

HALELE'A AGRICULTURAL SYSTEMS RECONSIDERED

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A critical review aims to clarify what is known and what is not known of the chronology of agricultural systems in Halele'a. This review considers oral traditions, comparative ethnography and linguistic terms, and archaeological stratigraphy and radiocarbon dates pertinent to the chronology of Halele'a agricultural systems. Albeit tentatively, this review suggests: 1) substantial but non-agricultural use of inland valleys as early as the AD 1200s; 2) agricultural terracing beginning approximately AD 1400; and 3) increasing intensity and more widespread agricultural terracing after AD 1600. The proposed sequence bears significant implications for studies of the dynamic relationship between population growth, subsistence production, and sociopolitical complexity.

The Halele'a District (Figure 1) is well known for its extensive agricultural complexes, where almost entire valley floors were transformed into successive steps of *lo'i*, irrigated terraces designed principally for growing *kalo* (taro or *Colocasia esculenta*). This scene presented a befitting case study for Earle's (1978, 1980) examination of traditional Hawaiian agricultural systems and their role in the development of complex chiefdoms.

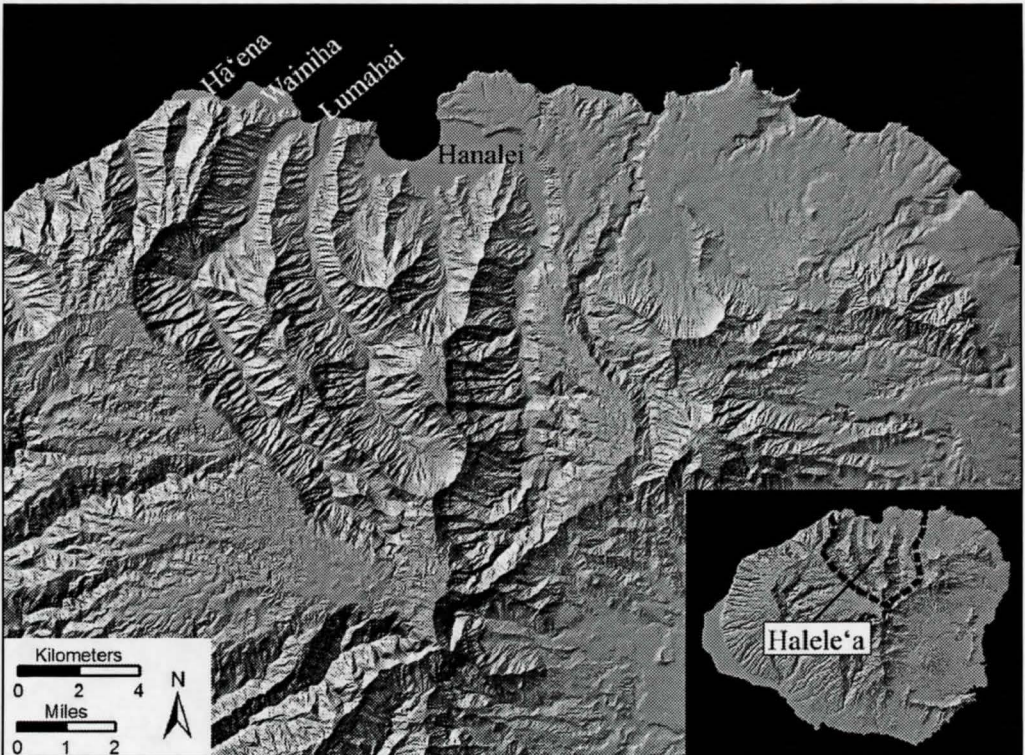


Figure 1. Map of the Halele'a District.

Despite the profound significance of this research topic, the actual chronology of events and processes has been muddled over the years by incomplete data and false impressions of those data. Athens (1983) attempted to clarify this situation, yet his conclusion of rather late development of intensive agricultural systems in Halele'a was not widely accepted in the early 1980s. As Kirch (1985:101) noted: "More extensive excavations need to be carried out in ... the Halele'a District, before a precise chronology for the development and expansion of taro irrigation can be determined."

KEY CONCEPTS

Few topics are as pervasive in archaeology as the relationship between population growth, subsistence production, and sociopolitical complexity. Detailed reviews of this topic have been published elsewhere (Leach 1999; Morrison 1994). Only a brief review is offered here as applicable to the Halele'a case, largely following Athens' (1983:3-18) earlier presentation of the research problem and its role in Hawaiian archaeology.

Most researchers credit Boserup (1965) with articulating a well reasoned argument for population-dependent agricultural development. Most basically, this argument proposes that societies operate by the principle of least effort. When population growth creates a demand for more food production per unit of area, then subsistence strategies may intensify.

Labor-intensive strategies are not necessarily efficient. They produce more food per unit of area, but they may also require more labor per unit of food produced. For instance, in arboricultural systems, trees bear edible fruits or other products with negligible human labor input. By comparison, an irrigated taro field can offer abundant and reliable edible product per area of cultivation, but this system potentially requires more actual labor investment than in an arboricultural system.

Concerning whether or not irrigated taro production complexes represent agricultural intensification, Spriggs (1982:256) notes that the yield per hectare of taro production in these systems is "considerably higher than that of the yield in rain-fed dryland conditions in a similar environment." Irrigated fields afford three major advantages: 1) year-round (non-seasonal) potential for planting and harvest; 2) reduced fallow period for fields to regenerate productive nutrients; and 3) reduction of inter-annual yield fluctuations. In addition, Spriggs (1982:256) mentions that "some crop pests can be cut out by growing taro in flooded fields."

Somewhat difficult to quantify, however, is to what extent irrigated taro fields are efficient or inefficient with the labor that they require. Bayliss-Smith (1980:74) presents admittedly tentative and limited evidence of decreased labor efficiency for Pacific Island societies involved in intensive taro production. Anecdotally, many Pacific Islanders regard irrigated fields as requiring extraordinary labor, whereas arboriculture presents a reasonable least-effort strategy.

Although population growth is a likely candidate to motivate agricultural intensification, it is not necessarily the only factor involved. Along with population growth, most societies develop greater internal diversity and potential conflicts, and more complicated

or complex sociopolitical systems tend to emerge under these circumstances. In this setting, agricultural intensification could be a response to new demands for support of increasingly complex sociopolitical systems.

Specifically for Halele'a, Earle (1978:181-182; 1980:4) proposed that chiefs sponsored the construction and maintenance of agricultural systems, motivated by a demand to use food production to support retainers and allies, as well as to enhance their own prestige and perceived authority. However, no exact date could be specified for this major economic, social, and political development. Moreover, the process may have unfolded over some centuries.

Given their sociopolitical role, many Hawaiian agricultural systems were likely constructed during periods of pitched competition between chiefdoms. Most overall models in Hawaiian prehistory suggest AD 1400 for the onset of major sociopolitical change, escalating further after AD 1600 (Kirch 1990). Cordy (2004) refers to this change as the development of a "feudal-land system" in pre-Contact Hawai'i, wherein large polities exerted control over their land units, the people in these lands, and the food and other resources produced there (see also Cordy 1974, 1981a, 1981b). Hommon (1976, 1986) emphasized that archaeological dates for inland settlement expansion were abundant after AD 1400, perhaps signaling the origin of the ethnographically defined *ahupua'a* system of large land units that typically incorporated multiple resource zones from the ocean to the mountain interior of each island.

ORAL TRADITIONS

If the extensive agricultural systems in Halele'a are indeed a late phenomenon, then perhaps oral traditions mention how these systems evolved or even credit them to a particular chief. Although no such specific information is available, some oral traditions refer to a group of "banana-eaters" in certain valleys in Halele'a, in contrast to the dominant taro-growing Hawaiian population. Traditions of the Mū 'ai mai'a ("banana-eating Mū") refer particularly to Wainiha and Lumahai in Halele'a (Lydgate 1912, 192; Thrum 1915).

A more detailed account of the Mū is beyond the scope of the present work, but the most important point here is that stories about the Mū appear to "reflect times when (or places where) bananas and other tree crops were more important in a local diet and landscape that otherwise came to be dominated by taro and other root crops" (Carson 2003:100). The primary references about the Mū are summarized in Luomala's (1951) review of Menehune and related traditions.

COMPARATIVE ETHNOGRAPHY AND LINGUISTIC TERMS

Kirch and Lepofsky (1993) documented an incongruence in linguistic terms associated with irrigation systems in various parts of Polynesia where they occur. The incongruence suggests that elaborate irrigation complexes developed independently in different places, at a somewhat late point in prehistory when the language groups of Polynesia had already diverged significantly.

Referring to Polynesian irrigation complexes in general, Kirch and Green (2001:131) remarked that "the large-scale terracing, canal networks, and the like were technological elaborations that would accompany much later stages in the transformation of Polynesian societies." Although Polynesian farmers were undoubtedly aware of the potential for increasing taro crop yields with irrigation, the scope and magnitude of artificial manipulation of taro-growing environments did not develop into vast and complex field systems in all parts of Polynesia. The uneven distribution may suggest a late development, much like the case for the linguistic terms.

Irrigation complexes do not appear to be an ancestral Polynesian trait that would have been implemented in various parts of Polynesia, but rather they appear to have developed independently and unevenly. Yen (1971, 1973) remarked that the emergence of intensive agricultural systems was a gradual process throughout Oceania, and the case for Hawai'i does not appear any different from the overall pattern (Kirch 1977:271-274).

ARCHAEOLOGICAL STRATIGRAPHY AND RADIOCARBON DATES

At least two archaeological investigations in Halele'a have provided radiocarbon dates from stratigraphic contexts both within taro terraces and in the underlying non-agricultural deposits that preceded them (Table 1). In Hanalei Valley, Athens (1983) obtained four dates for definite pondfield deposits, adding to Schilt's (1980) two dates from uncertain context. At Limahuli, Calis (2001) reported three dates from irrigated terraces and one date from an underlying cultural deposit.

The results in Table 1 indicate use of terrace pondfields after AD 1400. The earliest date range clearly associated with an agricultural terrace is cal. AD 1320 to 1630, with the majority of the probability distribution after AD 1400. Of the two pre-AD 1400 dates in Table 1, one (cal. AD 1030 to 1390) is certainly from a pre-pondfield layer, and the other (cal. AD 595 to 970) is from a lower deposit that is suspected to pre-date pondfield construction.

Based on a review of 66 available radiocarbon dates from the Halele'a District (see "A Radiocarbon Dating Synthesis for Kaua'i," this volume), Schilt's (1980) date of cal. AD 595 to 970 is clearly anomalous. Human occupation is evident in the range of AD 950 to 1300 in a few locations in Halele'a. More substantial and widespread settlement and land use, however, is indicated by the majority of the radiocarbon dates (N=50 or 75%), post-dating AD 1400.

Prior to AD 1400 in Halele'a, settlement was in a few places near the coast, but one date of cal. AD 1205 to 1315 (sample Beta-87546, Kaschko 1996) refers to a firepit feature in an inland setting in Hanalei. Preceding agricultural expansion, inland areas were certainly utilized for different purposes. Although the scope and range of these early inland activities are unclear at this time, they occurred at least as early as the AD 1200s.

Table 1. Radiocarbon dates from Halele'a irrigation terraces and underlying cultural deposits.

| Sample reference | Context | Conventional radiocarbon age (years BP) | Calibrated age range (2 Sigma, 95.4% probability) |
|-----------------------------|---|---|---|
| Beta-1240 (Schilt 1980) | Lower deposit, possibly preceding terrace pondfield | 1290 ± 95 | AD 595 to 970 |
| Beta-143795 (Calis 2001) | Cultural deposit pre-dating terrace pondfield | 780 ± 90 | AD 1030 to 1390 |
| Beta-2808 (Athens 1983) | Terrace pondfield | 460 ± 60 | AD 1320 to 1630 |
| Beta-143793 (Calis 2001) | Terrace pondfield | 400 ± 40 | AD 1430 to 1630 |
| Beta-1239 (Schilt 1980) | Terrace pondfield | 380 ± 80 | AD 1410 to 1665 |
| Beta-143794 (Calis 2001) | Terrace pondfield | 360 ± 40 | AD 1450 to 1635 |
| Beta-143796 (Calis 2001) | Terrace pondfield | 350 ± 40 | AD 1455 to 1635 |
| Beta-2809 (Athens 1983) | Terrace pondfield | 210 ± 50 | AD 1525 to 1950 |
| Beta-4157 (Athens 1983) | Terrace pondfield | 120 ± 70 | AD 1670 to 1950 |
| Beta-2807 (Athens 1983) | Terrace pondfield | 80 ± 50 | AD 1680 to 1950 |

CONCLUSIONS

The vast taro pondfields in Halele'a dominate the landscape, yet both oral traditions and archaeological evidence suggest such was not always the case. Stories about the Mū 'ai mai'a ("banana-eating Mū") refer to the loss of an ancient non-agricultural society in the area. These tales mention that the Mū arboriculturalists became restricted to the most remote upland portions of valleys, presumably beyond the reach of agricultural expansion. Eventually, however, taro-growing terraces were built in nearly every part of the Halele'a valleys.

The archaeological evidence from Halele'a indicates agricultural intensification and expansion by means of terraced pondfields after AD 1400, replacing earlier settlement and land use patterns. The timing coincides with what is expected to be an important period of sociopolitical change throughout the Hawaiian Islands. However, the correlation alone does

not necessarily imply a causal relationship between complex chiefdoms and agricultural intensification.

One of the goals of this review is to encourage more critical research on the topic of agricultural intensification, and additional data will undoubtedly provide a more substantial basis for interpretation. The dynamic and complicated relationship between population growth, subsistence economy, and sociopolitical complexity deserves more detailed attention.

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