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## **Recent Research on Pre-Hispanic Agriculture in Coastal Peru**

During the past decade coastal Peru has been the scene of active and intensive research on pre-Hispanic agriculture. This work has included studies of the physical remnants of agricultural systems (canals and fields, for example), analysis of vegetative remains from archaeological excavations (particularly from domestic middens), and general descriptions of the development of agriculture and the domestication process in the coastal region. This research is summarized below. Several problems that are still unanswered and in need of further study are described as well.

### **The Physical Region**

To the casual traveler, the coast of Peru is an inhospitable region. Rainfall is virtually nil, vegetation is largely confined to a few exotic river valleys, and the angular nature of the coastal hills and mountains seems to emphasize the starkness of the physical landscape. On closer inspection, the coastal region offers a great diversity of physical zones, many of which are potentially usable by man. Among the most important ecological zones are: 1) the coastal waters, which are well known as one of the world's greatest fishing grounds; 2) the littoral zone, which can be subdivided into the rocky littoral and the sandy littoral, both of which have a wide range of potential resources such as birds, shellfish, marine mammals, and inshore fish; 3) riverine areas along the region's exotic streams; 4) coastal marshes, both freshwater and tidal; 5) potentially irrigable areas within the river valleys; and 6) *lomas* areas on the slopes of the coastal hills. Less important to pre-Hispanic peoples were such zones as areas of eolian activity, barren rock outcrops, and thickets and scrub forest areas. The adjacent Andean highlands and the more distant areas of tropical forest to the east were probably important resource zones throughout much of Peruvian prehistory.

In terms of pre-Hispanic agricultural development, certainly the most important loci of development were the exotic river valleys of the coastal region. There are approximately 50 rivers flowing west out of the Andes. These include streams that range from several with average annual discharges above a billion cubic meters of water down to many that flow only during the wet season or, in some

cases, only in wet years. In terms of potential for human use, there is great variability among the individual valleys.

In general, the river valleys of Northern Coastal Peru are (and probably were) more useful for agricultural development than those of other regions of coastal Peru. As delineated here, the valleys of the Far North region today account for about 15 percent of the modern irrigated area, the North Coast valleys for about 40 percent, the Central Coast valleys for 27 percent, the South Coast valleys for 12 percent, and the Far South coast or 6 percent of the modern irrigated area in coastal Peru.<sup>1</sup> Although the area of ancient agriculture in each valley or region does not correspond exactly to the area of modern cultivation, in general the relative distribution of pre-Hispanic agriculture probably was about the same as the modern pattern. Thus more than half of all agricultural land in ancient coastal Peru was in the region north of Huarney, about one quarter in the Central Coast region, and less than twenty percent in the zone south of the Paracas peninsula. The northern coast, in prehistoric times, was also dominant in terms of the sophistication and diversity of agricultural practices.

## **Culture History**

Man first came to coastal Peru at least fourteen thousand years ago. The story of the first hunting and collecting peoples is not well understood, but they probably entered the region in pursuit of migratory large game animals and stayed in the area to exploit the multiple resource zones. Thousands of years of gradual development eventually lead to the rise of cultures that were among the most economically and politically sophisticated in the ancient New World. Although the exact sequence of development is still unclear, certain temporal generalizations about this process have been made and are widely accepted by Peruvianists.

The Central Andean culture sequence is generally divided into Periods (characterized by local developments) and Horizons (characterized by pan-Peruvian developments). Thus the Initial Period (1800-900 B.C.) is followed by the Early Horizon (900-200 B.C.); the Early Intermediate Period (200- B.C.-800 A.D.) by the Middle Horizon (800-1100 A.D.) and the Late Intermediate Period (1100-1470 A.D.) by the Late Horizon (1470-1532). The three Horizons are associated with well-known pan-Peruvian cultural traditions; Chavln, Wari, and Inca, whereas the three periods are usually defined by single sites or regional

cultures. For example, in the North Coast region the most important local cultures were the Moche during the Early Intermediate and the Chimú during the Late Intermediate periods.

### **Research Prior to 1970**

Although systematic excavation (i.e., looting) of ancient remains began soon after the Spanish conquest of Peru, scientific work began there little more than a century ago. With one notable exception, very little of the research carried out since the mid-nineteenth century has focused on early agriculture. To be sure, several studies did include information on pre-Hispanic cultivation. For example, the research of the Virú Valley Project (1946-1948) produced some evidence of ancient farming practices, excavations by Junius Bird at Huaca Prieta in the Chicama Valley (1946-47) revealed the early use of both cotton and gourds (Bird, 1948), and the work of Patterson and Lanning (1956-1963) at Ancon near Lima uncovered material relating to the beginnings of plant cultivation in the Central Coast region. Margaret Towle provided a synthesis of ancient plant use in Peru (Towle, 1961), but much of her data came from the research of others or observation of plant depictions on ceramics. For our purposes, it should be noted that none of the work cited above was of an ecological or geographical nature.

One man stands out in contrast to all of the other researchers mentioned above. Over a period of more than twenty years, Paul Kosok carried out a study of ancient irrigation systems throughout coastal Peru. A brilliant musician and economic historian, Kosok first became interested in the archaeology of Peru when he visited Lima as head of the Long Island University orchestra in the late 1930s. During several successive visits to Peru he carried out a detailed reconnaissance of canals throughout the coastal region. His work was done at a time when cartographic and aerial photographic coverage of most of the coastal region was inadequate at best, thus reducing the effectiveness of his work. Kosok was also hindered by a lack of time, money, and transportation facilities. He carried out no excavations of the sites that he discovered. Finally, his political beliefs (as a radical leftist he was persecuted during the McCarthy era) resulted in problems that delayed publication of the results of his research. One semi-popular book appeared posthumously (Kosok, 1965); a more detailed account of his work exists in draft form only therefore, in a very real sense, the value of the studies made by Kosok has been superseded by research conducted during the

past decade.

## **Recent Research**

This discussion of recent research on ancient agriculture in coastal Peru is divided into three sections. First, work on individual plants or animals or on various subsistence complexes or dietary patterns is discussed. Second, studies of pre-Hispanic cultivation techniques are covered. Finally, attempts to synthesize this material into coherent theories on agricultural development are considered. The paper concludes with a discussion of further research needs in this region.

### *Ancient Plant and Animal Domesticates*

A number of investigations during the past decade have focused on individual plant and animal species, groups of domesticated plants, or on aspects of the diet of the ancient coastal peoples. Some scholars have conducted archaeological excavations whereas others have studied ceramic artifacts, ethno-historical sources, ethnographic reports, or other bits of evidence. Although much research needs to be done, the results of the recent work provide a clearer view of the plants and animals that were in use in coastal Peru before the arrival of the Spaniards.

Numerous studies have focused on single species -- either as seen at a single site or for all of coastal Peru. Most numerous have been studies of cotton (Stephens, 1973; 1975; Stephens and Moseley, 1974a; 1974b; Vreeland, 1978). Although the exact domestication process for this plant is still unknown, it has been shown that cotton was one of the earliest cultivated plants in coastal Peru and also one of the few native species to be domesticated. The role of a semi-wild cotton (*Gossypium peruvianum*) in this process is under investigation (Vreeland, 1978). Maize has been analyzed in several studies (see Bird and Bird" 1980, or the work of Shelia Pozorski cited below); one recent article describes the varieties of maize shown on Peruvian ceramics during the period 100-1400 A.D. (Dunn, 1979). Data relating to both *Cucurbita* and *Lagenaria* species were included in a report by West and Whitaker (ms.) that covered plant remains excavated in the Virú valley. Of lesser economic note but of significant symbolic importance was a plant known as *ullucha* (species unknown); McClelland discussed its depiction in art of the Moche culture and its possible role within that culture (McClelland, 1977). The only domesticated animal discussed in detail was the llama (Pozorski, 1979).

Several authors have reported on the sum total of plants grown by the people of ancient coastal Peru. Donnan has shown those illustrated on Moche ceramics, following the lead of Towle. One of the significant results of his work has been the observation that, although many cultigens were shown on the ceramic pieces (squash, maize, pepino, pacaе, manioc, and peanuts, for example), many important food plants, such as avocados, guavas, and sweet potatoes, were not depicted in the ceramic art (Donnan, 1978, 56).

Perhaps the most interesting research for geographers has been the work focused on the sum total of subsistence activities. Excavations by two archaeologists have been of this type; both sets of excavations took place in the Moche valley. Richard Keatinge worked at several small sites just behind the beach; he has identified a variety of plant and animal remains from these excavations and has tried to determine subsistence patterns based on this research (Keatinge, 1975; Kautz and Keatinge, 1977). Shelia Pozorski excavated at eleven sites in the valley, with a spatial distribution ranging from near the shoreline to well inland. The temporal distribution of these sites was also much greater than for those studied by Keatinge -- from the beginnings of agricultural development to the period just prior to the arrival of Europeans. Pozorski also analyzed subsistence patterns, but went well beyond the work of Keatinge in terms of suggesting the relative importance of various elements in the ancient diets (Pozorski, 1976; Pozorski and Pozorski, 1979a; 1979b). In recent articles in the journal *World Archaeology*, both researchers reviewed the results of their work (Pozorski, 1979; Segler and Keatinge, 1979). Whereas Pozorski reaffirms the results of her earlier work, Keatinge argues persuasively that highly quantified subsistence studies such as those carried out by Pozorski cannot be taken at face value because of inherent sampling errors, differential preservation of organic matter, and the random nature of human refuse disposal. These studies have shown, at the least, the diversity of plants used by the inhabitants of coastal Peru during the pre-Hispanic period.

### *Agricultural Techniques*

Ten years ago, only two prehistoric agricultural techniques had received much attention in the literature -- irrigation (the work of Kosok) and sunken garden plots (Parsons, 1968; Moseley, 1969; Rowe, 1969). During the past decade, these two techniques plus three others -- flood water farming, back swamp cultivation, and terracing -- have been the focus of several research projects. In addition, one

author has examined the ancient use of fertilizer. As a result, we now have a good knowledge of how the agricultural systems in the coastal region operated in prehistoric times.

The area around the modern city of Trujillo has been the focus of much of the recent research on agricultural techniques. My own work in the early 1970s dealt with the La Cumbre or Chicama-Moche Canal, the largest pre-Hispanic canal in the New World (Kus, 1972; 1974; 1978). I dated the construction of the canal as c. 1100 A.D., explained its construction in terms of local geo-politics, and suggested reasons for the abandonment of the canal. Research by Ian Farrington on canals within the Moche Valley suggested to him that the inter-valley canal was constructed during the Inca occupation of the North Coast region, that is, between 1470 and 1532 (Farrington, 1974; 1977; 1980; manuscripts; Farrington and Park, 1978). Studies carried out by the Programa Riego Antiguo, led by Michael Moseley and me in 1976-77 and by Moseley and Pozorskis in 1978-79, have confirmed many of my assumptions about the intervalley canal system—specifically the early construction date and the sophistication of design inherent in the canal project (Moseley, 1977; Kus, manuscript a; Kus, et al., 1978b). In particular, Charles Ortloff, a Programa hydrologist, has demonstrated that the design of the La Cumbre Canal included virtually all of the techniques of water control in open channels known to modern engineers (Ortloff, manuscript). Much of this work has focused on ecological factors that caused the abandonment of portions of the canal systems in the valleys of the north Coast region (Kus et al., 1978a; Nials et al., 1979). Among such factors that have been identified so far are widespread movement of dune formations, tectonic uplift, and periodic flooding associated with "El Nino" rains.

The emphasis of my own research during the past few years has been on furrow patterns within the ancient irrigated fields of the Chicama and Moche valleys. I have mapped several large areas with distinctive furrow patterns and have identified a sequence of field layout and construction (Kus, manuscript b). Associated with this work has been the study of large-scale land-leveling projects on the north side of the Moche valley and of a limited area of terracing on the south side of the same valley. In both instances, these are the first recorded uses of these techniques in the coastal areas of Peru.

Several other areas of irrigated agriculture have also been studied during the past decade. A student at the University of Texas wrote on pre-Hispanic irrigation in

the Chicama Valley (Watson, 1979). Another student from the same university researched the early canal systems of the Jequetepeque area, and James Nolan from Columbia University studied irrigation in Zaña. Other cultivation techniques have also been the topics of research. Parsons and Psuty (1975) restudied the sunken fields of coastal Peru. Gregory Knapp of the University of Wisconsin studied fields watered by flooding in Chilca (Knapp, 1979). Michael West of California State University at Northridge examined several types of early fields in Virú (West, 1979) and all of these techniques have been covered by workers of the Programa Riego Antiguo. Finally, Catherine Julien has studied the use of guano fertilizer by the ancient inhabitants of the South Coast area (Julien, 1979).

## **Synthesis**

Unfortunately, there has been little general, comprehensive study of early agriculture in coastal Peru. Nothing yet published goes beyond Kosok's 1965 volume. Moseley has postulated a possible sequence of development for the origins of agriculture in the Central Coast region (Moseley, 1965), but his hypotheses have not been well received by Peruvianists. The Programa Riego Antiguo, which potentially could yield the comprehensive work on ancient agriculture in coastal Peru, has indefinite publication plans. To the best of my knowledge, no other general works on ancient agriculture in this region are in progress.

## **The Future**

Obviously, the most pressing need is for a general synthesis of recent research findings. Also of great importance will be the expansion of research on ancient agriculture into the South Coast and Far South regions, where little research on this topic has taken place. Beyond these needs, some specific topics can be suggested. Large canal systems in several valleys, notably Lambayeque and Piura, as well as in the Lima area, should be studied in detail. The routes of diffusion for the cultigens not native to the Peruvian coast have yet to be determined. The sequence of introduction for most of these plants is still to be established. Finally, the basic role of agriculture within the societies of pre-Hispanic coastal Peru needs to be better defined.

## **Note**

1. See Matos Mar (1979) for a discussion of the north-south division of Andean culture regions. Lumbreras (1974) and Lanning (1967) discuss the regionalization of coastal Peru. The Far North region includes the area from Tumbes to Piura; the North coast the region from Lambayeque to Huarney; the Central Coast from Fortaleza to Chincha; the South Coast is from Pisco to Acari; and the Far South is from Ocona to Tacna.

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