesticated in Africa, found their way to the Indian subcontinent more than 4000 years ago[1], [2]. In addition, smaller millets such as the species of Panicum, Setaria, Echinochloa, and Paspalum were domesticated in India since the Neolithic period. Archaeological research also revealed cultivation of several other crops 3000 to 6000 years ago. These include oil seeds such as sesame, linseed, safflower, mustard and castor; legumes such as mung bean, black gram, horse gram, pigeonpea . Millsp, field pea, grass pea andfenugreek, fibre crop such as cotton and fruits such as jujube grape,date, jackfruit, mango,mulberry and black plum. Animals, including livestock, sheep, goats, asses, dogs, pigs and horses were also domesticated. Early indigenous domesticates: Rice was identified from several sites dated earlier than 1500 B.C. from the Gangetic region. Vavilov listed 117 economic plants which were domesticated in the Indian center or origin/diversity of crop plants [3].

OriginofCultivatedPlants

IndianMainCenterincludesAssamandBurma:

CerealsandLegumes	• Rice,Oryzasativa • Chickpeaorgram,Cicerarietinum • Pigeonpea,Cajanusindicus • Urdbean,Phaseolusmungo • MungbeanPhaseolusaureus • RicebeanPhaseoluscalcaratus • Cowpea,Vigna sinensis
VegetablesandTubers	• Eggplant,Solanummelogena • Cucumber, Cucumissativus • Radish,Raphanuscaudatus • TaroColocasiaantiquorum • Tamarind, Tamarindus Indica
Fruits	• MangoMangifereindica • OrangeCitrussinensis • Tangerine,Citrusmedica • CitronCitrusmedica • Tamarind Tamarindusindica
Sugar,OilandFiberplants	• Sugarcane,Saccharumofficinarum • CoconutpalmCocosnucifera • SesameSesamumindicum • SafflowerCarthamustinctorius • TreecottonGossypiumarboreum • OrientalcottonGossypiumarboreum • Jute,Corchoruscapsularis • Crotalaria,Crotalariajuncea • Kenaf,Hibiscuscannabinus
Spices,Stimulants,Dyes,andMiscellaneous	• Hemp,Cannabisindica • BlackpepperPipernigrum • Gumarabic,Acaciaarabica • Sandalwood,Santalulmalbum

	• Indigo,Indigoferatinctoria • Cinnamontree,Cinnamomumzeylanticum • Croton,Crotontiglium • Bamboo,Bambusatulda

IntroducedorExoticCrops

During the sixteenth century, the Portuguese improved Indian agriculture by bringing in new crops and fruit trees. They were India's greatest benefactors [4]. The fragrant Persian rose was created by Babar. Similar to this, the botanical garden in Calcutta has introduced several significant new plants, which has served a very valuable purpose. The following list includes some of the plants and products that Portuguese traders brought back from Brazil, Chile, Peru, and Mexico. These plants and trees are now significant parts of the widespread farming systems used throughout the nation.

CropsintroducedbyBritishers

Pseudocereals	Oats
Grainlegumes	Pea
Fibercrops	Gossypiumbarbadense(cotton)
Vegetables	Leek, Asparagussp.,Betavulgaris(beetroot),Cauliflower,Brusselssprout,Knol-khol,Celery,Sweetpepper,Chicory,Squash, Daucascarota(carrot,orangetype),Lettuce,Tomato,Sweetpea.
Fruits	Bilimbi,Carambola,Papaya,Roseapple,Strawberry,Mangosteen,Helianthustuberosus(artichoke),Tapioca(cassava),Apple,Apricot,Cherry,Plum, Peach,Pear.
Medicinalandaromatic plants	Cinchonaofficinalis(quinine),Origanumvulgare(marjoram),Cinchonaofficinalis(quinine),Origanum vulgare (marjoram), Papaver somniferum(opium poppy),Pelargoniumcapitatium(Geranium),Salviaofficinalis(sage), Thymusvulgaris(thyme),Vanillaaromatica(vanilla).
Others	Casuarina equisetifolia (Casuarina), Coffee, Eucalyptus globulus (Tasmanian bluegum), Grevillea robusta (silver oak), Hibiscus rosasinensis (shoe flower), Lantanaodorata (Lantana), Magnolia grandiflora (Bull Bay), Myrtle, Horse bean, Parsnip,Avocado,Pine trees,Poinciana regia(Peacock flower),Mahogany,Cacao(cocoa).

i. **Crops introduced from West and Central Asia by Mughals or Arabs:** Onion, Garlic, Turnip, Cabbage, Coriander, Sweet muskmelon, Carrot, (black & red type), Date palm, Pea, Clover and Grape.

ii. **Crops introduced by Spaniards:** Phaseolus vulgaris (French bean).

iii. **Crops introduced from China:** Soybean, Loquat, Walnut, Litchi.

iv. **Crops introduced from Latin America:** Rubber, Pineapple.

v. **Crops introduced from South-east Asia and Pacific islands:** Sugar-palm, Breadfruit, Citrus decumanus (pomelo), Citrus paradisi (grapefruit), Durio zibethinus (durian) and Metroxylon sagus (sago).

Some Recent Introductions

i. Mentha arvensis (spearmint, USA) Acacia senegal (Australia),

ii. Acacia mangium (Australia) and Actinidia chinensis (Kiwifruit, New Zealand).

iii. Crops introduced by Portuguese: Groundnut, Tobacco, Potato and Agave.

iv. The introduction of tobacco occurred during the rule of Emperor Akbar. It seems that they brought it to Bijapur after introducing it to Goa initially. The Portuguese brought the potato (Solanum tuberosum), a native of the highlands of Chile and Peru, to India in the seventeenth century. at Terry's report of a dinner served to Sir Thomas Roe at Ajmer in A.D. 1615, Asaf Khan makes the earliest mention of potatoes in India. Agave (Agave Americana), sometimes known as the century plant, was introduced by the Portuguese and has since spread naturally across India. Its sword-like leaves shield our slopes, and its panicles of white blooms are quite attractive [5], [6].

DISCUSSION

One of the many factors that farmers must consider when planning their crop management is the potential for productivity drop from various pests. Crop raiding by animals is one such situation where farmers may be affected differently across landscapes and require spatially varied management options. In this investigation, we examined the spatial distribution of various land use types and generated crops in relation to probable crop raiding behaviour of larger animals from forest boundaries in a landscape in southwest Ethiopia[7], [8]. In several regions of Africa, huge creatures including baboons, monkeys, bush pigs, porcupines, chimpanzees, and elephants have badly harmed a number of types of cereals, root crops, and fruits. Crops farmed near to forest borders are more likely to be raided than crops grown farther out from the woods because wild animals abandon their native habitats to loot fields, according to a well-documented trend. Farmers may take action to decrease the impact of the raiders by cutting down trees in agricultural regions, removing forest boundaries close to crop fields, driving the raiders away or killing them, or changing the crop composition [9].

CONCLUSION

Many agricultural landscapes are diverse and do differ spatially in terms of types of land use, crop mix, and amounts of forest and tree cover. A fuller understanding of how species and biological processes are distributed throughout such landscapes is essential from the perspectives

of sustainable agriculture management and biodiversity conservation at a landscape level. This research and others have shown that crop raiders are a problem that varies in different regions of the landscape. A persistent conflict between crop raiders and farmers close to forest edges could lead to the farmers developing a negative attitude towards forest conservation, especially at forest-agriculture interfaces, even though this variation won't necessarily change how land use types and crop species are managed. To fully understand the relationships between crop-growing practises utilised by farmers, the consequences of crop raiders, and the threats to forest biodiversity in mosaic landscapes mixing agriculture and forests, additional ecological and socioeconomic study is generally needed.

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CHAPTER 16

AN ELABORATION OF THE AGRICULTURE CULTIVATION AND ITS HISTORY

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ABSTRACT:

Human societies have relied heavily on agriculture because it provides the resources needed for survival and economic growth. Agriculture production has a long and complicated history that has been influenced by cultural, environmental, and technical variables. Agriculture production has experienced various changes, inventions, and difficulties throughout the years, from the earliest days of simple farming to the birth of complex agricultural systems. An overview of the development of agriculture is given in this abstract, including major events including the beginnings of agriculture, the growth of farming communities, the dissemination of crop domestication, the effects of the industrial revolution, and contemporary agricultural methods. We may learn more about how cultures have created sustainable practices to address the problems of feeding an expanding population by studying the history of agricultural production.

KEYWORDS:

Agriculture, Agronomy, Cultivation, Crops, Food.

INTRODUCTION

Around 5000 years ago, rice was first produced in China. At the Yung Shao excavations in China, rice remains dating as far back as 2600 B.C. The planting of the less significant varieties of grain was left to the princes of his family, according to one source, Julien, and the Emperor of China was only allowed to distribute rice seed at a special rite (established about 2800 B.C.) at the beginning of the agricultural season. Rice production was evident during a 2300 B.C. archaeological investigation in Gujarat's Lothal, a southern frontier of the Harappan and Mohenjo-daro civilizations. Although Do Condolle claims that rice has been a prized crop in India since the Vedic era, the cultivation of the grain may not be as old in the subcontinent as it is in China. According to an archaeological sample of carbonised grains found in Hastinapur, north of Delhi, and Atrajnjikera, in Uttar Pradesh, rice was cultivated in India from 1500 to 700 B.C. Taking the Indian word "dhanya" for rice as an example, it means "supporter and nursery of mankind." The name Dhanya, which translates to "sustainer of the human race," indicates its historical importance. In ceremonies all over India, dhanya and the kernel tandula are frequently used because they are seen as symbols of wealth, fortune, and prosperity [1].

Rice was historically thrown at wedding newlyweds in China to wish them luck and guarantee they would have a big brood since it is a symbol of fertility. The word "Urihi" is used in the

Atharveda (1100 B.C.), which most writers interpret as being the most straightforward name for the grain in Sanskrit. It may be interesting to notice that the term for a rice kernel is "arisi" in Tamil, "alruzz" in Arabic, and "arroz" in Spanish. What asserts that the Tamil term (from which some think the word rice is derived) is not the source of the Arabic word al-ruzz, but rather the Greek word Aruza, which is the name for rice. In his "materia medica," the famed Ayurvedic doctor Susuta (about 1000 B.C.) specifies numerous varieties of rice according to time, water requirements, and nutritional value, suggesting them for different illnesses. Some of the kings of ancient India had names that were related to or derivations of the word "rice." For instance, in the sixth century B.C., the Nepalese monarch who served as Gautama Buddha's father was known as Suddhodana, which is Sanskrit for "pure rice." The term "neevara" in Sanskrit and "neevara" in Telegu are used to describe the wild rice that takes over fields and waterways. From India, rice travelled through China, Japan, and lastly Iran, Iraq, Turkestan, and Egypt before heading west. Alexander the Great (about 300 B.C.) brought rice from India to Europe, where it was thereafter sent to Egypt and other African countries. But it wasn't until the end of the seventh century A.D. that widespread cultivation began there because of the unfavorable environmental conditions. Rice was brought from India to Persia, Arabia, and Turkestan, where its cultivation is still in its infancy, due to a lack of the requisite environmental variables.

HistoryofWheatCultivation

Wheat wasn't very significant until the Christian period, despite the fact that it had been produced much earlier. Since it was the primary food of "the barbarians," also known as "the mlechcha" (non-believers in God), who may have included Greeks and other people living outside of India, it was known as "mlechcha-Bhojana" (meal for the non-believers). It has long been known to be a kind of barley known as "Yavana." Greek authors also made mention of wheat. Wheat is a crop grown throughout the winter, according to Parasara in Krishi-samgraha [2].

HistoryofSugarcaneCultivation

Sugarcane had been cultivated in India for a very long time and was a substantial crop by the end of the fourth century B.C. The Rig Vedic Aryans owned the cane, and it's conceivable that the family name Ikshaku was associated with a huge plantation. The cane seems to have been consumed mostly by eating, with some pressing and juice consumption. Later on, the idea of drying the juice over a fire was invented, and the first known item was a ball known as a "gula" or "guda." Bengalis call it "bheri" or "bheli" because of its form, which resembles a kettle drum. The material was not crystallised in any way. When crystals were ultimately allowed to grow, the next phase was when "sitopala," or white crystals resembling rock crystals, were produced. Our medical writings provide a completely scientific classification of manufactured goods. It's also important to note that there were twelve varieties accessible at the time Susruta arrived as compared to the two that Char aka was aware of. One of the latter's twelve was referred to as "tapasa," and it was unquestionably the wild ancestor of the modern varieties.

It is a remarkable fact that a cane variety still exists in the north-west of Bengal called "Uri akh" that blooms lavishly and the farmers utilise the seed for reproduction; the adjective "uri" indicates wild, as in "Uridhan." One of the twelve kinds of Susruta employed by our producers, "paundraka" or "paundra," also called as "paunda" and "punri," was unquestionably the best of the local canes. The cultivar's name was given to it because Punara, or Northern Bengal, was its

home region, according to the Amarakosha's commentators. It seems that the nation's name came from this occurrence, similar to how Gauda's name came from "guda." The people that grew the cane were the Paundras. During the conquest of India (327 B.C.), Alexander's soldiers discovered the locals producing 'honey' from reeds without the aid of bees. The cane-growing and sugar-making methods moved east to Indochina, west to Europe and the Arab countries. Kautilya understood the difficulty and expense of cultivating sugarcane. The difficulty was addressed thanks to cooperation. The farmers formed a "grantha" or "knot" or association for the sake of agriculture and sugar production. Cooperation was adopted when the individual peasants were unable to meet the necessities on their own. It is not at all a modern idea and is referred to as "ganta" in Bengali [3].

The share-produce method of agriculture, which is so common in our country, exemplifies cooperation. The word "sugar" is derived from the Sanskrit word "Sarkara," which meaning sand or gravel. Sand-like sugarcane juice was the original form of unrefined sugar. Over the course of the voyage, the original name was changed to sugar in English, then to 'Sukkar' in Arabic, 'Sakharon' in Green, and 'Sucre' in French. The next important breakthrough in the history of sugarcane was Captain Bligh's introduction of thick-stemmed varieties of Saccharum officinarum from Thailand to Jamaica in 1791.

HistoryofCottonCultivation

Gossypium herbaceum var. africanum might be thought of as a wild cousin of tamed plants. It suggests that Pakistan's Indus valley, rather than Africa, was where cotton fabrics originally developed. The opening of commercial channels between Africa and India at that time may have led to the importation of linted cotton, which was first employed as a trim or for embroidery on linen and woollen garments. The first cotton textiles in the Old World were made by the Indus civilization, demonstrating that Sind is where cotton initially emerged as an important new raw material. Cotton was discovered on household goods dating to about 3000 B.C. in the form of threads and bits of cloth during Gulati and Turner's 1928 excavations in Mohen-jo-daro, Sind, Pakistan (Indus Valley).

The Mohen-jo-daro shards were obviously made by competent craftspeople, not by someone clumsily experimenting with a new art form or with an unidentified raw material. All testable hair qualities of the Mohen-jo-daro cotton were comparable to those of modern Indian cotton, suggesting that the main changes in lint evolution had already taken place at that time. Cotton is also mentioned in the Rig Veda, the oldest Hindu text, which was composed about 1500 B.C. Both the 800 B.C. scriptures Manu and Asvalayana include several references to the usage of cotton. Cotton was imported from India to China and Egypt on the east and west coasts, respectively, about the year 600. Cotton was, however, probably not produced in Egypt as a field crop for textile usage until the twelfth or fourteenth century. Arab traders extended cotton growing to the rest of Africa. In the ninth and eleventh centuries, Arab conquistadors transported it to southern Europe (Sicily and Spain) [4], [5].

A.D. Silk and flax wool were the primary food sources in ancient Greek and Roman societies. The automated power loom invented by Edmund Cartwright in 1785 in England and the cotton produced by Eli Whitney in 1793 in America revolutionised the cotton industry. The nineteenth century saw a significant expansion in cotton production, and now it is cultivated in every

tropical, subtropical, and warm-climate zone. Wool, silk, and flax were used for spinning and weaving before cotton became popularity. According to Purseglove (1960, 1963), Gossypium herbaceum may have moved from the Antarctic to South America in the Tertiary, retreating northward as glaciation advanced. Fryxell (1965) demonstrated that cotton seeds can float in sea water for at least a year without losing any viability; as a result, they may be distributed by ocean currents. Purseglove (1968) said that cottonseeds travelling over the Atlantic from Africa to South America is the most likely theory.

CropProductionin AncientIndia

It is most probable that early agricultural farming started on the slopes of highland places with readily worked soil since expanding agriculture in valleys entails water management, which calls for greater expertise and a comparatively more advanced degree of technical development. Theoretically, agriculture initially appeared on forested slopes, according to American biographer Sauer. According to Sauer's (1952) view on the origins and development of agriculture:

i. Agriculture did not begin in societies where there was an extreme lack of food, but rather in places where there was an abundance of food, leading to a relative lack of need and desire.

ii. Areas with a noticeable variety of plants and animals are where you should look for the hearths of domestication.

iii. Primitive agriculture didn't start in expansive river basins that were susceptible to long growing seasons and needed protective dams, drainage systems, or irrigation systems, but rather on moist hill areas.

iv. Agriculture first spread via wooded areas, where the soil was soft and simple to work.

v. In the past, pioneers of agriculture needed specialized training, but hunters would have the least interest in domesticating plants.

vi. Crop cultivation takes continual care and monitoring and would fail if not adequately protected, the first agricultural pioneers were sedentary people.

Farming was an important activity even in the pre-Vedic period that put an end to the nomadic way of life. Animal husbandry was the main occupation, and cereals were grown alongside trees and animals. The economy of the country was based on agriculture and livestock raising, according to Patanjali. Farmers possessed a fundamental grasp of soil fertility, seed selection, planting and harvesting seasons, as well as other agricultural practices, such as manuring of fields, throughout the Vedic period. The "Arthashastra" discusses the suitability of different soils for agricultural development. Crop rotation's potential to boost soil fertility was known to farmers throughout the Vedic period. Plants with deep roots that served as natural aerators were grown there [6].

Sweet potatoes were used to aerate the soil in preparation for the next crop. The roots of the crop expanded and worked pretty explosively. Sweet potatoes were included to the fasting diet as a reward for the farmer, which unintentionally helped to raise consumer demand for the crop.

Plants with deep, shallow, and legume roots were typically rotated every three years. These included wheat-chickpea, sorghum, sugarcane-green manure crop, pigeon pea, and others. Mixed farming, which included aspects of both crops and cattle, was already in use. Mixed cropping was the norm for agricultural cultivation. Chickpeas and other pulses were often grown alongside wheat to boost the nitrogen availability for wheat. Some of the important crop combinations were sorghum + pigeon pea + cowpea, black gramme or green gramme (Mung bean) + sorghum or bajra, wheat + chickpea, and wheat + linseed. The practise of monocropping was not very common.

Seasons

Grishma (May–June), Varsha (July–August), Hemant (September–October), Sharad (November–December), Shishir (January–February), and Vasanta (March–April) are the six seasons described in the Rigveda. The following table, Table 1, lists the seasons in a temperate climate:

Table 1: Illustrated the Different Season.

Winter	Spring	Summer	Autumn
January February March	April May June	July August September	October November December

PlantingTimeandSelectionofLandForDifferentCrops (Kasyapa)

In many places, planting should start as soon as the rainy season arrives. If water was available, Kashyapa recommended harvesting a crop even in the heat. He separated arable land into two main categories: paddy land (area suited for cultivating rice) and other crop land. Rice was traditionally grown on low-lying soil that was easy to irrigate, whereas pulses were often grown on uplands with few water supplies. Rice fields were to be more fertile than fields used for other crops, bunded to hold in water, but with holes so that any surplus water might drain to other areas. Clayey rice soils were to be used, and rice fields were to be located adjacent to one another and the threshing place. Standing water was a given in rice fields. According to Kashyapa, farms for pulses and other crops should be located on highlands and be of inferior quality. These plants need less water.

LandPreparation

According to the Rigveda, farmers used to repeatedly plough the ground before planting seeds. Such ploughings must have been done in order to clear the area of weeds, loosen the soil, and pulverise it to the necessary degree. A ploughed field (2450–2300 B.C.) with a grid of furrows, with North–South furrows 1.9 m apart and East–West furrows 30 cm apart, was discovered during excavations in Kalibangan, Rajasthan (India). This pattern most likely points to the use of mixed cropping. The Brhat Samhita of Varha Mihira mentions the practise of using sesame as green manure prior to land preparation. Vedic literature makes mention of both heavy and light ploughs. These were probably used depending on the situation for deep or shallow ploughing. According to the wise man Parasara, the stars Anila, or Swati, Uttarashadha, Uttarabhardrapada, Uttarpahalguni, Rohini, Mrigashirsha (Mriga), Mula, Punarvasu, Pushya, Shravana, and Hasta,

are favourable for ploughing. Crops grow well when ploughed on Monday, Wednesday, Thursday, and Friday.

Ploughing is recommended on the second, third, fifth, seventh, tenth, eleventh, and thirteenth days of the month. Auspicious lagnas like Taurus (April 21), Pisces (February 20), Virgo (August 22), Gemini (May 21), Sagittarius (November 23), and Scorpio (October 23) are good times to start the harvest. Lagna is the precise time that the Sun enters each zone. A single furrow or groups of three to five furrows should be used. Success comes in one, riches comes in three, and a plentiful crop comes from five furrows. One plough each for silver and copper in Vasanta (April-May), and gold in Hamanta (December-January). only crops in the summer (June to July), but only poverty may be ploughed in the rainy season (August to September).

SoilasaBasicResourceforSuccessfulCropProduction(Kashyapa)

Kashyapa divided the agricultural area into two categories: adhakadibhu (land suitable for the production of pulses and other grains) and shalibu (field suitable for the growth of rice). Because it results in favourable outcomes, enhances family health, and encourages the growth of grain, cattle, and money, high-quality land benefits everyone. Therefore, it is impossible to overstate the importance of healthy soil. No of their caste, the monarch must choose knowledgeable experts to determine if a piece of land is suited for growing food, according to Kashyapa. The ideal soil, according to Kashyapa, should be devoid of bones and stones, have the consistency of plastic clay, be reddish or black in colour, be full of essence (potency), be glossy with water, not be too deep or shallow, be able to quickly absorb moisture, be the habitat of helpful living organisms (earthworms), and have a significant mass. Kashyapa asserts that the soil can exhibit Brahaminic, Kshatriya, Vaisya, and Sudra features. One could make the following predictions about soils based on traits typically found in these castes: a fertile soil should produce stable yields; a soil should produce yields by controlling pests and other enemies; a soil should occasionally produce bumper yields; and a soil should produce a good yield when carefully tended [7], [8].

DISCUSSION

Kashyapa divided the agricultural area into two categories: adhakadibhu (land suitable for the production of pulses and other grains) and shalibu (field suitable for the growth of rice). Because it results in favourable outcomes, enhances family health, and encourages the growth of grain, cattle, and money, high-quality land benefits everyone. Therefore, it is impossible to overstate the importance of healthy soil. No of their caste, the monarch must choose knowledgeable experts to determine if a piece of land is suited for growing food, according to Kashyapa. The ideal soil, according to Kashyapa, should be devoid of bones and stones, have the consistency of plastic clay, be reddish or black in colour, be full of essence (potency), be glossy with water, not be too deep or shallow, be able to quickly absorb moisture, be the habitat of helpful living organisms (earthworms), and have a significant mass. Kashyapa asserts that the soil can exhibit Brahaminic, Kshatriya, Vaisya, and Sudra features. One could make the following assumptions about these castes' traits: a soil should be fertile and produce stable yields; a soil should manage pests and other enemies to produce yields; a soil should occasionally produce bumper yields; and a soil should produce a good yield when carefully tended to, respectively.

CONCLUSION

As humanity adapts to climate change and lessens the impact of agriculture, it must address the fact that at least a billion people lack access to enough calories, more than two billion people lack enough nutrients, and paradoxically, more than two billion people consume too many calories. A important societal issue is addressing the growing "triple burden" of hunger brought on by under- and overconsumption. The world's population is predicted to reach 9 billion people by 2050, and against this background, food consumption patterns are rapidly shifting owing to increasing average wealth and greater consumption of meat in particular. Dietary alterations that lead to an excessive consumption of PBs should be avoided because of their disparate effects on different people. It also has a big impact on a lot of the PBs that are still in the safe zone. Interventions might be done in a number of locations to mitigate the consequences of agriculture. Nothing less than a completely changed system will be required, including many changes to every aspect of agriculture, more attention to landscape-level management, and changes to every link in the wider food chain. This is because there are many different ways to mitigate the effects of the food system, which includes production, processing, transportation, retail, and consumption, on PBs.

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CHAPTER 17

AN OVERVIEW OF THEPLOUGH IN AGRICULTURE

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ABSTRACT:

Plowing is one of the most important soil management practices, used for centuries to create a straight, grained, structural, and moist sowing layer. Plowing is a simple, but effective farm practice that cuts, granulates, and inverts the soil, creating furrows and ridges. The plow is one of the oldest farming tools with a remarkable revolution, originating from simple and primitive plows to modern plowing machinery. Historically, plowing was a demanding and labor-intensive farm practice. However, today's farmers have the opportunity to choose between various types of plows and improved farm machinery.

KEYWORDS:

Agriculture, Agronomy, Environment, Climate, Plough.

INTRODUCTION

Parasara provides information on construction details of the plough a version called the desi plough'wooden plough' as well as reference to a few other implements such as an abadha (disc plough)phalika (leaf shaped iron piece to replace the normal iron blade for deep ploughing), Viddhaka (spiketooth harrow with 21 spikes), and madika (wooden plant for levelling the field were provided. The useof a disc 54 angulas in diameter (approximately 1 M) in place of ploughshare for using on hard virgin soil isrecommended. According to the Table 1, the dates for ploughing operation are suggested on 20, February; 21, April; 21, May;22, August; 23, October and 23, November. A calendar for ploughing for taking the crops was onlymentionedinKrishi–Parashara
Kashyapahasspeciallyindicatedthatuseofstrongwoodforvariouspurposes(e.g.,makingatyingpost) such as tinduka (Diospyros melanoxylon), tinisha (Ougeinia oojeinensis) or a sarjaka (Vateriaindica). Manure should be available and used for increasing the 'potency' of the land. Besides plow,spades, lancets, small horns, (for breaking soils crust) knife, sickles, ropes, etc., were mentioned.Ploughing was to begin with the visibility of rain-bearing clouds and plots were to be filled with waterforpuddling to prepare for planting paddy. Kashya parefers to worship of plough as well as bullocks[1].

Table 1: Illustrated the Working of Starting of Ploughing.

Starting of ploughing	Crops
20, February	• Sugarcane, blackgram
21, April	• Rice(tobetransplantedlater)

21,May	• Rice(tobedirectlyseeded)andotherwarmseasoncropssuchascottonandsesame
23,October	• Latesownwheatandbarleyplusmustard
23,November	• Fieldvacatedbyriceforplantingsugarcaneandfoddercrops.

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Farm Implements

Ancient literature of the subcontinent did not miss out on farm implements.Vedas describe a simple bullock drawn wooden plough, both light and heavy with an iron bar attachedas a plough share to open the soil. Krishi Parashara (c. 400 B.C.) (Sadhale, 1999) gives details of thedesign of the plough with Sanskrit names for different parts. This basic design has hardly undergoneany change over centuries.

Even today the resource poor farmers use a similar bullock drawn plough.A bamboo stick of a specific size was used to measure land. Vedic literature and Krishi Parashara alsomention disc plough seed drill, blade harrow (Bakhar), wooden spike, root horrow, plankers, axe, hoe,sickle,supaforwinnowing,andavesseltomeasuregrain(udara).Pairsofbullocksusedforploughing in ancient days varied from one to eight. Plough was considered as the most sacred and essentialimplement in agricultural operations and was known by different names. The more commonly knowndesiploughwasamultipurposeimplement.

SeedCollectionandPreservation

i. **Sage Parasara:** All sorts of seeds should be procured in Magha (February) or Phalguna (March) andshould then be dried well in the sun without putting those directly on the ground. To procure healthyseeds of panicles are located in the field, cut from the standing crop, and collected in a pouch. A mixtureof different kinds of seeds causes great loss. Uniform seeds produce excellent results. The origin ofplentifulyieldistheseed.

ii. **Kashyapa:** A good quality of seed is stated to be the first step towards the success in farming.Seeds of several trees specified for plantation are also to be procured and preserved. Seeds of wheat,pulses, fruits, vegetables and condiments such as turmeric, cumin, black pepper, etc., also need to bepreserved for cultivation in the proper season. Kashyapa describes the procedure of preserving theseeds and advises farmers to dry the seeds in the sun, store them in different kinds of vessels, andprotectthemfromstormyrainsandmoistureaswellasfromrats,cats,andrabbits.

Crop Diversity

Cereals, millets, pulses, oil seeds, fibres, vegetables, and fruits were quite diverse in India. The variety of species and varieties offered several options for selection in accordance with the kind of soil, the temperature, and the management style. In ancient India, there existed a kind of rice that could be harvested in sixty days. Another kind known as rice of grandees, with its enormous grains and exceptional smell, was grown in Magadha. Eight different types of rice were known to as manasollasa, and they were identified by their colour, smell, size, and growing time. Five wild rice species were found in India, and each of these species had undergone a consistent process of evolution from perennial to annual habit, from cross-pollination to self-pollination, and from lower to higher fertility. The Triticum vulgare, Triticum compactum, and Triticum sphaerococum species of wheat that were found at Mohen-jo-daro. T. sphaerococum was a wheat that was commonly farmed in north India and dates back to 2300 B.C. It is quite drought resistant. All during the Harappan era, barley was grown.

The Aryans were used to eating barley. In the Indus Valley civilisation, they embraced wheat and barley and created the new diversity needed for extensive agriculture. Ragi, bajra, and sorghum were major millets as well. Although they were mainly grown for grain, the straw was also prized for use as cattle feed. There were reportedly over 25 different types of sorghum available. In 1800 B.C., it was discovered that ragi (Eleusine coracana) straw was being used as cattle feed. In the early time, pulses predominated in crop rotations and crop combinations. Being legumes, they preserved and enhanced the soil's fertility. Ancient pulses such lentil, black gramme, green gramme, and Lathyrus (Khesari) were discovered in the Narmada basin between 1657 and 1443 B.C. The green gramme originated in India. In Tarai woodlands, a wild form of Vigna sublobata was discovered. It was used in plant breeding and immune to the yellow mosaic virus. Since the Vedic era, black gramme has been widely regarded as a nourishing pulse crop in ancient Indian culture. It was used in socioreligious rites, and its significance has not diminished through time [2].

In a similar manner, lentils improved the traditional diet. Sesamum was the most significant crop farmed by the Harappans in the Indus valley in terms of oil seeds. Brown mustard, yellow mustard, and thoria are all members of the Brassica genus known as Indian rape. Linseed and castor oil seeds are among the other significant oil seeds. The Harappan people had knowledge of cotton farming. Cotton species that are weedy and wild have been found in Gujarat, Kathiawar, and the Deccan. They are known as tree cotton and are perennial. Date palm, pomegranate, lemon, coconut, and melon were also familiar to the Harappans. The flora Babar (pre-16th century) saw in India are documented in his diaries. Mango, plantain, tamarind, mahuwa, jamun, chironji, khirni, karonda, ber, orange, and karonda were among the fruits. It is clear that the people who lived in the past had a thorough understanding of agriculture. Based on the resources available to the person and his immediate and long-term requirements, the strategy for crop selection and the adoption of various cropping and farming methods was chosen. Promising plants or varieties were found by a continual process of selection and removal, and their reproduction was facilitated by the adoption of rigorous systems of seed collecting, storage, and exchange among the social groupings.

Choice of Crops andVarieties

Kashyapa listed rice and other cereals as the first, pulses and other grains as the second

vegetables(including fruits) the third, and creepers and flowers etc., the fourth. Kashyapa considered three mainvarieties of rice, Shali, Kalama, and Shastika. Shali rice is said to have twenty-six varieties dependingon the quality of land in different regions. Kalama is slightly thick white, and with a surplus sap. Shastikaistasteless. Vrihiisconsidered to beoldestnameforrice. Shuklavrihi(whiterice)mentionedin Krishna Yajurveda (300 B.C.). In the same Veda Krishnanam vrihini (black rice), asunam vrihinam(fast growing, 60-day rice), mahavrihinam (large seeded rice) and naivaram (wild rice) have beenmentioned. Atharvaveda, naivaram became nivara and in addition to black rice, red rice, and the 60-dayrice were mentioned. A new name for rice appeared in the Atharvaveda; i.e., tandula (for dehuskedrice). The word vrihi for rice was used in Upanishads. Shali was used for those rices, which wereplanted at the beginning of the rainy season and harvested in winter; these were probably the 6-monthvarieties. Vrihi, Shali, Nivara, Shastika as well as a new word Kalama appeared in Susruta Samhita (400B.C.) and AmarkoshaofAmarsinha(200A.D.).

RiceVarieties OtherAspects

Some of the other highlights under the topic collection and preservation of seed are:

- **i.** it is the king'sgovernment in today's context (responsibility to ensure seed supply),
- **ii.** seed must be properly driedinsun,
- **iii.** givingagiftofseedisasuperioract,
- **iv.** differentvarietiesofricematureatdifferenttimestaking3to8months,
- **v.** farmersshouldrespecttraditionalknowledgeoftheregionanduseit,
- **vi.** Seeds of all kinds of other crops should be likewise collected, dried, and stored in pots, heaps, ofhusk or bowls
- **vii.** seeds must be protected from rabbits, rats, cats, and moisture. Taking care ofgoodseedsreligiouslyisconducivetothebenefitoffarmers(ashasbeen)saidbygreatsages.

Basmati Rice: The word 'basmati' has its origin in the Sanskrit words 'vaas' means fragrance and 'matup' means possessing. Thus, vaasmati should mean something possessing fragrance in northernIndia, 'va' is often pronounced as 'ba' and thus the word 'basmati' should have been used for a kind or ricehavingfragranceofscent.

Golden rice: Kashyapa had claimed that Peetvarna vrihi (yellow rice) improved digestion or asambakavarietycalledHema(goldenrice).

Sequenceof Cropping

There are clear allusions to crop rotation in the Yajurveda. Rotation was used to cultivate crops in the same field, and the concept of fallowing was also well-known (Rigveda). Two harvests were collected from the same land over the course of a year, according to the Taittiriya Samhita. Additionally, it discusses the appropriate times to harvest each crop as well as the various seasons during which each crop ripens. A description of the Ramayana story shows godhuma and yava waiting for the crop as winter approaches. However, winter or rabi crops like wheat and barley are sown in October and harvested at the end of May. Directions for seasonal farming and

harvesting are provided by Kautilya. Not only does the Arthasastra demonstrate in-depth familiarity with these two harvests, but also with a third. A monarch is told to march against his opponent in Margasirsa (January) to annihilate his vernal crops and rainy season handfuls, in Caitra (March) to annihilate his vernal crops and autumnal handfuls, and in Jyesthamula (June) to do the same [3], [4].

Thus, there were three crops: one sown during the rainy season and harvested before Magha; another sown during the autumn and harvested before Caitra; and a third sown during the spring and stored by Jyaistha (cf. barley, which "ripened in summer while being sown in winter; rice, which ripened in autumn while being sown during the rains; and beans and sesame, which ripened in winter and the cool season). The crops of several seasons are listed in the Arthasastra. In the first season (purvavapah), paddy, kodruva, sesame, panic, daraka, and varaka are seeded; in the second season (madhyavapah), mudga, masa, and saivya; and in the third and final season (kusumbha, lentil, kaluttha, barley, wheat, kalaya, linseed, and mustard). According to the Artha sastra, kharif and rabi crops are compatible. Along with the regular rains of the late Summer and early Winter, the Milinda also mentions a third monsoon (pavllssako).

Of course, the three monsoons did not consistently travel over the whole nation each year, and whether a region produced one, two, or three crops depended on rainfall, climatic factors, and soil characteristics. Food crops and edible fruits and vegetables flourished naturally without ploughing in many areas. These occurrences were unusual to the Greek spectators. The Jatakas and the Epics (Ramayana, Mahabharata) usually go into great detail on the forest landscape, including the vegetables and fruits that grow naturally without human work. According to Arthasastra, farmers were sometimes required to raise a second crop as a last resort for taxes. The amount of rain needed by a certain crop is suggested after thorough examination of the weather charts, and the planter is given instructions for that crop near the rain forests [5], [6].

Crop rotation in Rigveda

Continuous cropping was a practice, but pulses (legumes) and other cropswere also sown. “Thecultivatorsharvestingthecropsingeneral,separatelyandindueorder”hasbeen interpreted to be giving an idea of crop-sequence or crop-rotation and line-sowing and avoiding overlapping during harvest.

DISCUSSION

Depending on their intended usage, tillage tools may be generally divided into many groups: Ploughs are tools that are used to break up and loosen the soil. Primary tillage is accomplished using ploughs. Three different kinds of ploughs exist: wooden ploughs, iron or metal ploughs, and ploughs used for specific purposes. A wooden tool with an iron share point is called an indigenous plough. Body, shaft pole, share, and handle make up this object. Bullocks are used to pull it. The earth is opened and a V-shaped trench is made, but there is no inversion. Because some unplugged strips are always left between furrows, ploughing is also not perfect. Cross-plowing helps to lessen this, although even then, some tiny squares are still disconnected. Depending on the kind of soil, iron bullocks or two bullocks are used to pull soil turning ploughs. Tractors are also used to pull these. Frog or body, moldboard or wing, share, landside, connecting, rod, bracket, and handle are the components of a moldboard plough. As the furrow slices are cleanly cut and inverted to one side, resulting in better pulverization, this type of plough leaves no unplugged land. The tiny, animal-drawn moldboard plough digs to a depth of

15 cm, whilst two larger moldboard ploughs coupled to the tractor dig to a depth of 25 to 30 cm. In situations when soil inversion is required, moldboard ploughs are employed. The Victory plough is a short-shafted, animal-drawn moldboard plough [7]–[9].

CONCLUSION

Agriculture implements are the several kinds of machinery used in agricultural practices to decrease human effort and increase crop output. Modern agricultural practices heavily rely on agricultural equipment. In both commercial and organic farming, they are commonly employed. These implements are used for planting, threshing, irrigation, harvesting, and field preparation. Harvesters, drags, disc harrows, seed drills, cultivators, packages, spades, ploughs, etc. are examples of important agricultural instruments. In nations like India and China, where farming and agriculture are the main employment for the majority of people, this equipment are frequently employed.

The fields' ripened crops are harvested using these agricultural tools. Harvesting is the process of collecting a crop's components after it has reached full maturity. In the past, a sickle a pointed, curved implement made of metal like iron and wood was used for the task. Harvesters are utilized for this in current agricultural methods. Combine harvesters, diggers, pickers, etc. are typical examples.

A combine harvester is a piece of equipment that can harvest, thresh, and clean cereal crops all at once. These tools aid in providing the necessary quantities of irrigation to the crops in the fields. It contains a fundamental pump system for extracting water from the ground as well as irrigation systems using central pivots. Sprinkler systems, drip irrigation systems, and other modern irrigation equipment are available. While giving the plants the necessary amounts of water, these systems aid in water conservation, particularly in dry areas. Irrigation equipment provides the moisture needed for plant germination, development, and other associated activities. Farmers utilize a variety of irrigation techniques depending on the crops, soil types, and seasons.

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CHAPTER 18

AN OVERVIEW OF THE SEED AND SOWING IN AGRICULTURE

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ABSTRACT:

Sowing, also known as seeding, is the art of placing a seed in suitable soil conditions for proper germination and growth. Seeding entails planting the right number of seeds per unit area, the depth at which the seeds are buried in the soil, and the distance between rows.Here are a few safeguards, which should be taken during this agricultural procedure, including selecting high-quality seeds, maintaining the proper depth and distance, and ensuring the soil is clean, healthy, and free of pathogens like fungus and other diseases. For seeds to germinate the process by which seeds grow into new plants all these measures are necessary.

KEYWORDS:

Agriculture, Crops, Foods, Plough, Seed and Sowing,

INTRODUCTION

Ancient scholars showed awareness of the importance of good seed; *i.e.,* selection of the apparentlyhealthyseedfromaripeningcrop,preservingitsafelyinstorage,withorwithouttreatmentsandsowingthegoodseedagainwithorwithoutsometreatment.About2000yearsago,Parashararecommended:

i. Roper drying of seed,

ii. Freedom from the seeds of weeds,

iii. Visual seed uniformity,

iv. Storingseeds in strong bags,

v. Storing seed

Where white ants wouldn't be able to get to it and away from areas where seed may come into touch with anything that might encourage the growth of mould, including cowshed waste, moist areas, or leftover food. According to Sage Parasara, the ideal nakshatras for sowing are Uttrashadha, Uttarashadha, Uttarabhardrapada, Uttarpahalguni, Mula, Jeyshtha, Anuratha, Magha, Rohini, Mrigashirsha (Mriga), Rohini, Hasta, and Revathi. Avoid seeding or transplanting on Tuesday because rodents are a concern, and on Saturday because locusts and other insects are a threat. 'Empty' days, such as the fourth, ninth, and fourteenth day of the lunar fortnight of a month, should not be used for sowing, particularly if the moon is faint. When the sun is in Cancer, grain seeds should be planted at a distance from the hand. The distance should

be cut in half in Leo. It should be four fingers, or 3–4 inches (=7.6–10.2 cm) in Virgo. Butter milk causes the seeds to sprout sooner than usual. The embryo would die from salt. In the Artha Sastra, Kautilya suggested that choosing whether to plant seeds for certain crops should be based on the known patterns of rainfall [1]. He advised planting rice first, followed by mung beans and black gramme. In order to guarantee excellent germination, he also advised several seed treatments (such as cow dung, honey, and ghee). Manu said that a skilled farmer, or "Vysya," must be able to assess the calibre of seed. Manu's most important suggestion was that a merchant selling fake seed be severely punished. To prepare the ground for sowing, Kashyapa would either plough, level, furrow, or dig holes. It is said that the process depends on the qualities of the terrain, the availability of water, the amount of sunlight, and more knowledge. To guarantee successful germination, Varahamihira advised pelleting seeds with rice, black gramme, and sesame flours and fumigating them with turmeric powder. Surapala mentioned a number of botanicals, including seed treatment products for trees and plants. Many farmers still use cow dung to treat cotton and some other seeds, as Kautilya first suggested in the fourth century B.C. One of the most significant events was the sowing of seed. The act of sowing was accompanied by rites and prayers. For planting seeds, crude bamboo drills were used. On the basis of sowing time, the inter-plant and inter-row spacing was adjusted; later planting resulted in more seeds per unit of urea. For even seed germination, sowed areas were covered with a wooden board. It is not a new practise to sow rice in tiny areas, i.e., in nurseries, and to transfer the seedlings. In the year 100 A.D., it was first developed in the Krishna and Godavari river deltas [2].

According to Varahamihira, the standard method of planting seeds included soaking them in milk for ten days, bringing them out everyday by hand, coating them with ghee, rolling them repeatedly in cow dung, and fumigating them with deer or hog meat. The seeds were then planted in soil that had previously been prepared with sesame, meat, and hog marrow. When milk and water were sprinkled on them, they grew and bloomed. Another approach included soaking the seeds a hundred times in a paste made of Ankola fruiter's oil or a paste made of Slesmataka fruit's oil before planting them in soil that had been mixed with hail. The seeds would immediately germinate and produce fruit. When dusted with a combination of rice, black gramme, sesame, and wheat particles together with expired meat and continuously fumigated with turmeric powder, hard seeds like tamarind emerged. The seeds for Slesmataka had their shells removed, were then soaked in water, combined with an alangium fruit paste, and seven times dried in the shade before being combined with buffalo dung and kept in the dry dung. The seeds were then planted on rain-soaked soil. The bearing worked well.

To achieve unique outcomes, seeds were given a particular treatment. To produce cotton with a red tint, cotton seed was specially treated with red lac juice. In order to simplify seeding and reduce seed-borne illnesses, it was additionally coated with cow dung paste. The seedlings were covered from root to stem with a combination of ghee, usira or khas (Vetiveria zizanioides), sesame, honey, vidanga (Emblica ribes), milk, and cow dung before being transplanted at a different location. Kalidas in Raghuvamsha used transplanting to cultivate sali paddy. In fact, in the Krishna-Godavari deltas in the year 100 A.D., the practise of transplanting rice was quite common. During the Sangam period (A.D. 300–600), it was the most significant agricultural activity. Two grafting techniques have been documented by Varahamihira and these are [3]:

i. Inserting thecutting of a plant into the root of another, cut off from its trunk,

ii. Inserting the cutting of a treeinto the stem of another.

In both instances, the intersection of the two was coated in mud and cow poo. For plants like jackfruit, ashoka, plantain, rose apples, lemons, pomegranates, grapes, jasmine, etc., grafting was encouraged. Additionally, he advised grafting plants that have not yet developed branching in February or March, those that have in December or January, and those with large branches in August or September. The grafted trees had to be watered every day in the summertime, every other day in the winter, and if the soil started to become dry in the rainy season.

Kashyapa'sViewonRiceCultivation

According to flavour and colour, specialists classify rice into three primary varieties: shastika, kalama, and shali. The peetavarna vrihi (yellow rice) and sambaka vrihi (golden rice), which cures dyspepsia. hema (golden) vrihi (rice) of the sambaka kind, kalama (red), thick, long, and vrihi (shape). Rice that soothes indigestion includes peetavarna vrihi (yellow rice), sat vrihi (white rice), and kala vrihi (sweet and nutritious rice). Ploughing, keeping standing water, planting seedlings, weeding, managing water, crop protection, harvesting at the right time, pounding on the threshing floor, washing, and storing in the home are all steps in Kashyapa's rice production process. For the first time in historical writing, Kashyapa advised trans-planting rice.

WeedsandWeeding

Our forefathers were well aware of how weeds might lower agricultural output. The necessity to weed rice fields was brought up by Parashara; as many as four weeding's were recommended. According to Sangam literature, weeding is a crucial step in growing crops. The collecting of agricultural seeds free of weed seeds is advised by Parashara [4].

NutrientManagement

In order to cleanse the air, Kashyapa emphasized that Vedic-trained Brahmins should sprinkle the five by-products of cow's milk, curd, ghee clarified butter, urine, and dung—over the land either in the morning or in the evening. Alternatively, they might simply sprinkle clean water over the ground. 'Panchakowia' is the name given to this.

WaterManagement

SageParasara:Building bunds to hold water in plots is advised for rice. Low-level fields are not a good candidate for bunding since there would be enough moisture. For low-lying places, direct rice sowing has been advised. Once the panicles have opened, don't flood the rice, but the soil must still be moist.

Kashyapa was Supportive of Irrigated Crop Production

Kashyapa concentrated on irrigation-based farming. Well construction and water-lifting equipment design had been covered. Kashyapa has provided specifics on the placement and design of water reservoirs. He emphasised the need of building a reservoir close to farmer fields, assuring the reservoir's water supply, building sturdy causeways to prevent floods in populated areas, and routinely examining and maintaining reservoirs, particularly during the rainy season. The last one serves as a useful lesson for the current, sluggish, and uncaring employees of the government irrigation agencies. Two reservoirs should be available to each farmer. The advice

given by Kashyapa regarding construction and reservoir upkeep is technically valid. Naturally, Kashyapa suggested planting trees around water reservoirs to beautify and protect them. He recommended picnic areas around reservoirs, which is a characteristic that is'modern' in the twenty-first century. Verse 111 through verse 143 of section I refer to the building of canals. There are four origins of canal, according to Kashyapa.

i. river,

ii. tank,whichcouldhavebeenfilledbyariver,

iii. largelake,

iv. canalscollectingwaterfrommountaincascades.

Kashyapa has emphasised the need of creating a network of canals that encircle communities and provide an appropriate gradient for the canals. He placed a strong emphasis on choosing soil that had the proper structure and profile for canal construction and avoided salty soils. The need of protecting the canal system and reservoirs was emphasised. Kashyapa advised building wells, particularly in locations without access to canal water.

The post-rainy season was the ideal period for well drilling. He recommended researching the existence of trees and, of course, water divining as signs of subsoil water. He emphasised the need of creating solid brick foundations and brick-and-mortar walls. It was even advised to provide instructions for entering a well.

The so-called Persian wheel, the ghatiyantra, has been used by bullocks, elephants, and people, according to Kasyapa. Rain harvesting was emphasised. "It may be a canal, a well, a pool, or a lake, but find they must and acquire a guaranteed source of water," reads a lyric that sums up all about water for farming."[5]

Land preparation before sowing

The first stage in cultivating a crop is soil preparation. By agitating and loosening the soil, extensive root penetration may be accomplished. Loosening the soil promotes the development of countless soil bacteria, earthworms, and other organisms that provide humus and other essential nutrients to the soil. The following are the three steps in soil preparation:

i. Ploughing

It makes it possible for plant roots to penetrate the soil deeply. Additionally, loose soil allows for better root aeration and breathing, which aids in the plant's establishment. Ploughing encourages the development of worms and microbes, which conduct decomposition and provide nutrients and humus to the soil, in addition to clearing the field of weeds and other undesirable objects.

ii. Levelling

Through land levelling, the land's surface is made plain. It increases the soil's capacity to hold onto water, enhancing productivity. The device used to level the soil is a big wooden or iron board known as a leveller. By levelling the land, irrigation water may be distributed evenly. This is the last step in soil preparation.

iii. Manuring

Manure should be added to the soil to increase its richness even before you begin to sow seedlings. We apply the fertilizers before we till the soil to make sure they will mix in.

Methods of sowing

Typically, seeds were planted using a tool with a funnel-like shape. Seeds fill the funnel, which has two or three pipes with sharp, pointed tips. The device is fastened to the plough shaft. When stored in a funnel, seeds slowly drop via the pointed ends that puncture the earth and plant themselves firmly. Both manually dropping seeds and mechanically dropping seeds are referred to in tradition as "Pora" and "Kera," respectively.

1. **Broadcasting**

The most common and fundamental method of sowing seeds is broadcasting. Broadcasting is the act of dispersing seeds throughout the surface of the earth. The broadcasting technique uses both mechanical and manual methods. Holding the seeds in our hands, we manually scatter the seeds over the soil as evenly (or as evenly as we can). The seeds are dispersed unevenly; some are covered while others are left uncovered. The number of seeds that will be distributed is automatically regulated. It results in seeds being dispersed uniformly across the soil. The next step is planking. Make sure the broadcaster is knowledgeable[6].

2. Drilling

In this procedure, furrow lines are continually filled with seeds, which are subsequently covered and compacted by soil. The seeds are spaced at various intervals. A seed drill or a seed-cum-fertilizer drill is used to achieve this. The appropriate amount of seeds are planted in the right places and at the right depths. Today, the majority of seeds are sown using seed drills, which offer greater precision and enable seeds to be sown uniformly and at the required rate. Drilling may be done using a variety of techniques, including:

i. Sowing after the plough.

ii. Tractor-drawn seed drills

iii. Bullock-drawn seed drills

3. Dribbling

The most frequent technique for placing seeds into holes drilled in the seedbed and covering them is dribbling. To plant seeds using this method, holes must be bored at a precise depth and distance apart. The tool used for dabbling is called a dibbler. A conical tool is used to drill accurate holes in the ground. In this method, holes that have been built at a certain dispersion depth and clear profundity are filled with seeds. This cycle should not be endured by little seedlings due to its laboriousness. The most well-known method for planting crops is dribbling[7], [8].

DISCUSSION

Agriculture has been an integral part of an economy's existence for decades. Agriculture provides food for the whole planet. Therefore, the primary function of agriculture is the production of

basic food crops. Around 70 to 80 percent of people on the planet work in agriculture. To produce crops of high quality and quantity, it is necessary to adhere to a number of rules and diverse agricultural practises. The act of sowing involves burying seeds in the ground. The right measures should be followed throughout this agricultural procedure, such as maintaining the correct depth and distance, and the soil should be clean, healthy, and free of illness and other diseases like fungus. For seeds to germinatethe process by which seeds grow into new plantsall these measures are necessary. In farming, sowing is significant. The best, disease-free, and pure grade of seeds are chosen and placed into the soil after the soil has been loosen and tilled. After choosing high-quality seeds, they are sowed on the prepared ground [9]–[11].

CONCLUSION

The soil drilling, seed sowing, fertiliser spreading, and soil marinating tasks are completed by the seed sowing cum fertiliser drilling machine, demonstrating its versatility. The machine's primary benefit is that it runs mechanically, manually, or without electricity. In comparison to earlier techniques for farming and crop cultivation, it is also a machine that takes significantly less time to operate. The basic goal of the sowing process is to plant the seeds and fertiliser in rows at the proper depth and seed-to-seed spacing before covering them with soil. To produce the best yields, various crops need varying row-to-row spacing, seed rates, seed-to-seed spacing, and depths of seed planting. The new suggested machine, which can carry out a number of simultaneous tasks and has a number of benefits, is compared to the conventional sowing technique. This equipment decreases the labour and overall cost of seeding and fertiliser placement since the availability of labour has become a major problem for farmers, driving up labour costs.

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CHAPTER 19

AN OVERVIEW OF THE NEW CROPS AND OTHER PLANTS

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ABSTRACT:

New crops and techniques are, in reality, modifications of the old. Soybeans, sugar beets, and grain sorghums, for example, all regarded as "new" crops, are new only in the sense that they are now grown in wider areas and have different uses from those of earlier times. Such techniques as terracing, dry farming, and irrigation are nearly as old as the practice of agriculture itself, but their widespread application is still increasing productivity in many parts of the world.

KEYWORDS:

Agriculture, Agronomy, Crops, Food, Irrigation.

INTRODUCTION

Portuguese introduced new crops and fruit plants during the sixteenth century and enriched the agricul- ture of India. They were the greatest benefactors of India. Babar introduced the scented Persian rose. Similarly, the botanical garden of Calcutta has performed a very useful function by introducing many important new plants. Following are some of the crops and plants which were introduced by Portuguese from Brazil, Chile, Peru and Mexico. These crops and trees now form important components of the common cropping systems followed in the country[1].

Crops

- **i.** Groundnut (Peanut) main source of edible oil in India. A native of Brazil.
- **ii.** Tobacco: introduced by Portuguese during the reign of Emperor Akbar.
- **iii.** Potato: widely accepted and grown in India as a favourite vegetable. It is a native of Chille and Peru.
- **iv.** Amaranth: the colorful crop is grown along the whole length of Himalayas. It is a native of Brazil.
- **v.** Chillies: the ornament of Indian garden and soul of pickles. It is a native of Brazil and Peru.
- **vi.** Agave: a century plant and has become acclimatized throughout India.
- **vii.** Allamanda: a climber with beautiful flowers. It is a native of Brazil and South America.

Fruits

i. **Cashew nut:** widely grown in India and a native of Brazil.

ii. **Guava:** common fruit crop of India. It grows wild in Brazil.

iii. **Custard apple:** widely grown as a forest crop. Introduced by Portuguese.

iv. **Sapota:** a gift from Portuguese. Delicious fruit and native of Mexico.

v. **Pineapple:** extensively grown in eastern parts of India. It is indigenous to Brazil. Indian people evinced keen interest in the introduced crops and gave a fair trial under close observation. This resulted in the spread of the selected crops throughout India.

Growth Promoters

In respect of diseases, Varahamihira says the tree catches disease from cold weather, strong winds and hot sun. In such cases a paste made of vidanga, ghee and silt must be applied to the affected parts. Water and milk should be sprinkled on such trees. When there is a premature fruit drop, the tree should be watered with milk that has been cooled after being boiled with horse gram, black gram, green gram, sesamum and barley. After this treatment, the trees will produce abundant flowers and fruits. A mixture of powdered dung of goats and sheep, sesamum powder, wheat articles, beef and water, kept for seven nights should be sprinkled for increasing flowers and fruits of trees, creepers and shrubs. In the Sangam age, the dung of cow and sheep and green leaves were used to increase the yield of crops. Krishi Parashara has prescribed the method of preparing manure from cattle dung and dry leaves.

Sesamum, cow dung, barley powder, fish and water when mixed in fixed proportions formed an effective manure[2]. According to Varahamihira, sesamum is sown and ploughed back when it blooms in order to mix it with the soil. Cow dung, dung of buffaloes, goats and sheep, clarified butter, sesamum, honey, horse gram, black gram, green gram, barley, roots of certain plants, ashes, stale meat, beef and marrow of hog were used as manure. The Indus valley produced surplus food. All-important cities had large storage facilities for stocking grains. The rulers at that time had the wisdom of maintaining buffer stocks. One of the granaries stored enough barley to provide wages for 400 days. Another granary had the capacity to pay in kind for 10,930-man days. Trade was by barter and payment to labourer was in kind. The artisans, carpenters and others received their wages in kind from the farmers[3].

Agriculture without supervision was considered fruitless. The owner of the field was to look after the field himself. If he failed to supervise the agricultural operations, the belief was that the Goddess of prosperity would desert him and in her place adversity would enter his field. According to Arthashastra, if any farmer was found negligent in his duties of carrying on the agricultural operations in time, the King had the right to snatch away the land from him and hand it over to another man of the village. The foremost duty of the King was to protect agriculture and render assistance to the farmers. These directions show that the concept of management was known and practiced by everybody including the King.

Harvesting and Measuring Yields

Sage Parasara: Aardra, Kritika, Chitra, Pushya, Hasta, Swati, Uttarashadha, Uttarabhadrapada, Uttaraphalguni, Mula, and Shravana are the nakshatras recommended for the token harvest. Harvest should not be done on 'empty' days. The fourth, ninth, and the fourteenth days of the lunar fortnight are Rikta or empty days. Grains should be measured from left to right and not the other way. Adhaka is a wooden vessel used to measure gains roughly equivalent to 7 lb and 12 or (about 3.5 kg). It is equal to one fourth drona. Measuring the grains from the right leads to expenditure whereas from the left leads to happiness and enhancement of yield.

Measurement of crop produce (Kashyapa): He should also make arrangements of prastha, kunja, drona, and small nadika for (proper) measurement of grains of cereals and adhaka (pigeonpea) etc., and other commodities. The first three are the measures of capacity, prastha = ¼ adhaka; drona = 4 adhakas, kunja–should have been kunchi = 1/32 adhaka, where one adhaka = 256 fistfuls = 32 kunchis, i.e., 32 handfuls, nadika is a measure of length = 2 hastas, where one hasta is the distance between the elbow and the tip of the middle finger and is approximately equal to 18 inches. Pala (a weight of gold = 4 karshas = 64 mashas = 640 grain of masha (black gram).

i. Storage of Grains

Sage Parasara: The auspicious Meena (Pisces) lagna (February) is the best for storing grains. Hasta, Sharavana, Dhanishtha, Shatabhishita, Pushya, Bharani, Uttarashadha, Uttarabharapada, Uttaraphalguni, Mula, and Magha are the auspicious nakshatras for storing grains. Monday, Thursday, Friday, and Saturday should of course be avoided[4].

ii. Farming Systems

The importance attached to food quantity in Anna Sukta shows that arable farming was given equal importance as stock farming. The praise of land, bullocks, seeds and peasants in various hymns clearly indicates importance attached to arable farming, crop husbandry with different types of field grasses for food and fodder being considered for the dual purpose of man and animal. The traditional land use and occupational structures in Indian agriculture have invariably been site-specific based on available resources and sound ecology. In India for example people of Rajasthan developed nomadic and animals care-based occupation because the land fragile and could not be used intensively. The people of Mizoram and Nagaland developed shifting cultivation as their system of survival because they had to live on slopes and this was the best way to sustain their soil fertility and productivity and conserve and use the bio-resources in sustainable manner. This highly organized agro-ecosystem called Jhum is based on empirical knowledge accumulated over centuries.

It functions in harmony with environment and provides enough time for recovered of forest and soil fertility that is lost during cropping phase. It involves slashing of vegetation burning it before the on set of monsoon raising mixture of crops on temporarily enriched soil for a year or two leaving it fallow for a few needs fresh system like Zabo system a combination of forestry soil and water conservation, Alder system for soil health and Panikheti system of wet rice cultivation with judicious use of water have been developed. Shifting agriculture practiced in India has

mixed cropping as a standard feature. It was once conceded primitive by scientists, however now it is being suggested as a means to increase world food production. During the cropping phase the farmers raise 8–35 crops species on a small plot of 2 to 2.5 ha with simultaneous sowing and sequential harvesting the crop mixture provides crop cover against loss of nutrients, optimisms resources facilitates recycling of biomass and nutrients and improves soil characteristics[5].

Zabo farming system is practiced in Nagaland. 'Zabo' means impounding of water. The system is a combination of agriculture, forestry, livestock, fishery and soil and water conservation. The Zabo system comprises protected forest land on the top of the hill, well planned rainwater harvesting tank on the top of the hill and indigenous methods of nutrient management in hill region, cattle yard and terraced rice fields towards foothills. The Soils of the area are salty clay loam in texture with grayish brown colors and there are no means of irrigation. Animal manure is the major source of crop nutrition. The silt deposited in the tanks is dug out during off-season and added to the fields. This silt is very rich in nutrients as it contains lot of forest litter. Farmers also add leaves and succulent branches to the fields and leave for decomposition. This helps in building up soil fertility and maintenance of soil health. This indigenous farming system is good example of integrated use of land, water and nutrient. Shifting cultivation, which otherwise causes soil and nutrients loss, the Zabo method of cultivation is ecofriendly, takes care of natural resources and soil erosion is negligible.

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Farms yield gold if properly managed but lead to poverty if neglected. Only the capable (people are) to undertake farming for the welfare of people. An incapable farmer lands himself in poverty. An agriculturalist who looks after the welfare of his cattle, visits his farms, daily has the knowledge of the seasons, is careful about the seeds, and is industrious is rewarded with the harvest of all kinds and never perishes. Farms should be never left to the care of anyone other than oneself. Kashyapa has recommended cooperative farming too for the first time. He also advises the farmers to take up second cultivation every year. This is said to be particularly beneficial on a fertile land with sufficient water supply throughout the year.

Soil Classification

Physically, India may be divided more or less into three main regions viz:

i. The mountainous borders of Himalayas in the north and of the Vindhyas in the south with the linings of Ghats in the south-eastern and south-western coasts and the traverse range or Aravalli hills;

ii. The Deccan plateau or table land;

iii. The plains or low-lands, a rich Indo-Gangetic alluvium over flown by the rivers–the Ganges, Jamuna and Brahmaputra.

Although primordial mountains remained inaccessible for human settlement, the foothills have been increasingly brought under cultivation and settlement and the upland valleys striking the Himalayas include some or the most fertile of Indian lowland formations. The whole Indo-Gangetic alluvium consists of rich fertile soil and has contributed materially to the growth of civilization.

i. **The Himalayas:** The Himalayas (Sanskrit: hima, 'snow' and alaya, 'abode'), the loftiest moun- tain system in the world, form the northern limit of India. This great, geologically young moun- tain arc is about 1,550 miles (2,500 km) long, stretching from the peak of Nanga Parbat in Pakistan-held Jammu and Kashmir to the Namcha Barwa peak in the Tibet Autonomous Region of China. Between these extremes the mountains fall across India, southern Tibet, Nepal, and Bhutan. The width of the system varies between 125 and 250 miles.

ii. **The Indo-Gangetic Plain:** The second great structural component of India, the Indo-Gangetic Plain (also called the North Indian Plain), lies between the Himalayas and the Deccan. The plain occupies the Himalayan fore deep, formerly a seabed but now filled with river-borne alluvium to depths of up to 6,000 feet. The plain stretches from the Pakistani provinces of Sind and Punjab in the west, where it is watered by the Indus and its tributaries, eastward to the Brahmaputra valley in Assam. The Ganges basin (mainly in Uttar Pradesh and Bihar) forms the central and principal part of this plain. The eastern part is made up of the combined delta of the Ganges and Brahmaputra rivers, which, though mainly in Bangladesh, also occupies a part of the adjacent Indian state of West Bengal. This deltaic area is characterized by annual flooding attributed to intense monsoon rainfall, an exceedingly gentle gradient, and an enormous discharge that the alluvium-choked rivers cannot contain within their channels. The Indus River basin, extending west from Delhi, forms the western part of the plain; the Indian portion is mainly in the states of Haryana and Punjab. The Great Indian, or Thar, Desert, forms an important southern exten- sion of the Indo-Gangetic Plain. It is mostly in India but also extends into Pakistan and is mainly an area of gently undulating terrain, and within it are several areas dominated by shifting sand dunes and numerous isolated hills[7].

iii. **The Deccan Plateau:** The remainder of India is designated, not altogether accurately, as either the Deccan Plateau or peninsular India. It is actually a topographically variegated region that extends well beyond the peninsula that portion of the country lying between the Arabian Sea and the Bay of Bengal and includes a substantial area to the north of the Vindhya range, which has popularly been regarded as the divide between Hindustan (northern India) and the Deccan (Sanskrit: daksina, "south"). Agriculturists in ancient India were quite conscious of the nature of soil and its relation to the production of a specific crop of economic importance. The vast knowledge acquired by experience has been handed over from generation to generation.

Soil Types of India

The investigations of Voelcker in 1893, and those of Leather in 1898, led to a classification if India soils into four major types and three minor types:

i. **The Indo-Gangetic alluvium;**

ii. **The black cotton soils;**

iii. **The red soils lying on metamorphic rocks;**

iv. **The lateritic soils.**

i. Indo-Genetic Alluvium:

The Indo-Gangetic alluvium is by far the largest and most important of the soil groups of India. The soils of this group cover about 777,000 square kilometers. They are distributed mainly the Punjab, Haryana, Uttar Pradesh, Bihar, Bengal and parts of Assam and Orissa. They produce bumber crops of wheat and rice. Geologically the alluvium is divided into:

a) Khadar, or new alluvium of sandy composition, generally light in colour, about 10,000 years old, and (ii) Bhangar, or the older alluvium of Pleistocene elate, of more clayey composition, generally of dark colour, and fun of pebbles or kankar. The soils differ in consistency from drift sand to loams, and from fine silts to stilts clays. A few pebble beds are also occasionally met with. The presence of impervious clays obstructs the drainage, and also promotes the accumu- lation of injurious salts of sodium arid magnesium, which make the soils sterile. The formation of hard pans at certain levels in the soil profile as a result of the binding of soil grains by the infiltrating silica or calcareous matter is often observed in these alluvial soils. A majority of the soils are loams or sandy loams, with a soil crust of varying depth. Soluble salts are present in considerable quantities.

The alluvial soils of Tamil Nadu are transported soils, found mainly in the deltaic areas and on the coastal line, A section of the profile shows alternate layers of sand and silt. The composition of the strata varies with the nature of the silt brought by the rivers which, in turn, varies with the catchment areas and the tracts through which the streams flow[8].

ii. Black Cotton Soils

The typical soil of the Deccan Trap is the regur or black cotton soil. It is common in Maharashtra, in the western parts of Madhya Pradesh, Karnataka, and ‘some parts of Tamil Nadu, including the districts of Ramnad and Tirunelvely in the extreme south. It is comparable with the chernozems of Russia and with the prairie soil of the cotton-growing tracts of the United States of America, especially the black adobe of California. It is derived from two types of rocks: the Deccan and Rajmahal Trap, and the ferruginous gneisses and schists occur- ring in Tamil Nadu under semi-arid conditions. The former attains sometimes considerable depths, whereas the latter are generally shallow. The black soil areas have, generally, a high degree of fertility, though some mainly in the uplands are of low productivity. The soils on the slopes and the uplands are somewhat sandy, but those in the broken country between the hills and the plains are darker, deeper and richer, and are constantly enriched by deposits washed down from the hills.

iii. Red Soils:

Red soils extend practically over the whole Archaean basement of Peninsular India, from Bundelkhand to the extreme south, covering 2,072,000 square km, embracing south Bengal, Orissa, parts of Madhya Pradesh eastern Andhra Pradesh Karnataka, and a major part of Tamil Nadu. These soils also occur in Santhal Parganas in Bihar, and in the Mirzapur, Jhansi and Hamirpur districts of Uttar Pradesh. They were produced as a result to meteoric weathering of ancient crystalline and metamorphic rocks. These soils started developing around the Mesozoic and Tertiary ages. The colour if these soils is generally red, grading sometimes into brown chocolate, yellow; grey and even black. The redness is due more to a general diffusion than to a high proportion of iron content. The soils grade from the poor thin gravelly and light coloured varieties of the uplands to the much more fertile deep dark varieties of the plains and the valleys. They are generally; poor in nitrogen phosphorus and humus. Compared with regur, they are poor in lime, potash and iron oxide, and are also uniformly low in phosphorus. The clay fraction of the soils is rich in kaolinite. More than two-thirds of the cultivated area in Tamil Nadu is covered by red soils they are in-situ formations produced from the rock below under the influence of climatic conditions. The rocks are acidic, consisting of mica or red granites. The soils are shallow and open in texture. They have a low exchange capacity and are deficient in organic matter and plant nutrients.

iv. Laterites:

Laterite is a soil type peculiar to India and some other tropical countries, characterized by the intermittent occurrence of moist climate. In formation it varies from compact to vesicular rock composed essentially of a mixture of hydrated oxides of aluminium and iron with small quantities of manganese oxides, titanium, etc. It is produced by the atmospheric weathering of several types of rocks. Laterites occur in Madhya Pradesh, the coastal region of Orissa, south Maharashtra, Malabar and part of Assam. All lateritic soils are generally very poor in lime and magnesia and deficient in nitrogen. Occasionally, the P_2O_5 content may be high, but there is deficient of K2O. In Tamil Nadu, there are both high-level and low-level laterites which are formed from a variety of rock materials under certain climatic and weather conditions. Thelaterites at lower elevations grow rice whereas those at higher elevations grow tea, cinchona, rubber and coffee. The soils are rich in nutrients and contain 10 to 20 per cent organic matter.

v. Forest and Hill Soils:

The soil formation is governed mainly by the character of the deposition of organic matter

derived from the forest growth. Broadly, two conditions of soil formation may be distinguished:

a. Soils formed under acid condition, with acid humus and low base status,

b. Soils formed under slightly acid or neutral condition with high base status, which is favour- able to the formation of brown earths.

Forest and Hill soils occur in Assam and in Uttar Pradesh, the Sub Himalayan tract comprises three distinct parts viz., bhabar area immediately below the hills, tarai and the plains. The tarai areas are characterized by extreme unhealthiness owing to excessive soil moisture and prolific growth of vegetation. The soils in Coorg has deep surface soil of great fertility, as it receives annually the decomposed products of the virgin forest. The areas towards the west are for the greater part reserved under forests and mountain areas. The land surface is full of pebbles, is easily drained, and has a laterite bed.

vi. Desert Soils

A large part of the arid region of Rajasthan and the Punjab and Haryana, lying between the Sutlej and the Aravallis, is affected by desert conditions, which geologically are of recent origin. This part is covered under a mantle of blown sand, and is dominated by conditions, which inhibit soil growth. Some of the soils contain a high percentage of soluble salts and varying percentages of calcium carbonate, and possess high pH. They are, however, poor in organic matter. Reclamation is possible only if proper irrigation facilities are made available.

vii. Saline and Alkaline Soils

These soils are extensively distributed throughout India in all the climatic zones. These soils occur in Bihar, Uttar Pradesh, Punjab, Haryana and Rajasthan. The injurious salts are confined to the top layers, being deposited there by the capillary transference of saline solutions from the lower strata. It has been estimated that nearly 850,000 hectares in Uttar Pradesh and over 200,000 hectares in the Punjab and Haryana have been affected by usar.

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CHAPTER 20

AN ANALYSIS OF THE MAINTENANCE OF SOIL PRODUCTIVITY

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ABSTRACT:

Crop Rotation Crop rotation helps in efficient use of nutrients. Farmers usually change crop rotation in every three or four years to have a better growth and performance of the cropping system. Stubble mulching is common in the high rainfall areas. Mulching raised the organic matter and nutritional status of soil. Practices such as using cover crops, applying manure and compost, rotating crops, and controlling erosion for soil conservation, can maintain or increase soil organic matter. Other practices, especially plowing, tilling and cultivating, can decrease the amount of organic matter in the soil.

KEYWORDS:

Plough, Rice, Soil, Soil Productivity, Wheat.

INTRODUCTION

In ancient India, the use of manures in achieving high agricultural yields was clearly understood. It is claimed in Krishi-Parashara that crops produced without manure would not provide a yield and that cow dung may be processed to create manure. The usage of cow dung, animal bones, fish, and milk as manure was noted by Kautilya. To promote tree blossom and fruiting, Agnipurana advises applying sheep and goat excrement as well as ground sesame that has been allowed to soak in meat and water for seven nights. It is advised in Varahamihira's Brhat Samhita to cultivate sesame to the blooming stage and then use it as green manure. A handful of these fertilisers are mentioned in The Abhilasitarthacintaman [1].

i. The soil under a lightning-damaged tree is beneficial for protecting trees from the effects of snowfall.

ii. Burning turmeric, Vidanga, white mustard, Arjuna tree blossoms, combined with fish, and Rohita (a kind of deer) meat would not only promote the development of flowers and fruits but will also eradicate all worms, insects, and illnesses.

The 'old' practise of making liquid manure (kunapa), according to Surapala (around 1000 A.D.), included boiling a combination of animal excrement, bone marrow, meat, and dead fish before adding sesame oil cake, honey, soaked black gramme, and a little amount of ghee (or clarified butter). 'Kunapa' preparation didn't call for any specific amounts of any certain components. Growing trees and shrubs was the principal purpose for this liquid manure. Green leaf manure is used as the primary fertiliser for the rice crop in the Himalayan parts of the subcontinent's traditional agriculture. Kunapa should be used to properly feed trees, according to Surapala and

Sarangadhara. Sarangadhara provides the following instructions for making kunapa: "One should boil the flesh, fat, and marrow of deer, pig, fish, sheep, goat, and rhinoceros in water. When it is properly boiled, one should put the mixture in an earthen pot and add milk, sesame oil cake powder, masa (black gramme) boiled in honey, the decoction of pulses, ghee, and hot water to the compound. There is no set quantity for any of these components, but when the pot in question is left in a warm environment for approximately a week, the mixture turns into something known as kunapa water, which is very nourishing for plants in general. Before Sarangadhara, the term "kunapa" was used to describe a substance made of boar excreta, bone marrow, meat, brain, and blood that had been combined with water and kept underground. Surapala also referred to "available" resources, which might include fish, ram, goat, and other domesticated animals as well as animal marrow, fat, and meat. Other elements were largely the same as those specified by Sarangadhara, with the exception of the little amounts of ghee and honey that were suggested. Kunapa water concentrates may easily be bulk produced, standardised, and made accessible to customers in jars. A business has the chance to support farmers, particularly orchardists. Firminger (1864), a "Chaplain of the Bengal Establishment," notes the advantages of using "liquid manure," made similarly to Kunapa, for vegetable farming. He has not said who came up with the idea for liquid manure.

a) Green Leaf Manures

Legumes, neem, and agricultural wastes were heavily used by farmers to improve the fertility of the soil. The usage of Calotropis gigantea, Morinda tinctoria, Thespesia populnea, Jatropha gossypifoila, and Adathoda sp. as green leaf manure has been frequently documented in ancient Tamil writings. To restore soil fertility, intercropping and crop rotation were used. Ants, earthworms, and frogs were utilised as fauna to enhance the physical characteristics of soil. Ancient writings on optimum agricultural techniques also include composting practises. Farmyard manure (FYM), oil cakes, compost, and green manures or green leaf manures are all common soil fertilisers used by Tamil Nadu farmers [2].

b) Recycling

In the foothill zones, recycling of nutrients by pond excavation was accomplished using tank silt or pond excavation. the pond sediments from fields, open areas, etc. during the monsoon. The common village pond also receives the sewage slurry, dissolved minerals, and nutrients in water from livestock sheds and household laundry. Clay and organic elements that have flocculated normally settle completely soon, leaving the pond's water pure. From this pond, animals used to drink. The farmers excavate the pond foundation by removing the dirt and transporting it to the fields as soon as the ponds dry up in the summer. About 30 cm of the pond base's top layer is typically removed. This is a plentiful supply of nutrients for plants. Each field receives pond sludge application once every 10 to 15 years. Tank silt increases the amount of clay in red soils with light textures, which helps to raise soil moisture levels and, ultimately, crop output. Farmers in the districts of Coimbatore and Trichy use tank sand to crops including banana, turmeric, and jasmine, while those in Ramanathapuram apply it to rice at a rate of 25 t/ha. With the advent of chemical fertilisers, the excavation of pond basins and their application to fields were discontinued. Farmers remove the topmost worn basalt rock, known as "murrum," and spread it over the fields.

c) Compost

In five to six months, the compost is ready for use. After being equally distributed around the field, this partly decomposed farmyard manure is worked into the soil by ploughing and then planking, as shown in Table 1.

Table 1: Illustrated the Ration of elements in Composts

Sr. No.	Crop straw	Grain to Straw Ratio
1.	Rice	1:1:5
2.	Pearl millet	1:2:0
3.	Maize	1:1:5
4.	Cotton	1:6:0
5.	Wheat	1:1:5
6.	Barley	1:1:5
7.	Mustard	1:2:0
8.	Pulses	1:1:0
9.	Sugarcane	1:0:2

d) Penning

Penning of sheep, goat, cattle and pig in the fallow fields is common. One or two fields by rotation are kept fallow to receive the animal dung and urine during summer as well as winter months. Large herds of sheep, goat and cattle are kept in the fallow fields. The farmers used to feel obliged and usually come with a request to cattle herd owners for the night stays at their farm land. The litters of sheep get well mixed with soil during the period of penning. Light cultivation before the onset of monsoon makes it more effective. Sheep feed on the existing farm residue and drops litter in the same field during resting period. The excreta of sheep are acidic in reaction. On each piece of land, penning is continued for 2 to 4 days depending on the size of the flocks to gather or accumulate sufficient manure to improve the fertility status of the soil [3].

e) Rishi–Krishi Method of Vermiculture

The Amrit pani consists of 250 g ghee from cow milk + 500 g honey + 200 litre water + 10 kg cow dung. Firstly, ghee is mixed with cow dung thoroughly followed by honey and then water is added to it. Farmers collect 25 kg soil from the base of banian tree which is sufficient for

sprinkling well-prepared Amrit pani on an acre uniformly. Normal earthworm count in an acre gets double (87120) due to enhanced energy and congenial soil environment. If the weight of one worm is 20 g which eats about the same quantity of soil, in 100 days, one worm can excrete 1kg excreta. Then 87 thousand worms will excrete 87 t of excreta rich in mineral nutrients, organic carbon, microbial population, organic acids, growth hormones and growth promoting substances.

f) Dead Animals

Dead animals (pet or domestic) were buried under the fruit trees such as mango tree. The dead animal contains large amount of biomass, mineral matter in the form of structure and bones specifically nitrogen in protein, phosphorus in bones etc.

g) Crop Rotation

Crop rotation helps in efficient use of nutrients. Farmers usually change crop rotation in every three or four years to have a better growth and performance of the cropping system. Stubble mulching is common in the high rainfall areas. Mulching raised the organic matter and nutritional status of soil.

Water Management

Rain is essential for cultivation and the latter is essential for life, so one should first acquire carefully the knowledge about rainfall. Over a large part of the country rain has always been unequally and irregularly distributed and that is why Indian cultivators have sought to supplement the rainfall by digging wells and conserve it by tanks and storage reservoirs.

a) Ancient Irrigation

Archaeological investigations in Inamagaon in Maharastra, India (1300 B.C.), revealed a large mud embankment on a stone foundation for diverting floodwater from the Ghod river through a channel. Rigveda mentions irrigation of crops by river water through channels as well as irrigation from wells. In the Rigveda, the word “well” frequently occurs (videante) and is described as “unfailing and full of water”. Water was raised from the well by means of a wheel, a strap and water pails, and also perhaps by buckets tied by rope to one end of a long wooden pole, working about a fulcrum near the other end that carried a heavy weight. The same old crude method is still prevalent in some parts of Northern India. Another method largely employed is to raise water by a small canoe tied by four strings-two at each side and worked between two men standing on a wooden platform projecting over a shallow reservoir. The canoe is swung to and fro, and at each end of the swing, water rises and pours out into the main channel. Macdonell and Keith find clear references to artificial water channels used for irrigation as practiced in the times of the Rigveda and Atharvaveda.

b) References in Epics, Arthasastra, Law-books and Jatakas

No grain is ever grown without water, yet too much water usually causes the grain to deteriorate. Crops are harmed by flooding; thus drainage must be supplied. Water on Earth may be obtained from specific sources such canals, wells, lakes, reservoirs, etc. Rainfall is guaranteed during the cloudy season, either by chance or due to the wisdom of the wise. Because agriculture solely depends on water, the king should store the rainwater that clouds pour down during the rainy

season in ponds, reservoirs, etc. for the benefit of the people. The renowned sage Kasyapa advised that any water that might be collected throughout the (rainy) season should be carefully maintained by both monarchs and other important people. According to the Arthasastra of Kautilyas, those who discharge water from tanks at locations other than their sluice gate must pay a punishment of six panas, and those who hinder the water's flow from the sluice gate of tanks must also pay the same penalty. Further, it is stated that "the water of a lower tank, when later excavated, shall not irrigate the field already irrigated by a higher tank and the natural flow of water from a higher to a lower shall not be stopped, unless the lower tank has ceased to be useful for three consecutive years." Irrigated water was subject to charges, regardless of the source. Gujarat's enormous Sudarshan Lake was built at the same period, in the fourth century B.C., and conduits were later added to it. The practice of building tanks for irrigation persisted in western India throughout the ancient era. It is documented in Buddhist literature from 500 to 300 B.C. that modest irrigation tanks were constructed [4].

In Sri Lanka and southern India, extensive tank irrigation systems were created throughout the first two centuries of the Christian period. Rice could now be grown across much larger regions because to the availability of irrigation, enhancing food security. The most recent tank irrigation technique expertise came from Sri Lanka. By the third century B.C., they could construct substantial tanks and regulate water release. The modern and succeeding kingdoms in southern India most likely benefited from Sri Lanka's tank-building skills. The theory of the effective Sri Lankan ruler from the 12th century. In such a nation, not even a tiny amount of rainwater should be allowed to enter the sea without helping people, he said. In the past, there were up to 14 large irrigation tanks in Sri Lanka's northern region.

Tank building is well suited to the topography of the Telangana area of Andhra Pradesh and Karnataka in India. Tanks in Telangana are unique in that they are built in sequence by bundling the same valley at several spots. Tanks at different elevations were hydrated by extra water from one tank, and so on. A number of the irrigation tanks built by the Chola monarch Karikalan and his successors in Tamil Nadu using canals from the Cauvery River still stand today. Eri-variyam, a village committee, was chosen to oversee tank upkeep. The committee saw to tank repairs, desilting, and water delivery. Plans were established during the Pallava era for the construction of dams, embankments, tanks, and aqueducts throughout southern India. From the Mauryans to the Mughals, ancient kingdoms developed a variety of techniques for managing soil water, including anaicuts, earthen dams, field bunds, check dams, canals, tanks, ponds, wells and reservoirs. Before Arab invasions, Babur observed two techniques for well irrigation in northern India: a leather bucket pulled by a pulley and a wooden Persian Wheel [5].

c) Locating Water Table - Keys to the Finding of Water Source

Chakrapani in his ‘Visva Vallava’ has dealt in detail as how one can have an approximate idea regarding water below the surface of different kinds of lands, based on certain characteristics on the land. Gen- erally water is found near or below a marshy place, at sea side, just by its shore, and in the desert, rocky and mountainous country far deep. From a mountain or from the root of a tree the underground artery (sometimes) goes below into a spring. At some places all the arteries are seen to terminate in caves. While digging if stone-like hard earth is reached and when struck it sounds like a thin slab of stone, then there is sure to be plenty of water beneath it. If in a place devoid of any water reservoir, there is found a rank growth of Vetasa (rattan), then there would be an artery of water two cubits below the surface flowing towards the west. If rattan plant

is seen growing in a place where there is no pool of water, then three cubits towards the west of that plant an artery of water would be found after digging seven cubits deep. If the tree Ficus oppositefolia is seen growing in a place devoid of a water reservoir of any sort, then three cubits towards its west there will be found an artery of water two and a half man-lengths below the surface of the earth. Where there stands an Udumbarika tree, there three cubits towards its west will be found a dark artery of water two and a half man lengths below the surface. If there is an ant-hill towards the north of an Arjuna tree, then three cubits towards the west of the tree, water is sure to be found at the depth of three and a half man-lengths. If a Badari (jujube) tree stands to the west of an ant-hill, then two cubits towards the west springs of water would certainly be found at the depth of three man-lengths. If there be the plant Bhargi (Clerodendrum siphonantus), Danti (Croton polyandrum) or Malika (double jasmine), then there is water towards its south at the depth of three man-lengths.

d) Locating Water in Arid Areas

Agriculture in India mainly depended on rainfall since ancient times. People knew that much of the rain water percolates through the soil and flows underground through aquifers. Observations about ground water and its exploration have been made by Saraswata Muni who was well versed with botany and zoology and Manava Muni who was a geologist. According to their observations, the presence of an ant hill or that of a serpent den was regarded as an indication of the underground water. A number of trees like Banyan, Gular, Palas (Butea monosperma), Bilwa (Semicarpus anacardium) has water at a particular depth in a particular direction. Manava Muni surmises presence of water by colour of the soil or of rocks and stones. He has given a list of the plants or trees, which indicates presence of water. Varahamihira was the greatest astronomer of the 6th century A.D. who had made certain observations on water exploration. According to him water in the ground is available in an arid place near Vetasa plant (Calamus rotalg); gular tree (Ficus glomerata), where current of sweet water many be found; in place where bilwa and gular trees are found growing together; if there is an ant-hill to the north of arjuna (Terminalia arjzma) tree; if there is a coconut tree with ant hill; if nirgundi tree (Vitex negzmdo) is found with an ant hill; if ant hill is inhabited by a serpent and is near to the north side of Mahuwa tree (Madhuka indica); near the milky trees having long branches; at spots where trees, shrubs and creepers are fresh and fine and leaves are unborn and near grasses of specific types. Digging of wells was not very common and people depended more on the monsoons and river water. Shallow wells were dug through human labour and water was lifted through indigenous devices which operated on man and animal power. These wells were dug after careful selection of site and after ascertaining availability of ground water through water diviners.

Ancient teachers have enumerated many methods of divining water in arid regions. If there is seen hot vapour (rising from the earth) then there would be found a stream of water at the depth of two man- lengths and underground vegetation. The two-man-deep water would turn pale-white and disappear. There are signs approved by (the astrologer) Sanmuni by which now it is possible to divine whether there is adequate supply of water underground or whether the water is sweet. For the facility of people living in desert places there generally exists underground a rich stream of water as big as the trunk of an elephant. If to the north of a Karira shrub there is an ant-hill then there would be found sweet water towards the south at the depth of ten man-lengths, and at the depth of one man-length there would be yellow frogs. And if on the west of a Rohita tree then water would be found at a distance of three cubits and twelve man-lengths below the surface, and towards the west there would be a profuse stream of salt water. If there is an ant-hill

of white colour then close to it towards the west there would be a water-vein at the depth of five man-lengths, and towards the west stones and yellow clay at the depth of one man- length. If there is an ant-hill to the east of which stands a Pilu tree, then at a distance of one man-length to the south there would be water at the depth of seven man-lengths. At the depth of first man-length there would be found a snake with black and white spots and plenty of salt (water) at the depth of three man-lengths. If an ant-hill stands to the east of Indradru (Terminalia arjuna), then just at one cubit to the west there would be found water at the depth of twenty man-lengths and an iguana only at the depth of one man-length. If there be a group of five ant-hills at one place - the middle one being white in colour - then there would be water under a depth of fifty five man-lengths. If there be Kusa grass growing over an ant-hill or there be pale-white adurva then twenty one man-lengths below it would be found water.

e) Locating Water in Marshy Lands

In a marshy country there are green herbs and the land is wet and full of mosquitoes. There is Andropogon muricatus. There is plenty of sweet water underground at the depth of one man-length. Where there are succulent herbs such as Ipomoea turpethum; creepers (garuda), Jyotismati (Cardiospermum helicacabum), Cyperus, there water is found very near (the surface). Towards the south of a grove of thick trees and creepers there is plenty of water at the depth of four cubits. In a valley the land is low, covered with green turf, sandy, resonant and rich in water.

f) Locating Water in Mountainous Country

Sarasvata and Varaha described clear formulae with respect to the mountainous country. Where there is a cluster of the Bodhi tree, Udumbarika, Palasa and Nyagrodha, at one place, water would be found three man-lengths below them even in arid and marshy lands. The place where the trees have glossy and thick foliage and shrubs and creepers have milky juice has sweet water very near (the surface) and is inhabited by sweet-voiced birds. In a place where there grow Kharjuri, Jambu, Sata-patra, Nipa, Sinduvara, Vata, Naktamala, Andumbari, Kakaranva and Vibhitaka, there water would be found at a depth of three man-lengths [6].

Water is said to exist underground in a place where flowering trees and plants like Jati, Kusthaka, Campaka, etc., and fruit-bearing trees like the pomegranate, lime (Citrus acida) and citron are found to grow. Where on a hilly place the Tala tree, the coconut, tree, Kancanara, Vetasa or any other trees are found to grow, sweet water is found there in plenty. What has been previously described as a Nirjahara (water-fall or cascade) is found in a mountainous country issuing from the crevices between the rocks or from the roots of the trees. In a wet mountainous country, a stream with a copious flow of water is generally found to flow from under the vegetation. Sometimes such a stream is also found to exist underground at holy places with shrines. Near the rocks that glisten like a copper vessel facing the east i.e. sun, or like glass and Vaidurya (eat's eye) or are bright like the pearls, or grey like the Patasa, or brown in color, there is plenty of water. Where the dark blue soil or the black soil is found in conjunction with gravel, or where there is white coloured soil and sand or where there is yellowish soil, there exists sweet water. In brown soil the water is acrid in taste and in polish soil of smooth surface it is salt.

DISCUSSION

The following passages from Chakrapani's book "Visva Vallabha" explain how reservoirs should be built after underground water has been discovered: "When water has been located, reservoirs

of various shapes and sizes should be constructed outside the villages, their sites and measurements being determined by the availability of space. Six configurations are possible for an artificial reservoir: circular, quadrangular (square), triangular, polygonal, oblong, and semi-circular (half-moon). After it has been dug, its capacity can be determined. The length of the largest reservoir should be one thousand poles (4000 cubits), followed by half and then one fourth of it. The amount of available space determines the size of additional reservoirs. By building a dam between two hills, in a mountain valley, or on a huge area at the summit of a hill, a large reservoir that will always have a significant storage of water may be built for a lower cost. A large reservoir may be created by building a dam there if there is a broad, high table area with substantial water inflow and a small outlet for the water to escape. A smart person would construct stairs that descend from the dam's top to the reservoir's base, and for the dam's strength, he would have lime cement plaster applied to both the inner and outer faces [7], [8].

CONCLUSION

A terrain that is low on all sides that is filled with water creates a pond and a natural reservoir. There cannot be any established standards for it. Kingly leisure cottages may be seen on the shores and in the midst of the lakes. A boat should be maintained there for leisurely excursions or splashing about in the water, or a bridge (or causeway) could be used to access the pleasure home. Nanda, Bhadra, Jaya, and Vijaya are the names of tanks with three peaks and one opening, nine peaks and three openings, and twelve peaks and four openings, respectively.If it is discovered that the well's bottom is filled with sand, a firm wood foundation pedestal should be positioned below so as not to obstruct the well's water springs. There are four different types of kundas, including Bhadra, Subhadra, Parigha, and Nanda. The first is quadrilateral, the second is Bhadra, the third is Subhadra, and the fourth is linked to Peatibhadra in the centre. They (the Kundas) should have four openings, one in each direction, and a half in one corner, along with a quadrangular courtyard and ventilators inside, measuring 128 cubits on each side. A extremely deep natural pool that has formed on its own might be of any shape. Its embankments might be paved with stone and lime mortar as they already are.

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CHAPTER 21

AN OVERVIEW OF THE CHANGING THE WATER QUALITY

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ABSTRACT:

Water quality is influenced by many factors like precipitation, climate, soil type, vegetation, geology, flow conditions, ground water and human activities. The greatest threat to water quality is posed by point sources of industries and municipalities. Maintain a cover of growing plants or residues over the soil surface at all times. Decrease the potential for water to flow off the land and increase the potential for water to infiltrate the soil. Increase soil organic matter, soil tilth, and water infiltration.

KEYWORDS:

Agriculture, Food, Crops, Water, Waste Management, Water Quality.

INTRODUCTION

Chakrapani in this chapter "Visva Vallabha" describes the methods to change water quality. If the powder of Khadira is poured into a well whose water is saline or acrid in taste, the water would be turned sweet. The turbid and pungent smelling water of pools etc. would turn sweet and pellucid if the powder as well as the juice of Kakubha, Musta, Usira, fruits of Dhatri and Kanaka and of Rodhra (Symplocos racemosa) and Rajasana is poured into them. The juice of Abhaya (Terminalia chebula) and the powder of Pathya Terminalia citrina), Kustha, Cardamom and Kataka fruit (Strychnos potatorum) along with the essence of Khadira and the fruit of wood-apple, if thrown in the turbid water or the salt water of well, they would at once turn the water (clear) and sweet[1].

i. Ancient Irrigation Systems

Devices for irrigation water lifting range from age-old indigenous water lifts to highly efficient pumps. Pumps operated by electric motors or engines have come into prominence in all large-scale lift irrigation schemes. There are several types of indigenous water lifts are in use in India. They may be manually operated or animal-operated. Based on the optimum range in the height of lift, they may be grouped under devices for low lift, medium lift and high lift.

Low Head Water Lifts: The swing basket, don, Archemedian screw, and water wheel are suitable when the depth to water surface does not exceed 1.2 m.

Medium Head Water Lifts: Medium head lifts are suitable when the height of lift is within the range of 1.2-10 m. The Persian wheel, chain pump, leather bucket lift with self-emptying bucket, circular two-bucket lift and the counterpoise-bucket lift fall in this category,

High Head Water Lifts: Rope-and-bucket lift. The only indigenous water lift suitable for deep wells is the rope-and-bucket lift (Charasa) operated by bullocks

ii. Rain Water Harvesting Technique

The most common practices followed by the farmers to conserve the soil moisture are summer tillage, field boundary bund with vegetative cover, use of farm yard manure and intercultural operation with hand/bullock drawn equipments. Farmers have followed the surface water harvesting rainwater harvesting techniques such as local percolation tank, farm pond, Tanka, Nada, Nadi, Talai, Talba, Khadin, Sar, Sagar and Samand. The water-harvesting methods differ from region depending upon rainfall, topography and soil type.

i. **Tanka** is constructed on farm in courtyard fort, etc. The shape of the Tanka is generally kept circular; however square Tankas are also constructed in buildings, forts and palatial buildings etc., for harvesting roof water, 2 m diameter and 3 m deep Tanka (capacity 10000 liter) is common. The Tanka is made on sloping land to arrest run off water in the farm however in house the construction is made on an elevated place to avoid entry of water into it.

ii. **Talai** is about 2–3 m deep, the soil scooped out from the Talai is spread around to make catchments area keeping its slope in mind special attention is paid for selection of locations such that there is adequate flow of rainwater into the Talai. Care is also taken so that loose soil does not flow along with water stream into the Talai. In contrast to the Tanka, the Talai is kept open from the top. A pucca masonry ram entrance is also provided on one side of the Talai to facilitate distribution of water using camel, donkey, bullock cart, etc. The stored water is generally used for animals.

iii. **Nada** is a common method of conserving rainwater in villages. Low-lying area in between hillocks the catchments area of the Nada is 5 to 10 ha. The Nada is constructed on rangeland, barren land, pasture land and agricultural field. It provides short-term storage of rainwater and mainly used for animals[2].

iv. **Nadi** compared to Nada high embankment is provided around the Nadi. Depth of Nadi is kept up to 6–8 m. Catchments area of 10 to 150 ha is common for a Nadi. However, area as high as 200 ha is found in certain specific cases. Nadi is generally constructed on sloppy area so that excess runoff water flows out without causing any damage to the embankment. Adequate cleanliness is maintained in the watershed to maintain purity or stored water. Bath is prohibited inside the Nadi. In the Nadi, water is available for whole of the year as a result it is shelter home for many wild animals and birds.

v. **Talab** it is relatively shallow and spread over to more area compared to Nadi Runoff from hillocks is channels to a low-lying area in the vicinity and adequately bunded to form a Talab. It is generally constructed on rangeland.

vi. **Khadin** it is the ancient indigenous rainwater harvesting method mainly found in jaisalmer district. Accumulation of runoff water in between hillocks is known as

khadin. Khadin means cultivation of crops in about 60–70 ha area. The khandi water is generally used for crop cultivation under preserved moisture conditions and animals consumption.

vii. **Sar, Sagar and Samand** in certain district of Thar Dessert sar, sagar and samand are used to harvest rainwater for irrigation purposes.

History of Salinization in India

A Thing to Remember No record of the rise of salinity irrigated tracts is documented with the development of canal irrigation from the era of sultan Feroz Shah Tughlak (1351-88) to the fall of the Mughal Empire (1857), despite the fact that people dug wells and built canals to supply water for crop production between 2000 and 6000 B.C. The salty patches in the soil are said to have developed as a result of canal irrigation. disappeared as soon as the canals ceased to be used. Irrigation is a mixed gift since salinity and water logging soon follow. In the past, all of these unusable regions were referred to as usar or ushtra, which indicate infertile or barren in Sanskrit. Usar fields were negatively impacted by dry weather or a lack of water. In the middle of the nineteenth century, geologists used the term "reh" to describe the appearance of salt efflorescence on the surface of lands that had been adversely affected by an excess of salts, neutral (NaCl) or alkali (NaHCO3, Na2CO3). Irrigated farming, which had been created in steep uplands, moved to lower river basins during the Chalcolithic era (c. 1300 B.C.). Canals were built, and floodwaters were held in reservoirs for valley irrigation. As a result, the Chalcolithic Period is also known as the Age of Irrigated Agriculture. At Kunal (Hisar, Haryana), archaeologists discovered a canal that was built during the pre-Harappan period (3000 B.C.). which, some 5000 years ago, was connected to the Saraswathi River. To give water to the crops, the peasants built canals and dug wells throughout the Vedic era (3700–2000 B.C.). There are references to soil erosion by rivers as well as irrigation using canals created from rivers. Being in Northern India, the Aryans had experience with ushara land, often known as "Alkali soil." Vennara and Arasil canals were built by the Chola King Karikalan (190 A.D.) and his successors. These canals branch out from the Cauveri River by channels carved out of dams, also known as anaicuts or dike [3].

Canal Irrigation in India

Sultan Feroz Shah Tughlak (1351–88), a forerunner in canal irrigation during the Middle Ages, took the initiative to start the construction of canal irrigation in the 14th century. Five canals were built during this time, with the Western Jamuna Canal being the most significant. When the canal was no longer in use after the collapse of the Mughal Empire in 1817, the salty patches in the soil that had formed under canal irrigation vanished. The Government of India selected Blane to revive the WJC, which took three years owing to a lack of funding. A natural channel and depression alignment of the ancient Munghal canal was followed, which led to the development of sizable marshes and considerable water logging. The Eastern Jamuna Canal (EJC), which was created by Ali Mardan Khan during the reign of Shah Jahan, was emerging from the river on its eastern side close to Naushera in Uttar Pradesh. Due to the waning influence of the Mughals, it was abandoned soon after construction began but reopened in January 1830. The East India Company's dominion over India ended with the construction of the Ganga canal. Military engineer Cautley suggested building a straight route from Hardwar to Roorkee in 1839. A sizable portion of Uttar Pradesh and the Punjab before partition were watered by the canal after its

opening in April 1854. Other canals built for famine protection include the Sirhind Canal in Punjab (1873–1882); the Lower Ganga Canal and the Betwa Canal in the North-West Provinces (1881–1893); and others. The Mutha Canal, Khadakwasa Dam, and Nira River Canals were constructed in the Bombay Presidency between 1869 and 1879.

Advancement in Irrigation Potential during 20th Century

When the benefits of canal irrigation in British India became apparent, interest arose for such projects in some princely states. The pioneer was the Mysore state that planed a Kannabadi Dam, later named the Krishna Raja Sagar Dam (after the ruler of Mysore, Krishna Raja Wadeyar II), constructed under confluence of three rivers, viz., the Kaveri, Hemavathi, and the Kakshmanatirtha. Two canals, namely, the north bank high-level canal (Visvesvaraya Canal) and the north bank low-level canal, took off from the reservoir. The Nizamsagar Project was another irrigation project executed by Government of Hyderabad (1924-1931). The project comprised of a dam across the river Manjira, a tributary of Godavari River. The Gang canal (1922–27), which takes off from the Sutlej River at the Ferozpore barrage on its left bank, was to irrigate land in the princely state of Bikaner. It was built with the initiative of Maharaja Ganga Singh (1880–1943) of Bikaner. The Sarda Canal Project in the United Provinces of Agra and Ouch was started in 1915 during the Viceroyalty of Lord Hardinge, and was completed in 1926. Government of India through Indian Council of Agriculture Research (ICAR) launched the All India Co-ordinated Scheme for studies on soil salinity and water management at different locations in 1968. It set up Central Soil Salinity Research Institute (CSSRI) at Karnal and Water Technology Centre at New Delhi in 1969. A part from these, another co-originated scheme on use of saline water in agriculture came in operation in 1972 at 5 centers in the state of Uttar Pradesh, Rajasthan, Karnataka, Andhra Pradesh and Maharashtra[4].

Plant Protection

Plant protection began when man attempted to understand ailments affecting crops. Crop plants are affected through ‘abiotic’ and ‘biotic’ disorders. Insects came on the agriculture scene more than 250 million years ago well before the human beings who appeared only about one million years age. The association of man with insects was well known to Indians who knew production of silk and lac in the days before 3870 B.C. The documents available on man’s efforts to protect crops are found in the Rigveda (c. 3700 B.C.), Krishi-Parashara (c. 100 B.C.), Sangam literature of Tamil (200 BC–100 A.D.), Agni-Purana (c. 400 A.D.) Varaha Mihiria’s Brhat-Samhita (c. 500 A.D.) Kashyapiyakrishisukti (c. 800-900 A.D.) Suprapala’s Vrikshayurveda (c. 1000 B.C.) Someshwera Deva’s Manasollasa (c. 1100 A.D.), Sarangadhara’s Upavanavinoda (c. 1300 A.D.), Tuzuk-e-Jahangiri (c.1600 A.D.) Dara, Shikoh’s Nuskha Dar Fanni–Falahat (c. 1650 A.D.) Jati Jaichand’s diary (1689–1714 A.D.) an anonymous Rajasthani manuscript (1877 A.D.) and Watt’s Dictionary of Economic Products of India (1889–1893 A.D.). Since the agriculture has a very long history of more than 10000 years its gradual development can be discussed briefly in the following periods for greater clarity: (i) The Ancient Period 10,000 B.C. to beginning of anno Domini (A.D.): (ii) The Medieval period beginning of A.D. to 18th Century A.D. and (iii) The Modern period –19th Century A.D. to date.

i. The Ancient Period

One of the major events in human history is the transition from hunting, gathering to agriculture. Susruta Samhita (400 B.C.) emphasized the importance of protecting seeds from white ants and

Kautilya (321–296 B.C.) was the first to suggest use of seed dressers for producing healthy plant stands. There is reference to algae and mushrooms in Rigveda only as saprophytes. In the Buddhist document Kallavagga (C. 100 B.C.) "mildew of paddy" and blight of sugarcane" is mentioned.

In Krishi-Parashara (Sadhale, 1999) we find that the plant protection in ancient days was not covered in depth, except for prayers to God Indra and other supernaturals. However there were several reference to the crop losses caused by insect pests. For example in the verse 126 it is stated "Commencing plowing on the 14th day of the month in any agriculture season was not shown as auspicious and met with several loss through insect pests". Also emphasized were the auspicious "lagnas" for initiating agriculture in a particular season such as Turus (21st April) based on the movement of the sun's entrance into the respective zodiac signs.

ii. The Medieval Period

The earliest specific reference to insects' pests is found in Krishi-Parashara. Rice pest, the gandhi bug (Leptocorisa varicornis F.) has been mentioned. Another word, pandarundi (White ear head) possibly implied rice stem borer (Trporyza incetulas walker) (Sadhale, 1999). Jahangir, the Mughal Emperor in India (1605–1627) in his memories described a disorder of marigold that could be ascribed today to species of Alternaria botrytis, or Sclerotia. The occurrence of melon fruit fly Dacus sp. during 1620 A.D. and the non-availability of control measures during that time were discussed (Nene, 1998). Jati Jaichand's diary (1658–1714) mentions possibly botrytis gray mould of chickpea and ear blight (Curvularia penniseti) of pearl millet (Javalia et al., 2001).

iii. Practices Using Inorganic and Organic Materials

It was Someshwara Deva (c. 1126 A.D.), a Chaluyka king, who suggested treatment of seed with ash, besides other materials to ensure good germination (Shamasastry, 1926): Use of ash however was suggested as far back as 120 B.C. by Varro a Roman encylopedist (Orlob, 1973), and was known to Tamils (Jeyarajan 1999). Dara Shikoh (Razia Akbar, 2000) mentioned the use of common salt solution for soaking fig cuttings prior to planting. Apparently, salt was used to disinfect cuttings. Unfortunately, concentration of salt solution was not mentioned[5], [6].

Nuskha Dar Fanni-Falahat (Razia Akbar, 2000) has many recommendations to project plant species from insects, fruit-drop, fruit cracking heat, and cold. These are:

a) Use of dung garlic, and pine oil should protect the cuttings from damage by some insects and pathogens. Burning of garlic was recommended for "expelling caterpillars" by the Roman author Palladius.

b) Resin application to roots has been recommended for preventing cracking of pomegranate is found in ancient literature.

c) Application of excreta of sheep, pig and donkey and human urine can at best keep the apple tree well-nourished which in turn perhaps keeps insect and diseases damage animals.

d) A practice that is still followed to protect melons from excessive heat or cold has been mentioned. Covering melon fruits earthen pots is a practice that small farmers can follow today.

DISCUSSION

Honey, mustard and licorice too possess antimicrobial properties cow dung which is unusually mixed with urine has antiseptic properties. In addition, cow dung can promote biological control. Milk could act as good sticker and may also promote biotical control of pathogens. In the 17th century, document of Dara Shikoh use of cow dung for smearing the cuttings of fig before planting is mentioned Garlic finds a mention especially for insects control In a 19th century document from Rajasthan, some interesting practices mentioned are: (1) use of foliar and soil applications of oil (sesame) to trees from frost and termites: (2) Sprinkling of curd (91) mixed with asadoetida on trees to prevent powdery mildew; and (3) use of Asafoetida exbelia ribes mixed with curd every 10 days to protect canker (or anthracnose of orange). Use of cow dung for dressing seeds, pasting cut ends of vegetative propagating units such as sugarcane setts, dressing wounds sprinkling diluted suspension on plants and applying to soil has been indicated since the time of Kautilya (c. 300 B.C.). Indian farmers continue to use cow dung in various ways but the agriculture scientists have ignored use for purpose other than use as manure[7]–[9].

CONCLUSION

The Kautilya's Arthasastra (about 300 B.C.), which describes how cut ends of sugarcane setts intended for planting were plastered with a combination of honey ghee, the fat from pigs, and cow dung, is likely the first source of information on the use of organic materials to prevent crop illnesses. Varahamihira recommended using cow dung and milk ghee to coat seeds and smoke them by smouldering animal meat or turmeric before planting. Along with stable minced meat, he also recommended sprinkling seeds with a mixture of cereal, legume, and sesame flowers. agricultural literature that covers topics including seed storage, crop protection, and the use of natural pesticides Neem leaves were often employed to keep storage insects and seed contamination at bay when seeds were being stored. Additionally, the application of coal ash to seeds prior to storage to prevent insect damage is mentioned. Sun drying of seeds to decrease moisture content was a typical practise throughout the Ancient Period for the control of insect pests, and pigeonpea seeds were no exception.

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CHAPTER 22

AN OVERVIEW OF THE PLANT PROTECTION

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ABSTRACT:

Plant protection products fall into a number of categories insecticides, acaricides, fungicides, nematicides, soil disinfectants, herbicides or plant growth regulators depending on their specific function. It undertakes all phytosanitary responsibilities for export of Agriculture commodities by providing technical inputs to get foreign market access, phytosanitary inspection, treatment, certification etc. to promote safe trade. The International Plant Protection Convention (IPPC) is a multilateral treaty overseen that aims to secure coordinated, effective action to prevent and to control the introduction and spread of pests of plants and plant products.

KEYWORDS:

Agriculture, Greenery, Plantation, Plant Protection.

INTRODUCTION

Man's quest to comprehend illnesses harming crops led to the development of plant protection. 'Abiotic' and 'biotic' problems have an impact on crop plants. Insects first originated in agriculture more than 250 million years ago, far earlier than humans, who just began to develop in the last million years. Indians who were familiar with the manufacturing of silk and lac in the era before 3870 B.C. were aware of the relationship between humans and insects. The Rigveda, Krishi-Parashara, Tamil Sangam literature, and Agni-Purana Varaha are among the texts that discuss man's attempts to safeguard crops. Brhat-Samhita Kashyapiyakrishisukti of Mihiria Vrikshayurveda of Suprapala Manasollasa of Someshwera Deva, Upavanavinoda of Sarangadhara, Tuzuk-e-Jahangiri Dara, and Nuskha of Shikoh The journal of Dar Fanni-Falahat Jati Jaichand, a secret Rajasthani manuscript, and Watt's Dictionary of Economic Products of India are all included. For clearer understanding, the slow evolution of agriculture during its more than 10,000-year history might be briefly addressed in the following time periods [1]:

i. The Ancient Period 10,000 B.C. to beginning of anno Domini

ii. The Medieval period beginning of A.D. to 18th Century A.D.

iii. The Modern period –19th Century A.D. to date.

a) The Ancient Period

One of the major events in human history is the transition from hunting, gathering to agriculture. Susruta Samhita emphasized the importance of protecting seeds from white ants and Kautilya was the first to suggest use of seed dressers for producing healthy plant stands. There is reference to algae and mushrooms in Rigveda only as saprophytes[2], [3]. In the Buddhist document

Kallavagga "mildew of paddy" and blight of sugarcane" is mentioned. In Krishi-Parashara we find that the plant protection in ancient days was not covered in depth, except for prayers to God Indra and other supernatural's. However, there were several references to the crop losses caused by insect pests. For example, in the verse 126 it is stated "Commencing plowing on the 14th day of the month in any agriculture season was not shown as auspicious and met with several loss through insect pests". Also emphasized were the auspicious "lagnas" for initiating agriculture in a particular season such as Turus based on the movement of the sun's entrance into the respective zodiac signs.

b) Use of Organic Materials

The Kautilya's Arthasastra, which describes how cut ends of sugarcane setts intended for planting were plastered with a combination of honey ghee, the fat from pigs, and cow dung, is likely the first text on the use of organic materials to treat crop problems. Varahamihira recommended using cow dung and milk ghee to coat seeds and smoke them by smouldering animal meat or turmeric before planting. Along with stable minced meat, he also recommended sprinkling seeds with a mixture of cereal, legume, and sesame flowers. agricultural literature that covers topics including seed storage, crop protection, and the use of natural pesticides Neem leaves were often employed to keep storage insects and seed contamination at bay when seeds were being stored. Additionally, the application of coal ash to seeds prior to storage to prevent insect damage is mentioned. Before storage became a regular practise in the Ancient Period for the control of insect pests, pigeonpea seeds were used as food.

c) The Medieval Period

The earliest specific reference to insects' pests is found in Krishi-Parashara. Rice pest, the gandhi bug has been mentioned. Another word, pandarundi possibly implied rice stem borer. Jahangir, the Mughal Emperor in India in his memories described a disorder of marigold that could be ascribed today to species of Alternaria botrytis, or Sclerotia. The occurrence of melon fruit fly Dacus sp. during 1620 A.D. and the non-availability of control measures during that time were discussed. Jati Jaichand's diary mentions possibly botrytis gray mould of chickpea and ear blight of pearl millet.

d) Practices Using Inorganic and Organic Materials

It was Someshwara Deva, a Chaluyka king, who suggested treatment of seed with ash, besides other materials to ensure good germination: Use of ash however was suggested as far back as 120 B.C. by Varro a Roman encylopedist , and was known to Tamils . Dara Shikoh mentioned the use of common salt solution for soaking fig cuttings prior to planting. Apparently, salt was used to disinfect cuttings. Unfortunately, concentration of salt solution was not mentioned. Nuskha Dar Fanni-Falahat has many recommendations to project plant species from insects, fruit-drop, fruit cracking heat, and cold. These are:

i. Use of dung garlic, and pine oil should protect the cuttings from damage by some insects and pathogens. Burning of garlic was recommended for "expelling caterpillars" by the Roman author Palladius.

ii. Resin application to roots has been recommended for preventing cracking of pomegranate is found in ancient literature.

iii. Application of excreta of sheep, pig and donkey and human urine can at best keep the apple tree well-nourished which in turn perhaps keeps insect and diseases damage animals.

iv. A practice that is still followed to protect melons from excessive heat or cold has been men- tioned. Covering melon fruits earthen pots is a practice that small farmers can follow today.

e) Fumigation

Diseases of cucurbits were controlled through smoking by burning the bones of cow and dog mixed the excreta of cat. For the control of insect pests several ancient recommendations.

i. Insects infesting trees could be removed by smoking a mixture of white mustard, black pepper, asafoetida, vidanga , vaca , and water mixed with beef horn of buffalo flesh or pigeonpea and the powder of bhillata [4].

ii. Sprinkling water mixed oil cake could control insects infesting creepers.

iii. Dusting cow dung ash and brick-dust could destroy leaf-eating insects.

Table 1. Illustrated the Information contained in Surapala's Vrikshayurveda, related to Kinds of Internal Disorders observed in Trees and Symptoms Attributes and Remedies Suggested.

Sr. No.	Symptoms	Caused elaborated	Possible causes
1.	Vata: Trunk slender and crooket, kots on trunk or leaves; hard fruits gradual defoliation flower and fruits	Arid land on account of excessive supply of dry and pungent substances	Underground mechanical barrier: leaf insects, root infecting fungi or nematodes virus's saline/ alkaline soils
2.	Pita: Leaf yellowing, premature drop/ strong decay of flowers and fruits	Occurrence at the end of summer if trees are excessively watered with bitter, sour salty and sore substances	Viral disease salinity in irrigation water. Predisposal to blossom blight and fruit decays due to fungal/bacterial infections
3.	Kafa: Fruit bearing delayed and fruits are tasteless and ripen prematurely oozing without wounds	Appears in water and spring if trees are excessively watered and spring if trees are excessively watered with sweet, oily sour or cold substances	Viral disease salinity in irrigation water. Predisposal to blossom blight and fruit decays due to fungal/bacterial infections Fungal gummosis/rot: nutrient deficiencies or toxicities: excessive watering

Honey, mustard and licorice too possess antimicrobial properties cow dung which is unusually mixed with urine has antiseptic properties. In addition, cow dung can promote biological control. Milk could act as good sticker and may also promote biotical control of pathogens. In the 17th century, document of Dara Shikoh use of cow dung for smearing the cuttings of fig before planting is mentioned Garlic finds a mention especially for insects control In a 19th century document from Rajasthan, some interesting practices mentioned are:

i. use of foliar and soil applications of oil to trees from frost and termites:

ii. Sprinkling of curd mixed with asadoetida on trees to prevent powdery mildew;

iii. use of Asafoetida exbelia ribes mixed with curd every 10 days to protect canker.

Use of cow dung for dressing seeds, pasting cut ends of vegetative propagating units such as sugarcane setts, dressing wounds sprinkling diluted suspension on plants and applying to soil has been indicated since the time of Kautilya. Indian farmers continue to use cow dung in various ways but the agriculture scientists have ignored use for purpose other than use as manure.

f) The Modern Period

A dictionary of economic products of India which include description of disorders of crops covering a period since 1820 and mentions several fungal diseases such as:

i. Ergots of barley oats, pearl millet and horse gram,

ii. Smut and rust of wheat,

iii. Leaf rot of coconut,

iv. Rust of barberry,

v. Rust

vi. Rust of mustard

vii. Late blight of potato

viii. Powdery and downy mildews of grape vine

ix. Root blight of tea

x. Bunt of wheat,

xi. Smut and rusts of barely and maize,

xii. False smut of paddy,

xiii. Blight of cotton

xiv. Cercospora leafspot of cotton in Madras

xv. Powdery mildew of indigo

xvi. Rust and smut of pearl millet in western united provinces

xvii. Mildew of black gram

xviii. Fingoid disease of betel vine in Bengal

xix. Whip smut of sugarcane

g) Pesticides

Mustard paste or suspension is known to possess antifungal, acaricidal, nematicidal, and insecticidal properties. The sprouting mustard seeds around the packed betel leaves would release a volatile anti- fungal gas.

h) Increased use of Animal Wastes for Manure

Kunapa, the liquid manure, is better for plants than the composts from plant residues. There is always a danger of passing on dormant pathogens to fields with plant-based composts. There should be no such danger with application of kunapa water. Also the animal wastes are likely to provide micro flora that might give better biocontrol of plant pests and disease than plant-based composts, and also attract predators of plant pests. From the volumes of the dictionary of the economic products of India by Watt , the available information on the practices followed in the 19th century India are[5]:

i. Application of cattle manure to pigeon pea to reduce frost damage;

ii. application of Calotropis gigantea for two years to reclaim soils with salts efflorescing;

iii. sanitation, Le., removal of all dead organic matter from the betel leaf sheds to prevent spread of diseases;

iv. reduction in betel vine disease by soil application of onion juice mixed with cow dung.

i) Relevance to Present Day Sustainable Agriculture

The present-day concept of integrated pest management is mainly oriented towards the eco-friendly approaches considering the human and animal's health and other profits. The use of botanicals and other safer chemicals. In fact this is not now and there was ample evidence that our ancestors had knowledge and experience and lived under healthier environments than the present situation. Though Indian agriculture in the modern age is making large strides of progress it is necessary to consider the treasure of ancient knowledge particularly the development and use of safer pesticides for the development of mankind.

j) Harvesting, Threshing and Storage

Riveda made reference to harvesting barely using sickles. Both cutting the crop down at ground level and removing the ear heads were used in the harvesting process. On the threshing floor, winnowing was done using a supa. Grain that had been cleaned was kept in bins, and waste was burnt. Making a flat threshing pit and installing a medhi, or threshing pillar, were both described in Krishi-Parashara. In order to acquire wood that is not too hard lest the grain be broken, the pillar's wood was procured from a tree that generates milky sap. Neem leaves and mustard were used to cure the pillar.

A wooden container called an adhaka with a 3.5 kilogramme capacity is mentioned by Parashara. The grain was kept in an area free of rodents, termites, and other pests. "Grain and other crops shall be collected as often as they are harvested crops," the Arthasastra of Kautilya declares.

When harvested, the crop must be piled high or arranged into turrets. The crop stacks must not be maintained close together. The threshing floors of several fields must be near together. Always beat the stalks on the ground or make the bullocks tread on them as you work in the fields to water them. Cleared paddy was gathered, measured, and properly stored. Millet heads were plucked using sickles and swords. Buffaloes were trained to stomp for threshing, or men would thresh the ears with their feed. Sicks were used to thresh the black gramme. Women made significant contributions to cleaning and threshing. ambanam was the name of a typical grain measurement container.

k) Post Harvest Storage Pest Management

The majority of farmers were observed to thresh their rice and maize by hand. Neem leaves, ash, salt, camphor, and other ingredients were often used, either alone or in combination, to protect food grains against pest infestation. Kerosene and ash, as well as onion, were often used for seed preservation. For the storage structure's plaster, some of the responders mixed neem paste, kerosene or the faces of sheep or goats with dirt. In both tribal and non-tribal regions, it was popular to use local methods of rat management, such as live traps, the keeping of dogs and cats, and the plastering of holes with ash, glass, and hair [6].

Gardening in Ancient and Medieval Period

In ancient times, gardens were a crucial component of home and community layout. Harappa's inhabitants were likely acquainted with the date palm, pomegranate, lemon, melon, and maybe the coconut, according to excavations. Numerous trees, including papal, Khadir, Shisham, Shimbalam, and palasa, are mentioned in the Rigveda. It seems sense that the Aryans of the Vedic era loved nature. They gave flowers the name sumansa, which means "that which pleases the mind," revealing their taste in aesthetics. Their gardens and very skilled gardening were reflections of these ideals. More than 30 different tree species are listed in the Artha Sastra as being common in woods, and all edible fruit trees are noted. Ashoka the Great promoted arboriculture. Plantain, mango, jackfruit, and grape trees were all frequently cultivated fruit plants. Jackfruit, coconut, date palm, arecanut, plantain, and tamarind are all mentioned in the Sangam literature. Many trees are mentioned in Agrnipurna, which also contains a separate PART on horticulture that served as the foundation for subsequent treatises. In his Brhat-Samhita, Varahimihira composed a PART on "tree treatment." One of the writings of Varahimihira that stands out is the detailed discussion of how to transplant plants such pomegranate, jack fruit, plantain, and jambu Kapittaha lemons. What is now referred to as "wedge grafting" was one of the grafting techniques that was described [7].

In subsequent eras, gardens remained a crucial component of the urban landscape. "Vrakshayur veda" is listed as one of the 64 kalas or arts that were revered in ancient India in Vats Ayana's Kamasutra. It involved the development and upkeep of gardens and parks for people's health, pleasure, and leisure. Pleasure gardens, gardens, and tanks are among the significant elements of a city that are listed in Jain canonical writings. Throughout the ancient era, gardens were still seen as a source of joy and happiness. Vrkshayurveda, an ancient text, states in its first verse: "He is indeed a monarch if his house has extensive gardens, spacious gardens containing large pools of water with lovely lotus blossoms over which humming bees fly... That may be regarded as the consummation of all happiness... intense pleasure to the mind." The issue is covered in some detail in the ancient literature. The Mahabharata gives a description of the recreation areas that surround Indraprastha. There are 500 gardens around Kapilavastu that were planned for

Prince Siddhartha, according to the Buddhist book Lalitavistara. The deity of horticulture in Indra's heaven is the holy Nandanakanan. For themselves, the ancient Indian monarchs created magnificent pleasure gardens. When writing about Chandragupta's palace, Megasthenes praised it, saying, "In the Indian royal palace... in the parks tame peacocks are kept and pheasants which are domesticated, there are shady groves and pasture grounds planted with trees,... while some trees are native to the soil, others are brought from other parts and with their beauty enhance the charm of the landscape." Many locations underwent the change from royal to public gardens during the early Buddhist era. Early Buddhist royal gardens included the Venuvana and Ambavana close to Rajagaha, the Mahavana close to Vaishali, the Nigrodharama close to Kapilavastu, and the Jetavana on the outskirts of Sravasti. These gardens were later made public and used as permanent retreats for monks of various orders. As a result, several monasteries developed gardens next to their monastery structures. In the ancient eras mentioned in the canonical text of the Jaina religion, horticulture was extensively established. The canons make reference to a variety of gardens. Arama, Sahasramravana, Agrodyana, Ashokavana, Gunashila Udyana, and Jeernodyana are a few examples. These gardens had a variety of trees, bushes, shrubs, and creepers, some of which produced fruit and others flowers. Aramas canopies draped in thick creepers kept the gardens shaded and gave the people who lived there a pleasant, comfortable environment.

DISCUSSION

We have a description of private gardens linked to a residence in Vatasayan's Kamasutra, which are undoubtedly of the wealthy and luxurious. It states: "Every home should have a vrksavatika or puspavatika, a garden where vegetables, fruit trees, and floral plants may flourish. In the centre, a well or tank of any size should be dug. The lady of the house was to be in charge of the garden and daily seed purchases of common culinary vegetables and medicinal herbs were to be made by her. Bowers and grape groves with elevated platforms for relaxation and pleasure were also planned for the area. On a location well-protected from the sun by a canopy of foliage, a swing was to be installed. She was to see to it that beds of plants that produce an abundance of flowers were laid out, with a focus on those with sweet fragrances, like the mallika and the navamalika, as well as those "that delight the eye, like the japa with its crimson glory or the kurantaka with its unfading yellow splendour. Additionally, there ought to be rows of shrubs like balaka and usirs that produce fragrant leaves or roots.

A stretch of water was an almost necessary component of the ancient garden, as it is in all hot climes. The constructed lakes, pools, and stairs that descend to them for swimming make up gardens. According to Kalidas, there was a summer residence erected in a cool location and encircled by fountains on all four sides named Samudragrha in the royal garden. The water machine, variyantra, was a further improvement for cooling the air during the hot season. According to Kalidasa's description, it seems to have been a kind of rotating spray, similar to the one used to irrigate lawns. Narrow drains with flowing water that had water fountains as their source were used to irrigate the landscape. The flower gardens and the circular ditch at the foot of the trees were constantly being flooded by water jets launched by water wheels. As was said previously, public gardens eventually appeared alongside the wealthy's private gardens. They were known as bahirupvana when they were located outside of the town. These were the townspeople's go-to vacation spots for picnics or udyanyatras. A group of well-dressed nagarakas would ride out of town to these gardens early in the morning, escorted by ganikas and followed by servants, to spend the day there, according to the Kamasutra[8].

CONCLUSION

Horticulture evolved as a subject and scientific knowledge was applied to the art of arbori-horticulture as gardens and parks became a significant background to the social life in ancient India. Evidence from the post-Vedic literature suggests that botany evolved into a separate discipline called Vrkshayurveda, upon which the sciences of medicine, agriculture, and horticulture were founded. The Upavanavinoda, a branch of Vrksayurveda, is a small section in Sarngadhara's encyclopaedic work, the Sarangadhara Paddhati of the 13th Century, which is a compilation of pertinent information from earlier classical sources. Despite the fact that there have not yet been any treatises on the topic of ancient horticulture as such. Additionally, management and upkeep procedures for parks and gardens were developed. There was a distinct agency in charge of taking care of the gardens and woodlands during the reign of Kautilya. One of the responsibilities of the forest officers was the maintenance of parks for the sake of public health and enjoyment. Numerous junior officers known as aramikas maintained order in the aramas or gardens. They worked under the direction of a supervisor named aramaprekshaka. Park caretakers lived in communities known as aramika Gama. The State supported certain groups of highly talented craftspeople. The Aramadhipatis, a unique class of accomplished artisans, gardeners, and weavers, Malakars and Malinis, are mentioned in Vatsayana's Kamasutra. Sometimes, gardens contained fruit trees in addition to flowering plants, which generated significant revenue for the government coffers. Ancient Indian gardening facilitated the connection of nature with daily life in urban places via design forms, procedures, and the fusion of scientific and aesthetic ideas.

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