

Water Saving Device "ITAOTOSHI"

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Abstract

Water management rationalization, water saving and workload streamlining, is a pressing need in Japan's paddy agriculture. Water saving is realized by prevention of water spill-over on paddy outlet. The problem is that requires farmers to go around fields frequently in a day, resulting much workload.

Recently, several type of ICT controlled full-automated paddy irrigation gates are invented in Japan. But these are too sophisticated & expensive to be broadly introduced to actual farming. And, full-automatic gates cannot so much contribute to reduction of field work as expected, because regardless of full-automated gates farmers go to every fields once in a day. Therefore, paddy agriculture in Japan needs simple & low-cost automated water saving device with function of minimum necessity.

ITAOTOSHI is half-automated paddy irrigation gate in other words paddy water depth limiter. It has function of only closing gate when paddy water surface reaches a certain level.

Keywords: water management, water saving, workload, automated gate

1. Introduction

Production cost reduction through enlarging farm management scale and introduction of high income crops such as vegetables are pressing needs of paddy agriculture in Japan. For large scale paddy farming, reducing workload for water management is a key issue. And, for introducing high income crop growing, work force shift from rice to veritable is also a key issue. However, streamlining water management workload by loosening management must be avoided, because it increases water waste.

To cope with these issues, automated paddy irrigation gate which achieve both labor saving and water saving could become effective solution. Important points is the device must be simple and low-cost to be easily introduced. Thus we devised half-automated paddy irrigation gate "ITAOTOSHI". It could become one of solutions to assist shift of agricultural management from conventional farming to high-income business.

2. Points of designing automated gate

2.1. Consideration of actual field work

- Regardless of installation of automated paddy irrigation system, farmers go to field every day for check of crop growing, pest and ridge leakage etc.
- In case of open canal, amount of water flow allocated to a canal is limited and constant. So, farmers must pay attention to other farmers in lower stream or opposite side of the canal when starting water intake, because water intake from canal flow influences other farmer's irrigation operation.

Therefore starting water intake with automated device, which cannot take into account condition of other farmers sharing the same canal, causes conflict in local community especially in regions without abundant water resources.



Photo 1. ITAOTOSHI on field canal



Photo 2. ITAOTOSHI and water depth sensor

2.2. Requirements necessary for farming device

- Both initial and running cost are inexpensive. Even if government subsidy is available for initial installation, farmers will bear the burden of renewal cost in future.
- Farmers can easily install and remove the device at fields. In case, initial installation needs some construction work or set & removal at the beginning & closing of paddy cropping season need much workload, farmers will be tend to refrain from introducing new method.
- The device is durable and easy to repair & parts-procuring. Even if it is useful, device with short lifespan cannot be broadly used because government subsidy will not be allocated to that.
- Operation is simple and easy so as to be operated by anybody. For fair water distribution, water for lower stream must be secured by preventing excessive water intake at upper stream. That can be realized through introduction of water saving devices in upper stream. In this case, main beneficiaries of the devices installed

at upper stream are farmers in lower stream.

Thus, one device benefits not only a farmer but also all farmers who share one canal. Therefore, water saving devices will be introduced by community based initiative, and can be operated by anyone in the community even if aged person.

3. Functions & features of ITAOTOSHI

3.1. Functions

- TAOTOSHI is automated water depth limiter, whose function is only stop water intake by closing gate automatically. Start of water intake can be done with minimum work load, if farmers open gates during daily field patrol for observation of crop growing, pest etc. Farmer can open gates by only pulling up handle-shaft, which needs only a few seconds. So, no work burden to farmers.

Therefore it can contribute reducing workload for paddy water management certainly, because it unnecessary field patrol for checking paddy water depth and it reduces workload for handling inlet gate.

- Main functional parts of ITAOTOSHI are gate-panel, handle-shaft, water level sensor, solenoid, and unit3 type battery etc. When farmers raise handle-shaft manually, gate-panel is held at high position. When sensor detect full water, solenoid loosen the hold of handle-shaft then gate-panel falls by gravity.



Photo 3. Hydraulic test

3.1.1. Features

- Initial & Running cost: Electric motor, gear, solar panel, rechargeable battery, electric controller are not used as parts of ITAOTOSHI, because gate raising is powered by human hand and gate descent is powered by gravity. Thus, this machine is so simple and inexpensive. Running cost is only expense for small battery.
- Installation and Removal: Installation is only fitting to groove for stop-log at inlet of concrete flume.
- Durability and Maintenance: It will not be easily deteriorated by weathering, because the body is made of plastic board and stainless steel. Parts such as sensor, switches etc. are available at electric parts shop.
- Operation: Starting automated system is only pushing on/off switch at the beginning of irrigation term. Water depth setting is adjusting sensor height above soil surface by hand.

4. Result of field test

We conducted field test using 30 units. Results are as follows.

- Resistance to weather: Failure has occurred just after heavy rain. It was solved when the devices dried the next day.
- Mechanical problem: Failure by friction on contact surface of parts has occurred. It was solved by spraying lubricant oil.
- Gate leakage: Slight water leakage between gate-panel and plastic body board was observed. Some farmer comment it as ignorable, other farmer say it will become problem during "Nakaboshi" mid-summer field drying.
- Gate handling: Unexpected comment as follow are offered. Gate handling with standing posture is very helpful, especially for aged farmers or large scale farmers managing dozens of field who are struggling to handle stop-log in water stream below foothold with crawling posture. If you remove electric parts, only the gate with handle-shaft will be selling well.
- Field conditions: Because sensor case bottom is open, wave and mud soil influenced sensor sensitivity.
- Water flow: Width of inlet flow cross section of ITAOTOSHI is smaller than that of inlet of concrete flume. Therefore, in case of shallow canal flow, concrete blocks named GETAMIZU BLOCK or wood boards were necessary to raise water depth.



Photo 4. Raising water depth by GETAMIZU BLOCK

- Misunderstanding: One farmer who share the same canal expressed concern that selfish water intake by machine causes trouble among farmers. By explaining that it is a tool for fair water distribution by water saving, he understood significance of ITAOTOSHI and expressed favor to it.

5. Others

ITAOTOSHI can prevent water pollution in river & lake by reducing nitrogen and phosphorus included in drained water overflowed from paddy outlet.

6. Conclusion

Further improvements based on result of field test makes ITAOTOSHI a well-functioning device.

Followings will be achieved through introduction of ITAOTOSHI. Farmers can save water by preventing water spill-over at paddy outlet without much workload. Farmers can enlarge management scale by streamlining workload. Farmers can introduce high income crop by rational allocation of work force. Saving water resources and prevention of water pollution will contribute to SDG's. Thus so simple device "ITAOTOSHI" will contribute to realizing important social goals.