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Shifting Swamp Rice Cultivation with Broadcast Seeding in Insular Southeast Asia: A Survey of Its Distribution and the Natural and Social Factors Influencing Its Use

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Abstract

It has been argued that one of the characteristics of swamp rice cultivation practiced in the tropical rain forest climate of the lowlands of insular Southeast Asia is the transplanting of seedlings grown in nurseries to paddy fields. Such transplanting is carried out as a countermeasure to the problem of vigorous weed growth in tropical climates, but the author has reported in previous papers [Ichikawa 2000a; 2000b] that swamp rice cultivation in Nakat village located in the Bakong River basin, Sarawak, East Malaysia, is carried out by broadcast seeding. In this village, seeded fields were sometimes shifted to fallow grasslands and forests to solve the weed problem.

The objectives of this paper are to describe other examples of broadcast seeding in swamp rice cultivation, to examine the distribution of this practice, and correlate it with the natural and social characteristics of the areas where it is currently practiced or was formerly used.

Interviews in villages located in some large river basins in Sarawak revealed that, although transplanting is the principal planting method used, broadcast seeding is also practiced in some villages. It was also discovered that even in villages in which transplanting is the only method practiced today, broadcast seeding was practiced successfully up to from 10 to 60 years ago. Previous studies have reported a few cases of shifting swamp rice cultivation utilizing broadcast seeding in the Malay Peninsula, West Kalimantan and Sarawak. Such rice cultivation is observed not only in Nakat, but also in the above-mentioned areas, and was no doubt practiced more widely a few decades ago.

Among the various conditions to be satisfied in the areas where shifting swamp-rice-cultivation with broadcast seeding is practiced, the two main conditions are: existence of abundant fallows which can be converted easily to new paddy fields, and favorable water conditions, the areas concerned being naturally protected from sudden flooding, and not being prone to flooding in the seed broadcasting season. To meet these conditions, swamp rice fields where broadcast seeding is practiced need to be located in swamps on slightly elevated grounds, such as flood plains, low terraces and fans, such as in Nakat. Insular Southeast Asia with its tropical rain forest climate is characterized by vigorous growth of plants and low population density. It is under such conditions that broadcast seeding in swamp rice cultivation has been practiced over broad areas as an appropriate labor-saving method, weeds being countered by shifting planted/seeded fields to fallows where few weeds grow.

Keywords: swamp rice cultivation, broadcast seeding, transplanting, swidden agriculture, Iban, Sarawak, Borneo

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I　Introduction

In rice cultivation in Asia, different methods are observed in different areas in accordance with factors related to the natural environment and the spread of farming methods [Takaya 1978; 1987; Tanaka 1987; 1988; 1991; Hill 1977; Furukawa 1987].[1)] Among such methods, this paper is concerned with a type of rice cultivation termed "swamp rice cultivation" by Furukawa [1992: 158] and Takaya [1978: 28]. This type of rice cultivation is found mainly on the islands of Borneo and Sumatra, and the Malay Peninsula [Furukawa 1987]. It is practiced in coastal lowlands and swamps in the lower and middle reaches of rivers in areas boasting a tropical rain forest climate. The techniques used are well adapted to swamp environments [Fukui 1980: 725], consisting of the cutting and burning of sedges for land preparation, followed by the transplanting of seedlings and harvesting. Irrigation facilities and bunds are not as a rule constructed. The characteristics of the farming method are land preparation without tillage, and transplanting [Takaya 1978: 32].

In contrast to the above, I have reported in previous papers [Ichikawa 2000a; 2000b] that the basic method of swamp rice cultivation[2)] observed in an Iban village called Nakat located in the Bakong basin, Sarawak, is broadcast seeding. The main reason normally given for transplanting is that paddy can gain an advantage in competition with vigorous weeds [Takaya 1990: 60]. In the period of my fieldwork (1995–98) in Nakat, seedlings were transplanted to many paddy fields after land preparation without tillage, but broadcast seeding was also practiced in many other paddy fields [Ichikawa 2000a]. Broadcast seeding, a labor saving technique, becomes feasible in cases where villagers shift cultivation to fallows where few weeds grow. Almost all families practiced broadcast seeding in this village until the end of the 1970s [Ichikawa 2000b]. In this paper, I use the term "shifting swamp rice cultivation with broadcast seeding" to refer to this kind of rice cultivation.

Is shifting swamp rice cultivation with broadcast seeding practiced outside of Nakat? The objectives of this paper are to examine the distribution of such shifting swamp rice cultivation, and its natural and social characteristics in those areas.

The contents of this paper are as follows: section II: a review of previous studies to determine the distribution of swamp rice cultivation, and the reasons for transplanting; section III: explanation of the distribution of shifting swamp rice cultivation with broadcast seeding in Sarawak revealed through a field survey conducted after the

1) These studies classify paddy cultivation in Southeast Asia in accordance with farming methods and shape of rice fields.

2) In Nakat, a swamp paddy field is called "*umai paya*" in Iban. *Umai* means paddy field. *Paya* means swamp.

publication of my previous papers [Ichikawa 2000a; 2000b], and of the distribution of broadcast seeding in insular Southeast Asia through a review of previous studies; section IV: examination of the factors behind broadcast seeding in areas where it is practiced, through comparison with areas where transplanting is the norm; and finally, section V: a summary of this paper, emphasizing the fact that broadcast seeding is a swamp rice cultivation method which is well adapted to the natural and social environment in wide areas of insular Southeast Asia boasting a tropical rain forest climate.

II Reasons for Transplanting in Swamp Rice Cultivation

In this section, I shall first describe the distribution of swamp rice cultivation areas based on the previous studies, and then summarize the reasons why transplanting has been employed as a planting method.

1. *Distribution of Swamp Rice Cultivation Areas*

Fig. 1 shows the principal areas in which swamp rice cultivation is practiced, but rice cultivation practiced by just cutting grass for land preparation and transplanting has also been reported outside of the indicated areas in this figure. For example, it is observed in South Sulawesi in Indonesia [Furukawa 1982: 32; Tanaka 1982: 88], Krian, Selangor, Negri Sembilan, Province Wellesley, and a part of Kedah in the Malay Peninsula [Ooi 1963: 237],[3] and coastal plains of Mindanao in Philippines [Takaya 1990: 76], and could accordingly be considered to be widely practiced in coastal plains and swamps along rivers throughout insular Southeast Asia. It is also practiced in mainland Southeast Asia in areas where perennial grasses grow vigorously, such as the coastal swamps of the Mekong Delta [Kaida 1974: 149; Fukui 1974: 172], Chao Phraya Delta [Takaya 1982a: 249], Ayeyarwady Delta [Takaya 1990: 78]. Although areas of swamp rice cultivation have been decreasing due to the mechanization of agriculture and spread of paddy foundation construction [Takaya

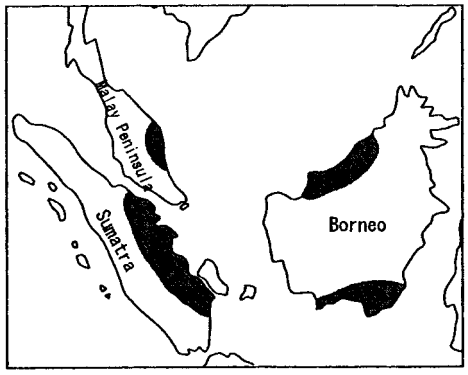

Fig. 1 Distribution of Swamp Rice Cultivation Areas
Source: [Takaya 1987: 55] (modified)

3) In the regions mentioned in Ooi's study, land preparation is practiced without tillage, solely by cutting grass. Ooi [1963] makes no mention of planting methods used in specific regions, but states that the method observed throughout is transplanting [*ibid.*: 238].

1978: 31], swamp rice cultivation has nevertheless been widely distributed until recent times on the mainland too.

Two other types of rice cultivation have been reported as similar to swamp rice cultivation, their methods of land preparation without tillage and transplanting being the same, but water use and shape of rice fields being different from that of the typical swamp rice cultivation mentioned in the introduction. The first type is wet rice cultivation with irrigation utilizing the difference between ebb and flow of tides [Takaya 1979: 460–462; Furukawa 1992: 187–188]. This kind of cultivation is observed in swamps on the east coast of Sumatra and the south coast of Borneo, where tidal differences are large. Irrigation systems are created by digging canals to connect rivers carrying abundant fresh water with peat swamplands. During high tide, the fresh water layer above the seawater is introduced to paddy fields, while during low tide, water is drained off. Land preparation for this type of paddy cultivation is done without tillage just by cutting grass [Takaya 1979], or by cutting sedge roots, rolling them up [Furukawa 1992], and then transplanting rice seedlings. This method is thought to have been established by combining traditional swamp rice cultivation with land reclamation in tidal zones through the digging of canals [*ibid.*]. The second type is rice cultivation practiced in Sumatra in inland swamps found along the middle reaches of rivers that overflow during the rainy season [Takaya 1979: 448–452; Furukawa 1992: 158–163]. At the beginning of dry season when the floods recede and land starts appearing, fields are prepared by cutting sedges and grass, followed by the transplanting of seedlings.

2. *Reasons for Transplanting and Land Preparation without Tillage*

Planting methods are related to land preparation methods. In this section, I summarize the natural conditions predicating land preparation without tillage, and explain the reasons for transplanting.

(1) *Land Preparation without Tillage on Wet Organic Soils*

In almost all areas where land preparation without tillage is practiced, sedges and grasses grow densely on wet organic soils. The reasons for land preparation without tillage have been explained as follows: firstly, tillage to break up the soil is not required because the swamp soil is always soft enough [Tanaka and Furukawa 1982: 37]; secondly, the soil is of such a nature that cattle or water buffalo would get bogged down and plows get caught by stumps and roots remaining in the soil without decomposing, making tilling a very difficult prospect [Takaya 1982a: 249; Hill 1977: 112; Poniman and Takaya 1988: 94]; thirdly, tillage using plows and hoes in swamps where dense root mats are formed is extremely hard physical labor [Tanaka 1987: 235]; and fourthly, according to Driessen and Suhardjo, deep tillage in organic soils generates an excess of nitrogen that causes production of empty grains [Fukui 1980: 714]. Land preparation without tillage is thus attributable not

to the absence of cattle or water buffalo[4] nor to backwardness of agricultural techniques, but rather to natural factors related to soils, rainfall and vegetation [*ibid*.].

According to my observations in Nakat, since swamp soils are always wet, tillage to break clods is not required, and tillage with plow and hoe would, as mentioned above, be inefficient work.

(2) *Reasons for Transplanting*[5]

Reasons for transplanting, as explained in the previous studies, can be summarized as follows. The main reason for transplanting is to counter weeds [Takaya 1990: 60]. Weeds compete with transplanted rice seedlings as they recover after being cut by parang, the rice winning by a narrow margin by the harvest season [*ibid*.]. In Nakat, where transplanting as well as broadcast seeding was observed in 1995, the villagers recognized that transplanted paddies have an advantage where competition with weeds and reliable growth is concerned [Ichikawa 2000a: 83].

The second reason for transplanting is to adapt to unstable water conditions. In regions where the above-mentioned rice cultivation is practiced at the beginning of dry season when floodwater is receding, unforeseen floods often occur in the transition period from rainy to dry season. As an adaptation to such water conditions, farmers practice multiple transplantation [Furukawa 1992: 158–162; Tanaka 1987: 248]. Rice nursery locations are shifted following the appearance of land as water levels recede. The number of transplants depends on the water conditions each year in each location. In the regions where tidally irrigated rice fields are observed, water flows in and out following daily ebb and flow of tides, and floods occur at the high tides after heavy rainfall. Transplanting represents an adaptation to these unstable water conditions [Furukawa 1992: 188]. The planting method is invariably also related to the depth of water covering the rice fields. Direct seeding could not be practiced in submerged rice fields, since seeds would suffocate, and as a result, the transplanting of seedlings is the only feasible method.

The third reason is related to soils and water quality. In areas where water is highly

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4) The Agriculture Department, Sarawak once tried to introduce cattle for wet paddy cultivation, but this attempt failed because local farmers did not accept them [Fukui 1980: 714].

5) In wet rice cultivation without tillage, methods other than transplanting and broadcast seeding have been reported [Poniman and Takaya 1988; Furukawa 1982: 31–32; Dove 1985: 189]. Seeds are dropped into holes made with a dibble in rather dry paddy fields located in slightly elevated locations. After sowing seed, water levels rise due to rain and the paddy fields take on the appearance of wet paddy fields. In the same areas, transplanting is also practiced in paddy fields located in lower areas [Poniman and Takaya 1988; Dove 1985]. The same method of sowing seed is seen in paddy fields just after being reclaimed. It is reported in Sulawesi that this method is practiced in paddy fields for two or three years after reclamation of swamp forests [Takaya 1982b: 111–112; Poniman and Takaya 1988: 41]. I observed the same method being used in Nakat too [Ichikawa 2002: 62].

saline or acid, direct seeding is not feasible because the seedlings tend to perish after germination, but transplanted seedlings are able to survive [Takaya 1982a: 78; Takaya, Fukui and Yamada 1978: 141]. In Nakat, the villagers explained to me that on sandy soil they practiced only transplanting, because if broadcast seeding is practiced there, rice growth after germination is poor.

The fourth reason is to counter crop damage by animals. In coastal swamps in Sumatra, direct seeding cannot be practiced because of damage by rats, and so seedlings that have grown to a certain size are transplanted there [Takaya 1979: 460]. The multiple transplanting mentioned earlier is an efficient way of circumventing damage by rats. For this purpose, the first nursery in particular is often prepared on a shelf or a raft in some areas [Furukawa 1992: 186; Tanaka 1987: 250; Takaya 1990: 77].

III　Shifting Swamp Rice Cultivation with Broadcast Seeding in Nakat and Its Distribution

In this section, I will firstly provide an outline of rice cultivation in Nakat (refer to Ichikawa [2000a; 2000b] for details), and then explain the distribution of this kind of rice cultivation as a result of my field and literature surveys.

1．*Outline of Swamp Rice Cultivation in Nakat*

In Nakat, swamp rice cultivation was observed from 1995 to 1999 in the location shown in Fig. 2. The swamps distributed along Bakong River have an average inclination of 0.7% toward the river.

Both transplanting and broadcast seeding were being practiced [Ichikawa 2000a]. If a rice field is flooded in the season of broadcast seeding, the farmers wait for a while, sowing seed after water recedes. They said that water would usually recede in a week or so. Ichikawa [*ibid*.] divided their methods of rice cultivation into two main categories, broadcasting type and transplantation type, and then, according to methods of land preparation, into a further six categories (Table 1). Among 38 households practicing swamp rice cultivation, 15 households fell into the broadcasting category, 18 into transplanting category, while the remaining 5 practiced both types [*ibid*.] Farmers selected method of cultivation based on their judgment of natural and economic conditions [*ibid*.]. They possess the ability to judge the likely amount of weeds in accordance with vegetation types. Economic factors include available labor of each household, projected income from selling paddy, cost of purchasing weed killers and so forth. In Nakat, rice nurseries had never been prepared until the end of the 1970s, and only broadcast seeding was practiced [Ichikawa 2000b].

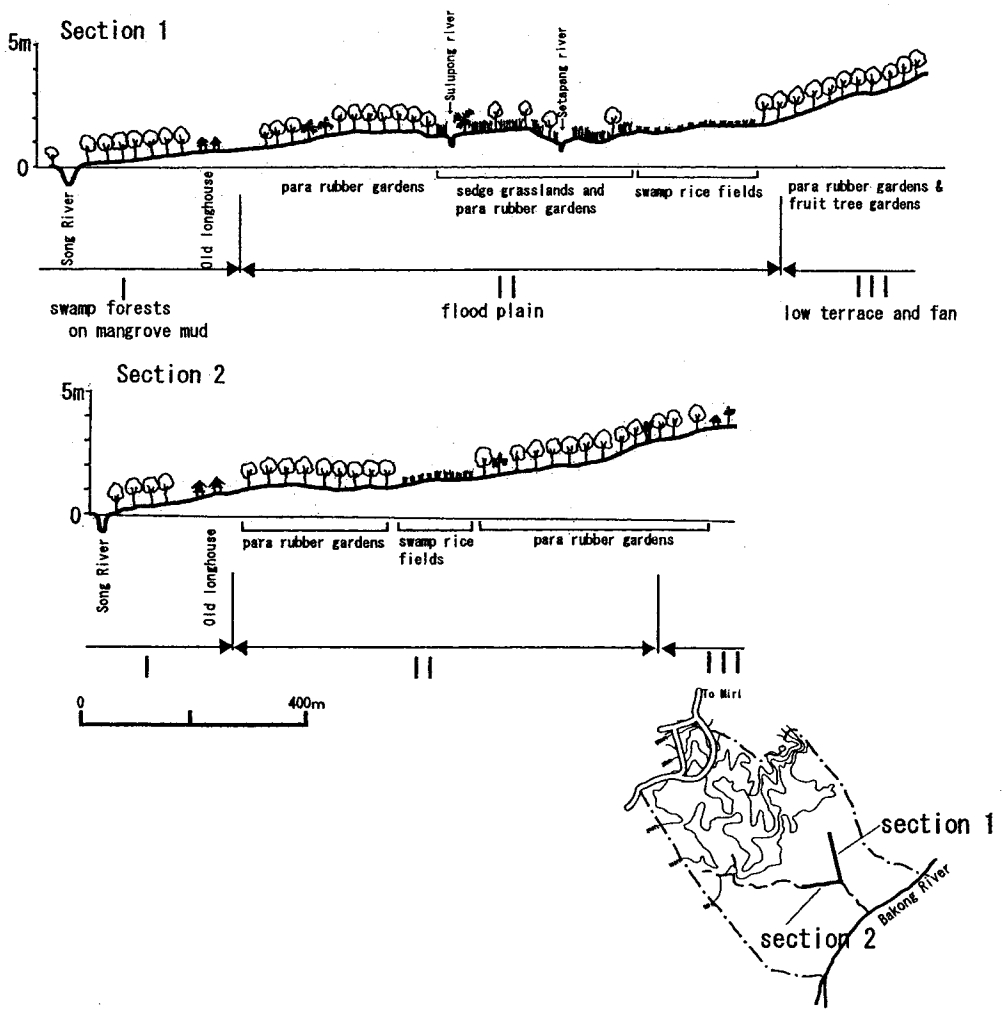

Fig. 2 Topography of Swamps along Bakong River in Nakat and Location of Swamp Rice Fields in 1995–99

Source: Field survey by the author

Notes: 1. A digital compass by which level and distance are measured is used for the field survey.
2. I, II and III in this figure are categorized by Professor Hisao Furukawa.
3. In Nakat, swamp rice fields were also opened in III before the 1980s (see Ichikawa [2000b]).

Table 1 Categories of Swamp Rice Cultivation Methods in Nakat

Categories			Working Process in Swamp Rice Cultivation						
Broadcast seeding	B 1	Slashing forests	Cutting vines and shrubs on forest floor	→slashing forest→	burning→broadcast seeding→weeding by parang→		adjustment of uneven density of young sprouts		→harvesting
	B 2	Land preparation by parang	Cutting grass by parang	→	burning→broadcast seeding→weeding by parang→		adjustment of uneven density of young sprouts		→harvesting
	B 3	Land preparation by parang/ replanting after broadcasting	Cutting grass by parang	→	burning→broadcast seeding→weeding by parang→		adjustment of uneven density of young sprouts/ replanting		→harvesting
Transplanting	T 1	Land preparation by parang	Cutting grass by parang	→	burning	→	weeding by parang→	transplanting	→harvesting
	T 2	Land preparation by parang and weed killers	Cutting grass by parang	→	burning	→	weeding by weed killers→	transplanting	→harvesting
	T 3	Land preparation by weed killers	Land preparation using weed killers	→	burning	→	weeding by weed killers→	transplanting	→harvesting

Source: [Ichikawa 2000a: 84]

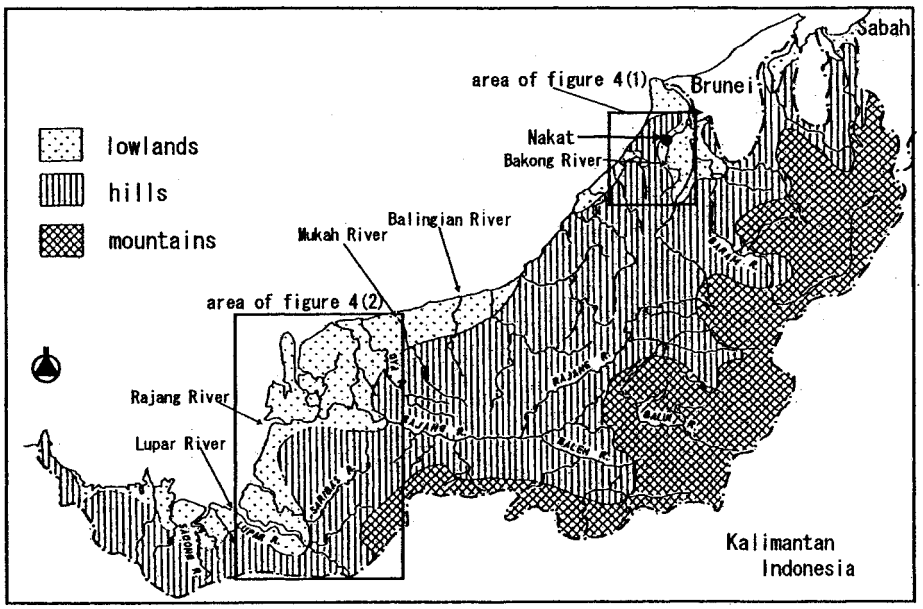

Fig. 3 Distribution of Lowlands in Sarawak
Source: [Lee 1970: 4] (modified)

2. *Distribution of Shifting Swamp Rice Cultivation with Broadcast Seeding*

(1) *Distribution in Sarawak*

Suitable areas for swamp rice cultivation in Sarawak are coastal lowlands and the lower and middle reaches of large rivers (Fig. 3). Almost all such areas are or were once occupied by peat swamp forests [Lee 1979]. I conducted an interview survey in order to study swamp rice cultivation methods in October and November, 2002,[6] in the area of Bakong, Lupar, and Rajang River basins and other basins located near these major basins. Almost all villages visited were Iban villages because the majority of people living in the lowlands of the above mentioned basins are Iban.

The methods of swamp rice cultivation used in the surveyed villages were considered to come under one of the types shown in the Table 1, although slight differences were found in some villages. Where broadcast seeding was at that time being practiced,

6) I conducted interviews with the village chief, if he was available, and several villagers. If the village chief was absent, I questioned villagers normally over 40 years old who had detailed knowledge of both present and past farming practices, spending about one hour in each village. I asked such villagers to provide me with a brief history of their village, number of villagers, village area, outline of livelihood activities, and swamp rice cultivation in the present and past. The interviews were conducted with the help of a Kayan assistant who could speak both Iban and Malay. Interviews were carried out in Iban in Iban villages, and in Malay in a Melanau village.

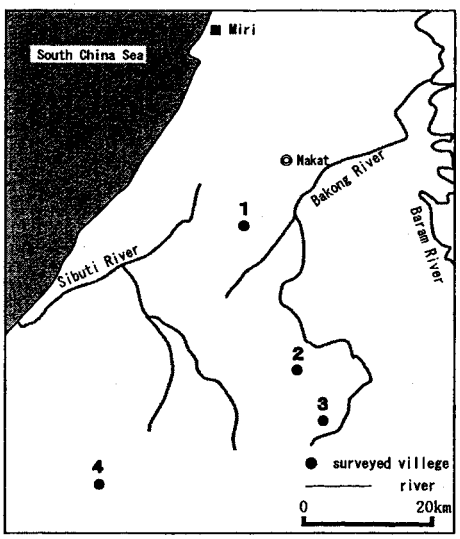

Fig. 4（1） Location of Surveyed Villages
Source: Fieldwork by the author in 2002

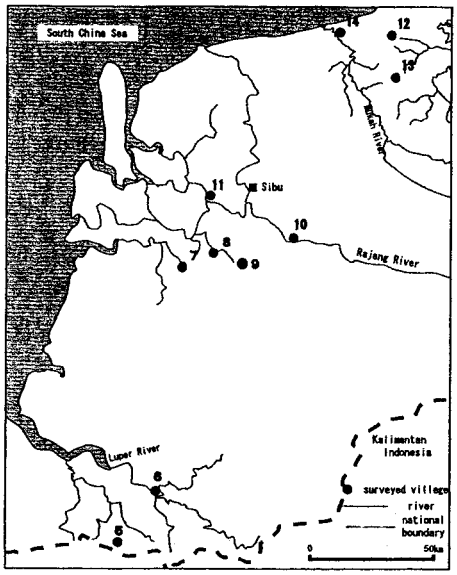

Fig. 4（2） Location of Surveyed Villages
Source: Fieldwork by the author in 2002

or had been in the past, the seeded fields were periodically shifted. In the same way that was done in Nakat, in the event that fields were flooded, farmers waited for a while for waters to recede before broadcast seeding. They said that they can normally use broadcast seeding after waiting for one week or so. Therefore, it is presumed that rice fields in the surveyed villages are usually located in topographically well-drained areas as in Nakat. The locations of villages surveyed are shown in Fig. 4, and a summary of interviews is shown in Table 2.

In the Bakong River basin, almost all of the villages are Iban. Many were established at the beginning of the 1900s, and only a rare few after World War II (1941–45). Broadcast seeding is practiced at present in one village. Even in villages in which only transplanting in more sedentary rice fields is practiced today, broadcasting seeding was apparently widely practiced until the 1980s. When I stayed in the Bakong River basin from 1995 to 1998 too, I heard that broadcast seeding was practiced at the time or had been in the past in a lot of Iban villages besides the villages surveyed in 2002.

Now let us look at the southwestern Sarawak. In the lowlands of the Rajang and Lupar River basins, almost all Iban villages were established before the eighteenth century[7] [Pringle 1970]. No villagers of the surveyed villages in these regions knew

7）It is thought that the Iban started migrating from the Kapuas River basin, West Kalimantan, to the Lupar River basin, Sarawak, in the mid-sixteenth century [Sandin 1967: 28; Pringle 1970: 39]. By the mid-eighteenth century, the Iban had occupied almost all↗

Table 2 Swamp Rice Cultivation in Several Major River Basins in Sarawak

No. of Village	Location (River Name)	Shifting Swamp Rice Cultivation with Broadcast Seeding Is/Was Practiced, or Not.			Information on Swamp Rice Cultivation
		At Present	In Past	Period When Broadcast Seeding Is/Was Practiced	
1	Bakong Riv.	Yes	Yes	Until present	Although today transplanting is mainly practiced, many farmers do broadcast seeding in fields opened in fallow forests and sedge grasslands. Until the 1970s, only broadcast seeding was practiced. The village was settled around 1900.
2	Bakong Riv.	No	Yes	Until the 1980s	In the early 1980s, although transplanting was observed, broadcast seeding was more commonly practiced. The village was settled around the early 1900s.
3	Bakong Riv.	No	Yes	Until the 1980s	In the early 1980s, although transplanting was done, broadcast seeding was more commonly practiced. The village was settled around the early 1900s.
4	A tributary of Niah Riv.	No	Yes	Until the 1980s	In the late 1980s, broadcast seeding was still commonly practiced. The village was settled around 1965.
5	A tributary of Lupar Riv.	Yes	Yes	Until present	At present, broadcast seeding is commonly practiced. In 2002, all households (8) in the longhouse carried out swamp rice cultivation, and 5 households practiced broadcast seeding in the fields opened in fallow forests. According to the villagers, broadcast seeding is done in only the first year after a new field opened. From the second year onward, transplanting is practiced.
6	Lupar Riv.	No	Yes	Until the 1960s	Today, only transplanting is practiced. The villagers recognize broadcast seeding as a method practiced in the past when rice fields were opened in forests. Today they can make permanent rice fields due to the availability of fertilizer. All farmers use weed killers for land preparation, and almost all of them use chemical fertilizers.
7	A tributary of Rajang Riv.	No	Yes	Until the 1960s	In the 1960s, broadcast seeding was practiced in rice fields opened in fallow forests. Seeded fields were shifted after soil fertility declined.
8	A tributary of Rajang Riv.	No	Yes	Until the 1940s	The informant, who was in his 60s, had never practiced broadcast seeding. He said that farmers of his father's generation had practiced it.

Table 2—Continued

No. of Village	Location (River Name)	Shifting Swamp Rice Cultivation with Broadcast Seeding Is/Was Practiced, or Not.			Information on Swamp Rice Cultivation
		At Present	In Past	Period When Broadcast Seeding Is/Was Practiced	
9	A tributary of Rajang Riv.	No	Yes	Until the 1970s	In the 1970s, almost all farmers grew paddy for 3 years continuously in the same field, and then opened a new rice field opening fallow forests. In the first year, broadcast seeding was practiced, while in second and third year transplanting was done. Reasons for the shift of seeded field are high soil fertility in fallow lands.
10	Rajang Riv.	No	Yes	Until the mid-1970s	In the 1970s, although transplanting was observed, broadcast seeding was more commonly practiced. Broadcast seeding was practiced until the second year after a new rice field was opened in fallow forests. The villagers said that there are fertile soils and few weeds in fallow forests.
11	A tributary of Rajang Riv.	No	Yes	Until the 1940s	During the World War Second when the villagers temporally ran away from the Japanese troops, they opened forests to make swamp rice fields and did broadcast seeding there. After the War, when use of fertilizer had still not spread, rice fields were shifted every 1 to 3 years. They practiced transplanting there.
12	A tributary of Balingian Riv.	No	Yes	Until the 1980s	In the early 1980s, although transplanting was practiced, broadcast seeding was more common. Seeded fields were shifted every year. The village was settled in the 1930s. The longhouse was reconstructed on the roadside in 1980.
13	A tributary of Balingian Riv.	No	Yes	Until the 1980s	In the late 1980s, transplanting was more commonly practiced than broadcast seeding. In the 1970s, only broadcast seeding was done. In these 10 years, fertilizer has been commonly used, and planted fields have not been shifted. The village was settled in the 1930s.
14	A tributary of Mukah Riv.	No	Yes	Until the 1960s	Until the 1960s, almost all of households practiced swamp rice cultivation, but after that it was discontinued. In recent years, a few households have started it again. In the 1960s, although transplanting was the norm, broadcast seeding was also practiced.

Source: Fieldwork by the author in 2002

Notes: 1. Only No. 14 is a Melanau village, the others being Iban villages.
2. The villages without description on the period of settlement already have a long history of at least 5 generations. In such villages, nobody knew the year of settlement or how many generations had already passed.

when their villages had been established, or how many generations had already passed since settlement. Settlement period was anyway much earlier than that of the Iban villages in the Bakong River basin. There is one village in which broadcast seeding is still practiced. In the other villages, only transplanting is practiced today, but broadcast seeding was practiced in the past. I heard that, unlike villages of the Bakong River basin, broadcast seeding was abandoned before the 1980s, and it would appear that the shift from broadcast seeding to transplanting in more sedentary rice fields occurred from the 1940s to the 1970s. In this region, the reasons given by the villagers for the shift of broadcast seeded/transplanted fields to fallow lands were sometimes different from those in Nakat. While the low level of weeds in fallow lands was given as the main reason in Nakat, here the villagers insisted that soil fertility was higher. The villagers explained to me that today, the availability of chemical fertilizers and weed killers enables them to practice more sedentary rice cultivation.

In the Balingian River basin, there are two villages estimated to have been settled in the 1930s. Shifting swamp rice cultivation with broadcast seeding was widely practiced there until the 1980s. After road construction, the longhouses were moved to the roadside where few swamps exist, and villagers started to practice a more sedentary form of rice cultivation with transplanting. This is similar to the changes that occurred in Nakat [Ichikawa 2000b].

Padoch [1982: 70] suggests that transplanting as well as broadcast seeding is practiced in an Iban village located in the upper stream of Sadong River where primary forests still remain [① in the Fig. 5]. In swamp rice cultivation there, a three-year fallow period is taken after three years of successive cultivation.

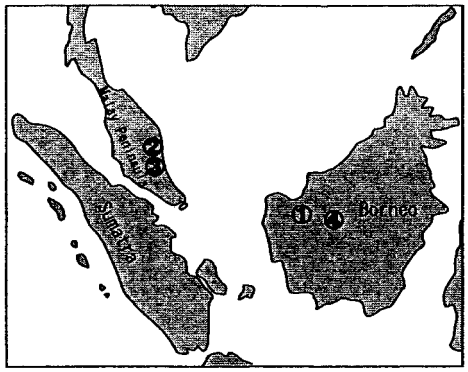

Fig. 5 Location of Shifting Swamp Rice Cultivation Areas with Broadcast Seeding Reported in the Earlier Studies

Source: [Padoch 1982: 70; Malaysia, Economics Branch of Dept. of Agr. 1939: 57, 162; Dove 1985: 189–191]

Note: The numbers in this figure correspond to the numbers in the text.

Two points became obvious as a result of the interview survey. Firstly, swamp rice cultivation is a sustainable agricultural system in Sarawak. According to Takaya's opinion [1987: 71], swamp rice cultivation is a form of transitional agriculture in reclaimed areas. After some

↘ basins of Sri Aman division, and further expanded their area of settlement towards the Rajang River basin. After that, their settlement was influenced by the Brooke administration. The Iban areas expanded following the expansion of Sarawak's territories [Pringle 1970].

years have passed there, plow and hoe would be utilized as rice cultivation becomes sedentary [*ibid.*]. However, even in regions where the Iban had been settled much longer than in the Bakong River basin, swamp rice cultivation without tillage was still practiced. This is because this cultivation method is suited to the natural conditions in Sarawak, as already explained in II. 2. Secondly, although transplanting is mainly practiced today, shifting swamp rice cultivation with broadcast seeding is practiced in a few villages and was widely practiced in all surveyed villages up to from 10 years to a few decades ago.

(2) *Shifting Swamp Rice Cultivation with Broadcast Seeding in Other Areas outside Sarawak*

With regard to shifting swamp rice cultivation with broadcast seeding observed in other areas outside Sarawak, I summarize reports from previous studies below (numbers correspond to those in Fig. 5).

In the lower reaches of the Pahang River (②) in the Malay Peninsula, an undeveloped and low population density area [Ho 1967: 34] where more primitive forms of agriculture are observed than in other regions, two ways of broadcast seeding rice cultivation are reported [*ibid.*: 57]. One, called *paya tabor*, involves land preparation by cutting grass, followed by the broadcasting of seeds soaked in water for about two nights beforehand. The other, called *pady simbah*, involves land preparation by cutting forests and burning cut trees, followed by the broadcasting of seeds soaked in water. In *pady simbah*, after two or three years of successive plantings, the land is abandoned and new areas are acquired for the same purpose. Though a rather old example, gleaned from an 1891 official report from Kuantan district (③) in the Malay Peninsula, *pady tabor* broadcast seeding was practiced there [Hill 1977: 162]. After sowing of seed, the same kind of adjustment of uneven density of young paddy sprouts [*ibid.*] observed also in Nakat [Ichikawa 2000a] was carried out through thinning them where seed had fallen too thickly and replanting the pulled seedlings in less densely growing patches.

In the middle reaches of the Kapuas River basin, West Kalimantan, Indonesia, both direct seeding and transplanting have been observed in Kantu'[8] swamp rice cultivation [Dove 1985: 189–191]. There are three methods of direct seeding depending on water conditions. Firstly, in rice fields flooded only after rain, seeds are dropped into holes made by dibbling. Secondly, where fields are flooded permanently up to ankle depth, seeds are broadcast. Thirdly, where fields are always flooded to more than ankle depth, clumps of seeds are put on the field. There is however no guarantee with this third method that seeds will succeed in sprouting. Among these methods, the second is considered to be similar to broadcast seeding observed in Nakat. According to my observations in Nakat, however, while the rice fields seeded by broadcasting were

8) Kantu' is linguistically considered as one of the Ibanic groups [Dove 1985].

invariably fairly wet, with puddles here and there, they were not totally flooded. Kantu' plant the same field for one to two years successively, and then abandon it for two to three years [*ibid*.: 83]. According to Seavoy [1973: 222], broadcast seeding is a common method in shifting swamp rice cultivation along riversides[9] in West Kalimantan, and adjustment of uneven density of young paddy sprouts is also reported.

IV Natural and Social Characteristics of Areas Where Shifting Swamp Rice Cultivation with Broadcast Seeding Is Practiced

Broadcast seeding in swamp rice cultivation, as explained above, was extensively and commonly practiced a few decades ago, especially in Iban villages in Sarawak. It is also practiced in Kalimantan and the Malay Peninsula, although few previous studies reported it. In this section, the backgrounds of both transplanting and broadcast seeding areas are examined. Firstly, characteristics of broadcast seeding and shifting seeded fields in Southeast Asia, and secondly, natural and social characteristics of areas where shifting swamp rice cultivation with broadcast seeding is observed are summarized.

1. *Characteristics of Broadcast Seeding and Shifting Seeded Fields*

(1) *Advantages and Disadvantages of Broadcast Seeding*

The advantages of broadcast seeding are that broadcast seed endures dryness and the practice saves labor. A major disadvantage, however, is vulnerability to fierce competition with weeds [Kurosawa 1994].

In Southeast Asia as a whole, broadcast seeding is frequently observed in rain-fed paddy fields in the plains of northeastern and central Thailand, and Cambodia where the dry season is distinctive [Takaya 1985: 72–80]. It is also practiced in the deltas of the Chao Phraya and Mekong Rivers [Takaya 1982a: 35; Fukui 1975; Kaida 1974: 146]. In those areas, broadcast seeding is an adaptation to the water conditions, such as severe dryness in dry season and deep flooding in rainy season. Broadcast seeding as such an adaptive method is observed as far as Kelantan in the Malay Peninsula [Takaya, Fukui and Yamada 1978: 138].

In lower latitudes of Insular Southeast Asia where the dry season is short, broadcast seeding is less common. This is because adaptation to dryness is not required in the rainy climate, and transplanting becomes dominant in order to adapt to unstable water conditions and to counter weeds, as explained above. However, broadcast seeding is practiced in areas where methods to control weeds exist. For example, broadcast seeding after hoof tillage is reported in South Sulawesi [Tanaka 1991: 343], Tana Toraja in South Sulawesi [Tanaka and Furukawa 1982: 32] and West Timor [Poniman and Takaya 1988:

9) The detail locations where the rice cultivation is observed are not indicated in his paper.

133–159].[10] Hoof tillage is a method whereby a large number of cattle or water buffalo are driven onto land that has been flooded, and herded round and round, thus trampling in the weeds and churning the ground into a mire. Broadcast seeding after plow tillage is also reported on alluvial plains along the Pahang River in the Malay Peninsula [Cant 1964: 13].

（2） *Areas Where Shifting Swamp Rice Cultivation Is Observed*

Shifting agriculture with fallows is generally found in tropical regions in cultivation on the slopes of mountains and hills. In Southeast Asia, however, several cases of shifting wet rice cultivation are reported, although planting and seeding methods are not always mentioned. In swamp rice cultivation without tillage in insular Southeast Asia, planted fields are sometimes left to fallow because, after growing paddy for several successive years, the weed type changes from perennial to annual grasses whose recovery is faster [Takaya 1987: 71]. In the transplanting type of rice cultivation in coastal lowlands of the lower reaches of the Komering River, planted fields are sometimes shifted in order to counter weeds and prevent damage by rats [Takaya 1979: 457–458, 463]. Near Mukomuko on the west coast of Sumatra, rice fields where seeds are dropped into holes made by dibbling are abandoned after three successive years' planting [Poniman and Takaya 1988: 80–81]. Ghee reported that in swamps in the lower reaches of the Pahang River in the later half of nineteenth century, planted fields located in slightly elevated areas are left to fallow after three to five year successive planting, and the fallow period also lasts three to five years [Takaya, Fukui and Yamada 1978: 327]. In the Malay Peninsula, shifting transplanted rice fields were observed in Kedah (with grass fallow) [Hill 1977: 61–62], and in coastal swamps in Selangor (with forest fallow) [*ibid*.: 153].

More cases of shifting transplanted fields have been reported in Sarawak than in other areas. Fukui [1980: 712] points out transplanting and fallow as characteristics of swamp rice cultivation in Sarawak. In swamp rice cultivation of the Iban, successive planting of more than two or three years is not practiced, and the fallow period is shorter than that of shifting cultivation in uplands [Pringle 1970: 26]. In swamp rice cultivation of the Iban living in the Rajang delta, two successive years of cultivation with transplanting, followed by seven years of fallow are observed [Sutlive 1972: 216]. Shifting swamp rice cultivation is practiced not only by the Iban, but also by the Melanau [Morris 1991: 90] and Bidayuh [Geddes 1954: 64], who practice transplanting. The same method is also reported in coastal areas [Seavoy 1973: 218] and inland swamps [Dove 1985: 83] located in West Kalimantan which is adjacent to Sarawak. The reasons given for the abundance of shifting transplanted field cultivation reported in Sarawak and its surroundings are that there are abundant lands to shift into due to the low population density, and the fallow

10）Broadcast seeding after hoof tillage is also observed outside Southeast Asia, in countries such as Sri Lanka [Tanaka 1991: 367] and Madagascar [Furukawa 1991: 297–298].

system is taken to counter weeds [Kyoto University Team 1978: 38–39].

2. *Conditions for Shifting Swamp Rice Cultivation with Broadcast Seeding*

In this sub-section, I examine the reasons behind the practice of broadcast seeding in swamp rice cultivation through comparing the natural and social conditions of both transplanting areas, and Nakat and other villages where broadcast seeding is practiced. If there are no pressing reasons to practice transplanting, broadcast seeding ought to be the norm because of its labor saving merits. However, as already explained, transplanting is practiced to counter weeds and prevent damage by animals, and as an adaptation to unstable water and soil conditions. The natural and social conditions of Nakat and other villages where broadcast seeding is practiced are examined with respect to such factors.[11)]

(1) *Countering Weeds: Social Backgrounds for Shifting Seeded Fields*

In Nakat, the problem of weeds was resolved basically by shifting transplanted or broadcast seeded fields to fallow where few weeds exist. The vigorous growth of plants in a tropical rain forest climate is utilized for weed control. A factor favoring the continuation of shifting agriculture was the existence of substantial amounts of lands where new rice fields could be opened. It is generally considered that, if the population density is low enough, there will be sufficient land for this type of agriculture. In this respect, the population density of Nakat is 12 persons/km^2, relatively low. The average population density of Sarawak is 13, and that of Miri division where Nakat is located is 9. It is 17 in Sri Aman division where the Lupar River is located, and 20 in Sibu division where the Rajang River flows [Malaysia, Dept. of Statistics 1997]. In the regions where shifting swamp rice cultivation with broadcast seeding has been reported in the previous studies (see III. 2. (2)), the population density of Kantu' areas in the middle reaches of the Kapuas River is 12 persons/km^2 [Dove 1985]. In the upper reaches of the Sadong River in Sarawak, population density was thought to be low because there were still unexplored primary forests there [Padoch 1982]. Insular Southeast Asia excluding Java is basically a low population density area [Tsubouchi 1986: 9].

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11) Regarding rice cultivation types and distribution of applied techniques, their spread is one of subjects requiring examination. The spread of swamp rice cultivation has been examined by Tanaka [1991], Takaya [1990] and Furukawa [1992]. Their papers include discussion on the relationship between swamp rice cultivation and a similar type of rice cultivation observed in southern China in the Han period that involves prior burning followed by weeding with water. The possible origins of swamp rice cultivation are also discussed. According to Tanaka [1991], rice cultivation originally spread from the lower reaches of Yangtze River toward lower latitudes, and remained as swamp rice cultivation only in Insular Southeast Asia. This is a fascinating subject, but I am not yet sufficiently qualified to discuss it here. I intend to conduct further study on this theme.

The government land tenure system is thought to be another factor contributing to the maintenance of low population density in Sarawak. According to the 1958 Land Code, Sarawak's land is divided into five categories. Mixed Zone Land, about 8% of the territory of Sarawak [Zainie 1985: 15], is the only category of land that Chinese people, who have the most economic power, can own, while they account for 27% (440,000) of Sarawak's total population. Indigenous peoples like the Iban can use large amount of land, because they are allowed to hold lands under native customary rights.

Iban customs that permit the borrowing of lands for rice cultivation without charge are another factor. Under such customs, even those who have little land can find fallows to open new rice fields.[12)]

The labor force is another factor promoting broadcast seeding. In Nakat, swamp rice cultivation was practiced with a small labor force [Ichikawa 2000a], because the population of the village was small, and moreover, the villagers did not always choose rice cultivation as their main economic activity [Ichikawa 2003b]. Because of the small labor force available for swamp rice cultivation, broadcast seeding may be practiced as a labor saving method.

On the other hand, in rice cultivation using tidal irrigation on the east coast of Sumatra, it seems that shifting of planting fields may be difficult because rice fields can be opened only in limited areas designated for reclamation by immigrants. In the middle reaches of the Komering River, where swamp rice cultivation is carried out as floods recede, the population density is 125 persons/km^2, fairly high [Poniman and Takaya 1988: 114–115], and the people living there face an insufficiency of land [*ibid.*]. In Insular Southeast Asia in general, the population has been gradually increasing [Tsubouchi 1986: 3]. A more sedentary style of life is also gaining ground with the introduction of cultivation of Para rubber and pepper [Sutlive 1992: 128], and establishment of longhouses near roads. The frequent shifting of planted/seeded fields may have decreased as a result of these socio-economical conditions. In Nakat too, transplanting rice cultivation in more sedentary fields near the longhouses has recently become popular, because the villagers want to spend more time producing commodities in their longhouse from which access to Miri is easy [Ichikawa 2000b].

(2) *Water and Soil Conditions, and Damage by Animals*

According to Furukawa [1992: 2], lowlands distributed in the middle and lower reaches of rivers in Sumatra and Borneo are divided into two areas. The first is coastal swamp where ebb and flow are observed everyday; and the other is inland swamp that is flooded for long period in the rainy season because it is far from the coast and drainage is not

12) The custom of borrowing lands is reported by Padoch [1982] and Freeman [1955]. In Nakat, there were villagers who borrowed lands and practiced swamp rice cultivation in the period of my fieldwork (1955–96).

good. Although the soils in the both areas are generally poor, exceptions are the fertile soils found in tidal flats where mangrove was established before, and those of riverside swamps where flood waters bring new soil [*ibid*.: 33].

Nakat is located in the riverside of the Bakong River. For swamp rice cultivation, no significant fluctuation of water level due to tides is observed there, but the river sometimes overflows after heavy rain and rice growth is affected on occasion. However, such inundations do not last long. These conditions differ from the already mentioned cases in the middle reaches of rivers in Sumatra,[13] where the difference in water level between dry and rainy season reaches 6–10 m, with back swamps being flooded during the whole of the rainy season, and also differ from areas where rice fields are so wet that cut grass cannot be burnt and is accordingly gathered by hand and disposed [Takaya 1978: 30]. In Nakat, the villagers said that cut grass is always burnt, and in the period of my fieldwork from 1995 to 1998, I too confirmed burning of cut grass in all swamp rice fields. Tidal influence is small in Miri division where the Bakong River flows [Kyoto University Team 1978: 16–17], and because the rivers in Sarawak are relatively short, flooded water recedes rapidly [*ibid*.: 24–25]. When floods occur in Nakat, the villagers practice broadcast seeding after waiting for one week or so for waters to recede. Frequently flooded areas within 300 m of the banks of the Bakong River near the village have never been utilized so far for swamp rice cultivation (see Ichikawa [2000b]), but the villagers recognized that soils of swamps along the rivers are fertile because of the new soil brought by flood water. Indeed, swamp rice fields in Nakat are prepared in swamps where soil fertility is maintained by flooding, but rice plants are not frequently and severely affected by floods, due to the fact that, as shown in Fig. 2, they are located on slightly elevated flood plains or low terraces and fans.

In Nakat, damage to rice plants by animals such as sparrows, monkeys, wild boars and deer was frequently observed and reported, but such damage was not as serious as that caused by rats in Sumatra [Takaya 1979: 460].[14] In broadcast seeding in Nakat, the most serious problem is the plundering of scattered seed by sparrows. Before the 1970s when broadcast seeding was done in all swamp rice fields (see Ichikawa [2000b]), farmers of Nakat and neighboring villages coordinated with each other to arrange for the same-day sowing of seed in order to prevent concentrated losses in specific fields.

(3) *Ethnic Characteristics*

Tanaka [1982] makes the point with the case of a settlement in South Sulawesi that

13) In Sumatra, long and narrow valleys have developed along fracture lines created in the main direction of lateral slip. In the rainy season, the water level of rivers rises dramatically because precipitation collects in these narrow river basins [Furukawa 1992: 6].

14) In Nakat, damage by rats to paddy stored in bins was considered to be a problem, but damage to broadcast seed and ripe paddy by rats was neither observed nor heard of there.

development patterns of wet rice fields differ according to ethnic group. For example, the Bugis have a tendency to engage in cultivation of cash crops, although they also grow wet paddy, while the Toraja put a great deal of time and efforts into paddy field establishment. After exploitation of swamp forests, they put a lot of labor into leveling fields and making bunds, finally establishing wet paddy fields where plow tillage can be practiced [*ibid*.: 77]. As for the Iban, they tend to change their economic activities according to the economic conditions of their surroundings [Sutlive 1992: 111; Cramb 1988]. The case of Nakat indicates that rice cultivation is not necessarily their main occupation [Ichikawa 2003b]. Previous studies have sometimes pointed out the highly migratory nature of the Iban [Morgan 1968: 144; Kedit 1993; Pringle 1970]. These migrations include movements of long distance between different river basins as well as of short distance within the same village, such as the changing of a longhouse site in Nakat [Ichikawa 2003a]. Anyway, the more frequently they migrate from one place to another, the more opportunities there are for rice fields to be newly opened in forests and fallows. People living in swamps in insular Southeast Asia are skilled at utilizing vigorously growing vegetation there [Furukawa 1992], and Furukawa concluded that their land use is transitory rather than sedentary in nature [*ibid*.].

V　Distribution of Shifting Swamp Rice Cultivation with Broadcast Seeding and the Conditions under Which It Occurs: Concluding Remarks

Through the analysis presented in this paper, several points on the distribution of shifting swamp rice cultivation with broadcast seeding and its background have become clear. Firstly, a review of previous studies and documents reveals that in the past 100 years or so, swamp rice cultivation has been observed in wider areas, beyond those indicated in Fig. 1, including deltas in mainland Southeast Asia. Secondly, in those areas, shifting swamp rice cultivation with broadcast seeding has in the past been widely practiced in some areas where several natural and social conditions are satisfied, and continues to be practiced, though not so widely, to the present day. Within Sarawak, this kind of rice cultivation is, or was up to from 10 to a few decades ago practiced in all surveyed villages over an extensive area that includes several major river basins.

The conditions to be satisfied are water conditions that make broadcast seeding possible, and social conditions that make shifting of fields possible. Where water conditions are concerned, swamp rice fields should be located on swamps on low terraces or fans which are not covered by flood water for extended periods in the season of broadcast seeding. In swamps near coasts where the ebb and flow of tides is observed everyday, broadcast seeds are unable to become established. The social conditions for the areas where shift of seeded fields is feasible are areas of low population density that offer plenty of fallow land to create or recreate rice fields. Ethnic characteristics, such as

relatively loose attachment to specific land and to work in certain occupations, also bear a relation. Also, in the case of Sarawak, land regulations that guarantee native use of large areas, and Iban customs regarding the borrowing of lands, make it easy for farmers to acquire lands for swamp rice cultivation. Suitable areas for broadcast seeding, where the above-mentioned conditions are met, exist quite extensively in Insular Southeast Asia. The above-mentioned conditions are, however, basic conditions, and as the case of Nakat shows [Ichikawa 2000a; 2000b], whether transplanting or broadcast seeding is chosen depends also on labor conditions and the economic strategy of each household.

Recently more sedentary agriculture is becoming the norm in Insular Southeast Asia, in response to changing socio-economic conditions, as mentioned in section IV. 2. Increased use of fertilizers and weed killers enables farmers to plant continuously in permanent swamp rice fields. As a result, as observed in Nakat, swamp rice cultivation with transplanting, a method that enables cultivation in fields near the longhouse, has become popular. However, Insular Southeast Asia with its tropical rain forest climate is originally an area characterized by vigorous growth of plants and low population density. People living there are skilled in utilizing its nature with minimum labor, and their land use has tended to be transitory in nature. Under such natural, social and cultural conditions, broadcast seeding, a labor saving method that utilizes vigorous plant growth to counter weeds, has been practiced as the principal method of swamp rice cultivation in swamps on slightly elevated flood plains, low terraces and fans in Insular Southeast Asia.

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