THE ARCHAEOLOGY OF FARMING SYSTEMS

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Summary

Between 12 000 and 8000 years ago a variety of different farming systems began to appear around the world. The emergence of farming reflects the coevolution of humans and plants, in that both acted to transform the other. Over the millennia more than 300 different plants have been domesticated, of which about 25 are today considered staples. Different plants and techniques appropriate to their cultivation developed at different times and in different places. However, the types of farming systems generally are the same throughout the world. The initial phase involved the harvest of natural stands and basic methods for encouraging the growth of certain plants. This was followed by the preparation of gardens in which a variety of cultigens were grown together (horticulture). These gardens were fallowed for longer periods than they were cultivated. Finally, agricultural production led to a focus on a few cultigens in specially prepared fields that were planted for longer periods than they were left fallow. The final phase involved the intensification of production involving further modifications to these fields by terracing, irrigation, mulching, and other methods of providing the plants with the medium, nutrients, pest control, and water that they needed to thrive. Through the coevolution of people and plants the world's food supply has increased dramatically through human history.

1. Introduction

In writing about the archaeology of farming systems the first question that must be addressed is: What constitutes a farmer? Although this may appear to be a relatively simple question, it is almost impossible to answer. One could certainly develop a series of arbitrary criteria, but the truth is that the transition to farming reflects a very subtle shift in the way people obtain their food. Foragers did not suddenly abandon hunting and gathering in favor of farming. Instead, cultivated plants were slowly added to the existing diet.

The earliest efforts to write a history of human society focused on farming as marking the shift from barbarism to civilization. This key role assigned to farming in human evolution was formalized in the concept of a Neolithic Revolution, which proposed a rapid and radical change in human societies with the adoption of farming. It has continued to the present in distinctions made between hunter-gatherers (food collectors/harvesters) and farmers (food producers). Even today, introductory textbooks categorize human societies as evolving through stages of big game hunters, foragers (mixing hunting with plant collecting), horticulturalists (mixing hunting with the cultivation of wide variety of crops), and agriculturalists (who at the extreme consume only domesticated animals and plants).

The view that the transition to farming marked a revolution in human subsistence practices led to enormous efforts focused on identifying the origins of agriculture, and on who were the first people to practice farming. One reason for this view is that farming seems to appear around the world at essentially the same time. Between 12 000 and 8000 years ago, farming became an important way of life around the world. This synchronicity may reflect the environmental transition to warmer and drier conditions that is now well documented for the end of the Pleistocene and the beginning of the Holocene. This transition may have favored the cultivation of plants by creating new habitats, and/or forced people to develop new forms of food production in response to declining returns from hunting and foraging. In either case, humans had already developed a substantial knowledge of local plants, their uses, and their requirements for growth.

To a large degree the earliest efforts to identify centers of plant domestication were misplaced. Research among modern foragers reveals that, with few exceptions (e.g. people inhabiting polar regions) plants provided at least as much food to the diet as did meat. Although it is true that modern foragers do not provide homologies for ancient human practices, it can be argued that, even if game animals were extremely abundant in the past, meat alone could not satisfy the nutritional requirements of human omnivores. Even the "Big Game Hunters" of the Pleistocene must have included fruits and vegetables in their diet. Although this review focuses on farming systems, it is important to remember that some alternate source of protein, usually meat or fish, is an essential supplement to an agrarian diet. None of the farming systems discussed below could have existed without a complementary source of protein. In most areas, animals were also domesticated to meet nutritional requirements.

From the earliest period of human history plants and people were connected inextricably. As Carole Crumley points out, there is a dialectical relationship between people and their environment. As a result, people and plants "coevolved." The simplest way to express this relationship is in strategic terms using the language of sociobiology:

while humans were manipulating plants to increase their productivity and their supply of food, plants were manipulating humans to increase the plant's reproductive contribution to the next generation. Although the strategic planning attributed to plants is clearly anthropomorphism, it is nonetheless true that corn and potatoes, for example, have been transformed from cultigens grown in relatively restricted areas into international products of immense outputs. It was the introduction of potatoes from Peru in 1570 that transformed Irish society, and then transformed the U.S. following the potato blight of 1845–1846. Never underestimate the power of plants.

This review begins with a brief discussion of the origins of farming systems, and explores more fully the notion of coevolution. The sections that follow provide basic introductions to archaeological studies of farming systems around the world. It is impossible to list all of the plants that have been brought under cultivation by humans, and equally impossible to provide a completely comprehensive discussion of every farming system in this short review.

2. Origins of Farming

Plants are ubiquitous in the environments inhabited by humans, and all have developed some form of seeds, fruits, nuts, or vegetative structures (e.g. roots and rhizomes) for reproducing. Many of these means of reproduction coevolved with animals that provided the means for dispersing the plant's seeds. These adaptations also made them edible by humans without significant processing. The human consumption of fruits, which had coevolved with other animals for the dispersal of seeds through consumption and defecation, was the basis for one of the earliest models for the origins of farming. The "dump-heap" hypothesis proposed that the earliest form of plant domestication occurred because plants that had passed through the human digestive tract self-generated in midden deposits, or the equivalent of prehistoric restrooms. Anyone who has walked downstream from a modern sewage treatment plant can attest to the number of tomato plants growing along the banks of the streams that carry the effluent. (Tomatoes have a small seed that passes through the human digestive tract.) Moreover, as human populations expanded across the planet they modified environments in a variety of ways (e.g. clearing land for settlements, using fire to clear the landscape and/or hunt game). These new, anthropogenic (human created) landscapes, were especially well suited for pioneering plant species, such as grasses (Graminaea), which is one of the most important families of cultigens. Thus, through the most basic uses of the landscape humans and plants began the process of changing together and changing each other.

Although the dump-heap hypothesis and anthropogenic landscapes suggest ways in which humans and particular plants were brought into closer association, they do not explain why humans began to cultivate plants. In the 1960s, the Near East became a hotbed of debate concerning the reasons for the adoption of farming. By this time it was already well established that there were large natural stands of grains growing in certain areas. These grains could have been harvested without any investment in cultivation, and "careless harvesting" would have ensured sufficient seed stock for the fields to regenerate on an annual basis. Evidence of an increase in aridity at the end of the Pleistocene also has accumulated through the study of pollen samples. It was reasoned

that as the environment became drier humans had to cultivate plants to satisfy their demands for food. Robert Braidwood suggested that this was the inevitable outcome of human evolution, and that people began to cultivate plants because the time was right. His emphasis on human motivation was criticized by Lewis Binford who recognized that explaining something as happening because the "time was right" was no explanation at all. Binford proposed that an increase in human population was the primary motive for the transition to farming. The problem with both hypotheses was that they failed to address the human-plant interaction in the domestication process. Jack Harlan and Daniel Zohary ably addressed this shortcoming by demonstrating that domestication had occurred as people began to move plants out of their primary habitats, where they flourished, and into marginal habitats where they required human assistance to successfully compete with other plants. In sum, while there were dense natural stands of wheat in some areas, and climate change may have reduced their productivity, and human population growth may have placed increasing demands on the harvesting of this food resource; actual cultivation required the movement of plants from their natural home range into habitats in which they could not survive without human assistance.

Determining the origins of agriculture turns out to be a remarkably simple problem. After tens of thousands of years of close interaction plants and humans have come to rely on each other for their survival and reproductive success. Through the process of providing plants with the habitats that they need to survive and flourish, people have at the same time increased their food supply. Most plants are willing participants in the process, although only a few actually meet human needs. Moreover, in addition to fruits and seeds, which often rely on animals to facilitate their dispersal, humans have also found ways to manipulate toxic species. A variety of plants, especially those that reproduce vegetatively, have toxins to prevent predation (e.g. maguey, manioc). Humans have found ways to detoxify these plants, and in the process have increased the plant's distribution and reproductive success. We again return to coevolution as the underlying process. What's good for the human is also good for the plant. A more difficult question is why farming began when and where it did.

3. The Archaeological Study of Farming

The archaeological study of farming initially focused on the identification of primary and secondary centers of domestication. However, as research progressed it became evident that humans succeeded in domesticating nearly 300 plants, although only about 25 are considered staples today. This very large number of domesticates indicates that the coevolution of plants and people is a nearly universal phenomenon.

Evidence for plant domestication has increased dramatically in recent years with the emergence of paleoethnobotany as a subdiscipline. The major advance was the introduction of systematic collection techniques (such as flotation) for the recovery of plant remains from archaeological sites. Investigators have also developed or improved microtechniques for pollen analysis, mineralized plants, phytoliths (silica structures), isozymes, DNA, chemical analyses, plant isotopes, and coprolite (fossilized feces) studies. Combined with the study of macroremains, these techniques have greatly expanded our understanding of prehistoric plant use. In addition, AMS dating has made

it possible to determine the age of individual seeds, thus giving more accurate dates for the appearance of plants in an area. Finally, remote sensing and GIS promise to provide improved methods for evaluating large-scale earthworks associated with irrigation and raised and drained fields.

The importance of environmental factors in the development of farming practices cannot be understated. Recent studies have investigated long-term episodes of climate change, short-term fluctuations such as El Niño/Southern Oscillation (ENSO) events, the impact of tectonic uplift on irrigation canals, fluctuations in groundwater levels, and human impacts due to land clearance. Such refined studies of environmental fluctuations have made it possible to examine more closely specific changes in farming practices. Finally, ecological, economic, social, and political models have been introduced to explain the development, adoption, and change in farming systems.

In order to adequately study prehistoric farming it is imperative that these multiple lines of evidence are combined in an integrated research design. Ecological models are crucial for understanding the needs of cultigens in varying environments. Economic and sociopolitical models facilitate specific predictions about farming practices that can then be subjected to empirical testing. The kinds of plants that were used (paleoethnobotany), and evidence for the techniques used to manipulate them (landscape and material culture studies) are crucial to describing plant manipulation at different points in time. Finally, it is important to determine what people were eating and in what percentages (isotope and trace-element studies of human bones) to accurately gauge the contributions of cultigens to human diets.

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Biographical Sketch

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