Irrigated Taro in the Indo-Pacific: Multiple Perspectives

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Irrigated Taro (Colocasia esculenta) *in the Indo-Pacific*
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Contributions to the present volume span a vast region, and provide multiple perspectives on the history of plant domestication, agriculture, and the development of social systems. The editors of the volume consider how the papers fit into a larger story of human settlement in the Indo-Pacific region, the development of archaeology as a discipline, and the future role of taro in food production.

In the agricultural sciences, a publication that is often cited to justify research on tropical plants is a slim volume entitled *Underexploited Tropical Plants with Promising Economic Value* (Ad Hoc Panel 1975). After explaining various positive attributes of the crop, the authors note that: 'Taro growing requires intensive effort. It calls for manual labor and long hours of work in muddy, flooded fields; consequently its production is decreasing'.

Growing taro must be especially dispiriting when production goals are not in balance with the available labour, land, fertility, climate, and demand. A lot can go wrong, logistically speaking, when taro cultivation becomes intensive and large scale. For this reason, the most obvious archaeological remains of infrastructure associated with taro—the intensive and extensive systems for taro irrigation described in the present volume—can be regarded as monuments to failure of one kind or another (*cf.* Bollt, King, this volume). Such remains can also be regarded as monuments to the aspirations and success of different peoples, at different times, and in different places. The present volume is the first edited monograph to treat taro as subject of broad historical, social, and cultural interest, yet our articles merely scrape the skin of the sometimes bitter, sometimes sweet history of taro. That taro persists today as a minor crop throughout much of the tropical and temperate world is also a monument—of a living kind—to the adaptability and resilience of vegetative clones.

Taro is a bland and savory food, qualities that allow it to be used in a huge variety of ways, in a huge variety of cuisines, around the world. In meals it can be a main staple, a side dish, or part of a sweet dessert. As a crop, taro can only persist where people appreciate its qualities as a food. Socially, it is not just the quantity and quality of taro that matters, but also its strategic value in diverse systems of production and consumption. Taro plants are useful when planted singly in a house garden, or in small patches next to streams (see Caillon, this volume) or in pits (Chazine, this volume), or *en masse* in complex pond-field systems cover-

ing large areas (McElroy, and others, this volume). To say that taro 'requires intensive effort' is only part of the truth. In fact the crop can respond positively to almost any level of effort. According to the variety used, the techniques applied, and efforts made, taro will give back something. Spriggs has argued that the return for labour using irrigated taro methods which create a permanent infrastructure over time of canals, terraces and bunds, is particularly favourable once this infrastructure is in place (Spriggs 1984). The relative permanency of much of this infrastructure, means that even when a garden area has been long abandoned, for instance because of 19th to 20th century population decline in many Pacific Island nations, the forest growing over it can be cleared and the irrigation systems brought back into commission. This is witnessed by recent efforts in Hawaii and Aneityum in Vanuatu, among other places, to revive ancient garden systems (see Spriggs 1989, 1993 for references).

One of the great and enduring debates regarding Southeast Asian and Pacific prehistory is the question of agricultural origins. We do not know when taro was first domesticated, but as Tudge (1999) argues for crops and agriculture in general, the earliest management and use of taro must have been long before monumental and archaeologically visible irrigation systems were created. From a biological point of view, it seems very likely that the rich Southeast Asian flora, the great diversity of environments, and the deep antiquity of human occupation led to early forms of plant management and use, and eventually to domestication and agriculture. Nothing is easier than managing and using wild taro as a perpetual food source, in naturally warm and moist environments (see Fig. 1, and Matthews *et al.* this volume).

Such management and use is difficult to recognise archaeologically, since it does not require any modification of the environment that is unique to taro, but is susceptible to residue analyses on stone tools in favourable conditions (*cf.* Loy *et al.* 1992). This volume includes

Figure 1 Wild taro on a flooded stream bank in northeastern Queensland, Australia (photo by Matthews, 2010). Wild taro was used as food by the indigenous inhabitants of Queensland until the early 20th century.

perspectives on domestication and diffusion of taro from linguistics (Blench), ethnobotany (Matthews *et al.*), and archaeobotany (Oliveira). There is clearly ongoing potential for all three areas to contribute to debate concerning the role of taro in the origins of agriculture.

Whether or not taro preceded rice in the irrigated pondfields of Island Southeast Asia remains a question worthy of further research. Taro pondfield systems to the exclusion of rice are even today found on Lan-Yu (Orchid Island, Botel Tobago) in the Taiwan Strait, between two major areas of rice irrigation in China and the Philippines (see Acabado this volume). This seemingly relict presence of irrigated taro along with other clues as to taro's precedence have long been suggestive of a general switch from taro to rice as economic circumstances in Island Southeast Asia changed and an easily storable commodity was required for the maintenance of early forms of hierarchical social organization (see Spriggs 1982 for references).

Rice, while certainly present as Austronesian farming societies spread south from Taiwan into Island Southeast Asia around 2000 BCE, did not become what is now archaeologically-obvious as a staple crop until Indian-influenced kingdoms developed in parts of the region soon after commencement of the Metal Age at about 100 BCE (Paz 2005). Rice failed to spread at all as the equatorial regions of Eastern Indonesia were reached, for good ecological reasons (Dewar 2003), and also because it met a westward-expanding, independent, New Guinea area Neolithic 'push' into Island Southeast Asia. This is reflected today in the relict presence of Papuan languages and physiognomies in East Timor and eastern Indonesia and the witness of various New Guinea-derived economic plants, including *Dioscorea alata* (greater yam), banana, sugarcane and various fruit trees that are today found across much of the region (Cox *et al.* 2010; Denham 2004; Denham *et al.* 2004). At the time of this meeting of 'Neolithics' around 2000–1500 BCE, taro had long been used as a crop in the New Guinea source area (Denham *et al.* 2003), but it was clearly already known as well, however, in the wider Southeast to East Asian region, as discussed by Blench (this volume). Genetic studies indicate that taro has been domesticated more than once in Asia and Oceania (Kreike *et al.* 2004; Yoshino 2002).

As archaeologists turn more to archaeobotanical methods to investigate past ways of living (see Oliveira, this volume; Denham *et al.* 2009; Paz 2005), and as archaeological efforts are directed more to reconstruction of past productive landscapes rather than just a focus on habitation and burial sites, better knowledge of the development of intensive agricultural systems in the region may help us answer questions concerning wider regional interactions. As this volume shows, there has been considerable development of taro-focussed archaeological research in the Asia-Pacific region over the decade since it was last reviewed in print (Spriggs 2002). The level of sustained field research on agricultural prehistory is particularly impressive in Eastern Polynesia and the New Guinea Highlands, but is still patchy elsewhere. One important issue is dating the field remains that we find, and the papers here by Acabado, McElroy and Sand warn of the difficulties for accurately dating the construction and use of garden systems. Their work suggests solutions that may be widely applicable. Research on the relationship between taro and rice in Island Southeast Asia, and on the dating and development of intensive systems for taro cultivation in the Pacific Islands, have the potential to impact on much wider social evolutionary questions to do with the development of hierarchical societies such as chiefdoms and states. In this volume the potentials are well-illustrated

by Earle's paper on staple finance and the development of states in Hawaii, further consideration of Kirch's ideas about the aggressive expansionism of chiefdoms based on unstable staple finance from dryland cropping systems by Bollt, and by McCoy and Graves, and a thoughtful consideration by Bayliss-Smith and Hviding of the often over-drawn but still very noticeable contrasts in hierarchical social development between the malarial and long-settled zones of Island Melanesia, and non-malarial archipelagoes with a much shorter history of human settlement, such as New Caledonia, Fiji and Polynesia.

Earle (this volume) reminds us of earlier arguments, such as that of Wittfogel (1957) about the complexities and scale of irrigation requiring permanent managers who could so easily become 'despots'. These arguments were discredited by a series of historical and ethnographic studies that showed—on a worldwide basis and across many crops—that a variety of forms of organisation, not necessarily hierarchical, could be found in the operation of even quite large irrigation systems. But we certainly know less about these in relation to taro than we do in relation to other crops such as rice. In some cases only a single farmer or family are involved in decision making, but some systems involve the cooperation of larger groups and for many of those operating today we have no understanding of how this is achieved. For some abandoned systems, such as the *ruta* of inland New Georgia described by Bayliss-Smith and Hviding in this volume, we shall never know. All knowledge of them has long disappeared along with the populations that constructed and managed them. Spriggs was surprised on a recent trip to Pangi in South Pentecost, Vanuatu, at the huge scale of production from a very large and complex pondfield system behind the village. This particular system, surely the largest on the island by a long way and many hectares in extent, has never—as far as he is aware—been remarked upon by agricultural officers, anthropologists or other visitors. It clearly requires management and labour beyond the means of any individual family, but how is it achieved? There is much more to learn here, as with so many other topics relating to taro.

Different types of wet taro cultivation clearly have different intensification and yield potentials, and the parameters of these are clearly subjects for important ongoing research. Simple irrigation is particularly suited to low-density, mobile groups, as Walter and Tzerikiantz argue in this volume. Other techniques such as pondfield cultivation may have an almost unlimited potential for intensification as argued here by Earle and others. The basic categories of irrigation types mask an incredible amount of variety at the local level, as shown here by descriptions in the ancient Chinese text of Huang, Sand's efforts at a more detailed level of discrimination between them for New Caledonia, and Caillon's description of the Vanua Lava systems in Vanuatu where pondfields are utilized with an alternation of wet and dry states through the planting cycle, and where planting in minimally-prepared stream bed gardens is also common. Chazine too shows us that low island and atoll pit cultivation are more variable than usually considered. Teasing apart the ecological, demographic and sociocultural reasons for this variation is only just beginning.

There is tremendous variety too in the very incidence of irrigation both within some of the larger islands, and certainly within individual archipelagoes. Walter and Tzeriakantz note that irrigation is only found in certain areas—particularly the west coast—of Vanuatu's largest island of Santo, but the reasons why it is absent elsewhere on the island are unclear. One

could make exactly the same observation for the next largest island of the group, Malakula, as well; irrigation there seems limited to a small area in the south of the island. Bayliss-Smith and Hviding employ a linguistic-cultural argument to explain the seeming lack of irrigated systems on several of the more southerly islands of the Solomons chain. Clearly again, more than ecology is at play here. Sand (this volume) expands the usual reasons given for the development of irrigation (demographic pressure and social production needs) to include responses to landscape degradation—which itself must have been very variable between different geologies and ecologies—and climatic fluctuations of the last thousand years or so. If such a range of causes once led to the development and extension of irrigated agriculture, then they might also be implicated in future developments; history hasn't stopped, after all.

Although the crop and intensive methods for its cultivation have clearly been declining, in Papua New Guinea, New Caledonia and Fiji for instance (see Bourke, Sand, and King, this volume), this trend is not likely continue to the point of general extinction. A more likely outcome is that taro will remain a culturally valued crop, at various scales of production, in changing agricultural systems that incorporate new and traditional crop species and varieties. New opportunities will emerge for the crop to prove its value, even as it continues to fail in some contexts. In relatively disease-free contexts where taro continues to thrive, such as in Vanuatu, irrigated and/or dryland taro remain very resilient staples on many islands. Climate change, however, may be taking its toll. Spriggs' observations on Aneityum (Vanuatu) over the last 33 years suggest that damage to the 'permanent' agricultural infrastructure of the island is increasing because of increasingly unpredictable rainfall patterns. Perennial streams that once fed irrigation canals are progressively failing, becoming only seasonal in flow in leeward areas, while extreme rainfall events are becoming common, are causing major changes in valley topography, and are wiping out entire terrace systems. Irrigation is becoming limited to windward areas with more reliable rainfall and fewer extreme rainfall events.

Constant trial and error—in the art of growing plants—is what makes agriculture intellectually sustaining, for farmers and scientists alike. In this volume, growing taro to prevent hunger and social collapse is highly recommended by Huang, in a work of early science writing that is echoed more recently in books such as *The Coming Famine* (Cribb 2011), and *Feeding People is Easy* (Tudge 2007). These are all works of anti-magical thinking. Perhaps the biggest unspoken debate in our volume is between those who see 'magic' in gardens, and those who have confidence, or over-confidence, in our own abilities to survive. Modern economics and development are also realms in which magical thinking can thrive.

Contributors to the present volume have suggested many different ways to think about taro, the history of agriculture, social relationships, and our interactions with plants. In the world today, there seems to be a large gap between those who think we must live in order to grow food (as slaves to an agriculture that cannot know limits, because our population must always expand), and those who think we can grow food in order to live (as autonomous members of a natural and social world in which limits are understood, or at least accepted). After reading this volume, readers might like to explore ways to bridge the gap.

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