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REVIEW

Characteristics of Paddy Fields and Irrigation in the Dry Season in a Village of Bangladesh

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Abstract

The authors describe characteristics of *boro* rice fields of a village in Bangladesh. *Boro* rice fields in the village are classified by elevation into six types, of which three are characteristic and representative, namely *char*, *khila* and *maath*. The lowest fields classified as *char* are located on the fringe of *bil* and are not irrigated. High yield variety rice, which is short and needs a long growing period, cannot be cultivated in *char*. Fields classified as *khila* have the top layer of soil removed to expose the clay layer which has high water retention. The soil removed is heaped up around the field to form a bund which gives these fields a characteristic external appearance. Fields classified as *maath* are simple fields that are fallow land dug shallowly and surrounded by a short ridge which serves as a border for these relatively large plots. Large scale earth-moving work such as that required for *khila* is not needed for *maath* and rapeseed cultivation irrigated by a power pump is followed by *boro* rice cultivation. Reclamation of *khila* brought the consciousness that the irrigation water from *bil* is limited and should be shared, which reflects the traditional social relationship in the village. On the other hand, reclamation of *maath*, in which irrigation is realized by a power pump, introduced the consciousness that irrigation water is a purchasable and economical commodity.

Discipline: Agricultural environment
Additional key words: *boro* rice cultivation, farm work, irrigation device, land classification, power pump irrigation

Introduction

The rainy season rice cultivation mainly depends on rain and, on the contrary, about 90% of *boro* rice cultivation fields in the dry season are irrigated artificially in Bangladesh. Based on their research the authors report the characteristics of *boro* rice fields of Jawar village (Fig. 1) which is located on the fringe of a *haor*, a large inundated area in the rainy season that dries up in the dry season.

The authors who discussed the position of fields in the hydrological environment in the village[3] are focussing on the fields as a respective plot in this report. They describe reclamation methods, form, soil texture, and analyze the pattern of farm work and irrigation to make clear distinctions between different types of dry season fields, from the viewpoint of rural hydrology[5], by which the existing hydrological condition is thought of as a historical by-product made by changes in the natural environment and human's approach to it by way of interviews and observations in rural areas. In indicating the distinctions of the fields they mention historical aspects of *boro* rice

Table 1. Glossary of non-English words excluding those for *boro* rice fields

Word	Meaning
Aman	Autumn rice
Bil	Marsh
Boro	Winter rice
Dhon	Traditional irrigation device
Jami	Land
Haor	Large inundated area in north-eastern Bangladesh

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Table 2. *Boro* rice fields classified by location and reclamation method

Field	Elevation	Characteristics	Area (%)[1)]
Char	Low	Appears in the dry season with water decreasing in *bil*	15
Petty	Medium	Oldest, fertile, dug down shallowly and largest area	42
Lunga	Medium	Most fertile reclaimed on old canal/river and smallest area	3
Khila	Medium-high	Dug down deeply and high water retention	28
Maath	High	Large plot, reclaimed after the 1960s, irrigated by power pump	4
Kanda	High	Highest and mainly transplanted *aman* rice in the rainy season	8

1): Percent of total *boro* rice field area.

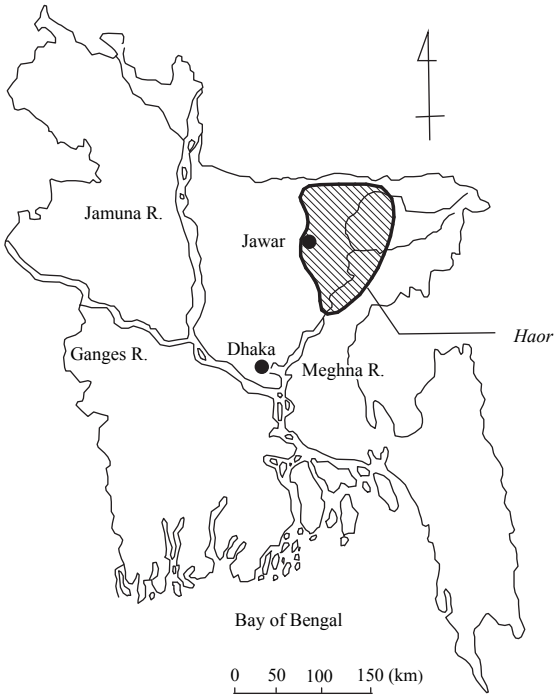

Fig. 1. Location of Jawar village

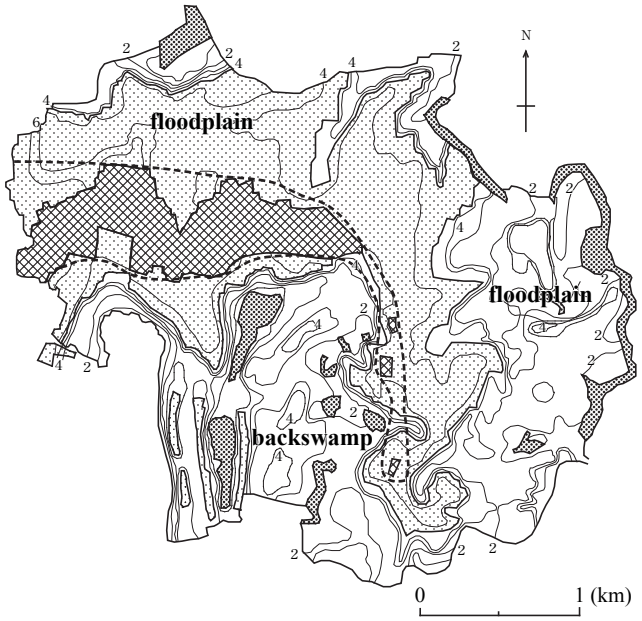

Fig. 2. Topography and land classification of Jawar village
: natural levee, : *kanda* (4–7m), : *boro jami* or *shail jami* (0–4m), : homestead, : *bil* (marsh)

cultivation and farmers' consciousness to irrigation water. A glossary is provided for helping readers easily understand non-English words (Table 1), excluding those of *boro* rice fields which are described in Table 2[1].

Topography and land classification of Jawar village

Fig. 2 shows the topography and land classification of Jawar village[6]. The natural levee slopes towards the southeast in the middle of the village with a backswamp in the south which has some *bil*s or marshes and sloping floodplain that widely spreads in the north and east. The farmers of the village classify the farmland into two basic types. One of these is the lowland called *boro jami* or *shail jami* which is located at 0 to 4 m elevation and another one is the highland called *kanda* at 4 to 7 m elevation. It is possible to cultivate crops throughout the year on the higher part of *kanda* and on the other hand, it is impossible to cultivate any crops in the rainy season on *boro jami* because of the excessive water depth. Meanwhile, in the dry season *boro* rice is cultivated using the abundant surface water on *boro jami*, most of which is used as *boro* rice single-crop farmland.

Boro rice paddy fields which are distributed on both *kanda* and *boro jami* or *shail jami* are classified into *kanda*, *maath*, *khila*, *lunga*, *petty*, and *char* in order of high to low elevation, respectively, as shown Table 2 and each field was reclaimed by a different method. Fields lower than *khila* are *boro* rice single-crop farmland and most of these fields except *char* are mainly irrigated by a traditional device, *dhon*, which lifts water by man power,

and sometimes, STW (Shallow Tubewell) and LLP (Low-lift Pump) are also used for supplemental irrigation. Meanwhile, the higher fields of *kanda* and *maath* depend on power pumps, mainly including STW and LLP for irrigation.

Paddy field soil in the village is clayey. According to the soil survey[2] the cross section of soil shows the layer of 0 to 50 cm is clayey and, especially 30 to 45 cm is clay, with the deeper layer rich in silty loam. Such a clay layer can decrease the vertical percolation of *khila* (and *petty*) after the top layer of soil is removed, accordingly, it is indispensable to describe the characteristic of the fields.

Among the fields shown in Table 2, transplanted *aman* rice in the rainy season is dominant on *kanda*, *lunga* occupies only 3% of total *boro* fields and *petty* was originally reclaimed like *khila*. Therefore in the following section a non-irrigated *char* field which is oldest in the village, a *khila* field which is dug down in large scale and cultivated before and after introduction of LLP, and newest *maath* field in which rice cultivation started with the introduction of power pumps are discussed.

Reclamation of paddy fields

1. *Char*

The lowest field, *char*, located on the fringe of *bil* appears on the surface of water with water recession in the dry season (Photo 1). So the cultivation area depends on the amount of *bil* water and the speed of water recession every year. The water in the field is connected with the *bil* and therefore the water depth changes according to the fluctuation of the *bil* surface water. Farm work of weeding and irrigation are hardly needed after transplantation but rice must be harvested before the water level increases. The increase in water level before the harvesting causes a fall in yield and, sometimes, farmers must labour in deep-waist water. Therefore, high yield variety (HYV) rice, which is short and needs a long growing period, cannot be cultivated. Moreover, in some years, rice seedlings cannot be transplanted in the deep part of the field. Earnest farmers make a bund on the edge of the *bil* side at the end of the dry season to deposit silt in the field. According to a *char* cultivator, they can deposit 1–2 cm of silt in an ordinal year and more than 3 cm in a flooding year when water hyacinth is rich in the *char*. Although the field is not easy for the farmers to deal with, they are trying to stabilize the rice cultivation in *char* with methods like this.

2. *Khila*

Khila which has the top soil layer removed to expose the deeper clay layer to the surface of the ground has high water retention (Photo 2). Soil removed from the field is heaped up around the field to form a bund of 0.6 m wide and higher than 1 m, which makes a characteristic external appearance. As *khila* can store the water of the rainy season, additional water is not needed until transplantation, but afterwards, farmers labour to irrigate because fields are far from a water source. They dug long canals and use several *dhon*s for irrigation to *boro* rice cultivation in *khila*.

Introduction of LLP and STW promoted the creation of *khila* on the higher non-irrigated land and, at the same time, changed the irrigation method even in lower *khila* which has depended only on *dhon*. The change of irrigation method also influenced the consciousness of farmers to the water. The farmers who don't have their own LLP and/or STW are obliged to purchase water for new built *khila*s. The consciousness that the irrigation water from *bil* is limited and should be shared is reflecting the traditional social relationship in the village. On the other hand, the appearance of the power pump produced the new consciousness that irrigation water is a purchasable and economical commodity[4].

Photo 1. Transplantation in *char*

Photo 2. *Khila* with high levee

3. *Maath*

The introduction of LLP in the middle of the 1960s mainly was promoted to build *khila*, compared to the introduction of STW after 1980 which quickened *maath* creation in higher elevation fields (Photo 3). *Maath* is a simple field that is created on fallow land or pastureland which is dug shallowly and surrounded by a short ridge which serves as a border to these relatively large plots. Large scale earth-moving work like that required for *khila* is not done and, sometimes, a plot is divided into a few parts by short ridges to keep water depth nearly equal in each part. Rapeseed cultivation irrigated by STW is regular before *boro* rice cultivation annually in the field. Farmers put in a large amount of fertilizer and manure for soil improvement because of low fertility as paddy field for first few years. The field is irrigated by a plot-to-plot method using STW and the short levee functions only as a border, differing from other fields.

Maath cultivators may think strongly that water is a purchasable commodity more than do those of *khila*. It seems that the reason why many farmers want to change from *maath* to *khila* is that they want to irrigate the fields using not purchasable water but traditional social water.

Photo 3. Land preparation in *maath*

Rice cultivating work

Fig. 3 shows the farm work in three kinds of rice fields. In *khila*, farmers gather water plants and make several mounds in the field every 4–7 m after closing the outlet with 30 cm water depth. The rotten water plants are used as manure. After this work, 10 to 12 days later, plants not rotted are heaped on the levee and farmers replace soil that fell down from the levee in the rainy season. Without this work plowing with buffalo does not come along as soil around bund rises.

Farmers, in the second place, plow to mix the rotten weeds in soil by water buffalo and rake to shatter soil clods using a wooden ladder *moi* when the water decreases to 15–20 cm deep by evaporation and percolation. After that they heap weeds on the levee and plow and rake several more times. Following the last plowing rice seedlings are transplanted in 8 to 10 cm water. A few weeks after transplanting, the field is first irrigated, followed by weeding and fertilizing a few days later and finally weeding is done more than three weeks later. After that, *khila* A is irrigated by LLP and *khila* B is irrigated by STW every 10 to 15 days on demand, and harvested in the middle of May. Only 25% of all *khila* in the village is irrigated only by power pump like these *khila*s. Although *khila* is located on the limit of high elevation which can be irrigated by *dhon*, 54% of *khila* is irrigated only by *dhon* and 23% is irrigated by *dhon* and power pump. This means *khila* is of importance not only for rich farmers but also for small and medium farmers who use *dhon* (Photo 4).

Rice cultivation in *char* is far simpler and extensive than that of in *khila*. Farmers gather water hyacinth floating on the field and pile them in the middle of January, when *bil* water recedes to the depth of their knees. Three days later they make a levee and heap piled weeds on it and plow, rake *moi* and transplant in the following three days. After that they don't do any farm work including irrigation and weeding until harvesting in the end of April.

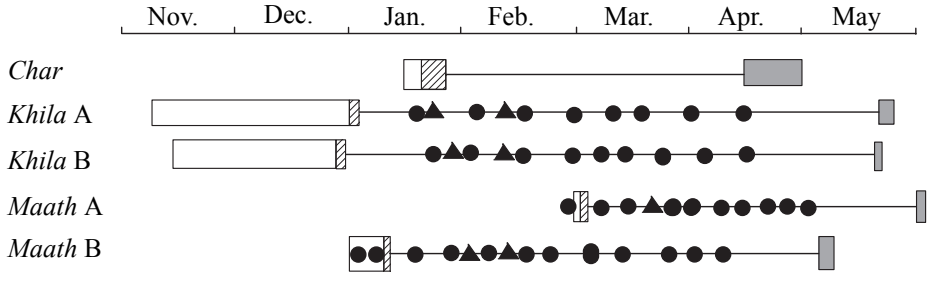

Fig. 3. Farm work in three kinds of paddy fields

□: land preparation, ▨: transplanting, ■: harvesting, ●: irrigation, ▲: weeding.

Photo 4. Irrigation by traditional device *dhons*

Sometimes harvesting in the *char* on high elevation starts one month earlier than that of low elevation *bil* because of early water recession.

In *maath* A farmers irrigate the field, in which rain water is not stored, using a power pump and, in the following day, plow and rake *moi*, and weed after three and five weeks of transplantation. The field is irrigated after three days of transplanting and thereafter once a week, and rice is harvested at the end of May. Farm work in *maath* B is almost the same as A but two months early.

Because transplanting work in other kinds of fields is concentrated in the end of December to the beginning of January, HYV rice transplanting in *maath*, where damage by early floods does not occur, is sometimes put off as in *maath* A. Farmers don't do the farm work of weeding and levee covering (by mud) which is seen in *khila* before transplanting. There is only one week between the first land preparation work and transplanting in *maath*, compared to one and half months in *khila*.

Such a short period for land preparation can be seen also in *char*. For example, the period between closure of the outlet to store water and transplanting is only one month but it is more than two months in half of the researched *khila*. Transplanting time in *khila* depends on transplanting of other kinds of fields and, in *char*, depends on water depth in which seedlings can be transplanted.

Conclusion

The area of *petty* has the largest percentage of *boro* rice in the village, which was also originally reclaimed in the old days like *khila* by digging and removing soil. Such fields used for many years are stable and newly made *khila*, mainly depending on pump irrigation, also look stable because of careful preparation for transplanting and farmers' devotion to irrigation using *dhon*. Compared with this, *char* utterly depends on the natural environment and even its shape is unstable. Flood and water recession in the period of transplanting and harvesting are the most important factors for *char* and farmers think they cannot control the *char* water. *Maath* is irrigated by groundwater using a power pump and there is no relation to surface water. *Maath* has an aspect of a dry field as *boro* cultivation follows rapeseed cultivation. *Boro* rice cultivation in *maath* can be described as rice cultivation in an inundated dry field rather than in a paddy field.

Production capacity has been expanded by monoculture in traditional *boro* cultivation of Jawar village, which was supported by surface water irrigation using *dhon*. Farmers could become the possessors of water, devoting their labor to making certain the surface water volume is adequate. At that time, water was absolutely their own and not an article of commerce which is to be sold and bought. Meanwhile, *boro* cultivation in *maath* which needs pump irrigation has expanded its production capacity in combination with rapeseed cultivation. In this case, water is a commodity to be bought by money, although farmers cannot make sure of its existence. STW irrigation has developed *boro* rice cultivation from monoculture to double cropping and, at the same time, introduced the new idea of water as a commodity to the farmers.

In Bangladesh STW had become widely used all over the country in the eighties and irrigated *boro* rice cultivation spread to the new areas. The authors are paying attention to the way such new rice cultivation will develop. Is it returning to monoculture by reclaiming *maath* to *khila* as Jawar farmers hope? Or, is it changing to double cropping, combining rice and dry field crops like rapeseed? We are interested in the result of the conflict between the idea of "own water" tilled by traditional irrigation and "marketable water" provided by modern irrigation.

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