Prehistoric Horticultural Practices on Easter Island: Lithic Mulched Gardens and Field Systems

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FOOD PRODUCTION ON EASTER ISLAND

Easter Island illustrates the importance of cultivation in support of large populations. Between the 9th and the 17th centuries an estimated 5000-10000 people were supported by their chiefs and kin groups including non-food producing members of society, such as the craftspeople who constructed, moved and erected the ahu and carved stone moai. Subsequent to the 17th century, as the centralized chiefdom gave way to competition among clans for leadership, warriors and competitors affiliated with the “Birdman cult” were also supported through cultivation of tuber and tree crops, the major means of subsistence for those who lived on Easter Island prior to European contact. Food production took on added importance as a subsistence practice, because terrestrial and marine faunal resources were reduced through exploitation that occurred between the 16th and 19th centuries (Ayres 1986; Steadman 1995) and possibly as a result of natural climatic changes between the 16th and 19th centuries (McCall 1993).

On Easter Island, during protohistoric times, techniques used for food production were described in reports and logs of early European voyagers visiting the island (La Pérouse 1799; Cuming 1827-28), and ethnographic descriptions of subsistence activities were recorded in the early 20th century (Routledge 1919; Metraux 1940). Archaeological surveys have identified architecture related to gardening (McCoy 1976; Cristino, Vargas and Izaurieta 1981). These eyewitness reports, studies and surveys contribute to the following view of prehistoric and early historic Easter Island agriculture. Easter Islanders raised chickens and Polynesian domesticates, such as Dioscorea yams, Colocasia and Alocasia taro, Musa bananas, Saccharum, Cordyline, Curcuma, and Broussonetia paperbark mulberry (used to make tapa cloth). These plants are derived from the cultigens brought from Southeast Asia (Zizka 1990). Easter Islanders also grew and used Lagenaria vulgaris gourds to hold water and the sweet potato, Ipomoea batatas, both of which had a South American origin (Yen 1974; Green 1999).

Early surveys (Ayres 1975; McCoy 1976; Cristino, Vargas and Izaurieta 1981) and more recent research by Vargas (1993) and Stevenson and Hsiao (1998) have associated prehistoric agriculture with architectural features, such as walled manavai gardens, planting circles, small terraces, and meter-deep rock accumulations encompassing planting wells holding individual plants. However, according to early European visitors to the island, large areas on the West Coast of Easter Island had rectangular field systems (Cuming 1827-28; La Pérouse 1799). These visitors described earth mounds several meters in diameter, or depressions and furrows in which banana plants grew aligned in rows within rectangular field systems. La Pérouse also mentioned use of a field system where:

“...this space abounds with a kind of herbage...[covering] large stones lying on the surface. These stones, which were found very troublesome in walking, are a real benefit to the soil, because they preserve the coolness and humidity of the earth, and in part supply the salutary shade of the trees, which the inhabitants have had the imprudence to cut down, no doubt at some very distant period. This has exposed their soil to the burning ardor of the sun, and has deprived them of ravines, brooks, and springs.” (La Pérouse ibid: p. 312)

These field systems and gardens, as described by La Pérouse, have not been identified as prehistoric features in the archaeological surveys carried out in early archaeological surveys.

GEOARCHAEOLOGICAL SURVEY TO IDENTIFY “CULTIVATED FIELDS” ON EASTER ISLAND

In order to locate and define the field systems described by the first European visitors to Easter Island I began a geoarchaeological survey of the Te Niu area in 1996 (Wozniak 1996). I systematically collected soil samples from shovel test pits. During the sampling procedure I found that areas of level or slightly sloping terrain in the vicinity of residential sites had discrete patterns of surface rocks near the remains of residential sites. Several excavations in these rocky areas revealed that a layer of surface rocks covered an organically rich, anthropogenic soil containing materials added by humans. McFadgen (1980) terms this type of anthropogenic soil “maori plaggen” soil. Plaggen is a Dutch term, which refers to “plowed” soil. On Easter Island however, a fire-hardened digging stick (called an oka) and basalt spades, rather than plows, were used to open the soil surface in order to place cuttings of tuberous plants or trees into holes.

LITHIC MULCH

The term “lithic mulch” is used by Lightfoot (1994) to describe the use of a layer of gravel or rocks covering the surface of an agricultural soil. A thick surface layer of small rocks has a mulching property because it protects the soil from desiccation, water and aeolian erosion, and rapid fluctuations in soil temperature (Fairboume 1973; Edwards, et al. 1984). Lithic mulching is a technique that is used to maximize food production under dryland conditions, such as those present on Easter Island. I am proposing that the surface layer of small rocks, which covers the maori plaggen soil horizon on Easter Island, is an artificially constructed, or artificially enhanced, agricultural innovation designed to increase food production, and that these rock layers constitute at least one type of field system used by Easter Islanders during the Prehistoric period on Easter Island (Figure 1). I refer to this rock layer as a “lithic mulch” and to the gardens as...
“lithic mulch (-ed) gardens”. Although lithic mulch was just one of the technological means used on Easter Island during prehistoric times to enhance food production, it was potentially one of the most important innovations.

During my survey on the Northwest coast of Easter Island, I found two dozen good examples of rock-covered maori plag-
than 5 cm diameter) organic-rich pit features, which protrude into this horizon from horizon above. These pit features represent the remains of roots protruding down from the plaggen layer.

Those gardens placed on the deep soils that had formerly supported forests tend to exhibit a narrow transition zone between the plaggen layer and the lower, yellow, clay-rich horizon. This transition zone and the top of the yellow horizon contain long pores about 5 mm in diameter extending vertically from the bottom of the overlying plaggen horizon. These pores, which are lined with carbonaceous material, appear to be the remnants of the extinct palm trees of Easter Island.

In contrast, the soil in the walled *manavai* garden has no lithic mulch cover but it does have a stratigraphy similar to the shallow garden soils (Figure 2B). This includes a plaggen layer, which has pit features that also extend into the lower regolith horizon. However, in place of the lithic mulch, the layer on top of the plaggen horizon consists of dark brown sediments that have a granular ped structure typical of mollic soils which form under a mat of grasses. Grasses replaced the forest biota on Easter Island (Flenley et al. 1991).

**DISCUSSION**

Easter Island lacks permanent streams; therefore irrigation to increase agricultural production has not been an option. The successful cultivation was and is solely dependent upon rainfall, fertility of the soil, and protection of plants and soils from extremes of climate. The soils derived from weathering of lavas on Easter Island are potentially fertile (Wright and Diaz 1962). Tuber crops thrive on a nutrient-rich soil supplied with phosphates produces during weathering of basaltic soils, so long as nitrogen, carbon and potash are provided in the form of ash or charcoal that aids in the release of phosphates from the insoluble form present in the soil. The benefits of a lithic mulch include: the maintenance of soil moisture within the root layer, protection of the soil from wind and water erosion, encouragement of a healthy microflora and fauna providing humic nutrients to the crop plants, and a reduction in extreme temperature fluctuations around roots and tubers (Wilson 1983). The rock layer also inhibits weeds from taking hold within the garden area, and would appear to be a deterrent to crop destruction by intruding rodents and chickens.

Lithic mulch gardens represent an innovative technology that allowed Easter Islanders to meet both their subsistence requirements and...
their social obligations during the prehistoric period. Islanders increased agricultural production through the retention of soil moisture, the encouragement of a microflora and microfauna that could provide a nutrient-rich growing medium, and the prevention of soil erosion. Lithic mulch gardens also represent a means by which intensification of food production in a dryland environment could be accomplished (Stevenson, et al. 1999, in press).

Cultivation techniques designed to meet the needs of feeding people resulted in the loss of the vegetation cover that had formally helped shade the soil surface. This alteration of the forest ecosystem would have had a negative affect on an already semi-dry environment. If climatic changes then transpired, as may have occurred during the Little Ice Age when local changes in temperature and precipitation occurred throughout the world (Cole 1996; Kreutz, et al. 1997; Mann et al. 1998), then the increased stress would have altered the already marginal productive capacity of Easter Island. An increased use of lithic mulch could have provided a means of food production during periods of environmental stress, such as those which accompanied forest-clearing, local weather changes caused by recurring El Niño events, or global climatic changes such as the Little Ice Age. Lithic mulch gardening was therefore most beneficial during the last 500 years, when the population is estimated to have reached its maximum size and dependence upon cultivation for subsistence became imperative owing to diminished food procurement from other sources (Ayres 1986; Steadman 1995).

There is evidence that lithic mulch gardening is not a unique strategy for food production found only on Easter Island. Lightfoot (1994) has reported at least twelve instances of gravel or rock mulch used in various locations worldwide where rocks are abundant and precipitation is minimal. Rock mulches were used by the Hohokom and the Anasazi of the American Southwest, the Maori of New Zealand and on the island of Hawaii. Gravel mulches were used prehistorically in the Negrev and on the lee-ward sides of the Andes. The technique of rock or gravel mulching was suggested for use in the dry portions of the Western United States by Rodale (1949) and by the USDA, who experimented with the technique for row crops on the lee-ward side of the Rocky Mountains (Fairbourne 1973).

Was the construction of lithic mulch gardens on Easter Island labor intensive? Does the presence of these extensive gardens suggest that chiefly intervention was necessary for their construction? It seems more likely that Easter Islanders took advantage of debris flows and the disintegrating lava flows rather than building a rock layer where no rocks were present. The homogeneous nature of the rock cover in many of the garden areas however, indicates that Easter Islanders enhanced the level terrain and concave geomorphic features that are most favorable as gardening locations owing to the deeper accumulation of soils and the favorable hydrologic dynamics of these areas.

The most supportive evidence for use of lithic mulch comes from the ethnohistoric references, such as the comments of La Pérouse (1799). Traditional farmers on Easter Island today use rocks as mulch around individual plants. They are able to identify various rock covered areas in remote places on the island as locations in which to plant occasional banana trees, taro, or many of the historically introduced American cultigens. At the same time they may not recognize as potential garden areas many of the same morphological characteristics of those garden areas in other locations, namely those identified in the geo-archaeological study, as part of the extensive prehistoric or early historic field systems. In part this is due to the increased importance of cattle raising and the use of field systems which can be easily plowed with tractors for the cultivation of historically introduced crops grown from seeds, such as maize, beans, and cabbage.

**Summary**

European visitors to Easter Island had described field systems in the 18th century. The 1996 geoarchaeological survey of soils was made on the northwest coast of Easter Island to search for those fields and to identify the characteristics of garden soils on Easter Island. During the soil survey, surface accumulations of small rocks that formed a discrete lithic layer covering an anthropogenic (maori plaggen) soil horizon, were found. The anthropogenic soils display archaeological, structural and textural evidence indicating that they had been used as garden areas. Wood and grass ash had been added as a "mature" to enhance soil fertility. The charcoal and obsidian fragments found within the plaggen horizon, were dated to between A.D. 1200 and A.D. 1850 (calibrated dates).

Ethnohistoric references and the use of traditional gardening methods by some 20th century Rapanui farmers support the geoarchaeological data. With the identification of lithic mulch gardens as archaeological features, a reassessment of the island-wide survey is in order so that we may better determine the temporal and spatial extent of the use of island soils for food production.

**References**


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