DEVELOPMENT OF TIDAL IRRIGATION IN THE GAMBIA

Geographical Environment

The Gambia, a country in West Africa bordering the North Atlantic Ocean, has a land area of 10,000 square kilometers that is entirely surrounded by Senegal. Its shape is narrow, extending for roughly 15–20 km on each side of the banks of the 740-km-long Gambia river. The river originates in Fouta Djallon in the mountain region of West Guinea and flows through Senegal and The Gambia before emptying its waters into the Atlantic Ocean.

The population numbers about 1.3 million, and is growing at an estimated rate of 3.42 percent. More than three quarters of the entire population depends on crops and livestock for its livelihood. About one third (343,339 hectares) of the land is cultivated with peanuts, millet, sorghum, rice and maize. Peanuts and peanut products make up about 70 percent of exports, and foodstuffs, especially rice, constitute the most important imports

Average annual temperatures in this tropical country are 21C°–33C°. The dry season lasts from November to May, and most of the rainfall occurs between July and September. Average annual rainfall for the country as a whole is approximately 750 mm, but there is less rainfall each year. With the limited rainfall hampering agricultural production and erratic harvests of dryland rice, irrigated paddy rice plays a major role.

Paddy Rice Production Overview and Project Goals

Paddy rice is grown primarily along the middle and lower reaches of the Gambia river, whose water is used for tidal irrigation in certain parts of the country. Although rice is a staple food in The Gambia, most farmers are too poor to buy the required fertilizer and agricultural machinery, and the small areas of cultivation and primitive farming technology keep output low, at about 1.5 metric tons per hectare.

The government allows the free import of rice, which discourages farmers from growing the crop. Most grow only sufficient rice to meet their own needs, with the result that the 20,000 metric tons produced annually account for less than one quarter of domestic demand. Over the years, the government has made increasing rice output a major policy objective, and it has used foreign aid money to develop 6,000 hectares of new rice paddies. However, most of those paddies have since been abandoned due to poor management and lack of resources.

The ROC technical mission has been promoting paddy rice production and the expansion of paddy fields since 1995. In an effort to increase unit output and reduce production costs, it has introduced improved rice varieties and more advanced technology. Following the intensive application of irrigation technology and the use of agricultural machinery, old paddy areas are now gradually being replanted.

Nonetheless, rice imports are continuing to increase. The Gambia's current agricultural policy is still to achieve self-sufficiency in grain production, but to reach an annual production of 80,000–90,000 tons will require the development and use of tidal irrigation. In order to do that, the close collaboration of local farmers, the government and international organizations will be required.

Relationship Between Tidal Irrigation and Tidal Height

Tidal irrigation is very different from ordinary gravity irrigation or pump irrigation. Tidal irrigation takes advantage of the ocean tides to force river water onto fields. Use of tidal irrigation to cultivate paddy rice in areas where the water contains no salt is a very uncommon form of irrigation. Tidal irrigation can generally be used to water marshy fields with an elevation of less than 1.7 meters above the average sea level. If no elevation data are available for a certain field, the mark left by high tides along the river bank may be observed to determine whether the land is marshland or agricultural land. Tidal irrigation may be employed for all land below the flood tide mark. It is therefore necessary to perform a careful survey and make topographical maps of potential areas at the beginning of a tidal irrigation project. The topographical maps can then be used to determine the feasibility of tidal irrigation in particular areas. The heights of flood and ebb tides were carefully traced in the Sapu section of The Gambia's Middle River Division.

According to the method of calculating tide height used in Taiwan, it is necessary to find out during what times of day the flood and ebb tides occur when the maximum flood tides come around the time of the new and full moon. These times can then be used to control the amount of water used for tidal irrigation. A water control valve is ordinarily installed where water enters the system, and the system should have separate inlets and outlets. River water is allowed to flow into the system at flood tide, and the outlet valve is shut as the tide ebbs to keep the water on the fields.

Irrigation methods are different during the rainy and dry seasons. Drainage is the paramount concern during the rainy season, while irrigation is the most important consideration during the dry season. The ditches of a tidal irrigation system therefore must have a dual irrigation/drainage function. It is necessary to prevent irrigation water from overflowing the fields, and attention must be paid to controlling irrigation and drainage at the times of flood and ebb tide. There is thus an intimate connection between tide level and tidal irrigation.

Where Tidal Irrigation Is Feasible

The three potential rice-growing areas differ considerably in ecological conditions and requirements for production. In the relatively upland areas, pumps can be used for irrigation. In the low-lying marshy areas, tidal flows can be employed for irrigation purposes. In the dryland areas, where it is expensive to pump water for irrigation, the farmers depend on natural rainfall. Unfortunately, inadequate rainfall can lead to drought and a poor harvest.

Tidal irrigation is not expensive and can be used in areas where the soil is fertile. Marshy areas along the section of the Gambia river located from 160 to 330 km from Banjul are suitable for growing approximately 50,000 tons of rice, but very little of that land is cultivated. Because the river water usually contains some salt in the area being suggested, and ordinary paddy rice plant varieties cannot be grown under such conditions, rainwater collected during the rainy season would have to be used to flush out the salt in order to grow a crop of rice. However, the middle reaches of the river, beyond the 240 km mark, are not affected by salt, and two rice crops could be grown there each year.

Some work has already been done on tidal irrigation. Between 1991 and 1996, the Small Scale Water Control Project (SSWCP), financed by the International Fund for Agriculture, developed 482 hectares of tidally irrigated land around the middle of the river, but the area is small and some of the land can produce only one rice crop per year. Other irrigation projects, which ended in the same year, were the Jahally & Pacharr Smallholders Project (JPSP), funded by the African Development Bank and the World Bank, and the Rice Development Project (IRDEP), financed by the African Development Bank. The JPSP developed 849 hectares of tidally irrigated land and 560 hectares of pump-irrigated land, but the 242.6 hectares developed by the IRDEP are all pump-irrigated.

A 20-year project which began in 1997 is the Lowland Agricultural Development Project (LADP), which is being funded by the International Fund for Agriculture and the African Development Bank. Its goal is to develop 3,735 hectares of land during the first eight-year stage, following which an assessment of whether to continue to the next stage will be conducted.

The technical mission has already performed careful surveys and made topographical maps of potential rice-growing areas that can be used to determine the feasibility of tidal irrigation in specific areas. Results of evaluations made by the technical mission indicate that the areas where tidal irrigation is feasible include Wassu, Kuntaur, Tobakuta, Sukuta and Bauajali on the north bank, and Sapu, Willirgara, Kuffzally and Yidda on the south bank in the Middle River Division.

Economic Analysis of Tidal Irrigation and Pump Irrigation

The technical mission has made a detailed analysis of the costs and benefits of tidal irrigation and pump irrigation, taking into account fixed costs (including interest calculated at 6 percent per annum and repayment of principal over 30 years at 1.265 percent per annum), an equipment replacement reserve fund based on a replacement cycle of 30 years, and realistic operating and maintenance costs.

When all factors are taken into account—the costs of installing the irrigation systems (US$4,000 per hectare for tidal irrigation and US$10,000 per hectare for pump irrigation), production costs (seeds, land preparation, transplanting, fertilizer, harvesting), the anticipated rice output after implementation and the value of that output, etc.—the analysis indicates that the profit/cost ratio for tidal irrigation is 2.025, while that for pump irrigation is 0.72. It is evident, therefore, that by using tidal irrigation The Gambia could increase its rice output significantly.

Conclusions

The Gambia is rich in water resources and possesses many favorable conditions. By fully developing tidal irrigation and using superior seed rice provided by the ROC technical mission, together with the best cultivation technology, The Gambia can greatly increase output per unit area and even attain self-sufficiency.

However, success will require increasing the cultivated area considerably and actively promoting tidal irrigation. Extensive cultivation should be adopted in the beginning, and farmers should have easy access to superior varieties of rice and training. With government support, rice cultivation can be extended to all the potential tidal irrigation areas in the Middle River Division. Besides achieving self-sufficiency at an early date, this strategy may also produce enough rice to export and earn additional foreign exchange.

If tidal irrigation is to succeed in increasing The Gambia's rice output, the following measures are required:

- Farmers must be trained in effective rice cultivation techniques.
- Farmers must learn to control and use tidal irrigation. Drainage time needs to be satisfactorily controlled during the rainy and dry seasons, and the farmers must be able to take advantage of flood and ebb tides in order to increase rice output.
- Farmers must be encouraged to change their attitudes and receive training in the use of draft animals to replace human labor, as a means of reducing costs and increasing profits.
- Farmers' associations or similar organizations need to be established or strengthened, and cooperation improved. Such associations could handle agricultural loans and savings, etc.
- Irrigation or similar associations should be established and given responsibility for managing water resources and irrigation operations, and extending irrigation facilities within their districts. These duties are currently being performed by the implementing units of the various projects, but the work is not achieving as good results as might be possible.