



E-C O N T E N T

UDAI PRATAP COLLEGE, VARANASI-221002

Programme/Class: Diploma in Plant Identification, Utilization & Ethnomedicine/BSc-IV Semester

UG, Year: II, Semester: IV, Paper: I, UNIT-I

Subject: Botany; Course Code: BO40401T

Course Title: Economic Botany, Ethnomedicine and Phytochemistry

Topic: Origin and Domestication of cultivated plants

Name: Prof. Ajai Kumar Singh, **Department of Botany**, Faculty of Science,
Mobile No. 9450538149, E-mail: ajaiupcollege@gmail.com

THE NEOLITHIC REVOLUTION

The Neolithic Revolution was a process of transition from a nomadic lifestyle of hunter-gatherer communities to one of agriculture and pastoralism, as well as the start of a sedentary lifestyle. This transition took place at a varying pace in different regions of the world. It is assumed that the major proportion of the human population underwent this process in the period between 10,500 and 6,000 years ago.

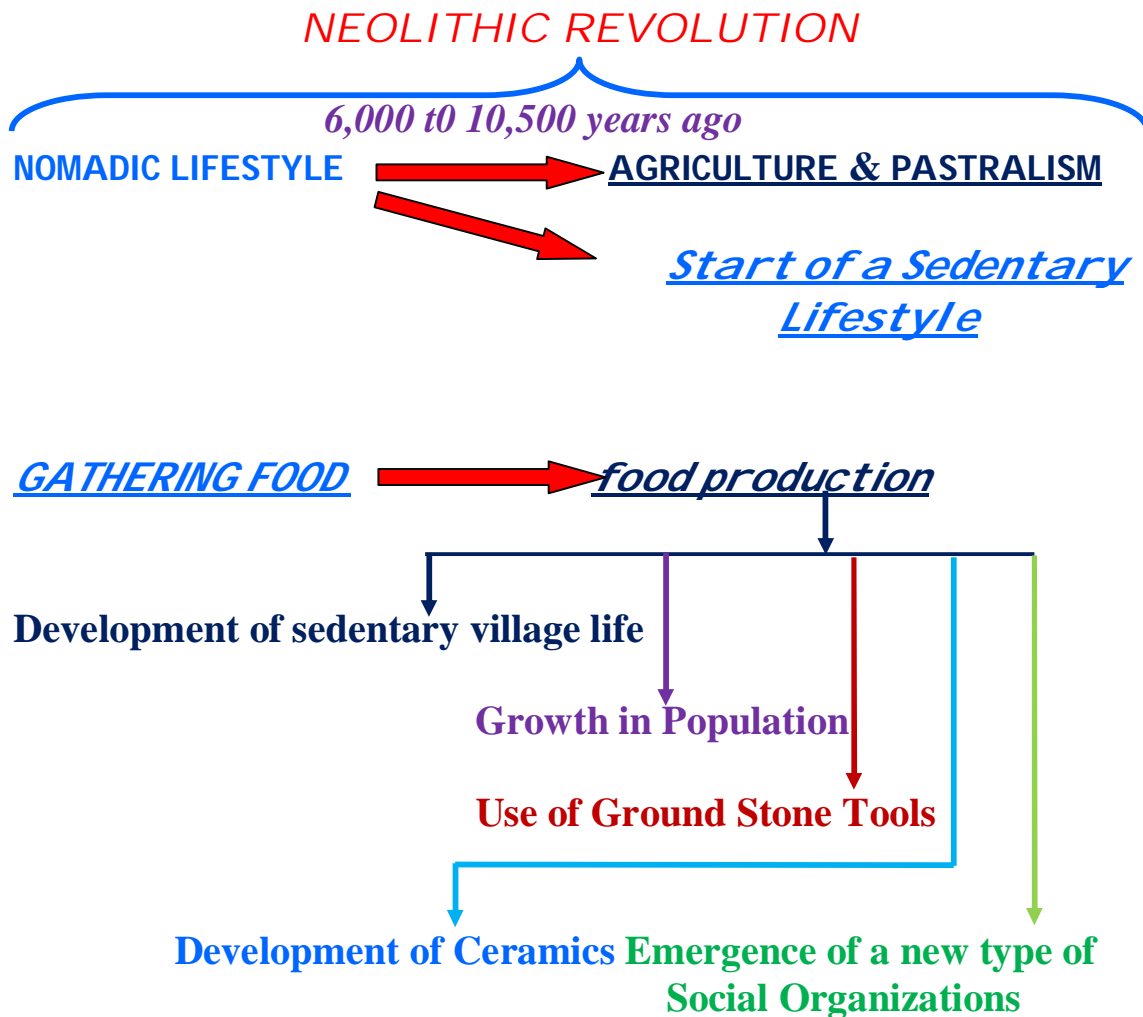
The Neolithic Revolution was a consequence of a transition from gathering food, which was typical of pre-agrarian societies, to food production, which is observed in agricultural societies. It was accompanied by fundamental changes, which were characteristic of the whole process, such as development of sedentary village life, growth in population, use of ground-stone tools, development of ceramics, and the emergence of a new type of social organisation.

This term Neolithic was coined by Sir John Lubbock in 1865 to denote an Age in which the stone implements were more varied and skilfully made and often polished. V. G. Childe defined the Neolithic-Chalcolithic culture as a self-sufficient food producing economy. Some characteristic features of Neolithic culture as explained by M. C. Burkitt were:

- a. Practice of Agriculture;
- b. Domestication of Animals in terms of economic life;

- c. Grinding and Polishing of stone tools; and
- d. Manufacture of tools.

The Neolithic or New Stone Age denotes to a stage of human culture following the Palaeolithic and Mesolithic periods and is characterized by the use of polished stone implements, development of permanent dwellings, cultural advances such as pottery making, domestication of animals and plants, the cultivation of grain and fruit trees, and **weaving**. All of these complex societies emerged in the fertile valleys of different river located in different parts of the globe. Some of these early groups settled in the fertile valleys of Nile, Tigris-Euphrates, Yellow, and Indus Rivers. These settlements with surplus agricultural products and trade subsequently resulted in the rise of the great civilization in Egypt, Mesopotamia, China, and India.



The crucial factor which contributed to the advent of the Neolithic Revolution was the invention of Agriculture, since it allowed humans to satisfy basic needs in a permanent and stable way.

COMPARISON BETWEEN HUNTER-GATHERERS AND FARMERS

The following table indicates the basic difference between hunter-gatherers and farmers.

| Hunter-gatherers | Farmers |
|---|---|
| Hunting gathering economy, economy based on wild resources | Economy based on domesticated crops and animals |
| Mobile (<i>very few possessions of material culture</i>) | Sedentary (<i>some accumulation of possessions, esp. Pottery, in permanent dwellings</i>) |
| Low population density | High population density |
| Overall stability of groups | Expansion necessary due to population increase |
| Relatively little impact on environment | Clearance of land for arable farming; impact of livestock (<i>use of ground Stone axes and fire in clearance</i>) |
| Sparse archaeological record (<i>campsites, rock shelters, debitage scatters</i>) | Archaeological imprint on landscape (<i>settlements, boundaries, monuments, permanent dwellings</i>) |

To understand the complete process of Neolithic Revolution, it is necessary understand the process of domestication.

Zeder (2015) defined domestication as, "a sustained multi-generational, mutualistic relationship in which one organism assumes a significant degree of influence over the reproduction and care of another organism in order to secure a more predictable supply of a resource of interest, and through which the partner organism gains advantage over individuals that remain outside this relationship, thereby benefitting and often increasing the fitness of both the domesticator and the target domesticate".

The process takes place between the two poles designated by 'wild' and 'domestic'. Consequently, one can talk about various stages or levels of domestication, which are dependent on the scope of the influence exerted by environmental, biological and cultural factors. These factors can have either a rapid or a gradual impact on the living organism.

Animal domestication is an excellent example of the latter type of domestication, as it consists of a number of clearly discernible intermediate stages. At the initial, 'wild' stage

of domestication, a given population of organisms generally has no experience of any direct or indirect impact on the part of man. Domestication ends at the 'domestic' stage, when a given population is totally dependent on humans with regard to such issues as survival, reproduction and nutrition.

In case of plant domestication, depending on the means used by man, the process can be divided into several stages:

- 1). Unconscious selection of plants for desirable traits, by 8,500 B.C.;
- 2). Conscious cultivation of plants with desired traits, about 10,500 years ago;
- 3). Deliberate breeding to improve traits, in the 18th century.
- 4). Scientific breeding: genetic mechanisms known and exploited, at the beginning of the 20th century, and
- 5). Direct genetic manipulation, from the 20th to the 21st century.

Despite numerous studies in this area, it is still impossible to provide a precise answer to the questions of how, where and when plant domestication, which initiated the development of Agriculture, was practiced by humans for the first time.

Difference between DOMESTICATION and TAMING

Taming is usually defined as the conditioned behavioural modification of a wild-born animal, when its natural avoidance of humans becomes reduced and it accepts the presence of humans.

Domestication is a permanent genetic modification of a bred lineage that leads to an inherited predisposition towards humans.

1. Agricultural Transition

There is no specific proof about the area or the date of the transition from gathering to producing food for the first time. Most probably, it was a gradual process.

Hunter-gatherer communities began to increase their economic reliance on the production of food, gradually turning into agricultural communities.

It appears that, for a long time, people gathered the grains of wild cereals, which constituted a significant component of their diet. Most likely, however, the first domestication of plants did not take place before approximately 8,500 years B.C., while domestication of animals not before approximately 8,000 years B.C.

There are also many indications that food production began at different times in different areas. In some cases, food production was initiated as a

result of independent discoveries, while in other, from borrowings from neighbouring societies.

In all probability, humans began to produce food for the first time in the valleys of two great Asian rivers, the Yellow River and Yangtze River. Modern research can indicate with certainty five areas where the first domestication of plants took place (Diamond, 1997).

- 1). Southwest Asia [The Near East/The Fertile Crescent].
- 2). China;
- 3). Mesoamerica [Central and southern Mexico and the areas adjacent to Central America];
- 4). The Andes of South America, and possibly the adjacent Amazon Basin, and
- 5). The eastern United States.

It may be assumed that food production most likely took place also in:

- 1). Africa's Sahel zone;
- 2). West Africa;
- 3). Ethiopia, and
- 4). New Guinea.

Most of the Scientists are generally unanimous as far as the beginnings of agriculture are concerned. It appears that land has been cultivated by humans for over 10,500 years. Naturally, this does not imply that 10,500 years ago land was cultivated all over the world, since at that time food production started only in selected areas. It is much difficult to specify the genesis of agriculture than the date of its introduction. **There are many hypotheses which attempt to explain why humans domesticated plants and animals and began to produce food.**

A number of theories presented different workers with the view of explaining the origin of agriculture. The important views include the following.

➤ **The Oasis Theory:**

This is one of the earliest theories and it was put forwarded by Raphael Pumpelly in 1908. Modern climate research, however, does not confirm assumptions but the theory does not have many supporters nowadays.

This theory argues that the climate change that occurred in the late Pleistocene caused the expansion of desert areas in the Near East which, in turn, forced humans and many species of fauna and flora to cluster in a small area of a group

of oases. Such concentration of many edible species of plants and animals meant that people began to experiment with them, and thus invented agriculture.

➤ **Hilly Flanks Theory:**

This theory postulates that the development of agriculture was a 'logical outcome' of the evolutionary tendency to specialise. After gatherer communities settled at the end of Pleistocene, they gained better knowledge of the plants and animals living their settlements. It helped to change the system of obtaining food from collection to production.

According to this concept, humans noticed exceptional growth of wild ancestors of today's wheat and barley in certain locations, i.e., on the slopes of mountains in regions with frequent rainfall and characterised by favourable temperatures. Plants grew there without the need to provide them with water. However, modern geomorphology and paleoclimatology does not confirm this view S

➤ **Feasting Model Theory:**

This theory strictly not connected with the environmental factors and it assigns the key role in the development of agriculture to cultural factors. This theory was presented by Bryan Hayden, who took the view that the origin of agriculture was inextricably associated with the exercise of power in primitive human societies. According to this theory, the need for increased quantities of food somehow forced gatherer communities to invent a new strategy of acquiring it, i.e., it production.

➤ **Domestication Theory:**

This theory argues that humans settled in particular areas, abandoning the gatherer-hunter strategy of acquiring food. Establishing annual or seasonal settlements, they were able to take care of the species living in the areas. In this way, they gained food to satisfy their essential needs. This lifestyle led to the invention of agriculture. The theory of the origin of agriculture is supported by Daniel Quinn, and others.

➤ **Dump Heap Hypothesis:**

This hypothesis assumes that people invented agriculture by chance, when they observed how the seeds of edible plants thrown on dumpheaps grew into robust plants because of the abundance of nutrients available there. With time, those accidental 'crops' induced humans to undertake deliberate and planned activities, which resulted in the invention of agriculture. This concept was popularised by Edgar Anderson.

➤ **Marginal Habitat Hypothesis:**

States that the climate change which took place at the end of Pleistocene led to the concentration of areas rich in resources, and this contributed to sedentarism

and growth in the human population. Some human societies increased their numbers to such an extent that they had to use the areas which did not constitute an optimal environment for breeding plants and did not provide as much food as the more fertile areas. Consequently, people were forced to undertake some soil management practices in those marginal environments in order to increase the amount of the acquired food, which initiated the cultivation of crops. Supporters of this concept include Lewis Binford and others.

- **Coevolution/Symbiotic Hypothesis** states that food production was the outcome of a natural symbiotic relationship between humans and nature. Selection of plants did not take place as the result of human conscious decisions but was a by-product of the ways in which humans used various species of flora and fauna. Supporters of this group include David Rands among others.

The theories presented above constitute just a few examples of explanations regarding the roots of agriculture. Due to the very limited knowledge regarding human life several thousand year ago, it is impossible to state with absolute certainty which of the concepts is true or to what extent it reflects the cause of the invention of agriculture.

All the theories, provide a picture that illustrates the complexity of the problem and its multiple conditionings, due to which, humans, through the Neolithic Revolution, entered a new stage of history.

2. Domestication of Plants

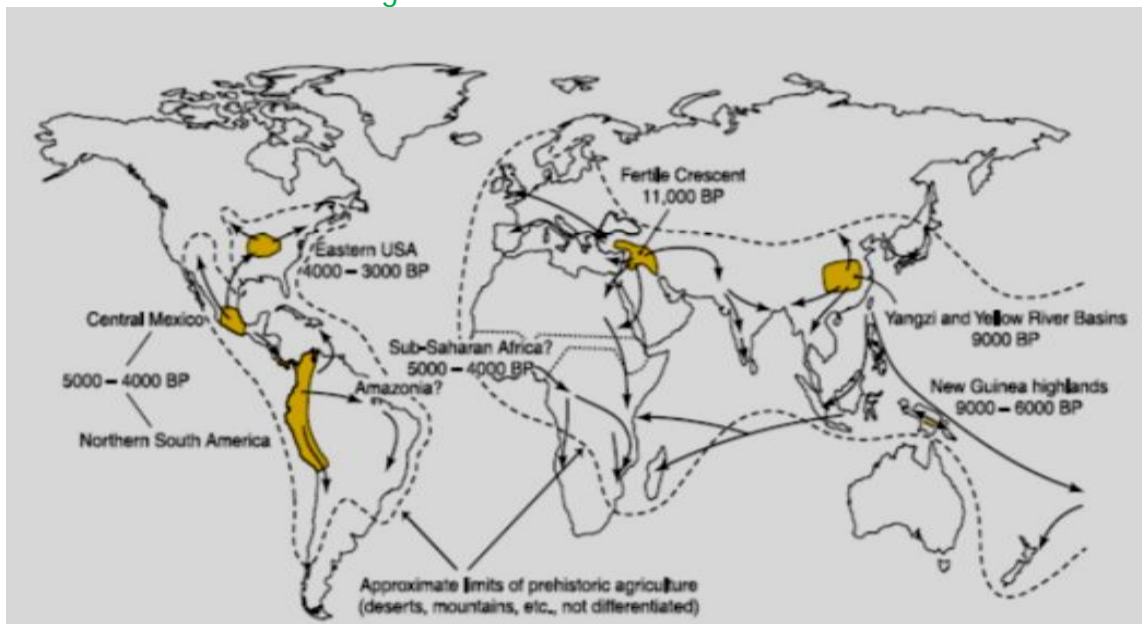
The domestication of plants was a necessary condition for the Neolithic Revolution. Without its discovery, agriculture would not be possible at all. It is difficult to provide general information regarding the domestication of particular species of plants, i.e., dates and regions where it took place.

The human evolution in the last 10,000 years BP, which is geologically termed as the Holocene period, witnesses a revolutionary change in the history of human being. During this time, early man acquired slowly the knowledge of taming and bringing several animals and plants under their control, which finally lead to early domestication process.

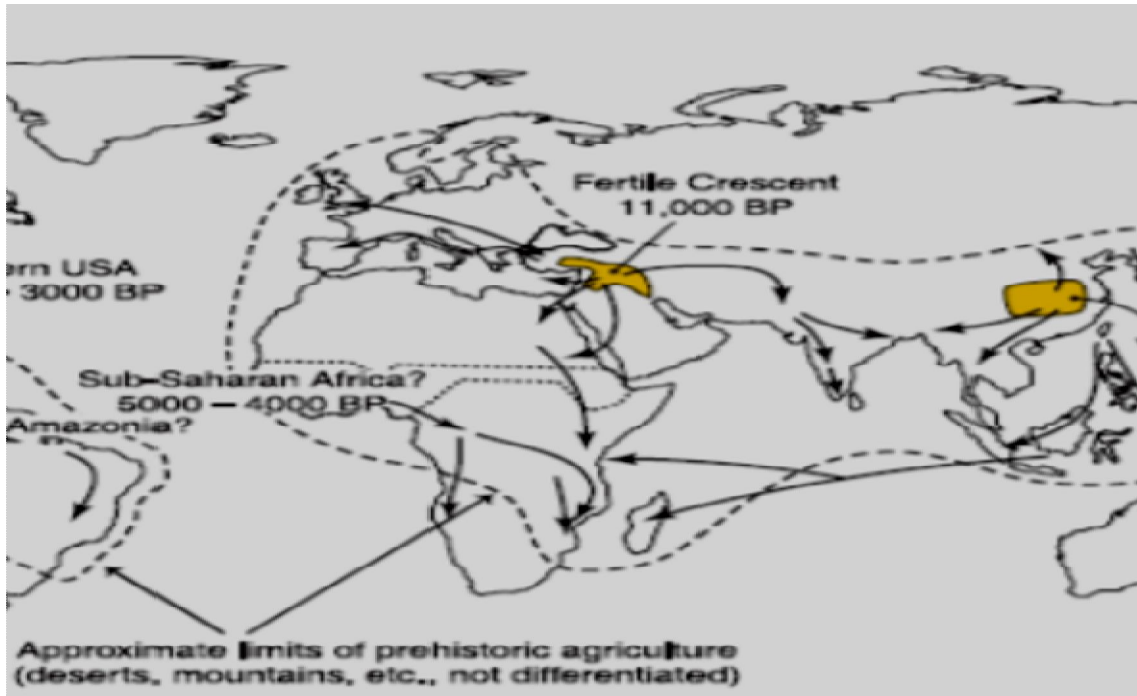
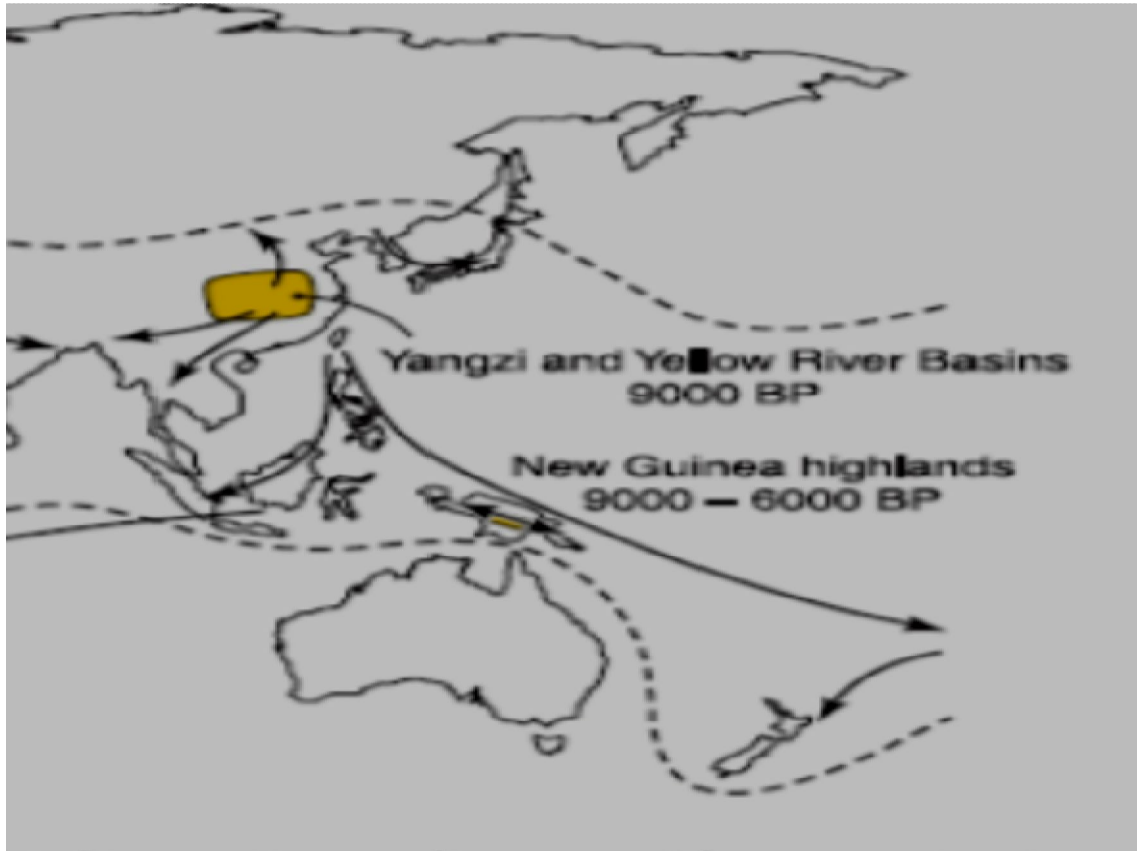
Domestication simply means **'to bring plants/animals under human control, to tame'**. It is an evolutionary process during which many behavioural traits have changed from the wild types to the existing domesticated populations. The grains of wild varieties of plants like wheat, barley, rice etc. usually fall on the ground before maturation (**Shattering**

Effect) which makes difficulties for harvesting. With the beginning of farming and irrigation, these plants lost many of their wild characters. Yields gradually increased with intense care of the early farmers. The Neolithic farmers selected those varieties which could retain the seeds longer for mature harvesting.

Agriculture refers to a series of discoveries involving the domestication, culture, and management of plants and animals. Agriculture was adopted repeatedly and independently in various parts of the world after the retreat of the Pleistocene ice around 12,000 years ago. The precise origin of the first centre of agriculture is unknown. The earliest evidence of agriculture development occurs in the area known as the **FERTILE CRESCENT** (present day **Iraq, Syria, Lebanon, Israel**). Agriculture also developed in other areas such as **China** and **Meso-America** but at a later date. Different plants were cultivated in different areas by the early Neolithic people, i.e. wheat and barley Southwest Asia, rice in East, South and Southeast Asia, maize in America and sorghum and millet in Africa.

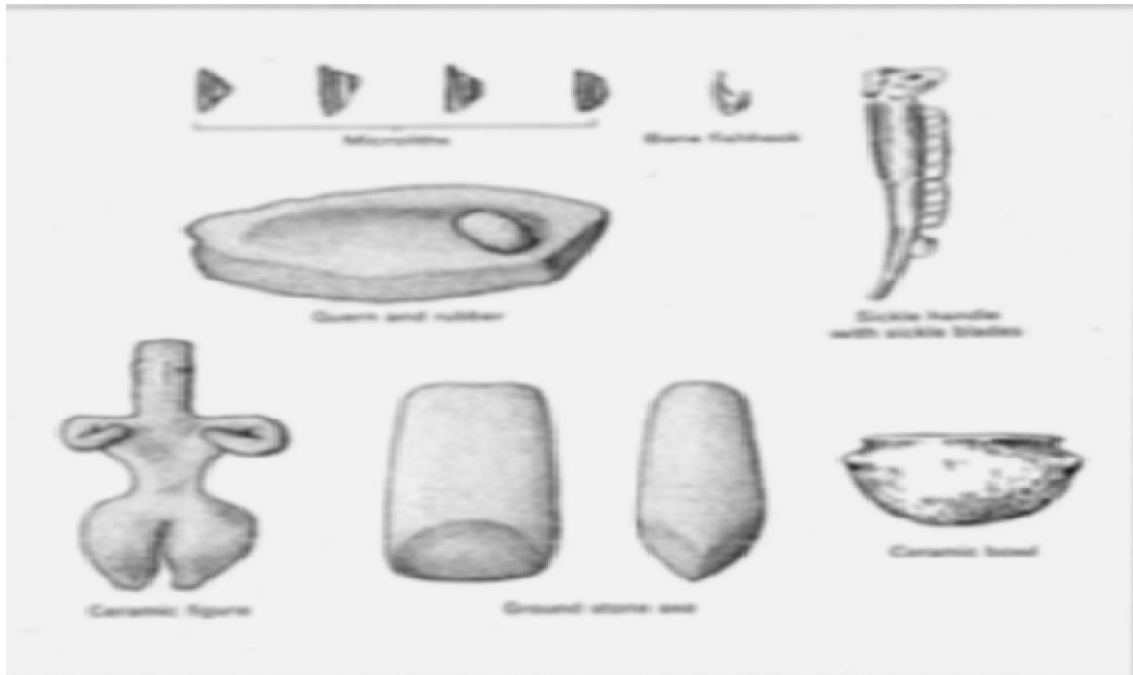


Archaeological map of agriculture homelands and spreads of Neolithic/Formative cultures





POLISHED AXES OF NEOLITHIC PERIOD



Artefacts associated with early Farming Communities

Hunter-gatherers of the near east (Fertile crescent) were first to adopt an agricultural lifestyle – 8500 B.C. based upon the cereals Barley & Wheat and on domesticated Goats & Sheep.



Maize-cultivators of Central Mexico-8000B.C. and the Rice producers along the Yangtze River-7500 B.C.

However, in retrospect, we can identify the species of domesticated plants that played the most important role in the development of human civilization. Most often, this group includes eight crops, which are defined as the 'FOUNDER CROPS'. In all likelihood, plant domestication took place in the *Fertile Crescent*.

FOUNDER CROPS:

1. EMMER WHEAT; 2. EINKORN WHEAT; 3. BARLEY; 4. LENTIL; 5. PEA;
6. CHICKPEA; 7. BITTER VETCH; and 8. FLAX

The difficulty in presenting the data on plant domestication consists of, among others, the fact that several species were domesticated independently in various parts of the world at different, sometimes distant, periods of time. As a result, it is sometimes difficult to define the time and region of the first domestication of a given species.

Domestication of Plants

| DATE | REGION | DOMESTICATED PLNTS |
|--|-----------------------|------------------------|
| Independent Origins of Domestication | | |
| 8,500 B.C. | Southwest Asia | wheat, pea, olive |
| by 7,500 B.C. | China | rice, millet |
| by 3,500 B.C. | Mesoamerica | Corn, beans, squash |
| by 3,500 B.C. | Andes & Amazonia | Potato, manioc |
| 2,500 B.C | Eastern United States | Sunflower, goosefoot. |
| by 5000 B.C.? | Sahel | Sorghum, African rice |
| by 3000 B.C.? | Tropical West Africa | African yams, oil palm |
| ? | Ethiopia | Coffee, teff |
| 7000 B.C. ? | ?New Guinea | Sugar cane, banana |
| Local Domestication Following Arrival of Founder Crops from Elsewhere | | |
| 6,000 B.C. to 3,500 B.C. | Western Europe | poppy, oat |
| 7,000 B.C. | Indus Valley | sesame, eggplant |
| 6,000 B.C. | Egypt | sycamore fig, chufa |

2. Animal Domestication

Another important aspect of the Neolithic revolution is that at this stage people began to domesticate animals they were hunting previously. They herded these animals and kept in rough enclosures where grasslands are available. The size, temperament, diet mating patterns, and life span of animals were factors in the desire and success in the domestications of animals. These animals formed a large source of proteins and food in these Neolithic communities. Animals such as cows and goats provided milk which is a rich source of protein. Some of the animals have the ability to work in ploughing as well as food sources which were important factors for this selection. Certain animals provided materials like leather, wool, hides, and fertilizer.

Animal domestication was a consequence of plant domestication and it significantly contributed to the development of agriculture through the various ways in which the animals were used in the cultivation of land. As in the case of plant domestication, it is difficult to determine either the region or the date of the first domestication in the case of particular species of animals, especially given that some of them were domesticated independently in different regions of the world.

A good example of the difficulty in determining the place and time of domestication of some species is cattle, which were domesticated independently in India and in western part of the Eurasia during the last 10,000 years. In both the regions, however, two different subspecies were domesticated that had originally diverged hundreds of thousands of years earlier.

In various regions of the world, humans domesticated numerous species of animals. Most of them were small mammals and birds.. The biggest role in the Neolithic Revolution was played by domestication of big terrestrial herbivores (over 100pounds). Until the nineteenth century, only 14 such species were successfully domesticated. Those species usually divided into two groups.

The Major Five: Five domesticated species that spread almost all over the world and played a major role in the development of human civilization: **Sheep, Goat, Pig, Cattle, and Horse.**

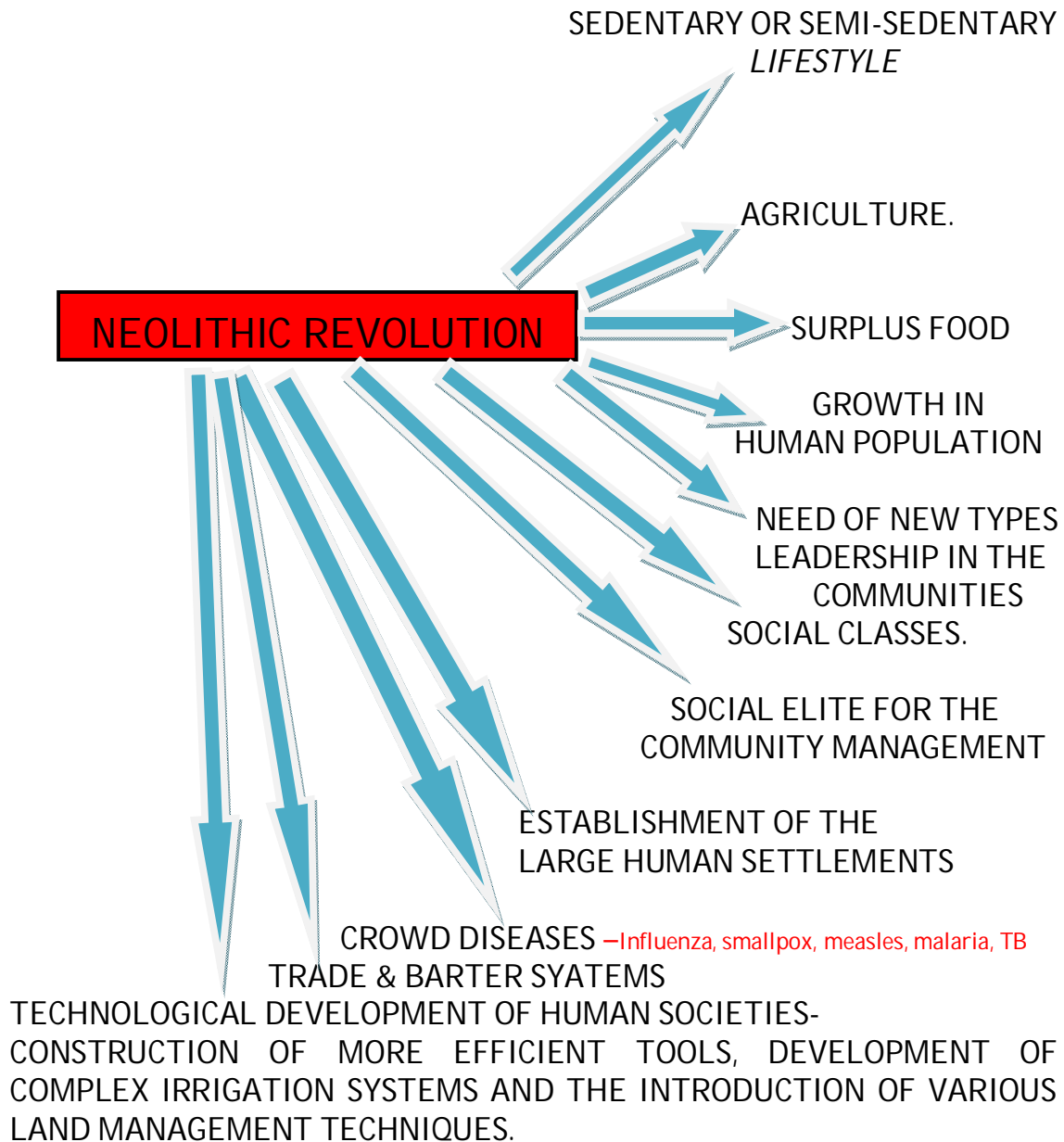
The Minor Nine: Nine domesticated animal species that live only in certain areas and played a significant role in the development of civilization in different regions: **Arabian (one-humped) camel, Bactrian (two-humped) camel, llama, and alpaca, donkey, reindeer, water buffalo, yak, Bali cattle, and mithan.**

Following table presents general information on the domestication of selected animal species, indicating where and when the first confirmed domestication took place.

ANIMAL DOMESTICATION

| DATE | DOMESTICATED ANIMALS | REGION |
|---------------|----------------------|------------------------|
| 8,500 B.C. | sheep, goat | Southwest Asia |
| by 7,500 B.C. | pig, silkworm | China |
| by 3,500 B.C. | turkey | Meoamerics |
| by 3,500 B.C. | llama, guinea pig | Andes and Amazonia |
| | none | Eastern United States |
| by 5000 B.C. | Guinea fowl | ? Sahel |
| | none | ? Tropical West Africa |
| | none | ? Ethiopia |
| | none | ? New Guinea |
| | nono | Western Europe |
| 7000 B.C. | humped cattle | Indus Valley |
| 6000 B.C. | donkey, cat | Egypt |

CONSEQUENCES OF THE NEOLITHIC REVOLUTION



The Neolithic Revolution played a crucial role in the development of civilisation. Its consequences for the progress of human societies cannot be overestimated. Changes induced by the Neolithic Revolution were most visible in its social, medical and technological consequences.

(a). Social consequences of the Neolithic Revolution

One of the consequence brought about by the Neolithic Revolution was a **surplus of food**, which had an impact on the **growth in the human**

population and an increase in the number of individual human communities.

This was possible due to the introduction of a sedentary or semi-sedentary lifestyle, forced by agriculture.

*The transition from a nomadic lifestyle of hunter-gatherers to a **sedentary lifestyle agriculturists enabled people to raise more children.** A nomadic lifestyle and the associated restrictions resulted in the fact that women in hunter-gatherers communities were only able to raise children at intervals of at least four years, while women in agricultural communities could raise children at two year intervals.*

The emergence of large communities meant the need for new types of leadership, which were not necessary in relatively small, egalitarian groups of hunter-gatherers.

This developmental of governmental organization also brought about the emergence of social elite, whose main role consisted of making decisions and managing the community. Developing agriculture led to the formation of social classes. Those groups later specialized in the production of food, manufacture of products, and trade of food and craft products, as well as defence and management of the community.

One result of the phenomena initiated by the Neolithic Revolution was the establishment of the first cities and the first state structures.

(b). Medical consequences of the Neolithic Revolution

The another important effect was the appearance of so-called **crowd diseases** and the easier spread of infections brought about by the Neolithic Revolution.

The development of densely populated, sedentary societies, in which people lived in close proximity with domesticated animals and in conditions of poor hygiene, gave rise to new types of ZONOTIC diseases. It was a new phenomenon, which had not occurred in hunter-gatherer communities. An increased density of population and the development of trade contacts were also conducive to the easier transmission of diseases, which constituted a serious threat to entire communities. Examples of zoonoses which appeared at that stage of development of civilisation were **influenza, smallpox and measles.**

Communities which first domesticated animals came into contact with new diseases and, consequently were the first to build up immunities to the

diseases. This was of great importance in the colonisation of further areas. In the period of great discoveries, Europeans, who had long been immune to many diseases present in the Old World, passed those diseases onto the people of the New World, who were not resistant to new infections. This resulted in plagues that decimated indigenous communities, sometimes resulting in a mortality of up to 90%. The transfer of Old World diseases to the colonised areas significantly contributed to the successful conquest of new lands by Europeans.

(c). Technological consequences of the Neolithic Revolution

The development of technology was another significant consequence of the Neolithic Revolution.

The Neolithic Revolution contributed to the rapid and systematic technological development of human societies.

The appearance of large human settlements gave rise to a social group engaged in the production of tools and other goods. The growing demand for better agricultural tools and weapons, as well as contacts among communities, enabled people to exchange their inventions, and brought about systematic development of new technologies.

This process began with the use of river floods and the burning of forests for cultivation, constructing ever more efficient tools and leading to the development of complex irrigation systems and the introduction of various land management techniques.

- **The first stone and wood implements were used in the cultivation of land between 7,000 and 4,000 years ago.**
- **The first primitive ploughs were used 5,000 years ago.**
- **From 4,200 to 2,800 years ago, first animal-drawn plough.**
- **Starting in the pre-Roman Iron Age (2,800 to 2,000 years ago) the ploughshare was reinforced with iron.**
- **The first irrigation systems were created, probably in Egypt, 7,000 years ago.**
- **The Sumerians started building irrigation and drainage canals 5,000 years ago, in the Euphrates and Tigris region.**

People also systematically worked on improving domesticated species of plants and animals through selective breeding of plants and line and cross breeding of animals.

CONCLUSION

The Neolithic Revolution was the critical transition that resulted in the birth of agriculture, taking Homo sapiens from the scattered groups of hunter-gatherer to farming villages and from there to technologically sophisticated societies with great temples and towers.

The Neolithic Revolution, or the (First) Agricultural Revolution, was the wide-scale transition of many human cultures during the Neolithic period from a lifestyle of hunting and gathering to one of agriculture and settlement, making an increasingly large population possible.

Domestication of animals and plants is often attributed to Neolithic revolution. Neolithic revolution is used to describe change from hunting gathering economy to an economy based on farming and the Technologies that included polished stone tools, pottery, and weaving. In this stage, humans were no longer dependent on hunting, fishing, and gathering wild plants.

The three effects of the Neolithic Revolution were as follows:

- Mass establishment of permanent settlements,
- Domestication of plants and animals,
- Advancement in tools for farming, war and art.

Tools (blades) of flint and obsidian, helped the Neolithic farmer and stock-rearer to cut his food, reap cereals, cut hides etc. Larger tools of polished stone provided adzes for tilling the earth, axes for the logging of trees, chisels for wood, bone and stone working (e.g. stone vessels, seals, figurines).

- ❖ Mehgarh (Balochistan, Pakistan) is the earliest Neolithic site, where people lived in houses built of sun-dried bricks and cultivated crops like cotton and wheat
- ❖ THE BRONZE AGE FOLLOWS ON FROM THE NEOLITHIC PERIOD AND IS FOLLOWED BY THE IRON AGE.

The first Neolithic communities lived in densely built settlements and numbered 5-300 individuals. During the Pre-Pottery, Early and Middle Neolithic, the unit of society was the clan or extended family that consisted of parents, children, grandparents and other close kinship.

The Neolithic Revolution is the first in the history of the human race which, due to a radical change in lifestyles, allowed for a systematic development of humankind. This revolutionary transition seems to have provided the foundations for the subsequent revolutions, i.e., **the scientific revolution, industrial revolution, technological revolution, digital revolution, and nanotechnology revolution.**

The unprecedented development of the human species was, only possible thanks to the Neolithic Revolution, during which humans abandoned the nomadic lifestyle of hunter-gatherers and adopted the sedentary lifestyle of farmers.

Domestication of many species of plants and animals catalysed the development of agriculture and allowed for the production of large surpluses of food. This, in turn, enabled a significant part of the human population to live in cities and create complex social and state structures.

The emergence of specialised social groups contributed to technological development and cultural exchange due to lively contacts between communities.

The Neolithic Revolution, however, also had disastrous consequences for humans. The most conspicuous example here is the appearance of new diseases brought about by the domestication of animals and human residence in large population centres.

The invention of new types of weapons allowed humans to eradicate biodiversity of animals and exterminate many human communities.

This revolution resulted in anthropogenic changes in the environment on a massive scale, which consequently led to the contemporary ecological crisis.

It seems that a proper understanding of the process initiated by the Neolithic Revolution and an in-depth reflection on the style of human presence in the world can raise hope that the threats faced nowadays by our planet may be identified and it will enable us to develop strategies to overcome the ecological crisis.

Declaration

This E-content is exclusively meant for academic purposes and for enhancing teaching and learning only. Any other use for economic/commercial purpose is strictly prohibited. The users of the content shall not distribute, disseminate or share it with anyone else and its use is restricted to advancement of individual knowledge. The information provided in this e-content is authentic and best as per knowledge.

T H A N X