TARC Note

Technical Strategies to Increase Rice Yields in the Wasan Rice Project, Brunei Darussalam

The Department of Agriculture, Brunei Darussalam, and Tropical Agriculture Research Center, Japan, have been carrying out a cooperative engineering study in the Wasan Rice Project since 1987 to develop land improvement techniques for rice production adapted to the local requirement, i.e., a farming system with high labor productivity under tropical humid climate. In the present paper, the authors propose technical strategies to increase rice production in the project area based on a preliminary study.

The annual rainfall in the area is approximately 3,000 mm. The wettest season from November to January has monthly rainfall more than 300 mm, while the driest season from February to April has 100 to 150 mm monthly. The monthly mean air temperature is almost constant ranging from 28° to 26°C all year round.

In traditional rice single cropping in rainfed fields, sowing is generally done in September, transplanting in October, and harvesting in March. The main season cropping in the Wasan Rice Project follows the traditional schedule. The off-season cropping is not fully practiced due to insufficient water resources.

The Wasan Rice Project

This project located in the Brunei River basin, about 30 km upstream to Brunei Bay, is composed of 321 ha of rice field, a reservoir with a capacity of approximately 200,000 m^3, seven pump stations connecting irrigation pipe lines, drainage canal systems, farm road networks, etc. The rice field consists of 70 lots, and the standard size of each lot is 500 m long and 120 m wide.

Direct sowing system is adopted to economize labor. In spite of less tolerance to fertiilzer and diseases, and a long growing period of 140 days, a local variety named Disbok is planted because of its excellent eating quality.

Condition of rice production

The rice yield target of the project was 4.0 t/ha. Since the project was launched in 1979, however, the yield has been extremely low (Table 1). The planted area and yield have fluctuated largely season by season. The off-season crop is especially unstable.

Table 1. Rice production in the Wasan Rice Project

Year	Off-season			Main season		
	Planted area (ha)	Production (t)	Yield (t/ha)	Planted area (ha)	Production (t)	Yield (t/ha)
1979	87	18	0.21	129	101	0.78
1980	0			174	164	0.94
1981	166	69	0.42	211	276	1.31
1982	0			243	304	1.25
1983	0			204	196	0.96
1984	0			101	80	0.79
1985	86	0	0	305	174	0.57
1986	35	10.5	0.30	197	7	0.04
1987	0			233	354	1.52

Discussion on the low yield

During the field observation in the main season 1986/87, the extreme sterility was found although the number of panicles and spikelets per unit area was normal. In addition, close correlation ($r=-0.654^*$) was found between rice yields and dry weight of weeds per unit area[1].

In the main season 1987/88, the high yield was recorded, but it was still as low as 1.52 t/ha in average (ranging from 3.6 to 0.0 t/ha). Success in artificial flooding in this

* Significant at P=0.01 level.

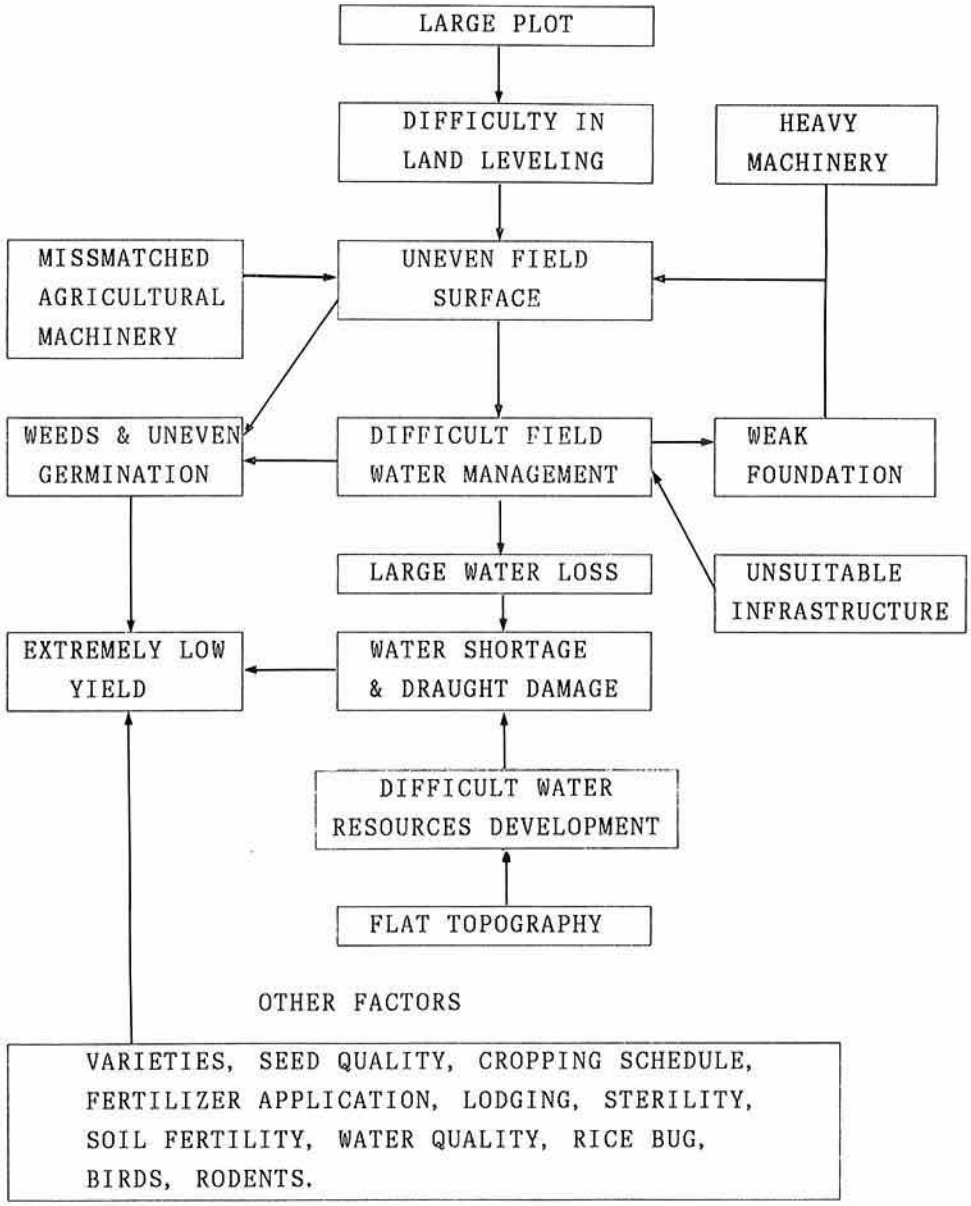

Fig. 1. Factors causing low yields of rice

season must be a reason for such an increased yield. In the past seasons, water control was not properly done due to much water loss through levees of rice fields. Other factors causing the low yield are damages by weeds, rice bugs, and birds, and low productivity of the planted variety. The ripening ratio was 56% in a plot where rice bugs damaged 25% of grains. Uneven field surface causes difficulty of water management, weed problem, uneven germination and ill-drained condition. All of them induce low yields (Fig. 1).

Engineering countermeasures

Rationalization of water management is the most important subject. Three factors can be pointed out, i.e., leveling of field surface, irri-

gation and drainage facilities, and irrigation water resources.

1) Land leveling

Difficulty in precise land leveling in large plots, and deep and wide tracks formed by wheels of tractors cause the undulating and rugged field surface, which inhibits proper field water management. The leveling of field surface is urgently needed*. Since the cage wheels attached to rear tires are wider than the rotary plow, it is necessary to use rotary plows with the width wider than the present 2.8 m of the tracks. In order to maintain flat surface, it is also needed to form flat and stable foundation capable of supporting agricultural machinery.

2) Irrigation and drainage facilities

It is necessary to improve irrigation and drainage facilities to enable a few fields staffs to operate the facilities properly. The project has too many structures, but a few staffs. The structures (ca. 300) are usually very simple with the function not enough for proper water management, causing a lot of leakage, and for precise timing of water management required by direct sowing culture. It results in weed problem, drought damages, failure in raising seedlings in time, etc.

3) Water resources

In spite of the alluvial area, irrigation is a must to stabilize the direct sowing culture, which requires precise water management. Without irrigation, crops are often damaged during a long dry spell. Flat topography allows only a few adequate dam sites, and river water contains salt. These factors make it difficult to secure water resources in this region.

Strategies of future development

Technically, it is not so difficult to conduct precise land leveling in large plots, when a leveling machine guided by a laser machine control system, for example, is adopted. Water shortage problem will be improved when an irrigation canal constructed by the government is completed, and the project area can receive water through the canal from Benutang Dam located in the Tutong River basin adjacent to the Brunei River basin. Pests such as rice bugs can be controlled by adopting aerial application of pesticides and forecasting systems.

Rice varieties now in use show poor germination under deep water, and hence, elaborated water depth control is required from land preparation to the early growth period. It spends a lot of labor and water. Development of varieties which germinate well under flood condition can simplify the water management, save water consumption, and labor input, alleviate weeds problem, and eventually increase and stabilize rice production.

Brunei has more than 3,000 local varieties, but their characteristics are not clarified yet. It seems to be highly possible that some of them may have promising agronomic characters such as good germination under flooding conditions, pest-resistance, etc. and they can be used as genetic materials to develop excellent varieties well adapted not only to the area, but also to other parts of the country.

* For example, 95% of the field surface should be within 5 cm above or below the average ground level by the Japanese standard.

1) Kobayashi, H. & P. Mariance PDNP. Monin: Lowland rice cultivation agronomical aspects study in Burunei Darussalam (Main season 1987/88), 1–52 (1988) (Mimeograph).

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