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**Pre-Hispanic Agricultural Fields in
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CHAPTER 19

THE DATING OF RAISED-FIELD AGRICULTURE IN THE LAKE TITICACA BASIN, PERU

Clark L. Erickson

ABSTRACT

Previously, the raised-field agricultural systems of the Lake Titicaca basin of Peru and Bolivia have been attributed to various prehistoric cultures through indirect dating of the fields by using the region's archaeological sites. However, these dates are uncertain due to the lack of archaeological research on the actual fields. Because raised fields in the Lake Titicaca basin were structurally complex and appear to have been labor intensive, there has been a tendency to place them late in time when Andean state structures were well established, and population stress was at a maximum. Archaeological fieldwork done from 1981-1983 used controlled trenching in prehistoric raised fields and provided the first direct dating of the area's raised fields. Stratigraphic profiles of trenches were used to document the original field morphology, construction stages, periods of use, and final abandonment. The trench profiles also provided a good context for in situ recovery of associated cultural remains. These remains were dated using absolute methods such as the thermoluminescence technique and comparative dating of ceramics. The resulting dates from various contexts within the fields indicate that there were at least two distinct periods of construction and abandonment. This data, combined with radiocarbon dates and seriation of ceramics from associated occupation sites, demonstrates that raised-field agriculture probably began around 1000 B.C., and was well established by 500 B.C. The raised fields were an important part of the economic base of Pukara culture. After the collapse of Pukara, field construction and use in the northern lake basin appears to have decreased sharply. This probably resulted from social and political changes occurring as Tiwanaku gained prestige and power in the south. A resurgence of raised-field construction in the northern lake basin occurred after A.D. 1000, and lasted until the Inca conquest of the area. Chronological documentation of the origins, evolution, and abandonment of this Prehispanic system of intensive agriculture helps us to evaluate general theories about agricultural development and its relationship to Prehispanic social organization.

INTRODUCTION

Previously, indirect dating has been used to associate the raised-field agricultural systems of the Lake Titicaca basin of Peru and Bolivia with the occupation sites of various prehistoric cultures (Smith et al. 1968, 1981; Kolata 1982, 1986; Turner and Denevan 1985). However, these dates are uncertain due to the lack of archaeological research done in the fields themselves. Because the raised fields of the Lake Titicaca basin are structurally complex and appear to be labor intensive, there has been a tendency to associate them with

later periods when it is presumed that state structures were well established and population stress was at a maximum. Archaeological fieldwork done during 1981-1983 in the District of Huatta, Department of Puno, Peru, has provided the first direct dating of the area's raised fields, and indicates that they have a time depth of at least 2,500-3,000 years.

The altiplano (high plain) of Peru and Bolivia, at an elevation of over 3,800 m above sea level, is a very difficult environment for agriculture. The Lake Titicaca basin is slightly more favorable, and is where the densest populations (both prehistoric and modern) are found (Fig. 1). The remains of prehistoric raised fields (camellones in Spanish; waru waru in Quechua) are also found in this area, distributed throughout more than 82,000 ha of the seasonally innundated pampa (plain) near the lake (Smith et al. 1968, 1981). The soils of the zone are considered to be generally poor due to their high pH levels, salt accumulations, and impermeable clays (ONERN-CORPUNO 1965). Irregular rainfall causing sporadic droughts and flooding and frequent hail and frost during the growing season, cause additional problems for the farmers (Monheim 1963; Morlon 1979; ONERN-CORPUNO 1965). The prehistoric farmers of the pampa adapted to these limitations through the development of an elaborate system of raised fields which improved hydraulic control, increased the depth of fertile soil, and provided some frost control. The canals between the raised fields conserved water, stored heat for protection against frost, produced green manure for fertility recycling, and may have been used for aquaculture and transportation (Smith et al. 1968, 1981; Lennon 1982; Erickson 1985, 1986; Garaycochea 1986, this vol.; Denevan and Turner 1974).

The archaeological investigation of 1981-1983 focused on the zone of Huatta, located in the center of the largest block of remains of raised fields in the Lake Titicaca basin. The project combined archaeological survey, excavation of raised fields and prehistoric settlements, and the construction of experimental raised fields using prehistoric models (Erickson 1984, 1985, 1986; Garaycochea 1984, 1986, this vol.). Of major interest was the establishment of a chronology for the evolution of the raised-field agricultural systems. In order to determine their original morphology, recover soil and pollen samples, and recover artifacts in situ for direct dating, trenches were excavated across raised fields and their associated canals (see Figs. 2, 3). In addition, test excavations were made in several prehistoric occupation sites to obtain additional data for the indirect dating of field systems and the structure and organization of the associated prehistoric populations.

EXCAVATIONS IN RAISED FIELDS

Stratigraphic trenches excavated in raised fields provided evidence that there were various stages of field construction and maintenance. All of the soil excavated from cultural strata of the raised fields and canals was carefully screened to recover artifactual remains for direct dating. In most of the trenches, as may be expected for agricultural contexts, few artifactual remains were recovered. The majority of the cultural remains recovered came from raised field excavations near prehistoric settlement mounds.

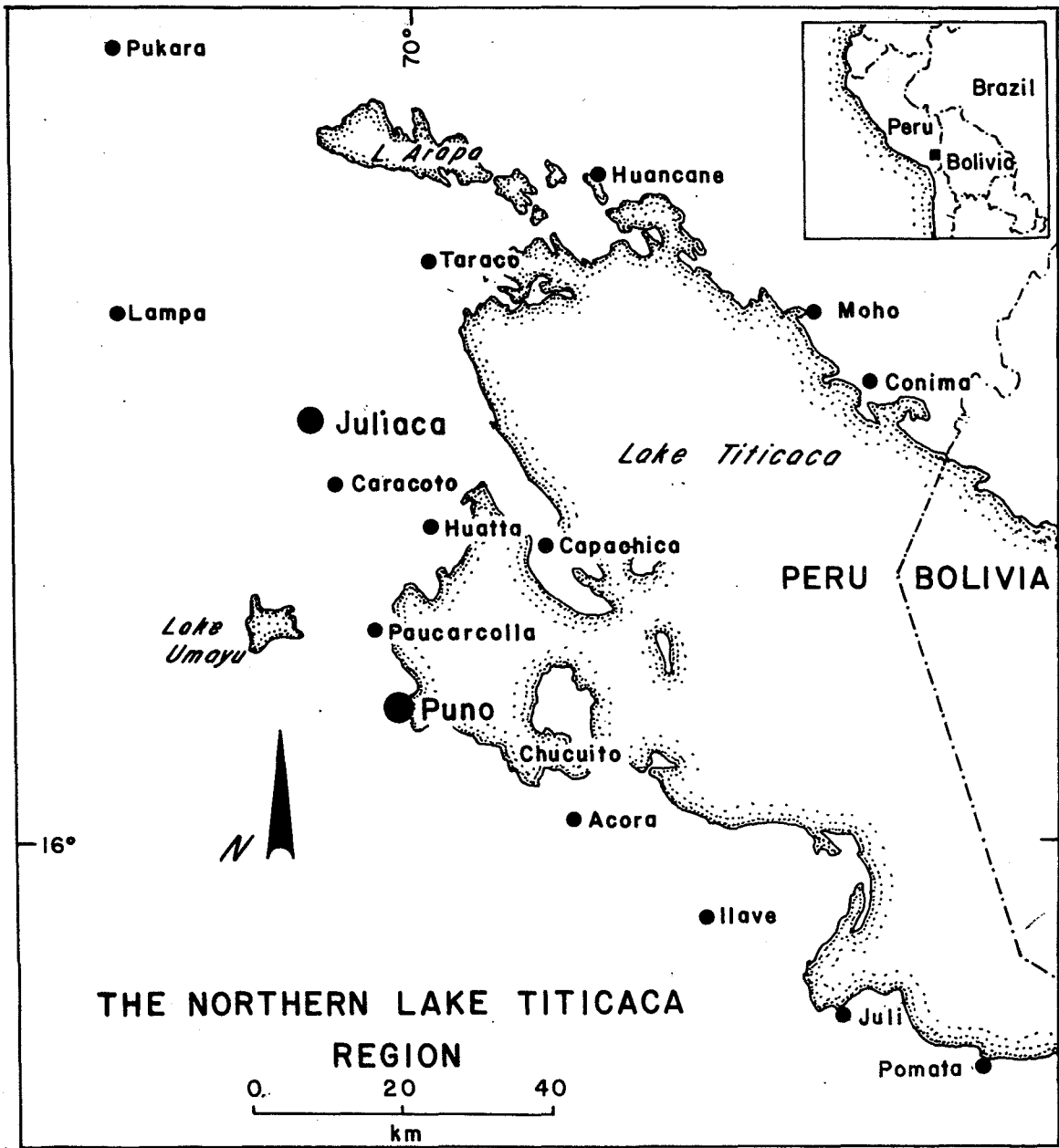


Figure 1. Location map showing the northern Lake Titicaca Basin.



Figure 2. Excavation of Unit N at the site of Pancha (PPu7-28) showing two Phase I raised fields below Phase II raised fields.



Figure 3. Excavation of Unit A at the site of Viscachani Pampa (PPu7-58).

Using the thermoluminescence (TL) technique of dating, seven samples of ceramics from three different raised field locations were submitted to the University of Durham Laboratory for dating. A summary of the TL dates and their contexts is presented in Figure 4.

These seven TL dates provide direct dates for key strata within the raised fields themselves. In addition, indirect dates obtained for the fields (through radiocarbon and diagnostic ceramic evidence from adjacent settlement sites) supported the interpretations obtained through TL dating.

Summary of the Phases

The raised field stratigraphy and the dates obtained by TL dating indicate that there were two major phases or time periods of raised field construction, referred to here as Phase I and Phase II.

Phase I. The raised field remains of Phase I are the earliest that were discovered in the Huatta pampa. In the stratigraphy of two trenches in raised fields next to the site of Pancha (PPu7-28), there was evidence of a series of small raised fields under larger superimposed raised fields whose remains form the modern pampa surface. The mean wavelength of these early raised fields is approximately 5 m, the original surface of the fields was 2.5 m wide and .5 m tall (see Figs. 2 and 5). The oldest TL date for these remains is 1320 B.C. + 660 years, obtained from a sample recovered from a stratum of abandoned canal sediment. Although this date is very early, its large sigma value overlaps with that of the next oldest date, 400 B.C. + 500 years. This comes from another trench (Unit N) at the same site from a stratum interpreted as raised-field construction fill. These two dates indicate the construction and use period of the Phase I field. Three overlapping TL dates, A.D. 80 + 380, A.D. 380 + 320, and A.D. 440 + 310, date three different Phase I canal fill contexts (Pancha Unit M and Unit N; Juchatta PPU7-57, Unit A) and indicate the time of post-abandonment sedimentation and erosion. A series of radiocarbon dates from associated settlement locations corroborate the TL dates of Phase I. The dates for these pre-Pukara occupations cluster between 600-800 B.C.

Phase II. After a period of abandonment or disuse, the raised fields were modified by adding construction fill to alternating abandoned canals, thus increasing the field surface to 5 m wide, 1 m or more tall, and resulting in a wavelength of 10 m. We do not have a direct date for this period of reconstruction and modification in Phase II; dates of A.D. 1325 + 120 years and A.D. 1540 + 90 years obtained from samples from sediments of canal fill (Pancha Unit N) indicate the period after the final abandonment of the fields of Phase II. Diagnostic ceramics in associated occupation sites support these terminal dates and indicate that the construction and use of the raised fields of Phase II can be attributed to the cultures of the Late Intermediate period (A.D. 1000-1476) and were possibly continued by the cultures of the Late Horizon (A.D. 1476-1534) in the northern lake basin.

In summary, there were two distinct phases of construction and use of the raised fields in this zone. Construction of Phase I raised fields began sometime before 1000 B.C. and, using dates from

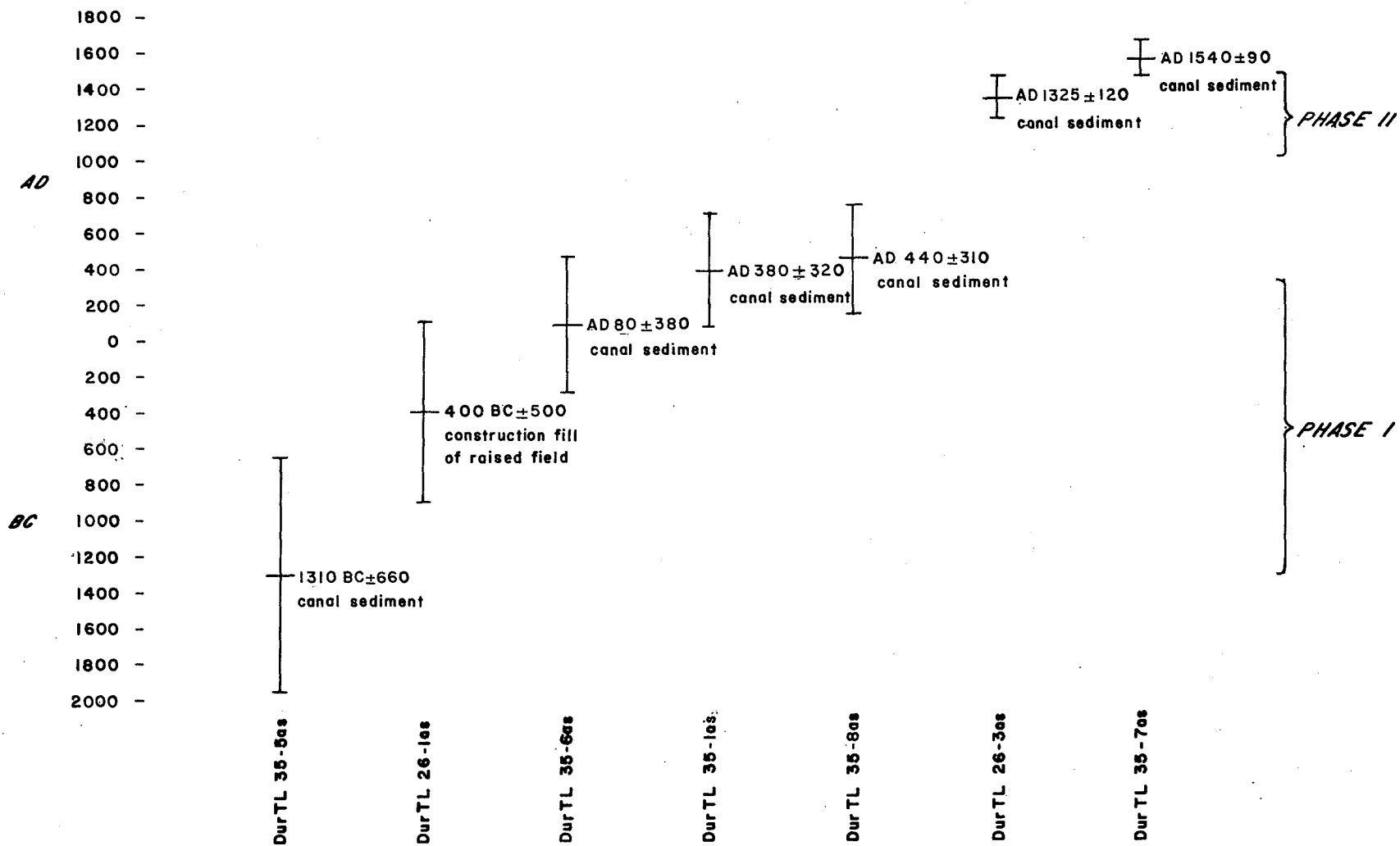


Figure 4. Thermoluminescence dates and their contexts from excavations in raised fields in the Huatta pampa.

BEFORE RAISED FIELD CONSTRUCTION

unmodified pompa

a.

RAISED FIELD CONSTRUCTION

PHASE I

1000 BC - AD 300

raised field

raised field

canal

canal

canal

b.

RAISED FIELD CONSTRUCTION

PHASE II

AD 1000 - AD 1450

raised field

raised field

canal

c.

PRESENT DAY

modern surface

d.

0 1
m

Figure 5. Reconstruction of events based on the stratigraphic profile from the excavation of Unit N at the site of Pancha.

associated settlement mounds, appears to have reached a peak around 600-800 B.C.; their abandonment occurred sometime after A.D. 300. The reconstruction and reutilization of these raised fields in Phase II probably began about A.D. 1000 and lasted until the Inca conquest of the lake zone sometime after A.D. 1450.

DISCUSSION

Relating the TL dates to what we know about the prehistoric cultures of the zone permit us to interpret the significance of the raised fields in terms of local culture history. The remains of early farming cultures of the altiplano, Qaluyu, Wankarani, and Chiripa, indicate an economic orientation towards the lakeshores and wetland zones. The exploitation of lacustrine resources was probably similar to the economy of the present day lakeshore dwellers, which combines agriculture, fishing, hunting and collecting. Besides increasing the area of arable land around the lakeshore and rivers, the practice of raised-field agriculture would have also expanded the ecozone that favored wetland flora and fauna (Erickson 1986). Construction of the raised fields probably began along the shores of the lake and rivers, expanded throughout the seasonally flooded plains, and later extended into the drier areas of the pampa. The peak in early raised field use during Phase I apparently coincided with, or perhaps began somewhat earlier than, the rise in importance of the ceremonial center of Pukara in the northern lake basin. The locations of major and minor Pukara settlements on the lake edge suggest an economy based on raised fields and qochas (sunken fields), probably also including andenes (terraces) on hillslopes in close proximity to the lake.

During the period around A.D. 200-300, the southern lake basin culture, Tiwanaku, usurped the power and prestige of Pukara. With the subsequent collapse of Pukara, there is evidence of the abandonment or disuse of the raised fields in Phase I of the pampa of Huatta. We suggest that this abandonment was related to the shift of power from the northern to the southern capital. We can attribute the lack of diagnostic ceramics of the Tiwanaku period in the pampa of Huatta to one of two factors: a major depopulation or migration out of the area, or the continuation of the local non-Tiwanaku ceramic tradition. Alan Kolata (1982, 1986) suggests that the raised fields in Koani Pampa in Bolivia are related to Tiwanaku occupations IV and V, which coincide with the period of abandonment of raised fields in the north. With the collapse of Tiwanaku around A.D. 1000, raised field construction appears to have stopped in the southern basin, and a resurgence of construction of raised fields is seen in the north (Phase II). These raised fields are related to the Lupaca and Qolla ethnic groups. It is highly likely that the final abandonment of these raised fields occurred during the Inca occupation of the Lake Titicaca basin. The Spanish and indigenous chroniclers make no reference to raised-field agriculture, whereas they wrote detailed descriptions of other forms of indigenous Andean agriculture; thus, when the Spanish arrived, the raised fields were probably in disuse. It is suggested that the abandonment that ended Phase II, in addition to that of Phase I, can be attributed to socio-political changes in the Lake Titicaca basin. In other publications, these explanations will be examined in more detail. Here it can only be emphasized that the dates obtained by TL for the beginning of Phase I raised-field use

correlate closely with the dates, established by other investigators, for early sedentary agricultural communities in the Lake Titicaca basin; and the TL dates for the decline of Phase I raised-field use correspond to those previously determined for the collapse of the Pukara culture.

LABOR ORGANIZATION AND INTENSIFICATION IN RAISED-FIELD AGRICULTURE

The direct dates obtained through TL, which indicate a very early use of the raised fields in Phase I, contradict the hypotheses of other investigators. The attribution of raised fields to late prehistoric cultures is based on the notion that the construction of the system would have required large dense populations with an advanced bureaucratic structure to organize and direct the labor, and that the pressure to develop such an intensive system of agriculture arose from the necessity of feeding this large population (Harrison and Turner 1978; Kolata 1986; Turner and Harrison 1983; Turner and Denevan 1985). Data from the 1981-1983 archaeological investigations and continuing agronomic investigation from 1983 to the present indicate that these ideas are not necessarily relevant to the development of raised-field agriculture in the Lake Titicaca basin.

Discussions of labor input related to the construction and maintenance of raised fields are generally based on the figures derived by Erasmus (1965), Puleston (1977), or non raised-field analogies (see Turner and Denevan 1985; Knapp 1984; Denevan and Mathewson 1983, Mathewson, this vol.), but the results from their experiments can not be directly applied to the construction of raised fields in the Peruvian altiplano. With the chakitaqlla (Andean footplow), an excellent agricultural tool for cutting pampa sod, a single worker can construct 1 m³/hour under ideal soil conditions (Erickson 1985; Garaycochea, this vol.). This figure results from more than 4 years of experimental construction of raised fields in the zone of Huatta. The labor requirements for the construction of raised fields are thus not necessarily as high as previously believed.

Due to the sophistication of the system of raised fields, it has been commonly assumed that some form of centralized administration would have been necessary for field planning and management (Kolata 1982, 1986; Harrison and Turner 1978; Turner and Harrison 1983). Construction and use of raised fields in Huatta have demonstrated the contrary: that small communal groups of 20-40 families can effectively manage this technology; and smaller groups, even individual families, have also been very successful. There is no evidence that a more elaborate socio-political organization than the traditional Andean ayllu (local-level land holding group) is necessary for the construction and maintenance of raised-field systems.

Many investigators, following Boserup (1965), believe that intensive agriculture only developed in response to severe population pressure. Although the raised fields supported a large and dense population, the new dating evidence indicates that the system was developed long before there had been severe problems in supporting a large population. As explained earlier, it seems that the raised fields of this zone developed early in order to increase the area of

prehistorically preferred ecozones, river and lakeshore margins, which today are considered 'marginal' for agriculture (Erickson 1986).

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