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9 *Ethnoecological observations on wild and cultivated rice and yams in northeastern Thailand*

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Rice and yams are two of the most important crop plants of Southeast Asian agriculture. Their occurrence as wild and cultivated plants in northeastern Thailand was observed as part of an ethnoecological study of modern-day natural resources (with an emphasis on edible plants) conducted between October 1979 and May 1981 when the author lived in the village of Ban Chiang, the site of an early village community dating back to the fourth millennium bc (Higham & Kijngam 1979, White 1982a, 1982b, 1984 and, for a revised chronology for Ban Chiang, White 1986). The study grew out of a general interest in prehistoric plant exploitation in Southeast Asia, particularly issues surrounding the emergence of domestication, and one of its many aims was to attempt to identify in the Ban Chiang region 'wild' examples of plant species which botanists have considered to be originally domesticated in Southeast Asia.

Particular attention was directed towards documenting the presence of wild rice, because, at the time of the study, some form of rice was the only plant identified archaeologically at Ban Chiang (Yen 1982, Chang & Loresto 1984). Although not yet identified from archaeological contexts, yams were also a key focus of the study because they figure hypothetically in many discussions about the earliest agriculture of mainland Southeast Asia. Hundreds of other plants and resources were documented in the study, but this chapter addresses only three selected topics relating to rice and yams: (a) the presence of wild rice and yams in the Ban Chiang region today; (b) some ecological characteristics of rice and yam species, including differences in habitat preference; and (c) the seasonal availability of rice and yams and its impact on the scheduling of exploitation.

Information on the local plant resources was derived from extensive interviews with the villagers, in particular from one principal informant who was unusually knowledgeable about the local flora, and from on-foot surveys of the local area. Plant specimens were identified at the Royal Forest Herbarium in Bangkok.

The term 'wild', as used in this chapter, implies that a plant is considered a wild and not a cultivated variety by the local villagers. Such 'wild' plants are found in uncultivated areas, and they may, of course, be feral, i.e. a plant originally brought into the area as a cultivar which subsequently escaped and established itself in uncultivated habitats.

The ethnoecological study reported in this chapter was seen as an initial step towards identifying the local occurrence of wild relatives of eventual domesticates in an area that may have witnessed an early, if not necessarily an incipient, stage in the development of agriculture.

Environmental setting

The landscape of the Ban Chiang region can be characterized as a gently undulating plateau. The climate is tropical but with distinct wet and dry seasons, each of about six months' duration. During the dry season, which lasts approximately from November through April, many of the smaller lakes and the upper reaches of watercourses dry up. The water table can drop several metres. The marked annual fluctuation of water resources represents the major environmental condition to which plants and animals must adapt. The response of much of the forest vegetation in northeastern Thailand to low water availability is deciduous behaviour. Most trees drop at least some of their leaves during the dry season.

The Royal Forestry Department describes the predominant forest type (Deciduous Dipterocarp Forest) as open, grassy, and often savanna-like (Royal Forestry Dept. 1962, p. 7). However, local inhabitants recognize a diverse set of plant communities which form a patchy mosaic across the landscape, determined to some extent by local variations in soil and drainage conditions. Furthermore, knowledgeable inhabitants not only consider plant and animal resources to have a patterned distribution relative to the overall system of plant communities, but are also able to estimate the possible presence of plant and other resources in the vicinity by observing the vegetation type of a locale.

Although not scientifically measured, the floristic diversity of the locally recognized plant communities is considerable; they range from highly diverse to nearly monospecific stands, although, compared with equatorial rain forests, seasonal tropical forests tend to exhibit lower species diversity. Ecological behaviours that affect the distribution of individual plants, such as seed-dispersal mechanisms, can promote relatively localized relationships among plant generations. As a result, plant resources are not necessarily widely and randomly dispersed, as has sometimes been suggested for the forests of Southeast Asia (e.g. Hutterer 1976, although see Hutterer 1983 for a revised view). In northeastern Thailand, at least, wild plant resources are, in some cases, densely clustered.

Wild rice

Local inhabitants of the Ban Chiang area refer to wild rice as *khao nok* meaning 'bird rice'. It is easily recognizable from the awns which are

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5–10 cm long and sometimes reddish in colour. The panicles are small and bear fewer and smaller seeds relative to the rice cultivated in the paddy fields. How the plants which local inhabitants refer to as *khao nok* relate to the taxonomy for wild and weedy varieties of rice discussed by Chang (1976 & Ch. 25, this volume) is not yet known. What villagers of the Ban Chiang area refer to as *khao nok* may be attributable by botanists to several different species of wild rice.

Khao nok grows along lake and stream edges, sometimes in dense stands. Such stands may not be truly monospecific, but competing species appear to occur at a low density. *Khao nok* can also be found in disturbed or man-made habitats, such as fallow paddies and roadside ditches. A key characteristic of these habitats relates to the local water regime. The areas where *khao nok* grows experience some, usually gradual, inundation during the wet season to depths of 50 cm or less, but during the dry season the land area dries out. Another way of describing the preferred habitat of *khao nok* is as the zone along lakes and rivers between the wet season high-water line and the dry season low-water line. According to informants, wild rice is sensitive to turbulence and does not grow along river edges on stretches that experience fast-moving floodwaters from heavy rains.

Towards the end of the rainy season the seeds of wild rice disperse onto the drying ground where they remain dormant until the rains come several months later, when they germinate. Thus the annual seeding habit of *khao nok* is closely synchronized with the seasonal fluctuation of water.

During October and November several patches of *khao nok* are observed to ripen at different times and even the seeds on the same panicle ripen on different days. Seeds usually disperse within a day or so of hardening, although quite often they even disperse before hardening. Within a day or two the seeds are either 'empty', filled with a milky substance, or already dispersed. Once dispersed, they are very difficult to collect from the tangle of leaves and stems on the ground. To achieve a maximum yield, ancient wild-rice collectors would therefore have had to be strategically poised at selected locales at the time of maximum yield.

Comparisons between wild and cultivated rice

Traditional rice cultivation in the Ban Chiang region parallels the *khao nok* ecology in terms of life cycle and water regime. Shortly after the start of the rainy season rice seed is broadcast onto prepared seed beds which can be best described as planes of mud. After about one month's growth, seedlings are transplanted into prepared fields bounded by low dikes. In these paddies the water level gradually increases, commonly to depths of 10–20 cm. There is no large-scale irrigation in the Ban Chiang area, and little in northeastern Thailand as a whole. Farmers practise some small-scale water control, involving the channelling of water between fields and occasionally the lifting of water from streams. However, most of the water comes from rain falling directly into the paddies. This type of wet-rice cultivation is described as 'rainfed rice agriculture'. By the time that the rice has matured and is ready for harvest, the rains have virtually ceased and the fields have dried up.

The growth cycle and maturation process of both cultivated and wild rice in the Ban Chiang area, from germination to production of viable seed, are clearly keyed to the course of the rainy season. Both cultivated and wild rice grow in dense, nearly monospecific, stands on land that over the course of the year is dampened, becomes slowly inundated, and then dries up. In this context paddies may be considered as a close ecological analogy to the natural lake-edge environment.

Table 9.1 Common wild yams in the Ban Chiang area.

Local name	Tentative binomial
man hoerp and *man luang*	*Dioscorea alata*
man goy	*Dioscorea hispida*
man perm	*Dioscorea esculenta*
man nok	*Dioscorea* (?) *glabra*
man sang	*Dioscorea* sp.

Wild yams

Only the most common of the edible wild yams (*man*) recognized by villagers in the Ban Chiang area are discussed here. Some of them have been tentatively identified by their Latin binomials (Table 9.1).

The five types of *man* listed in Table 9.1 are commonly eaten steamed as a snack food, and, in the appropriate season, can be found in the Ban Chiang morning market. Each is known to have a preferred habitat, differing in drainage, soil richness, and plant community.

Man sang produces a few relatively small ovoid tubers 2.5–7.5 cm in diameter. At one end of the drainage spectrum, this type (the species could not be identified) can be found along stream edges which overflow their banks for two or more days. It therefore occurs in riparian habitats near wild rice. The residents characterize this tuber by remarking that *man sang* can withstand flooding.

Man nok is found at the drier end of the drainage spectrum. Examples dug up by the author and her main co-worker were from well-drained soils, usually white sand, which supported an open dipterocarp forest of rather short stature. *Man nok* produces one long, thin tuber, usually less than a metre in length, but one example excavated (in about 10 min) was 80 cm long and weighed 200 g.

Man hoerp corresponds to the (domesticated) greater yam (*Dioscorea alata*). One large specimen which was over 2 m long and weighed 4 kg took about

two and a half hours to dig out. Relative to the preferred habitat of *man nok*, *man hoerp* is found in well-drained but deeper and richer soils which support a taller, denser, and richer type of forest.

Man goy (*Dioscorea hispida*) produces a large, stumpy, knobbly tuber. A specimen weighing 1 kg was excavated in less than a minute. *Man goy* contains toxins which must be leached out before the tuber can be eaten. Its preferred habitat is similar to that of *man hoerp*, i.e. well-drained and rich soils which support a relatively diverse forest.

Man perm seems to be equivalent to the (domesticated) lesser yam (*Dioscorea esculenta*). It produces several ovoid tubers somewhat larger in size than *man sang*, about 7.5–10 cm in diameter. In the wild, most of the plants have sharp, thorny roots just under the soil surface and above the tubers (cf. the wild West African yams discussed in Ch. 21, this volume, by Chikwendu & Okezie). *Man perm* grows in relatively rich soil, like *man goy* and *man hoerp*, but the local people say that it prefers a different plant community.

The life cycles of all the wild yams are basically similar. Vines develop during the rainy season, using the nourishment available from the previous season's tubers. Thus, during the rainy season the previous season's tubers become shrivelled and fibrous, and are not considered edible. In the latter part of the rainy season – the precise time varying with the species – new tubers begin to form, and by the end of the season, between September and November, they are fully formed. During the dry season the vines die back, but viable tubers remain undergound until the next rainy season when the cycle is repeated. The timing of the growth of vines and tubers differs in each species and the differences appear to relate to the drainage conditions. For example, by the time *man nok* in the well-drained soils has produced a substantial tuber, perhaps in September, *man sang*, which is adapted to much wetter soils, may have begun to form its tubers.

Comparisons between wild and cultivated yams

Several varieties of yams were observed under cultivation in the Ban Chiang area, most often in house gardens. A few examples were regarded by the gardeners as transplanted wild types and these are not discussed here. Some varieties, however, were considered to be strictly propagated types.

The leaf morphology (shape and size) of most of the cultivated yam varieties (at least three) seen by the author was similar to wild *man hoerp*. The tubers of these cultivated yams were comparable in weight to specimens of *man hoerp* but differed in their morphology. Instead of a long, thin tuber reaching 1–2 m below the soil surface, the cultivated varieties form a thick, shallow tuber. Directly under the soil surface *man khao kam*, a relatively common variety, forms a lumpy, bag-like tuber with a purplish skin. A type called *man ngoo*, which means bending or turning tuber, has an elongated tuber which extends vertically for 20–30 cm and then turns to extend horizontally for another 40–50 cm. *Man kha chang*, or elephant-leg yam, forms a tuber with a broad part just under the surface which tapers to a narrower part at greater depths.

Our observations suggest that the tubers of all the cultivated varieties form at much shallower depths (usually less than 50 cm) than do the very deep tubers of the wild *man hoerp*, and their excavation therefore takes only 10–30 min (maximum) as opposed to over two hours for a comparable 2–4 kg wild sample.

Both wild and garden yams are propagated in the same manner. After excavation of the tuber, the lower, more recently formed part is cut off for consumption. The upper part, which is older, reputedly less flavourful, and which includes secondary roots, is left attached to the vine. This upper part is then reinterred. The soft, loose soil created by digging up the yams is reputed to encourage large yams to grow in the following year.

The yam which seems to be most commonly eaten is *man goy*, the toxic wild yam (*Dioscorea hispida*). Although it is easily excavated, it takes considerable effort and expertise to prepare the tuber for consumption, a process which involves peeling, slicing, and leaching. There are several recipes for leaching. One requires soaking the slices for three nights in salted water, followed by 2–3 days in fresh water, which is changed daily. This variety is apparently preferred because it keeps for days, whereas the other non-toxic varieties are only edible for a day or two. The slices of the *man goy* tuber can also be dried and stored for several months.

Conclusion

One of the major differences in exploiting wild rice and wild yams is in the importance of the timing of harvesting. In the case of wild rice this is critical because the ripe grains must be gathered during a relatively brief period of time, whereas yams can be harvested over a comparatively broad time-span. There is, presumably, some flexibility with regard to rice, in so far as different patches may ripen at slightly different times, but in the case of yam tubers the flexibility is much greater. For example *man goy* is often eaten before the end of the rainy season during August when water is easily obtained for the leaching process; and, in any case, viable tubers remain underground during the dry season and can be located over several months from the withered remnants of the vines. Their harvesting can therefore be spread over several months. It is important to note, therefore, that, although both rice and yams produce their starchy reserve at the end of the rainy season, the time of their harvesting (and consumption) do not necessarily conflict.

The field observations of rice and yams summarized in this chapter demonstrate how narrow is the dividing line between 'wild' and 'domestic' varieties, in terms both of their habitats and of the people's perceptions of them – a dividing line of which the prehistoric domesticators of these plants in Southeast Asia may initially have been unaware.

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10 *An example of intensive plant husbandry: the Kumeyaay of southern California*

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Introduction

During the early stages of agriculture, as recognized on the basis of botanical evidence, tool complexes did not differ materially from those of hunting–gathering societies (Meighan *et al.* 1958, pp. 131–50, Alexander 1969, pp. 123–9, Higgs & Jarman 1972, pp. 9–10). It is thought that before the cultural selection of genetically variable plants had led to their domestication, the social and economic structure necessary for food production had developed, modifying the relationships of humans to plants and land, and of person to person within society (Jarman 1972, p. 15). Processes leading to food production are not well understood and many theories are being tested (Harris 1969, 1977, Jones 1971, Struever 1971, Yarnell 1971). Most recent is the search for evidence of the change in human activity in regions other than early agricultural centres of complex civilizations, and also the examination of plant use among hunter–gatherer societies (Harris 1984).

The definition of agriculture is crucial to a discussion of the transition. Harris (1969, pp. 6–7) defined agriculture as manipulation of the natural ecosystem by substituting domesticated species for wild species in appropriate ecological niches. However, the original process began by substituting desired wild food-plants for those which did not produce food. Higgs & Jarman (1972) suggested the term 'plant husbandry' to distinguish production activity from simply collecting what nature produced. That is, plant husbandry is manipulating an ecosystem by substituting species desired by humans for food, medicine, and technology for unused species. This definition modifies the Harris definition by omitting the word 'domesticated', that is, omitting reference to the selection of plant genetic variability and emphasizing other changes in human economic activity.

This chapter describes plant-husbandry practices of the Kumeyaay (also known as Diegueño-Kamia, or Tipai-Ipai) of southern California. This American Indian nation occupied the region extending from coastal southern