Water Management of Lowland Rice Paddy Fields in Saga Area

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1. Introduction

In many of the lowlands' situations around the world, rice/paddy is an important food crop and is widely cultivated in large areas. Due to these conditions of flat topography, rice is the food crop that can be successfully grown. Even though rice can be grown under waterlogged conditions, increasing in crop yields can be obtained by providing proper drainage.

In Saga area, due to land and water management, drained water is almost not reused for irrigating water at present. In this condition, the water quality for irrigation water is analyzed to consider whether nutrients included drainage water influence rice cultivation or not.

2. Field Study

Individual Paddy Field Layout: Around the fieldwork area there are three types of channel, drainage(interceptor drain), creek (modified creek) and irrigation(irrigation channel or main channel). Irrigation channel is far from the rice paddy. So this irrigation channel is not used for irrigating water directly. The channels that have relationships to rice cultivation in the rice paddy are drainage and creek.

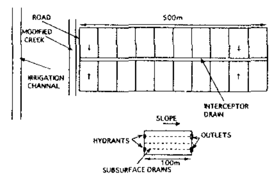

Fig.1 The General Paddy Field Layout

Water Balance Components: $W_d^J = W_d^{J-1} + P_f^J + I_r^J - R_e^J - D_r^J$ (1)

where, W_d^J = water depth in the field,

W_d^{J-1} = water depth in the field during previous time interval,

P_f^J = Precipitation, I_r^J = irrigation

R_e^J =Recession Depth(S^J=seepage (include percolation) and E_t^J= evapotranspilation) and D_r^J = drainage.

There are some assumptions for estimating water balance components.

1. In case of $P_f^J=0$ and $I_r^J=0$, $W_d^J - W_d^{J-1}$ depends on R_e^J and D_r^J.
2. In case of supplied water for irrigation, D_r^J is 0.
3. In case of $P_f^J>0$, I_r^J is 0.

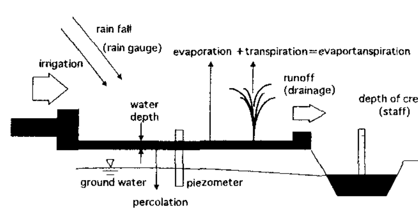

Fig.2 Water Balance component

In this study soil moisture content is not considered. In calculating equation (1) under the assumptions, the value of drainage is possible to be negative. In this case, this value is considered not to be negative by adding negative drainage to recession depth.

In the equation (1) of water balance, some of the components can be measured and some need to be estimated. In this study evapotranspilation is estimated by the Penman-Monteith method outlined in FAO paper number 46(Smith, 1992). This is an approach based on climatic parameters.

Table 1 Recession Depth

month	term	recession depth
June	13th to 20 th	20(mm/day)
	21st to 26th	10
	27th to 30th	10
July	1st to 10	10
	11th to 20th	10.6
	21st to 31th	12.4
Aug.	1st to 5th	12.4
	6th to 10th	12.3
	11th to 20th	14.9
	21st to 31th	15.1
Sept.	1st to 10th	13.2
	11th to 20th	13.7
	21th to 30th	13.5

Water Level Observation: Water depth in the rice paddy, ground water level and the rice paddy level and surface water level in the interceptor drain are measured for estimating water balance in the rice paddy.

Table 2 Evapotranspiration value in the rice paddy

month	ave.temp ℃	humidity %	windspeed km/day	sunshine hours	sol.radia MJ/m/day	ET_0 mm/day	ET_{crop} mm/day
May	21.6	69	285	5.3	17.8	4.09	4.908
June	23.4	80	294	3.6	15.7	3.54	4.248
July	27.5	79	294	5.6	18.3	4.32	5.184
August	28.7	76	285	6.6	18.8	4.74	5.688
September	25.6	76	138	6	16.1	3.49	4.188
October	20.4	74	112	4.5	11.8	2.46	2.952

3. Result and Discussion

Water Balance Components: The sum of seepage, percolation and evapotranspiration losses (recession depth) was estimated through the report of Estimation of water for irrigation in the lower region of the Chikugo River(MOA,1985). The data of recession depth is shown in Table 1. Considering the evapotranspiration values given in the Table 2, there is a variation of seepage and percolation losses depending on the surface water level in the interceptor drain. The estimated water balance is shown in Fig. 3. It is said that the average amount of water for irrigation is 900-1400m^3/10a in Japan. In case of taking account moisture content, the amount of water for irrigation will be a little increased. However it is seemed that water is well managed.

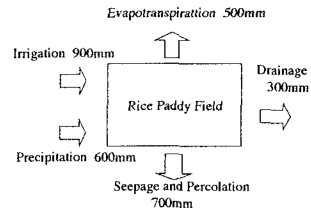

Fig.3 Water Balance

The Result of Cone-Penetrometer Test in place: In the last term of July, cone-penetrometer test in the rice paddy (center and drain side) were carried out to measure soil bearing capacity which is the ability of a soil to bear the weight and traction of equipment. The result is shown in Fig.4. The cone index of penetration represents the resistance (kgf/cm^2) to pushing a cone into the layer. It can be said that the plowed soil layer is the depth of 25cm from the surface of the rice paddy.

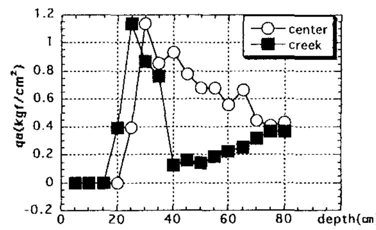

Fig. 4 Cone-Index in the rice paddy

Water Level Observation: Some water levels in the period from Aug.6th to Aug.16th are shown in Fig.5. During the period of summer drainage, the first ten days of Aug., soil moisture in the rice paddy was decreased. As the reason of falling down in ground water level, surface water was drained.

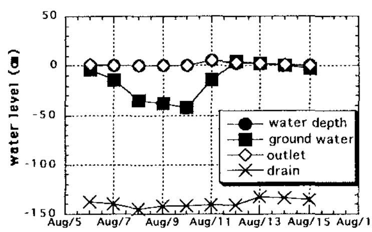

Fig. 5 Water Level Measurement

A Questionnaire study on Water Environment in creeks: This questionnaire study was carried out for inhabitants around creeks in summer season. In this response, almost all of them feel this water in creeks causes some problems, smell, insects and for scenery and don't use this water for any purposes(except agriculture, rice cultivation) recently. In addition, it seems that they think they should/have to clean these creek many times.(at present, the number of cleaning is twice a year)

Water Quality Analysis: The water qualities in several locations are analyzed. The averages of results are shown in table 3. Excepting the period of spreading fertilizer, the water quality (COD) in creek is not better than the standard for paddy in Japan. This water quality standards can be understood as maintaining desirable level for rural administration. (set up the standard by MAFF in 1970).

Table 3. The average water quality (except the periods of spreading fertilizer)

	BOD(mg/l)	COD(mg/l)	EC(μS/cm)	pH	T-N(mg/l)	T-P(mg/l)
drainage	7.93	18.7	113	6.54	0.64	0.14
creek	3.68	8.97	93.9	6.64	0.72	0.08
irrigation	2.34	4.64	81.9	7.28	0.53	0.04
the standard	-	6.0	-	6.0 - 7.5	1.0	-

4. Conclusions and Recommendations

In the rice paddy taken up for study it is seen that the water in the paddy are well managed, however for more better water management, the surface water level in interceptor drain should/have to be managed.

5. References

V.V.N.Murty, H.Araki, J.Namie(1998): Evaluation of water balance components in lowland rice cultivation.
Smith,M.(1992) CROPWAT a Computer Program for Irrigation Planning and Management.