Social Experiment of Volumetric Irrigation Fee Scheme: Case of Gravity Irrigation System in Bohol, the Philippines

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Abstract

Increasing in water productivity in rice is crucial as irrigated rice production consume a substantial part of the total world's fresh water. To promote the adoption of water saving technologies, farmers are provided with a tangible incentive to save water is necessary. The social experiment survey of volumetric pricing had been conducted in Bohol, the Philippines, where double rice cropping has been started since 2008 under gravity irrigation. The preliminary results showed that both economic incentive and technical training promoted the efficient water use.

Keywords: social experiment, volumetric pricing, AWD, gravity irrigation, the Philippines

Introduction

The current scheme of irrigation fee, in most of Asia, is charged according to the area irrigated. This scheme may induce overuse of irrigation water as the payment amount is fixed regardless of the actual water use. Area basis charge scheme has long been practiced due to technical difficulty of measuring water intake at farm level, for gravity irrigation system in particular. Fresh water has become increasingly scarce resource worldwide due to increasing in demand of urban and industrial use. Global warming and climate change may worsen this situation.

Considering that irrigated rice production consume a substantial part of the total world's fresh water use, increasing in water productivity in rice is crucial (Shivakoti *et al* 2005). To promote the adoption of water saving technologies, providing farmers with a tangible incentive to save water is necessary. Charging irrigation fee according to the volume of actual water use is such an incentive. The social experiment survey of volumetric pricing had been conducted in Bohol, the Philippines, where double rice cropping has been started since 2008 under gravity irrigation. Research questions were: 1) Whether volumetric incentive effectively induces water saving efforts of water users group, and 2) Whether training of water saving technology (Alternate Wetting and Drying, AWD) contributes efficient water use.

Materials and Methods

Bayongan Dam System of Bohol Integrated Irrigation System, Stage II (BIS-II), was selected as the study site (Map) (Figure 1). The system was constructed with the financial and technical support of JICA (Japan International Cooperation Agency). The system started operation in May 2008 covering 4,000 ha (designed area).The main canal of 6,662 m and 15 laterals, Lateral-A to O, are fully lined, and each TSA (Turnout Service Area, unit of water users) is equipped with spindle gate, by which farmers can control water intake by themselves, and a level gauge by which the volume of water is measured by the third party (Nippon Koei *et al.* 2007).

The experiment design was as follows. The volume of water intake was estimated based on the gauge reading three times a day (morning, noon and afternoon) at head gate of each TSA. Irrigation fee was firstly collected by area basis as usual, then to be paid back to TSA according to the percentage of saved water based on the required water volume for conventional continuous flooding practice.

Randomized field experiment was applied to 67 TSAs of upper portion of the system among total 147 TSAs. The data collections were conducted for five crop seasons from November 2008 to May 2011. No intervention was applied in the season 0 for all samples as the base line. Volumetric incentives had been applied to the half of TSAs randomly selected for four seasons from the season 1 to the season 4. Technical training of AWD was provided to the half of experimental TSAs and the half of control TSAs before the season 3 (May-Sep 2010). These two interventions resulted in the four groups (Table 1).

Figure 1. Map of the Philippines.

Table 1. Number of sample TSAs by treatment and season

Season 0 Nov08-Mar09	1 May-Sep09	2 Dec09-Apr10	3 Jun-Nov10	4 Dec10- May11	Treatment
67	34	34	16	16	CC
			18	18	CA
	33	33	20	20	VC
			13	13	VA

CC: No intervention
CA: AWD training only
VC: Volumetric only
VA: Volumetric and AWD training

Results and Discussion

In this analysis only the data of the season 0 to 3 were used, as the data of season 4 was still being processed. Profile of the sample TSAs is presented in Table 2. The average size of TSA was around 15 ha of irrigated paddy field with 25 members of farmers. Double rice cropping was practiced in irrigated paddy, while rice-upland crop in rainfed paddy and cassava in upland were common cropping systems. As the designed irrigation area was larger than the actual one, land leveling was still in process and irrigated area was gradually expanding. Main Farm Ditch (MFD) was the soil canal draws water from a lateral into TSA area. National Irrigation Administration (NIA) was responsible to design and construct MFD, while after completion its maintenance was assigned to each TSA. Efficient water use and equity distribution among the members were highly dependent on operation and maintenance of MFD. Almost all of the TSAs organize a regular monthly meeting and collective maintenance work as members obligation. In average, water intake reduced by 30% from Season 0 as baseline to Season 3, the third session of the experiment. Though other factors affecting water intake such as rainfall should be carefully took into account, the experiment seems successful as a whole.

Table 2. Profile of sample TSAs

n=67	Average	STDV
Number of members/TSA		
Season 0 (Nov08-Mar09)	24.7	14.4
Length of Main Farm Ditch (m)		
Season 0 (Nov08-Mar09)	650.5	495.2
Area irrigated (ha)		
Season 0 (Nov08-Mar09)	14.36	9.32
Season 3 (Jun10-Nov10)	16.44	9.02
Water intake (m^3/ha)		
Season 0 (Nov08-Mar09)	10,600	5,493
Season 3 (Jun10-Nov10)	7,308	4,964

Source: TSA interview survey, 2009.

Table 3. Rice yield under rainfed and irrigation by Lateral

Lateral	Rainfed (2007)			Irrigated (2009)			Irrg/Rain
	n	Average (t/ha)	STDV	n	Average (t/ha)	STDV	
A	28	2.39	0.67	84	2.79	1.43	1.17
B	5	2.46	0.59	12	2.22	0.86	0.90
C	NA	NA	NA	10	2.62	0.72	NA
D	11	2.68	0.83	29	2.92	1.59	1.09
E	5	2.04	0.55	14	2.87	1.6	1.41
F	13	2.02	1.14	33	2.42	1.39	1.20
G	5	1.86	0.9	14	2.67	1.45	1.44

Note: Lateral, A to G, aligns from up to down along the main canal.

Before evaluating the impacts of the experiment in detail, the effects of irrigation construction were briefly examined. The rice yield increased by 20 to 40% after irrigation, with some exception (Table 3). It should be noted that the effect was more obvious in down portion, suggesting irrigation contributed to not only production increase as a whole but also to mitigation of spatial disequilibrium.

Change in Locational Water Distribution

The distribution of water intake by TSA in Season 0 and 3 are shown in Figure 2. As expected, there was a tendency that TSAs in upper portion used more water than those in lower portion both at lateral level and within a lateral. This finding was consistent with the frequently cited "Upstream vs Downstream problem." Taking the advantage of position in the system, farmers in upstream likely to take water excessively under the condition of area basis water fee. This caused water shortage in the downstream, often resulting in conflict between the up- and downstream farmers. It is worth to point out that additional water use did not necessary resulted in higher yield (Table 3). This suggested that saving water in upper portion could contribute to increase in total rice production of the system level, provided saved water is to be effectively distributed down portion which suffers insufficient and unstable water supply.

Comparing the two seasons, a down ward slope from right to left became slightly flattened after experiencing three experiments. The upper portion (Lateral A-D) saved more water than the lower E-F, suggesting saved water was transferred to down portion (Lateral G and after), resulted in more equitable water distribution in the system-wide.

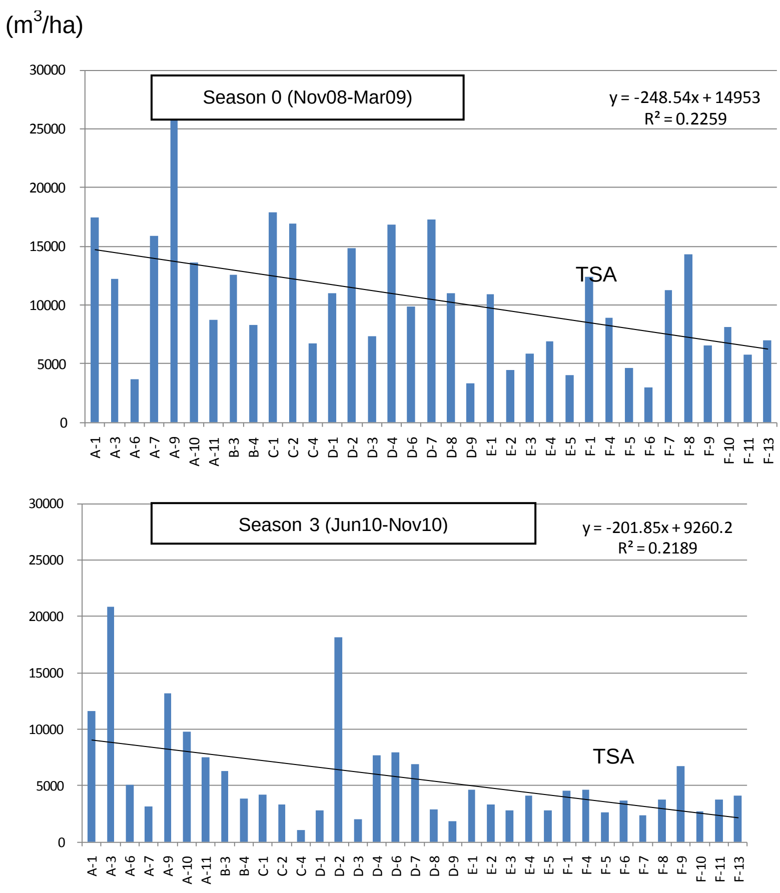
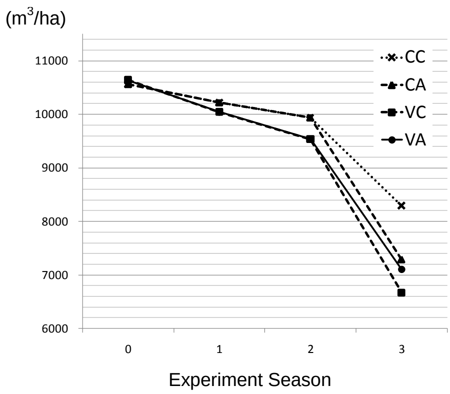


Figure 2. Spatial distribution of water intake by TSA.

Effects of Experimental Intervention

For further examining farmers' response to experimental interventions, changes in water intake by experimental group were compared. Average of water intake by experimental group is presented in Figure 3. Corresponding to the difference of experimental interventions, CC and CA were treated as one group, same as VC and VA, from Season 0 to 2. As the samples were selected randomly, water intakes of the two groups were mostly identical at the baseline (Season 0). The volume has been consistently declined including the control group (CC). The factors affecting overall water intake other than the experiment are rainfall, amount of water release from the dam, NIA's promotion of water saving technology. To evaluate the experiment effects separately from these factors, deviation of experimental groups from the control group should be focused. Economic incentive for water saving was effective, and efficacy of water saving efforts seem to be intensified as time goes. It seems that once farmers are convinced of no adverse effects on crop production (Season 1), they continue water saving efforts and learned effective ways by themselves (Season 2-3).

Providing technical training also showed its effectiveness, as the group of AWD training only (CA) substantially declined their water use compared with the control group (Season 3). There was anecdotal evidence from farmer interview, indicating ADW or intermittent irrigation may enhance yield by increased number of tillers and mitigating damage of golden apple snail. During the experiment period, farmers had chance to learn these information from their neighbors. Part of the sharp decline from Season 2 to 3 might be explained by this spillover effect. In addition, farmers had also chance to attend trainings by NIA and other institutions such as extension offices and NGOs. The synergy effect of economic incentive and training was not obvious. The performance of the group of volumetric and training (VA) is not so striking compared with the group of volumetric only (VC) and training only (CA) (Season 3).



CC (n=16): No intervention; CA (n=18): AWD training only
VC (n=20): Volumetric only; VA (n=13): Volumetric and AWD training

Figure 3. Change in water intake by experimental group.

Conclusions

The preliminary results of social experiment for volumetric water pricing clearly show 1) farmers well respond to economic incentive to save irrigation water use, 2) technical training was also effective to reduce water intake independently of economic incentive, 3) saved water was efficiently redistributed to down portion, enhancing system-wide equity. In this preliminary study social factors, which are highly expected to influence collective actions like irrigation management, were not considered. Reduced water may entail the risk of yield loss, while technical training and collective actions for water saving may contribute to yield increase and stabilization. These were the remaining issues for further analyses.

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-- back to Table of Content --