# Agricultural Practices, Nature, Technology, and Texts

# In Medieval India

*A Thesis Submitted to the University of Hyderabad*
*in Partial Fulfillment of the Requirements for the Award of*

**DOCTOR OF PHILOSOPHY**
**IN**
**HISTORY**

**By**

**RANJITA BADASETH**
Registration No. 16SHPH08

Supervisor
**Prof. Sanjay Subodh**

हैदराबाद विश्वविद्यालय
University of Hyderabad

प्रतिष्ठित संस्थान
INSTITUTION OF EMINENCE
राष्ट्रीय अपेक्षाएँ, वैश्विक मानक
National Needs, Global Standards

**SCHOOL OF SOCIAL SCIENCES**
**UNIVERSITY OF HYDERABAD**
**HYDERABAD- 500046 (INDIA)**
**December 2022**

# DECLARATION

I, Ranjita Badaseth, hereby declare that the thesis entitled, **"Agricultural Practices, Nature, Technology, and Texts In Medieval India"** submitted by me under the supervision of **Prof. Sanjay Subodh,** School of Social Sciences, University of Hyderabad, is a bonafide research work which is also free from plagiarism. I also declare that it has not been submitted previously in part or in full to this University or any other University or Institution for the award of any degree or diploma. I hereby agree that my thesis can be deposited in Shodhganga/INFLIBNET.

A report on plagiarism statistics from the University Librarian is enclosed.

**Signature of the Candidate**

**Date:29/12/2022** **Ranjita Badaseth**

**Place: Hyderabad** **Reg. No. 16SHPH08**

# CERTIFICATE

This is to certify that the thesis entitled **"Agricultural Practices, Nature, Technology, and Texts In Medieval India"** submitted by **Ranjita Badaseth,** bearing **Reg. No. 16SHPH08** in partial fulfillment of the requirements for the award of the Degree of Doctor of Philosophy in the School of Social Sciences, is a bonafide work carried out by him under my supervision and guidance.

This thesis is free from plagiarism and has not been submitted previously in part or in full to this or any other University or Institution for the award of any degree or diploma.

A part of this thesis has been:

**A. Published in the following Publications:**

1. Ranjita Badaseth (2019). '**Agricultural Practice and Changes: A Study in Medieval India.**' UGC Care List Journal, *Think India Journal*, Vol. 22, Issue 14 December, 2019. ISSN No. 0971-1260.
2. Ranjita Badaseth (2022). '**Contemporary Sources Knowledge and Information: A Study of Agricultural Practice in Medieval Indian Society.'** UGC Care List Journal, *Shodhasamhita*, Vol. IX, Issue II July, 2022. ISSN No. 2277-7067.

**B. Presented in the following Conferences:**

1. Presented a Paper in the Indian History Congress Conference- 2019 on '**Agricultural Practice and changes: A Study in Medieval India.'** Organized by Kannur University, Kerala, 28th - 30th December, 2019.
2. Presented a Paper titled '**Agricultural Production in Mughal India: A Study of Nature, Crops, Society and Food Habits'** in the National Seminar "New Trends

and Approaches in Indian History" Conducted by P.G. Department of History Berhampur University, Berhampur, 16th March, 2022.

Further, the student has passed the following courses towards the fulfillment of the coursework during the M.Phil. June-December, 2015.

| Course Code | Name | Credits | Pass/Fail |
|---|---|---|---|
| 1. **HS701** | **Historiography** | **4** | **Pass** |
| 2. **HS 702** | **Historical Methods** | **4** | **Pass** |
| 3. **HS703** | **Seminar Course** | **4** | **Pass** |

**//Countersigned//**

**Supervisor** **Head of the Department** **Dean**
**School of Social Science**

**Date:**
**Place: Hyderabad**

# Acknowledgment

Firstly, I would like to express my sincere gratitude to my supervisor Prof. Sanjay Subodh for the continuous support of my Ph.D. study. His guidance and faith in my research topic helped me in the time of research and writing of this thesis. I could not have imagined having a better supervisor and mentor for my Ph.D. study.

I extend my sincere thanks to the head of the department for her continuous encouragement and motivation. I would also like to thank all my Doctoral Committee members and other faculty members in the department for their valuable suggestions and input in writing my thesis. Non-teaching staff of the department helped me in completing all the official paperwork on time, for which I am thankful to them.

I would especially like to thank Prof. Sandhya Rani Sahoo, Dr. Sidharth Satpathy, Sanjay Sir, Prasanth Bhai, Alexander Ekka Bhai, Joshi Bhai, Jitu, Pradeep Bhai, and Ajit Bhai, for their financial support to complete my Ph.D. Thesis.

I am grateful to have Dr. Prasanth Singh Bhai as one of my roommates at the university, who helped me in various ways starting from the editing work to financial and mental support. I also feel fortunate to have a friend like Nalin Ranjan Sharma, who also immensely supported me in drafting this thesis. Dr. Simpul Behera always supported me to complete this work. Like others, he also read this thesis again and again and gave valuable input.

I cannot imagine completing this research work without the support of my family members. Thank Dr. J.K. Parida sir, Subhasree madam and his family for their various support to complete this draft. Last but not least, I would also like to thank all my seniors, Pradeep Bhai, Pinku Bhai, Ramu Bhai, Abhaya, Samar, Mir, Dinesh, Suman, Priya, my other friends, and juniors, for helping me in various ways to complete this research work.

**Table of Content**

## Introduction

Man has been tilling the land since the beginning of time, and agriculture has traditionally been regarded as one of the noblest and most useful professions. Baron Liebig,[1] a well-known agricultural chemist states that, "there is no profession which can be compared in importance with that of agriculture, for to it belongs the production of food for man and for animals, on it depends the welfare and development of the whole human species, the riches of states, and all industry, manufacturing and commercial. There is no profession in which the application of correct principles is productive of more beneficial effects, or is of greater and more decided influence."[2] Now the moot question before us is that if we depend so much on agriculture then it is very important to have a proper knowledge on methods of agricultural production. H. A. Alford Nicholls says that in the country where peasants are familiar with "the art, the crops are large, the people are richer, and there is more general prosperity,"[3] in comparison to those countries where the peasants do not possess all this knowledge. Thus, knowledge of agriculture is a very important prerequisite for the cultivation of land. Prosperity of the country also depends on its agricultural production.

Indian agriculture has inherited sustainable practices; knowledge of agriculture in India passed from one generation to another. From ancient times, agriculture has been the main occupation of the people of India. In the other words, for Indian people, agriculture is not simply an occupation, rather we can say it is a way of life and main source of livelihood for many populations. It is the fundamental basis of the rural economy. Almost the entire population of rural India is associated with the land for earning their livelihood as they have no other sources of income. Up to 1990, agriculture played a vital role in the Indian economy. That's why our present day generation should need to understand our traditional agricultural practices and system of production. This will not only help us to build the

[1] Justus, Baron Von Liebig, famously known as Baron Liebig, was a "German Scientist who made major contributions to agricultural and biological chemistry, and is considered one of the principal founder of organic chemistry."

[2] H.A. Alford Nicholls, *A Text-Book of Tropical Agriculture*. New York, 1900, pp, 3-4.

[3] *Ibid*, p, 4.

future research and strategy, this will also enable us to understand the rich agricultural knowledge and practice which was in 'consonance with nature.' In terms of the application of modern tools and technology in agriculture and related industries, the country has made some progress. The problem arises when we use different modern mechanisms for getting extra surplus production without realizing its long term impact on our environment and without taking care of the problem related to sustainability of agriculture. The best example could be the excess use of chemical fertilizers, insecticides and exploitation of natural resources which damage the agro ecosystems, and damage the productivity of land. In this process our soil is getting impoverished; water, which is the main source of irrigation for agricultural production and air are also getting polluted. This also has caused the increasing erosion of genetic resources on the earth. Therefore, we need to shift our focus towards a sustainable form of agriculture. The medieval system of production provides insight into sustainable agriculture, because the system our Indian peasants followed during this period was 'environment friendly' in nature.

Agricultural production and income out of it accounted for the largest share in the state revenue during the medieval period. In this period of time, India had vast areas of land which were cultivated by the peasants living in the country.[4] European travellers who visited India during this time period reported that Indian peasants used agricultural production methods comparable to those used in Europe. The peasants grew traditional crops, but when they were introduced to new crops, they cultivated them with the same zeal. According to Abul Fazl, during Akbar's reign, each locality cultivated as many as 41 crops in a year.[5] The method of agricultural production since ancient times has been changing and it has changed according to the need. The Indian soil also helped the peasants in cultivating different types of crops such as food crops, cash crops, vegetables and spices. They were very familiar with various advanced techniques of growing crops of their times like double cropping, three crops harvesting, crop rotation, use of manures and range of

[4] Sanjay Subodh, 'Agricultural Methods and Environment in Mughal India: A Study of Manuring System,' *Asian Agri-History,* Vol. 2, No. 2, 1998, p, 121. Henceforth cited as Sanjay Subodh, Agricultural Methods.

[5] Abul Fazl, *Ain-i-Akbari,* Vol, II. Eng. Tr. H.S. Jarret, Calcutta, 1891, p, 86. Henceforth cited as *Ain-i- Akbari,* Vol, II.

devices for irrigation etc. In contrast, during the 19th century the debate around application of science being used in agriculture was a point of discussion in Europe. Jean Baptiste Boussingault laid the foundation of agricultural chemistry in 1834 and in 1845, Royal Agricultural College of London was established. The purpose was to teach the science of agriculture and other related sciences. Along with that, the practical application of these sciences to the cultivation of the soil and the rearing and management of livestock has been emphasized. The then British Government of India also wanted to apply the scientific experiment to Indian agriculture. Lord Mayo, the then Governor-General, wanted to establish a Department of Agriculture in each province with the direct supervision of a director. The primary objective was to bring agricultural reform in India and promote scientific farming. In 1880 the Famine Commission strongly recommended the necessity of establishing an Agricultural Department under a Director in each province to the Secretary of State. The Secretary of State also realized the importance of having a scientific ground-work as the basis of all attempts at agricultural improvement, and chemistry being the science that bore, perhaps, most directly on agriculture. Later the Secretary of State was asked to sanction the appointment of an Agricultural Chemist to act with the department. The selection of an expert was entrusted to Sir James Caird, who was one of the members of the famine Commission. On his advice, John Augustus Voelcker, an agricultural chemist of the Royal Agricultural Society of England, came to India in 1890 to join as an expert to report on Indian Agriculture. The purpose of his mission was first, the improvement of Indian agriculture by scientific means and second, the improvement of Indian agriculture in general. He suggested systematic prosecution of agricultural enquiry and agricultural education through research and teaching in India.[6] In 1892, Dr. J. W. Leather, another agricultural chemist, was appointed. Dr. Leather's appointment was not permanent, he was appointed only for five years. For Srabani Sen, Dr. Leather's appointment marked the beginning of agricultural chemistry and soil science research in India.[7] The credit also goes

[6] Deepak Kumar, 'Science in Agriculture: A Study in Victorian India,' *Asian Agri-History*, Vol. I, No.2, 1997, p, 81.

[7] Srabani Sen, 'Scientific Enquiry In Agriculture In Colonial India: A Historical Perspective,' *Indian Journal of History of Science,* 2010, p, 206. Henceforth cited as Srabani Sen, Scientific Enquire.

to Dr. Leather for initiating permanent manure experiments for critically evaluating soil productivity on a long-term basis.

The question that lies before us is what methods were adopted in the pre-colonial period and how scientific those methods were? The question is important from the view that pre-colonial India followed more or less the same method of production over a period of thousands of years. From *Arthashastra* to *Nuskha Dar Fanni-Falahat*, there does not seem to be much change in the methods, tools, and technology. However, it does not mean that the period did not undergo any kind of change. The introduction of new crops and grafting technology and improvement on variety of fruits bear the fact that the Indian peasants were not averse to new technology or change. The main research questions of the present study are: What were the methods, tools, and technologies used in medieval agricultural production? What were the different types of manures used in the medieval period and how was that in consonance with nature? Another research question would be how nature played an important role in crop production; whether cropping patterns decided the food habits of the people or food habits of the people determined the cropping patterns? What were the various sources of information which helped Indian peasants in agricultural production over a period of time? The last research question of the present study would be to see how cropping patterns changed post-19$^{th}$ century and what were the impacts of the green revolution in the field of Indian agriculture in the long run?

Most of the scholars have done extensive studies on medieval agriculture starting from the early medieval period to Mughal rule, which includes the system of production, land revenue system, tools, and technology used for agricultural production. The various contemporary texts starting from *Arthashastra* to *Nuskha Dar Fanni-Falahat*, speak about the use of different types of natural manure. Many scholars studied the Indian green revolution and its positive and negative impact on society. However, there is a dearth of studies on the use of different types of natural manure for agricultural production. The usages of night soil as natural manure, as well as its varied chemical compositions, were not given adequate consideration in previous studies. Emphasis was also not given to understand whether the medieval system of production was in 'consonance with nature' or

not? And no importance was given to understand whether the methods followed by Indian peasants during the medieval period were scientific in nature or not?

Therefore by using the existing research work on medieval agriculture as a background for my study, the broader objectives of this work would be to understand the medieval system of production through the realm of modern science. The work also tries to understand the use of different types of natural manures in the medieval period, its various chemical compositions, the relationship between soil and manure, and whether the medieval system of production was in 'consonance with nature' or not? The study's objective is to understand the role of nature in agricultural production and how cropping patterns affect food habits. As we all know, the knowledge of agriculture in India is passed on from one generation to another; however, specific contemporary texts prescribed certain rules and regulations for agricultural practice. The research aims to extract the knowledge described in those contemporary sources and determine whether or not the agricultural practices had changed through time. Another objective of the study is to analyze the post-19th-century changes in terms of cropping patterns and the impact of the green revolution and why are we going back to organic farming again?

"Kautilya's *Arthashastra*," an ancient text broadly discusses the function of state such as economy, politics, military strategy and how diplomacy of state should work. While dealing with the works of state bureaucracy, Kautilya talks about the superintendent of agriculture and his role and responsibilities. He says that the agricultural superintendent was the final authority, and had to decide which crops should be sown in what time, by taking consideration of the weather condition of that particular region. *Arthashastra* throws light on how and when different types of crops were produced in ancient times. The text divides all these crops into three categories; wet crops (*kedara*), winter crops (*haimana*), or summer crops (*graishmika*). References are also made on different types of vegetables, fruits and cash crops, which were produced in this period such as pumpkin, long pepper, grapes and sugarcane.[8] Kautilya's *Arthashastra* also explains how different types of lands could be used for producing different crops. In this context, the text mentions, "Lands that

[8] Kautilya, Arthashastra. Eng. Tr. & Ed. R. Shamasastry, *Kautilya's Arthashastra.*Wesleyan Mission Press, Mysore, 1929, p, 165. Henceforth cited as Kautilya's *Arthashastra*.

are beaten by foam (*phenaghatah, i.e.* banks of rivers, etc.) are suitable for growing *valliphala* (pumpkin, gourd and the like), lands that are frequently overflown by water (*parivahanta*) are suitable for growing long pepper, grapes (*mridvika*), and sugarcane, the vicinity of wells for vegetables and roots, low grounds (*hariniparyantah*) for green crops, and marginal furrows between any two rows of crops are suitable for the plantation of fragrant plants, medicinal herbs, cascus roots (*usinara*), *pindaluka* (lac)."[9]

Another text on ancient Indian agricultural science is written by sage Kashyapa, entitled, "*Kashyapiyakrishisukti*." In this text, Kashyapa divided his work into four major sections. First one is the orderly exposition of grain-agriculture. The second one is well-organized vegetable farming. Third one is the display of edibles and non-edibles foods. And the last one is an orderly presentation of facts about sacrificial offerings. In the first section, the text deals with division of land, where he speaks about the selection of proper pieces of farmland. Natural vegetation is one of the important factors to be considered, selection of land was based on scientific analysis of the soil. It is asserted to be the king's responsibility to get the whole land analyzed by experts and identify land and decide which land was suitable for what types of agricultural cultivation.

"*Krishi – Parashara* (Agriculture by Parashara)," primarily deals with agriculture. Scholars like Majumdar and Banerji (1960), Singh (1971), and Krishnamurthy (1992), provide the meaning of *Krishi-Parashara*. According to them, krishi means to plow or to cultivate and parashara is the title of the author and it had a long lineage, so it's determining the identity of the author, and the first member of the compound (Krishi) is also used several times in the text. The original text *Krishi-Parashara,* broadly explains all aspects related to agricultural production. The text speaks about the importance of agriculture and traditional methods of prediction of rainfall throughout the year. As we all know that agriculture in India largely depends on rainwater. The text talks about the management of agriculture, management of cattle, and the use of cow dung as natural manure and also about the plough and other implements, the ploughing, seed collection, and preservation. The text provides detailed descriptions of each part of the plough. Instructions were also provided in this text on how to make a plough. The text discusses different methods of farm

[9] Kautilya's *Arthashastra,* pp, 165-166.

operations like sowing, transplanting/planting, water retention, weeding, draining of water, plant protection, water harvest, and reed-fixing ceremony. The other agricultural methods like harvesting and storage are also discussed in detail. The text also narrates the importance of other methods like token harvest, threshing pillar, the Pushyayatra festival, harvesting and measuring yields, then storage of grains.

"Surapala's *Vrikshayurveda, (The Science of Plant Life)*" mainly deals with various topics related to the science of plant life. It describes procuring, preserving, and treating of seeds before planting, preparing pits for planting saplings, selection of soil, method of watering, nourishments, and fertilizers, plant diseases and plant protection from internal and external diseases, the layout of a garden, agricultural and horticultural wonders, groundwater resources, etc. The text also speaks about different types of soils, such as arid, marshy and ordinary as three types of land. Based on their colour and savor, soils are classified into six types, i.e., Black, white, pale, dark, red, and yellow, are the colours, and sweet, sour, salty, pungent, bitter, and astringent are the tastes. According to Surapala, arid and marshy land is unsuitable for agricultural production, whereas ordinary land can be used for agriculture. The text explains how various methods should be used for the sowing of seeds. Emphasis is also given to the use of different types of manures for different kinds of plants. The text also provides a detailed description of the preparation of various manures. It says, "The excreta, marrow, of the bones, flesh, brain, and blood of a boar mixed with water and stored underground is called *Kunapa*."[10]

"*Upavana-Vinoda A Sanskrit Treatise on Arbori-Horticulture*," mainly deals with horticultural aspects. This text talks about the glory of trees, good and evil omens relating to a residence near trees, selection of soil (for planting different types of trees), classification of plants, sowing of seeds, the process of planting, watering of plants (after planting), the rules for the protection of plants, *kunapa* water (recipe for a nutrient solution), treatment of plants in disease and health, botanical marvels and ascertainment of the price of things. On the basis of the nature of the soil, the text divides it into three broad

[10] Surapala, *Vrikshayurveda*, (The Science of Plant life), Eng. Tran. By Nalini Sadhale. Asian Agri-History Foundation, AP, India, 1996, p, 48. Henceforth cited as *Vrikshayurveda*.

categories, such as, Jangala,[11] Anupa[12] and Sadharana.[13] For sowing of seeds the text prescribed certain steps. It says, the seeds should be taken up in the palm greased with ghee and thrown into milk, on the day following the seeds should be taken out of the milk with greased fingers and the mass separated into single seeds. This process is to be repeated on ten successive days. Then the seeds are to be carefully rubbed with cow dung, and afterwards steamed in a vessel containing the flesh of hogs or deer. Then the seeds are to be sown with the flesh, with the fat of the hogs added in a soil previously prepared by being sown with sesame and dug added in a soil previously prepared by being sown with sesame and dug up or trodden down, and then to be sprinkled daily with water mixed with ksira.[14]

"*Krishi Gita (Agricultural Verses)*" is a treatise on indigenous farming practice of the Malayalam Desam (Kerala). This particular work primarily speaks about the system of agricultural production of Kerala, in the pre modern era. The text explains how different types of methods were adopted for different types of agricultural products in the pre-colonial period. Then the text also discusses different types of rituals performed before cultivation of the land.[15]

"*Nuskha Dar Fanni-Falahat.*" In this work, Dara Shikoh, speaks about the techniques and methods of agricultural production. He talks about the best season for planting different plants, suitable season for cultivation of fields, time of sowing seeds and protecting plants from insects. The text speaks about the different types of manures and their usages as, dung, salt, and nitre. The text recomends the use of pigs dung and sheep's blood in guava,

[11] Satis Chandra Seal. Eng. Tran. *Upavana Vinoda*, Calcutta. 1935, p, 9, says that, The region called Jangala is full of unobstructed open spaces, where a steady and dry wind blows, pervaded with expansive mirages, rivers and rivulets scarce, abounding in (artifical) wells (i.e. scarcity of water), also abounding in dry and rough sands and big sandy particles.

[12] *Ibid,* p, 10, writes, Anupa means, literally marshy, or swampy and water-plants littoral, or inland. Mostly abounding in rivers and bordered by seas, swept by cold wind, i.e., charged with abundant moisture.

[13] *Ibid,* p, 10, Sadharana means, the region which is endued with creepers, and plants and trees of both the classes, i.e., the Vanaspatis and Vanaspatyas, is called Sadharana.

[14] *Ibid,* p, 14.

[15] B Mohan Kumar. Eng. Tr. *"Krishi Gita (Agricultural Verses) a treatise on indigenous farming practice of the Malayalam Desam*" (Kerala). Asian Agri-History Foundation, 2008.

dry dung of pig in almonds, and cow dung in carrots cultivation.[16] Interestingly except one nitre, all the mentioned manures are organic in nature. The text reveals how grafting technology was used for grafting different varieties of fruits. Dara Shikoh also explains the methods of transplanting big trees which is very unique in nature, because this type of method is not mentioned in other contemporary sources.

The early 12th century historiography of medieval India mainly offers a sense of understanding about the political and military achievements of the rulers. Because most of the court historians, or the chroniclers of early medieval India were interested in recording the king's military and political achievements. The socioeconomic elements of the people received little attention.[17] However, many travellers and court historians began to document the people's socio-economic conditions later on. The modern day's medieval Indian historiography provides considerable emphasis on socio-economic history. The works of W.H. Moreland provide a broader understanding of the socio-economic history of medieval India. His first contribution came in the year (1904), with his work entitled "The Agriculture of the United Provinces." His second work was published in the year 1911, with the title of "The Revenue Administration of the United Provinces." This study covers the agricultural circumstances in the unified provinces from ancient times through the Mughals and the existing tax structure in the provinces. Gradually he published three major works which provided a broader understanding of the socio-economic conditions of medieval India in large and Mughal India in specific. The first work titled "India at the Death of Akbar" was published in 1920, second work titled "From Akbar to Aurangzeb: A Study in Moslem India." was published in 1923. The third one was published in 1929, titled "The Agrarian System of Moslem India." Moreland claims in his works that the agriculture

[16] Dara Shikoh, *Nuskha Dar Fanni-Falahat*: *The Art of Agriculture*, Asian Agri-History Foundation, 1994, p, 76. Henceforth cited as Dara Shikoh, *Nuskha Dar Fanni-Falahat.*

[17] W.H. Moreland, *The Agrarian System of Moslem India*, Allahabad, 1929, p, 26. Henceforth cited as W.H. Moreland, *The Agrarian System.* Moreland writes, "*Minhaj-ul Siraj,* the chronicler of Alauddin Khalji period, was an ecclesiastical jurist, who for long periods was at the head of the qazis of the kingdom; his chronicle shows no trace of interest in economic or social matters."

and revenue departments in medieval India were valued more highly since they were crucial in defining the state's socio-economic conditions.

Many scholars have addressed the study of the economic history of medieval India. Irfan Habib's work on Mughal India was first published in 1963 under the title "The Agrarian System of Mughal India 1556-1707." Radhakamal Mukherjee's "Economic History of India 1600-1800", H.K. Naqvi's (1968) "Urban Centres and Industries in Upper India 1556-1803", were some of the important works dealing with the economic history of India. Similarly, N.A. Siddiqui Worked on the "Land Revenue Administration under the Mughals." H.K. Naqvi's (1971) another work deals with "Urbanization and Urban Centres Under the Great Mughals" along with A.I. Chicherov's (1971) "India: Economic Development in the $16^{th}$-$18^{th}$ Centuries". S. Nurul Hasan contributed his work on medieval agriculture, published in the year 1971, titled "Agrarian Relations in Mughal India" and Jagdish Narayan Sarkar, (1975) "Studies in Economic Life in Mughal India." Both Tapan Raychaudhuri and Irfan Habib, (1982) edited volume titled "The Cambridge Economic History of India Vol. I. 1200-1750" broadly focused on the socio-economic conditions of medieval India. Satish Chandra's (1982) work on medieval India broadly deals with the political, social, and economic aspects. Some of his well-known works are "Medieval India: Society, the Jagirdari Crisis and the Village". H.K. Naqvi (1986), another work entitled, "Agricultural, Industrial and Urban Dynamism Under the Sultans of Delhi 1206-1555." Shireen Moosvi, (1987), "The Economy of the Mughal Empire c. 1595, A Statistical Study." Satish Chandra, "Essays in Medieval Indian Economic History." (1987). Jagdish Narayan Sarkar (1991), "Mughal Economic Policy of the Sultans of Delhi." Tripta Verma, (1994), "Karkhanas Under the Mughals From Akbar to Aurangzeb: A Study in Economic Development." Satish Chandra (1997), "Medieval India: From Sultanate to the Mughals: Part one Delhi Sultanate (1206-1526)." Sanjay Subrahmanyam, ed., "Money and Market in India 1100-1700" published in (1998). Satish Chandra, (1999) published another work, "Medieval India: From Sultanate to the Mughals: Part II-Mughal Empire (1526-1748)." Irfan Habib (2001), "The Economic History of Medieval India: A Survey." And another work of Irfan Habib published with the title, "Technology in Medieval India c. 650-1750," in (2008). Apart from that, there are some articles which deal with the socio-economic history of medieval India like, Shireen Moosvi's (1983), work "The Economy of Gujrat c.

1600 - The Ain's Statistics." A.J. Qausar (1992), "Agricultural Technology Depicted in Mughal Paintings." Sanjay Subodh (1998), "Agricultural Method and Environment in Mughal India: A Study of Manuring System." Ranbir Chakrabarti (2008), "Agricultural Technology in Early Medieval India (c. A.D. 500-1300)." All these above-mentioned scholars contributed significantly to the study of medieval socio-economic history. Like this, several other scholars largely contributed their academic expertise to studying Indian agriculture in general and medieval agriculture in particular. Some of the scholarly works dealing with various aspects of agriculture are discussed below.

Campbell Morfit in his (1848) work "*Manures, The Farmers Guide and Field Companion*" discusses the advantage of use of cow dung as manure for agricultural production. He argues that the preparation of cow dung as a manure is very easy in comparison to others. He provides the various chemical compositions of cow dung. He says, when cow dung is in a dry state it "contains 2.6 percent of nitrogen, and in the moist stage it contains only 0.36 percent."[18] He also analyzes the use of human excrements as manure and he finds that human excrements constitute one of the most energetic manures. In this work, he explains how Chinese people used human excrement in agricultural production. After carefully examining all its chemical composition he recommends its use as manure.[19]

After travelling to different regions of India and meeting the representatives of all the provinces, Dr. Voelcker (1893) drafted a report titled "*Improvement of Indian Agriculture*"[20] where he pointed out that the lack of facilities in the field of agricultural research and training was the most responsible factor for the underdevelopment of Indian agriculture. Like other scholars, Voelcker did not state Indian agriculture as primitive and backward rather he blamed the existing system of agriculture in India. Dr. Voelcker in his report made a recommendation to establish an agricultural research institute to promote scientific farming. Lord Curzon, the then governor-general of India considered the

[18] Campbell Morfit, *Manures, The Farmers Guide and Field Companion*, Philadelphia, 1848, p, 38.

[19] *Ibid*, p, 42.

[20] J.A. Voelcker, *Report on the Improvement of Indian Agriculture*, London, 1893. Henceforth cited as J.A. Voelcker, *Report on Indian agriculture*.

recommendations of Dr. Voelcker and later established the Imperial Agricultural Research Institute at Pusa-Bihar in 1905 which is now situated in New Delhi.

H.A. Alford Nicholls, (1900) in his work "*A Text-Book of Tropical Agriculture*" explains the meaning of agriculture. Agriculture, according to him, is a compound word formed from two Latin words such as "ager and cultura", where ager refers to a field and cultura refers to soil cultivation. Agriculture, on the other hand, can refer to more than two Latin words in various languages. Agriculture in the contemporary sense refers to the art of cultivating or tilling the soil in order to produce the highest quality agricultural products for human and domesticated animal consumption.

J Mollison's (1901) work "*A Text Book on Indian Agriculture*" talks about the nature of Indian agriculture. His emphasis was to understand Indian soils that played an important role in the agricultural products. In his work he made an extensive study on the nature of Indian soils, and divides it into different categories. The work also tried to study the various chemical composition of soils, and usages of verities of manure. He strongly advocated the peasants to judiciously use different types of manure as per the requirement of the cropping pattern. He argued that peasants should use organic manure. He recommended the use of cow dung as natural manure for agricultural production and other farmyard manure as well.

James C. Scott, in his (1907) work "*Against the Grain, a Deep History of the Earliest States*" narrated the transitions of human history, being hunter-gatherers to settled agriculture cultivators. Scott highlighted the early states' formation and their agricultural practice in Mesopotamia and other regions. For him, the early state itself was not stable because of the regular natural calamities i.e. floods in Mesopotamia, Egypt, and China. It was not supporting people to survive long in one place and practice. The reasons he mentioned are the war, high epidemics, or under nomadic groups that foraged in forests, hills, waters, or grasslands. He further argues that "these nomads may themselves practice widen or shifting cultivation, grow root vegetables, which since they do not mature synchronously make it difficult for the state to extract taxes. Agriculture therefore

coexisted with nomadic lifestyles where the metronome of daily life was quite different from a permanent domus."[21]

J. Alan Murray's "*Soils and Manures*" deals with the various compositions of soils, different stages of soil formation, and classification of soils. J. A. Murray argues that the most difficult task for a farmer is to maintain the natural vegetation of the soil, because natural vegetation of the soil determines the growth of crops. For Murray soil is the natural habitat of plants. The work offers the general definition of manure, classification of manures etc. Then the work also shed lights on use of different types of manure for different crops. After carrying out a lot of experiments on the ground, J.A. Murray strongly advocated to use farmyard manure for agricultural production. Manure should be used as per the natural requirement of the soil. He provides a detailed description of the chemical compositions of farmyard manure.

John Donaldson (1911) in his book "*Soils and Manures, the important of land and the rotation of crops*," explained the different types of manures. He divided manures in three broad categories. First the animal, second the vegetable, and the third one is the mineral. He says, "The first division comprehends those substances that are derived from animals, either in the shape of excrements or from their dead bodies. Then the second one includes the vegetables so applied, either singly or mixed, and the last one contains the minerals, fossils, earths, or earthy substances, used in the original state, or mixed with other materials."[22] However he did not include farmyard manure in these three categories. But he argues farmyard manure can be placed in the mixed manure category. And for him this is the widely used manure. For him "Farm-Yard Dung is composed of the culms or straws of the different grains that are used for food and litter, and the excrements of the domestic animals, the horse and the dog, the ox and the cow, and the poultry-yard."[23] While analyzing the quality of the farm-yard dung he reveals, the quality of the dung depends on the quality of the food that a particular animal consumed. Why is cow dung widely used as

[21] James C. Scott, *Against the Grain, A Deep History of the Earliest States*, London, 1907.

[22] John Donaldson, *Soils and Manures, The Improvement of Land and the Rotation of Crops*, London, 1911, p, 52.

[23] *Ibid,* pp 52-53.

farm-yard manure? Here he says, it is used because "the dung of cattle contains better soluble water and gives in fermentation nearly the same products as vegetables, absorbing oxygen, and producing carbonic gas."[24]

E.J. Russell's (1921) work "*A Student's Book on Soils and Manures,*" offers the basic fundamental understanding of agriculture, the relationship between nature and agriculture, and how it changes from country to country and region to region. The work also explains why farmers need a basic knowledge of soils. E.J. Russell argues that in agricultural farming soils played a very vital role, so it is very essential for farmers to understand various chemical compositions of soils. Because the chemical, physical, and biological compositions are involved in the growth of plants in the soil. So being a farmer one should have the essential ability to read this soil composition while ploughing his land. Then the work also offers how manures can be used for agricultural production and the relationship between soils and manure. Russell says the nature of soils varies from one region to another and the requirement of the soils also varies, so the use of manure also varies from soil to soil. So as a farmer, one should understand this fundamental difference.

Seedick R. Sayani's "*Agricultural Industries in India*," mainly concentrates on how Indian agricultural industries developed over a period of time and how the adoption of new scientific methods helped to improve Indian agricultural industries and production. According to him, the possibility of scientific methods of agriculture lies in three directions. The first one is the increased output of staple crops already being grown in India with the assistance of suitable manures, better implements, attention to the proper rotation of crops, selection and cultivation of best seeds. The second one is the commercial use of plants already growing in the country, but not utilized through ignorance or any other cause. The third one is the introduction of new plants like ramie, which hold out possibilities. He also advocates some other measures for agricultural development. These are namely, the introduction of subsidiary industries, like sericulture. He divided manure into three broad categories. The first one is Farm-yard manures. The second one is the application of green manures, and the third one is artificial manures. Like others, he also

[24]*Ibid*, p 53.

suggested the maximum use of cow dung as natural manure. He believes that, for achieving the increase of average output per acre, suitable manures are the most important.

R. Gangopadhyaya's (1932) work "*Some Materials for the Study of Agriculture and Agriculturists in Ancient India,*" analyses the agricultural practices during ancient India by taking various contemporary sources such as Kautilya Arthasastra, Krishi Parasara, and so on. He argues that, when Kautilya Arthasastra was composed, agriculture became an essential department of the government under the charge of a special officer well-versed on the subject and attained a stage of perfection astonishing for the age. The Arthasastra, though essentially a treatise on royal polity and art of government, deals with agriculture under an important sub-head of *Krsi-tantra.* The text like Brhat Samhita and the Puranas, the Agnipurana particularly, incidentally deal with "plant physiology, selection of soil, manuring, cultivation under favorable meteorological conditions, collection and treatment of seeds, sowing, planting, cutting, grafting, nursing and reaping."[25] Much of the art of cultivation as it existed in ancient days can also be gleaned from a hand book written by Parasara bearing the title of *Krsi-samgraha.* These small treaties supplemented with Khana's maxims, throws a flood of light on the perfection attained in the art of agriculture in ancient India.[26]

Margaret Mead's (1943) work "*The Factor of Food Habits,*" reveals how geographical and social factors affect the food habits of American people. Mead argues that food habits are an aspect of individual behaviour. It can be subjected to change in society characteristically selected out by parents, teachers, physicians, physical trainers, and others. These people of the society to be commented upon in terms of change. The article also deals with how people change their food habit due to some of the unavoidable factors, such as, "changes dictated by physical circumstances, changes dictated by a lowering of the economic status

[25] R. Gangopadhyaya, *Some Materials for the Study of Agriculture and Agriculturists in Ancient India.* N.C. Mukherjee, Serampore, 1932, p, 4.

[26] *Ibid,* pp, 4-5.

of the individual, the group, or the nation, and changes dictated by alternation in the bodily state of the individual."[27]

K.M. Ashraf (1959) in his work "*Life and Conditions of the People of Hindustan*," discusses the condition of Indian peasants during Delhi Sultanate rule. He also attempted to throw some light on the various steps that were taken by the Delhi Sultanate to develop agriculture. He says that, "As a result of canal irrigation introduced under Firuz Shah Tughluq, the area round Hissar and Firuzabad added to the existing cultivation of sesame and pulses the culture of wheat and sugarcane."[28] He believes that the system of production which was followed during the medieval period was more or less the same in the present time. Rice, wheat, barley, pulses, millet, peas, sesame, and oilseeds, sugarcane and cotton were the chief crops produced in this time. Medicinal herbs, spices, and fragrant woods were also grown in vast quantities and sold in India and abroad. He also argued that the Sultans of Delhi and other rulers appear to have taken pains to improve the quality of Indian fruits and the system of gardening as a whole.[29] Firuz Tughluq created 1,200 gardens in and around Delhi, including eighty on the Salora embankment and forty-four near Chitor. Various types of fruits were produced during this time period. Mango, grape varieties, dates, pomegranates, plantains, Indian melons, peaches, apples, oranges, grapefruit, figs, lemons, karna, jhong, khirnee, jaman, jackfruits, and cocoanuts are just a few examples. Among these entire fruits mango was considered as the best fruit of the period under review.[30]

Irfan Habib in his (1963) book titled, "*The Agrarian System of Mughal India 1556-1707*" concentrates on the medieval system of agricultural production during Mughal rule. He traces the total area of cultivated land under the Mughals. In this work he tried to provide a full description of medieval agricultural practices such as, the system of production, use of various agricultural technologies, methods of irrigation, a crop rotation system, use of

[27] Margaret Mead. 'The Factor of Food Habits.' *American Academy of Political and Social Science*. Vol. 225 Sage, January, 1943.

[28] K M Ashraf, *Life and Conditions of the People of Hindustan*. New Delhi, 1959, p, 118.

[29] *Ibid*, p, 119.

[30] *Ibid*, p, 119.

manure, land tax, and so on and so forth. He also informs about the various new crops introduced during Mughal's rule in India such as tobacco and maize. The work also talks about the measures that were undertaken by the Mughal rulers for the improvement of agriculture.

Irfan Habib's (1980) another work "*The Technology and Economy of Mughal India*," dealt with how Indian people responded to new technology during Mughal rule. Were there any changes in medieval technology? While discussing the agricultural practices and use of technology and new technological addition in this field, he argues that dibbling, or pouring seeds into holes dug into the ground with a stick, was an early seventeenth-century agricultural practice. For Habib, the new addition of the Persian wheel was another crucial technological change in the field of medieval agriculture. Apart from that, he tells us that during the seventeenth century, a number of new crops were introduced in India. And our peasants produced it with the same zest and zeal as other crops. Tobacco production was the best example. During the 16th century, tobacco cultivation was introduced on the western coast. Later on, by 1650, it was being cultivated in almost every part of the Mughal Empire. He also argues that the 17$^{th}$ century was also a period of innovation and significant changes in horticultural practices. Pineapple was introduced from the western hemisphere. The period also saw the extensive application of grafting. Habib states that grafting is not just individual practice but comprehends a number of different methods. The methods included are tongue grafting, side, crown, deft, saddle and root grafting, and veneering, inarching, and inlaying. By applying these different types of grafting methods, Indian peasants could produce high-quality fruits. Production of apricots, mulberry production in Kashmir, production of different varieties of oranges, and production of Alfonso mango were some of the best examples.

M.S. Randhawa also made a contribution to the study of Indian agriculture by publishing a number of volumes. From the year (1980-86) he published four major volumes under the title "*A History of Agriculture in India, Vol. I, II, III, & IV*." The first volume examines the evolution of Indian agriculture during the Ancient period. He begins his work in this first volume by outlining the nature of Indian soils and how climate varies from region to region, and how it has influenced Indian agriculture. Furthermore, this volume

addresses how Indian agriculture evolved over a period of time and how ancient emperors helped to improve agriculture. His second volume deals with the agricultural practice in the medieval period, where he talked about the method of cultivation starting from the Delhi Sultanate rule to the Mughals. The particular volume also discussed the different types of crops, fruits, and vegetables produced in medieval India. In his second volume, he also discusses the introduction of various new crops to India. The third volume explained how scientific development and new experiments and research in the field of agriculture in European countries influenced Indian agriculture. During British rule, all these scientific experiments in the field of agriculture were also introduced to India. The then East India Company and the British government established new farms and gardens and appointed new agricultural experts to examine Indian agriculture. Various types of experiments were carried out on these farms, and new cash crops were introduced in India. In this third volume, he also explained the other initiatives undertaken by the British Government to improve Indian agriculture, such as opening new agricultural research institutes and universities, spreading agricultural education, and allowing scientists to carry out research work on developing new high-yielding crops. In the last volume (volume IV), M.S. Randhawa shows how Independent India took various measures to improve Indian agriculture and was able to achieve remarkable success in the field of surplus food production. This volume also looks at how India achieved a green revolution in three different areas such as wheat, rice, millets, and maize production, which helped India produce large amounts of food grains for its largely growing population.

Irfan Habib's (1982) work, "*The Peasants in Indian History*," provides a broader understanding of the evolution of peasants history in India. He says that the scholars like D.D. Kosambi and R.S. Sharma, along with Daniel Thorner, were the first to bring peasants into the study of Indian history. According to Habib the definition of peasant means "a person who undertakes agriculture on his own, working with his own implements and using the labour of his family."[31] Then he discusses the different types of peasants as per their economic status in society, such as the rich, middle, and poor peasants. Then the work

[31] Irfan Habib, 'The Peasant in Indian History,' *Proceedings of the Indian History Congress*, 1982, Vol. 43, pp, 3-4.

explained the historical evolution of the Indian peasantry, where he says that the concept of the presence of peasantry as a social class developed in the Indus (Harappan) civilization. Because this was the period where we found full fledged agricultural production. The Indus people produced both food crops and cash crops. Crops like wheat, barley, rice, bajra, millet, and pulses were some of the dominant food crops, whereas cotton was known to be the major cash crop produced in this period. He writes, "The Indus culture not only gave India its first cities in Harappa and Mohenjodaro, but also its first peasantry."[32] In this paper, he critically analyses the various historical stages in which the caste-based peasantry has emerged in India. He found that in India, peasants were always placed in the lower strata of the caste system. While addressing the medieval peasantry, he asked some fundamental questions, like, whether there developed any internal factors for change in the mode of peasant production and structure of the village community. Then he argues that agricultural technology, the use of new tools and methods of production, like grafting technology, and the introduction of new crops in the 17th century played an essential role in the lives of the medieval peasantry. He further says that all these new changes have not made any impact on the basic fundamental and social relationships within the village. The example he cited was the Indian caste system. According to Habib, the new medieval Islam rule could not change the Indian caste system. The peasants' relations with other elements of the rural population also remained unaltered. The work also deals with how the medieval land tax system pressured all the rural classes. Habib explained how the peasants in medieval times were forced to pay land tax. If the peasant failed to pay the land tax, they would become subject to raids and enslavement by the King's troops. He argues that a triangular relationship was developed during the medieval period between the peasantry, the *zamindars*, and the ruling class. This work also highlights the number of peasant uprisings starting from the Delhi Sultanate rule to the 18th century. Habib talked about the various causes responsible for the peasant revolts, and its consequences on society's social, political, and economic spheres. He concludes, "The peasantry's first steps

[32] *Ibid*, p, 6.

towards the attainment of its self-awareness is an achievement of the National Movement, for whose success the peasants were so largely responsible."[33]

Ahsan Jan Qaisar (1982), in his book titled "*Indian Response to European Technology*," examines how the European invasion of India during the 16th and 17th centuries affected the existing technological and cultural sectors. He also discusses various debates which argue that Indian society is static and the technology of Indians is not advanced in nature. A.J. Qaisar's work broadly explains how the European invasion influenced different fields like shipping technology, military technology, painting, etc. However, he did not discuss agricultural technology. So one possible reason could be that Indian agricultural technology was not affected by the European invasion, or the technology which was used in European countries had some similarities with ours. In his concluding remarks, he states that Indian people were well advanced in using different types of technologies. So it is possibly not correct to get into the perception of the backwardness of the Indian people in adopting new technology. This was the same in the case of Indian peasants' use of new technology in the field of agriculture. Our Indian peasants never hesitate to adopt new technology when it fulfills all their needs and requirements.[34]

While comparing the agricultural production cycle of north and south India, L.B. Alaev, in his work, "*The System of Agricultural Production in South India*," argues that, like north

[33] *Ibid*, p, 37.

[34] Ahsan Jan Qaisar, *Indian Response to European Technology*, 1982. He also published another article in 1992, title, "Agricultural Technology Depicted in Mughal Paintings," discusses the different types of agricultural technology portrayed in the Mughal paintings. He identified each and every technology used in the field of agriculture and explained how they were used in different regions. Generally, the perception of the plough and ploughing varies in size because the Indian soil differs from place to place. However he found only one type of light ploughs in all Mughal paintings. Further he extensively talks about the use of different types of water lifting devices and its evolution over a period of time. Apart from that, Qaisar's work also shades light on other agricultural technology which were depicted in the Mughal paintings such as, harvesting, threshing and winnowing. He also argues that paintings can be used as primary sources for research work and to make this work more reliable one should use other literary sources for elaboration, corroboration or for further information. He says that to understand the continuity and change in medieval agricultural technology one should visit fields, which will provide certain local terms that are not always mentioned in the literary sources.

India, south India doesn't have two agricultural seasons i.e., *kharif* and *rabi.* By taking some of the agricultural production of south India he states that in North Arcot, dry crops such as, (kumbu, red gram, horse gram, and castor) were sown from May to September-October and these crops were harvested during the month of August to December – January.[35] In the month of August to September *ragi* and *cholam* were generally produced in the wetlands, and in between February to March the paddy crop was harvested. It was found that some of the paddy crops used to stand in the land from the months of June – July up to December – January. And the next paddy crop was standing from January – February up to April – May. Then he argued that the third category of land was used throughout the year for indigo, sugarcane, and saffron cultivation, and sometimes the same land was under crop for three years in which peasants grew various cash crops like, betel vines, and various economical plants. There were some other lands in which two crops were raised in a year, i.e. pulses and grains by applying the crop rotation system.

Shireen Moosvi (1987), work titled, "*The Economy of The Mughal Empire c. 1595 A Statistical Study*," broadly dealt with the late 16th centuries economic system of the Mughal Empire. Emphasis was given to study the statistical data provided in the *Ain-i-Akbari.* While dealing with the agricultural production of crops and yields she made a comparative study of the crops and yields of the Mughal period with the crops and yields produced in the nineteenth century. In her study she found a steady increase of wheat production in the western UP, whereas she found a sharp fall in the Jowar production of the same area. The work also discusses other food crops produced in the Mughal Empire. Apart from that, the work also focused on the land revenue collection of the Mughal Empire, urbanization, money economy, both local and foreign trade and population of the Mughal Empire.[36]

---

[35] Tapan Raychaudhuri & Irfan Habib, Ed. *Cambridge Economic History of India,* Vol. I, Hyderabad, Orient Longman, 1982, p, 217. Henceforth cited as Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History,* Vol. I.

[36] Shireen Moosvi, *The Economy of The Mughal Empire c. 1595 A Statistical Study,* 1987. She has also published another work, The Economy of Gujrat, c. 1600- The Ain's Statistics, *Indian History Congress,* 1983, Vol. 44. In this work she explains how natural rainfall played a crucial role in agricultural production and revenue collection. On the basis of total rainfall she divided Gujrat in three broad regions such as, low rainfall region, moderate rainfall region and high rainfall region. The entire eastern tract such as Sorath and

Gerald E. Wickens, N. Haq and Peter R. Day, (1989) Ed. "*New Crops for Food and Industry*," looks at how introduction of new crops has made the change in society in terms of its adaptability by the producing class. Then the work analyzed how different strategies were made to sell these new crops in the market with a better price and the work also tried to understand the consumers reaction towards these new food crops. The introduction of a number of new plants and application of new methods, tools and technology also discussed. They studied the major relationship and differences between the food industry and agriculture. For them, "A major difference between agriculture and industry is that, in agriculture a farmer cannot move his major means of production, such as land, internationally. Whereas in industry you can move your activity internationally to the most optional location. Therefore farmers think rationally. In years to come even farming may have to move and think internationally."[37]

K.T. Achaya, (1994) in "*Indian Food A Historical Companion*," explains how food habits evolved over a period of time. He argues that in the first stage of human evolution, fruits were the dominant diet of human beings, then meat dominated the diet, and as agricultural skills improved, agricultural products started dominating the main diet. In his work K.T. Achaya tried to provide a food history of India, starting from its antiquity to modern times. This work discusses the regional variation of the food habits of the people. Then he also discusses how food habits of North Indian people are different from South Indian people.[38]

Irfan Habib (1995) published another work titled "*Essays in Indian History: Towards a Marxist Perception.*" This work brings together articles written by Irfan Habib over the last thirty years. The scope of the work is vast; topics range from the origins of the doctrine of

---

some parts of the Patan and Ahmadabad Sarkar come under the first category (i.e. low rainfall areas). The central and southern parts of Ahmedabad, Baroda and Broach Sarkar come under the second category (i.e. moderate rainfall area between 30" and 40"). Whereas the southern and western region including the whole Sarkar of Surat comes under the third category (i.e. high rainfall area above 40"). She argues that the regions which come under moderate rainfall produce cotton and those are the most fertile land of Gujrat, and it generates large revenue. On the other hand the revenue from the low and high rainfall regions differs from 13 to 16 *dams* per *bigha* of *arazi* land.

[37] G.E. Wickens, N. Haq and P. Day, Ed. *New Crops for Food and Industry*, London, 1989, p, 13.

[38] K.T. Achaya, *Indian Food A Historical Companion,* Delhi, 1994, p, 1.

*ahimsa* (nonviolence) mentioned in ancient Indian religious scripture to the discussion of the sources of finance for the British Industrial Revolution. The unifying theme is the effort to understand Indian history from a Marxist perspective. In other words the work tried to critically understand Marx's early writing on Indian history with limited evidence and how Marx's perceptions towards Indian history changed over a period of time. According to Habib, the Mughal Empire was highly centralized; the structure of government was determined by the need to collect land tax, which was the primary source of income. This tax, which could be as large as one-half of the output, was typically collected in cash, which forced peasants to sell some of their production. The commercialization of agriculture was driven by this need to pay land revenue in cash rather than by profit opportunities for the peasant. He argued that these land revenues financed the lifestyle of the ruling elite, and urban manufacturing centers developed to meet their demand for textiles, huge military expenditure for the maintenance of armed men, and various luxury products. Trade was not an engine of growth; it was mainly aspects of the process of extraction and surplus consumption by the ruling elites. While dealing with the cause of the decline of the Mughal Empire, Habib says the decline of the Mughal Empire was largely due to its excessive and growing demand for land revenue, partly to finance military adventures. In this work, he explained how the Mughal Empire lost its political and economic power and how the East Indian Company entered India and slowly gained economic and political power. The work also deals with the theory of the drain of wealth. Like other scholars, Habib also explained the drain of wealth from India to Britain in the form of plunder, salaries, and so forth. In this work, he also deals with the impact of de-industrialization and de-urbanization. By and large, this work brings together several essays on the Mughal and colonial economies, as well as papers on Marxist methodology, Marx's view on India, and the role of caste, and this work also helps to a better understanding of the concept like the peasant in Indian history.

Deepak Kumar, and Bipasha Raha. (2016) Ed. "*Tilling the Land, Agricultural Knowledge and Practice in Colonial India.*" This book offers a collection of chapters authored by various scholars where they discuss agricultural knowledge systems, inherited agricultural practices and related activities, the adoption of new knowledge, and modernization endeavours. Deepak Kumar in the first chapter of this book talks about the use of scientific

knowledge in the field of agriculture during the colonial period, he argues that all the new agricultural technologies came to India during the British period. Bipasha Raha, in her chapter, analyses the system of agricultural production in colonial Bengal and how Rabindranath Tagore played an essential role in the improvement of agriculture.

Y. L. Nene (2017) "*A Critical Discussion on the methods currently recommended to support organic crop farming in India*," discusses the need for a green revolution in India and how India became a food exporting country after the green revolution. He argues that the excess use of chemical fertilizers causes the loss of natural soil fertility and production capacity. He explains how the internal market needs organic products and how Indian farmers start cultivating organic farming by adopting the old methods. This work discusses the old agricultural methods which our peasants practiced over a period of time. Nene has critically examined other traditional methods, which were suggested by different scholars across the globe. After that, he also analyses how Indian farmers widely accept these methods. In his concluding remarks, he claims that organic farming is becoming more popular in India due to market demand at both national and international levels.

For the particular study, emphasis has been given to a collection of primary and secondary sources from different states' archives, national archives, digital archives, and libraries. The methodology of the study is historical in nature, and I have used both analytical and descriptive methods for drafting this thesis.

The thesis is divided into four major chapters, excluding the introduction and conclusion. The introduction of the thesis provides a broad outline of the research work, which includes a review of literature, research questions, research objectives, and methodology used for the work.

The first chapter of the thesis is "Production and Technology: Medieval Understanding." In this chapter, I have tried to explain what were the different methods followed by Indian peasants in agricultural production, starting from the ploughing of land to the harvesting of crops. The chapter also discusses the use of different types of agricultural technologies. Further, it discusses how medieval rulers encouraged peasants to cultivate their land by giving financial assistance and other special measures such as excavating new canals, issuing takavi loans, etc.

The second chapter of this thesis is “Soil, Fertility and Manuring” where I have discussed the nature of Indian soils and how the nature of soil determines agricultural production. Further, different types of manure used by the peasants is also discussed. This chapter also focuses on the use of natural manure for agricultural production, the use of night soils and how soil fertility was maintained during the medieval period.

The third chapter of the thesis titled “Nature, Crops, Society and Food Habits” analyzed how nature played an important role in agricultural production. Due to its geographical location, some of the regions in India receive adequate amounts of rainfall. In contrast, some other regions do not receive the minimum amount of rainfall which damages agricultural production. The chapter also discusses different types of crops produced in the medieval period, emphasis was given to the introduction of various new crops. The chapter also looked at the relationship between cropping patterns and food habits and their impact on society.

The fourth chapter of the thesis “Agrarian Production, Practice and Text: A Study of Select Contemporary Texts” focused on the various sources of knowledge described in the contemporary sources, such as *Krishi – Parashara*, *Vrikshayurveda* (The Science of Plantlife), and *Nuskha Dar Fanni – Falahat*. All these sources speak about the agricultural practice of the particular time; therefore, the chapter discusses different types of agricultural methods followed over a period of time. The chapter also examined the change and continuity of agricultural practices.

The conclusion of the research work tried to understand the introduction of agricultural reform, application of scientific research and experiments introduced by the then British Government of India. The section tried to explain the Post-19th century changes in cropping patterns. Furthermore, the particular section also outlined how India achieved a green revolution. Then, the section concludes with the major findings of the research work and provides some constructive suggestions for the improvement of present-day agriculture.

## Chapter One

## Production and Technology: Medieval Understanding

Land was the major source of state's income in medieval India, and agriculture contributed significantly to the state's income. The process of agricultural production involves several steps. From the selection of land to preparation of land, selection of seeds, ploughing, levelling the land, sowing of seeds, irrigation, manuring the field, harvesting, and storage of crops, the medieval peasants used different types of agricultural technologies in each production stage. Peasants needed a plough and a pair of oxen for ploughing the land. For irrigation, medieval peasants used different kinds of water-lifting devices. After completing all the mentioned activities, peasants harvested their mature crops and removed grain from stalks, weighing them and storing them in the granary.[1] Different measures were taken to improve agricultural production, from the Delhi Sultanate to Mughal rule, such as constructing canals, wells, dams, and water reservoirs[2] and improving irrigation systems. Medieval rulers encouraged peasants to cultivate their land by issuing different agricultural incentives, including sanctioning of agrarian loans. Apart from that, land revenue concessions were given to the peasants for the cultivation of forest/barren land.[3]

---

[1] Parashra, *Krishi Parashara, (Agriculture by Parashara)* Eng. Tan. By Nalini Sadhale, Asian Agri-History Foundation, AP, 1999, p, 65. Henceforth cited as, *Krishi Parashara*. The text speak about the agricultural processes such as, "collection, preservation and sowing of seeds, leveling off the field after sowing, harvesting of ripened crops, separating the grain from the stalks, weighing them and the arranging their storage in the granary." Also see, Ranbir Ckharabrati, 'Agricultural Technology in Early Medieval Idnia (c. A.D. 500-1300)'*The Medieval History Journal,* 11, 2 (2008): 229-258 Sage Publication, New Delhi, p, 232. Henceforth cited as Ranbir Ckharabrati.

[2] Mohammad Qasism Ferishta, *Tarikh-i-Ferishta,* Eng Trans. J. Briggs, *History of the Rise of the Mohomedan Power in India,* Vol. I, Calcutta, 1966, p, 465. Writes, besides construction of canals, Firuz Shah paid attention to other irrigation works as well. He constructed 150 wells, 50 dams and 40 water reservoirs.

[3] Abu-l-Fazl, *Ain-I-Akbari,* Vol. II, pp, 62-69. Writes, "For the *polaj* and *parauti* lands taxes were decided as per Sher Shah's *rai.* Whereas for the *chachar* land (land which was uncultivated for three years or four years) 2/5 of the standard demand should be realized in the first year, 3/5 in the second year, 4/5 in the third and the full amount in the fifth year. In the same way the tax for *banjar* land (which was untilled for five years or more) was also prescribed in *Ain-I-Akbari,"*pp, 68-69.

The present chapter concentrates on the medieval production system, use of technology, and agricultural practices. The chapter further explains the different types of agrarian measures introduced by medieval rulers. In other words this chapter is broadly divided into two parts. The first part deals with the medieval agricultural production system and use of different types of technologies in each stage of production. Then, the second part of the chapter discusses the various agrarian reforms introduced by medieval rulers and how those reforms integrated with agricultural production.

The medieval system of agricultural production involved a number of stages. Starting from preparation of soil to harvesting and storage of crops. For preparation of soil, peasants needed simple equipment, a plough and a pair of oxen [4] and of course the land. The land may be ancestral legacy, acquired personally or received on rent from the landlord-*kadiwar* or *zamindar* in the original, to cultivate for the season, or as might be stipulated in the tenancy contract.[5] Now the important question before us is, who owned the land during the medieval period. The European travellers and British officials who visited India in the sixteenth and seventeenth centuries said that the king was the owner of the land. For Habib, the question of ownership of land was coined by the European travellers and British officials in the eighteenth century so that we have an assertion of the king's right to ownership.[6] During medieval times another class enjoyed the power of collection of land tax. They were known as *zamindars*, who often bought and sold villages, including cultivated land, on which they claimed ownership rights.[7] We had peasants directly associated with land cultivation and other activities, so can we say peasants were the actual owner of the land? When Abu-l Fazal talked about the justification of the imposition of

[4] K. A. Nizami, Ed. Kabiru'l Majalis, *Conversations of Shaikh Nasiru'ddin Mahmud,* recorded *(c. 1354)* by Hamid Qalandar, Aligarh, 1959, p, 140. Also see, Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History*, Vol. I. p, 48.

[5] Hamida Khatoon Naqvi, *Agricultural, Industry and Urban Dynamism Under the Sultanas of Delhi*, New Delhi, 1986, p, 16. Henceforth cited as H.K. Naqvi, *Agricultural Industry.*

[6] Irfan Habib, *The Agrarian System of Mughal India, 1556-1707*, Oxford Univrsity Press, New Delhi, 2014, p, 121. Henceforth cited as Irfan Habib, *Agrarian System*.

[7] Irfan Habib, 'The Peasant in Indian History,' *Proceedings of the Indian History Congress*, 1982, Vol. 43, p, 30.

taxes on the peasant and the sovereign's right of ownership he says that it's a social contract between the king and the peasant where the sovereign obtains his remuneration through taxation in return for providing protection and justice to his subjects.[8] Habib says that even though peasants tilled the land and paid the tax, they did not fully enjoy the ownership right of the land. He concluded by saying that during the Mughal period, there was no exclusive right of property vesting in anyone; instead, the system contained a network of transferable rights and obligations, with different claimants (the king or his assignee; the *zamindar;* and finally, the peasant) to differently defined shares in the produce from the same land.[9] But practically, it can be said that, more or less, the peasants enjoyed 'land ownership' because land ownership was passed on to them on a hereditary basis. And if a peasant migrated to some areas for any reason and returned, he could claim his land, and the land would be restored. Thirdly, he cultivated the land and directly paid the revenue. Likewise, there were so many other advantages that medieval peasants enjoyed during Mughal rule.[10]

The use of the plough was discovered in the Indus culture at Kalibangan which explains the large extent of Indus agriculture, covering up to north-western plains and extending into Gujarat.[11] Hamida Khatoon Naqvi says, "The plough was a horizontal beam structure, termed *takhti-i-isterash* in the Persian lexicon, and *hal* in the local dialect. It had a metal pointed downward projection called ploughshare which made a deep line of furrows in the ground as it was pulled along by the yoked bullocks."[12] Tillage was performed with a pair of oxen attached to the plough. It was approached with, three basic things: "a long wooden beam or shaft attached to the plough was fastened to the middle of the yoke placed over the depression between the neck and the hump of the animals; and two ropes, one for each ox, the one end of which passed through the nostril of the oxen while the other end was

[8] Abu-l-Fazl, *Ain-I-Akbari*, Vol, II. pp, 290-91.

[9] Irfan Habib, *The Agrarian System*, pp, 121-135.

[10] For detail description of ownership of land see, Irfan Habib, *Agrarian Economy*, pp, 121-135.

[11] Irfan Habib, *Technology in Medieval India c. 650-1750*. Tulika Books, New Delhi, 2008, p, 1. Henceforth cited as Irfan Habib, *Technology in Medieval India c. 650-1750*.

[12] Hamida Khatoon Naqvi, 'Cultivation Under The Sultans of Delhi c. 1206-1555.' *Indian Journal of History of Science,* 1984, p, 332. Henceforth cited as H.K. Naqvi, Cultivation Under The Sultans of Delhi c. 1206-1555.

held in the hands of the tiller."[13] Ox-drawn plough was continued from the Rig Vedic Period. Unlike European peasants, our Indian peasants never used horses for ploughing the land. They always used oxen.[14] Neither the cows appear to have been put to ploughing nor depicted in any of the Mughal paintings.[15] Terry described Indian plough as "foot-plough."[16] Irfan Habib found no fundamental change in the structure of the ox-drawn plough to have occurred. Iron begins to be mentioned in the late Vedic texts. Earlier, wooden ploughshare[17] was used, whereas some regions like Bengal and Deccan, the coulter was made of iron, which helped in the tillage of comparatively harder soil.[18] The plough

[13] A. Jan Qaisar, 'Agricultural Technology Depicted in Mughal Paintings,' *Itinerario,* Volume 16, Issue 02, July 1992, pp, 63- 65. Henceforth cited as A.J. Qaisar, Agricultural Technology.

[14] Irfan Habib, *Agrarian System*, p, 24. Also see, A.J. Qaisar, Agricultural Technology, p, 65.

[15] A.J. Qaisar, Agricultural Technology, p, 65.

[16] Edward Terry's account in William Foster, Ed, *Early Travels in India.* New Delhi S. Chand, 1968, p, 298. He differentiate between the "foot, and wheel-plough, whereof the first one is used in the deep and clay lands, being accordingly fitted with a broad fin share." It did not thus have a wheel, nor, according to Moreland (*India at the Death of Akbar,* p, 160), a mould-board. Neither the inverting nor the deep-digging plough is suitable for most Indian soils. (Also See, The Royal Commission on Agriculture in India, Report, London, 1928, pp, 110-112). However, according to Elliot, Indian peasants used different types of mould-board plough for sugarcane cultivation. (See, H. M. Elliot, *Memories On the History Flok-Lore, And Distribution of the Races of the North Western Provinces of India.* Vol. II, 1954, London, pp, 340-341.). Henceforth cited as Elliot, *Memories.* Vol. II.

[17] John Fryer, *A New Account of East India and Persia Being Nine Years Travels, begun 1672-81.* Ed, W. Crooke, III Vols. Hakluyt Society, 2nd Series. Vol. II, 2017, Taylor & Francis, p, 108. Henceforth cited as John Fryer, *A New Account of East India and Persia Being Nine Years Travels, begun 1672-81.* Also see, John Burnell, letters (1710-12) and an account of Bengal (1712-13), collected in *Bombay in the Days of Queen Anne.* Ed. Samuel T. Sheppard, William Foster, Evan Cotton and L.M. Anstey, Hakluyt Society, London, 1933, pp, 60-61. Who talks about use of "wooden colter" in Bengal. Henceforth cited as John Burnell.

[18] Satpal Sangwan, 'Level of Agricultural Technology in India, (1757-1857)' *Asian Agri-History,* Vol. 11, No. 1, 2007, p, 5. Henceforth cited as Satpal Sangwan, 'Level of Agricultural Technology in India, (1757-1857), he talks about the use of different types of plough in Bengal and Deccan region. Also see, R.S. Sharma, *Material Culture and Social Formations in Ancient India,* New Delhi, 1983, pp, 92-96. Also see R.S. Sharma, 'Class formation and its Material Basis in the Upper Gangetic Basin,' *Indian Historical Review II,* (1975), p, 13.

shown in Gandhara sculpture of the early centuries of the Christian era is not very different in shape from that pictured in the illustrated manuscript of the dictionary, "*Miftahu'l Fuzala."*[19] However, the ancient text *Manusmriti* mentions the use of small 'iron tip' in the plough. On the other hand the iron share in the fifteenth century plough is quite large and heavy.[20] *Krishi Parashara* talks about different types of ploughs used for ploughing different types of soils. The circular *abaddha* (a disc-plow) used on hard, virgin soil. The *phalaka* (plowshare) is used on irrigated soils. For deep ploughing *phalika* is recommended. A *viddhaka* is a harrow that is recommended for multiple uses. *Krishi Parashara* also says that a *viddhaka* is a harrow that plows multiple rows. This is used for sowing seeds in dry soil. *Madika* is a wooden plank fitted to the plough to level soil inundated with shallow water. [21] John Fryer,[22] in the year 1670, Francis Buchanan,[23] in 1801, and H.M. Elliot [24] In 1842, observed different types of ploughs used in different regions depend on the nature of soil. Francis Buchanan in 1801, witnessed large plough drawn by eight oxen, the iron coulter weighing about 3.3 kilograms.[25] On the other hand H.M. Elliot observed that, when deep ploughing was required for sugarcane cultivation, the peasants provided their ploughs with a wooden mould-board in the areas of Delhi and western Uttar Pradesh.[26] William Tennant observed that the Indian plough merely scratched the soil resembling the digging of a mole, rather than dig deep into it.[27] This was primarily due to the fact that the fertility of most soils in India lies at the surface. Thus, any

[19] Irfan Habib, *Agrarian System*, p, 24.

[20] Elliot, *Memories.* Vol. II, p, 342. Which talked about the use of iron share in the plough, called *'phala, Chau, or Kusa.* Also see, Irfan Habib, *Technology in Medieval India c. 650-1750*, p 3.

[21] Krishi Parashara, p, 56.

[22] John Fryer, *A New Account of East India and Persia Being Nine Years Travels, begun 1672-81*. p, 108. Also see, John Burnell, p, 108.

[23] Francis Buchanan, *A Journey from Madras, Through the Countries of Mysore, Canara, and Malabar*, Vol. II, London, 1807, p, 219. Henceforth cited as, Buchanan, *Journey from Madras,* Vol. II.

[24] Elliot, *Memories.* Vol. II, pp, 340-341.

[25] Buchanan, *Journey from Madras,* Vol. II, p, 17.

[26] Elliot, *Memories.* Vol. II, pp, 340-341.

[27] W. Tennant, *Indian Recreations: Consisting of strictures on the Domistic and Rural Economy of the Mohamedans and Hindoos*, Vol. II, 1804, pp, 77-48

deep ploughing would not have been necessary. A heavier iron-shod plough was occasionally employed on ground that was rather stiff, or which had perhaps become weedy or less fruitful, and therefore, required somewhat deeper ploughing.[28] In the alluvium of northern India and Bengal, a light plough with an iron soil-inverting mouldboard was used.[29] Now it can be say that perhaps a smaller quantity of iron was used in the medieval ploughshare.[30]All these indicate the regional variations of the size and weight of ploughs. Because the nature of Indian soils varies from region to region.[31]

Diffrent types of tools were used for clearing, and leveling of the land. For example, in order to clear the land of stones and weeds the tools like, tongs, *phalis* were used.[32] In the case of thorny weeds the use of sickle was more effective. Whereas to level the soil by breaking the clods or lumps of earth medieval peasants used wooden boards. This was called *patela* (a Hindi word) in some parts of north India.[33] For instance, the process of cleaning and levelling methods for cane or wheat were complex and time consuming. It requires five ploughing cycles. However, for barley the method was much simpler, or in case of millet, no prior treatment of the soil was needed.[34]

Seeds were sown in a variety of ways. In general, four methods of sowing of seeds were found all over the world. Those were, broadcasting, seed drill, sowing in a row, and dibbling method. The common method was broadcasting the seeds. It is depicted in *Baburnama* illustration where a man is scattering seeds in a garden, which he takes out from the improvised cloth-bag slung over his shoulder.[35] Seeds were also sown with the

[28]Satpal Sangwan, 'Level of Agricultural Technology in India, (1757-1857) p, 5, he says that, in Deccan the heavy ploughshare was used to break the black soil into huge clods and it penetrated usually to 10 or 12 inches.

[29]Satpal Sangwan, 'Level of Agricultural Technology in India, (1757-1857) p, 5.

[30] A.J. Qaisar, Agricultural Technology, p, 63, he writes the existence of the iron share and coulter, though very important, was taken for granted by the Mughal artists who did not project it clearly.

[31] A.J. Qaisar, Agricultural Technology, p, 63.

[32] H.K. Naqvi, *Agricultural Industry,* p, 14.

[33] A.J. Qaisar, Agricultural Technology, p, 65.

[34] H.K. Naqvi, *Agricultural Industry,* pp, 14-15.

[35] A.J. Qaisar, Agricultural Technology, pp, 66-67.

help of the seed drill. The knowledge of using seed drills in the medieval period cannot be ignored. Duarte Barbosa, who came to India in the early sixteenth century noticed the use of this method in a place near Bhatkal (Portuguese name Baticala presently known as Bhatkal) of the western coast. He writes, "All round they sow it in valleys and flats covered with water, for it is sown and reaped in water; they plough the land as we do with oxen and buffaloes yoked in Paris, and the ploughshare has a hollow in it wherein the rice is carried when the land is flooded, and as the share ploughs the rice goes on setting down under water and earth. On dry land they sow by hand. And every year this land bears two crops"[36] The method of seed drills was used in India and China, even before it was used by European countries.[37] For cotton cultivation our peasants used the dibbling method.[38] In the medieval period, rice cultivation was done using transplantation methods.[39] Transplanted rice was put in regular furrows.[40]

Since time immemorial Indian agriculture has been dependent on rain water as well as other sources of water (river, dams, canal, wells, tanks, lakes, etc.). Water was used for different purposes in medieval times such as – agriculture, human needs, garden, running of fountains and building construction. However, as an important aspect of Indian agriculture, artificial irrigation has always been supplementing the natural monsoons, for which canals, tanks and wells were constructed.[41] The most important technological

---

[36] Mansel Longworth Dames, Ed. *The book of Duarte Barbosa,* Vol. I. Hakluyt Society, London, 1918, p, 192.

[37] J. Needham, *Science and Civilization in China* VI, Part 2, Cambridge, 1986, pp, 251-276. Also see, Mansel Longworth Dames, *opcit.* p, 192, says that, Barbosa observed the drill-sowing methods on the western coast. Also see, Elphinstone, *An account of the kingdom of Caubul, and its dependencies, in Persia, Tartary, and India,* Volume I, London, 1842, p, 399. He writes "the drill-plough" which is used in India is not known to Afghanistan people. J.A. Voelcker in his *Report on Indian agriculture*, p, 223, described the use of seed-drill by 'native' people. He says, "the native seed-drill is wonderfully efficient and leaving little to be desired."

[38] Irfan Habib, 'The Technology and Economy of Mughal India,' *Indian Economic and Social History Review.* Vol. XVII No.1 (1980), p, 3. Habib says, dibbling is the dropping of seeds into holes driven into the ground by sticks. Also see, A. Qaisar, Agricultural Technology, p, 67.

[39] John Burnell, p, 61.

[40] Irfan Habib, *Agrarian System*, pp, 26-27.

[41] Irfan Habib, *Agrarian System*, p, 28.

advance was registered in the field of irrigation. By using different types of mechanism, water was drawn from the origin, and supplied within the city area, or the fort area or for the irrigation purpose.[42] In his *Indika*, Megasthenes noted that India's agrarian prosperity was largely dependent on two rainy seasons, which allowed for the production of a double crop.[43] Krishi Parashara also speaks about the interrelation between rainfall and agriculture. The expansion of agriculture, the diversity and profusion of crops included both edible and non-edible and the growth of a complex sedentary society was further linked to the availability of adequate irrigation facilities.

The new water lifting devices like *araghatta* and *Vapi* were used in the early medieval period. These devices were used for lifting water from great depths. A branch of the Chalukyas in Gujarat encouraged people to take different irrigation projects to build storage tanks. As a result, Mularaja (941–996) is said to have ordered his officers to dig wells, tanks, and *vapis*. The excavation of tanks reported at Anahilapataka (presently situated in Patna) were named after the ruler Durlabharaja (1010-1024). Likewise there were two tanks constructed under the guidance of King Karna (1066-94) and named after him i.e. 'Karnasagara.' Both Karnataka and Maharashtra sourced natural water from its tanks and lakes. However, larger parts of local irrigation of Karnataka was dependent on the artificial lake or tank. The reign of Vikramaditya VI (1076-1126) witnessed a remarkable construction of a tank at Kattageri of Badami taluk of Karnataka. The region, like Tamil Nadu's agricultural production mainly depended on tank irrigation.[44] Irfan Habib also agreed that, in medieval times, south Indian rulers constructed a large number of tanks and canals. He says, in the eleventh century or a little later the Grand Anicut, a

[42] A. Jan Qaisar, Agricultural Technology, pp. 69-73. He provides detailed descriptions of how water was lifted by using different types of water lifting devices and used for various purposes. Also see, Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History*, Vol. I. p, 49. Irfan Habib writes, "From wells and canals peasants raised water by various means. An improvement in one of the system of water-lift probably belongs to this period. The ancient Indian noria, the *araghatta*, used to carry a string of pots fixed close to its rim; at a later period, it was given the rope-chain, enabling it to reach water at some depth. Finally, it was equipped with pin-drum gearing, which made it possible for it to be worked by animal power."

[43] R.C Majumdar, *The Classical Accounts of India*, Calcutta, 1960, p, 252.

[44] Ranbir Ckharabrati, *op cit.* pp, 237-253.

dam over 300 metres long, up to 5.5 metres high and up to 18 metres thick, over the Kaveri river, created a lake from which irrigation canals took off. [45] Further he also says that, by blocking Kumudvati River in Karanataka a lake was constructed, and from there a number of canals were cut to irrigate lower areas. Construction of tanks, dams and canals were also found during the Vijayanagar Empire (1346-65).[46] Tavernier, a contemporary traveller, described the country of Golconda as being full of tanks, which were created by building dams, sometimes half a league long, so as to enclose the water in natural depressions and use it for the crops after the rains.[47]

The Tughlaq emperors attempted to enhance agricultural production by building irrigation systems. Firuz Shah Tughlaq laid the largest network of canals in north India.[48] Irfan Habib argued, "With the coming into use of lime and gypsum mortar and arcuate techniques, the environs of Delhi saw, in the fourteenth century, fairly sophisticated waterworks."[49] The one Firoz Tughlug (1351-88) built at Wazirabad (Delhi) over his Tughluqshahi canal consists of a solid masonry bund, 34.7 metres long.[50] Ghiyasuddin Tughluq was the first Sultan who started construction of canals. Ibn Batuta writes: "During the years of famine Muhammad Tughluq had ordered the sinking of wells outside the capital city and the cultivation of crops there. For this purpose he had provided the people with seeds as well as with the requisite sum of money."[51] The construction of canals work reached its peak during the rule of Firoz Shah Tughluq, He writes that "All are agreed that building canals, planting trees, creating land endowments for the welfare of the public, are meritorious acts under the sharia."[52] While writing on Firuz Shah Tughluq's canals, Afif says that Firuz

[45] Irfan Habib, *Technology in Medieval India c. 650-1750*, p 14.

[46] *Ibid*, p 14.

[47] J. B. Tavernier, *Travels In India Vol. I*, Eng. Trans. V. Ball, London, 1889, p, 150.

[48] H.M. Elliot, The History of India As Told by Its own Historians, Ed, John Dowson, *Tarikh-I- Firoz Shahi*, of *Shams-I Siraj Afif*. Calcutta, 1871, p, 127. Also see, Tapan Raychaudhuri & Irfan Habib, Cambridge Economic History, Vol. I, p, 49.

[49] Irfan Habib, *Technology in Medieval India c. 650-1750*, pp 14-15.

[50] Irfan Habib, *Technology in Medieval India c. 650-1750*, pp 14-15.

[51] Ibn Battuta, p, 88.

[52] Firuz Shah, *Futuhat-i-Firuzshahi*, Eng. Trans. Azra Alavi, Delhi, 1996, p, 28.

Shah excavated two canals; the Rajab-wah and Ulugh-khani. It was to supply water to his new city of Hisar Firozah. Rajab-wah was cut from river Jamuna, Ulugh-khani from Sutlej. Both of these streams, on the other hand, flowed through Karnal. They discharged their waters into the town via one canal after a length of roughly eight *kos*.[53] Another canal known as Firuzabad canal starting from Mandali and Sirmoor hills gets uniting with various (seven) other canals entered into Hansi and end in Hisar Firozah.[54] One more canal was excavated from the Ghaggar River and water was drawn up to Harni khera. Another canal was dug from river Budhi and water was taken to the Firozabad area. Apart from these there were plenty of canals which were excavated during this period, such as, few canals in the Multan region, constructed by local people. Firuz Shah's contribution was not limited to the construction of a good number of canals, however he gave attention to constructing a number of wells and dams. Ferishta, a contemporary source, mentioned that Firuz Shah constructed 150 wells, 50 dams, and 40 water reservoirs.[55]

Both in Upper Gangetic plains and parts of the south, wells' water acted as a main source of irrigation. As it is stated, most of the wells were *kachcha* and made without use of masonry. And these types of wells were dug every year. While referring to the Agra region, Pelsaert said, "The wells were annually made during the rabi season; so they must have been of this type."[56] While talking about agricultural production, Abu-l-Fazl mentioned Indian agricultural production to be largely dependent on rainwater and partially wells. But when he discussed the agricultural production of the Lahore region he writes; "This

---

[53] Shams-I Siraj Afif, *Tarikh-I-Firozshahi,* Eng. Trans. R.C. Jauhri, *Medieval India in Transition – Tarikh-I- Firoz Shahi A First Hand Account,* New Delhi, 2001, p, 92. Also see, H.M. Elliot, The History of India As Told by Its Own Historians, Ed, John Dowson, *Tarikh-I- Firoz Shahi,* of *Shams-I Siraj Afif.* Calcutta, 1871, p, 35.

[54] Yahya bin Ahmad Sihrindi, *Tarik-i- Mubarak Shahi,* Eng. Trans. By K.K. Basu, Baroda, Baroda Oriental Institute, 1932, pp, 130-31. Also see, H.M. Elliot, The History of India As Told by Its Own Historians, Ed, John Dowson, *Tarikh-I- Firoz Shahi,* of *Shams-I Siraj Afif.* Calcutta, 1871, p, 36. Also see Habib Medieval Indian Technology, p 15.

[55] Mohammad Qasim Ferishta, *Tarikh-I-Ferishta,* Eng. Trans. By J. Briggs, *History of the Rise of the Mohomedan Power in India,* Vol. I, Calcutta, 1966, p, 465.

[56] Francisco Pelsaert, *Jahangir's India,* Eng. Tran. By W.H. Moreland & P. Geyl. Cambridge, 1925. p 48. Henceforth cited as Pelsaert, *Jahangir's India*.

province is populous, its climate healthy and its agricultural fertility rarely equaled. The irrigation was chiefly from wells."[57] It is reflected in the demand for well-water irrigation in the field of agriculture in these regions. In the other region, specifically the central Ganga-Yamuna doab; there was a sharp decline in the number of wells.[58] And construction of new modern canals were started. Tanks and canal irrigation are also found in south India. As we already mentioned, according to Tavernier, "the country of Golkunda was full of tanks, which are said to have been made by building dams, sometimes half a league long."[59] Similar types of works were found in the other regions as well. Madag Lake, constructed by the Vijayanagara rulers in the 15th or 16th century is one of the best examples of traditional Indian civil engineering.[60] The Madag Lake was not the only irrigation lake confined in south India, the lakes like Dhebar which rebuilt and reinforced in 1687-91,[61] Udaisagar that was built in 1559-65 and Rajsagar in the 17th century were some of the constructions by Mewar rulers.

Similarly, the Mughal emperors continued the Delhi Sultans' legacy of canal construction. Shah Jahan's Ravi Canal, which was constructed to bring water from the river's upper reaches to Lahore. For Irfan Habib, this was one of the most expensive canals of Shah Jahan's time. He says, the canal was dug twice and yet its water could not reach Lahore. Only after the third attempt, involving the abandonment of all but a short stretch of the original canal, success was achieved in bringing it to Lahore.[62] Shah Jahan's West Yamuna

[57] Abu-l-Fazl, *Ain-I-Akbari,* Vol, II. p, 312.

[58] W.H. Moreland, *Agricultural Conditions of the United Provinces and Districts*, Allahabad, 1912, pp, 79-83. Henceforth cited as Moreland, *Agricultural Conditions of the United Provinces and Districts*. He talks about the wells irrigation in the united provinces. The effects of canals on wells has been of two kinds. First one was like the canals have appropriated to themselves, or cut off the supply of sub soil water of many tracts, which caused a fall in the underground water level. Moorland in this work has observed a number of these types of cases and he provides a detailed description of the decline of wells in different regions, such as, Aligarh, Mathura, Maipur and Agra.

[59] J. B. Tavernier, *Travels In India* Vol. I, Eng. Trans. V. Ball, London, 1889, pp, 121-122.

[60] James M. Campbell, Ed. '*Gazetteer of the Bombay Presidency.'* Vol. XXII, 1874-85, p, 261. He provides the detail description of the construction of lake.

[61] Abu-l-Fazl, *Ain-I-Akbari,* Vol, II, p, 509.

[62] Irfan Habib, *Technology in Medieval India c. 650-1750*, p, 15.

Canal [63] was brought to Delhi from Safedon. This canal water was further redistributed by excavating different sub canals for the irrigation purpose. This also created a multitude of watercourses intersecting the country on both banks (of the canal) from Karnal to Delhi.[64] Another canal was excavated in the Punjab region during Shahjahn rule, known as Shahnahr canal. Apart from these other canals were constructed in Punjab region to carry water to Pathankot, Batala and Patti Haibatpur. We have found canal irrigation in the Kashmir region as well. Bernier talks about rice cultivation using canal water.[65] Mughal rulers like Jahangir and Shahjahan also constructed canals to water their gardens.[66]

It's a well-known fact that artificial water bodies were constructed to facilitate agricultural production. Water was used from tanks, canals and wells. There were two kinds of wells, one was ordinary wells, and the other were the step wells. Reservoirs, and tanks were also found in this period. These were named according to the particular builders. For example, in Delhi, the Hauz Khas, was built by Hauz of mahaldar Khan in 1725. At Agra there were four large tanks, Hauz I Kalan, one in the mausoleum of Qandhari Begam, one in Dehra Gardens, and another, in the tombs of Etebar Khan. At Lahore there was one tank name mentioned as Kamboh.[67]In both Patna and Banaras, water was being used from rivers, tanks, and wells. During the medieval period water was drawn from the well and ponds by using different types of devices. One of the general water lifting devices was the *dhenkil*. It consisted of a long rope attached to the fork of an upright beam or the trunk of a tree to swing it in a swinging posture. The bucket was attached to a rope, and the other end of the rope was linked to one of the swinging poles hanging above the well. A counterweight was attached to the other end of the poles, which was somewhat heavier than the bucket when it got filled with water. This contraption could be operated by pulling the rope down into

[63] Irfan Habib, *Agrarian System*, p, 33.

[64] Sujan Rai Bhandari, *Khulasatu-t Tawarikh*. Ed. Zafar Hasan, Delhi, 1918, pp, 29-30.

[65] Francois Bernier, *Travels In The Mogul Empire A.D. 1656-1668*. Eng. Tr. & Ed. Vincent A. Smith, London, 1916, p, 396. Henceforth cited as, Bernier.

[66] Jahangir, *Tuzuk-i-Jahangir*, Eng. Tr, by Henery Beveridge, London, 1909, p, 347. Henceforth cited as Tuzuk-i-Jahangir. Also see, Irfan Habib, *Agrarian System*, p, 39.

[67]Hameeda Khatoon Naqvi, *Urban Centres And Industries In Upper India: 1556-1803,* Bombay, 1928, p, 30. Henceforth cited as Naqvi, *Urban Centres.*

the well and releasing it. The counterweight then brought the bucket up which was upturned to let the water flow into a channel. This particular water lifting device is known by various names. For example, *shaduf* in Egypt, *tula* in Sanskrit. Whereas in places like Bihar and Bengal, they call it *dhenkil* or *lat/latha*.[68] Even today, in the rural setup of Bihar and Bengal, people used this technique for irrigation purposes.[69]

Like *dhenkil*, another device was used for the lifting of water, known as charasa. In this method, animals were used to draw the water. While visiting Agra, Babur found this water lifting device and he gave a detailed account on this technique. He writes: "In Agra, Chandwar, Biana and those parts, again, people water with a bucket; this is a laborious and filthy way. At the well-edge they set up a fork of wood, having a roller adjusted between the forks, tie a rope to a large bucket, put the rope over the roller, and tie its other end to the bullock. One person must drive the bullock, another empty the bucket. Every time the bullock turns after having drawn the bucket, in pollution of urine and dung, before it descends again into the well."[70] Babur also said that, "To some crops needing water, men and women carry it by repeated efforts in pitchers."[71] If the water gets polluted after the addition of urine and dung, then it could not be suitable for the day to day human use, so it can be argued that this water was used only for irrigation.[72] Using *charasa* was a little more expensive than the use of *dhenkil*, because its operation needed two men and one or two bullocks. By using this method water could be drawn from the deep wells and irrigate the larger area.

The development of waterwheels played an important role in the field of irrigation. This development took place in three stages. First, the ancient Indian *noria*, the *araghatta*, used to carry a string of pots fixed close to its rim. In the second stage the rope-chain get used to reach water at some deeper place. Later on in the final stage of development, it was

[68] A. K. Coomarswamy, 'The Persian Wheel,' *Journal of American Oriental Society* Vol, 54, (1931), pp, 283-284.

[69] A.J. Qaisar, Agricultural Technology, p, 73.

[70] Baburnama, p, 487.

[71] *Ibid*, p, 487.

[72] A.J. Qaisar, Agricultural Technology, p, 73.

equipped with pin-drum gearing. In this stage it was allowed to be operated by animal power.[73] *Noria* is considered as one of the oldest water lifting devices in India. *Noria* is the scientist's term for a vertical wheel that has water containers on its rim.[74] An vertical wheel set up over a sheet of water. Its rim-containers are used to pick up water. The process follows as these go down into the water and then come up with a rotation of the wheel. When they pass the top of the wheel and descend, they empty themselves, pouring their water into a channel prepared alongside.[75] It was worked by manpower only. In the later stage, the earthen pots were transferred from the rim of the wheel to the garland or chain to exploit it over wells. A chain or garland (*mala*) of pots was provided which was long enough to reach the water level of the well.[76] This chain was created up of two ropes with no exposed ends, and timber strips securing the pots in between. It was designed in such a way that when the wheel was turned by hand, the pot-garland turned with it. This allowed the pots to receive water as they went down and then discharge it when they came up and turned back to go down. It was also known as *ghatiyantra* in Sanskrit. The terminology like *araghatta* and *arahatta* were still being used to describe both forms of *noria*.[77] With the chain of pots, India had the *saqiya*, and its functions are totally different from *noria* and there was a difference between *saqiya* and Persian wheel.[78]

During the medieval period peasants also used the Persian wheel as a water lifting device. The Persian gearing mechanism allows animal power to be used for successful handling of the chain's speed and controlling wheel.[79] While discussing the difference between *noria*

---

[73] Baburnama, p, 486, all these were the major developments of water lifting devices in India before the 16th century, afterwards we found the use of Persian wheel. Babur in his work provides the detailed description of the use of Persian wheel. Also see, Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History,* Vol. I. p, 49.

[74] Irfan Habib, *Technology in Medieval India c. 650-1750*, p, 9.

[75] *Ibid,* p, 9.

[76]*Ibid*, p, 10.

[77] A.J. Qaisar, Agricultural Technology, p, 75.

[78] Irfan Habib, *Technology in Medieval India c. 650-1750*, p, 11.

[79] Irfan Habib, 'Technological Changes and Society: 13th and 14th Centuries, 'Presidential Address, Part II, *Proceedings of the Indian History Congress* Varanasi (1969), p, 150. Henceforth cited as, Irfan Habib, Technological Changes and Society.

and Persian wheel, Habib says that the principal difference between the *noria* and the Persian wheel as far as practical results are concerned, is that the *noria* can only operate on an open surface (stream or reservoir), whereas the Persian wheel can also raise water from deep wells.[80] The use of such types of gearing technology comes from Babur's description. While describing Persian wheels, Babur writes: "In Lahor, Dipalpur and those parts, people water by means of a wheel. They make two circles of ropes long enough to suit the depth of the well, fix strips of wood between them, and on these fasten pitchers. The ropes with the wood and attached pitchers are put over the well-wheel. At one end of the wheel-axle a second wheel is fixed, and close (qash) to it another on an upright axle. This last wheel the bullock turns, its teeth catch in the teeth of the second, and thus the wheel with the pitchers is turned. A trough is set where the water empties from the pitchers and from this the water is conveyed everywhere."[81] While talking about the development of the Persian wheel, A. Jan Qaisar divided it into three categories. First, the lantern-wheel which was set up on an upright axel and moved by animal power round and round horizontally. This wheel was provided with vertical pegs at regular intervals. Second, the pin-wheel which was arranged vertically with a shaft or an axel. In the last stage, this axle was connected with the third wheel over the well that carried the pot-garland. The animals turned the lantern-wheel whose pegs got enmeshed with the teeth or cogs carried on the pin-wheel. This operated as a gear system, causing the pin-wheel to rotate vertically and transmitting the vertical action to the water wheel with the pot-garland over the well through its axle.[82] The Persian wheel became one of the most important water lifting devices in the Indus and trans-Jamuna regions in the 16th century.

During the medieval period different types of manures were used for agricultural production. Starting from the older text like, *Harshacharita* of Banabhatta to Abu-l-Fazl, *'Ain-I-Akbari,'* all talked about the use of cow dung as a common manure for agricultural

[80] Irfan Habib, Technological Changes and Society, p, 150. Also see, John Fryer, *A New Account of East India and Persia,* p, 94, he talks about the use of *noria* on the western coast.

[81] Baburnama, p, 486. Also see, A.J. Qaisar, Agricultural Technology, p, 75.

[82] A.J. Qaisar, Agricultural Technology, pp, 75-77.

production. Fish manure was used for sugarcane cultivation in Gujarat, and it was also used for coconut palms in Konkan.[83]

From the ancient period till now, the Indian peasants produced a number of crops. More or less it was the same in the medieval period. The key feature of Indian agriculture was the harvesting of the multiple crops in a year cycle. Some of the areas produced two crops in a year, while some other areas produced three crops in a year.[84] Abul Fazal says that as many as 41 types of crops were produced in each locality in a calendar year.[85] The vast patches of the land was "single-cropped" (*yak-fasla*) where either *rabi* (spring) or *kharif* (autumn) were harvested. But in some portions it was also double-cropped (*do-fasal*), being sown with crops of both harvests in succession.[86] In the first case that is in single cropped, the land remained fallow for about half the year, and could have a repetition of the same crop.[87] But in the double cropped pattern, land was necessarily at first a two-crop cycle, because the crops of the two harvests were different. Peasants of this period had better understanding of rotation of crops. In Bengal there was a land known as *danka-tanka* where people produced rice-tobacco-cotton, by following a land rotation system. Buchanan says that people of south India also followed the land rotation system.[88] Both Voelcker and Elliot appreciated the Indian peasants for their knowledge of the principle of crop-rotation. Voelcker says, "Fallowing is quite well known to the Indian cultivator, and its value is

[83] Surendranath Sen. Ed. *Indian Travels of Thevenot And Careri*, New Delhi, 1949, pp, 36-37. Henceforth cited as Thevenot. Also see, John Burnell, p, 83. In the next chapter, I will broadly discuss the use of different types of manure for agricultural production, crop rotation system, and how soil fertility was maintained during the medieval period.

[84] *Ain- I- Akbari,* Vol. II, pp, 5-6.

[85] *Ibid,* pp, 70-72.

[86] *Ibid,* p, 247.

[87] Buchanan, *Journey from Madras,* Vol. II, p, 219.

[88] *Ibid,* pp, 324-325.

understood."[89] The medieval period produced a variety of crops, like, rice, wheat, barley, millet, peas, oilseeds, sugarcane, and cotton etc.[90]

Different methods were used for harvesting, threshing, and winnowing the crops. Generally, matured crops were harvested with the aid of sickles. Four important agricultural activities were depicted in Mughal painting, one, a man cutting the crop with a semi-circular sickle. Two, a man is making bundles of the harvested crop. Three, one is driving a single bullock upon a threshing-floor and the last one is winnowing the threshed-out material.[91] Two types of methods were used for threshing crops, which were not only practiced in India, but in other countries as well. In the first method, animals were used, and in the second flail or sticks were used for threshing.[92] The wind was mostly employed to separate the grain from the chaff. According to A. Qaisar, "the threshed-out matter was first put in a basket and, then, it was shaken at a set pace throwing the contents outside the basket when the lighter matter, that is, the chaff got scattered by the wind and the grain fell on the ground."[93] Grain was generally stored in grain-pits called '*khattees,'* which allowed the grain to be maintained for a long time. The sides and bottom of these pits were lined with wheat or barley stubble. The grain was covered with straw. More importantly, the opening of the pit was sealed off with a coating. The coating of clay and cow-dung acted as resistance of the monsoon and was renewed as the torrents injured it. As a result, the grain could be stored for years without harm.[94] Ibn Battuta mentions that stocks of rice and millet had been preserved without suffering damage for ninety years. He further pointed

---

[89] J.A. Voelcker, *Report on Improvement of Indian agriculture*, pp, 233-236.

[90] A detailed study of diverse types of crops that produced in the medieval period will be discussed in the third chapter.

[91] A.J. Qaisar, Agricultural Technology, p, 79.

[92] Needham and Bray, *Science and Civilization in China Vol. VI*, Cambridge University Press, Cambridge, 1984, pp, 345-362.

[93] A.J. Qaisar, Agricultural Technology, p, 79. Also see, Needham and Bray, *op, cit.* pp, 363-378. They says, In China they used baskets, trays, sieves and even fans for winnowing. Then it was also done with shovels and forks by tossing the harvest.

[94] K.M. Ashraf, *Life and Conditions of the People of Hindustan*, New Delhi, 1970, p, 118, see its footnote 5 for detail description of the methods of storing the grain.

out, the rice that was carried out from one of these granaries, however, had developed a dark colour but had a good flavour.[95]

Among agricultural practices, the practice of grafting was known in India from ancient times. Grafting is an old practice, known in classical antiquity and in ancient India.[96] However, grafting as a means of extending the cultivation of particular varieties of fruit or developing new varieties, does not seem to have been employed in India before Mughal times, although the practice was apparently known earlier in Iran.[97] It was Ali Quli Afshar, (Akbar's governor of Kashmir) an Iranian, who introduced the first grafting technology in India. In that process sweet cherries were introduced in Kashmir. During Jahangir's period, grafting technology was used for grafting mulberry fruits and making them edible. Likewise Shahjahan's period has witnessed a remarkable practice of grafting technology. By using grafting methods, the quality of the three oranges had substantially improved, namely, the '*sangtara,' 'kaunla,'* and *'narangi'*.[98] In the 16th and 17th centuries, Portuguese introduced a number of new fruits, like pineapple, papaya, cashewnut and guava. They were the first people who used grafting technology in the production of new varieties of mango.[99] Like agricultural crop production, the medieval peasants also produced different types of vegetables and fruits.[100]

The period under review found that some medieval rulers introduced a few agrarian reforms, which helped improve agricultural production. In this chapter, I would like to discuss the relationship between land revenue systems and agricultural reforms introduced by medieval rulers and how that helped agricultural improvement. The year 1206 marked as an important period in Medieval Indian history. In this year Qutbuddin, the Governor appointed by the king of Ghazni, assumed the title of Sultan and ascended the throne. He

---

[95] Ibn Battuta, *Rehla*, Eng. Trans. By Mahdi Husain (Baroda: Oriental Institute, 1953), p, 26. Henceforth cited as Ibn Battuta.

[96] Irfan Habib, 'The Technology and Economy of Mughal India,' *Indian Economic & Social History Review,* 1980, p, 4. Henceforth cited as, Irfan Habib, The Technology and Economy of Mughal India.

[97] Irfan Habib, *Medieval Indian Technology*, p 8.

[98] Irfan Habib, The Technology and Economy of Mughal India, p, 5.

[99] Irfan Habib, *Technology in Medieval India c. 650-1750*, p, 8.

[100] All the detailed studies are going to be discussed in the third chapter.

established the first independent Turkish rule in India. Now the question before us is, what type of tax system and agricultural reforms were introduced by these new rulers in India? The major source of income was coming from land for the medieval Indian state. In addition, agriculture was contributing the most in the state's income. Now the question is, did the Delhi Sultanate follow the old Indian land revenue system? Or they had introduced a new system. Before establishment of Turkish rule in India, there was constant interaction between Arab world and India,[101] Perhaps more or less the similar kind of land revenue system was introduced in India, which was practiced in the Arab countries. Irfan Habib argued, since Sind and South-Western Punjab had remained under the Ghaznavids, from the reign of Mahmud of Ghazni (999-1030) onwards, the western portion of the Delhi Sultanate inherited the institution of the heavy land tax called *kharaj*. Initially, the nature of the tax collection was attributed more or less as a tribute collected through the agency of *thakurs*. By the passage of time in the 13th century when Delhi Sultanate was established, the tax had begun to be levied in terms of money. The collection of tax in the form of money made at the village level, if not from the peasants individually.[102]

From 1206 to the end of Delhi Sultanate rule, we had found several agrarian reforms introduced by these kings. However, no major changes took place before Alauddin Khilji's rule.[103] The credit of taking definite steps to organize land revenue goes to Sultan Alauddin Khalji. He was the first sovereign of the Turkish line to show a keen interest in revenue reforms.[104] Alauddin Khalji (1296-1316) not only considerably extended the limits of the Sultanate, but sought greatly to enlarge his resources by establishing a highly systematized

[101] Moreland, *The Agrarian System*, p, 21.

[102] Irfan Habib, *Economic History of India AD 1206-1526, The Period of the Delhi Sultanate and the Vijayanagar Empire*, Tulika Books, 2016, p, 17. Henceforth cited as, Habib, *Economic History of India AD 1206-1526*.

[103] W.H. Moreland, *The Agrarian System*, p, 26. Moreland writes, "There is no record of any large change in the agrarian system of the Delhi kingdom earlier than that which was effected by Alauddin Khalji about the year 1300." Then he further mentioned, "*Minhaj-ul Siraj*, the chronicler of this period, was an ecclesiastical jurist, who for long periods was at the head of the qazis of the kingdom; his chronicle shows no trace of interest in economic or social matters; and I think it is quite possible that he might have ignored changes of importance in the agrarian system."

[104] P. Saran. *Studies in Medieval Indian History*, Ranjit Publisher, Delhi, 1952, p, 145.

system of land revenue assessment and collection.[105] The agrarian reforms made by Sultan Alauddin Khalji were motivated by political and military considerations. It seems to have less of a philanthropic motive and more of an economic motive. During his first tenure of rule, Alauddin Khalji faced two challenges, one was internal rebellions and the second was Mongol threat. Mongol deployed a large number of armies outside of the Indus.[106] In order to counter these challenges he needed a large army, which led him to introduce his first reforms, both in the military and revenue departments. A contemporary historian of this period, Ziauddin Barani, in his *Tarik-i-Firozshahi*, explained the intentions of Sultan's measures and divided it into three parts. First, to provide means of preventing rebellions which had successfully troubled Sultan Alauddin Khalji, since his accession. Second, to break the power of the local khots, muqaddams and chaudharis, famously known as intermediaries, and thus bridging the gap between peasantry and the state. Last one was to add the income of the state by enhancement of land revenue.[107]

Practice of land grants was a common phenomenon in Indian history, as it was in the medieval period as well. Kings give land grants to religious leaders and other aristocratic people in order to gain their support and loyalty.[108] Alauddin Khalji himself purchased the support of the nobility and the people of Delhi by lavish distribution of the enormous treasures which he had brought from his Deccan expedition, and by conferring on them Iqtas, Inams and offices. The rebellions at the very beginning of his reign, however, led him to search for causes, and he was told by his confidential advisers that one of the causes was the accumulation of money in the hands of the people. Barani states: "if men had no money, they would attend to their own business, and would never think of riots and revolts. And if rioters and rebels had no money, they could never count upon the assistance of low

[105] Habib, *Economic History of India AD 1206-1526*, p, 17.

[106] W.H. Moreland, *The Agrarian System*, p, 31.

[107] Ziauddin Barani, *Tarikh-i-Firozshahi*, Eng. Tran. By, Elliot and Dowson, The History of India as told by its own Historians, Vol. III, London, 1871, pp, 172-179. Henceforth cited as, Ziauddin Barani, *Tarikh-i-Firozshahi*. Barani gives a detailed description of the rebellion faced by the sultan in different regions.

[108] *Ibid*, pp, 283-289. Also see, Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History*, Vol. I. p, 75. The practice of different types of land grants during the Sultanate period is explained in pp, 75-76.

and turbulent people."[109] Barani also says that, Sultan Alauddin ordered that, "wherever there was a village held by proprietary right (Malik), in free gift (inam) or as a religious endowment (wakf), it should by one stroke of the pen be brought back under the exchequer."[110] The effect of this measure was such, that "excepting maliks and amirs, officials, multanis, and bankers, no one possessed even a trifle in cash."[111]

The organization and implementation of new agrarian regulations brought officials like; accountants (*mutsarrif*), collectors (*amils*) and agents (*gumashtas*) in Sultan's office.[112] Records were issued to all village *Patwari*, and all these records were audited in the regular interval. This is called *Patta* in Hindi, which means records of land holdings. Both Irfan Habib and Satish Chandra state that, for the first time we now hear of this type of practice.[113] Drastic measures were taken to stop corruption in the revenue department. The Sultan also increased the salaries of those officials who were engaged in revenue collection, so that they should not indulge in bribery. Alauddin, then, ruthlessly punished all those who indulged in corruption. In this context Barani writes: "There was no chance of a single *tanka* being taken dishonestly, or as bribery, from any '*Hindu'* or '*Musulman'*. The revenue collectors and officers were coerced and checked, imprisoned and kept in chains for years. Men looked upon it as a great crime, and no man would give his daughter to a clerk. Death was deemed preferable to revenue employment. Offtime's fiscal officers fell into prison, and had to endure blows and stripes."[114] So the question of its practical implementation on the ground was possible, because of all these strong rules and regulations framed by the sultan.

Afterward, like agrarian reform, Alaudin Khalji also introduced the new market reform that helped the agricultural development of the period. All commodities prices were set by

---

[109] Ziauddin Barani, *Tarikh-i-Firozshahi,* p, 178.

[110] *Ibid,* p, 179.

[111] *Ibid,* p, 179.

[112] Satish Chandra, *Medieval India, From Sultanat to The Mughals, Part One.* New Delhi, 2017, p, 80. Henceforth cited as, Satish Chandra, *Medieval India, Part One.*

[113] Irfan Habib, *Economic History of India AD 1206-1526,* p, 19. Also see, Satish Chandra, *Medieval India, Part One,* p, 80.

[114] Ziauddin Barani, *Tarikh-i-Firozshahi,* p, 183.

Alaudin Khalji. From food grains, sugar, and cooking oil to needles, and from expensive imported cloth to horses, cattle, and slave boys and girls.[115] Malik Kabul Ulugh Khan was designated as a market controller.[116] Alaudin Khalji established three markets in Delhi: one for food grains, another for expensive fabric, and a third for horses, slaves, and cattle.[117] To make his market reform successful on the ground Alauddin Khalji introduced some regulations. Barani talks about all these regulations in detail, according to him, the Regulation-I, was fixing the price of grain. Regulation-II was made to ensure affordability of grain. For controlling the price of commodities, Malik Kabul Ulugh Khan, an intellectual and practical man was assigned the duty. According to the Regulation-III, crop like corn was placed in the king's granaries. Regulation- IV- 'the caravans', under which the Sultan brought all the carriers of his kingdom under one umbrella of the markets. Regulation- V- 'regrating', under this provision regrating (buying and selling at the same place or a nearby place for profit) was against the law. It was so strictly followed in this time that no one could keep or sell a *man* or half of a *man* of grain at his shop for a *dang* or a *diram*. Doing such was against the law and punishable in the court of law. Under Regulation- VI, engagements were collected from the provincial revenue officers and their assistants. According to this, the matter of supply of corn to the corn-carrier from *raiyat* should happen in the field. Hence, the cultivator should sell it at a low price and be unable to carry it to their house to regrate. In other words it would help the dealers and will not be delayed in the marketing process, to procure the constant and secured supply. Moreover, the corn-cultivators were also permitted to carry their products into the market to sell it at regulated price. Regulation-VII, posed a strong marketing sense and loyalty check by the Sultan. Further, it was very systematic in reporting indeed. The channels of appointed officials had to provide reports at three distinctive levels; superintendent; *barids* or reporters; *manhis* or spies. The transaction of the market was made on a daily basis, any variance and deviation was punishable by the authority.[118] Similarly the price of the slave boy and girl, cattle were also fixed in the Sultan's period. In this way Alauddin Khalji maintained his price

[115] *Ibid,* p. 196.

[116] *Ibid,* p. 193.

[117] *Ibid,* p. 196.

[118] *Ibid,* pp. 192-196. For detailed descriptions of all these regulations see page number 192-197.

regulation. And he made it possible up to the end of his rule. The measures of Alauddin's taking out the burden of the weak remain in doubt because the amount of agrarian tax paid by the peasants and the low price rate was not in favour of the peasants.[119] However, his new reforms in the field of administration and introducing new measures such as measurement of land, issue of *Patta*, to the *Patwari*, Market reforms, and maintenance of low price rate made him different from the others.

Muhammad bin Tughlaq, famously known for his experimental approach, like shift of capital from Delhi to Daulatabad (Devgiri), introduction of 'token currency,' economic and agrarian reform. However, this chapter only deals with some of his important measures for the expansion of agriculture. Muhammad bin Tughlaq, shifted his capital from Daulatabad to Delhi in the year 1337. When the Sultan arrived in Delhi, he saw a severe famine and all agriculture had been abandoned. The country was desolate and in Barani's words, "when the Sultan reached Delhi, not a thousand part of the population remained."[120] The Sultan tried to rehabilitate agriculture and restore cultivation. Ibn Battuta says, "when the famine was raging allover Hind and Sind and prices became exorbitant to such an extent that the price of a maund (*mann*) of wheat rose to six *dinars*, the Sultan ordered six month's provisions at the rate of a daily allowance of one and a half *ratl* of *maghrib* per head to be given to all the people of Delhi. He ordered this to be given to everyone great or small, free or slave. The Jurist and Judges set out registering the names of the inhabitants in different streets, sending for the people and giving to each victuals amounting to six months provision."[121]

---

[119] Ziauddin Barani, *Tarikh-i-Firozshahi*, p, 287. Also see Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History, Vol. I.* p, 62. Irfan Habib says that, "The *khots* and *muqaddams* could not exempt themselves from tax and make other peasants bear the entire tax due from the village. This would imply that Ala-u-ddin Khalji imposed the revenue demand on each cultivator separately. But one may well doubt whether this could have been done in practice. Even had this been done, and had every peasant paid in money the value of half his produce, the tax would have remained very heavy and regressive. A government levying such a tax could, therefore, hardly have protected the 'weak', except in so far as it tried to exclude or restrict further exploitation by the rural upper strata in order to safeguard its own share."

[120] *Ibid*, p, 244.

[121] Ibn Battuta, pp, 84-85.

Ibn Battuta also says that the "Sultan had ordered the sinking of wells outside the capital city and the cultivation of crops there. For this purpose he had provided the people with seeds as well as with the requisite sum of money. And he made them undertake this cultivation with the object of enriching the granary."[122] In this context Barani says, in order to promote cultivation, the Sultan advanced loans (*sondhar*) from the treasury to buy seed, bullocks etc. and provisions were made to dig wells for irrigation. However, the rains failed and nothing could be done.[123] He made a number of regulations for agricultural-expansion. A new agricultural department (*Diwan-i-Amir-i-kohi*) was established for the growth of agriculture. The main objective of this department was to promote agriculture and increase revenue collection. Moreover, a number of officers were employed to take charge of territorial divisions with the approximate area of thirty *kroh* by thirty *kroh*. Every plot of land in each *kroh* was to be cultivated so that one span of land would not remain uncultivated. Importance was given to cultivate all barren (*banja*) land, and measures were also taken to improve the quality of cultivated land.[124] Rotation of crops method was introduced to increase the fertility of the soils. Wheat would be sown instead of barley, and sugarcane instead of wheat, vines and dates would be planted instead of sugarcane.[125]

To implement the scheme, the Sultan had appointed hundred *shiqdars.*[126] Large amounts of loans were given to the *shiqdars*, to bring barren land under cultivation. Barani says, "Seventy *lacs* of *tankas* had been issued from the state treasury."[127] This scheme failed and during three years not a lot of wasteland was brought under cultivation. He writes: "The officers entrusted with the distribution of loan from the public treasury took care of themselves, and appropriated the money to their own wants and necessities. Much of the pasture land being unfit for cultivation remained uncultivated, and the superintendents were in dread of punishment. In the course of two years about seventy lacs of *tankas* had been issued from the treasury to the superintendents of the cultivation of waste lands, and

[122] *Ibid*, p, 88.

[123] Ziauddin Barani, *Tarikh-i-Firozshahi*, pp, 245-246.

[124] *Ibid*, p, 250. Also see, Satish Chandra *Medieval Inia Part One*, p, 107.

[125] W.H. Moreland. *The Agrarian System*, p, 50. Also see, Satish Chandra, *Medieval India Part One*, p, 108.

[126] Satish Chandra, *Medieval India Part One*, p, 108.

[127] Ziauddin Barani, *Tarikh-i-Firozshahi*, p, 250.

not one hundredth or a thousandth part of what was disbursed was reproduced in agriculture. If the Sultan had returned from his campaign against Thatta, not one of these superintendents and managers would have remained alive."[128] We can't say the total scheme of the Sultan's improvement of agriculture failed. By implementing the new cropping pattern, he was perhaps the first ruler to formulate a systematic policy for agricultural advancement. The peasants were given loans to help them expand their cultivation and dig wells. The modern historian Satish Chandra argued that, "Nevertheless, the scheme cannot be called a total failure. The idea of extending and improving cultivation with the help of agricultural loans became a standard practice with later sultans, and became a part of the agricultural policy of the Mughals. Thus both Alauddin Khalji and Muhammad bin Tughlaq helped in the evolution of an agrarian policy which matured fully under the Mughals."[129]

Like Delhi Sultans, Mughal rulers also took some special measures for the improvement of agriculture. Agricultural production was directly influenced by so many natural calamities, which affected the total produce. The collection of arrears, from the peasants who had escaped or died were the common practice in medieval times. Orders were made during the Mughal period to put an end to this practice, and no farmer could be held liable for arrears contracted by another. Only arrears from the year immediately preceding were to be recovered, all older arrears being written off.[130] During Akbar rule, the land was divided into four categories, i.e. Polaj, Parauti, Chachar, and Banjar. Among these Banjar land was uncultivated for five years and more.[131] And during Akbar rule, peasants were encouraged to cultivate the wasteland by issuing revenue concession. For example, in the initial year, the land revenue was charged half or less than half. Peasants were also encouraged to improved the cropping pattern.[132] The advancement of *taqavi* loans to the peasants was another important method of encouraging cultivation. According to Abul

[128] Ziauddin Barani, *Tarikh-i-Firozshahi,* p, 250.

[129] Satish Chandra, *Medieval India Part One*, p, 108.

[130] Irfan Habib, *Agrarian System,* p, 291.

[131] *Ain-i-Akbari,* Vol. II, p, 63.

[132] Irfan Habib, *Agrarian System*, pp, 290-295.

Fazl, the revenue collector assisted the needy husbandman with financial assistance.[133] *Taqavi* loans were offered to cultivators who were in financial difficulties and lacked seeds or cattle. Amin at the local level were asked to see whether the ploughs in a village are sufficient for tilling the land belonging to it, if not, he should give *taqavi* to the cultivators for the purchase of bullocks and seeds. In south India, *taqavi* loans were issued to construct dams. Instructions were issued to revenue officials to repair and dig wells for cultivation. In Multan provinces the canal superintendent was asked to dig new channels and build dams. We have also seen that during Shah Jahan's rule, a number of new canals were constructed to irrigate the agricultural land as well as for the royal garden.[134] During the great famine of 1630-32, Shah Jahan declared seventy lakhs of rupees as a special remedy. During Aurangzeb's rule, some measures were taken to improve the cultivation. The first order issued by the ruler was to increase the cultivation and welfare of the peasants.[135] A revenue Ministry was set up and known as the provincial Diwan, the main aim of the ministry was, extension of cultivation and increase of land revenue. The provincial Diwan consisted of three sections, and in each section the officials were appointed. In the first section, the Amins were appointed, whose primary work was assessment of the land. In the second section, the Kroris were appointed, and they were asked to collect land revenue. The Treasurers were appointed in the third section, they handled the money when it was received. The Ministry issued various policies to develop agriculture. The first was the expansion of agriculture, followed by the expansion of the area under high-class crops, and finally, the maintenance and building of irrigation wells. Peasants who supported this policy got empathy and were treated with consideration. Hence their reasonable requests for assistance were also fulfilled.[136]

The methods followed by our Indian peasants during the medieval period such as ploughing the land, sowing of seeds, crop rotation system, use of manure, grafting technology, methods of irrigation, and construction of canals, were also more or less scientific in nature.

---

[133] *Ain-i-Akbari*, V. II, pp, 43- 44**.**

[134] Irfan Habib, *Agrarian System*, p, 297.

[135] W.H. Moreland, *The Agrarian System*, p, 132.

[136] *Ibid*, 133- 134.

The measures taken by medieval rulers like the construction of new canals, the introduction of new water-lifting devices, issuing agricultural loans to the peasants, agrarian reforms, and market reform during the rule of Delhi Sultans helped to improve agricultural production. The use of natural manure, production of varieties of crops, and improving the quality of fruits by using grafting technology, were some of the important features of medieval agriculture. The next chapter is going to deal with the different types of soils, how the fertility of the soil was maintained and what types of manures were used for agricultural production during the medieval period.

## Chapter Two

## Soil, Fertility and Manuring

The nature of the soil and its fertility decides agricultural production. Hence, if the soil is not fertile, high production would not be expected from the soil. So it is very important for a peasant to understand the fertility of the soil, and if the soil is not fertile, then the peasant needs to apply some fertilizer or manure to get the high production from his land. Voelcker, in his report, says that a subject like manure is considered one of the fundamental aspects of Indian Agriculture. He emphasized the supply of adequate manure for agricultural production.[1] Before us, the critical question is what types of fertilizer or manure were used in the medieval period. How was the fertility of the soil maintained? Firstly, the chapter tries to study the nature of Indian soils. Second, the chapter discusses the different types of manures used by Indian peasants during the medieval period. Third, the chapter also tries to understand how fertility of the soils was maintained during medieval period. In the end, the chapter tries to analyze how all these manuring methods and land cultivation during the medieval time were in 'consonance with nature.'

In India, the selection of land is essential for growing a particular crop because we have different types of soils which are not suitable for growing all crops. Therefore, applying manure in the field according to the nature of the soil seems very important for peasants. The high fertility of Indian soil has been a feature of its agriculture through the ages. The geographical location of the Indus and upper Gangetic plain is always helpful for agricultural production.[2] And during the medieval period, this was the central political location for many kingdoms, starting from Delhi Sultanate rule to Mughals. Babur writes in the *Baburnama* that the great part of the Hindustan country is situated on level land.[3]

---

[1] J.A. Voelcker, *Report of Indian Agriculture,* p, 93.

[2] H.K. Naqvi, *Agricultural Industry,* p, 11.

[3] *Baburnama*, p, 486.

The bulk of the terrain is composed of alluvial soil.[4] The Indus basin consists of alluvial silt deposited by river Sind and its tributaries. According to Ibn Battuta, "This is one of the largest river beds of the world. It overflows in summer, and the people of Punjab cultivate the soil after its overflow."[5] Amir Khusrau (1253-1325), while talking about the Indian climate and the nature of soils, mentions the fertility and fruitfulness of Indian soil as well as the temperate character of its climate.[6] The renewal of soil fertility took place due to the annual silt deposited by the rivers in the plains. The Indus and the Ganga have been estimated to carry 900,000 and 1,000,000 tons of suspended matter daily. In comparison, the Brahmaputra deposits suspended matter more than these two. The Indus soils are generally coarser, and there is a much larger area of fine silt in the Ganga basin.[7] To comprehend the role of manure in enhancing soil fertility, it is essential to understand the fundamental principles of soil. How is the fertility of the soil determined? To what extent does manure increase soil fertility? What is the impact of manure on the environment in the long run?

In India, the nature of soil varies from region to region. Arid, Marshy, and ordinary are the three types of land mentioned in *Vrikshayurveda.*[8] During Akbar's rule, the land was divided into four categories, i.e., Polaj, Parauti, Chachar, and Banjar. Polaj land was never allowed to go to waste. Parauti land was left uncultivated for a period to enable it to regain its strength. Chachar land was left fallow for three or four years. Banjar land was uncultivated for five years and more. Both Polaj and Parauti land were further divided into three categories: good, average, and poor.[9] The classification of land is perhaps done based

[4] Alberuni Kitab-ul-Hind Ed, & Eng, Tr, by Edward C. Sachau. *Alberuni's India,* Vol. I, London, 1910, p, 259. Henceforth cited as, *Alberuni's India,* Vol. I.

[5] Ibn Battuta, p, 2.

[6] Yusuf Husain, *op. cit.* p, 122.

[7] O.H.K. Spate & A.T.A. Learmonth, *India and Pakistan, A General and Regional Geography,* Vol. 12. London, 2017, p, 43.

[8] *Vrikshayurveda,* says that "Arid, Marshy, and ordinary are the three types of land. It is further subdivided into six types by color and savors. Black, white, pale, dark, red, and yellow are the colors and sweet, sour, salty, pungent, bitter, and astringent are the tastes by which land is subdivided." p, 45.

[9] *Ain-i-Akbari,* Vol. II, p, 63.

on the fertility of the soils. During Malik Ambar's rule, the same practice of land classifications was found in South India. The land was divided into two categories based on soil fertility: good and bad.[10] However, the rice cultivated lands were divided into four categories; first, second, third, and fourth (Aval, Dum, Sim, and Charsim).[11] Many scholars studied the nature of Indian soils and classified them into different categories. J.A. Voelcker divided Indian soils into three broad categories; brown (alluvial tracts), green (black cotton-soil), and red (hard rock). The vast alluvial plains composed of mud and sand stretch across the northern portion of the country from west to east. The second type, or black cotton-soil, is a basaltic formation and occupies mainly the central and western divisions. Finally, the hard rocky type, composed of archaean and metamorphic rocks, covers the southern and south-eastern divisions.[12] J. Mollison, divided Indian soils into different categories, such as sand, clay, lime, vegetable matter, etc. He explains the process of soil formation and says that soils are those friable parts of the land surface that can be tilled and capable of supporting vegetation. Soil forms a superficial layer of variable thickness. By digging down a certain depth, unchanged rock material is invariably found. This rocky material can be converted into soil by disintegration and decomposition.[13] The relative fertility of soils largely depends upon the proportion of these constituents mixed.[14]

A soil in which sand largely predominates is called sandy. The soil of this class would be of low agricultural value. Pure sand is perfectly sterile. Although only valuable as a portion of plant food for a limited extent, a due proportion of sand gives our agricultural fields

---

[10] Malik Ambar, *A Biography Based on Original Sources*, By Jogindra Nath Chowdhuri, Calcutta, 1940, p, 165. Henceforth cited as Malik Amber.

[11] Malik Amber, p, 166. Also see, B.G. Tamaskar, *The Life and Work of Malik Ambar,* Delhi, 1978, p, 263.

[12] Voelcker, *Report of Indian Agriculture,* p, 35.

[13] J. Mollison, *A Text Book on Indian Agriculture,* Vol. I. Bombay, 1901, p, 1. Henceforth cited as J. Mollison, *Indian Agriculture,* Vol. I.

[14] *Ibid,* pp, 17-18. Also see Moreland, *Agricultural Conditions of the United Provinces and Districts*, p, 43, he divided Indian soils into three broad categories first, clay soils; second, sandy soils and last loam soils. While talking about the soils of the provinces, Moreland says, "The soils of the Provinces fall into two main classes depending on their origin on the south of Jumna most of the soils have been formed from fragments of rock brought down from the hills of Central India and they are very different from those of the rest of the provinces which are derived from the Himalayas." (See p, 30).

certain invaluable qualities. The amount of sand in the soil determines its texture. Sandy soil would contain less than 10% clay and greater than 80% sand.[15] Clay soils are termed argillaceous. Pure clay is as sterile as pure sand but seldom is found in nature. Clays are commonly seen to be fertile, and they remain fertile because they can conserve what they contain. Clay soils are dense and are difficult and expensive to till. They are plastic, i.e., soft and glutinous when wet and hardened when dry. This type of soil must be cultivated with a good deal of judgment. If ploughed in a wet condition and exposed to the sun afterward, they bake and harden and become difficult to reduce to an acceptable state of tilth. Clay is retentive of manure and moisture. They usually contain the decomposition of feldspathic rock that contain these substances. Heavy clay soil might be composed of 85 percent clay, 10 percent sand, 2 percent lime, and 2 percent humus. And a lighter class of clay soil contains more sand and less clay, and all clay soils contain over 50 percent clay.[16]

Limestone soils are called cretaceous or calcareous. And it contains over 20 percent lime. They are found to vary very much in character and are usually light and efficiently worked. A more significant proportion of them is poor thin soils with a low fertility standard. Lime can make clay less tenacious and sand more sticky, as well as be key plant nourishment and manure. A vegetable soil is rich in humus or organic matter. The rich garden mould, which contains about 10% humus, and the poor peat, up to 80% vegetative matter, are examples of such soils. Loam soil is a mixture of clay and fine sand, and it includes a higher percentage of organic matter than clay does. Soil cannot be called a loam unless sand is present in sufficient quantity to make it friable and easily tilled.[17] Loamy soils are much esteemed. They have enough retentive capacity to keep manure and moisture in bed. They may or may not contain all of the components of fertility. They could have come from alluvial deposits. They are naturally well-drained and capable of growing nearly any type of crop. They are warm soils with a lot of depth. Therefore they don't get depleted rapidly.[18]

---

[15] J. Mollison, *Indian Agriculture,* Vol. I, p, 18.

[16] *Ibid,* pp, 18-19.

[17] *Ibid,* p, 19.

[18] *Ibid,* p, 19.

Marls are soils that contain more than 5 percent and less than 20 percent lime. Clay marls, loamy marls, and sandy marls are the three main classifications. Clay marls are the most prevalent. Marls are a type of sea formation. Shells and other shellfish remains are common, which most likely explains the occurrence of phosphoric acid in sufficient quantities to give some marls a significant manorial value.[19]

The last category of soil is alluvial soil. Alluvial soils are freshwater or river deposits. Soils of this class are found fringing the courses of many streams, particularly at points where their flow is slow. Alluvial soils are often of considerable depths and usually partake of a loamy character, being formed by the deposition of denuded material brought down from the upper reaches of rivers. This material being ordinarily of a mixed nature, there is every probability that the resulting soil will contain an abundance of the elements of fertility.[20]

It is very important to understand the necessary elements or compounds of plant nutrients that determine soil fertility. Most of these elements and combinations can be found in soil or the atmosphere in sufficient quantities for the plant's requirements.[21] Fertility is measured not only by a sufficiency of plant food existing in the soil for the time being but also by the capacity of a soil to yield by proper management of a continuous supply of those elements of nutrition that plants obtain from it. However fertile soil may be; usually, very little of its weight is soluble. Continued fertility greatly depends upon the rate at which the mineral and nitrogenous substances in the soil are made more or less soluble by air, warmth, moisture, etc.[22] Starting from the medieval period until now, different types of manures were used for crop production. The second part of the chapter tries to discuss what types of manure were used during the medieval period and how the fertility of the soil was maintained during the medieval period. Before exploring all these answers, this chapter tries to understand some of the basic concepts of manure. Like, what is the definition of

[19] *Ibid,* p, 19.

[20] *Ibid,* p, 19.

[21] *Ibid,* both inorganic and organic elements and compounds are found in the soil. such as lime, magnesia, potash, soda, iron, manganese, silicon, sulfur, phosphorus, chlorine, and carbon. And some of the organic elements are nitrogen, carbon, hydrogen, and oxygen, pp, 29-31.

[22] *Ibid,* p, 31. Also see Sanjay Subodh, Agricultural Methods, p, 124.

manure? What are the different types of manure used in agricultural production, and its various chemical compositions?

The term manure, as commonly used by farmers, is generally understood to refer to the mixture of animal waste and litter removed from the cowsheds, stables, and pens where animals were kept.[23] While dealing with manure and fertilizer, E.J. Russell tries to differentiate both fertilizer and manure, and he mentions that there is no basic difference between fertilizer and manure. A fertilizer is a concentrated substance imported onto the farm from a foreign country or a factory, and therefore it is frequently called an artificial fertilizer. And manure is a more bulky material either produced on the farm or closely related to farm products.[24] The word manure can be defined in various ways depending on the perspective from which the subject is seen. It will, however, be used here to include all and only such substances as contain appreciable quantities of plant food in a condition suitable for assimilation by plants or which readily change into such a condition and are directly incorporated with the soil.[25] This definition consists of farm-yard manure, the waste animal and vegetable matter, which is restored to the soil-to which the name manure has sometimes been exclusively applied. It also includes seaweed, town refuse, and other animal and vegetable matters obtained from outside the farm, mineral substances, and bye products from the gasworks, ironworks, bone works, etc.[26] John Donaldson divided manures into three broad categories. First is the animal, the second is the vegetable, and the third is mineral manure. The first division comprehends those substances derived from animals, either in the shape of excrements or from their dead bodies. Then the second one includes the applied vegetables, either singly or mixed. The last one contains the minerals, fossils, earth, or earthy substances, used in the original state or mixed with other materials.[27] "Farm-yard manure consists of the solid and liquid excretions from the animals

[23] J. Alan Murray, *Soils and Manures*, New York, 1910, p, 3.

[24] E.J. Russell, *A Student's Book on Soil and Manures,* Cambridge University Press, London, 1915, p, 117.

[25] J. Alan Murray, *op. cit.* p, 178.

[26] *Ibid,* p, 178.

[27] John Donald Son, *Soils and Manures, The Improvement of Land and the Rotation of Crops*, London, 1911, p, 52.

together with the litter. It is the oldest and the commonest of all the fertilizers."[28] For Russell, animal urine produced the best farm-yard manure. The chemical composition of urine represents the nutrition that is quickly degraded. They easily convert to ammonia and other valuable chemicals in the soil.[29] Seedick. R. Sayani divided manure into three parts, the first one is Farm-yard manure, the second one is the application of green manure, and the last one is artificial manure.[30] He argued, that Farm-yard manure is no doubt one of the cheapest and best manures, but its manuring properties are largely wasted through ignorance at present. The use of cow dung was suitable manure for the Indian peasant.[31] John Donaldson did not include farm-yard manure in those three broad categories. He placed farm-yard manure in the mixed manure category. And for him, this is the widely used manure. He believes that farm-yard dung is composed of the culms or straws of the different grains used for food and litter and the excrements of the domestic animals, the horse and the dog, the ox and the cow, and the poultry-yard.[32]

The dung quality depends on the quality of the food that a particular animal consumes. Scholars like Seedick. R. Sayani, and John Donaldson argued that cow dung is widely used in farm-yard manure, "the dung of cattle contains better soluble in water and gives in fermentation nearly the same products as vegetables, absorbing oxygen, and producing carbonic gas."[33] The quality of the land determines the impact of manures of all types.

[28] E.J. Russell, *op. cit.* p, 150.

[29] *Ibid,* p, 150.

[30] Seedick R. Sayani, *Agricultural Industries in India*, Madras, (n. d.) p, 72.

[31] *Ibid,* pp, 72-73.

[32] John Donald Son, *op. cit.* pp 52-53.

[33] *Ibid,* p 53.

Table No. 1

(Chemical components of cow dung fresh)

| Name of the chemical | In percentage |
|---|---|
| Lime | 12% |
| Phosphate of Lime | 12.5% |
| Magnesia | 2% |
| Iron | 5% |
| Alumina, with some Manganese | 14% |
| Silex | 52% |
| Chloride of Potassium, and Sulphate of Potash | 2.5% |
| Toal | 100% |

(Source: John Donald Son, *Soils and Manures, The Improvement of Land and the Rotation of Crops*, London, 1911, p, 53.)

Green manure is practiced in various parts of the country but is often unsuccessful by ignoring its scientific principles. Green manuring primarily consists of growing a leguminous crop (generally) and ploughing it into the soil at the time of flowering.[34] Many peasants use this manure to produce staple crops because it generates nitrogen in the earth. Krishan Chandra talked about different types of organic manure, and he gave a table of organic manure, which mainly deals with the chemical composition such as; Nitrogen (N), Phosphoric Acid (P2O5), and Potash (K2O).[35]

[34] Seedick R. Sayani, *op. cit.* p, 73.

[35] Dr. Krishan Chandra, 'Organic Manures' Published by, *Regional Director, Regional Center of Organic Farming* No. 34, Bangalore. January 2005, pp, 11-12.

Table No. 2

(List of Organic Manures)

| Manure | Percentage Content | | |
|---|---|---|---|
| | Nitrogen (N) | Phosphoric acid (P2O5) | Potash (K2O) |
| Coir Pith | 1.20 | 1.20 | 1.20 |
| Blood Meal | 10-12 | 1.2 | 1.0 |
| Press Mud | 1-1.5 | 4-5 | 2-7 |
| **Bone Meal** | | | |
| Rawbone meal | 3-4 | 20-25 | - |
| Steamed bone meal | 1-2 | 25-30 | - |
| Fish meal | 4-10 | 3.9 | 0.3-1.5 |
| Animal refuse | 0.3-0.4 | 0.1-0.2 | 0.1-0.3 |
| Cattle dung, fresh | 0.4-0.5 | 0.3-0.4 | 0.3-0.4 |
| Horse dung, fresh | 0.5-0.5 | 0.4-0.6 | 0.3-1.0 |
| Poultry manure, fresh | 1.0-1.8 | 1.4-1.8 | 0.8-0.9 |
| Sewage sludge, active dry | 2.0-3.5 | 1.0-5.0 | 0.2-0.5 |
| Sewage sludge, activate dry | 4.0-7.0 | 2.1-4.2 | 0.5-0.7 |
| Cattle urine | 0.9-1.2 | trace | 0.5-1.0 |
| Horse urine | 1.2-1.5 | trace | 1.3-1.5 |
| Human urine | 0.6-1.0 | 0.1-0.2 | 0.2-0.3 |
| Sheep urine | 1.5-1.7 | trace | 1.8-2.0 |
| Ash, coal | 0.73 | 0.45 | 0.53 |
| Ash, household | 0.5-1.9 | 1.6-4.2 | 2.3-12.0 |
| Ash, wood | 0.1-0.2 | 0.8-5.9 | 1.5-36.0 |
| Rural compost, dry | 0.5-1.0 | 0.4-0.8 | 0.8-1.2 |
| Urban compost, dry | 0.7-2.0 | 0.9-3.0 | 1.0-2.0 |

| | | | |
|---|---|---|---|
| Farmyard manure, dry | 0.4-1.5 | 0.3-0.9 | 0.3-1.9 |
| Filter-press cake | 1.0-1.5 | 4.0-5.0 | 2.0-7.0 |
| Rice hulls | 0.3-0.5 | 0.2-0.5 | 0.3-0.5 |
| Groundnut husks | 1.6-1.8 | 0.2-0.5 | 1.1-1.7 |
| Banana dry | 0.61 | 0.12 | 1.00 |
| Cotton | 0.44 | 0.10 | 0.66 |
| Maize | 0.42 | 1.57 | 1.65 |
| Paddy | 0.36 | 0.08 | 0.71 |
| Tobacco | 1.12 | 0.84 | 0.80 |
| Pigeon pea | 1.10 | 0.58 | 1.28 |
| Wheat | 0.53 | 0.10 | 1.10 |
| Sugarcane trash | 0.35 | 0.10 | 0.60 |
| Tobacco dust | 1.10 | 0.31 | 0.93 |
| **Tree leaves, dry** | | | |
| Calotropis gigantean | 0.35 | 0.12 | 0.36 |
| Careya arborea | 1.67 | 0.40 | 2.20 |
| Cassia ariculata | 0.98 | 0.12 | 0.67 |
| Dillenia pentagyna | 1.34 | 0.50 | 3.20 |
| Madhuca indica | 1.66 | 0.50 | 2.00 |
| Pongamia pinnata | 3.69 | 2.41 | 2.42 |
| Pterocarpus marsupium | 1.97 | 0.40 | 2.90 |
| Terimalia chebula | 1.46 | 0.35 | 1.35 |
| Terminalia paniculata | 1.70 | 0.40 | 1.60 |
| Terminalia tomentosa | 1.39 | 0.40 | 1.80 |
| Xylia dolabriformis | 1.37 | 0.30 | 1.61 |
| **Green manures, fresh** | | | |
| Cowpea (vigna unguiculata) | 0.71 | 0.15 | 0.58 |
| Sesbania aculeate | 0.62 | - | - |
| Cluster-bea (cyamopsis tetragonoloba) | 0.34 | - | - |

| | | | |
|---|---|---|---|
| Horse-gram (Dolichos biflorus) | 0.33 | - | - |

| | | | |
|---|---|---|---|
| Moth bean | 0.80 | - | - |
| Green gram (vigna radiate) | 0.72 | 0.18 | 0.53 |
| Sunnhemp (Crotalaria juncea) | 0.75 | 0.12 | 0.51 |
| Blackgram (vigna mungo) | 0.85 | 0.18 | 0.53 |
| **Non-edible Oil Cakes** | | | |
| Castor cake | 4.3 | 1.8 | 1.3 |
| Cotton cake | 3.9 | 1.8 | 1.6 |
| Karanj cake | 3.9 | 0.9 | 1.2 |
| Mahua cake | 2.5 | 0.8 | 1.8 |
| Neem cake | 5.2 | 1.0 | 1.4 |
| Safflower cake | 4.9 | 1.4 | 1.2 |
| **Edible Oil cakes** | | | |
| Coconut cake | 3.0 | 1.9 | 1.8 |
| Groundnut cake | 7.3 | 1.5 | 1.3 |
| Niger cake | 4.7 | 1.8 | 1.2 |
| Rapeseed cake | 5.2 | 1.8 | 1.2 |
| Sesame cake | 6.2 | 2.0 | 1.2 |

(Source: Dr. Krishan Chandra, 'Organic Manures' Published by, *Regional Director, Regional Center of Organic Farming* No. 34, Bangalore. January 2005).

If we see the table, then it is found that medieval texts also recommended these types of manures for agricultural production. One of the best examples could be the use of cattle dung, fish meal, etc. It contains both nitrogen, phosphoric acid, and potash, which are very essential requirements for a plant to grow. These types of green manures can be used for

the profitable growth of agricultural production, particularly while growing products like rice and wheat.[36]

Manures were also used to restore the fertility of the fields. Indian peasants also made full use of manures and fertilizers. For manure preparation, they collected animal dung and let it dry for ten months. Whereas for the application of fertilizer, they used liquid manure and various animal and vegetable products. They utilized crop rotation and land fallowing to avoid exhausting of the soil.[37] Texts like *Arthashastra, Brahatsamhita, Agni Purana, Uktivyaktiprakarana, Krisi-Parasara, Vriksa-Ayurveda,* and *Nuskha Dar Fanni – Falahat,* contain advanced knowledge of crops, weather, rainfall, fertilizers, implements, etc.[38] The *Arthashastra* of Kautilya describes how grains were prepared before being sowed and manured. It says the grains were exposed to mist and heat for seven nights before being planted. It also recommends using a mixture of honey, clarified butter, the fat of hogs, and cow dung for plastering the cut end of the seeds of sugarcane. Cotton seeds were to be treated with cow dung.[39] The Arthashastra recommends "manuring with a fresh haul of minute fishes and the milk of the *snuhi* plant only when the seeds have sprouted. (Euphorbia Antiquorum)."[40]

A seventh-century text, *Harshacharita* of Banabhatta, gives an apparent reference to the usage of cow dung as manure. Further, he provides a thorough account of how a farmer transported cow dung and other rubbish to a field in ox-drawn carts to improve soil fertility.[41] *Krishiparasara* recommended specific methods in which the manure was prepared in this period. One of the methods described by *Krishiparasara* is "In the month of Magha (January - February), a dung heap (gomayakuta) is raised with the help of spade (kuddala). When it is dried in the sun (raudre samsoshya), smaller balls are made out of it (gundakarupinam). In the month of Phalguna (February – March), these dried balls of dung

[36] Seedick R. Sayani, *op. cit.* p, 74.

[37] Jeannine Auboyer, *Daily Life in Ancient India,* London, 1967, p, 64.

[38] R.S. Sharma, *Material Culture and Social Formations in Ancient India,* New Delhi, 1983, p, 15.

[39] Kautilya's *Arthashastra,* p, 166.

[40] *Ibid,* p, 166.

[41] Lallanji Gopal, *Aspects of Agriculture in Ancient India,* Varanasi. 2008, p 99. Henceforth cited as Lallanji Gopal, *Aspects of Agriculture in Ancient India,* Also see, Ranabir Chakravarti, *op cit.* p, 236.

are placed into holes dug for the purpose in the field (saram garte nidhapayet), and at the time of sowing (vapanakale), they are scattered over the field (saravimochanam)."[42] The text recommended the usage of dung as manure in the agricultural field. It says that crops produced without the use of manure will not give yield.[43] R Gangopadhyaya talked about the merits of this method and said that "the merits of this method are that the undisturbed dung heap minimized the loss of nitrogen, the chief fertilizing element; that the drying of the dung into balls reduced ammonia which is injurious to plants; that the dung balls in the pits augmented humus, thereby further fertilizing the soil."[44]

Another text, *Vrikshayurveda*, also known as (the science of plant life), extensively talks about manure in agricultural production. The text recommends certain steps for the preparation of manure. The recommended steps are; "to promote inflorescence and fructification, a mixture of one adhaka (64 palas) of sesame, two adhakas of excreta of goats or sheep, one prastha (16 palas) of barley powder, one tula (100 palas) of beef thrown into one drona (256 palas) of water and standing over seven nights should be poured around the roots of the plant."[45] *Vrikshayurveda*, also suggests sprinkling the washing of fish for manure preparation. It also suggests using a blend of powdered barley, sesame, and goat offal matter as manure. However, special importance was given to using cow dung as manure.[46]

*Sarngadharaoaddhati*, written by Sarngadhara, a courtier of King Hammira of Sakambhari (1283-1301), suggests manure for general and specific use like other texts. And the text

---

[42] *Krishiparasara*, p, 54. Also see, Lallanji Gopal, *Aspects of Agriculture in Ancient India*, p, 101. Also see, R. Gangopadhyaya, *Some Materials for the Study of Agriculture and Agriculturists in Ancient India*, 1932, pp, 57-58.

[43] *Krishiparasara*, p, 87.

[44] R. Gangopadhyaya, *op. cit.* pp, 58-59. Also see Lallanji Gopal, *Aspects of Agriculture in Ancient India*, pp, 101-102. Also see Ranabir Chakravarti, *op cit.* p, 237.

[45] Varahamihira, *Vrikshayurveda*, Eng. Tran. By, Lallanji Gopal, Vrksayurveda In Ancient India, With Original Texts and Translation, Super Prakashan, New Delhi, 2000, p, 99. Henceforth cited as Varahamihira, *Vrikshayurveda.* Also see Lallanji Gopal, *Aspects of Agriculture in Ancient India*, pp, 102-103.

[46] Surapala, *Vrikshayurveda*, (The Science of Plant life), Eng. Tran. By Nalini Sadhale. Asian Agri-History Foundation, AP, India, 1996, p, 48. Henceforth cited as Surapala *Vrikshayurveda*.

also speaks about how different types of manures were used for different plants.[47] Thus, we find that various decoctions and mixtures are mentioned in the ancient texts for manuring plants. These require the use of animal excreta, fish and fish washings, beef and bones, milk, and extracts of cereals, pulses, green leaves, and plants. [48] In this, one can note some of the modern fertilizers employed in a crude form. It is also difficult to claim that the chemical properties of these fertilizers were realized in ancient and medieval India. But in any case, the cultivators of those times seem to have known through experience the practical utility of the manuring formulae.[49]

Some of the methods followed during ancient periods were also found in medieval times. Nevertheless, medieval peasants were well aware of different kinds of manures. Despite that, they mainly relied on natural methods of manuring.[50] The use of animal manure in the form of animal droppings must have helped to restore the fertility of the fields. In India, cattle were available in large numbers and sold at lower prices.[51] By taking two villages, namely big Laras and small Laras, Firuz Shah established the city of *Hisar Firoaz*. Afif described that there were fifty animal sheds of bamboo or *kharaks* (cattle-pen) in big Laras and forty animal sheds of bamboo in small Laras, respectively.[52] Looking at the larger wasteland site, including fallow and forest, it was understood that there was little shortage of pasturage for cattle. The *Arthasastra* advised the king to make arrangements for pasture grounds on unproductive tracts and referred to the office of the superintendent of pasture lands.[53] Moreland also observed that there was more wasteland available for grazing in most parts of the country, though not everywhere. It is reasonable to infer that cattle would

---

[47] Lallanji Gopal, *Aspects of Agriculture in Ancient India*, pp, 109-110.

[48] R. Gangopadhyaya, *op. cit.* p, 58.

[49] Lallanji Gopal, *Aspects of Agriculture in Ancient India*, p, 111.

[50] Sanjay Subodh, Agricultural Methods, p, 123.

[51] Shihabuddin al Umari, Masalik-ul-Absar, Eng. Trans. Iqtidar Husain Siddiqui, *Perso-Arabic Source of Information on the Life and Conditions of the Sultanate of Delhi*. New Delhi, 1992, p, 133. Henceforth cited as Umari. Also see Hamida Khatoon Naqvi, *Agricultural, Industry & Urban Dynamism*, p, 17.

[52] Shamsi-I-Siraj Afif, Tarikh-I-Firozshahi, Eng. Trans. By, R.C. Jauhri, *Medieval India in Transition – Tarikh-I- Firoz Shahi, A First Hand Account*, New Delhi, 2001, p, 91.

[53] Kautilya's *Arthashastra*, p, 247.

be obtained more cheaply and easily than possible.[54] However, Moreland disagreed with the argument that the availability of large cattle indicates an ample supply of cattle manure for agricultural production.[55] The medieval agronomist advocated the bean seeds be moistened for 24 hours before the actual sowing; for gram seeds, the use of lukewarm water was recommended. For faster growth and larger yields, lentil and vetch seeds were mixed with cow manure.[56] Whereas in Gujarat, peasants used fish manures for sugarcane cultivation, and in the Konkan region, it was used for coconut palms.[57] Campbell Morfit argued that "fish in an incipient state of decay form excellent manure when dried and powdered. Dried herring contains 10.54 percent of nitrogen; when moist, only 0.19. Thoroughly dried Codfish has 10.86% nitrogen."[58] Cow dung was recommended to produce carrots, and for the cultivation of sweet almonds, the use of pig dung was mentioned.[59] The text (*Nuskha Dar Fanni-Falahat*) talked about the usage of natural manure.[60] The Indian agricultural producer knew the benefits of crop rotation, fallows, and manuring.[61] Dry black soil retained its fertility for a long period, and during years of lower output, organic matter was deposited, boosting productivity at the start of the next agricultural cycle. That's why peasants did not use manure for this type of land. Manures were only used for the red soil, and cow dung was used as more favourable manure for this land.[62]

---

[54] W.H. Moreland, *India at the Death of Akbar: An Economic Study*, London, 1920, p, 106. Henceforth cited as Moreland, *India at the Death of Akbar*.

[55] *Ibid,* p, 107.

[56] Hamida Khatoon Naqvi, *Agricultural, Industry & Urban Dynamism,* pp, 15-16.

[57] Surendranath Sen, *Indian Travels of Thevenot And Careri*, New Delhi, 1949, pp, 36-37. Henceforth cited as Thevenot. Also see John Burnell, p, 83.

[58] Campbell Morfit, Manures, *The Farmers Guide and Field Companion*, Philadelphia, 1848, p, 52.

[59] Dara Shikoh, *Nuskha Dar Fanni-Falahat, (The Art of Agriculture)*. Eng. Trans. By, Razia Akbar, Asian Agri-History Foundation, Secunderabad, 1994, p, 76. Henceforth cited as Dara Shikoh, *Nuskha Dar Fanni-Falahat.*

[60] *Ibid,* p, 76.

[61] Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History,* Vol. I, p, 230.

[62] *Ibid,* p, 231.

The use of night soil as manure in the medieval period is a debatable subject. Night soil means the excrement of the body; it can be from an animal or a human being. Excrements are also called "feces, or dregs." This term is generally applied to all refuse and sedimentary substances, particularly to the excrementitious matters of the intestines or the alvine excretions. Feces vary from a fluid to nearly a firm and solid state in different animals. It also varies in the same animals at different times. The color also varies a lot. The dung of pigs is generally grayish, that of the horse and cow, a dark green, that of the dog varies from white to black, and is more or less yellow in man. It is white like chalk in some other animals, red from the flea and bugs, and green from other insects. The quantity of bile is supposed to give different colours. And the stinky smell has been attributed to an incipient fermentation during the progress through the intestines. [63]

From the ancient to medieval periods, probably not a single source talked about the direct use of night soil (particularly human excrement) as manure for agricultural production. However, it does not mean that night soil was not in play in agricultural production during medieval times. Because if we see the practice of rural people going to toilets, it was found that still, most people use their land as a toilet. It can be argued that people used their own land as a toilet during the medieval period. In this process, over time, the night soils got deposited in the field and later acted as natural manure for the field. If we see the table (Table no. 3) of night soil, we will find that night soil contains various chemical compositions that are very useful for agricultural production.

The use of night soils as manure was only found in the work of Voelcker, where he says the people of Meerut and Hoshiarpur used large amounts of night soils along with well water.[64] He further states that Indian cultivators knew the value of night soil. By using night soil, the people of Farukhabad produced three crops in a year, namely; maize, potatoes, and tobacco.[65] Peasants in Pona also used night soil for sugarcane cultivation.[66] Countries

[63] John Donald Son, *op, cit.* p, 66.

[64] J.A. Voelcker, *Report of Indian Agriculture,* p, 95.

[65] *Ibid,* p, 120.

[66] *Ibid,* p, 121. Voelcker writes that the people of Cawnpore, Allahabad, Behar, Madura, and Amritsar, used night soil as manure.

like China and Japan have developed the modern mechanism of collecting night soils directly from each household and using it for agricultural production.[67]

The chemical composition of night soil of human beings is described in detail in the following table.

Table No. 3.

(Chemical composition of night soil of human beings).

| Name of the chemical | The total amount of chemical composition in % |
|---|---|
| Water | 73.3 |
| Vegetable and animal remains | 7.0 |
| Bile | 0.9 |
| Albumen | 0.9 |
| Peculiar extractive matter | 2.7 |
| Salts | 1.2 |
| Slimy matter, being resin of bile, peculiar animal matter, and insoluble residue. | 14 |
| Total | 100% |

(Source: John Donald Son, *Soils and Manures, The Improvement of Land and the Rotation of Crops,* London, 1911).

A total of 1.2 percent of salts described in the above table, containing, 0.35, carbonate of soda, chloride of sodium contains 0.4 percent, sulphate of soda contain 0.2 percent, ammonio-phosphate of magnesia contain 0.2 percent and ammonio-phosphate of lime contain 0.4 percent.[68]

[67] Yuko Shirai, Stephen J. Leisz, and Kazutake K. 'A Short History of the Utilization of Nightsoil in Agriculture,' *Sanitation, Nature, Culture, Health,* 2020, pp, 3-8. Also see, Bo Ling, 'Safe use of treated night soil,' *Ileia Newsletterr,* October, 1994, pp, 10-11.

[68] John Donald Son, *op, cit.* p, 66.

Now, the important question before us is, if medieval peasants were well aware of using all these different types of manure and its methods, then why only selected or natural methods were preferred? Sanjay Subodh argued, "It would be pertinent to mention here that, the knowledge of the use of leguminous crops as green manure must have reduced the peasant's dependence on animal meat or fish as manure. The usefulness of leguminous crops was known to the peasants of the Harappan and Pre-Harappan period, and cultivation of legumes, in both seasons, summer (rainy) season and winter, sustained soil fertility to a large extent."[69] And medieval peasants were well aware of the environment where they lived. The technological developments of the 17th century proved that agriculture in India was not static, and these developments contributed to the extension and reinforcement of peasant agriculture.[70]

The use of manure helped in restoring those plant nutrients in which the soil is deficient. Although the Peasants of Mughal India were largely uneducated, through their experience, they knew different methods to preserve the fertility of the soil.[71] It is found that from the ancient to medieval period, Indian peasants used 'eco-friendly' methods. Cattle manure or farm-yard manure was widely used as manure. Harsha Charita of Bana, a 7th-century text, explains the usage of cow dung as field manure.[72] This manure consists mainly of solid and liquid excreta of domesticated animals, to which litter and other refuse are added. Therefore, the undigested and indigestible food and the waste from the animal body are easily mixed into the soil. It is expected that if the dung and urine of domesticated animals are stored and used largely as manure, the fertility of the land under cultivation will be maintained.[73]

---

[69] Sanjay Subodh, Agricultural Methods, p, 123.

[70] Irfan Habib, 'Technology and Economy of Mughal India,' *Indian Economic and Social History Review* XVII (I), pp, 4-6.

[71] Sanjay Subodh, Agricultural Methods, p, 124. Also see Lallanji Gopal, *Aspect of History of Agriculture in Ancient India*, p, 111, and R. Gangopadhyaya, *op. cit.* p, 59), both mentioned that the use of manure for agricultural production comes through practical experience. And it's a long time process.

[72] Lallanji Gopal, *Aspect of History of Agriculture in Ancient India*, p, 99.

[73] Williams, A.C., and Meagher, D.J. *The Farm Manual*. Government Printing Press, Calcutta, 1903, p, 14.

During the medieval period, our peasants used different methods to maintain soil fertility, such as dry cultivation and wet cultivation. Then two field rotation systems and rotation of crops. The main objective of dry cultivation was to conserve limited moisture during dry weather by reducing or even eliminating runoff and evaporation, thereby increasing soil absorption and retention of water. By adopting the wet cultivation method, medieval peasants produced different types of crops, such as rice, cotton, and sugarcane. The medieval peasants also used two-field rotation systems. In the two-field rotation system, peasants utilized only half of their available land for crop production, leaving the other half fallow or unused. In this process, the empty land retained its soil fertility and gave better agricultural output in the following cycle. Among the four categories of land mentioned in the *Ain-i-Akbari, Parauti* is the land that is left out of cultivation for some time so that it may recover its strength. *Chachar* is the land that lay fallow for three or four years. *Banjar* is the land uncultivated for five years and more.[74] Medieval peasants also practiced a crop rotation system that helped improve soil fertility.[75] Indian peasants followed the fallowing system chiefly to free the land from deep-rooted weeds. Mollison also strongly agreed with this, and he says the crop rotation systems help maintain the fertility of the soil. The different families of plants require plant food of different sorts or at least indifferent proportions within certain limits. Some plants feed near the surface; others employing their long taproots, go further afield for their sustenance. A deep-rooted crop may help the succeeding surface-feeding one. Because roots that force their way into the subsoil collect a fair proportion of their plant food there, and the fallen leaves, the decaying roots, and other residue and fertility to the upper layer of soil provides plant food for the succeeding surface-feeding crop.[76] The two common crops raised were horse gram and Bombay hemp. Mollison argued that these crops "By decay of their roots, stems, and leaves, leave the surface soil much richer in organic matter, in nitrogen, and to a lesser extent in the other

[74] Abul-Fazal, *Ain-i-Akbari,* Vol, II, p, 63. The four categories of land during the Akbar times were *Polaj, Parauti, Chachar,* and *Banjar. Polaj* is the land that is annually cultivated for each crop in succession and is never allowed to lie fallow.

[75] Sanjay Subodh, Agricultural Methods, p, 124.

[76] J. Mollison, *Indian Agriculture,* Vol. I, p, 42.

elements of nutrition than before their growth."[77] The history of crop rotation goes back to the Neolithic-Chalcolithic culture, which "engaged them in farming year-round, leading to increased food production."[78] We may argue that peasants in medieval India had a practical understanding of crop rotations, as evidenced by the fact that they planted mixed crops on the same field year after year without utilizing artificial fertilizers.[79] During the Mughal rule, Indian peasants produced double crops in a year by employing this crop rotation method.[80]

Interestingly, somewhere in Bengal in the eighteenth century, peasants also produced rice-tobacco-cotton in a year following a land rotation cycle.[81] The successful practice in the growth of mixed crops in India assumes the actual farming of the educationally backward Indian *ryot.* For centuries, it has been determined to provide an inexhaustible nitrogen supply for agricultural land.

During the medieval period, large numbers of land remained uncultivated. Most of the land was covered with forests.[82] The foreign travellers who came to India during this period talked about thick forests and narrated the stories of how they encountered wild animals.[83]

---

[77] *Ibid,* p, 43.

[78] K. L Mehra, 'Biodiversity, and subsistence changes in India: The Neolithic and Chalcolithic Age.' *Asian Agri*-History Vol. 2, June 1997, pp, 105-126.

[79] Sanjay Subodh, Agricultural Methods, p, 125. J. Mollison, *Indian Agriculture,* Vol. I, p, 43.

[80] W.H. Moreland. *The Agrarian System,* p, 50. Also see Satish Chandra, *Medieval India Part One,* p, 108.

[81] Khwaja Yasin of Delhi, *Glossary of revenue and administrative terms*, Add, 6603, Delhi, 1966, p, 47. Also see Voelcker, *Report of Indian Agriculture,* p, 233. He says that Rotation is well known to the Indian cultivator. Also see, Irfan Habib, *The Agrarian System*, p, 27.

[82] Ziauddin Barani, *Tarikh-i-Firozshahi,* Eng. Tran. By, Elliot and Dowson, The History of India as told by its own Historians, Vol. III, London, 1871, pp, 492-493. The text says that in the fourteenth-century large number of peasants took refuge in the jungle of the large tract between the Yamuna and Ganga. Also see, Irfan Habib, *The Agrarian System,* p, 1. Also see Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History,* Vol. I, p, 48, where Irfan Habib says, "Large tracts of the Gangetic plains were still under forest."

[83] J. Horton Ryley, Cf. *Ralph Fitch: England's Pioneer to India and Burma,* London, 1899, p, 103. Also see, Jahangir, The *Tuzuk-I-Jahangiri* or Memoirs of Jahangir, Eng. Trans. By, H. Beveridge, 1909, p, 185. Narrated a story of how Jahangir was encountered with a tiger. Also see Tapan Raychaudhuri & Irfan Habib,

Forests also have a significant role in maintaining the fertility of the soil. "India has a tropical climate, and the atmosphere is loaded with miasmata, and the fertility of the land is dependent on the supply of water."[84] The purity, humidity, and temperature of the atmosphere, and the supply of water on the earth's surface depends on the foliage of trees. The abundant or scanty supply of rain depends on the number or scarcity of trees.[85] Trees send their roots far, searching for food and moisture. Their natural decay or the annual fall of their leaves adds year by year to the fertility of the upper layer mostly at the expense of the subsoil. In reserved forest tracts, a turf of more or less value as grazing becomes established. It prevents waste of soil material by surface washing, which would inevitably occur on any bare, exposed surface during the monsoon rainfall. Any soil carrying a forest growth of the same age is usually rich brown in colour, friable and moist; the decaying vegetable matter it contains gives it these qualities. Tree planting influences not only on improving the soil but also on improving the climate.[86] J. Mollison, strongly advocated for not destroying or cutting down the forests because, for him, forests help to increase rainfall. Abul Fazl, in his book *Ain-i-Akbari*, mentioned that Akbar had remitted many imposts as thanks offering to the Almighty. Among these was a tax on each tree called "Sar-i-darakhti."[87]

Irrigation provides water to the soil, but it also softens it and helps extract plant nutrients from insoluble soil material. It improves soil fertility because no water is entirely devoid of manure components. The soil compresses and crumbles between irrigations. The contraction and expansion cycles are beneficial. The air easily enters the soil and acts as

*Cambridge Economic History,* Vol. I, p, 48. Irfan Habib also talks about the tiger harassed wayfarer's between Badaun and Delhi.

[84] Sanjay Subodh, Agricultural Methods, p, 125.

[85] Edward Balfour, 'Notes on the Influence Exercised by Tress in Inducing Rain and Preserving Moisture' *The Journal of Literature and Science,* Vol. XV, 1849, p, 403.

[86] J. Mollison, *Indian Agriculture,* Vol. I, p, 80.

[87] *Ain-i-Akbari,* Vol. II, p, 66. Also see, K.M. Jhaveri, *Imperial Farmans (A.D 1557 to A.D. 1805)*, Bombay. Farman No. IV, footnote, 9a.

an aerator as the water drains away.[88] In Mughal India, peasants used both rainwater and other water sources (rivers, dams, canals, wells, tanks, etc.) to cultivate the land. Medieval rulers constructed many wells, tanks, and canals to supplement the rainwater. The land thus irrigated was provided with water and plant nutrients. Voelcker has talked about the chemical composition of canal water and well water in India (detailed data is presented in table no 4). The rainwater carries dissolved carbon dioxide and oxygen. It brings to the soil "appreciable quantities of combined nitrogen which has a certain manure value. Certain kinds of soil particles have the power to abstract and concentrate upon their surfaces for the use of plants."[89] The inflow of water mostly carried the mineral and organic substances which acted as natural manure and helped to improve soil fertility.[90]

[88] Alfred Deakin, *Irrigated India*, W. Thacker and Co. London, 1893, pp, 116-117. Also see J. Mollison, *Indian Agriculture,* Vol, I, p, 58.

[89] J. Mollison, *Indian Agriculture,* Vol. I, p, 59.

[90] Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History,* Vol. I, pp, 230-231.

Table No. 4.

(Chemical constituents of canal water and well water in India in the late nineteenth century).

| Constituent | Canal water (grains gallon.-1)1 | Well water (grains gallon.-1)1 |
|---|---|---|
| Sulphate of lime | 1.80 | 10.71 |
| Phosphate of lime | 0.13 | 1.59 |
| Carbonate of lime | 4.55 | 4.09 |
| Carbonate of magnesia | 3.52 | 13.23 |
| Chloride of potassium | 0.63 | 0.59 |
| Carbonate of Potash | 0.60 | - |
| Chloride of sodium | - | 14.69 |
| Nitrate of soda | - | 8.66 |
| Carbonate of soda | 2.39 | 16.41 |
| Oxide of iron and alumina | 0.28 | - |
| Soluble silica | 1.26 | 1.96 |
| Total solid residue | 15.16 | 71.93 |

(1.1 Grain = 0.0648 g; 1 ounce contains 437.5 grains.)[91]

(Source: J. Voelcker, *Report of Indian Agriculture,* 1893).

Shireen Moosvi has provided data on the proportional value of several crops produced in the Delhi and Agra regions. She conducted comparative research from 1545 to 1870 and 1870 to 1875. In her study, she found that, apart from cash crops, the value of the output of food grains, in general, remained more or less the same. The study also found that the methods adopted by peasants of Mughal India checked the exhaustion of the soil and

[91] J. Voelcker, *Report of Indian Agriculture,* p, 77.

maintained a high standard of fertility, which resulted in a steady increase in agriculture.[92] The Mughal rulers were not indifferent to the promotion of agriculture as is generally thought to be. While granting Madad-i-maash grants, it was a general rule that it should consist of both the cultivated land and the cultivable waste. According to Irfan Habib, "The standing rule, says Abul Fazl, was to give half the area of the grant inland already cultivated and the other half in cultivable waste, and if the latter was not available, the area of the grant was to be reduced by fourth."[93] One also comes across a Farman 'a royal decree' of Jahangir addressed to Jan Beg appointing him as Faujdar of Baroda in Suba Gujarat.[94] The duties and functions which were intimated to him include administering the country well, eliminating disagreeable and seditious elements, and endeavoring to encourage and promote cultivation and inhabitation. There is a reference to another Farman of Jahangir, conferring the offices of Zamindari and Chaudhari of *tappas* Barai and Dewra on Hira Nand.[95] He will attend to his duties and by his good behavior, keep the ryots and tenants happy and pleased and endeavor to increase the population and improve cultivation. Aurangazeb in a Farman exempted from the Jiziya "The small peasants who engage in cultivation but depend wholly on debt for their subsistence, seed, and cattle."[96] Medieval rulers also encouraged peasants to cultivate new land by issuing different types of loans.

Most of the historians who worked on medieval agriculture and system of production argued that despite of knowing the use of new technology [97] and methods, the medieval ruler did not force the peasants to use artificial manure, nor did our peasants adopt it to get extra output from the land. This basically shows that the medieval peasants were well aware

---

[92] Shireen Moosvi, *The Economy of the Mughal Empire, c. 1595 A Statistical Study,* Oxford University Press, Delhi, 1987, p, 88. Henceforth cited as Shrine Moosvi, *The Economy of the Mughal Empire.*

[93] *Ain-i-Akbari,* Vol. II, p, 63. Also see Irfan Habib, *Agrarian System*, p, 302.

[94] S.A.I. Tirmizi, *Mughal Documents (1526-1627) Vol. I*. Manohar Publications, Delhi, 1989, p, 81.

[95] *Ibid,* p, 81.

[96] Malikzada, *Nigarnama-i-Munshi*, Lucknow, 1884, p, 139. Also see, Irfan Habib, *Essays in Indian History. Towards a Marxist Perception*, Tulika, New Delhi, 1997, p, 152. Henceforth cited as Irfan Habib, *Essays in Indian History*.

[97]Ahsan Jan Qaisar, *The Indian Response to European Technology and Culture (A.D 1498-1707).* Oxford University Press. Delhi, 1982, pp, 128-139.

of the ecological balance of nature.[98] During the Medieval period, peasants used natural manure for agricultural production. Now the question is, if at all different methods of manuring were known to peasants of medieval India, then why only selected or natural methods were used? Because they were more conscious about the fertility of the soil and the environment where they lived? From the Vedic Period onwards, there is evidence of the use of some kind of manure to increase the productivity of the land. And the methods which they adopted, like the construction of canals, laying of orchards and gardens,[99] tilling of new land, and use of natural manures, proved that medieval agricultural production was in 'consonance with nature.'[100] On the contrary, we have seen the excess use of artificial manure during the green revolution to improve agricultural output which had an adverse impact on the fertility of the soils. How did nature play a significant role in agricultural crop production? What were the new crops introduced in the medieval period? And was there any relationship between cropping patterns and food habits? These questions are going to be discussed in the next chapter.

[98] Sanjay Subodh, Agricultural Methods, p, 129.

[99] Sanjay Subodh, in his work, Agricultural Methods, p, 129, says that The Mughal rulers encouraged to laying of orchards and gardens which helped in maintaining the fertility of the soil. A copy of parwana, dated 26 February 1655 AD states that 10 *bighas* (1 *bigha = 3025* sq. yd. =5/8 acre=0.25 ha) barren land, suitable for cultivation, exempted from the *jama*, by Gaz-i-Ilahi in the suburb of Hakimpur, *qasba* Sandila, has been assigned to Hafiz Shaikh Abdul Halim for laying out a garden. It cautions against any infringement of the order. A signed note states that the grant has been made for laying a garden as a propitiation for the Emperor and as Khairat for the said amir.

[100] *Ibid*, p, 129.

## Chapter Three

## Nature, Crops, Society, and Food Habits

In India, nature has always played an essential role in agricultural production. Still, a large number of Indian peasants depend on rainwater. Some regions receive adequate rainfall, whereas some other areas do not receive the minimum rainfall. The rainfall is generally adequate in regions like craggy Shivalik Hills in the northwest, Aravalli in the southwest of Delhi, and the Gangetic plain. At the same time, the rainfall decreases to an annual average of 12-17-25'' in the southern portions. Mewat region receives inadequate rainfall.[1] The monsoon water had to be frequently supplemented by an artificial irrigation system using different water-lifting devices to ensure satisfactory cultivation. The nature of Indian soils varies from region to region. The Indus basin comprises an enormous alluvium that the Sindh River and its tributaries deposited.[2] Whereas the regions like Rajasthan [3] and Punjab [4] have different types of soils and climates. Due to this soil and climate variation, crop production in India also varies from one region to another. Generally, Indian peasants harvested two crops: *kharif* and *rabi* crops.[5] While in some other parts, a third or additional crop of short duration was also sown.[6] According to Irfan Habib, "The great cultivated expanse of India's plains, valleys and hill-slopes has been created in the course of a

---

[1] H.K. Naqvi, Cultivation Under The Sultans of Delhi c. 1206-1555, p, 330. Also see J.A. Voelcker, *Report on Improvement of Indian agriculture,* pp, 25-26. Where he explained how rainfall varies from one region to another, and its impact on agricultural production.

[2] Edward C. Sachau, Ed. *Alberuni's India,* Vol. I. London, 1910, p, 259. Also see Ibn Battuta, *The Rehla of Ibn Battuta.* Eng. Tran. By, Mahdi Husain, Baroda, 1953, pp, 1-2. Henceforth cited as Ibn Battuta.

[3] S.P. Gupta, *Agrarian System of Eastern Rajasthan,* Delhi, 1986, p, 38, says most of the desert land is found in western and northern Rajasthan, and rainfall is sparse.

[4] J.A. Voelcker, *Report of Indian Agriculture,* p, 26, mentioned that, "The regions like, Assam, Eastern Bengal and the coasts of the Western Ghats receives abundant rainfall, whereas parts of Punjab not received adequate rainfall, and it is one of the driest regions of North India."

[5] *Ain-i-Akbari,* Vol. II, pp, 70-71, provides a detailed description of land revenue collection of both *kharif* and *rabi* crops.

[6] H.K. Naqvi, Cultivation Under The Sultans of Delhi c. 1206-1555. p, 330. Also see J.A. Voelcker, *Report of Indian Agriculture,* p, 26.

stubborn struggle against nature, which the Indian peasant has carried on for thousands of years. Forest and waste have retreated, recovered and again retreated, in endless cycles, before his hoe and plough."[7] While explaining the evolution of Indian agriculture, he writes, "Hoe-cultivation, migratory agriculture, permanently settled cultivation, were all historical stages in the evolution of productive techniques, themselves in their turn so largely influenced by the extent to which virgin land was available for fresh occupation in the respective periods."[8]

In India, the history of crop production goes back to ancient times. Indian peasants were producing varieties of food crops, cash crops, vegetables, and fruits. Text like *Arthasastra* gives a detailed description of crops grown in ancient times.[9] Crops produced in the early

[7] Irfan Habib, *Agrarian Economy*, p, 1.

[8] *Ibid*, p, 1.

[9] Kautilya's *Arthashastra*, pp, 165-166. Kautily's Arthashastra says that a superintendent of agriculture was appointed to look after the agricultural production throughout the year. And he was the final authority, who had to decide which crops should be sown in what time, by taking consideration of the weather condition of that particular region. In Kautilya's Arthashastra, we have found the mention of different crops names, those were, *Sali* (a kind of rice) *vrihi* (rice), *kodrava* (Paspalum Scrobiculatum), *tila* (sesamum), *priyangu* (panic seeds), and *varaka* (Phraseolus Trilobus). All these crops were started cultivation at the commencement of the rainy season. *Mudga* (Phraseolus Mungo), *masha* (Phraseolus Radiatus), were grown in the middle of the season. Then the crops like, *Kusumbha* (Safflower), *masura* (Ervum Hirsutum), *Kuluttha* (Dolichos Uniflorus), *yava* (barley), *godhuma* (wheat), *kalaya* (leguminus), *atasi* (linseed), and *sarshapa* (mustard) were grown in the last. The text broadly divided all these crops in three categories. Those were wet crops (*kedara*), winter crops (*haimana*), or summer crops (*graishmika*). And it suggested to grow all these crops as per the availability of the water and workmen. Reference are also made on different types of vegetables, fruits and cash crops, which were produced in this period such as pumpkin, long pepper, grapes and sugarcane. Kautilys's Arthashastra also talked about how different types of lands could be used for producing different crops. In this context the text mentioned, "Lands that are beaten by foam (*phenaghatah, i.e.* banks of rivers, etc.) are suitable for growing *valliphala* (pumpkin, gourd and the like), lands that are frequently overflown by water (*parivahanta*) are suitable for growing long pepper, grapes (*mridvika*), and sugarcane, the vicinity of wells for vegetables and roots, low grounds (*hariniparyantah*) for green crops, and marginal furrows between any two rows of crops are suitable for the plantation of fragrant plants, medicinal herbs, cascus roots (*usinara*), *pindaluka* (lac)." Also see, K.T. Achaya, *op cit.* pp, 15-17. Says that, wheat and barley were the main food crops produced in the area of Montgomery district of Pakistan, Mohenjodaro and Kalibangan in Rajasthan. However, Banawali in Rajasthan produced only wheat. At least four different varieties of wheat

medieval period was more or less the same as the crops produced in ancient times.[10] During the medieval period, probably from the 16th century onwards, some new crops were introduced in India. This chapter tries to study the different types of crops produced in the medieval period. The chapter also tries to understand the new crops raised in the period under review, and how our peasants responded to them, and how it affected the existing cropping pattern. The chapter discusses the relationship between cropping patterns and food habits to explore the related changes in food habits in the society.

In medieval India, a great expansion of agriculture took place. In the 13th and 14th centuries, large tracts of the Gangetic plains were covered by dense forests. Kautilya's *Arthashastra* mentions 17 kinds of crops sown in different seasons.[11] By the twelfth century A.D., 24 to 25 varieties of food crops, including fruits and vegetables were cultivated. A medieval text

---

were found in this region. The barley found at all places was of both the two-rowed and six-rowed cultivated types. Rice spikelets or their imprints showed up at the Gujrat sites of Lothal and Rangpur, and at Hulas in the Saharanpur district of Uttar Pradesh, representing probably the easternmost point of the Harappan civilization. Italian millet, ragi, and the grain amarnaths, production were found from Surkotada in Kutch area. From the ancient time to till now, pulses remained important food item for the Indian people. During this period, Peas were found in Harappa, Kalibangan and Daimabad, and the chickpea (chana, Bengal gram, Cicer arietinum) at Kalibangan and Daimabad. Masur dhal (*Lens culinaris*) production was found from Daimabad, Navdatoli-Maheshwar region. The horsegram (kulthi, *macrotyloma uniflorum*) and mung (greengram, *Vigna radiata*) are found in a later phase though even this is before 1500 BC. Apart from that oilseed and fruits were also produced in the Indus Valley period.

[10] Ranabir Chakravarti, *op cit.* pp. 234-235, gives a detailed description of crops produced in the early medieval period. According to him, early medieval India saw a huge paddy cultivation in north India. *Sunyapurana* gives the list of 60 different types of paddy found in eastern India. The arid region like Rajasthan experienced the generation of both summer and autumn crops, which included not only wheat and millet, but rice too. Peasants also produced cash crops such as cotton, which provided the raw material for the vibrant textile production in India. Another important cash crop produced in this period was sugarcane, the best variety being grown in Pundravardhana (North Bengal). The sugarcane of North Bengal received special attention from the various authors and travellers, starting from the days of Banabhatta, the author of *Harshacharita,* to the Arabic and Persian writers on travel and geography of the eleventh and thirteenth century. Different types of oil seeds were also grown in this period.

[11] Kautilya's *Arthashastra,* p, 164.

*Sunya Purana* says more than 60 varieties of paddy were grown in Bengal.[12] Towards the end of the 16th century, most of the Indo-Gangetic tract had been brought under cultivation.[13] In the land-locked Indus and upper Gangetic plain lay the heartland of the imperial territory of the Sultans of Delhi (1206-1555), where then as ever, agriculture was the paramount productive activity.[14] Irfan Habib states that "Agriculture was carried on by peasants living in villages. Each village contained 200 or 300 men. Cultivation was based on individual peasant's farming. The size of land cultivated by them varied greatly, from the large holdings of the *khots* or headmen, to the petty plots of the *balahars*, or village menials."[15]

During Medieval rule, Indian peasants produced a wide range of food crops, cash crops, vegetables, and spices. They were familiar with numerous innovative crop cultivation techniques of the period, such as double cropping, three crop harvesting, crop rotation, manure utilization, and a variety of irrigation equipment, among others. The chief crops were rice, wheat, barley, millet, pulses, peas, sesame, oilseeds, sugarcane, and cotton.[16] Ibn Battuta, after visiting all over India, listed out several food grains and various other crops, fruits, and flowers produced in the country. He says that the soil was so fertile that could grow two crops every year; *rabi* (winter) and *kharif* (monsoon) crops.[17] Seven varieties of autumn crops (including millet, peas, and beans of different kinds) were grown in summer when the rains fell and reaped sixty days after sowing. Four spring crop varieties, including wheat, barley, chickpeas, and lentils, were planted in the same soil as the autumn grains.[18] Shihabuddin-al-Umari mentions different kinds of food grains such as rice, barley, wheat,

[12] Ranabir Chakravarti, *op cit.* p, 234.

[13] Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History of India,* Vol. I, p, 48.

[14] H.K. Naqvi, Cultivation Under The Sultans of Delhi c. 1206-1555, p, 329.

[15] Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History of India,* Vol. I, p, 48.

[16] K. M. Ashraf, *Life and Conditions of The People of Hindustan,* New Delhi, 1970, p, 118. Also see, Hamida Khatoon Naqvi, *Agricultural Dynamism,* pp, 18-25.

[17] Satish Chandra, *Medieval India from Sultanate to the Mughals. Part one,* p, 145.

[18] Ibn Battuta, p, 16-19.

lentils, grams, mash (*urd*), *lobiya*, peas, and sesame.[19] New crops like maize, red chilies, and tobacco were introduced during the seventeenth century.[20]

Abul Fazal says that as many as 41 types of crops were produced in each locality in a calendar year.[21] The *Ain-i-Akbari*, gives revenue rates for sixteen crops of the *rabi* (spring) harvest developed in all the revenue circles of the Agra provinces.[22] Twenty five crops of *kharif* (autumn) were cultivated in the same provinces.[23] In the *Ain-i-Akbari,* rates for other provinces show a multiplicity of assessed crop such as; seventeen *rabi crops* and twenty six *kharif* in *suba* of Delhi.[24] Apart from that, *Ain-i-Akbari* also talked about the spring and autumn, products of other provinces like Allahabad, Oudh, Lahore, Multan, and Malwah.[25] According to revenue records from a village in eastern Rajasthan dating back to 1791, during the *Kharif* season, three strata were found. A sample of forty-two peasants was taken, the top twelve peasants in the stratum grew various crops ranging from six to nine, including cotton, *til,* and maize. Second, a group of eleven peasants grew three or four crops. Third, the other nineteen peasants only sowed one or two crops, indicating that they were at the bottom of the stratum.[26] This demonstrates that Mughal India's peasantry had sufficient agricultural expertise and skill to deal with a vast inventory of crops, due to the

---

[19] Umari, p, 114.

[20] Satish Chandra, *Medieval India from Sultanate to the Mughals. Part one,* p, 145.

[21] *Ain-i-Akbari,* Vol. II, pp, 70-72. Also see, Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History of India,* Vol. I, p, 217.

[22] *Ain-i-Akbari,* Vol. II, pp, 70-72, Rabi crops produced in Agra provinces were, wheat, cabul vetches, Indian vetches, barley, pot-herbs, poppy, safflower, linseed, mustard, adas (pulse), arsan (millet), peas, Persian musk melons, Indian muskmelons, kur rice, ajwain (lignsticum ajowan), onions, fenugreek carrots, and lettuces.

[23] *Ain-i-Akbari,* Vol. II, pp, 70-72, Kharip crops produced in Agra provinces were common sugarcane, sugarcane paunda, shali mushkin, common rice, munji rice, dark colored rice, cotton, potasherbs, sesame seed, moth lentils, mash, mung, jowar, lahdarah, lobiya, kodaram, kori, shamakh, gal (a sort of millet), arzan, mandwah, Indigo, hemp, turiya, turmeric, kachalu (arum colocasia), hinna, kult, watermelons, pan, singhdrah etc.

[24] *Ain-i-Akbari,* Vol. II, pp, 69-114. Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History of India,* Vol. I, p, 217.

[25] *Ain-i-Akbari,* Vol. II, pp, 63.

[26] S.P. Gupta, *Agrarian System, op, cit.* pp, 127-129.

country's favourable tropical environment, which made cultivation relatively much easier.[27]

It is well known that Indian peasants used similar farming methods to their European counterparts. John Fryer, noted no less remarkable difference from other nations in tilling and dressing the land for corn production.[28] The technology employed by Indian peasants was similar to or even superior to the one used by their counterparts in Europe. The peasants also shifted to cultivating new crops with zeal.[29] Their understanding of various crops set them distinct from peasants in other places, whose knowledge was limited to only a few crops. A detailed study of all those food crops, cash crops, spices and vegetables produced during the medieval period are discussed below.

Wheat was one of the principal food crops produced in the medieval period**.** Wheat was abundant at Dhar in Malwa. The city of Marh (near Gwalior) produced an excellent quality of wheat which was matched only by that of China. Its grains were long, deep, yellow, and thick.[30] Wheat was an important food crop in the Mughal period. It was mainly cultivated throughout its natural region. Provinces like Agra,[31] Allahabad,[32] Awadh, [33] Delhi, [34] Bengal,[35] Orissa,[36] Lahore, [37] Multan,[38] and Malwa, [39] produced wheat. In the *dastur* table of *Ain-i-Akbari*, it comes under spring harvest. So we can say that in those days, wheat was

[27] Irfan Habib, *Agrarian Economy,* p, 40.

[28] John Fryer, *A New Account of East India and Persia being Nine Years' Travel, 1672-1681*, Vol. II, London, 1912, p, 108. Also see Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History of India,* Vol. I, p, 214. Also see, Sanjay Subodh, Agricultural Methods, p, 121.

[29] Sanjay Subodh, Agricultural Methods, p, 121.

[30] Ibn Battuta, p, 161 and p, 167.

[31] *Ain-i-Akbari,* Vol. II, p, 70.

[32] *Ibid,* p, 73.

[33] *Ibid,* p, 76.

[34] *Ibidb,* p, 78.

[35] De Laet Joannes, *Imperio Magni Mogolis.* p, 71.

[36] Thomas, Bowrey, *Country Round The Bay of Bengal: 1669 to 1679*, London, 1895, p, 121.

[37] *Ain-i-Akbari,* Vol. II, p, 81.

[38] *Ibid,* p, 83.

[39] *Ibid,* p, 86.

the main spring crop.[40] Tavernier, while visiting Surat to Agra via Sironj, found a number of fields of wheat. He says that wheat production is also found in Baroda.[41] Sir Thomas Roe, who visited India under the rule of Jahangir, once saw 10,000 wheat-laden bullocks at Berampur. Good quality wheat was produced in the Golconda[42] and Masulipatnam region.[43] During Sahjahan and Aurangzeb's rule wheat cultivation was found in Thatta provinces.[44] Like wheat, barley cultivation was also found in Allahabad, Awadh, Delhi, Lahore, Multan, and Malwa, provinces, which one known as the central plains. [45] Apart from that, barley cultivation was also found in Orissa [46] and Gujrat. [47]

In Ancient India, three types of rice were produced; white, black, and the so-called 'rapid.' The rapid rice ripened in two months.[48] Twelve varieties of rice such as, Ratsal, Kalwa, Khirat, Kand, Bandri, Sikandhak, Koharpa, Dhaula, Lackbir, etc.,were harvested during the Sultanate rule.[49] According to Ibn Battuta rice was harvested three times a year in Delhi region, and it was one of their main cereals.[50] The city of Sarsuti (modern Sirsa) produced an abundance of fine rice which was exported to Delhi.[51] It was also produced in the Multan regions.[52] Rice was one of the primary food grains of Mughal India.[53] Rice cultivation

---

[40] *Ibid,* p, 62.

[41] Tavernier**,** p, 28.

[42] De Laet Joannes, *Imperio Magni Mogolis,* p, 73.

[43] Moreland, *Relations of Golconda in the Early Seventeenth Century*, p, 63.

[44] John Princeton, *Collection of Best Travels,* Vol. VIII, Journal of Sir Thomas Roe, London, 1896, p, 5.

[45] *Ain-i-Akbari,* Vol. II *dastur* table, pp, 70-87. It talked about barley cultivation in the *zabti* province of (Ilahabad, Awadh, Agra, Ajmer, Delhi, Lahore and Multan).

[46] Thomas, Bowrey, *Country Round The Bay of Bengal: 1669 to 1679*, London, 1895, p, 121.

[47] John Fryer, Vol. I, p, 297.

[48] Jeannine Auboyer, *Daily life in Ancient India*, London, 1967, p, 65.

[49] Umari, 115. Also see, Hamida Khatoon Naqvi, *Agricultural Dynamism,* p, 19.

[50] Ibn Battuta, p, 19.

[51] *Ibid,* p, 23.

[52] Umari, p, 114. Also see, Hamida Khatoon Naqvi, *Agricultural Dynamism,* p, 19.

[53] *Ain-i- Akbari,* Vol, I, p, 62. While talking about the prices of certain articles, Abul Fazal mentioned different types of rice such as, Sukhdas rice, Dunahparsad rice, Shakarchini rice, Dewzirah rice, Jinjin rice, Dakah rice, Zirhi rice and Sathi rice.

required plenty of water and high temperatures.[54] The chief varieties are Kur and Shali; the superior quality is the shali rice, which ripened quickly. It was chiefly grown in the Tattah region.[55] Munji rice was highly-priced, and it was primarily found in Agra provinces.[56] The Subah of Awadh produced three different types of rice called, *Sukhdas, Madkhar,* and *Jhanwah.* In Abul Fazal words, these rice were known for "whiteness, delicacy, fragrance, and wholesomeness are scarce to be matched."[57] The rice cultivation was not limited to only one province; it spread to many other provinces, such as the eastern side of Assam, Bengal,[58] and Orissa.[59] In the South, rice cultivation was found in the Tamil country.[60] Whereas, in the Golconda region, rice was produced as double crops in a year. In some areas, it had three crops in a year, and in most places, it grew as a single crop.[61] Rice cultivation was highly increased in these regions.[62] Provinces like Kashmir, Bihar,[63]

[54] J.A. Voelocker Report, *Report of Indian Agriculture,* p, 26.

[55] *Ain-i- Akbari,* Vol, II, p, 338.

[56] *Ibid,* p, 71.

[57] *Ibid,* p, 171.

[58] *Ibid,* p, 121. In Bengal, rice was grown three times a year on the same piece of land. Also see, De Laet Joannes, *De Imperio Magni Mogolis,* Eng. Tr. by J.S. Hoyland in, The Empire of the Great Moghul, Bombay, 1928, p, 71. Henceforth cited as De Laet Joannes, *Imperio Magni Mogolis.* Who writes, the Bengal province produces quantities of rice, wheat, sugar, ginger, pepper, cotton, and silk.

[59] *Ibid,* p, 126. Abul Fazal says that, "The staple cultivation is rice and the food of the inhabitants consists of rice, fish, the egg-plant and vegetables. When the rice is cooked, they steep it in cold water and eat it on the second day."

[60] John Fryer's, *A New Account of East India and Persia, 1672 – 1681.* 1909. London, Vol, I, p, 99. Henceforth cited as John Fryer, Vol. I.

[61] De Laet Joannes, *Imperio Magni Mogolis,* p, 73. Also see W.H. Moreland, Ed, *Relations of Golconda in the Early Seventeenth Century,* London, 1931, p, 8. Henceforth cited as Moreland, *Relations of Golconda in the Early Seventeenth Century*.

[62] Moreland, *Relations of Golconda in the Early Seventeenth Century*, p, 8.

[63] *Ain-i- Akbari,* Vol, II, p, 151. Abul Fazal writes, "Agriculture flourishes in a high degree, especially the cultivation of rice which, for its quality and quantity is rarely to be equalled."

Ilahabad,[64] Awadh [65] and Khandesh,[66] also produced rice. Rice cultivation was also found in the southern coastal belt of Gujrat,[67] Sind, and Lahore [68] provinces. Peter Mundey found 14,000 Banjara of Oxen, all loaded with a grain like wheat and rice. [69] Bernier observed rice cultivation in Navapura on his journey from Surat to Agra, which grew good rice irrigated from a nearby river. This rice was half the size of other rice of similar quality. It had a musk scent and was white, and all of India's elite groups consumed it and sent it to Persia for presentation.[70] Tavernier also talked about the rice grown in south India. On his journey from Surat to Broach, he found several rice fields. In Ootockmond, he met women and rice sellers. He says that, "an oxen back in Persia loaded 300 to 350 lbs of cargo ten to twelve thousand oxen at a time laden with rice, corn, and salt to the place where they could exchange it. They carried rice to corn growing areas, corn to rice growing areas, and salt to areas where salt was not produced, respectively."[71] Burhanpur was known for its rice production, rice was stored for a long time, and later it was exported to other countries.[72] The territory lying between the Indian Ocean and the Western Ghats, extending from Bombay to Goa, a narrow rugged strip of land, is called the Konkan. And this portion

[64] *Ibid,* p, 158. Also see Peter Mundy, *The Travel of Peter Mundy, In Europe and Asia, 1608-1667*. Ed. By, Sir Richard Carnac Temple, Cambridge Press, pp, 91-98. Henceforth cited as Peter Mundy.

[65] *Ibid,* p, 171.

[66] *Ibid,* p, 338. Also see, V. Ball, *Travels in India by Jean Baptiste Tavernier,* Vol I, New York, 1889, p, 41**.** Henceforth citied as Tavernier, Vol I. Also see**,** Surendranath Sen, *Indian Travels of Thevenot And Careri*, New Delhi, 1949, p, 102. Henceforth citied as Thevenot.

[67] Tavernier, Vol. I, p, 54. Also see Thevenot, p, 37.

[68] Thevenot, p, 85. Also see Sebastien Manrique, *Travels of Fray Sebastien Manrique, 1629-1643*. Vol. II. Eng. Trans. By, C. Eckford Luard, 1927, p, 221. Henceforth cited as *Manrique* Vol. II.

[69] Peter Mundy, *The Travel of Peter Mundy, In Europe and Asia,* Vol. II, *1608-1667*. Ed. By, Sir Richard Carnac Temple, Cambridge Press, p, 95. Henceforth cited as Peter Mundy, Vol. II.

[70] Francois Bernier, *Travels in Mogul Empire: 1656-1668*, Eng. Tr. by Archibald Constable, London, 1891, p, 312.

[71] Tavernier, Vol, I, Chapter III, p, 39-40.

[72] J. Horton Ryley, Cf. *Ralph Fitch: England's Pioneer to India And Burma,* London, 1899, p, 95. Henceforth cited as, Ralph Fitch.

received heavy showers of monsoon and produced rice on the sea coast.[73] Rice production was found in the Masulipatnam region.[74] From Masulipatnam port, rice, and cotton cloth were exported to Achin, Priaman, Queda, and Perak.[75] Bernier says that Bengal rice was carried up to the Ganges as far as Patna, and shipped by sea to Masulipatnam and many other ports of Coromandel. It was also sent to foreign Kingdoms, principally to the islands of Ceylon and the Maldives.[76]

Millet was found in abundance. It was the staple food of the saints, abstainers, and the poor. Millet production was found in the same regions where wheat was produced. Millet production was found mainly in areas of poor soil and deficient rainfall. Malwa, Gujrat, Ajmer, Delhi, Lahore, Agra, Allahabd, and Multan were among the places where jowar was cultivated.[77]Jowar was the main kharif crop. Millets were cultivated in the Golconda region.[78] Pulses were also one of the main food crops produced in Mughal times. *Ain-i-Akbari*, mentioned different types of pulses such as Mung dal, Mash, Nukhud dal, Moth dal, *Lobiya Kult, Matar,* and *Urd,* which were produced in different provinces like Awadh, Ilahabad, Multan, and Bihar.[79] All these major pulses were grown in the autumn harvests.[80] Pulse cultivation was also found in the Krishna district which came under the Golconda region.[81]

Maize became one of the very significant and new food crops grown in India during the Mughal period.[82] It was cultivated in Spain and Morocco before the sixteenth century A.D.

---

[73] Malik Ambar, *A Biography Based on Original Sources,* By Jogindra Nath Chowdhuri, Calcutta, 1940, p, 1.

[74] Moreland, *Relations of Golconda in the Early Seventeenth Century*, p, 63. Says that, a place called Naraspur Peta lies about 10 to 12 leagues beyond Masulipatnam is exceedingly productive of rice.

[75] *Ibid,* p, 60.

[76] Francois Bernier, *Travels in the Mughal Empire***,** 1656-68, London, 1916, p, 438.

[77] *Ain-i-Akbari*, Vol. II *dastur* table, pp, 70-87.

[78] Moreland, *Relations of Golconda in the Early Seventeenth Century*, p, 8.

[79] *Ain-i-Akbari*, Vol. II pp, 70-87. Also see, See *Ain-i-Akbari*, Vol. I, p, 63.

[80] V. Ball, *Travels In India by Jean Baptiste Tavernier (1640-67)* Eng. Tran. & Ed. By V. Ball in 2 Vols. London, 1889, III, p, 246.

[81] Moreland, *Relations of Golconda in the Early Seventeenth Century*, p, 8.

[82] Irfan Habib, *Agrarian Economy*, p, 42.

Later it spread to other parts of the Mediterranean.[83] The crop name does not appear in the detailed crop lists given by Abul Fazal in his *Ain-i-Akbari*. Some of the scholars argued that before the 17th century, maize cultivation was found in the Vijayanagara Empire. On the other hand P.K. Gode and Moreland reject the argument of the Indian origin of maize, and they have not found any major reference to it in literature before the 17th century.[84] In India the common name of maize is *makka* which is very similar to the word Mecca, strongly suggesting its arrival by the Red sea route.[85] Up to the 17th century the maize cultivation in India was very slow. However, in the 19th century when peasants began to replace smaller millets on drier soils, maize cultivation was more extensive and spread to other parts of the country.[86]

Apart from maize, the geographical distribution of all principal food crops indicates that the 16th and late 19th century was pretty similar. Moosvi, has made a detailed comparison of the yield table (*rai*) in the *Ain-i-Akbari* with the data on yields of various crops in the Delhi-Doab regions during the latter half of the 19th century. She also found that there were minimal changes in the yields of food crops.[87] The same kind of assessment was also seen in Moreland's earlier finding, which was based on the *Ain-i-Akbari*'s prices and rates of different crops in the provinces of Agra, Awadh, and Delhi. From 1600 to 1910, he discovered that the value of produce per acre of one food crop in terms of another did not change significantly. However, the only exception was found in the case of bajra which appeared to be one of the undervalued crops in the earlier period.[88]

Two kinds of peas were known, such as *mash* and *mung.* According to Ibn Battuta, "*mung* was a kind of *mash,* but its seed was long, and it was bright green in color. It was eaten for

---

[83] Fernand Braudel, *The Mediterranean and the Mediterranean world in the Age of Philip II*, Vol. I. Eng. Trans. by Sian Reynolds, 1995, Univ of California Press, p, 424.

[84] Moreland, *India at the Death of Akbar*, pp, 305-306. Also see P.K. Gode, *Studies In Indian Cultural History, Vol, I*, Hoshiarpur, 1961, pp, 283-294.

[85] Irfan Habib, *Agrarian Economy,* pp, 42-43.

[86] Ibid, p, 43.

[87] Shrine Moosvi, *The Economy of the Mughal Empire.* pp, 73-86.

[88] Moreland, *India at the Death of Akbar*, p, 103. Also see Shireen Moosvi, *The Economy of the Mughal Empire*, pp, 86-92.

breakfast when cooked with rice along with ghee."[89] Barbosa observed that wheat, millet, gingelly, peas, and beans were abundant and cheaply produced in the kingdom of Gujrat in the early sixteenth century. In the Deccan region, there were many beautiful villages with well-tilled lands and other villages with gardens for the cultivation of betel leaf.[90]

The Delhi Sultanate period also produced different types of cash crops. Two types of cotton were produced in this period. *Sembhal* (gosaypium aberasum), a perennial tree of wild growth, yielded cotton suitable for wadding and quilting of beddings.[91] The other was the herbaceous cotton (gossypium herbaceous), which produced material not only for padding but also for weaving cloths. It was known as Indian cotton and became quite an essential part of Oriental commerce.[92] Edward Terry, mentioned that the cotton seeds, after sowing, grow into shrubs producing first a yellow blossom and then into small pods containing a moist yellowish substance. As it ripens, it swells bigger till it breaks the covering, and so in a short time becomes white as snow, and then they gather it. Once sown, the shrubs bear for three or four years.[93] Mughal peasants also produced different types of cash crops. Modern 'cash crop' classifications are nearly equivalent to what Mughal documents refer to as *jins-i kamil* or *jins-i ala*.[94] The high-grade crops- like cotton and sugarcane were chiefly produced for the market.[95] Cotton excels in a subtropical climate with moderate and consistent temperatures and little rainfall. Cotton grows in a black soil with lime and a saline climate. In India both the Malwa plateau and Peninsular India contain the majority of black soil, that's why cotton cultivation was largely found in this region. Such as

---

[89] Ibn Battuta, pp, 18-19.

[90] Duarate Barbosa, *The Book of Duarte Barbosa*. Eng. Tran. By, Mansel Longworth Dames. London, 1918. Vol, I, pp, 154-55 and also see pp, 166 & 168.

[91] Hamida Khatoon Naqvi, *Agricultural Dynamism,* p, 28.

[92] E.H. Warmington, *The Commerce Between The Roman Empire and India,* 2nd Ed. Delhi, 1974, pp, 210-211.

[93] William Foster, *Early Travel in India, Ed,* Edward Terry, New Delhi, 1968, p, 301.

[94] Irfan Habib, *Agrarian Economy,* p, 43. Habib writes that these two terms are very frequently encountered in the revenue literature of the period from the *Ain-i-Akbari* onwards, but the sense seems everywhere to have been regarded as self-evident. Khafi Khan classifies crops as *jins-i ghalla* (food grains) and *jins-i a la* such as sugarcane, etc. (c, f, footnote, 44).

[95] Irfan Habib, *Agrarian Economy*, p, 43.

Khandesh,[96] Berar,[97] Aurangabad and southern Maharastra,[98] Coromandel Coast and Golconda.[99] Good quality cotton cultivation was found in Vijayanagara Empire.[100] Cotton cultivation was also found in northern Indian provinces, such as Agra, Allahabad, Oudh, Delhi, Lahore, and Multan. Cotton cloth was made in Burhanpur and it was painted.[101] Banaras is known for its quality cotton production.[102] Cotton is an autumn harvest grown in India. Bengal produced fine cotton cloth.[103] During the 17th century the rapid expansion of sericulture cultivation was seen in Bengal, later considered as the great silk producing regions of the world.[104] Cotton cultivation was found in Patna, and a large volume of trade and traffic was seen for this cotton cloth trade.[105] Both Ujjain and Sironji were known for cotton cultivation and the cotton trade. Cotton cloth was exported to Achin, Priaman, Queda, and Perak. Ships that sailed to Ceylon and Maldives carried coarse cotton cloth.[106]

Sugarcane was found in abundance at Kara and Manikpur.[107] While discussing sugarcane production, Umari writes, "sugarcane abounds everywhere in India. One is of black color with a hard covering (shell) among its varieties but it is excellent for chewing. This variety of sugarcane is not found in any other country. Sugar is prepared in large quantities of different types, cheaper than candy. It is not crystallized and rather resembles white flour."[108] During Akbar's rule, Bengal was known for its sugarcane cultivation, but later it was declined. However, up to 1910, this crop remained one of the important crops in this

---

[96] Pelsaert, *Jahangir's India*. p, 9. Also see Thevenot, p, 101, and Tavernier, Vol. I, pp, 42-43.

[97] Thevenot, p, 101.

[98] *Ibid,* p, 102.

[99] Moreland, *Relations of Golconda in the Early Seventeenth Century*, p, 61.

[100] Narrative of Domingos Paes in Robert Sewell, *A Forgotten Empire (Vijayanagar),* London, 1900, p, 237.

[101] Ralph Fitch, p, 95.

[102] *Ibid,* p, 103.

[103] De Laet Joannes, *Imperio Magni Mogolis,* p, 71. Also see, Bernier, p, 402, and p, 439. Also see, Ralph Fitch, pp, 25-28. Also see, William Finch, Early Travels, p, 112, and p, 118.

[104] Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History of India,* Vol. I, p, 217.

[105] Ralph Fitch, p, 101.

[106] Moreland, *Relations of Golconda in the Early Seventeenth Century*, p, 60.

[107] *Ibid,* p, 19 and p, 40.

[108] Umari, p, 115.

province.[109] Abul Fazal says that during Mughal rule peasants produced two types of sugarcane, known as ordinary and thick (Paunda).[110] Three different types of sugar were produced in the time of Jahangir's rule, candy, powdered, and jaggery which are found in the present day as well. Sugarcane cultivation was also found in other provinces, such as Delhi,[111] Agra,[112] Allahabda, Oudh, Lahore,[113] Multan,[114] Malwa, and Ajmer.[115] J.S. Hoyland's account tells us that the country between Agra and Lahore was one of the most fertile regions of India. It was well cultivated and produced various crops abundantly, among which sugar was the main crop and its production was very high.[116]

The fiber-yielding crops, *san* or sunn-hemp known as jute, was also grown in the Mughal period. The *dastur* table of *Ain-i-Akbari* indicates the cultivation of jute found in almost every portion of the *zabti* provinces.[117] Bengal produced hemp, gunneyes, and many other types of jute for the local market. The enormous extension of its cultivation in Bengal took place in the nineteenth century. W.H. Moreland argued that, in *Ain-i-Akbari*, jute was mentioned as *tatband,* which means sack-cloth.[118] On the other hand Irfan Habib says that, *tatband* was one type of silk and was mostly produced in Bengal.[119]

Another important cash crop raised in this period was Indigo. It came to be identified with India for its origin. The Indian Indigo produced both black and blue colours.[120] It was a

---

[109] Irfan Habib, *Agrarian Economy,* p, 45.

[110] *Ain-i-Akbari,* Vol. II, p, 71.

[111] *Baburnama,* p, 360. Also see, Thevenot, p, 85.

[112] Bernier, p, 282. Also see, Thevenot, p, 68.

[113] Thevenot, p, 77. Also see, Pelsaert, *Jahangir's India*, p, 31.

[114] De Laet Joannes, *Imperio Magni Mogolis,* p, 78. Writes that, the chief products of the province are sugar and great quantities of which are conveyed in boats down the Indus to Tata and in the opposite direction to Lahore.

[115] See *Ain-i-Akbari,* Vol. II, dastur table.

[116] De Laet Joannes, *Imperio Magni Mogolis,* pp, 54-55.

[117] Irfan Habib, *Agrarian System,* p, 46.

[118] Moreland, *India at the Death of Akbar*, p, 119.

[119] Irfan Habib, *An atlas of the Mughal Empire* (Vol. 6), Oxford University Press, New Delhi, 1982, p, 3, 11 B.

[120] E.H. Warmington, *op, cit.* pp, 204-205.

small plant, not above a yard high. It had seeds in a tiny circular pod that was about an inch long. It was sown once every three years. The yield of the second year was the best, being very light and of perfect violet colour.[121] Indigo flourished in areas of brackish water and dense soil. Indigo was one of the important cash crops grown in Mughal India. The best quality Indigo was produced in the Bayana tract near Agra.[122] According to William Finch, "Indigo grows up to a yard and its stalk in the third year is no more than a man's thumb. The herb is sown once every three years. In the month of August and September just after the rains, the leaves are cut and gathered, cast into a long cistern, pressed down with stones, and left therein with water. In the first year of its growth, the leaves are tender and not having attained perfection produced heavy reddish nill. In the second year, it is called cyeree (Jari), very light and of a perfect violet color, swimming on the water. In the third year, the herb is declining and this nill is called catteld (Khutiyal or Khunti) being a weight blackish nill, the worst of the three, if rain falls it looseth its colour and gloss and is called aliad (ala or moist). Four things are required in nill, a pure grain, a violet colour, its glosse in the sunne and that it be dry and light, so that swimming in the water, or burning in the fire, it cast forth a pure light violet vapour, leaving a few ashes."[123] Agra, Delhi, Oudh, Multan, Allahabad, and Sarkhej near Ahmadabad, were the most important provinces engaged in Indigo cultivation.[124] In the South, Telangana also produced good quality indigo.[125] Apart from that, Indigo cultivation was also found in Bengal[126] and Bihar region.[127] Up to 1880, most of the Indian Indigo was exported to European countries. However, the demand for Indian Indigo in the European market came down when they

[121] William Finch Account in William Foster Ed., *Early Travels in India*, New Delhi, S Chand, 1968, p, 153. Henceforth cited as William Finch in William Foster.

[122] William Finch, Early Travels, pp, 151-152. Also see, Peter Mundy, pp, 222-234. Also see, Tavernier, Vol. I. p, 72, and Pelsaert, *Jahangir's India*, pp, 13-14.

[123] *Ibid*, pp, 151-154.

[124] Tavernier, Vol, I, p, 54.

[125] William Foster, p, 93. Also see Moreland, *Relations of Golconda in the Early Seventeenth Century*, pp, 35-36.

[126] Tavernier, Vol. II, p, 8.

[127] Peter, Mundy, p, 151.

started manufacturing synthetic products which were used as a substitute product for Indigo.

Opium was mainly manufactured from poppy seeds. Its cultivation was found in almost every part of the Mughal Empire. Opium cultivation was largely found in Bihar,[128] Malwa,[129] Berar, Ghazipur, Bengal,[130] Gujrat, Khandesh, and Multan.[131] During Aurangzeb's rule opium cultivation was prohibited.

Tobacco was one of the first new crops to be introduced to India in the seventeenth century, and within a shorter period of time, its cultivation spread throughout the country. The introduction of tobacco and its rapid extension of cultivation was a notable feature of the agricultural history of the period.[132] Habib says that, "A pious pilgrim returning from Mecca had brought news of the novelty to the court, and in 1603 an imperial envoy coming back from Bijapur, where the use of tobacco had already become common, was able to present to Akbar a hookah (*chilim*) well and properly made in every respect."[133] The addiction to tobacco spread fast. During Jahangir's rule, tobacco production was prohibited but it has no longer been impacted. Instead, during Shahjahan's time, the use of tobacco reached to the perfumery of aristocratic households,[134] and tobacco consumption also increased during his reign. Many of the Indian peasants gave importance to tobacco cultivation, and as a result within a shorter period of time, it began to predominate other crops. Tobacco cultivation was found in Surat, Bihar and Golconda regions. Terry says that

---

[128] Ryley Fitch, p, 110.

[129] William Finch, Early Travels, p, 142. Also see, John Jourdan, *The Journal of John Jourdan*, 1608-1617, Ed. By. William Foster London, 1905, p, 149. Henceforth cited as, John Jourdan.

[130] Bernier, p, 440.

[131] Thevenot, p, 77. Also see, Pelsaert, *Jahangir's India*, p, 31.

[132] Irfan Habib, *Agrarian Economy*, p, 50. Also see, Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History of India*, Vol. I, p, 217. Irfan Habib says that, "the rapid extension of tobacco was spectacular" tobacco cultivation was started from western coast soon after 1600, and by 1650, the cultivation of tobacco was spread to all over the Mughal Empire.

[133] Irfan Habib, *Agrarian Economy*, p, 50.

[134] Jahangir, *The Tuzuki Jahangir, or, Memoirs of Jahangir*, Eng Tr. Alexander Rogers, Ed. Henry Beveridge, London, 1909, p, 183. Henceforth cited as *Tuzuk-I-Jahangir*.

it was grown "in abundance."[135] Indian tobacco was also exported to other countries such as Mocha and Arrecan.[136]

Saffron was another important cash crop grown in Kashmir. Its cultivation mainly took place in the months of March and April. According to Abul Fazl, the land was ploughed up and turned soft at the end of March and April, and each piece was prepared for planting with the spade, with the saffron bulbs hard in the ground. They sprouted in one month and were fully matured by the end of September.[137] Pampur, south of Srinagar, was known for its saffron cultivation, where it was extended up to 10 to 12 thousand *bighas*.[138] The other location was the Paraspur area near Indrokol, where saffron was also grown, with cultivation extending up to one kosh.[139] It was believed that saffron seeds came from Zewan village.[140] Jahangir said that Kashmir produced the highest amount of saffron in the

[135] William Finch, Early Travels, p, 299.

[136] Moreland, *Relations of Golconda in the Early Seventeenth Century*, p, 36.

[137] *Aini-i-Akbari,* Voll, II, p, 357. Abul Fazl, explained the method of saffron cultivation in the Kashmir valley. According to him, "At the close of the month of March and during all April, which is the season of cultivation, the land is ploughed up and rendered soft, and each portion is prepared with the spade for planting, and the saffron bulbs are hard in the ground. In a month's time they sprout and at the close of September, it is at its full growth, shooting up somewhat over a span. The stalk is white, and when it has sprouted to the height of a finger, it begins to flower one bud after another in succession till there are eight flowers in bloom. It has six lilac-tinted petals. Usually among six filaments, three are yellow and three ruddy. The last three yield the saffron. When the flowers are over, leaves appear upon the stalk. Once planted it will flower for six years in succession. The first year, the yield is small, in the second as 30 to 10. In the third year it reaches its highest point and the bulbs are dug up. If left in the same soil, they gradually deteriorate, but if taken up they may be profitably transplanted."

[138] *Ibid,* p, 357. Also see, *Tuzuk-I-Jahangir,* p, 92.

[139] *Tuzuk-I-Jahangir,* p, 93.

[140] *Aini-i-Akbari,* Vol, II, p, 358. Abul Fazl Writes, "In the village of Zewan are a spring and a reservoir which are considered sacred, and it is thought that the saffron seed came from this spring."

world.[141] From Kashmir, saffron was sent to Agra and it was also exported to many other countries.[142] Saffron cultivation was also found in South India.[143]

Cultivation and consumption of coffee and tea in Mughal India is still a debatable subject. J Ovington says that Indian people had temptations to drink coffee plentifully. He also talked about the art of making coffee. He mentioned, "When it is truly boiled and prepared, it carries a kind of yellow oil upon the head of it, by which it acquires a soft, pleasant relish, and requires so much art in bringing it to this perfection."[144] Irfan Habib says that the use of coffee as a beverage had become familiar for the upper class Indian people. However, he also says that coffee is not mentioned in the *Ain-i-Akbari*, or other sources of the Mughal times up to Shahjahan's reign. So it is likely, therefore, that it became popular only in the latter part of the 17th century.[145] In Aurangzeb's time, coffee was used as a gift item at the court. In those days, coffee was largely grown in Arabian countries, particularly in Mocha, and from there it was imported to India.[146] During Mughal rule, tea was just coming to be known, but was not produced anywhere in India, even not in Assam,[147] which is famously known for the tea cultivation in the present time. J. Ovington, on the other hand argues that, tea was a popular drink among all Indians. He claims that tea with some spicy spice mixed in and heated in water is said to be effective against headaches, gravel, and gut cramps and that it is commonly consumed in India, either with sugar-candy or for the more

[141] *Tuzuk-I-Jahangir,* pp, 92-93. He mentioned that, "The annual crop is 500 maunds by Hindustan weight, equal to 5,000 *wilayat* (Persian) maunds."

[142] Pelsaert, *Jahangir's India*, p, 35. Also see, De Laet Joannes, *Imperio Magni Mogolis,* p, 58.

[143] Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History of India,* Vol. I, p, 229. L.B. Alaev says that in South India the third category of land produced different types of crops for whole year and saffron was one amongst them. The other crops were like, Sugarcane and Indigo also produced throughout the year.

[144] J. Ovington, *A Voyage to Surat In The Year 1689,* Oxford University Press, London, 1992, p, 180. Hence forth cited as J. Ovington, *A Voyage to Surat*.

[145] Irfan Habib, *Agrarian Economy*, p, 51.

[146] J. Ovington, *A Voyage to Surat*, p, 180.

[147] Irfan Habib, *Agrarian Economy*, p, 51.

adventurous, with small conserved lemons. Good quality tea cultivation was found in China. A Chinese Mandarin brought different types of tea to Surat.[148]

In south India, Malabar was known for its spices. Ibn Battuta provides a complete description of the pepper production in Malabar. He noticed that the natives planted the pepper bushes opposite the coconut trees. It is because they can climb like vines, but they have no tendrils as in the case of vines.[149] Different types of spices were grown in Mughal India, and like other crops, it was also one of the major crops of the period under review. Pepper, ginger, cardamom, nutmegs, maces, cloves, and cinnamon were some of the major spices.[150] Pepper was one of the main commercial articles. Bengal produced long pepper.[151] Black pepper, one of the best items of world trade, was produced in the southern ranges of the Western Ghats. Pepper cultivation was also found in Bijapur, Bihar,[152] Kutch, and Malabar regions. The Malabar pepper and other spices were of high market value not only in southern India but all over the world.[153] From Masulipatanam, pepper, and spices were exported to Pegu and Sumatra.[154] Whether capsicum or chilli production was known to Mughal India or not? G. Watt argued that these names were not mentioned by any Sanskrit scholars and perhaps their introduction into India might have taken place in recent times. He also says that it was the Portuguese who brought this fruit to India from the West

[148] J. Ovington, *A Voyage to Surat*, p, 181.

[149] Ibn Battuta, pp, 183-184.

[150] William Finch, Early Travels, pp, 45-46. Explained different types of peppers cultivation in India. He writes, "The pepper is grown in many parts of India, especially about Cochin, and most of this grow in the fields among the bushes without any labour, and when it is ripe they go and gather it. When they first gather it, it is green, and then they lay it in the sun, and it became black. The ginger grown like into our garlic, and the root is the ginger. It is to be found in many parts of India. The cloves do come from this place. The nutmegs and maces grow together."

[151] Ryley Fitch, p, 189. Also see, William Finch, Early Travels, p, 46. Also see, Bernier, p, 440. Also see, Thomas Bowrey, p, 134. Also see, De Laet Joannes, *Imperio Magni Mogolis*, p, 71.

[152] Tavernier, Vol, II, p, 12.

[153] For Bijapur and Malabar region see, William Finch, Early Travels, pp, 45-46. Also see, Fryer, Vol, I, p, 139. And Tavernier, Vol, II, p, 11. Also see, Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History of India*, Vol. I, pp, 233-234.

[154] Ralph Fitch, p, 94.

Indies.[155] Capsicum or chilli, one of the widely used ingredients in preparing Indian meals, was unfamiliar to Mughal India. It was introduced in India only in and about the mid of the 18th century.[156] A native of America, probably from Brazil, cultivated capsicum and chilli all over the plains of India, and on the lower hills of Kashmir and in the Chenab valley up to the altitude of 6,500 feet. As per its length, shape, and colour, seven different varieties of capsicums and chillies were found in India.[157]

Areca-nuts were found in abundance at Budfattan, one of the oldest harbours of Malabar, from where they were exported to China.[158] Agricultural products shipped during this period were wheat, millet, rice, pulses, oilseeds, scents, medicinal herbs, and sugar. Some of the countries surrounding the Persian Gulf relied entirely on the subcontinent for their food. Cash crops like cotton cloth and other textile products were among the most widely traded items to Southeast Asia and East African countries. However, some of the products also reached Europe as well.[159]

Umari talks about the vegetables grown in the sultanate period. Such as ginger, carrots, turnip, vegetable marrow, eggplant, asparagus, beetroots, fennel, and thyme. Green ginger was cooked in the same manner as the carrot, and its taste was incomparable.[160] Different types of vegetables were grown throughout the Mughal Indian cities. Abul Fazal provides

[155] George Watt, *A Dictionary of The Economic Products of India, Vol, II*, Calcutta, 1885, pp, 134-135. He mentioned that, there was a great confusion exists in the Indian literature as to the cultivated species of capsicum. The larger one designated as capsicums and the smaller called as chillis. Cultivation of capsicums needs a light well-manured soil, which is the best for growing all kinds of capsicum. The plants should be picked out at about four inches apart when they attain a growth of three inches, and afterwards put out into a bed of rich light earth when they attain six inches in height, and good supply of water was necessary and it should be keep out from weeds.

[156] Irfan Habib, *Agrarian Economy,* pp, 51-52.

[157] George Watt, *A Dictionary of The Economic Products of India,* Vol, II, Calcutta, 1885, pp, 134-135.

[158] Ibn Battuta, pp, 187-188.

[159] S.M. Ikram, *Muslim Civilization in India,* Ed. By. Ainslie T. Embree, Columbia University Press, 1964, New York, p, 110.

[160] Umari, p, 115.

a list of vegetable names which were produced in Mughal times.[161] The period under review also found the introduction of some new vegetables. Such as sweet and ordinary potato, probably the later addition in Mughal times, which was introduced by Portuguese.[162] Apart from that, tomato and okra were also newly introduced. The period under review produced large varieties of vegetables which impressed all the foreign travellers. Pelsaert says that "turnips, various beans, beetroot, salads, potherbs grow here in abundance, as in Holland."[163] Edward Terry talked about different types of vegetables grown in this period, such as carrot, onions, garlic, ginger etc.[164] Manucci found a large supply of vegetables throughout the Kingdom of the Mughal Empire.[165]

The principal fruits produced during medieval period were apples, mangoes, oranges, grapes, dates, melons, pomegranates, plantains, peaches, grapefruit, figs, lemons, *amla*,

---

[161] *Ain-i-Akbari*, Vol. I, pp, 63-67. He writes, Fennel, Spinach, Mint, Onions, Garlic, Turnips, Cabbage, Kankachhu, Dunwretu, Shaqaqul (wild carrot), Upalhak, Jitu, Ginger, Pol, Kachnarbuds, Chuka (sorrel), Bathwah, Ratsaka, Chaulai. Palwal, Gourd, Badinjan, Turai, Kanduri, Senb, Peth, Karilah, Kakurah, Kaachalu, Chachinda, Suran, Carrots, Sing'harah, Salak, Pindalu, Seali, Kaseru. Surans and sealis were grown during summer season, palwaals, gourds, turais, kachalus, chachindas, kanduris, senbs, peths, karilahs, kakurahs, and singharahs were produced in rainy season. Carrots, salaks, pindalus, and kaserus were cultivated in winter. Badinjans were produced throughout the year.

[162] George Watt, *A Dictionary of The Economic Products of India*, Vol, III, Calcutta, 1885, p, 117. He says, "There is no Indian name for the sweet potato that has any stronger claim to being original and specific in its nature, so that there seems no doubt as to the sweet-potato being a modern introduction into India, and most probably considerably after the date of Linschote's visit to the Portuguese possessions on the western coast." Also see G.E. Wickens, N. Haq and P. Day, Edit, *New Crops for Food and Industry*, London, 1989, p, 131, talked about the chemical composition of sweet potato, he stated that, "The chemical composition of sweet potato tuber consist of 50-81 percent moisture, 8-29% starch, 0.5-2.5% reducing sugars, 0.5-7.5% non-starch carbon hydrates, 0.9-2.4% protein, 1.8-6.4% either extract and 0.9-1.38% mineral matter (ash). Sweet potato is rich in carotene, especially in the orange fleshed varieties. It is also a good source of vitamin C and those of the B complex."

[163] Pelsaert, *Jahangir's India*, p, 48. Also see, Surendranath Sen, Ed. *Indian Travels of Thevenot and Careri*, New Delhi, 1949, p, 199-206.

[164] Edward Terry, *William Finch, Early Travels*, p, 297.

[165] Niccolao Manucci, *Storia Do Mogor or Mogul India*, Tr. By, William Irvine, Vol. I, London, 1907, p, 66. Henceforth cited as Manucci. Also see, peter Mundy, p, 310.

bananas, guavas, *mahwa*, tamarind, *jamun*. *Karna, jhong, khirnee, jaman*, jack-fruits, and cocoanuts were plentiful on the coasts.[166] While talking about mango and mango tree, Ibn Battuta states, "The fruit of the tree is as large as a big pear and is green before it is quite ripe. The mangoes which have fallen from the tree are picked up, sprinkled with salt, and pickled like the sweet lime and lemon in our country."[167] Babur also talked about mango, he writes, "Mangoes are usually plucked unripe and ripened in the house. Unripe, they make excellent condiments that are also preserved in syrup."[168] Mango was considered one of Hindustan's greatest fruits by Babur, who preferred it above all other fruits except musk-melon.[169] Unripe mangoes were also used for conserves.[170] Mangoes were found all across India, particularly in Bengal, Gujrat, Malwa, Khandesh and Deccan. Mango cultivation had increased in Punjab, when Akbar made Lahore as his new capital.[171]

Another fruit was the *kasera* harvested from the ground, which was extremely sweet.[172] Jambol (*Jamun)* trees were large in size. It was black in colour and, like the olive, had one stone.[173] Babur says, "The *jamun* fruit is like a black grape, is sourish, and not very good."[174] While talking about the production of bananas, Umari tells us, "The Banana abounds in India, but it is rarely planted in Delhi and the area around it. It is brought to Delhi in plenty."[175] Oranges were abundant in India. They grew well in Lamghanat, Bajaur, and Sawad. The *Sangtara* was a fruit resembling the orange. The large lime (*gal-gal*) also compared to the oranges and was remarkably juicy. The lemons resembled oranges and were also acidic. [176] The jack-fruit was a fruit of singular form and flavour. It was

---

[166] K. M. Ashraf, *Life and Conditions of The People of Hindustan,* New Delhi, 1970, p, 119.

[167] Ibn Battuta, p, 16.

[168] *Baburnama*, p, 503.

[169] *Ibid*, p, 503.

[170] Ibn Battuta, p, 16, *Baburnama,* p, 503.

[171] *Ibid*, p, 68.

[172] *Ibid*, p, 18.

[173] *Ibid*, p, 17.

[174] *Baburnama*, p, 506.

[175] Umari, p, 115.

[176] Ibn Battuta, p, 17. Also see, *Baburnama,* pp, 510-512.

sickeningly sweet and very adhesive.[177] The (Sans) *amla* (the myrobalan-tree) was a five-sided fruit, and it was a wholesome fruit and astringent in taste.[178] According to K. M. Ashraf, "Babur never forgets the melons of his country when he goes about Hindustan. In fact, he had some of the best musk melon plants of Kabul brought to India and planted in his garden at Agra."[179]

Akbar thought that fruits were one of the utmost gifts of God, and he paid more attention to them for which he invited the horticulturists of Iran and Turan.[180] After the conquest of Kabul, Qandahar, and Kashmir, loads of fruits were imported and for the whole year the stores of the dealers were full with fruits, and it was delivered to the market as well.[181] Abul Fazal said that Muskmelons were delicious, tender, opening, and sweet smelling. Kashmir, Punjab, Bhakkar, and its vicinity produced a large number of muskmelons.[182]

During the Mughal rule, different types of grapes were produced in Kashmir. Eight sets of grapes were sold in Kashmir at one dam, and the cost of the transport was two rupees *per man*. The Kashmirians bring them on their backs in conical baskets. [183] From the month of September to March-April, grapes, and cherries were imported from Kabul, and from Samarqand, melons, pears, and apples were imported.[184] During Jahangir rule, different types of fruits were imported from Kabul and Kandahar, such as apples, pears, quinces, pomegranates, melons, almonds, dates, raisins, filberts, pistachios, etc.[185]

Like Vegetables, different varieties of new fruits were also introduced in the Mughal period, such as pine-apple (Ananas) which was introduced by the Portuguese.[186] Within a

---

[177] *Baburnama*, p, 506.

[178] *Ibid*, p, 508.

[179]*Ibid*, p, 503. Also see, K.M Ashraf, *op. cit.* p, 119.

[180] *Ain-i-Akbari*, Vol. I, p, 64.

[181] *Ibid*, p, 64.

[182] *Ibid*, p, 65.

[183] *Ibid*, p, 65.

[184] *Ibid*, p, 65.

[185] *Tuzuk-I-Jahangir*, p, 48.

[186] John Huyghen Van Linschoten, *The Voyage*, Ed, By. Coke Burnell, London. 1885. Vol, II, p, 19. Henceforth cited as Linschoten. Writes, "Ananas is one of the best fruits, and of the best taste in all India. It

shorter time period the cultivation of pineapple spread to many parts of the country. Abu-l Fazal, mentioned it as one of the prominent fruits of India. Papaya and cashew-nut were also introduced by the Portuguese. However, the cultivation of papaya and cashew-nut took more time to spread.[187] Guava, another new fruit, was probably introduced after the Mughal rule.[188] The Portuguese were also probably the first to produce varieties of mango by using grafting technology.[189] Before Akbar's rule, sweet cherry was not cultivated in Kashmir, it was Muhammad Quli Afshar who introduced it from Kabul by using grafting technology. By adopting the same method a large number of apricot trees were grown.

Delhi sultanate period witnessed the remarkable development of gardens, which contributed to the improvement of Indian fruit quality.[190] During Muhammad Tughluq's rule, peasants were encouraged to raise a large number of grapes.[191] Firuz Tughluq was very fond of laying gardens.[192] He carried out an extensive programme of laying gardens. His chronicler tells us that he built 1200 gardens in the proximity of Delhi,[193] which were green and blooming.[194] In every garden, all varieties of fruits were found. Palm dates, oranges, beautiful red flowers, trees, wild tansy, plums, and seven types of fruits of grapes,

---

was first brought by the Portingalles (Portuguese)." Also see, Della Valle, Vol, I, pp, 135-136. And also see *Tuzuk-I-Jahangir*, p, 173.

[187] Della Valle, *The Travels of Pietro Della Velle in India*, Vol. I, Ed, By, Edward Grey. London, 1891, pp, 134-135. Henceforth citied as Della Valle. While he was in Daman, he had tested these two fruits. He says papaya tests and shapes were the same with melons found in their country. Also see, Thevenot, p, 102, who found its cultivation in the route from Surat to Aurangabad. Also see, Linschoten, Vol, II, p, 27, says Cashew-nut cultivation was found in Portuguese, from which it came to India.

[188] Irfan Habib, *Agrarian Economy*, p, 55, says that the term *amrud* which is mentioned in the Mughal literature is not similar to guava.

[189] Manucci, Vol, II, p, 169. Writes, mango the best flavoured fruit in India. He mentioned the name of Niculao Afonco mango of Goa, perhaps named after the use of grafting technology.

[190] *Ibid*, p, 119.

[191] Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History of India,* Vol. I, p, 53.

[192] Shams-I Siraj Afif, *Tarikh-I-Firozshahi*, Eng. Trans. R.C. Jauhri, *Medieval India in Transition – Tarikh-I- Firoz Shahi A First Hand Account*, New Delhi, 2001, p, 171.

[193] *Ibid*, p, 171. Also see, Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History of India,* Vol. I, p, 53.

[194] *Ibid*, p, 171.

like white and black, were grown in these gardens. One jital per seer was the price for these fruits.[195] Apart from that, different varieties of dry fruits were also produced in each garden. At Daulatabad, grapes and pomegranates were raised, which bore fruit twice a year. Whereas there were orchards of fruit trees, the lands were irrigated by water wheels at Sagar (on the Narmada).[196] Chittor, Dholpur, Gwalior, and Jodhpur adopted improved fruit cultivation and gardening methods. Meanwhile, in Jodhpur, considerable emphasis was given to the improvement of pomegranates. Sikandar Lodi compared the flavor of Jodhpur pomegranates to that of Persian pomegranates, claiming that the variety in the flavor of Jodhpur pomegranates was superior to that of Persian pomegranates.[197] Afif says that Orissa produced a large number of grains, the houses of the people were wide and spacious with gardens that were capable of growing fruits and dry fruits within their compound.[198] Shihabuddin al Umari tells us that Delhi was surrounded by gardens and each one stretched to the extent of twelve miles. Only the western side of Delhi had no gardens because this side has Aravalli hills.[199] The various types of fruits grown in these gardens were largely meant for the towns and wealthy individuals. However, all these gardens generated some employment and added revenue to the state.[200]

During the Mughal period melons, grapes, and other fruits were grown in the gardens and orchards. Great and wealthy people planted Persian vines in their gardens. Seedless grapes were grown, but only one out of every three years does the fruit develop properly. During the months of December, January, and February, oranges were abundant, and they were

---

[195] *Ibid*, p, 171. Also see, Shams-I Siraj Afif, *Tarikh-I-Firozshahi*, Eng. Trans. By, Elliot and Dowson, *The History of India As Told By its Own Historians.* Calcutta, 1871, pp, 86-87. Also see K.M Ashraf, *op. cit.* p, 119.

[196] Ibn Battuta, pp, 170-172.

[197] K.M Ashraf, *op cit.* pp, 119-120.

[198] Shams-I Siraj Afif, *Tarikh-I-Firozshahi*, Eng. Trans. R.C. Jauhri, *Medieval India in Transition – Tarikh-I- Firoz Shahi A First Hand Account*, New Delhi, 2001, p, 109. Henceforth cited as R.C. Jauhri, *Medieval India in Transition.*

[199] Umari, 116.

[200] R.C. Jauhri, *Medieval India in Transition*, p, 171. Afif says that the gardens added one lakh eighty thousand tankas revenue. In comparison, the total revenue collection of the Doab territory was eighty lakh *tankas.* And the entire revenue collection of the sultanate of Delhi rose to six core and fifty lakh *tankas.*

also grown in June and July. Large quantities of lemons and oranges were produced in the Bayana region.[201]

Starting from being a food gatherer, then becoming a food cultivator, the food habits of human beings have constantly changed. In the first phase, fruits were the main dietary item. When man developed his hunting skills, meat began to enter the meal. Then after the development of agriculture, the dependence on meat started to decline.[202] As we know, from the earliest time to till today, the food habits of Indian people are different from one place to another.[203] The food habits of South Indian people are different from the food habits of the North Indian people. [204] This difference in food habits occurred due to various reasons. It may be the availability of the food crops produced in that particular region or may be due to the climate which suits particular food for consumption, the economic condition of the people, traditional norms, religious beliefs, and societal values.[205] Food habits also change because of the introduction of new crops and migration from one region to another.[206]

Now the question before us is, what were the food habits of medieval people, was there any change or not? The period under review found the introduction of new crops. Iban Batuta states that "kudhra (paspalum scrobiculalum), a kind of millet, which is found most abundantly, *qal*, which resembles the type of millet called *anli*, and *shamak*, which is smaller in the grain than *qal*, were the food of the poor and needy."[207] They prepare *mung*

[201] *Tuzuk-I-Jahangir*, pp, 48-49.

[202] K.T. Achaya, *op cit.* p, 1. He explained how the food habit of man changes over a period of time, starting from the glacial ages to till now.

[203] T. Krishnakumar, 'Traditional Foods of India,' *Research Gate*, p, 3.

[204] K.T. Achaya, *op cit.* pp, 117-141, gives a detail description of the food habit of different regions.

[205] Arani Saikia, 'Food-Habit in Pre-Colonial Assam,' *International Journal of Humanities and Social Science Invention*, Vol. II, June, 2013, p, 1.

[206] Margaret Mead. The Factor of Food Habits. *Op. cit.* p, 137. In this work she explained how various factors affect food habits of American people, such as geographical factors, social factors. The work also deals with how people change their food habit due to some of the unavoidable factors, i.e. changes dictated by physical circumstances, changes dictated by a lowering of the economic status of the individual, the group, or the nation, and changes dictated by alternation in the bodily state of the individual.

[207] Ibn Battuta, p, 18.

with rice and consume them with ghee for breakfast, which they call *khichri*.[208] The common people's food of Mughal India, were jowar or bajra flour which was kneaded with water and jiggery and baked into rotis. Rice cooked with pulses known as *khichri*. During Mughal rule south India produced different types of crops. Millets (*cholam, ragi, varagu,* etc.) occupied a comparable area of production. The poor people of this region used to exchange their rice to purchase *ragi* and *cholam* for their own consumption.[209] Khafi Khan says Jowar and Bajra were the main support of the people of the Deccan, while the rice was the principal food in Telangana.[210] Pelsaert also says that jowar, bajra and kangi were the food grains consumed by the poor.[211] Fernao Nuniz, a Portuguese traveller who visited the Vijayanagar Empire in 1535, claimed that millet was the most consumed grain in the land**.** Betel was cultivated in this region and the people of this country "always eat and carry it in the mouth."[212] Regional variation of food habit was also noticed in the Mughal period.[213]

---

[208] Ibn Battuta, pp, 18-19.

[209] Tapan Raychaudhuri & Irfan Habib, *Cambridge Economic History of India,* Vol. I, pp, 233-234. Also see, K.T. Achaya, *op cit.* p, 45.

[210] Yusuf Husain, *Glimpses of Medieval Indian Culture*, London, 1957, p, 150.

[211] Francisco Plesaert, p, 48.

[212] Fernao Nuniz, *A Forgotten Empire (Vijayanagar),* Ed. By, Robert Sewell, London, 1900, p, 333. Also see, M.S. Randhawa, *A History of Agriculture in India,* Vol. II. *Eight to Eighteenth Century*. New Delhi, 1982, p, 66. He write, "cereals which Indian sow and use for food."

[213] *Ain-i-Akbari,* Vol. II, p, 239, says, the principal food crops produced in the Gujrat provinces was, Jowari and Bajrah, and that was the principal food of the people. Also see, *Ain-i-Akbari,* Vol. II, p, 239, talks about the food habits of Bengal. In Bengal, people eat rice, fish, wheat and barley and that was their staple food. Today rice and fish curry is one of the common meal for every Bengali household. Also see, Ralph Fitch, p, 100, who mentioned that, the people of Satagam in Bengal, eat rice, butter, milk and fruits. Also see *Ain-i-Akbari,* Vol. II, p, 126, where it mentioned that, the people of Orissa eat rice, fish, the eggplant and vegetable. Abu-l- Fazal says that, the common food habits of the people of this Subah was, "when the rice is cooked, they steep it in cold water and eat it on the second day." And still these food habits exist in the state. Like this, *Ain-i-Akbari,* gave a detail descriptions of the food habit of the people of various provinces. The poor people of Bihar eat rice and pulses and Bihar is known for its cultivation of quality and quantity rice. The staple food for the people of Kashmir was rice, fish, wine and various vegetables. And the staple food of people of Tattah was rice and fish.

Now we can say that, in the medieval period, people largely used to eat those foods which were produced in their locality. And in this process the food habits of the people developed over a period of time or in the other words, the local crop pattern determined the food habits of the people who lived in that particular region. In India, we cannot produce all types of crops in one region, because the cultivation of crops depends on various factors. Such as the nature of the soil, fertility of the soil, climatic condition, and availability of water supply. So mostly it was the cropping pattern or availability of food grains, which determined the food habits of the particular region. However, it cannot be ignored that the choice of food habits and preferences, was also determined by the crop production of the particular region.[214] So it can be argued that many times crop production had its direct impact on food habits. Whereas K.R. Krishna and Kathleen D Morrison, argued that the food habits of the people and their choice of food, too influence cropping patterns. The period also witnessed the introduction of new food grains and vegetables such as maize and sweet potato, but it had not made any major impact on the existing food habits of the society. If there were any changes in people's food habits, it may be due to significant changes in cropping patterns in specific regions.

In this chapter, it was found that the principal food crops produced during our period were, wheat, rice, millets (jowar, bajra), barley, maize, and a variety of pulses. Cash crops grown in this period were sugarcane, Indigo, cotton, silk, opium, and tobacco. During the medieval period, different varieties of fruits and vegetable crops developed rapidly, which was able to impress all European travellers. By adopting new grafting technology, different varieties of mangoes and cherries were produced. Plenty of grapes and melons were grown in the gardens and orchards. Pepper, clove, cardamom, turmeric, saffron, betel leaf, and other vital spices were produced by medieval Indian peasants. Because of the great demand, the majority of the spices were exported to other regions of the world. The period

[214] K.R. Krishna and Kathleen D Morrison, 'History of South Indian Agriculture and Agroecosystems.' *Research Gate*, 2009, p, 12. While discussing the development of cropping patterns and food habits of South India, K.R. Krishna and Kathleen D Morrison, says that, "Agroclimate, water resources and soil nutrient status might have played crucial role in movement and establishment of new crops either way, into or outside of Southern Indian Neolithic sites. of course, food habits and preferences, too influence cropping pattern in a location, be it in Neolithic or modern times."

also witnessed the introduction of new crops, and new grafting techniques. In those days, both cropping patterns and the food habits of the people were interrelated with each other. The next chapter will be going to study the various contemporary sources and information related to agricultural practices, such as the method of cultivation, grafting technology, plant diseases, and their corrective measures, and various methods applied for predicting the availability of groundwater.

## Chapter Four

## Agrarian Production, Practice, and Text: A Study of Select Contemporary Texts.

Agriculture has always played a significant role in Indian society. Right from ancient times, the profession of agriculture has been appreciated. The discipline of agriculture or tilling the land is considered one of the oldest sciences and arts on the earth. The agricultural production system involved several steps, starting from the selection of land, to harvesting and storing the grains. Thus, before tilling the land, a peasant should have some essential skills and knowledge of agriculture, such as the selection of land for the crop he wishes to grow, selection of seeds, methods of cultivation, use of water, judicious use of manure, rotation of crops, the introduction of new crops, management of cattle, and so on. Now the critical question is, what was the source of knowledge in agriculture during the pre-colonial period? Were there any prescribed rules and regulations for the cultivation of land? By and large, peasants of those periods mostly gained knowledge from practical experiences or actual farming. Later on, they passed it on to the next generation. In other words, with the passage of time, the knowledge of agricultural production was passed from one generation to another. The important question before us is if the knowledge of agriculture production was passed from one generation to another from practical experiences, then were there any other sources of knowledge or text which prescribed the art of cultivation? The answer would be yes. Specific texts like "*Krishi – Parashara, Vrikshayurveda,* and *Nuskha Dar Fani Falahat*" dealt with agricultural production methods. All these three texts represent different time periods, which help us to understand the knowledge available in those periods. The authors of these texts also belonged to different regions. Irfan Habib[1] used "*Nuskha Dar Fani Falahat*" in his work because of its importance in obtaining knowledge on medieval agricultural practices, especially during the Mughal period. Apart from that text, not much attention has been given to other texts like "*Krishi Parashara* and *Vrikshayurveda,*" which contain valuable sources of knowledge for traditional agricultural practices followed in different periods and different regions. The gap in the

[1] Irfan Habib, *Agrarian Economy, op. cit*., p, 468.

acknowledgment and analysis of these texts has led me to explore these texts for the valuable knowledge on medieval agricultural practices. Therefore in this chapter, I have selected all these three texts and tried to understand what types of agricultural knowledge were described in these texts.

This chapter critically analyzes what kinds of information are available in these various texts in relation to agricultural production. This chapter also tries to understand the different types of methods of cultivation described in those sources and the different types of plough used for cultivation. How did peasants predict the availability of groundwater? What were the different corrective measures taken for the treatment of plant diseases, and how grafting technology was used for grafting different types of trees together? Further, the chapter also tries to understand whether the sources of knowledge keep on changing over a period of time or not.

Krishi – Parashara, a Sanskrit text written by the sage Parashara, was probably composed during 1050 A.D. and is the only available independent text on agriculture prepared during the early medieval period. This particular text is very useful because it gives us an insight into the methods followed in agricultural production during that period.[2] Today the text is available in printed form.[3] In this chapter, I would like to discuss some of the recommendations related to agricultural production, starting from ploughing the land to harvesting and storing of grain.

Krishi – Parashara, primarily speaks about agricultural practice, the term Krishi itself refers to agriculture. Krishi Parashara states that "the prosperity of the country is directly linked with the success of agriculture."[4] It also says that agriculture has been considered the main source of income, and it has remained the backbone of the country's economy with or

[2] Lallanji Gopal, *Aspects of History of Agriculture in Ancient India.* Bharati Prakashan, Varanasi, India, 1980, p, 1. Henceforth cited as Lallanji Gopal, *Aspects of History of Agriculture in Ancient India.* Also see, Sanjay Subodh, Agricultural Methods, p, 122.

[3] *Krishi Parashara*, pp, 33-34, for the first time, Majumdar and Banerji translated this text into English and published it in 1960. In the later period, other scholars also translated this text into Hindi and published it.

[4] *Krishi Parashara*, p, 31.

without *vanijiya* being associated with it.[5] The first member of the compound (*krishi*) is also used several times in the text. Its derivatives, such as *'krishaka,' 'karshaka', 'krishana',* and '*krishika',* all meaning 'a plowman' are also used frequently. Compounds such as '*karshakala'* (the time of ploughing), '*krishikarma*' (the act of ploughing or farming in general), and '*krishitapara*' (vigilant farmer) are also used. The word '*krishi*' is derived from '*kris*' (*karsati*), which means to plough or to cultivate.[6]

The process of agricultural production passes through different stages, such as preparation of soil, leveling of the soil, sowing of seeds, watering, manuring, harvesting the mature crops, and storage of the crops. For tilling the land, peasants needed a pair of oxen and a plough. Krishi – Parashara suggested a pair of black, red, or black red oxen for pulling a plough.[7] The text also gives a detailed description of the plough used for agricultural production.[8] Different parts of the plough are also discussed. The different parts of the plough are, *isha,* (the beam connected to the yoke), *yuga,* (where oxen are tide), *sthanu,* (the wooden support of the ploughshare), *niryola,* (steering rod used to control the direction of the plough), *niryolapashika,* (the handle for the farmer to get a grip on the plough), *addachalla,* (wooden pegs fitted through holes on the yoke), *Shaula,* (ploughshare iron blade used for digging the soil/mud), *panchanika,* (stick used to drive oxen). The measurements of *Isha* is five hand in length.[9] *Sthanu* should be five *vitastis*.[10] *Niryola* should be one and half hand while *yuga* should be extended up to the ears of the oxen. The

[5] *Krishi Parashara*, p, 31.

[6] Ibid, pp, 35- 36.

[7] *Ibid,* p, 57.

[8] *Ibid,* p, 56, talks about the different types of plough recommended for agricultural production. For plowing hard virgin soil, the circular *abaddha* (a disc-plow) was recommended, and its range should be fifty-four *angulas* (in diameter). *Phalaka* another type of plough was used for deep plowing, and its length should be measured nine *angulas.* A *Viddhaka* should have twenty-one spikes, and a *madika* measuring nine 'hand' is recommended for several uses. *Viddhaka* is a harrow that plows multiple rows and also used for sowing seeds in dry soil.

[9] *Krishi – Parashara*, p, 54, according to the text, *Isha* is five hand in length (the length from the elbow to the tip of the middle finger is one hand).

[10] *Krishi – Parashara*, p, 54, says, *Sthanu* should be five *vitastis* (the length from the trip of the thumb to the tip of the little finger of an extended palm is one *vitasti*).

other parts of the plough are not so large such as *Niryolapashika* and *addachalla* which measure twelve *'angulas'* (the breadth of a finger is one '*angulas'* and twelve *angulas* make one *vitasti*.). Whereas *Shaula* should be of an *'aratni'* measure, (the distance between the elbow and the tip of the little fingers is one '*aratni*').

*Panchanika,* another important part of the plough made up of bamboo,[11] with iron-end and the measurement of which is twelve and a half or nine 'fists.' For ploughing the hard virgin soil, the text recommended a circular *abaddha* or a disc-plough, and the length should be fifty-four *angulas* (in diameter). *Yotra is* one type of belt used around the neck of the ox and its length should be four hands. Likewise, rope (*rajju*) is also used for the same purpose and its length should be five hands. The *pahalaka* (ploughshare) is stated to measure a hand or a hand and four fingers while a phalika resembling a leaf of an *arka* shrub (*Calotropis gigante*) measures nine *angulas.* There are also accessories of the plough to be used as a substitute for the *Shaula,* as and when needed. *Phalaka* is used on irrigated soils, and *phalika* is used to plough deep. A *viddhaka* should have twenty-one spikes. A *madika* measuring nine hands is recommended for several uses. *Viddhaka* is a harrow that ploughs multiple rows. This is used for sowing seeds in dry soil. *Madika* is a wooden plank fitted to the plough to level soil inundated with shallow water. As per the text, farmers are strongly recommended to use all this equipment in various farming activities. Any deviation in the implementation is not used as it is stated in this text that it may cause obstruction to the work.

As per the text, the peasants should know which are the best days for plowing the land. Peasants are advised to Plow their land on Mondays, Wednesdays, Thursdays, and Fridays, which promotes healthy agricultural production. On the other hand, plowing on Tuesday, Saturday, or Sunday, may cause impediments from the king. Plowing on the second, third, fifth, seventh, tenth, eleventh, and thirteenth days of the month is described as good. Furrows should be single, or in groups of three or five in number. Single furrows lead to success, three furrows to prosperity, and five furrows give a bumper crop. If an ox drops dung while plowing the soil, it suggests an increase in agricultural yield, whereas if an ox

[11] *Krishi – Parashara,* p, 56, the text says, the *Panchanika* should be strong, made of bamboo, (*Bambusa arundinacea* Willd).

drops urine, it indicates an increase in the probability of floods. If a peasant has not plowed his land in *Mrigashirsha (Mriga) nakshatra* in the sign of Aquarius (January 20-February 18) should not expect any fruit of his labor of tilling. Likewise, the text also speaks about the number of auspicious and inauspicious days of plowing. It is strictly recommended the days, dates, and other astrological numbers for when to plow the land and when the peasant should avoid plowing his land.[12]

After plowing, different types of tools were used for clearing and leveling the land.[13] However, this text is silent about the use of different types of tools that were used for clearing and leveling the land. The very next step suggested in the text after plowing the land is the collection and preservation of seeds. In the months of *Magha* (February) and *Phalguna* (March), all varieties of seeds should be purchased and dried thoroughly in the sun, rather than being placed directly on the ground. *Putikas* (small receptacles) are afterward made and the seeds are kept in them. Different kinds of seeds must be kept separate, for mixed seeds are not good. After the seeds have been placed in, the *Putika* must be well closed, grass that may grow out of it must be up-rooted or when the seeds sprout, the field will be full of grass. Ghee (clarified butter), oil, buttermilk, lamp, or salt should never be used on seeds by accident. Seeds that have come into contact with light, fire, or smoke and have been exposed to rain or stored in a pit should always be removed, as non-viable seeds turn everything into barrenness, including the farmer, the manure, the furrow, the oxen, and the multiplicity of rain clouds. These instructions can be used to sow sesame (Sesamum indicum L.), rice, and barley seeds. As a result, every effort should be made to obtain and preserve these seeds, because a good quality seed gives a good agricultural output.[14]

---

[12] *Krishi Parashara*, pp, 56-58.

[13] H.K. Naqv, *Agricultural Industry*, p, 14, says that during the medieval period, peasants used different types of tools for clearing and leveling of land. In order to clear the land of stones and weeds, tools like tongs, *phalis* were used. In the case of thorney weeds, the use of a sickle was more effective. Whereas to level the soil by breaking the clods or lumps of earth, medieval peasants used wooden boards. This was called *patella* (a Hindi word).

[14] *Krishi Parashara*, p, 59.

There are two types of seeds: one for sowing and one for planting. It says that seed meant for sowing is free of diseases and those for planting always carry disease. Paddy seedlings that have grown into plants in the nursery should not be transplanted since they are ineffective. It means fully grown plants should not be raised; transplanting should be done while the plants are young. The text also recommended the distance between two plants, "the seeds of grains should be planted at a distance of a hand (approximately 1 ½ ft = 45 cm) when the sun is in Cancer. In Leo, the distance should be half of it. In Virgo, it should be four fingers (3-4 inches = 7.6-10.2 cm)."[15]

Sowing seeds in the month of *Vaishakha* (May) is best, sowing of seeds in the month of *Jyeshtha* (June) is average, In *Aashadha* (July) bad, and in *Shravana* (August) the worst. The months from (April to May) known as the hot season, is the best time to sow seeds for transplantation. *Uttarashadha Uttarabhadrapada, Uttaraphalguni, Mula, Jyeshtha, Anuradha, Magha, Mrigashirsha* (*Mriga*), *Rohini, Hasta,* and *Revati* are recommended as the good *nakshatras* for sowing. According to the text, a farmer reaps only seeds by sowing seeds in *Shravana, Purvashadha, Purvabhadrapada, Purvaphalguni, Vishakha, Bharani, Aardra,* and *Swati nakshatras.* Both Tuesday and Saturday are advised to avoid sowing and transplanting. The Earth resonates with the sound of water and is said to be in *menstruation* at the end of *Mrigashirsha* (*Mirga*) and in the first quarter of the next star, i.e. *Aardra,* therefore, sowing of seeds is not recommended at this time. Further, the last three days of *Jyeshtha* and the first three days of *Aashadha are also* prohibited for sowing of seeds. Peasants need to level[16] their land after sowing for good germination of seeds; otherwise, seeds do not germinate properly.[17]

After ploughing, sowing, and leveling of the land, the next steps are watering and manuring. Water is a very essential prerequisite for Indian agricultural production. Parasara also gave importance to the judicious use of water**.** Whether it is *Aashadha* (July) or *Shravana* (August), the peasants need to construct small bunds to retain water. And if rains

[15] *Krishi Parashara,* p, 60.

[16] *Ibid,* p, 60, the text only talks about the leveling of land after the sowing of seeds however, the tools used for leveling the land is not discussed.

[17] *Ibid,* p, 60.

are scanty, attentive peasants need to construct these bunds in the sign of Cancer (June) itself. *Krishi Parashara* talks about the systematic and regular use of cow dung as manure. Cow dung should be taken out as manure at the time of sowing, and crops grown without manure will not give yield.[18]

The necessity of the second ploughing of the land has also been discussed in this text. We have already discussed that the seeds are of two types. In the case of those for which transplanting is not necessary, the field is ploughed for a second time in the month of *Asadha* or *Sravana*, after the seeds grow into plants. This destroys some of them but they subsequently turn into manure and give healthier growth. For want of sufficient timely rains, the second ploughing may be done in the month of *Bhadra*, but in that case, the products will only be half. If the second ploughing is not done before *Asvina*, the prospect of harvest is little.[19] Even a well-grown crop, will not provide full returns if the grass is not weeded out. Due to the grass, the yield is significantly decreased. The wedding should be done twice in *Ashwin* (October), and peasants need to make a full effort to weed out all grass, for getting good output from the land.[20]

To maintain the crop disease-free, peasants need to drain all the water from the land during the month of *Bhadrapada*. Only enough water to moisten the roots should be preserved. "If crops are allowed to be in large quantities of water in *Bhadrapada* (September), they are damaged by various harmful factors depriving the farmer of a good harvest."[21]

Token harvest should start during the month of "*Margashirsha"* (November and December). On a particularly auspicious day, the farmer should first bathe and then pluck two and a half fistfuls of grain from the crop. For this purpose, the peasant should first worship the plants of grains in the northeastern direction of the farm with sandal paste, flowers, offerings, and incense and then pluck the plants as enjoined. The text recommends many ceremonies related to crop harvesting.[22] Peasants were advised to start digging (of

[18] Krishi Parashara, p, 54.

[19] R. Gangopadhyaya, *op. cit.*, pp, 70-71.

[20] *Krishi Parashara*, p, 61.

[21] Ibid, p, 61.

[22] *Ibid*, pp, 62-63.

the threshing pit) after leveling, and the same should be smeared with cow dung in the month of "*Margashirsha"* (November-December). Then a (threshing) pillar should be implanted carefully. And the threshing pillar should not be implanted in "*Pausha"* (January), on an inauspicious day, or in the "*Shravana"* asterism.[23] The text recommended the harvesting of the crop in the month of *"Pausha"* (January), and after threshing the crop, peasants need to measure the grains with "*Adhaka."* [24] Grains should be stored in the auspicious "*Meena"* (Pisces) "*lagna"* (February), which was believed to be the best month for storing the grains.[25] The following agricultural implements such as, "*Srini* (sickle), *Khanitra* (hoe), *Musala* (pestle), *Udukhala* (mortar), *Surpa* (winnowing basket), *Dhanyakrt* (winnowing fan), *Calani* (sieve), *Sthivi* (granary), *Methi* (the post of threshing floor round which cattle turn to thresh out the grains)," etc. used for agricultural production.[26]

Like Krishi Parashara, another early 12th century medieval text "*Vrikshayurveda*" written by Surapala, who was a physician to king Bhimapala of Bengal and belonged to the early part of the 12th century.[27] This text deals with various aspects of agricultural practices in general and plant related issues in particular. In other words, the text primarily dealt with the plants, such as the best time to plant trees, different types of plant diseases and their corrective measures, merits and demerits of planting trees near the house, methods of the plantation, and the nature of soils. Apart from that, the text also talks about the prediction of groundwater, horticultural wonders, etc.

---

[23] *Krishi Parashara,* p, 63-64.

[24] In *Krishi Parashara,* "*Adhaka,* is stated to be measuring twelve fingers." *Adhaka,* is a wooden vessel used to measure grains roughly equivalent to 7Ib and 12 oz (about 3.5 kg). It is equal to one-fourth *drone.* This is obviously different from "*jalaadhaka*" defined in verse 26 which is a unit for measuring the amount of rainfall, p, 65.

[25] *Krishi Parashara,* p, 65.

[26] R. Gangopadhyaya, *op. cit,* p, 65.

[27] Lallanji Gopal, *Aspects of History of Agriculture in Ancient India*, p, 104. Also see, Sanjay Subodh, Agricultural Methods, p, 122.

"*Vrikshayurveda*" starts with the importance of planting trees,[28] the merits and demerits of planting different types of plants near the residential areas, different types of soil, methods of planting trees, plant nourishment, etc. This chapter is going to deal with certain specific recommendations like plant disease, its corrective measures, and how the availability of groundwater was predicted.

All plant diseases are divided into two broad categories. Those are internal and external diseases. For example, internal diseases are those associated with the *vata*, *pitta*, and *kafa* (humor). Whereas external diseases include those caused by insects, cold weather, and other factors. The diseases induced by *vata* are caused by the land becoming arid because of an abundance of dry and smelly materials. Most of these diseases are the thinness and crookedness of the trunk, the appearance of knots on the trunk or leaves, and the fruits being hard, with less juice and less sweetness.[29]

The *pitta* type of disease takes place at the end of summer if the clouds disappear and the trees receive an excessive amount of water which are bitter, sour, salty, and strong. These illnesses include decay, dryness, and paleness of leaves, flowers, and fruits, premature fruit drop, and yellowness of the leaves. Whenever trees are subjected to extreme heat, the roots are eaten away by insects, resulting in drying yellowness and excessive paleness of foliage. Stormy winds generate stress, resulting in the tree breaking, uprooting, and twisting. There are two types of breaks: The branches stay attached in the first type of break. Whereas in the second type of break, the branches fall off. The *kafa* types of diseases are mostly found in the time of winter and spring if the trees are overwatered with substances that are sweet, oily, sour, or cold. Generally, these types of diseases take a longer time to bear fruits, paleness, dwarfing of leaves, tastelessness, and prematurity of fruits.[30] The trees dry up for a variety of reasons, such as when a tree gets exposed to fire, or lightning, due to the aridity of the soil, and sometimes due to the absence of water when struck with an axe, etc. the

[28] *Vrikshayurveda,* p, 52. According to the text, planting five trees is far better than giving birth to ten sons as the former offers libations to the father planter with leaves, flowers, and fruits. Like this, the text provides many other example of the benefit of planting trees.

[29] *Ibid,* p, 52.

[30] *Ibid,* pp, 52-53.

trees are wounded, and that results in dryness of all types of trees. The trees ooze out even without wounds due to an imbalance of the "*kafa*" element. The corresponding diseases of the "*vata*" type develop if the wrong treatment is applied. Most of the trees lose their leaves, flowers, and fruits day by day because of the *vata-type* of diseases. Similar consequences occur due to excessive watering, heat exposure, or the wrong type of soil and unfavorable season. The imbalance of these elements, such as *Vata, pitta,* and *kafa* enhances the disease of jaundice (yellowing). The trees which get affected by jaundice disease, their trunks, fruits, and leaves turn yellow. An imbalance in the elements, like, *vata, pitta,* and *kafa,* develops due to faulty seed, lack of treatment, and wrong treatment and renders all the trees unproductive.[31]

Trees suffer from bad smell, lack of original smell, and dwarfing of leaves and sprouts because of ant attacks and indigestion caused by excessive water. The trees are also destroyed due to fire, wind, friction with other trees, a constant presence in the shade, inhabitation by too many birds, excessive growth of creepers, and the growth of weeds nearby. Various diseases of trees should be diagnosed, and treatment should be given as per the need and requirement. "*Vrikshayurveda*" prescribed different types of corrective measures for the above mentioned diseases. Some of the corrective measures are discussed below.[32]

Meat, marrow, and ghee are the remedies suggested for the treatment of *vata* types of diseases. The sprinkling of "*Kunapa*" water is also recommended for the treatment of this particular type of disease. Apart from that, the *vata* type of diseases can be quickly controlled by using liberal fumigation with a mixture of hog fat of the hog, the Gangetic porpoise, ghee, hemp, and horsehair oil, and cow's horn that has been boiled and decocted. The diseases of the *kafa* type can be overcome with bitter, strong, and astringent decoctions made out of *panchamula* (roots of five plant species-*sriphala, sarvatobhadra, patala, ganikarika,* and *syonaka*) with fragrant water. For warding off all "*kafa"* types of diseases, the paste of white mustard should be deposited at the root and the trees should be watered with a mixture of sesame and ashes. If trees get affected by the "*kafa*" types of disease,

[31] *Vrikshayurveda,* p, 53.

[32] *Ibid,* p, 53.

then the earth around the roots of the trees should be removed, and fresh, dry earth should be replaced to cure them.[33]

A knowledgeable person should handle all types of trees infected by the "*pitta"* type of disease with cool and sweet substances. Trees suffering from "*pitta*" diseases are treated when they are watered with a decoction of milk, honey, *yastimadhu*, and *madhuka*. Watering with the decoctions of fruits, "*triphala,"* ghee, and honey are also used for the treatment of all types of "*pitta"* diseases. To remove insects from both roots and branches of the trees, one needs to water the trees with cold water for seven days. The worms can be killed with a paste of milk, "*kunapa*," water, and cow dung combined with water, as well as by putting white mustard, *vaca*, *kusta*, and *ativisa* on the roots. The worms that have accumulated on trees can be promptly cured by burning them with a mixture of white mustard, *ramatha*, *vidanga*, *vaca*, *usana*, and water combined with meat, buffalo horn, pigeon flesh, and *bhillata* powder. Worms, insects, and other pests are killed by anointing with *vidanga* mixed with ghee, watering for seven days with salt water, and (applying) ointment consisting of beef, white mustard, and sesame. Insect-eating creepers should be sprayed with a solution of water and oil cake. The insects on the leaves can be killed by spraying ashes and brick dust on them. After being anointed with a mixture of *vidanga*, sesame, cow's urine, ghee, and mustard, a wound caused by insects cures if it is sprinkled with milk.[34]

If the Tree is suffering from (damage due to) frost or scorching heat. In such cases, first, the tree should be externally covered, and then it should be sprinkled with *kunapa* water and milk. The fractured trees should be covered with a paste made from *plaksa* and *udumbra* bark mixed with ghee, honey, wine, and milk, and the broken pieces should be tightly bound together with rice stalk rope. The basin around the trees should then be filled with fresh soil, sprinkled with buffalo milk, and soaked with water. As a result, they recover. If the tree's branches break off, the area should be coated with a honey-ghee mixture and milk and water sprinkled over it so that the tree will have its branches reaching the sky. If the branches have been burned, they should be chopped off, and the particular

[33] *Vrikshayurveda*, p, 54.

[34] *Ibid,* p, 54.

damaged portions need to be sprinkled with water and milk, smoked with carb shells, and so on. Thus treating the trees will put forth fresh sprouts.[35]

If the trees are scorched with fire, the whole tree should be smeared with mud from the lotus creeper and then should be watered with *kunapa* mixture. Then its branches grow up to the sky. Trees that are dried up due to heat caused by fire are cured when a mixture of sugar, sesame, and milk is used for watering and anointing them and when they are smeared all around by the mud from the bottom of a lotus plant. If the drying is due to the lack of water, the text recommended using milk water and properly fomented by the smoke of carb shells.[36]

The text says that jaundice can be brought under control only in weeks by sprinkling water mixed with the powder of barley and wheat added to honey and milk. Non-productive trees bear fruits and flowers to one's complete satisfaction when they are fed with milk and '*kunapa'* water. Unproductive trees fill the quarters with branches covered with flowers and fruits without fail if treated with a cold mixture of sesame, barley, *kulattha,* green gram, and black gram. Sesame and the dung of the goat and sheep each measuring one *adhaka* (256 handfuls), water measuring one *drone* (1024 handfuls), and the corresponding quantity of beef if allowed to set for seven nights and then used for watering, the trees put forth flowers and fruits. They produce fruits also if watered with the thick mixture of the flesh of tiger, leopard, and fox and with milk of elephant and buffalo.

"*Vrikshayurveda*" talks about the natural indications of groundwater for the construction of wells. It says that "currents of water rise upward from the nether world and spread in all the directions beneath the ground. Investigating these, one should plan wells."[37] Like this, other natural indications are also discussed. If canes grow in a waterless region at a distance of three hands, currents flow to the west of it at the depth of one and half a man's height. It is the west current that flows there. On digging a depth of half a man-height, if a frog of whitish colour and yellowish soil are seen, then those are indications that on penetrating

[35] *Vrikshayurveda,* pp, 54-55.

[36] *Ibid,* p, 55.

[37]*Ibid,* p, 60.

further through the layers, the rock beneath will contain abundant water. If there is an ant hill' near to the east of a *jambu* tree, then there is plenty of water on the southern side of the tree at a depth of two man-heights. At that spot, after digging the depth equivalent to half a man-height, if there are indications of a fish, the rock is of the color of a pigeon, and the soil is blue, there is ample water lasting for a long period.[38] In a land where a *nirgundi* tree is surrounded by hills, at a distance of three hands to the south, a current of continuous sweet water will be seen at the depth of two and quarter man height. If to the east of *badari* tree there is an ant hill, then the existence of water should be advised at the depth of three man-heights of the west. After digging half a man's height, a white shrew is seen.[39]

Where there is an ant hill in the vicinity of *kastha* and *udumbara* trees water current flows to the western direction at the depth of three and a quarter man-height. There the soil is whitish-yellow, the rocks are milk-white, and after digging half the man-height a mouse white like a lotus is seen. If an ant hill is sighted to the south in the vicinity of *bibhitaka* tree, then to the east thereof, water current flows at one and a half man height. And if the ant hill is to its west at a distance of one hand, water current flows at the depth of four and a half man-height.[40]

Availability of groundwater can be predicted by observing the movement of snakes and frogs. If a snake of pink color resembling the interior of a lotus on digging one man-height is seen, red soil and rock of ruby color are said to be the indications of the availability of groundwater. If a frog is seen among multiple trees, water will be found below it at a depth of four and a half man heights and a distance of one hand.[41]

Different types of soils also help to predict the availability of groundwater. Land which is full of *munj* grass or of *kasa* and *kusa* grass and where the soil is grainy and of a bluish color, there the water is in ample quantity and of sweet taste. Then if the soil is black or red, water is sweet and abundant. A reddish grainy soil makes the water astringent in taste,

[38] *Vrikshayurveda,* pp, 60-61.

[39] *Ibid,* p, 61.

[40] *Ibid,* p, 61.

[41] *Ibid,* p, 61.

the land of tawny color makes it caustic, and the whitish land is stated to make the water saltish while the blue land makes it sweet.[42]

"*Nuskha Dar Fanni – Falahat,* (The Art of Agriculture)," a 17th century text written by Dara Shikoh, deals with agricultural practices.[43] It talks about various aspects related to agriculture. In India, the nature of the soil varies from region to region. Therefore, it is very essential for a peasant to understand the nature of the soil, because the nature of the soil determines what type of crop is suitable to grow. *Nuskha Dar Fanni – Falahat,* talks about the nature of the soil that suits to grow certain plants and crops. The text says plants like palm trees grow in saline soil, pomegranates in dry and gritty soil, peach in wet soil, near the banks of canals or nearby areas, and oranges in wet and fertile soil prepared properly with manure. For growing crops, it says rice is grown mostly in hot countries, and except in India, it is grown at the beginning of spring. Its soil is prepared in such a way that one and a half feet of water always remains there, wheat grows in both hot and cold countries. Sometimes it grows in rainfed fields and sometimes in irrigated fields. And at certain places, they are grown even without water. The most appropriate soil for growing wheat is clayey soil, of black or yellow colour. Cotton grows better in a moderate climate and gives

[42] *Vrikshayurveda,* p, 61. The text says that one can predict the availability of groundwater according to the colour of the soil, for example, where the soil is grainy, and of a bluish, there the plenty of sweet water is available. Whereas the reddish grainy soil makes water astringent in taste, the tawny colour makes water caustic, the whitish soil makes the water saltish, and the blue land makes the water sweet.

[43] Dara Shikoh, *Nuskha Dar Fanni-Falahat,* p, vi, Rahman in his work "*Science and technology in medieval India,*" says that this manuscript was transcribed in 1693, and though attributed to Dara Shikoh, appears to be a work of Amanullah Husaini, son of Mahabat Khan, a noble in the court of Jahangir (1569-1627), who was the Mughal ruler of a large part of the Indian subcontinent from 1605 to 1627 AD. On the other hand, some other scholars argued that "there is no indication about the scholarship of Amanullah and Rahman has given no reference to support his view about the authorship of this text. According to Rahman, this manuscript is a summarized version of a full text. Since the colophon clearly mentions Dara Shikoh as the compiler, and since he was known to be a great scholar, we would like to maintain that Dara Shikoh was the 'author' and not Amanullah. Since it is unlikely that Dara Shikoh had expertise in crop production, he must have sought help from experienced agriculturists."

better crops. Sugarcane requires plenty of water, and for growing sugarcane, the soil needs to be prepared properly.[44]

After identification and preparation of soil, it is very important for a peasant to know the best time for planting trees and sowing of seeds. Because sowing seed in the proper season gives a good crop. The text points out that the appropriate time for cultivation is when the sun is in the sign of Libra. (September 23 to October 23), but it must be remembered that seeds should not be sown when the North wind is blowing for, in that case, seeds will not yield a good crop. It says, some farmers sow seeds at the beginning of the season, some in the middle, and some in the end, so that if one crop is damaged, the next one survives. And the best time for sowing the seeds is the first half of the sowing season. That will yield a good crop, and the production will be high. It also suggested that the planting of trees can be done from the end of the sign of Pisces (February 19 to March 20), i.e., mid-March, which is the beginning of spring. There is, however, a contradiction when it is stated that trees planted in autumn do not grow long branches and roots, but trees planted in the spring season grow a large number of branches.[45] If planting is done when there is bright moonlight, trees will grow very tall but will produce lesser fruits, whereas if planting is done during the waning of the moon, the trees will not grow tall but will produce more fruits. The first day (i.e., full moon day), the fifth, or the thirteenth day of the bright fortnight is good for sowing.[46]

After sowing seeds and planting trees, the next step suggested in the text is transplanting big trees. It says while transplanting big trees, certain steps need to be followed. First, "dig a pit three yards long, three yards wide, and three yards deep. Cut off some branches of the tree to reduce its weight."[47] Second, "dig up the tree along with all its roots and veins, without causing any harm to them, and then, instead of roughly handling the tree, carry it carefully to the place where it is to be planted and lower it to the bottom of the pit which

[44] Dara Shikoh, *Nuskha Dar Fanni – Falahat*, pp, 9-40.

[45] *Ibid,* p, 4.

[46] *Ibid,* p, 70.

[47] *Ibid,* pp, 4-5.

has been made for it."[48] The other steps are, maintaining the position of the tree, and watering for two months.[49] Such a procedure has not been described in any other available ancient or medieval texts of India. The text's recommendation is based on extensive expertise in effectively transplanting huge trees.[50]

The very unique feature of the text is the method prescribed for grafting technology. "*Nuskha Dar Fanni – Falahat*," explains each and every step of grafting. It says for grafting a tree with thick bark, "a hole is made in the bark of a tree with a bamboo spike or any other spiked wood; then a branch of the tree which is to be grafted is passed through it and tied to a wooden splinter, which is then covered with clayey soil. After this, a pitcher that has a tiny hole at the bottom is filled with water and kept hanging over the graft so that water may keep dripping, drop by drop, on it. This process is continued till the tree is fully grafted."**[51]** It is very important to understand when one should do grafting and when one should not do it**.** It advised grafting should be done when the North wind blows. Grafting will be better if it is done in the waning light of the moon when the South wind blows. If there is rainfall on the grafted, it will be beneficial, provided the skin of the grafted tree is thin; because if it is thick, rainfall will be harmful.[52] The best time for grafting is from the beginning of autumn to the month of *Azur* (December) when there is an equinox. Some people say that it is better if grafting is done when Sirius is in ascendance and the summer heat is less.[53]

The text gives a number of tree names and explains how different types of trees can be grafted together, and it also explains the logic behind it. A branch of a fig tree can be grafted on an apple, guava, or mulberry tree because all these are compatible companions of each other. When a hole is cut in the tree's bark for grafting, care should be taken to ensure that

---

[48] Dara Shikoh, *Nuskha Dar Fanni – Falahat,* pp, 4-5.

[49] *Ibid,* pp, 4-5. For watering the tree, the text says, get two water-filled pitchers with small holes at their bottom, and place them on either side of its roots in such a way that water keeps dripping on it. This process needs to follow for two months, and after that water the tree normally.

[50] *Ibid,* p, 75.

[51] *Ibid,* p, 6.

[52]*Ibid,* p, 6.

[53]*Ibid,* p, 6.

it is not damaged. If a branch of a guava tree is grafted on a mulberry tree, the fruits of the guava tree will be red. Similarly, if a branch of an apple tree is grafted on a mulberry tree, the fruits of the apple tree will be red. The walnut tree cannot be grafted on any other tree, it can be grafted only on itself. Apricot and almond trees can be grafted on each other. As all trees are compatible companions of quince trees, all can be grafted on them. A branch of an orange tree can be grafted on an apple tree. If it is grafted on a mulberry tree, it will produce red oranges. The pomegranate tree is a compatible companion with the orange tree, and the orange tree is a compatible companion with the vine. Almonds and pistachio trees can be grafted on green berry trees.[54]

The text explained how a vine tree can be grafted with an apple tree. When the two are near each other, a hole is drilled through the trunk of the apple tree, and the nearest branch of the vine is inserted through it, but it is not separated immediately from the vine. After two years, when the vine covers the hole completely, it is cut from the vine. By this time, the grafted creeper of the vine has united itself to the apple tree and gets sustenance from it. This vine will produce more grapes than other vines. During the two years, new branches of the apple tree are cut to give more strength to the vine.[55]

Certain steps were followed in grafting peach trees onto apple trees. First, a sampling of the willow tree is planted. Then a peach tree is grown near it. When the booths grow up, a branch of the willow tree is made spiky and buried firmly in the ground. After this, a hole is made in the middle of the cuneiform branch of the willow tree, and a branch of the peach tree is passed through it to the other end. Then the split of the willow tree is then covered by a splinter, which is tied to it tightly with a string and covered with clayey soil. Then, a water-filled pitcher with small holes at its bottom is hung over the graft so that its water may keep dripping, drop by drop, on it throughout summer. Then, in the next spring, the roots of the peach tree are served from the willow tree. Fruits produced by this peach tree will be seedless. If you want to make peaches sweet, take one seed each of quince and almond, remove their pith, place it in the pith of the peach and sow them. The fruits of this

[54] Dara Shikoh, *Nuskha Dar Fanni – Falahat*, p, 7.

[55] *Ibid*, p, 7.

peach tree will be extremely tasty once the three seeds have grown into a single peach tree. If a rose is planted near a peach tree, the peach tree's fruits will have a sweet smell.[56]

Manures mentioned in this text are restricted to some specific plants like palm trees, vines, figs, olives, pomegranates, guava, peach, almond, pistachio, and carrot. For palm trees, it recommended dung, salt, and nitre, whereas for vine trees, nitre, and vine sap are recommended. For the pomegranate trees, the text recommends pig's dung and human urine.[57]

If a peasant wants his fields to remain free from weeds, he needs to pull out the weeds with a weeding knife from their very roots, when the sun is in the sign of Gemini. Then leave them there in a heap to dry up and decompose. After this, mix them in the manure. Weeds will not grow there again. Then it says, if the weeding knife is made of copper, it will prevent the weeds from growing again. Then it is also said that if the roots of a tree, which has thorns, are scraped, and cut at dawn, during the rising of the sign of the Zodiac, and the mixture of tar and pitch is applied to the place from where the tree has been cut, the tree will not blossom again. If the weeds are removed on the last day of the lunar month when the moon is in the sign of Virgo, they will never grow again.[58]

The text also talks about the treatment of insects. To protect walnut kernels from insects after sowing, wrapping them in woolen cloth or in poplar leaves is recommended. Kernels thus treated will be protected from rats and bird damage as well. To control insects of vines, the application of dung to the lower part of cuttings has been suggested.[59] The use of dung, garlic, and pine oil to protect the cuttings from damage by some insects and pathogens is a good idea. Growing creepers in the vicinity could provide vegetation for predators and parasites of insects that attack the vine. For the fruit-drop disorder in figs, the application of a little salt and mulberry vinegar after exposing roots is also recommended.[60]

---

[56] Dara Shikoh, *Nuskha Dar Fanni – Falahat*, 6-8.

[57] *Ibid*, p, 76.

[58] *Ibid*, pp, 3-4.

[59] *Ibid*, p, 13.

[60] *Ibid*, p, 14.

The Biocidal properties of salt and vinegar are known, and the application of resin is an interesting recommendation. Natural resins from trees have been available in India for centuries. Resins are complex chemically and often contain cinnamic and benzoic acids as well as tannins. The latter is known to have biocidal properties. Tannins from *Shorea robusta* Gaertn are known to possess anti-termite properties. Good resins are also produced from "*Calophyllum inophyllum* L, *Tectona grandis* L," and several other trees. In order to prevent damage to fruits by birds, the roots of pomegranate should be covered with pumpkin roots and leaves during winter.[61]

For controlling insects attacking apples, a sprinkling of resin on soil is recommended at the time of planting. Strangely a mixture of sheep droppings, pig's dung, and human urine is put around roots, again to keep apple trees free from insects. To save apple plants from all calamities, the weekly application of donkey's dung suspended in water has been recommended. Application of excreta from sheep, pigs, donkeys, and human urine can at best keep the apple tree well-nourished, which in turn, perhaps keeps insects and disease damage minimal.[62] In the case of mulberry, placing wild onions (*Urginea sp., syn. Scilla sp.*) in the root zone of the transplanted sapling is recommended as useful. Onions and garlic are known to possess biocidal properties. Wild onions (*Urginea indica Roxb, kunth*) are poisonous to rats. It has been mentioned that a procedure that is still used to preserve melons from extreme heat or cold has been described. Small farmers can adopt the habit of covering melon fruits with earthen pots today.[63]

Some strategies for preserving fruits and flowers are described in this text. However, the text did not mention the methods of harvesting and storing mature crops such as rice, wheat, barley, millet, etc. Some of the techniques related to the preservation of fruits and flowers are discussed. First, place the quince in a man-waist deep pit near the tree, cover it with its leaves and sand, and level it. Keep the top of the pit wet. It was stated that the fruits could be stored for a year in this manner. For apple fruits and grape cuttings, a similar technique

[61] Dara Shikoh, *Nuskha Dar Fanni – Falahat*, pp, 79-80.

[62] *Ibid*, p, 80.

[63]*Ibid*, p, 80.

was advised.[64] Second, plant a mature blue-flower lily bud in an earthenware pot, close the container's mouth with clay, and bury the pot in soil for a year. If you place the bud in the light, it will stay fresh and flower. The third technique is to keep a red rosebud in a hollow reed and bury it in the ground for some time. It will be preserved and then blossom when taken out of the reed, and hot water is poured on it.[65]

If we critically analyze all these three major sources, then it is found that the knowledge which is shared in those texts has major relevance in the present-day context. The text, like "*Krishi Parasar*," deals with all aspects of agriculture. Starting from the cultivation of land, and use of manures to the collection and storage of grains. The detailed description of the plough was one of the important aspects of the text because it helps us to understand what types of technology were used by the peasants to plough their land, whether they used a heavy plough or not, and whether iron was used for land cultivation or not. All these types of answers we get from these descriptions. The text also gives importance to the conservation of rainwater by digging wells and ponds. It also advised the use of groundwater for agricultural production. Different ways of predicting rainwater are also discussed in this text. The text also gave emphasis on the rotation of crops, which helped to maintain the fertility of the soils.

Text like Surapalas's "*Vrikshayurveda*" fully deals with the various aspects of plant science. And the major contribution of the text is the identification of internal and external plant diseases and their corrective measures, apart from that, the text also gives a full explanation of how to predict groundwater. Groundwater contains different minerals which are very helpful for agricultural production. The text "*Vrikshayurveda*" contains knowledge on the related subject of preserving the quality of soils and the distribution of plant species to fulfill the food, shelter, and aesthetic demands of various social strata. Surapala's book on Indian arbori-horticulture is an organized endeavor to comprehend how plants develop and how their products might be perpetuated through agronomic

[64] Dara Shikoh, *Nuskha Dar Fanni – Falahat*, p, 11.

[65] *Ibid*, p, 84.

management if scientific knowledge means gathering correct and systematic knowledge as we understand it today.[66]

Like other sources, "*Nuskha Dar Fanni-Falahat,* The Art of Agriculture" speaks about the best time for land cultivation, sowing of seeds, the use of manure for different plants, transplanting big trees, and grafting time and techniques. This particular text gives a full description of when and how different types of plants can be grafted to gather and get high-quality products.

So, in conclusion, it can be argued that the knowledge and information shared in all these texts are more or less similar in nature. Whereas some of the knowledge described in these sources are also very unique in nature. For example, "*Krishi Parasar*" gives a detailed description of plough, which is not found in the other texts. "*Vrikshayurveda*" primarily deals with plant science, different types of diseases related to plants, and their corrective measures. On the other hand, "*Nuskh Dar Fanni-Falahat*," talks about grafting technology. Some of the similarities are also found in terms of the agricultural knowledge shared in these three above mentioned texts, like the preparation of soil, the best time for sowing seeds and planting trees; when it comes to the use of manure, all these three texts recommend the use of natural manure for agricultural production. All these indicate both continuity and change in knowledge and ideas over a period of time. However, it does not mean that Indian agriculture was static in nature. From time to time Indian peasants also adopted new tools and technology wherever there was a need. In the post-19th century, we have seen the application of 'scientific' farming and experiment in the field of agriculture. The then British government introduced 'agricultural reforms' in India and tried to promote 'scientific farming.' Apart from that, we have also seen changes in cropping patterns due to various reasons.

[66] *Vrikhshayurveda,* p, 75.

## Conclusion

The application of science in agriculture started in Europe in the 1834s, when Jean Baptiste Boussingault developed the foundations of agricultural chemistry.[1] Further, The Royal Agricultural Society of England was established by the Royal Charter in 1840 to encourage farmers and scientists to use scientific experiments in agriculture. The Society also published a journal, which gave information related to new knowledge based on scientific research on agriculture in England and abroad. The British Government gave financial assistance to the Society. With these financial aids, Society tried to develop new inventions and discoveries related to agriculture. The whole emphasis was given to implementing new scientific-based agriculture and farming.[2] A laboratory was established in Edinburgh in 1842 with the help of the Agricultural Chemistry Association of Scotland, a voluntary agricultural society. Then In the following year, in 1843, an experiment station was established at Rothamsted by Sir John Bennet Lawes on his ancestral estate near London. In 1845 Royal Agricultural College of London was established to teach the science of agriculture and other related sciences and the practical application of these sciences to the cultivation of the soil and the rearing and management of livestock.[3] Gradually, the concept of 'scientific' research and experiments in the field of agriculture spread to other countries in the world, and the then British Government of India also started implementing it in India.[4]

In 1890 Dr. J.A. Voelcker, an agricultural chemist of the Royal Agricultural Society of England, was sent to India to advise on the best course of action for developing Indian agriculture. [5] In his report, he advocated for the systematic pursuit of agricultural research

---

[1] Srabani Sen, Scientific Enquire, p, 204.

[2] M.S. Randhawa, *A History of Agriculture In India,* Vol, III, *1757-1947I.* New Delhi, 1983, p, 174. Henceforth cited as M.S. Randhawa, Vol. III.

[3] *Ibid*, p, 174.

[4] *Ibid*, p, 175.

[5] Deepak Kumar, 'Science in Agriculture: A Study in Victorian India,' *Asian Agri-History*, Vol. I, No.2, 1997, p, 81.

and disseminating general and agricultural education in India through research and teaching. In 1892, Dr. J.W. Leather, an agricultural chemist, was appointed for five years, manifesting the first scientific staff in the Department of Revenue and Agriculture.[6] In this way the then British Government of India started 'scientific' experiments on Indian agriculture and undertook various measures for the development of agriculture. Before going to the conclusion, I would like to explain the various 'agricultural reforms' and the application of 'scientific' farming introduced by the British government. Apart from that, an attempt was made to understand changes in cropping patterns in the post-19th century. Then the particular section also discusses the research findings and suggestions for the present-day improvement of agriculture.

Lord Mayo wanted to set up an agriculture department in India and across the provinces. The main goal was to investigate the problems related to agricultural production. When he arrived, he found the government was not giving enough importance to agriculture. He wrote a letter to Lord Napier to establish the government agriculture department. He stated that "the time is coming when we ought to start something like an agricultural department in the Government of India, with branches in the Presidencies and the Lieutenant-Governorships. Agriculture, on which everyone here depends, is almost entirely neglected by the government."[7] In the year 1871 the first Agricultural Department was set up.[8] Lord Mayo also said that most Indian peasants knew agricultural production methods, so the government's role was to provide proper guidance.

A.O. Hume also recognized the silks of Indian peasants and said that the tradition and experience of three thousand years have given them minute knowledge with regard to their own ancestral holdings. He found that Indian peasants knew which was the best time for sowing seeds**.** They were able to distinguish different types of soils and the properties and capacities of the soils. Indian peasants were likewise aware of the importance of manure. They understand the benefits of deep ploughing and the need to pulverize the soil thoroughly. They also knew how to control the weeds, and the methods adopted by the

[6] Srabani Sen, Scientific Enquiry, p, 206.

[7] W.W. Hunter, *A Life of the Early of Mayo, Fourth Viceroy of India,* Vol. II, London, 1876, p, 320.

[8] J. A. Voelcker, *Report of the Improvement of Indian Agriculture,* p, 1.

Indian peasants to control weeds in their fields were very similar to Europe. He argued that the role of the government is to teach them the scientific methods and their application in the field of agricultural production. Because Hume believed that Indian agrarian production methods were greatly influenced by 'tradition and superstition.'[9]

The court of directors mentioned recommendations for teaching practical agriculture in the well-known dispatch of July 19th, 1854, on the subject of education in India. Sir John Strachey, the Lieutenant-Governor, developed a provincial department of agriculture in 1874, with Sir Edward Buck as its first director. Edward Buck will be remembered as the pioneer of agricultural prosperity in India. Cawnpore, one of India's oldest farms, was expanded. A tobacco farm was constructed in Ghazipur, a silk farm in Dun, and a fruit farm in the Kumaon Hills. Apart from all these, an agricultural school was also opened at Cawnpore.[10]

In 1880, Ripon succeeded Lord Lytton as Viceroy of India, and during his reign, he implemented several 'agricultural reforms.' His first measure was the establishment of The Revenue and Agricultural Department. As we know, British India experienced many great famines and natural calamities. Large numbers of people were dead due to a shortage of food grains. In 1880, the Government of India constituted a famine commission to study the total aspect of the famine and asked to recommend the possible steps to face this type of natural calamities in the coming days. The famine commission of India submitted its report in the same year. It strongly recommends improved agriculture, and it says improved agriculture should be the first step toward ensuring food security against catastrophic failures. The famine commission recommended setting up a department of agriculture at the central and provincial levels. The government of that time wanted to establish an agricultural department in India to look after the surplus food production and development of agriculture. Also, ensure that food supply mechanisms are developed to satisfy the needs of the rapidly rising population. The government's main objective was to face famine and calamities with systematic knowledge gained from the past. Sir Edward Buck was appointed as the new Secretary of the Department and oversaw the creation of provincial

[9] M.S. Randhawa, Vol, III, p, 173.

[10] *Ibid*, p, 190.

agencies. The department's primary objectives were "agricultural inquiry, agricultural improvements, famine relief," and the appointment of directors of agriculture at the provincial level.[11]

An attempt was made to develop agriculture at the provincial level. For the experimental basis, this plan was implemented in three provinces such as Bengal province, which included Bihar, Orissa, and Assam. The second was Bombay, and the third one was Punjab. In 1881, a director of agriculture and three other subordinates trained at Cirencester was posted in the Bengal provinces. Following that, experimental farming on court-of-wards estates began. The central part of the scheme was to set up the Sibpur farm in 1887-88, where the experiment related to agricultural production was started, and that importance was given to the study of soil. In 1883, a director of agriculture was appointed for the Bombay presidency. His first duty was to collect the statistical data related to agriculture and make sure not to neglect agricultural-related work. In 1890, a superintendent of an experimental farm was appointed to enhance agriculture on a scientific line. J. Mollison, a well-known agricultural scientist, was named Superintendent, and under his direction, the department was well organized.

Marquess of Lansdowne was the then Governor-General of India in 1889. During that time, the Secretary of State wanted to send a competent agricultural chemist to assess the condition of Indian agriculture and advise on the best way to improve it. M. Lansdowne also wanted to develop Indian agriculture by applying the teaching of agricultural chemistry. Another reason for sending the agricultural chemist was to investigate a wide area of land in the Northwest Provinces (now Uttar Pradesh) that was infested with noxious salts and unfit for agricultural cultivation. As a result, it was assumed that science might help the reclamation of these lands. Sir James Caird, one of the famine commissioners, requested the appointment of an agricultural scientist, and he chose Dr. John Augustus Voelcker, a Royal Agricultural Society of England consulting chemist. J.A. Voelcker came to India on December 10$^{th,}$ 1889, and left in the year of 1891.[12]

[11] M.S. Randhawa, Vol, III, p, 233.

[12] *Ibid,* p, 234.

J.A. Voelcker visited many parts of India and met many stakeholders of agriculture and representatives of all provinces. During his stay, he attempted to understand Indian agriculture starting from ploughing of the land to harvesting, which includes the agricultural technology used by the Indian peasants, cropping pattern, nature of the soil, use of manure, irrigation system, Indian climate, and financial condition of the peasants, etc. After that, he prepared a report known as the "*Report of the Improvement of Indian Agriculture.*" Voelcker felt the need for a 'scientific' experiment in the field of Indian agriculture. When he prepared his report, he strongly recommended the application of science in agriculture. Voelcker recommended J. Mollison, who had done admirable work as a deputy director of agriculture in Bombay, and was appointed as the inspector general of agriculture in 1897. His principal responsibilities included advising the Imperial and Provincial governments on agricultural issues. J. Mollison also made a high contribution to the study of Indian Agriculture and its improvement. However, his deep study of different types of Indian soil and its use in agriculture was well-known.[13]

In 1898, Lord Curzon was appointed Viceroy of India. Like Mayo, he was another Viceroy who had an agricultural background. With this background, he came to India. The great famine of 1899-90 occurred in the next year of his arrival. This famine was not limited to one province. It was spread all over India, starting from all the western parts of India, the Deccan, which includes the Nizam's states. The Central Provinces, the Central India Agency, the Bombay Presidency, including Gujarat (comprising Kathiawar, Cutch, and Baroda), Sind and Rajputana, and Punjab. The southern part mainly affected the area of over 475, 000 square miles (1, 230, 240 $km^2$). During his stay, he undertook various measures to develop Indian agriculture. Lord Curzon was the one who paid attention to the issue of irrigation.[14] For him, the land is not only a source of revenue but also a means of production. He believed that irrigation was one of which could substantially increase the production of food and fiber among the many production processes. With this thought in mind, Lord Curzon set up a commission in 1901. The commission was chaired by Sir Colin Scott-Moncrieff. He was not only asked to investigate the entire irrigation problem in India

[13] J. A. Voelcker, *Report of the Improvement of Indian Agriculture,* pp, 296-299.

[14] Jeffery Paine, *Father India*, 1999, New York, pp, 50-51.

but also to provide a solution to the particular problem as well. One of the commission's primary objectives was to report on the desirability of the extension of irrigation to protect against famine. The commission visited all provinces and studied the existing irrigation system. In 1903, the commission presented its report and recommended various policies related to the selection of land, financing, and maintenance of irrigation works. After the commission proposal, many new irrigation projects were started, which was also known as the Irrigation Commission of 1901-1903.[15]

In 1901, the inspector general of agriculture was appointed to oversee and direct the new agricultural strategy. M.S. Randhawa says, Lord Curzon was the first person to "Introduced the application of scientific inquiry to the needs of Indian agriculture, on a comprehensive and systematic basis."[16] While delivering his speech to the Bombay Chamber of Commerce, Curzon says that our real reform has been to endeavour for the first time to apply science on a large scale to the study and practice of Indian agriculture. The government established The Imperial Agricultural Research Institute PUSA to implement all 'agricultural reforms' in 1905 to conduct 'scientific' research related to agriculture.[17] Apart from the agricultural research work, this institute also provided basic solutions to the fundamental problems related to tropical agriculture. During Curzon's time, the government allotted Rs. 2 million annually to assist in the development of agricultural research, demonstration, and spreading of agricultural education at the provincial level. In most of the important provinces, full-time agricultural directors were appointed. With this fund, agricultural colleges and research centers were established at the provincial level. Some of the names of the colleges set up in the first phase are Poona, Canwnpore, Sabour, Nagpur, Lyallpur, and Coimbatore.[18] The nearby farm set up adequate equipment, laboratories, and classrooms. A different branch of study was opened in these colleges. Staff from different disciplines were appointed, consisting of experts in agriculture, an economic botanist, an agricultural chemist, an entomologist, and a mycologist. The staff

[15] M.S. Randhawa, Vol, III, p, 267.

[16] *Ibid,* p, 270.

[17] *Ibid,* p, 303

[18] *Ibid,* p, 272.

were asked to carry out both teaching and research work. Among these staff members, one of the members was appointed as a college principal. The provinces were separated into circles to implement research activity at the local level, and each circle had one experimental farm based on regional variations in soil and climatic conditions. These farms were further asked to distribute seeds and manures and implement the government agricultural policy at the ground level.[19] Apart from that, new varieties of wheat, cotton, maize, and sugar-cane seeds were also introduced in this period and distributed to the farmers.[20] Experiments of the cultivation of all these above mentioned new varieties of seeds were found in different regions.[21]

In India, wheat is known as one of the major food crops and the chief cereal of north India. The Indian peasants carried out wheat cultivation on a hereditary basis over a period of time. Most of the selected seeds were suitable for their land or grown in nearby areas. Wheat research was started for the first time at the Imperial Agriculture Research Institute in Pusa, under the direct supervision of Sir Albert Howard.[22] He laid the foundation for wheat genetic improvement and other range of crops such as; tobacco, linseed, chickpea, and fibers.

The only way to comprehend the difficulty of wheat cultivation was to examine, review, and classify most of the wheat produced in India. Intensive examinations were undertaken by taking thousands of specimens. A mass of data on the inheritance of characters has arrived. These examinations covered the points like beardedness, grain colour, felting, grain consistency, and the shattering of the ear. In 1906 and subsequent years, the Sampling seeds from significant wheat-growing locations were sowed, and the outcomes were examined. The wheat seeds of Punjab were analyzed independently in Lyallpur College, and a few unit species were identified between the years 1906 and 1909. Towards the end of the 19th century, different types of new exotic wheat were brought from various parts

[19] M.S. Randhawa, Vol, III, pp, 271-272.

[20] J. A. Voelcker, *Report of the Improvement of Indian Agriculture,* p, 238.

[21] J. A. Voelcker, In his report, talks about the introduction and experiment of new varieties of seeds in different regions, for detail descriptions see pp, 239-241.

[22] M.S. Randhawa, Vol, III, p, 342.

of the world, such as; Canada, America, England, and Australia. On an experimental basis, all these new exotic kinds of wheat were started cultivation in various research stations. In the first phase, the cultivation of exotic wheat failed due to different reasons like the timing of the introduction, Indian climatic conditions, lack of knowledge, etc. In the later stage, extensive research and experimental work were carried out on the improvement of wheat crop cultivation in different phases.

The Canal Colonies of West Punjab, commonly known as the Bars, were India's breadbasket, spanning 5½ million acres of land established in the districts of Lyallpur, Sargodha (Shahpur), Montgomery, and Multan.[23] The Lyallpur colony was irrigated by the lower Chenab Canal. The Sargodha Colony was started in the year 1897, when irrigation was extended to it by the lower Jhelum canal. It was followed by the coming of Montgomery Colony, also known as Nilli Bar. From 1905-1917 three canals were constructed, famously known as the triple project. In the first phase, the Upper Jhelum, took the spare water of the Jhelum and poured it into the Chenab, which irrigated 350,000 acres of land. In the Second phase, both Chenab and the Ravi were linked together, and the Upper Chenab was able to irrigate another 650,000 acres of land in Gujranwala and Sheikhupura. The third canal, the Lower Bari Doab, took it to another 134 miles or 216 km through Montgomery into the heart of Multan.[24] In this way, water was supplied to the different parts of Punjab. Wheat was one of the favourite crops among the colony's people. Five European exporting firms based in Lyallpur spend their entire time in procuring and transporting colony wheat. A considerable grain accumulation at a colony station or market in the wheat season after the harvest is sight. There were so many different types of Lyallpur wheat that various colonists introduced. The Lal Kasarwali Chitti,[25] bearded wheat with a red ear and white grain, was the most favoured of all wheat. This particular wheat could be cultivated in most seasons, didn't require a lot of water, and had an excellent market price.[26] The Agriculture Department introduced another bread known as Australian

[23] M.S. Randhawa, Vol, III, p, 282.

[24] *Ibid,* p, 282.

[25] *Ibid,* III, p, 288.

[26] *Ibid,* III, p, 288.

wheat No. 27, which was also produced by the colonists and grew in popularity. Each colonist grew a little amount of "Goni" or "Vadhank" wheat for their personal consumption. "Goni" is beardless wheat with fragile straw that falls if the winds are strong during the colour change. During maturity, it also shells quickly. Vadhanak is a tall and hefty wheat variety. It requires more water than any other type of wheat in the colony and is severely harmed by its weight if there are rains or strong winds during harvest.[27]

Like wheat, a 'scientific' experiment was also carried out on the production of rice.[28] In India, rice is the staple food of nearly three-fourths of the population. Different types of High Yielding Variety (HYV) of rice seeds were introduced in this period. Rice production is largely found in the eastern and southern Indian states, such as West Bengal, Bihar, Assam, Orissa, Eastern UP, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, and Kerala. Other two states, i.e. Punjab and Haryana, have recently emerged as important rice-growing states, and these two states supply a substantial quality of this food grain to the Nation's food bowl.[29] Apart from wheat and rice, 'scientific' experiments were also carried out on the production of cotton, sugar cane, and maize, etc.[30]

Cotton was an extraordinary crop on the virgin soil of the Bar when it first came under irrigation. On quite a new land, with hardly any preparation, cotton in the colony used to produce "10 to 15 maunds to the acre (922 to 1,383 kg/ha) commonly."[31] Colonists brought numerous types of short-staple cotton with them and generated good profits from this crop. They were not hesitating to experiment with cotton cultivation. They always tried to experiment with several kinds of cotton. Both Hissar cotton and the red-flowered Multan cotton are the best locally grown cotton. Colonists also tried to produce Khaki-coloured cotton, Spencer's cotton, American cotton, hybrid American and Egyptian, and Assam cotton. Among this cotton, only Assam cotton (the Garo hill type) is growing well and appears to be the same in nature and requirements as the Hissar cotton, on which it is an

[27] M.S. Randhawa, Vol, III, pp, 288-289.

[28] J. A. Voelcker, *Report of the Improvement of Indian Agriculture,* p, 242.

[29] M.S Randhawa, Vol. IV, p, 377.

[30] J. A. Voelcker, *Report of the Improvement of Indian Agriculture,* pp, 239-241.

[31] M.S. Randhawa, Vol, III, p, 289.

improvement. In contrast, the majority of the other cotton did not grow well.[32] *Toria (Brassica rapa Var, napus)* is a curiously popular crop. Most of the grantees in their old homes grew *sarson (Brassica rapa var. glauca)* and *taramira (Eruca saliva)* only and had never heard of this kind of oilseeds. Along with cash crops, colonists also grew some of the food crops, such as maize and millet. These two crops were mainly grown in the *kharif* season. By following the rotation system, these crops were raised along with wheat, oilseeds, and cotton. Apart from this, the colonists produced large amounts of sugarcane. The most interesting thing was that most of the small peasants were actively engaged in sugar cane cultivation. New technologies, such as iron-roller sugar mills, were deployed for sugarcane cultivation, and a large amount of money per acre was invested in this crop.[33]

Sugarcane has been one of India's most important cash crops, and it is produced throughout the country. In 1912, it was grown on more than 2.6 million hectares of land, with a production of 156.9 million tonnes.[34] At present, India produces the highest amount of sugarcane in the world, followed by Brazil and Cuba.[35] Sugarcane cultivation in India is found in both tropical regions as well as sub-tropical regions. The tropical belt includes states such as "Maharashtra, Andhra Pradesh, Karnataka, and Tamil Nadu;" in these belts, sugarcane yield is maximum, and sugarcane farming occurs year-round. Whereas states like Uttar Pradesh, Bihar, Punjab, Haryana, and Rajasthan come under the sub-tropical belt. These subtropical belts, especially northern India, contributed 70 percent of the total sugarcane that was produced in India.[36]

---

[32] M.S. Randhawa, Vol, III, p, 289. Randhawa says that only Assam cotton is grown well, and the rest of the other varieties are not grown properly he says, "Egyptian cotton has been a failure. The bolls form too late, and their complete expansion is checked by early frosts. American cotton has paid some of its devotees but is undoubtedly more delicate than native varieties. Some colonists are preserving with Spence's tree cotton, but it has brought no lint to their mill as yet and is alleged to act through the winter months as a hot case for the preservation of all the pests to which cotton is heir."

[33] *Ibid,* p, 289.

[34] *Ibid,* p, 327.

[35] *Ibid,* p, 327.

[36] *Ibid,* p, 327.

The period under review, that is, the post-19th century, mainly focused on implementing cash crops. While discussing the introduction of different types of new crops by the British Government in India. J. Mackenna noted that a few significant triumphs in introducing new crops were obtained where the environment was suitable: peanuts in Burma, potatoes, and fruits in the Kumaon Hills, and American cotton in the United Provinces.[37]

All these 'agricultural reforms,' 'scientific' experiments, availability, and use of new farm technologies such as high-yielding crop varieties, use of fertilizers, and farm mechanization in the post-19th century influenced cultivation practice and cropping patterns. The introduction of new crops primarily took place in two directions. First, the crops may be entirely new to the country. Second, it may be merely new to the particular district.[38] The new crops which were introduced to the country in the 17th century or later period spread to the district level in the post-19th century. For example, before the 19th century, the cultivation of tobacco, maize, potato, and many other kinds of vegetables was known to certain areas only.[39] However, in the later period, its cultivation was spread to the regional level and influenced the existing cropping pattern.[40] The improved irrigation practices, especially the development of canal systems, also led to the change in cropping patterns. For example, the Deccan region, which gets low rainfall and was known for jowar cultivation, started cultivating rice which required more water to grow. It was also found

[37] J. Mackenna, *Agriculture in India,* Simla, 1915, p, 16.

[38] J. A. Voelcker, *Report of the Improvement of Indian Agriculture,* p, 240.

[39] M.S. Randhawa, Vol, III, p, 129. According to M.S. Randhawa, Up to 1829, potato cultivation was unknown to the people of Nilgris hill; this crop was first introduced into these hills by Sulavan in the year 1830. Potato research was carried out at Nanjanad's Agricultural Research Station. The potato became the Nilgiri people's principal commercial crop, and it was grown on a total of 20, 000 acres (8, 094 ha) of land. Potato growing improved the financial condition of the Nilgiris, which was previously a backward and impoverished region. People of these regions were encouraged to grow different types of economic plants, and local people also actively participated and started cultivating these economic crops on a grand scale. The majorities of the commercial yields grown in the Nilgiris hill regions are exotic in nature and incorporated to the region for the first time.

[40] J. A. Voelcker, *Report of the Improvement of Indian Agriculture,* pp, 238-246. Voelcker says that the agricultural farms which were established at the regional level helped to promote new crop cultivation at the local level.

that the peasants in the dry areas had shifted from traditional, region-specific crops such as coarse cereals, millets, and barley to irrigation intensive non-region specific crops such as paddy, sugarcane, cotton, and vegetables.[41] Similarly, rice cultivation began in Punjab and Haryana, which are known to be less rice-consuming states. Earlier, these areas were known for their wheat cultivation.[42] The use of well irrigation came down in the Punjab region, and peasants depended on the canal water. As per the government statistics, it was found that from 1868-69 to 1918-19, there was a considerable decline in well irrigation in Punjab. On the other hand supply of canal water was increased.[43] The main argument is that the development of irrigation systems helped our peasants to produce different varieties of water-consumed crops, and that affects the existing cropping pattern. Another factor responsible for the change in cropping pattern was the price rise and high market demand for the cash crop. For that, importance was given to the production of cash crops.[44] And in this process, the peasants who were earlier producing food crops were shifted to cash crops. Apart from that, changes can also be seen in the introduction of new types of equipment and technologies and the excessive use of artificial manure to achieve extra surplus agricultural production. On the other hand the excessive use of artificial manure had damaged the long-run productivity of the soil. The best example before us is the impact of the green revolution on our soil.

After independence, the Indian Government undertook many measures to improve the existing agricultural condition. A number of new agricultural research institutes were established at both state and central levels.[45] New agricultural universities are coming up,

---

[41] J. A. Voelcker, *Report of the Improvement of Indian Agriculture,* p, 241.

[42] Karam Singh & Sajla Kalra, 'Rice Production in Punjab Systems, Varietal Diversity, Growth and Sustainability,' *Economic and Political Weekly,* July, 27, 2002, p, 3139.

[43] M.S. Randhawa, Vol, III, pp, 290-291.

[44] *Ibid,* p, 354. M.S. Randhawa says that the post-19th century was mainly focused on the implementation of cash crops. Most of the experiments and introduction of new HYV of seeds were carried out to develop the output of cash crops. Cash crops such as cotton, sugar cane, and Indigo were produced and exported to other countries.

[45] Katherine Mayo, *Mother India,* New York, 1927. Said that in 1923-24 there were only 13 universities in India, and a total of 11,222 graduates passed out. Out of which, 86 took their degrees in agriculture, and they were mostly taught the relationship between soil and crops, p, 183.

where the emphasis is given to promoting agricultural research and education. The agricultural price commission was set up to fix the minimum support price of agricultural products. A number of new fertilizer plants are established throughout the country. The Government of India started many new projects. In 1961, The Intensive Agricultural Programme (IADP) or package programme was introduced at different state levels to increase food production in India. With the same objective, another programme was launched in 1964-65, called The Intensive Agriculture Area Program or IAAP. The Core idea of the IAAP was to develop 'scientific' and progressive agriculture effectively in the areas with high production potential. The development of global connectivity helped the world to share new knowledge and innovation. And agricultural knowledge was also spread from one country to another. In the year 1943 to 1965 green revolution was found in Mexico,[46] which helped Mexico to meet its massive food shortage. Because before the green revolution, Mexico imported more than 50 percent of the wheat and a considerable percentage of maize from other countries.[47]

Attempts were made in India to increase food production on a large-scale basis to avoid the food shortage for the rapidly growing population. To achieve this aim and objectives, the Government of India appointed many agricultural scientists and gave them financial assistance to carry out their research work. Dr. M.S. Swaminathan, The Then-Director of the Indian Agricultural Research Institute and Director-General of the Indian Council of Agricultural Research, was one of them, and he was instrumental in the Indian green revolution. He was the first person to introduce wheat cultivars known as dwarf Mexican to India. Apart from that, he also introduced other varieties like "NP 809" and "NP 824."[48] In 1965, nearly 250 tonnes of Mexican wheat seeds were imported to India. The Indian Government sent a team of scientists to Mexico to get a bulk shipment of seeds of improved varieties in the very next year. After visiting a number of wheat-grown fields and farms in Mexico, they arranged for the import of 18,000 tonnes of seeds of dwarf varieties Lerma

[46] M.S. Randhawa, *A History of Agriculture in India* Vol, IV *1947-1981,* New Delhi, 1986, p, 357. Henceforth cited as M.S Randhawa, Vol. IV.

[47] *Ibid,* p, 357.

[48] *Ibid,* p, 367.

Rojo 64 and Sonora 64. After taking so many measures and well-planned initiatives, India witnessed the green revolution in the field of wheat production. After the USSR, USA, and China, India became the fourth-largest wheat-producing country in the world. From 1971 to 1972 total wheat cultivation area was spread to 19.1 million hectares and total wheat production was 26.4 million tonnes. In the year 1973-74, the area under high-yielding wheat was 10.91 million per hectare as compared to 4.80 million hectares in 1968-69.[49]

In the later period, the experiment was carried out on rice, millet, and maize production. The main objective was to increase rice, millet, and maize production. New different varieties of high-yielding rice breeds, millets, and maize breeds were distributed throughout the country. Indian scientists also started their research work on these new breeds. Like the wheat revolution, India experienced the rice, millet, and maize revolution within a short period. The impact of the Indian green revolution was not limited to one particular field, rather it has influenced agriculture as a whole. After this revolution, India started producing a surplus amount of food grains. All these surplus amounts of production due to the green revolution helped India become a food importing country to a food exporting country in the world. There is no doubt that India was able to produce an extra surplus of food grains because of the green revolution, which helped it satisfy the food requirement for its rapidly growing big population.[50] On the other hand, the green revolution in India has had both positive and harmful outcomes. For example, the overuse of chemical fertilizers has harmed soil production in the long run. It has resulted in the emergence of new hazardous diseases, environmental hazards, social inequalities, and so on.[51] Even today, some of the lands in the Punjab region are not suitable for agricultural production. In 1969-70 more than 54 percent of soil in Punjab and Haryana was found to be deficient in zinc.[52] This thesis, therefore, argues that before going to exploit the soil and its productivity, we should need to revisit our past and draw some good lessons from it.

---

[49] *Report of the National Commission on Agriculture,* Part I, 1976, p, 283.

[50] M.S. Randhawa, Vol, IV, p, 648.

[51] Peter B.R. Hazell and C. Ramasamy, *The Green Revolution Reconsidered: The Impact of High-Yielding Rice Varieties in South India,* The Johns Hopkins University Press, Baltimore, and London. 1993, p, 1.

[52] S.P. Gupta and S.S. Dahiya, 'Micronutrients need attention in Haryana,' *The Tribune, Chandigarh, India-Agriculture Tribune,* August, 2003.

And today's new concept of organic farming is nothing but agricultural production methods by using natural manure or green manure, which our medieval Indian peasants widely practiced. I hope implementing these methods would be very helpful for the twenty-first century's agricultural production and maintenance of ecological balance.

Many contemporary scholars think that science was applied to agriculture after the establishment of the Royal Agricultural College of London in 1845. The British were the ones who introduced science to agriculture in India. The process of agricultural production went through various stages. The first thing a peasant had to consider was what he should grow. To make a proper decision even on this point, he must know the different products his land was capable of producing. For these, he had to reject several options, simply on the principle known as the rotation of crops. Once this was done, he had to consider the highest paying crops, considering the limited amount of money and skill at his command, which manures he was able to use and for what kind of crops they were most suitable. Even the selection of seeds tested his utmost skill because the quality of the seeds decided the quality of the crop. The implements used and the methods of sowing also exerted a significant influence. Before the product could be marketed advantageously, he had to overcome many other difficulties. Now the question arises, could he do all these things without any 'scientific' knowledge of agriculture?

My argument in this thesis is that the methods followed by our Indian peasants during the medieval period, such as ploughing the land, selection of seeds, sowing of seeds, transplanting method, crop rotation system, use of manure, grafting technology, irrigation methods, and construction of canals, were also more or less 'scientific' in nature. In this thesis, all along, I have tried to argue that, despite having the knowledge of new tools and technology, our medieval rulers paid maximum attention to improving agricultural production by applying the old tools and technology.[53] And in the same way, despite knowing the use of artificial manure, neither the Indian ruler forced peasants to use artificial methods of manuring for extra output, nor did our peasants adopt it. Importance was given to maintaining soil fertility, for which they used the land rotation system, dry

[53] Ahsan Jan Qaisar, *The Indian Response to European Technology, and culture (AD 1498-1707)*. Delhi, 1982.

and wet cultivation, crop rotation method, etc. Thus, it basically shows that the medieval peasants were well aware of the ecological balance of nature.[54] The methods which were adopted, viz. the construction of canals, laying of orchards and gardens, tilling of new land, and use of natural manures proved that medieval agricultural production was totally in 'consonance with nature.' Medieval period produced different types of food crops, cash crops, and vegetables. The period under review also found the introduction of new crops such as Maize, red chillies, and tobacco. When it comes to the relationship between cropping patterns and the food habits of medieval people, we found that it was the local cropping pattern that determined the food habit. Apart from that, we have seen regional variations in food habits. The study also tried to understand the agricultural production methods and knowledge shared in the various texts like "*Krishi – Parashara, Vrikshayurveda,* and *Nuskha Dar Fani Falahat.*" All these texts provide different types of agricultural production methods followed in the medieval period. For example, "*Krishi – Parashara*" gives a detailed description of the system of agricultural production, starting from the preparation of soil to the harvesting, and storing of crops. On the other hand, "*Vrikshayurveda*" discusses many aspects related to plant science, such as different types of diseases and their corrective measures. "*Nuskha Dar Fani Falahat*" also dealt with various aspects related to agriculture like the best time for sowing seeds, transplanting big trees, and grafting technology.

At present, Indian farmers are facing so many new challenges and financial distress. Most of them cannot even repay their loans taken from various government and non-government agencies for multiple reasons. Most of the farmers are not getting adequate prices for their agricultural products. Our farmers cannot store their surplus crops for an extended period due to a lack of cold storage, which forces them to sell their products at reduced rates. In order to avoid all these problems, the government should give importance to agriculture. Incentives like the direct cash transfer to the farmers, creating one all-India market for agricultural products, govt. should stop the flip-flop in agriculture trade policy, incentives should be given for water conservation, and the government should encourage farmers to grow new GMO (Genetically Modified Organisms) crops. Best agricultural practices like

[54] Sanjay Subodh, Agricultural Methods.

contract farming, drip irrigation, and environmentally conducive crops should be encouraged. The success of contract farming in some sectors, like cash crops and the vegetable market, should serve as a guiding role in making agriculture profitable and shock-resistant. Similarly, shifting away from water-intensive paddy crops in regions where there are water scarcity problems can heavily reduce the input costs of farmers, thereby contributing to increasing their income. The agriculture sector can be made more shock-resistant by simultaneously expanding the dairy and other associated industries to generate additional income for farmers. Today, stubble burning became a common practice in the states like Punjab, Haryana, and U.P., which has attributed to environmental and air pollution.[55] This pollution increases human morbidity. State and central governments need to take some extraordinary measures to stop this practice by introducing agricultural education and agricultural loans to the farmers to handle stubble differently. The government should also need to enforce some environmental laws and regulations to stop this practice. In the end, I hope that implementing all these measures mentioned above in this thesis would help us to achieve a sustainable agriculture model in the long run for every stakeholder, people, farmer, government, ecology, and environment where we live.

[55] L.S. Kurinji and Srish Prakash, 'Why Paddy Stubble Continues to be Burnt in Punjab' *CEEW The Council,* October 2021. This recent study explains stubble burning in Punjab, how it caused environmental pollution, and the remedial measures to avoid stubble burning.

## BIBLIOGRAPHY

**Primary Sources.**


Babur, Z, M. (1922). Tuzuk-I- Baburi, Eng. Tran. By. A.S. Beveridge, *Baburnama*, Vol. I. & II. London.

Badauni, Al. (1986). *Muntakhabu-t-Tawarikh* Vol. II. (Eng. Tr. and Ed. by W.H. Lowe). New Delhi.

Bhandari, S, R. (1918). *The Khulasatu-T-Tawarikh,* Ed. M. Zafar Hasan, Delhi.

Ball, V. (1925) *Travels in India by Jean Baptiste Tavernier*. Vol. I. (2nd Edition) Oxford University Press. London.

Ball, V. (1925) *Travels in India by Jean Baptiste Tavernier*. Vol. II. (2nd Edition) Oxford University Press. London.

Barbosa, Duarate. & Henry E. J. Stanley. (Eds.). (1865). *A Description of The Coasts of East Africa and Malabar In the Beginning of The Sixteenth Century.* London.

Barbosa, Duarte & Mansel Longworth Dames. (Eds.). (1918). *The Book of Duarte Barbosa* (Vol- I). London.

Battuta, I. (1976). *The Rehla of Ibn Battuta*. Trans. Mahdi Husain. Baroda: Oriental Institute.

Bernier, F. (1891). *Travels in The Mogul Empire AD 1656–1668*. Trans. Archibald Constable, London.

Bowrey, T. (1895). *A Geographical Account of Countries Round the Bay of Bengal, 1669 to 1679* (No. 12). London.

Chapot, V. (1928). EH Warmington. *The Commerce Between the Roman Empire and India*. Revue des Études Anciennes, 30(4), 328-330.

Commissariat, M. S. Bahadur Khan. (1940). Imperial Mughal Farmans in Gujarat. *Journal of the University of Bombay*, 9 (1), 1-56.

Coryat, T., William, Foster., ed. (1921). *Coryat's Crudities: His Letters From India, Early Travels in India: 1583-1619.* London.

Crooke, W. (Ed.). (2017). *A New Account of East India and Persia. Being Nine Years' Travels, 1672-1681, by John Fryer:* Volumes I-III. Taylor & Francis.

Dara, Shikoh (1994). *Nuskha Dar Fanni-Falahat: The Art of Agriculture (Persian Manuscript Compiled in The 17th Century),* India: Asian Agri- History Foundation.

De Laet, J. (1928). *Imperio Magni Mogolis.* Eng. Tr. By. J.S. Hoyland, *The Empire of The Great Moghul,* Bombay.

Edward Terry Account in William Foster, Ed. (1968). *Early Travel in India.* New Delhi, S. Chand.

Elliot, Henry M. (1954). *Memoirs on the History, Folk-Lore and Distribution of The Races of the North Western Provinces of India*. (Vol. II). London: Trubner & Co.

Elliot, H. M., & Dowson, J. (1872). *The History of India, as Told by Its Own Historians. The Muhammadan Period: Ed. from the Posthumous Papers of the Late Sir HM Elliot.* (Vol. IV). Trübner and Company.

Elliot, H. M., & Dowson, J. (1871). *History of India as Told by Its Own Historians*. (Vol. III). Muhammadan period.

Elphinstone, M. (1842). *An Account of The Kingdom of Caubul* (Vol. 2). R. Bentley.

Fazl, A., & Akbari, A. I. (1873). Vol. I, Eng. tr. by H. *Blochmann, Asiatic Society of Bengal, Calcutta*, 223.

Fazl, A., & Akbari, A. I. (1891). Vol. II, Eng. tr. by Colonel H.S. Jarrett, Calcutta.

Ferishta. M, K. (Ed.) Briggs, J. (1966). *History of the rise of the Mahomedan Power in India* Vol. II. Editions Indian.

Ferishta. M, K. (Ed.) Briggs, J. (1966). *History of the rise of the Mahomedan Power in India* Vol. III. Editions Indian.

Fernao N. (1900). *A Forgotten Empire (Vijayanagar),* Ed. By, Robert Sewell. London.

Fryer, John. (1909). *A New Account of East India and Persia, 1672 – 1681*. Vol. I. London.

Foster, W. (1912). *The English Factories in India, 1637-1641: A Calendar of Documents in the India Office, British Museum, and Public Record Office* (Vol. 6). Clarendon Press.

Foster, W., Fawcett, C., & Cadell, P. R. (1914). *The English Factories in India: 1646-1650* (Vol. 8). Clarendon Press.

Foster, W. (Ed.). (2017). *The Journal of John Jourdain, 1608-1617, Describing his Experiences in Arabia, India, and the Malay Archipelago*. Taylor & Francis.

Government of India. (1924-1925). *Punjab District Gazetteers,* Vol. VII, Part A, Kangra District.

Hawkins, W., & Foster, W. (Eds.). (1968). *Early Travels in India, 1583-1619*. New Delhi: S. Chand.

Jahangir, (1909). *The Tuzuk-I-Jahangiri* or Memoirs of Jahangir, Eng. Trans. By, H. Beveridge, London.

Jahangir, (1875). *Wakiat-I-Jahangiri,* Eng. Tr. By. H.M. Elliot, Calcutta.

K.M. Jhaveri. (n.d.). *Imperial Farmans (A.D 1557 to A.D. 1805)*, Bombay. Farman No. IV.

Lahori, A, H. (1875). Badashah-Nama, *Shah Jahan*, Sh. Mubarak Ali. (Ed & Eng. Tr. H.M. Elliot). Lahore.

Manrique, S. (1926). *Travels of Fray Sebāstien Manrique, 1629-1643: A Translation of The Itinerario De Las Missiones Orientales* Vol. I. (No. 61). Hakluyt Society.

Manrique, S. (1927). *Travels of Fray Sebāstien Manrique, 1629-1643: A Translation of The Itinerario De Las Missiones Orientales* Vol. II. (No. 61). Hakluyt Society.

Manucci, N. (1907). *Storia Do Mogor of Mogul India: 1653-1708,* Vol. II, (Eng. Tr. William Irvine). London.

Meredith-Owens, G. M. (1963). Khair-u'l-Majalis. Conversations of Shaikh Nasir-u'd-din Chiragh of Delhi (ob. 1356) compiled by Hamid Qalandar. Ed. by Khaliq Ahmad Nizami, Reader in History, Aligarh Muslim University. With a foreword by Dr. Tarachand. pp. 67, 307. Muslim University of Aligarh, No. 5. Studies in Indo-Muslim Mysticism 1. 1959. *Journal of the Royal Asiatic Society*, *95*(1-2), 105-106.

Minhaj-i-Siraj. (1881). Tabaqat-i- Nasiri, Tabaqat-i Nasiri Vol. I, (Eng. Tr. by H.G. Raverty). London.

Mollison, J. (1901). *A Text Book on Indian Agriculture,* Vol. I. Bombay.

Monserrate, A., & Monserrate, F. (1922). *The Commentary of Father Monserrate: SJ, on His Journey to the Court of Akbar*. Asian Educational Services.

Motte, T. (1930). *Early European Travellers in the Nagpur Territories*, Nagpur.

Mundy, Peter. (1914). *The Travel of Peter Mundy, In Europe and Asia, 1608-1667* Vol. II, Eng. Tr. By. Sir Richard Carnac Temple, London.

Mulage, S, B. (2017). History of Agriculture System in India: A Legal Perspective, *International Journal of Humanities Social Sciences and Education,* Vol. 4, Issue, 7, 25-30.

Nizamuddin, Ahmad, Eng. Tr. by H.M. Elliot & J. Dowson. (1873). *Tabakat-i-Akbari,*The History of India As Told By Its Own Historians Vol. V. London.

Ovington, J. (1929). *A Voyage to Surat in the Year 1689*. Oxford University Press London.

Ovington, J. (1984). *A Voyage to Surat in the Year 1689*. Vol. I. Oxford University Press, Reprint. London.

Pelsaert, Francisco. (1925). *Jahangir's India*. (W.H. Moreland & P. Geyl. Trans.). Cambridge: W.Heffer & Sons.

Princeton, John. (1896). *Collection of Best Travels,* Vol. VIII, Journal of Sir Thomas Roe, London.

Ptolemy. (1885). *Ancient India*, (Eng. Tr. by J.W. Mc Crindle). London.

Raverty H. C. Ed. (1880). *Tabaquat-i-Nasiri,* Calcutta.

Rennell, J. (1793). *Memoir of a Map of Hindoostan, or the Mogul Empire*. Bulmer.

Rennell, J. (1788). *Memoir of a Map of Hindoostan; Or, The Mogul Empire: With an Introduction, Illustrative of the Geography and Present Division of that Country: and a Map of the Countries Situated Between the Head of the Indus, and the Caspian Sea*. M. Brown.

Ryley, J. H. (1899). *Ralph Fitch, England's Pioneer To India and Burma: His Companions And Contemporaries, With His Remarkable Narrative Told In His Own Words*. London.

Sachau, E. C. (1910). *Alberuni's India: An Account of the Religion, Philosophy, Literature, Geography, Chronology, Astronomy, Customs, Laws and Astrology of India About A.D. 1030.* Volume II. London.

Sachau, E. C. (1910). *Alberuni's India: An Account of the Religion, Philosophy, Literature, Geography, Chronology, Astronomy, Customs, Laws and Astrology of India About A.D. 1030.* Volume. I. London.

Sadhale, N. (1999). *Krishi-Parashara (Agriculture by Parashara).* Asian Agri-History Foundation. AP, India.

Sadhale, N. (1996). Surapala, *Vrikshayurveda,* (The Science of Plant life), Asian Agri-History Foundation, AP, India.

Sarwani, A, K. (1871). *Tarikh-i-Sher Shahi,* (Eng. Tr. by E.C. Baly). Calcutta.

Seal, Satis Chandra. (1935). *Upavana Vinoda,* Calcutta.

Sen, S.N. (1949). I*ndian Travels of Thevenot and Careri: Being the Third Part of the Travels of Jean de Thevenot Into the Levant and the Third Part of a Voyage Round the World by Dr. John Francis Gemelli Careri.* New Delhi: National Achieve of India.

Sen, Surendranath (Ed.). (1949). *Indian Travels of Thevenot and Careri,* New Delhi.

Sewell, R., Nunes, F., & Paes, D. (1900). *A Forgotten Empire (Vijayanagar): A Contribution to The History of India*. London.

Shah, Firuz. (1996). *The Futuhat-i Firuz Shahi*, trans. Azra Alavi, Delhi: Idarah-i Adabiyat-i Delli.

Shamasastry, R. (1929). *Kautilya's Arthasastra*. Wesleyan Mission Press, Mysore.

Sirhindi, Yahya bin. (1932). *Tarikh-i-Mubarak Shahi*, (Tr.), K.K. Basu, Baroda.

Tamaskar B.G. (1978). *The Life and Work of Malik Ambar,* Delhi.

Tavernier, J. B. (1889). *Travels in India, 1640-67.* Vol. III. Eng. Trans. V Ball, New York.

Tavernier, J. B. (1889). *Travels in India, 1640-67.* Vol. II. Eng. Trans. V Ball, New York.

Tavernier, J. B. (1889). *Travels in India, 1640-67.* Vol. I. Eng. Trans. V Ball, New York.

Umari, al- Shihabuddin. (1992). *Masalik-ul-Absar,* Eng. Trans. Iqtidar Husain Siddiqui, *Perso-Arabic Source of Information on the Life and Conditions of the Sultanate of Delhi*. New Delhi.

Valle, Della. (1891). *The Travels of Pietro Della Velle in India*, Vol. II. Ed, By, Edward Grey. London.

Valle, Della. (1891). *The Travels of Pietro Della Velle in India*, Vol. I. Ed, By, Edward Grey. London.

Van Linschoten, J. H. (1885). *The Voyage of John Huyghen Van Linschoten to the East Indies: From the Old English Translation of 1598: the First Book, Containing His Description of the East* Vol. II. (No. 70). Hakluyt society.

Varahamihira, Vrikshayurveda. (2000). Eng. Tran. By, Lallanji Gopal, *Vrksayurveda In Ancient India, With Original Texts and Translation*, Super Prakashan, New Delhi.

Voelcker, J. A. (1893). *Report on The Improvement of Indian Agriculture*. London.

Watt, G. (1893). *A Dictionary of The Economic Products of India*. Voll. 6. Superintendent of Government Printing.

William Finch in William Foster. Ed. (1968). *Early Travels in India*, New Delhi, S Chand.

Yasin, Khwaja (1966). Of Delhi, *Glossary of Revenue and Administrative Terms*, Add, 6603, Delhi.

**Secondary Sources.**

Achaya, K. T. (1994). *Indian food: A Historical Companion*. Delhi: Oxford University Press.

A.C. Williams, and D.J. Meagher, (1903). *The Farm Manual*. Government Printing Press, Calcutta.

Afif, S. S., & Jauhri, R. C. (2001). *Medieval India in Transition: Tarikh-i Firoz Shahi: a First Hand Account*. New Delhi: Sundeep Prakashan.

Ambar Malik, (1940). *A Biography Based on Original Sources*, By Jogindra Nath Chowdhuri, Calcutta.

Appadurai, A. (1988). How to Make A National Cuisine: Cookbooks in Contemporary India, *Comparative Studies in Society and History*, Vol. 30, No. 1, 3-24.

Ashraf, K. M. (1932). *Life and Conditions of The People of Hindustan (1200-1550 AD).* University of London, School of Oriental and African Studies (United Kingdom).

Auboyer, J. (1961). *Daily Life in Ancient India*, London.

Balfour, Edward. (1849). Notes on The Influence Exercised by Tress in Inducing Rain and Preserving Moisture: *The Madras Journal of Literature and Science, Vol. XV.* Madras.

Basant, R. (1987). Agricultural Technology and Employment in India: A Survey of Recent Research, *Economic and Political Weekly,* Vol. 22, No. 32, 1348-1364.

Biswas, K. (1940).The Royal Botanic Garden, Calcutta, *Nature,* June, 22, Vol. 45.

Biswas, K. (1938). *Address of Welcome on 150$^{th}$ Anniversary of the Royal Botanic Garden, Calcutta* (1787-1937), Herbarium, Royal Botanic Garden, Calcutta.

Braudel, F. (1995). *The Mediterranean and the Mediterranean World in The Age of Philip II:* Vol II. Univ of California Press.

Braudel, F. (1972). *The Mediterranean and the Mediterranean World in The Age of Philip II:* Vol. I. Univ of California Press.

Burnell, J., Foster, W., Cotton, E., & Anstey, L. M. (1933). *Bombay in the Days of Queen Anne. Being an Account of the Settlement Written by John Burnell*. Hakluyt Society. London.

Briggs, J. (1966). *History of The Rise of the Mahomedan Power in India.* Vol. I. Editions Indian.

Chakravarti, R. (2008). Agricultural Technology in Early Medieval India (c. AD 500–1300). *The Medieval History Journal*, *11*(2), 229-258.

Chandra, Dr. Krishan, (2005). “Organic Manures” Published by, *Regional Director, Regional Center of Organic Farming No. 34,* Bangalore.

Chandra, S. (2005). *Medieval India: From Sultanat to the Mughals Part-II*. Har-Anand Publications.

Chandra, S. (2005). *Medieval India: From Sultanat to the Mughals Part-I*. Har-Anand Publications.

Chandra, S. (2007). History of Medieval India, New Delhi.

Chowdhuri, J. N. (1934). *Malik Ambar: A Biography Based on Original Sources* (Doctoral dissertation, MC Sarkar).

Clouston, D. (n. d.). Cattle Manure, *Agricultural Journal of India.* Taylor & Francis.

Collingham, L. (2006). *Curry A Tale of Cooks and Conquerors*. Oxford University Press, New Delhi.

Dasgupta, B. (1977). Indian’s Green Revolution, *Economic And Political Weekly,* 241-260.

Deakin, Alfred. (1893). *Irrigated India,* W. Thacker, and Co. London.

Deka, I. (2018). Food Habits of 12th Century A.D. In India and Its Health Benefits with Special Reference to Sriharsa’s Naisadhacaritam. *International Journal of Recent Research Aspects,* Vol. 5. Issue 1, 284-292.

De Laet, J. (1928). *The Empire of the Great Mogol: A Translation of De Laet's" Description of India and Fragment of Indian History"*. DB Taraporevala sons & Company.

Donaldson, J. (1851). *Soils and Manures, The Improvement of Land, and The Rotation of Crops.* London.

Gangopadhyay, R. (1932). *Some Materials for the Study of Agriculture and Agriculturists in Ancient India*. Serampore, India.

Gangulee, N. (1919). *The Indian Peasant And His Environment.* Oxford University Press, Calcutta.

Gardener, D. F. (1908). *Fertility of Soils As Affected By Manure,* Washington.

Goswami, K., Ram, K, H. (2017). Ancient Food Habits Dictate that Food Can Be Medicine but Medicine Cannot Be "Food"! *Journal of Medicines,* 2017, 4, 82.

Gupta, S. P. (1990). The Magnitude of Land Revenue Demand in the Mughal Administration during the Late 17th and 18th Century, *Proceedings of the Indian History Congress,* Vol. 51, 338-346.

Gupta, S. P. (1986). *The Agrarian System of Eastern Rajasthan, c. 1650-c. 1750*. Manohar.

Gode, P.K. (1961). *Studies In Indian Cultural History,* Vol. I. Hoshiarpur.

Gopal, Lallanji, (2008). *Aspects of Agriculture in Ancient India,* Varanasi.

Gottipati, R., B. R. Pavan., Menon, S. (2021). Stubble Burning: Root Cause, Impacts, and Its Management In Indian Scenario, *Environment Conservation Journal,* 22 (3): 37-45.

Government of India. (1976). *Report of the National Commission on Agriculture,* Part I.

Government of India. (1849). *Report on Development of Irrigation in India*. Calcutta.

Habib, Irfan. (2016). *Technology in Medieval India, C. 650-1750.* New Delhi: Tulika Books.

Habib, Irfan. (2016). *Economic History of India AD 1206-1526 The Period of the Delhi Sultanate and the Vijayanagara Empire*. New Delhi: Tulika Books.

Habib, Irfan. **(**2010). *Man and Environment, The Ecological History of India*, New Delhi: Tulika Books.

Habib, Irfan. (1997). *Essays in Indian History. Towards a Marxist Perception*, New Delhi: Tulika Books.

Habib, Irfan. (1982). *An Atlas of The Mughal Empire* (Vol. 6). New Delhi: Oxford University Press.

Habib, Irfan (1980). Technology and Society in Mughal India. *Presented at the Symposium on Problems of Acclimatization of Foreign Technology*. Japan.

Habib, Irfan. (1980). The Technology and Economy of Mughal India. *The Indian Economic & Social History Review*, *17*(1), 1-34.

Habib, Irfan. **(**1963). *Agrarian System of Mughal India*. Bombay: Asia Publishing House.

Habib, M., & Nizami, K. A. (1970). *A Comprehensive History of India: The Delhi Sultanat (AD 1206-1526), ed. by Mohammad Habib and Khaliq Ahmad Nizami* (Vol. 5). People's Publishing House.

Hastings, F. R. H. M., & Marchioness, S. F. C. C. S. (1858). *The Private Journal of the Marquess of Hastings, KG, Governor-General and Commander-in-Chief in India*. Saunders & Otley.

Hazell, Peter and C. Ramasamy. et al. (1993). *The Green Revolution Reconsidered: The Impact of High-Yielding Rice Varieties in South India,* The Johns Hopkins University Press, Baltimore, and London.

Howard, L. E. (1953). *Sir Albert Howard in India*, London: Faber & Faber.

Hunter, W.W. (1868). *Annals of Rural Bengal*, New York.

Hunter, W. W. (1875). *A Life of the Earl of Mayo, Fourth Viceroy of India* (Vol. 2). Smith, Elder, & Company.

Husain, Yusuf. (1959). *Glimpses of Medieval Indian Culture (Second edition)*. London.

Ikram, S. M. (1964). *Muslim Civilization in India*. Columbia University Press.

James C, Scott. (1907). *Against the Grain, A Deep History of The Earliest State.* London.

John, Beams. (1961). *Memoirs of a Bengal Civilian.* London.

Jr, White, L. (1962). *Medieval Technology and Social Change*. London.

Kawa, C, Nicholas. (2019). Night Soil: Origins, Discontinuities, and Opportunities for Bridging the Metabolic Rift, *Journal of Ethnobiology Letters*, Vol. 10 (1), 40-49.

Koch, E. (1991). Shah Jahan's visits to Delhi prior to 1648. New evidence of ritual movement in urban Mughal India. *Environmental Design: Journal of the Islamic Environmental Design Research Centre*, *1*(2), 18-29.

Krishna, K. A., & Morrison, K. D. (2009). History of South Indian Agriculture and Agroecosystems. *South Indian Agroecosystems: Nutrient Dynamics and Productivity*, 1-51.

Krishnakumar, T. (2019). Traditional Foods of India, *Research Gate*, January.

Krishnaprabu. S, (2019). Organic Farming in India: Concept, Applications and Perspectives, *Journal of Physics*, Vol. 1326.

Kumar, D. (1997). Science in Agriculture: A Study in Victorian India. *Asian Agri-History (India).*

Kumar, D., & Raha, B. (Eds.). (2016). *Tilling the Land: Agricultural Knowledge And Practices in Colonial India*. New Delhi, Primus Books.

Kumari, T. (2014). Crops of Medieval India-Innovations in Economic Area, *ISRO Journal of Humanities and Social Science,* Vol. 19, Issue, 7, (July 2014), 61-64.

Kurinji, L. S., Prakash, S. (2021). Why Paddy Stubble Continues to be Burnt in Punjab? Meeting Challenges With Solutions, *The Council CEEW.*

Leather, J. W. (n. d.). Water Requirements of Crops in India, *Taylor & Francis.*

Lyon, T, L. (1917). *Soils And Fertilizers,* New York, The Macmillan Company.

Mackenna, J. (1915). *Agriculture in India,* Simla.

Mahtab, H. K. (1959). *The History of Orissa,* Vol. I. (up to 1568 AD). Cuttack.

Mate. M. (1985). Agrarian Practices: The Determining Factors, *The Agricultural History Review,* Vol, 33, No, 1, 22-31.

Magara, Y. (1980). Design and Performance of Night Soil Treatment Plants, *Journal (Water Pollution Control Federation),* Vol. 52, No, 5, 914-922.

Majumdar, R. C. (1960). *The Classical Accounts of India*. Firma KL Mukhopadhyay, Calcutta.

Mayo. K. (1927). *Mother India,* Blue Ribbon Books, New York.

Mead, M. (1943). The Factor of Food Habits. *The Annals of The American Academy of Political and Social Science, 225* (1), 136-141.

Mehra, K. L. (1997). Biodiversity and Subsistence Changes in India: The Neolithic and Chalcolithic Age. *Asian Agri-History* Vol. 2. June.

Morfit, C. (1848). *Manures, Their Composition, Preparation, and Action Upon Soils: With the Quantities to be Applied. Being a Field Companion for the Farmer. From the French of Standard Authorities*. Lindsay and Blakiston.

Moreland, W. H. (1990). *India At The Death of Akbar: An Economic Study,* New Delhi.

Moreland, W.H. (1990). *From Akbar to Aurangzeb, A Study in Indian Economic History.* New Delhi.

Moreland, W.H. (Ed.). (1931). *Relations of Golconda in The Early Seventeenth Century*, London.

Moreland, W. H. (1929). *The Agrarian System of Moslem India*. Allahabad.

Moreland, W.H. (1912). *Agricultural Conditions of The United Provinces and Districts*, Allahabad.

Morfit, Campbell. (1848). Manures, *The Farmers Guide and Field Companion,* Philadelphia.

Mukerji, N. G. (1901). *Hand-Book of Indian Agriculture,* Calcutta.

Malikzada (1882). *Nigarnama-I-Munshi*, Lucknow.

Murray, J. Alan. (1910). *Soils and Manures*, New York.

Moosvi, S. (1987). *The Economy of the Mughal Empire, c. 1595 A Statistical Study,* Oxford University Press, Delhi.

Moosvi, S. (1983). The Economy of Gujrat, c. 1600—The Ain's Statistics. In *Proceedings of the Indian History Congress* (Vol. 44, pp. 224-233). Indian History Congress.

Moosvi, S. (1971). Production, Consumption and Population in Akbar's Time, *Proceedings of the Indian History Congress,* Vol. 33, 260-369.

Naqvi, H. K. (1990). Agricultural, Industrial and Urban Dynamism Under the Sultans of Delhi, 1206-1555. *Journal of the American Oriental Society*, 110 (1).

Naqvi, H. K. (1984). Cultivation Under the Sultans of Delhi c. 1206-1555. *Indian Journal of History of Science*, *19*(4), 329-340.

Naqvi, H. K. (1972). *Urbanization and Urban Centres Under the Great Mughals,* Shimla: Indian Institute of Advanced Study.

Naqvi, H. K. (1968). *Urban Centres and Industries in Upper India 1556-1803*. Bombay.

NCA, N. D. (1976). *Report of the National Commission of Agriculture*. *Part V,* New Delhi.

Nicholls, H. A. A. (1900). *A Textbook of Tropical Agriculture.* (No. 631.0913 N. 614). Macmillan and co.

Needham, J. & Bray. (1984). *Science and Civilization in China.* (Vol. 6). Cambridge: Cambridge University Press.

Nene, YL. (2017). A Critical Discussion on the Methods Currently Recommended to Support Organic Crop Farming in India, *Asian Agri-History* Vol. 21, No, 3, 267-285.

Nene, YL. (2012). Potential of Some Methods Described in *Vrikshayurvedas* in Crop Yield Increase and Disease Management, *Asian Agri-History* Vol. 16, No. 1, 45-54.

Nene, YL. (2012). Significant Milestones in Evolution of Agriculture in the World. *Asian Agri-History Foundation AP*. Vol.16, No. 3, 219-235.

Panigrahi, K. C. (1986). *History of Odisha*, Cuttack.

Paine, J. (1999). *Father India* New York.

Panse, V. G. (1944). Manuring of Cotton In India, *Indian Farming Journal,* Vol. V, No. 3.

Patnaik, N. R. (1997). *Economic History of Orissa*, New Delhi.

Pingle, G. (2017). Paddy Yields in Pre-Industrial South India, *EPW,* Vol. LII No. 16. 36-45.

Prakash, Om. (1961). *Food And Drinks In Ancient India (From Earliest Times To c. 1200 A.D.).* Delhi.

Qaisar, A. J. (1992). Agricultural Technology Depicted in Mughal Paintings. *Itinerario*, *16*(2), 61-84.

Qaisar, A. J. (1982). *The Indian Response to European Technology and Culture (AD 1498-1707).* Delhi: Oxford University Press.

Randhawa M.S. (1986). *A History of Agriculture in India,* Vol. IV. New Delhi.

Randhawa M.S. (1983). *A History of Agriculture in India,* Vol. III. New Delhi.

Randhawa M.S. (1982). *A History of Agriculture in India,* Vol. II. New Delhi.

Randhawa M.S. (1980). *A History of Agriculture in India,* Vol. I. New Delhi.

Raychaudhuri, Roy, M. (1993). *Agriculture in Ancient India-A Report.* New Delhi.

Raychaudhuri, Tapan.,& Habib, Irfan. (Eds.). (1982). *The Cambridge Economic History of India*. Vol. 1. Hyderabad; Orient Longman.

Raychaudhuri, T., Kumar, D., Habib, I., & Desai, M. (Eds.). (1983). *The Cambridge Economic History of India: Volume 2, C. 1757-c. 1970* (No. 2). CUP Archive.

Rehber, R., Turhan, S., Vural, H. (2018). Organic Farming: A Historical Perspective, *In Journal of Biological and Environmental Science, Research Gate,* Vol. 12 (36), 113-122.

Report, Canadian Public Health Association. (1913). The Use of Night Soil in the Vegetable Garden as a Possible Disseminator of Disease, *The Public Health Journal,* Vol, 4, No, 8, 487.

Report, Public Health Reports. (1896-1970). Pennsylvania: Night Soil. Use as Fertilizer, *Public Health Reports,* Vol, 28, No, 48, 2581-2582.

Report, Public Health Reports. (1896-1970). Maryland: Use of Night Soil for Fertilizing Growing Vegetables, *Public Health Reports,* Vol, 28, No, 17, 807.

Report, Scientific American, a division of Nature American. (1857). Utilization of Night Soil, *Scientific American,* Vol. 12, No, 48, 382.

Roy, M. (2009). Agriculture In The Vedic Period, *Indian Journal of History of Science.* 44.4, 497-520.

Sangwan, S. (1991). Level of Agricultural Technology In India (1757-1857), *Indian Journal of History of Science,* 26 (1).

Russell, E.J. (1916). *Manuring For Higher Crop Production*, Cambridge University Press.

Russell, E.J. (1915). *A Student's Book on Soil and Manures,* Cambridge University Press.

Sangwan, S. (1988). Indian Response to European Science and Technology 1757-1857. *The British Journal for the History of Science,* Vol. 21, No.2, 211-232.

Sarkar, J. (1912). *History of Aurangzeb,* Calcutta.

Sarkar, J. (1943). *The History of Bengal Vol. II, Muslim Period 1200-1775 A.D*. Delhi.

Saikia, A. (2013). Food Habits in Pre-Colonial Assam. *International Journal of Humanities and Social Science Invention*, *2*(6), 1-5.

Sayani Seedick, R, (n. d.). *Agricultural Industries in India*, Madras.

Scoot. L. (2013). British Agricultural History Society Winter Conference 2012 Science and Knowledge in Agriculture, *The Agricultural History Review*, Vol. 61, No, 2, 367-368.

Sen, B., Ed. Hadden., G, Susan. (1976). The Green Revolution in India: A Perspective, *The Journal of Asian Studies*, Vol. 35, No. 3 (May, 1976), 522-523.

Sen, S. (2010). Scientific Enquiry in Agriculture in Colonial India: A Historical Perspective. *Indian Journal of History of Science.*

Sen, T, Colleen. (2015). *Feasts and Fasts A History of Food in India*. London.

Sharma, R, K. (1974). Green Revolution & Farm Employment: An Analysis of Experience in The Punjab, *Indian Journal of Industrial Relations,* Vol. 9, No. 1974, 417-426.

Sharma, R. S. (2007). *Material Culture and Social Formations in Ancient India*. Macmillan.

Sharma, R. S. (1975). Class Formation and Its Material Basis in the Upper Gangetic Basin (c. 1000-500 BC). *Indian Historical Review II.*

Sharma, R. S. (1974). The Economic History of India up to AD 1200: Trends and Prospects. *Journal of the Economic and Social History of the Orient.* Vol. 17, No. 1 (March, 1974), 48-80.

Sidhu, S, H. (2002). Crisis in Agrarian Economy in Punjab Some Urgent Steps, *Economic and Political Weekly*, 3132-3138.

Singh, S. (1982). Agricultural Science and Technology in The Punjab In The Nineteenth Century, *Indian Journal of History of Science*, 17 (2): 191-204.

Singh, Vijender. (2016). Akbar's Land Revenue System, *International Journal of Engineering, Management, Humanities and Social Sciences Paradigms.* Vol. 19, Issue, 01, 8-15.

Singh, V. K., Kumar, A., Saini, D. K. (2019). Stubble Burning, *Biomolecule Reports,* Vol, 09, 1-8.

Sivasubramaniyan, K. (2006). Sustainable Development of Small Water Bodies in Tamil Nadu. *Economic and Political Weekly*, Vol. 41, No. 26 (June. 30- July. 7, 2006), 2854-2863.

Srinivasan, T.M. (1970). Water-Lifting Devices In Ancient India: Their Origin And Mechanism (From The Earliest Times to c. A.D. 1000), *Agricultural Journal of India.* Taylor & Francis.Vol. 5. No.2.

Srinivas, T. (2006). As Mother Made It: The Cosmopolitan Indian Family, Authentic Food and The Construction of Cultural Utopia, *International Journal of Sociology of the Family,* Vol. 32, No. 2, 191-221.

Spate, O.H.K. & A.T.A, (2017). *India and Pakistan, A General and Regional Geography*, Vol. 12. London.

Son, John Donald. (1911). *Soils and Manures, The Improvement of Land and The Rotation of Crops*, London.

Subodh, S. (1998). Agricultural Methods and Environment in Mughal India: A Study of Manuring System. *Asian Agri-History* Vol. 2, No. 2, 121-130.

Super, C. J. (2002). Food and History, *Journal of Social History*, Vol. 36, No. 1, 165-178.

Taylor, S., Ghosh, M. (n. d.). Experiment on The Green-Manuring of Rice, *Agricultural Journal of India,* Vol. XVIII.

Tirmizi, S.A.I. (1989). *Mughal Documents (1526-1627)* Vol. I. Manohar Publications, Delhi.

Vaidyanathan, A. (1985). Water Control Institutions and Agriculture: A Comparative Perspective, *Indian Economic Review*, Vol. 20, No. 1 (January - June 1985), 25-83.

Warmington, E.H. (1974). *The Commerce Between The Roman Empire and India*, 2nd Ed. Delhi.

Wickens, G. E., Haq, N., Day, P., & Day, P. R. (Eds.). (1989). *New Crops for Food and Industry*. Springer Science & Business Media.

# Agricultural Practices, Nature, Technology, and Texts In Medieval India

*by* Ranjita Badaseth

**Submission date:** 28-Dec-2022 11:19AM (UTC+0530)
**Submission ID:** 1987035198
**File name:** Ph.D_Draft.pdf (2.67M)
**Word count:** 46756
**Character count:** 239754

# Agricultural Practices, Nature, Technology, and Texts In Medieval India

ORIGINALITY REPORT

| 4% | 3% | 0% | 0% |
|---|---|---|---|
| SIMILARITY INDEX | INTERNET SOURCES | PUBLICATIONS | STUDENT PAPERS |

PRIMARY SOURCES

| | | |
|---|---|---|
| 1 | archive.org<br>Internet Source | 1% |
| 2 | www.infinityfoundation.com<br>Internet Source | <1% |
| 3 | ddceutkal.ac.in<br>Internet Source | <1% |
| 4 | egyankosh.ac.in<br>Internet Source | <1% |
| 5 | singhaniauniversity.co.in<br>Internet Source | <1% |
| 6 | www.insa.nic.in<br>Internet Source | <1% |
| 7 | www.archive.org<br>Internet Source | <1% |
| 8 | doku.pub<br>Internet Source | <1% |
| 9 | qdoc.tips<br>Internet Source | <1% |

*THINK INDIA JOURNAL*

ISSN:0971-1260
Vol-22- Issue-14-December-2019

# Agricultural Practice And Changes: - A Study In Medieval India.

**Ranjit Badaseth**

Ph.D. Research Scholar

RESEARCH SUPERVISOR Prof. SANJAY SUBODH

UNIVERSITY OF HYDERABAD

Mail ID - ranjitbadaseth@gmail.com

**Abstract:**

India as a predominantly agricultural country attributes a major share of its overall development to the agricultural sector. Up to 1990, agriculture played a vital role in the Indian economy. At present large number of people are employed in this sector. After the consecutive three great famine (1880, 1898, 1900) the Government of India wanted to set up a central department of agriculture. The prime motive of the department was, to look after the agricultural development and famine relief in the country. In 1890 Dr. J.A. Voelcker,[1] an agricultural chemist of the Royal Agricultural Society of England was sent to India to advise on the best course to be taken for improving Indian agriculture. In his report on "Improvement of Indian Agriculture", he recommended systematic prosecution of agricultural enquiry, and the spread of general and agricultural education through research and teaching in India. In this way the colonial government taken so many initiatives to improve the agricultural production. Then the need to bring about a rapid increase in food production in the years after independence necessitated for the re-examination of the existing system of agricultural research and education. It was realized that the goals of increased production could be achieved only through application of science and technology to agriculture. An attempt has been made in this paper to understand, the methods of agricultural production in pre-colonial period. The importance also given in this paper to understand, each process of production and understand it from the realm of modern science.

**Key words:-**Arthashastra, Agriculture, Phal, foot-plough, Technology.

# CONTEMPORARY SOURCES KNOWLEDGE AND INFORMATION: A STUDY OF AGRICULTURAL PRACTICE IN MEDIEVAL INDIAN SOCIETY

**Ranjita Badaseth***

*Ph.D. Research Scholar, Department of History, University of Hyderabad, Hyderabad

**Abstract**

Agriculture has always played a significant role in Indian society. Right from the ancient times, the profession of agriculture has been appreciated. The discipline of agriculture or tilling the land is considered one of the oldest sciences and art on the earth. The agricultural production system involved several steps, starting from the selection of land, to harvesting and storing the grains. So before tilling the land, a peasant should have some essential skills and knowledge of agriculture. Such as selection of land for the crop he wishes to grow, selection of seeds, methods of cultivation, use of water, judicious use of manure, rotation of crops, the introduction of new crops, management of cattle, and so on. Now the critical question is what was the source of knowledge in agriculture during the pre-colonial period? Were there any prescribed rules and regulations for the cultivation of land? By and large, peasants of those periods mostly gained knowledge from practical experiences or actual farming. Later on, they passed it onto the next generation. In other words, with the passage of time, the knowledge of agricultural production was passed from one generation to another. The important question before us is if the knowledge of agriculture production was passed from one generation to another from practical experiences? Then, were there any other sources of knowledge or text which prescribed the art of cultivation? The answer would be yes; specific texts starting from Kautilya's Arthashastra to Nuskha Dar Fani Falahat dealt with agricultural production methods. Hence an attempt has been made in this paper to analyze what kinds of sources of knowledge and information's available in those various texts in relation to agricultural production. Attempt has been also made in this paper to understand what were the methods of cultivation followed in those periods? What types of plough were used for cultivation? How peasants predicted the availability of groundwater. What were the different methods used for the treatment of plant disease and how grafting technology was used for grafting different types of trees all to gather?

**Keywords:** Agriculture, Vrikshayurveda, Krishi – Parashara, Nuskha Dar Fanni-Falahat.

## Contemporary Sources

### Kautilya's Arthashastra

The text says that the superintendent of Agriculture should possess the knowledge of the science of agriculture to deal with the plantation of bushes and trees or need to help others who were trained in such sciences. He should collect all kinds of seeds of grains in time such as flowers, fruits, vegetables, bulbous roots, roots, pallikya, fiber-producing plants, and cotton. The text also talked about sowing of seeds in crown lands.[1] The text gives more importance to the prediction of rainfall, because it argued without sufficient rainwater the agriculture production is impossible. On the basis of the rainfall the superintendent shall decide how much seed needs to be sown. The text gives a detailed description of sowing of seeds in different seasons.[2] It says that the superintendent should grow both winter crops and summer crops according to the supply of water and labour.