JSIDRE Award (1992)

The following (persons) received the JSIDRE Achievement Awards for fiscal 1992. The award ceremony and the authors’ lectures were held on the occasion of 1992 JSIDRE meeting at Hokkaido University on August 26, 1992. The total number of recipients of the JSIDRE Awards is 113, 136 persons, and recipients of the Dr. Ueno Award number 24.

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**Science Award**

**A Series of Fundamental Studies on Individual Hydrologic Processes**

Toshisuke MARUYAMA*

Irrigation and drainage is a scientific technology which provides a suitable water environment for agricultural lands by the replenishment of the natural hydrologic cycle. Therefore, in order to establish irrigation and drainage science, the individual hydrologic processes have to be made clear. Based on this concept, a series of studies was carried out. The content of this study consisted of the following four hydrological processes.

1. **Studies on Evapotranspiration and Heat Allocation**

Seasonal variability of evapotranspiration from a basin was qualitatively studied by the application of water balance method among the same discharge periods (with Takase). At the same time, a method of estimating the temperature of water ponded in paddy fields was proposed based on an idea which uses a function of net radiation of water surface on paddy fields and the leaf area index (LAI) of a rice plant. The usefulness of this method was verified by comparing the theoretical procedure with actual experimental data (with Ohara). Furthermore, combining of the heat and water balance methods gave an explanation for the fact that evapotranspiration from paddy fields sometimes exceeds the potential evaporation estimated when the Penman equation is employed.

2. **Studies on Run-off Analysis**

The weighted least square method was applied for the run-off analysis of low flow, because the simple least square method is not a very reasonable way of determining the parameters of a run-off model. The validity of this method was confirmed by actual experimental data. At the same time, a complex reservoir model was

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proposed and applied for analysis of the water demand and supply relationship. Valuable knowledge about return flow was obtained from this study (with Tomita). Run-off analysis of reclaimed land from a mountainous area was also carried out. From the study it was apparent that the discharge from the reclaimed area changed extraordinarily, due to lowering of the infiltration rate and changes in the layout of channels and in the roughness coefficients of the basin (with Kobayashi). Estimation of effective rainfall which has an important role in run-off analysis was also conducted. The results showed that the effective rainfall changed outstandingly with rainfall patterns.

3. Studies on Ground Water Hydrology

In the Kashima coastal area, which is a rapidly developing industrial area, the changes in the level of ground water as a result of construction of a harbor were estimated in terms of permeability, obtained from the reciprocal method using the shape of the ground water table and the quantity of ground water recharge which was estimated by the water balance method. In the Nobi Plain area, for instance, the change of the hydrologic cycle and the ground water movement by urbanization were studied. It was obvious from this study that the water supply at the initial stage of the irrigation period was consumed for the rising of the ground water table, and the subsidence of ground level occurred not only through the over-pumping of ground water but also through a decrease in permeable area due to urbanization (with Mitsuno).

4. Study on Underdrainage Mechanism of Paddy Fields

For a clayey paddy field, the role of cracks and backfill trenches was established by an underdrainage test. Simulation of the relation between undulation and residual water on paddy surfaces was also carried out, and an effective system for residual water drainage was proposed. The occurrence of subsoil cracks was also analyzed. This study showed that cracking was closely related to the amount of evapotranspiration in nonirrigation periods and to the density of the subsoil.

At the same time, flow resistance in cracks was investigated at the laboratory level. The experiment revealed that Darcy’s law was nearly applicable for the discharge calculation of the existing paddy. An applied and theoretical study of the relations between ground water level and aquifer pressure was further carried out, and valuable knowledge of sub-surface drainage planning was obtained. The results of this study have been employed for the design criteria of sub-surface drainage by the Ministry of Agriculture and are widely in use for the planning of existing drainage systems.