THE TRANSITION TO CONTINUOUS RICE CULTIVATION
IN KALIMANTAN*

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ABSTRACT. Population pressure induces Dyaks and Malay subsistence cultivators on the island of Kalimantan (Borneo) in Indonesia to make the transition from shifting to continuous wet cultivation of rice (sawah). The techniques used for continuous cultivation of rice are adapted from those used in wet shifting cultivation.

KEY WORDS: Dyaks, Indonesia, Kalimantan-Borneo, Population pressure, Shifting cultivation.

SHIFTING agriculture requires a minimum input of labor to achieve subsistence once the virgin forest has been cleared, but it requires an abundance of land. Population pressure associated with an increase in population may force a change to more intensive cultivation. The transition to continuous cultivation does not force the people to change their social values or institutions as long as subsistence remains their desired social goal. Slight annual increase in labor input from a continually growing labor force can usually produce an acceptable level of subsistence, until the land has reached its maximum agricultural utilization. Many stages in this transition were seen in Kalimantan (Borneo), but they were still a very long way from the intensive agriculture practiced in most districts in Java and Bali.

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and burned in these swamps is mostly a tall sedge.

DRY SHIFTING CULTIVATION

Dry shifting agriculture (ladang) requires each household to cut down the trees on approximately two hectares of land each year. Arduous labor is required if virgin forest is cleared, and it is done by the men, but mature trees are never allowed to grow again. Second growth forest is preferred for slashing because it is much easier to cut. If the land has been out of agricultural production for eight years or less almost all of the trees can be felled with a large bush knife (parang). The first trees cut are saplings and bamboo, which form a ground mat of combustible material when they dry. The trees at the edges of a dry field are felled inward so that fire will not spread into the surrounding second growth vegetation, which may be cut for next year’s rice field. A belt of trees is usually left as a fire guard where the edge of a new field borders a recently abandoned ladang (Fig. 1).

This fire guard protects the highly flammable tangle of grasses, bushes, and saplings growing on the old field, which would be taken out of the normal rotation if it were burned.

The felled trees produce an intense fire of short duration. A well burned ladang is an open litter of charred tree trunks and large limbs, blackened stumps about a meter high, and clumps of bamboo roots (Fig. 2). Bare soil is everywhere exposed. Secondary burning is necessary if the felled trees were not fully dry when they were burned, and the fire was spotty. The unburned limbs and poles are stacked over clumps of bamboo roots or on patches of unburned ground, and a small fire is started.

Immediately after burning the crops are planted by an enlarged family group in a single day. The principal crops in Kalimantan are rice, cucumber, and maize. The rice and cucumber seeds are mixed indiscriminately, and three or four seeds are dropped into a hole poked in the ground with a sharpened stick. Cucumbers ripen at about the same rate as rice; they provide a
succulent fruit for the guards when the rice heads begin to fill with grain and the fields must be protected against birds, and for the family at harvest time, when they are working in the hot fields. Maize seeds are planted separately. They grow faster than rice, and provide full ears in three months. The rice is not harvested for six months.

Burning kills most of the tree stumps, but it does not usually kill the bamboo roots, nor does it affect the deeply buried but attenuated roots of some grasses and ferns. Bamboo roots and the surviving stumps send up shoots and wind blown seeds arrive in large numbers. These plants find ideal growing conditions, and become intense competitors with the rice stalks. The whole family joins in weeding. If the field has been well burned, weeding is necessary only once or twice about three months after planting, when weeds are on the verge of becoming serious competitors. If the field was poorly burned, however, several efforts must be made to keep the weeds under control. The bamboo sprouts are gathered for eating, stump shoots are kicked over, and the grass blades are pulled. Weeding is arduous, and it is very hard on the hands, especially in poorly burned fields.

The rice plants must be protected from deer and other grazing animals. Flimsy bamboo fences are built around the fields by tying poles to trees with split rattan vines. In the month prior to harvest the whole family usually moves to a temporary field house and take turns guarding the crop. During the day a family member pulls rattan ropes which radiate to many places in the field and move palm fronds to scare away birds; at night a guard will often walk rounds with a lantern or torch to scare away wild hogs and deer. Sustained labor by the whole family is needed at harvest to cut the rice heads before the birds eat it or the stalks are broken by heavy rains, and then to carry the grain to a safe place for storage. Weeding and harvesting are the only times during the year when sustained labor is required.

In west central Kalimantan a family of six cultivates approximately two hectares of land a year, which yields about 2,000 kilos of unhusked
grain (padi). When milled the padi produces about 1,000 kilos of grain (beras). Only one rice crop is grown per year. Rice provides over ninety percent of the food value obtained from new fields, the remainder coming from maize and cucumbers. At least seventy-five percent of a subsistence cultivator's total food intake comes from rice, which is probably a lower percentage than in Java, because Kalimantan peasants can still supplement their diet by hunting and gathering, and from a relatively greater abundance of fruit.

Sweet cassava and sugar cane are planted on limited portions of the field after the rice has been harvested, and some farmers plant vines which climb the charred limbs and trunks that litter the field. The vines are varieties of squash, green beans, or gourds which can be hollowed and used to carry water. Sometimes rubber saplings are planted.

Cassava and sugar cane grow sufficiently fast and are tall enough so they can successfully compete for one year with bamboo sprouts and saplings. Cassava makes up approximately seventy-five percent of the second crop. It is not harvested for eight months or longer after planting. Both crops are easy to plant. A stalk about thirty centimeters long from a mature plant is inserted into the ground and left to grow without further care. No field is cultivated a third year; it reverts to a dense secondary growth called “belukar.”

The food value obtained from the second year's planting is about fifteen percent of the food value obtained from rice. After cassava and sugar cane have been planted the subsistence cultivator has three or four months of leisure to make household items, tap rubber trees, plant additional rubber saplings, harvest coconuts, hunt, travel, or more usually, do nothing. He is free of most obligations unless the regional government requires him to work on a road or the village council requires him to work on a path.


WET SHIFTING CULTIVATION

The preferred location for wet shifting agriculture (paya) is small interior valleys (among medium-sized hills) with flat floors drained by permanent watercourses (Fig. 3). The gradients of the streams must be low enough so that water is on the ground and the valleys are shallow swamps for most of the year, but the gradients must also be steep enough to drain the swamps during the dry season (or season of less rainfall) so that the cut vegetation will burn. This “marsh rice” form of cultivation has not been adequately described.

The ordinary succession of vegetation after the rice has been harvested is the low grass Isachne glabosa (rumput njabu), a quick growing perennial that seeds best on mud. When mature it forms an open tangled carpet about a meter high. Isachne is followed by a mixture of saplings and the tall sedge Scleria bancana (rambang). The saplings would rapidly grow into a mature forest if left undisturbed. This succession can be arrested by cutting down the Scleria-sapling mixture every three to five years and planting rice, and if this rotation is continuously practiced Scleria will form a nearly solid vegetative cover. Scleria has a tough, supple, triangular stem which grows to a height of two to two-and-a-half meters in a homogeneous stand, but it can grow higher than three meters if it intertwines with saplings.

With the advent of the dry season the mature Scleria is cut and burned, and the swamp's crust is broken by slashing with a large bush knife (parang) or chopping with a large hoe (tjankol). Many of the larger root clumps of Scleria are pulled from the mud during this process and collected into heaps (often around

FIG. 3. Area of wet shifting agriculture (paya) in a small interior valley. The pattern of *Scleria* cutting follows the stream in places, but elsewhere rectangular fields are shaped by dikes and drainage ditches.

A residual stump) or stacked as low dikes at the edge of the field. The chopping of the roots brings a layer of mud (paya) to the surface, and rice seeds are planted in the mud. Mud cultivation—paya—gives the name to wet shifting agriculture. Paya fields are subject to uncontrolled flooding after heavy rains, and unless there is deep inundation rice grows faster than *Isachne*, whose seeds arrived at the same time rice was planted. The flooding also slows the regeneration of *Scleria*'s disturbed root system, and a rice crop can be grown during the time *Scleria* takes to regain dominance.

Paya rice is planted by three methods. The usual way is to broadcast the seeds, and to transfer seedlings after they have sprouted from places where they are thick to places where they are sparse. At the same time some weeding may be done. The second way is to poke a hole into the mud with a stick and drop in a few rice seeds, using the same procedure as in dry cultivation. The third method is an outgrowth of the first, and has the advantages of even spacing of the second. A seed bed is used to sprout rice seeds, and the sprouts are transplanted by hand to the field. The seed bed is either a patch of mud at the bend of a stream, or a rectangular plot surrounded by low dikes made up of *Scleria* roots.

Wet shifting cultivation of rice usually yields two to three times as much grain as dry shifting cultivation, but the labor input is considerably greater, and higher risks are involved; the equatorial dry season may be so short that the valley will not drain enough to permit the cut *Scleria* to burn, and excessive rains can drown the seedlings. Some Dyaks and Malays forestall this danger by converting the streams into straight channels down the centers of the valleys (Fig. 4). The material excavated from the channelized stream is used to make dikes. The major problem in Kalimantan is to build an efficient drainage system, and dikes and ditches are built at the sides of the valleys to intercept and carry away runoff before it inundates the rice. Initially the peripheral dikes are made of clumps of *Scleria* roots pulled from the field (Fig. 5).

The amount of diking done in any one year outlines the area that a family of subsistence...
Rice cultivation is willing to cultivate during one growing season. The same field is repeatedly used on a three to five year cycle, with the dikes being raised each time the field is cleared and cultivated. The eventual result is a permanently diked wet field which can maintain a layer of water. The cover of water performs the same function as Scleria; it controls the growth of weeds that would compete with rice. Scleria does this inefficiently, by choking them out on a three to five year planting cycle, and not at all during the growth of the rice crop. Water is more efficient, because its level can be raised to drown the competing weeds as the rice grows taller.

A rice paddy (sawah) is not created until a continuous and uniform layer of water can be maintained, and only then can continuous wet cultivation of rice begin. The outlines of a paddy are usually several generations in the making. One generation clears the mature jungle, another cultivates it long enough for a homogeneous growth of Scleria to become established, and another improves it by ditching and diking so that rice can be continuously cultivated.

Wet shifting cultivation cannot be practiced in the swamps back of natural dikes along the major rivers above their tidal estuaries, because these swamps are frequently flooded by highly variable depths of water. On the other hand, river floods tend to flatten to a nearly uniform depth when they reach the delta, and this, in combination with strong flushing currents in the main delta channels during the ebb tide, prevents extreme variations in water level and makes wet shifting agriculture possible.

The Pawan River near Ketapang in west Kalimantan is a good example of a delta where wet shifting cultivation is practiced (Fig. 6). The fine sand soil has a modest clay content and generous amounts of lime in the form of small shells. It is moderately fertile, easily ditched, and drains rapidly. During most of the year the delta lands (at about sea level) are nearly continuously inundated. High tides twice daily back up river water, and combine with almost daily rains to keep the fields under a more or less constant cover of water during rice's growing season. The construction of drainage ditches to the nearest delta channel allows as much water to drain from the fields as will be replaced by rain, and if the field is close to the river the low dikes made of Scleria roots will retain enough water so the field will remain wet. The fallow fields drain to mud level only during periods of relatively less rainfall, and then the homogeneous growth of Scleria will dry when cut.

The food supply can be increased with minimal amounts of labor merely by intensifying cultivation once wet shifting rice fields (paya) have been converted into continuously cultivated wet rice fields (sawah). The transition from shifting to continuous cultivation can be made in a few years if population pressure provides the necessary labor. Only population pressure will force the transition, and only further population pressure will force its extension into areas where the seasonal variation in rainfall is less reliable, or where the scale of drainage must be larger than in the small interior valleys or on the small deltas where the transition is easily made.

**Transition to Continuous Cultivation**

The transition from wet shifting to continuous cultivation of rice demands few technological
Fig. 5. Newly planted rice field in small inland valley where wet shifting agriculture (paya) is practiced. Uncut Scleria is in the background, and low dikes of Scleria roots surround the cultivated field.

innovations, because the skills required for sawah production are easily adapted from the skills used in wet shifting cultivation. Prior to the imposition of order by the Dutch, delta areas lacked enough protection from sea attacks to attract and maintain a sufficiently dense population to force the adoption of continuous cultivation. Furthermore, most coastal locations usually required a larger scale of initial development than a single village or group of villages could manage, because coastal settlers had to cope with the major floods that frequently submerged the lowlands. The smaller valleys of the interior, however, were more easily converted to sawah in a piecemeal fashion as a village’s population increased. There was no need for a larger scale of planning or more labor than could be supplied by one village. Continuous cultivation of rice first began in Indonesia in the interior valleys of central Java (Jogjakarta region) in response to population growth in a protected locality with intrinsic soil fertility. A similar combination of factors probably explains the origin of the spectacular rice terraces of the Bontoc Igorot in the Philippines.6

The transition to continuous cultivation merely intensifies one form of food production technology (wet shifting) at the expense of another (dry shifting). Dry shifting agriculture does not cease. It is frequently practiced on hill-sides adjacent to the valleys devoted to wet shifting or to continuous rice cultivation, and it will continue on the hills until population density forces terracing. The major change required in the transition to continuous cultivation is more labor. The intensification of labor usually creates a demand for new tools (hoes, plows, draft animals) and requires the modification of older techniques (regulated flooding instead of unregulated flooding to control the growth of weeds). The transition is made to maintain the same level of subsistence for a larger number of people. The social values of subsistence living are only slightly modified by transferring culti-

viation to more fertile alluvial soils and making it continuous.

Sawah cultivation does not absolutely require the use of draft animals to pull a plow (although a village may own one or more animals), because the wet soil can be turned by a man using a hoe. Sawah cultivation demands more village discipline, more communal labor to maintain the irrigation and drainage ditches and dikes, and considerably more individual labor at planting. The location of the villages usually remains the same.

The change from mixed sawah and dry shifting cultivation to all sawah and permanent dry fields (tegalans) can occur gradually or rapidly. The expansion of sawah cultivation by terracing until the maximum area of wet land has been created is a process that occurs simultaneously with the beginning of multiple cropping. Labor needs and food production increase at every step, but usually the output of food per man hour of labor decreases as the peasant concentrates more labor on a smaller plot of ground. It is for this reason that labor intensive sawah technology will only be applied under the stimulus of population pressure. Its application requires considerably more physical labor than the subsistence cultivator is willing to expend unless population pressures force him to do it.\(^7\)