

International Symposium on Water Management in Rice Fields

Sponsored by

The Tropical Agriculture Research Center, Ministry of Agriculture and Forestry,
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It is a well-known fact that the reliable water supply through irrigation, drainage and flood control is an essential pre-requisite for the application of modernized agricultural production technology such as high-yielding varieties, fertilizer application and other improved crop managements. However, it is also generally recognized that the reliable water supply can exhibit its beneficial effects

only by the use of improved field water management practices.

In 1972 Japanese Government, with co-operation of FAO, held an international seminar on water management and control for agriculture in Tokyo. In 1973 the Asian Development Bank held a regional workshop on irrigation and water management in Manila with field trips to irrigation projects

in Indonesia, Philippines and Thailand. These seminar and workshop were concerned mostly with engineering aspects of water control. However, there has been no international convocation dealing comprehensively with aspects of field water management, i.e., relationship between water management and plants and soils, generally defined as irrigation agronomy.

This was the reason why the Tropical Agriculture Research Center held the symposium which was designed to offer an international forum for exchanging technical information and discussing various problems of field water management with the joint contributions of both sides of irrigation engineering and irrigation agronomy.

The symposium was organized by the Committee consisted of authorities and experts of the Ministry of Agriculture and Forestry, National Research Institute of Agricultural Engineering, Japan International Cooperation Agency and others, including Director of the Tropical Agriculture Research Center. Dr. Hitoshi Chaya, Director of the National Research Institute of Agricultural Engineering, chaired the Organizing Committee and Tropical Agriculture Research Center served the Symposium Secretariat.

Program and speakers

The sessions of the Symposium were held during the period of August 26 to 29 at a Conference Hall of the Do Sports Plaza in Tokyo, followed by a 3-day field trip to Dainaka Reclaimed Area of Shiga Prefecture. The program and speakers were as follows:

Opening Session (August 26)

Session 1, Country Report (August 26)

Chairman: Takashige Kimura (Japan)

H. K. Pande (India): Present status and problems of water management of rice field in India.

Gatot Sunaryo (Indonesia): Report on water management in rice field.

Cheong Chup Lim (Malaysia): Irriga-



tion development and present status of farm water management in Malaysia.

Sebastian I. Julian (Philippines): Country report of the Philippines.

G. E. M. Gomez (Sri Lanka): Present status and problems of water management in rice field in Sri Lanka.

Charin Atthayadhin (Thailand): Water management of rice field in Thailand.

Katsumi Deguchi (Japan): Country report of Japan.

Session 2, Technical Report (August 26 to 28)

(1) Chairman: H. K. Pande (India)

Peter Kung (FAO): Water management for paddy fields in tropical Asia.

Katsuo Sugimoto (Japan): Relationship between evapo-transpiration and dry matter production of *indica* rice.

(2) Chairman: Otje S. R. Bratamijaya (Indonesia)

Wisit Cholitkul (Thailand): The changes in some physical and chemical properties of paddy soils under water management.

Yutaka Onikura (Japan): Soil characteristics concerning with beneficial effect of water management in rice cultivation.

(3) Chairman: Wisit Cholitkul (Thailand)

- John Aroonkumar Lewis (Sri Lanka): On-farm supplementary irrigation requirement for rice in the dry zone of Sri Lanka.
- Hiroshi Sakai (Japan): Effect of water management on paddy soil metabolism and its use in the growth control of rice plants.
- (4) Chairman: J. A. Lewis (Sri Lanka)
Otje S. R. Bratamijaya (Indonesia): Effect of flooding depth on yield and water requirement.
- Ichiro Tanaka (Japan): Agroecological roles of irrigation in rice culture.
- (5) Chairman: Gatot Sunaryo (Indonesia)
Charin Atthayodhin (Thailand): Improvement of irrigation and drainage system of rice in Thailand.
- Sho-ichiro Nakagawa (Japan): Water requirements and their determination.
- (6) Chairman: Cheong Chup Lim (Malaysia)
G. E. M. Gomez (Sri Lanka): Crop diversification as an aid to water management—some computer studies on Mahakandarawa Irrigation Project, North Central Province, Sri Lanka.
- Kiyomitsu Yukawa (Japan): Distribution system of irrigation water in Japan.
- (7) Chairman: S. I. Julian (Philippines)
H. K. Pande (India): Water management practices and rice cultivation in India.
- Gatot Sunaryo (Indonesia): Tertiary pilot unit.
- (8) Chairman: G. E. M. Gomez (Sri Lanka)
Cheong Chup Lim (Malaysia): Some aspects of farm water management in Malaysia.
- Kaname Ezaki (Japan): Drainage of paddy field in Japan.
- (9) Chairman: Charin Atthayodhin (Thailand)
Sebastian I. Julian (Philippines): Water management in Philippine irrigation systems.
- Shigetaka Taniyama (Japan): Land consolidation in paddy field.
- Session 3, General Discussion (August 29)
Chairman: Peter Kung (FAO)
Kiyomitsu Yukawa (Japan)
- Closing Session

Problems highlighted

During the presentations and discussions of the symposium, it was felt that field water management practices which seem to have been rather neglected in the past have now gaining an increasing importance in research and development of rice production in the tropical Asia. Some of the problems highlighted in the discussion are noted here.

1) *Significance of submerged irrigation*

Is submerged irrigation essential to rice cultivation? In other words, is there any other method of supplying water to rice that is better than the submerged irrigation?

It was shown that if any loss of water caused by evapotranspiration and percolation could be made up by some other method of water supply submerged irrigation may not be indispensable for growth and grain yield of rice. Rice plants grown experimentally at upland condition, soil moisture of which was kept at field water capacity, showed higher yield than that grown with submerged irrigation. In this experiment, however, there was no water stress even though the plants were grown at the moisture level of field water capacity, because water was supplied continuously whenever the plants require

water. This result indicates that as far as enough water is supplied to meet the requirement of plants, methods of water supply is not a matter of concern to plants.

However, although it is true theoretically, it can not be applied to practical rice cultivation unless special facilities are devised. The best way to supply water to rice plants without causing any water stress is the submerged irrigation. In addition, the submerged irrigation has many advantages of great importance, such as (a) effect of maintaining soil fertility by preventing rapid aerobic decomposition of soil organic matter, (b) effect of weed control, (c) killing some nematodes and pathogenic microorganisms in upland field by submerging, etc.

2) *Physical and chemical changes in soils in relation to water management*

Comprehensive reviews were made on the physical and chemical changes in soils that take place in relation to water management practices, such as mode of soil crack formation by drainage, chemical or microbiological changes of plant nutrients in soils, particularly of nitrogen (nitrification, denitrification, volatilization, etc.), formation and behavior of toxic substances like hydrogen-sulphide, various organic acids, ferrous iron, etc. in relation to irrigation and drainage.

Such physical and chemical changes in soils must be taken into consideration whenever we consider the field water management practices.



3) *Mid-summer drainage*

There is a problem of terminology. The word "mid-summer drainage" may be originated from Japanese "Nakaboshi", but the word does not literally means mid-summer, but it means mid-growing season. Therefore, "mid-season drainage" seems to be preferable.

The practice has several advantages: (a) bringing back the extremely reductive state of soils to less reductive or oxidative state by draining water from the soils, and preventing roots damage caused by serious reduction. Roots can be kept healthy (physiologically active), (b) removing toxic substances like sulfide, ferrous iron, etc., and (c) preventing overgrowth (excessive vegetable growth) which causes mutual shading of leaves and reduces net photosynthetic production, by removing available nitrogen in the soils, and exposing plants to water shortage.

These effects of mid-season drainage can be advantageous when plants are grown on fertile soils with liberal application of nitrogen fertilizer. Question was raised whether this practice can be effective in less fertile soils with shortage of fertilizers, that prevail commonly in tropical Asia at the present time, except in some problem soil areas where serious root damage usually occurs.

4) *Water depth*

Importance of water depth in paddy fields in relation to water requirement and grain yield was reported. Shallow irrigation was found to be effective in reducing the water requirement (evaporation + transpiration + percolation) and increasing grain yield. However, in practical rice cultivation, it is almost impossible to maintain submerged water at a given depth from day to day. Question is what would be a critical water depth, beyond which plants may suffer from the deep water damage. Determination of the allowance limit of water depth was felt needed.

5) *Rate of percolation*

Japanese experiences indicate that daily field water requirement at a rate of 20 to 25 mm/day gives the highest yield of rice, and the rate higher than or lower than 20 to 25 mm/day results in decreased yield. Since evapotranspiration is considered almost constant throughout the country, the percolation is the governing factor for water requirement. Methods of measuring percolation rate, methods of reducing excessive percolation, and changes of percolation rates with the number of years on newly reclaimed fields, etc. were discussed.

Question was raised on what would be the optimum rate of percolation. It was discussed that the optimum rate may differ with different objective of percolation practice: i.e., whether does it aim at increasing grain yields, facilitating farm mechanization, or removing soil salinity, etc. In Japan, the percolation at a rate of 15-25 mm/day is regarded as optimum by considering following factors in combination: plant growth, efficiency of water use, drainage required for farm mechanization, etc. Studies are needed in tropical Asian region with various natural, social and economic environments.

6) *Field water duty*

Field water duty is an important basic data for planning irrigation. However, research results on water duty and its components have not been sufficiently accumulated in the tropical Asian region. Of the components of water duty, i.e., evapotranspiration (ET), percolation, farm waste, conveyance loss, and effective rainfalls, it was reported that ET shows a small regional variation, and can be estimated directly by pan evaporation or solar energy at a given location, and growth duration of rice varieties. Other components than ET are location-specific so that they can hardly be generalized or formulated.

7) *Land consolidation*

Some discussions were made on the ter-

minology of land consolidation. The terminology has not yet been well established, so that the term is used with different definition in different countries. In southeast Asian countries, land consolidation signifies mostly irrigation and drainage works, not including changes of field blocks. The main purpose is to stabilize rice production and increase the productivity of land.

In Japan, the term signifies the re-arrangement of field layout, accompanied by the transfer of land-ownership, in combination with irrigation and drainage improvement, soil improvement and farm road construction. The objective is to increase labor productivity as well as productivity of land.

In Europe, particularly in recent years after the War, the improvement of infrastructures of rural community was included in the land consolidation works in addition to the improvement of farmland and farm facilities. Thus, the works aim at not only an increase of productivity but also the improvement of living environment of rural people.

In this symposium discussions were made only on the problems of terminology as described above. There are many important and difficult problems confronting us "how can we develop the land consolidation in southeast Asian region and by what steps?"

All the papers presented to the symposium will be published from the Tropical Agriculture Research Center in the form of Symposium proceeding in a near future.

The Tropical Agriculture Research Center has been holding a symposium annually on selected subjects of technology of tropical agriculture since 1967, a pre-creation stage of the Center. The present symposium is the ninth one of the series of annual symposium.

Finally, the Center express its sincere gratitude to all the participants for their valuable contributions and kind cooperation to the symposium.