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Evidence of Plant Cultivation in Jomon Japan: Some Implications

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Recently accumulated archaeological evidence from Jomon sites indicates that cultivation of plants other than cereal grains started very early in Japan, during the Early Jomon period, and that cereal grains were already under cultivation in the Late Jomon period. This suggests a long existence of knowledge about plant cultivation throughout the Jomon era, well before the introduction of wet rice agriculture in the Final Jomon period.

The Jomon economy was thus, in part, supported successively by cultivation of plants other than cereal grains, cereal grains themselves, and wet rice agriculture. The importance of cultivation activities in temporal as well as regional terms, however, still remains to be elucidated. [Incipient Agriculture, Agricultural Origins, Plant Cultivation, Prehistoric Subsistence, Jomon, Japan.]

INTRODUCTION

The natural vegetation distributions in the Japanese Islands are, from south to north, the subtropical forest zone, the evergreen broad-leaved (or luciphyllous) forest zone, the deciduous mixed forest zone, and the boreal forest zone. These forests are not uniform within their areas of distribution, but rather vary in response to local geomorphological features. As a consequence, both macro- and microecological zones in Japan are rather complex and varied, following river valley systems and mountain chains. These vegetation zones are significantly related to and influenced by ocean currents, with the warm current (the Kuroshio or Japanese current) and the cold current (the Oyashio or Okhotsk current) meeting off the Tohoku region, approximately the border between the evergreen broad-leaved and the deciduous mixed forest zones. Changes in vegetational distributions and climatic conditions in prehistoric times have been reconstructed on the basis of pollen analyses as well as macro-botanical identification [e.g., TSUKADA 1974; NAKAMURA 1952, 1967].

Jomon subsistence practices developed under these conditions. Hunting activities included land mammals, both migratory and non-migratory birds, and a limited number of sea mammals. Fishing activities were directed at salt water fish in various ecological niches as well as freshwater fish. Collecting activities secured not only terrestrial plant resources but also both salt and freshwater shellfish and seaweed.

These activities must have been carried out in response to the seasonal availability of resources and their distribution areas (micro-ecological zone); some form of scheduling must also have been at work.

In addition to these activities, the problem of farming or cultivation during the Jomon era (traditionally called the "Jomon farming hypothesis") has long been debated by scholars. In this paper, I will examine evidence of plant cultivation from Jomon sites, and will give some implications about farming activities during the Jomon period.

ESTABLISHMENT OF WET RICE AGRICULTURE

Anthropologists and historians in Japan commonly agree that the basic elements of contemporary Japanese culture were established as early as the Yayoi period; not only subsistence based on wet rice agriculture and its associated techniques, but also the language itself came into use as a complex at this time. Chinese historic documents indicate that a high level of sociopolitical organization, which may be termed chiefdom, also existed in western Japan. In short, all indications point to the Yayoi period as the time of formation of the historic Japanese culture [ISHIDA 1962; ONO 1962].

Some important problems, however, are still to be solved regarding the transition from the preceding Jomon era to the Yayoi period. One of them is the technological basis for wet rice agriculture, a main characteristic of the Japanese culture. Specifically, cultivated rice plants (*Oryza sativa* L. ssp. *japonica* Kato) as well as the techniques and tools necessary for rice cultivation were well-developed during the Yayoi period: selection of land for rice fields, building of rice fields, irrigation devices, reaping tools, and so forth. Since *Oryza sativa* L., a cultivated rice plant, is not native to Japan, the plant as well as the associated technology must have been introduced. Archaeologists in Japan, with the help of scientists in related fields, have been trying to elucidate the process of wet rice introduction. At present, the Lower Yangtze valley is presumed to be a region from which wet rice agriculture diffused. Three possible routes of introduction have been proposed, all of which originate in the Lower Yangtze valley. One route goes via Formosa, through the Ryukyu Islands, to the Pacific coast of Japan. This is the route proposed by the late Kunio Yanagita, a prominent Japanese folklorist [YANAGITA 1963]. The second route reaches northern Kyushu, after crossing the East China Sea, either directly or indirectly via the southern Korean Peninsula. The third route goes northward toward the Shantung Peninsula, crossing the Pohai Sea to arrive on the western coast of the Korean Peninsula and then eventually into northern Kyushu. Many Japanese archaeologists now regard the second or third route as the more likely.

Wet rice agriculture spread rapidly within Japan as soon as it was introduced. Archaeological evidence shows that wet rice cultivation reached the Tokai region in central Japan by the end of the Early Yayoi period, and the following Middle Yayoi period saw it spread further eastward and northward to the northern Tohoku region.

Rice did not, however, penetrate into Hokkaido, which has a different history of wet rice farming.

It is obvious, in light of these developments, that the seemingly rapid transition in subsistence basis to wet rice agriculture was a fundamental economic change, which occurred all over Japan (except Hokkaido) within a short period of time. If the transition is regarded as diffusion from the Asian continent, as has long been claimed, why and on what basis did it spread so rapidly? Was it a large-scale diffusion involving a number of migrations? Physical anthropological data indicate that only a small number of people may have migrated into western Japan at the time of wet rice introduction [KANASEKI 1966].

THE JOMON FARMING HYPOTHESES

Until recently, only a few archaeologists claimed that wet rice agriculture was brought into Japan during the Jomon era. The basis for such a claim is rice kernel impressions left on surfaces of pottery excavated from Jomon sites (and other indirect evidence).

Historically, four categories of explanations have been offered for the rapid acceptance or spread of wet rice agriculture during the Early Yayoi period. One explanation is concerned primarily with differences in subsistence activities between western and eastern Japan and the resulting delay in accepting wet rice cultivation [YAMANOUCHI 1964]; but the exact nature of subsistence bases both in eastern and western Japan still remains to be elucidated.

Another explanation assumes that some farming or cultivating activities during the preceding Jomon era were a prerequisite for the acceptance of wet rice. This explanation, the traditional "Jomon farming hypothesis," presumes that wet rice agriculture was introduced into a cultural context which already had some knowledge of, and technology for, agriculture.

This hypothesis has been repeatedly proposed by many archaeologists [e.g., FUJIMORI 1970]. The basis of this hypothesis varies from merely circumstantial evidence to more concrete data. A common underlying rationale is that many Jomon sites, particularly those settlements in the central highlands and those shellmounds in the Kanto region, are very large in size and sedentary in nature, suggesting a very large population size. To maintain this presumed large population it has been hypothesized that some forms of food production other than collecting, fishing, and hunting activities might have been necessary. Evidence used to establish the presence of farming activities remains, however, largely circumstantial: chipped stone tools, such as implements necessary for loosening the soil or processing harvested grains [TORII 1924; OYAMA 1927; SUMITA 1955; ESAKA 1968; KAGAWA 1967]; clay figurines and polished stone clubs thought to have been related to fertility cults or ceremonies in agricultural societies [FUJIMORI 1970; TSUBOI 1962]; the sedentary nature of the Jomon sites is another characteristic claimed as a prerequisite for an agricultural society [SAKAZUME 1957; FUJIMORI 1970]; exploitation of multi-

ecological zones or a complexity of subsistence activities has also been cited as a prerequisite for, or a proof of the existence of, agricultural activities themselves [FUJIMORI 1970; TSUBOI 1962]. All of this indirect evidence is, however, insufficient to prove the existence of farming activity, since all could be interpreted in other ways. There is, for example, the widely known case of native villages on the Northwest coast area of North America. The sedentary nature of settlements is not necessarily associated with farming activities at all (see SCHALK, this volume).

A third line of reasoning is strongly advocated by Nakao [1966, 1967] and Sasaki [1970]. On the basis of ethnobotanical and ethnological evidence, Nakao emphasizes that a farming pattern developed in the evergreen broad-leaved or luciphyllous forest zone in East Asia. Nakao maintains that this farming pattern is an outcome of influence from both the tropical and the deciduous forest zones, and he proposes a five-fold developmental scheme of subsistence activities in the luciphyllous forest zone of western Japan [NAKAO 1967: 369]. The first stage is characterized by collection of chestnuts, buckeyes, acorns and walnuts, as well as carbohydrate-rich wild roots, such as arrowroot, brackenroot, and the like. The second stage involves incipient cultivation, namely, the selection and improvement of edible plant species such as Japanese yam, chestnuts, etc. The third stage is represented by cultivation of root crops including taro, Chinese yam and devil's tongue; the slash-and-burn farming of these root crops (with a fallow period) is proposed. The fourth stage is considered to be characterized by cultivation of various species of millet, including barnyard millet, ragi and dry rice; Nakao suggests slash-and-burn farming during this stage. The major characteristic of the final stage is wet rice agriculture, associated with irrigation systems and permanent paddy fields.

Combining Nakao's scheme with field research on slash-and-burn agriculture, both in Japan and East and Southeast Asia, Sasaki strongly proposes a hypothesis that slash-and-burn farming without upland rice as a main crop must have been practiced prior to wet rice introduction [SASAKI 1970: 34-40].

This "luciphyllous forest hypothesis" has become increasingly popular recently, and the existence of slash-and-burn agriculture in Jomon contexts is today sometimes taken for granted. Two basic categories of concrete evidence must be obtained from Jomon sites to prove the existence of such slash-and-burn agriculture. One is the presence of plural cultigens which indicate some combinations of crops supposedly under cultivation, and the other is evidence that a rotation farming practice existed on a particular dry field, with a certain fallow period. Thus the existence of slash-and-burn farming activities is theoretically and practically viable if proper analytical methods are applied. But no such attempts have been undertaken, even by prominent proponents of this hypothesis. Under these circumstances, it must be concluded that there is no concrete archaeological evidence for the presence of slash-and-burn agriculture in the Jomon cultural context.

The search for concrete evidence of farming activities has, however, been carried out by another group of scholars. Professors Takashi Okazaki and Teijiro Mori have attempted to elucidate the processes of wet rice introduction in northern Kyushu

[MORI and OKAZAKI 1962; OKAZAKI 1968]. Starting from the Yayoi period, Mori and Okazaki, moving back in time to the Final Jomon period, successfully proved the presence of farming during the Final Jomon. Recently, the existence of rice paddies, with sticks for supporting levees and with pedologically characteristic sediments, including plant opals of motor cells of rice plants, has been revealed at the Itatsuke site in Fukuoka [YAMASAKI 1979; FUJIWARA 1979]. These ancient rice paddies yielded pottery specimens dating to the Final Jomon period. This evidence convinces us that wet rice agriculture was already being practiced at this site prior to the Yayoi period.

ARCHAEOLOGICAL EVIDENCE OF PLANT CULTIVATION IN THE JOMON ERA

The archaeological evidence for the existence of farming activities has been discussed by many scholars in various fields closely related to archaeology [e.g., RENFREW 1969; HELBAEK 1963; ALEXANDER 1969, among others]. The following categories of evidence seem to be sufficient to substantiate the presence of agriculture: (a) plant remains recovered as carbonized kernels, grains, stems, etc.; (b) grain or kernel impressions accidentally left on pottery surfaces; (c) silica skeletons or plant opals of Gramineae cultigens; and (d) pollen grains derived from the cultivated plants themselves. Since these four are mutually independent phenomena, any one of them could provide a good indication of the existence of plant cultivation.

Table 1 and Figure 1 summarize evidence of plant remains so far reported from Jomon sites, in terms of the above four categories of evidence. Recently, the number of such sites has increased considerably because of the flotation technique which retrieves small-scale plant remains from deposits in association with Jomon artifacts and features. Moreover, the Ministry of Education, Science and Culture has funded two long-term major projects on "Archaeology and Natural Science," producing a large quantity of new evidence. Unfortunately, until recently these plant remains were usually regarded as intrusive from more recent human occupations. The number of sites yielding such evidence is now simply too large to ignore, and it is totally inconceivable that such sites should yield intrusive remains so consistently all over Japan.

The number of cultivated plant remains seems rather small at present, and such sites are rather sporadic and restricted to western Japan. Table 1, however, suggests some interesting aspects of Jomon plant utilization. First of all, the practice of wet rice agriculture during the Final period is now firmly substantiated. This requires a revision of the traditional view that wet rice agriculture, and thus food production, was closely related only to the Yayoi period.

Several kinds of plants other than wet rice seem to have been under cultivation during the Jomon era: gourd or cucurbit, pea, bean, barley, and buckwheat. These cultigens are dry-land crops and the existence of dry-land farming before the introduction of wet rice agriculture must be seriously considered. Dry-land farming

Table 1. Jomon sites yielding cultivated plant remains.

Period	Name of Sites	Evidence	Reference
Early Jomon (5000 B.C.–3500 B.C.)			
	1 Hamanasuno	Buckwheat	Crawford <i>et al.</i> [1978]; Crawford [1979]
	2 Otsubo	Gourd	Kokawa [1978]
	4 Torihama	Gourd Red Bean	Kokawa [1978]; Nishida [1980]
Middle Jomon (3500 B.C.–2000 B.C.)			
	5 Ueno	Barley (?) Peach	Kokawa [1979]
	6 Tsurune	Barley or Wheat Pea	Kokawa [1978]
Late Jomon (2000 B.C.–1000 B.C.)			
	7 Sakurabora	Red Bean	Kokawa [1978]
	8 Kuwagaishimo	Red Bean Barley Rice	Nishida [1975]
	9 Katsurami	Red Bean	Kokawa [1978]
	10 Shika	Barley Red Bean Gourd	Fujiwara [1978]; Kokawa [1977]
	11 Wakudoishi	Rice	Mori and Okazaki [1962]
	13 Rokutanda	Rice	Nakamura [1971]
Final Jomon (1000 B.C.–300 B.C.)			
	3 Shimpukuji	Gourd	Kono [1953]
	12 Uenoharu	Rice Barley	Kotani [1972]
	14 Arami	Rice	Sato [1971]
	15 Nogoe	Rice	Harunari [1969]
	16 Itatsuke	Rice Gourd	Fujiwara [1979]; Yamasaki [1979]; Okazaki [1968]
	17 Kunden	Rice	Okazaki [1968]
	18 Haruyama	Rice	Mori and Okazaki [1962]
	19 Yamanotera	Rice	Mori and Okazaki [1962]
	20 Kureishibaru	Rice	Sato [1968, 1971]

does not necessarily mean slash-and-burn agriculture, however, as pointed out above. We must not confuse the practice of burning forests as a primary means for opening fields with the continuous practice of slash-and-burn agriculture based on a fallow system. The latter has yet to be proved (as indicated above).

IMPLICATIONS FOR AGRICULTURAL ORIGINS IN JAPAN

Middle Jomon sites throughout Japan have not yielded much evidence of crop



Fig. 1. Distribution of Jomon sites yielding evidence of plant cultivation.
(For explanation, see Table 1.)

farming, contrary to a long standing hypothesis. This seeming lack of evidence leads us to conclude that the Middle Jomon farming hypothesis cannot be substantiated on the basis of evidence now available.

In addition, we still lack remains of root crops in the Jomon cultural context, and also have no convincing evidence for the practice of shifting agriculture in the Jomon era. Since these two are the basis for the so-called luciphyllous forest hypothesis, the present archaeological record cannot support its validity.

Further, from the list of cultivated plant remains (Table 1), it can be said that cucurbits, red beans, and peas appeared first as plants under cultivation. Barley and rice were then cultivated. Considering site locations, it seems that rice of the Late Jomon period was a dryland type, although its true nature remains unknown. Wet rice was introduced during the Final Jomon period.

This evidence may suggest that the basic Japanese agricultural pattern, mainly characterized by wet rice, took some 3,000 to 4,000 years to become fully established after the initial appearance of cultivated plant remains; this is a rather long drawn-out process compared with Mesoamerica and elsewhere [WILLEY 1966: chapter 3; FLANNERY 1968].

The importance of food production at each time level is another subject so far unexplored by archaeologists. Most research has focused on the presence or absence of farming activities in a particular period, and analysis of the relative importance of each economic activity has never been attempted.

Koyama suggested that collecting activities in the mixed deciduous forest zone in eastern Japan were deeply related to estimated higher population sizes in eastern Japan during the Jomon era [KOYAMA 1978]. But the importance of each subsistence activity remains open to question.

It is impossible to quantify the importance of cultivating activities during the Jomon era on the basis of plant remains now available. It seems necessary to make a distinction between western and eastern Japan. As a first approximation, we can say that cucurbits, peas, and beans (which appeared earlier in Jomon periods) probably had only negligible significance in the total subsistence base; but their presence indicates clearly some knowledge of cultivation among the early Jomon people. The presence of barley and rice, which were under cultivation during the Late Jomon period, further suggests that farming became increasingly important as time passed. Wet rice agriculture probably provided a considerable portion of the total food supply, but its relative importance even during the Yayoi period is not fully understood.

In addition, the initial introduction of wet rice agriculture in Japan must be seriously examined against newly available palynological evidence, suggesting forest destruction and increases of Gramineae pollen around 2000 B. C. in northern Kyushu, and slightly later throughout western Japan [NAKAMURA 1971].

Finally, the distribution of known plant remains is restricted to western Japan, and there is little evidence of cultivated plants in eastern Japan, where the Jomon culture fully developed and survived later. This may indicate that wet rice agriculture was the initial mode of food production received in eastern Japan, and that the eastern Jomon culture had a different subsistence base than that of western Japan (as pottery typologies indicate). The nature of this apparent difference remains to be examined.

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