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Improvement of Traditional Rain Water Harvesting Structures for Multiple Use of Water Through IFS Module under Farmers' Participatory Action Research Programme

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ABSTRACT: *Availability of water for agricultural use has been reducing due to growing water scarcity and competing water demands. Efforts are needed to utilize the available limited water resources efficiently and effectively to increase water productivity by adopting suitable IFS modules. To increase water productivity and to provide better employment in farm sector, a Farmers Participatory Action Research Programme (FPARP) on water management was carried out by Krishi Vigayan Kendra Sonitpur, Assam during 2011-12. An IFS module integrating horticultural crops, fisheries and poultry component was adopted for judicious use of harvested rainwater from a renovated traditional rain water harvesting structure under the FPARP. The study revealed markable increase in water productivity and other parameters in the IFS module adopted for multiple use of water in comparison to the conventional system. The daily per capita availability of energy (K cal) was recorded to be 551.97 in conventional system and 851.14 under multiple use of water. The B:C increased from 3.2 (conventional system) to 4.7 in multiple use. In conventional system water requirement (ha cm), WUP (kg/ha.cm), labour requirement (man days/ha) and labour use efficiency (kg/ha/labour) were recorded to be 90, 27.28, 16 and 14.2, respectively and their corresponding values recorded in multiple use of water were 240, 40.5, 83 and 25.5.*

Key words: *IFS, FPARP & Multiple Use of Water*

INTRODUCTION

Water occupies 70.9% of the Earth's surface, and is critical for all known forms of living beings. About 96.5% of the Earth's water is found in oceans, 1.7% as groundwater, 1.7% in the form of glaciers and the ice caps, a small fraction in other large water bodies, and 0.001% in the air as vapour, clouds, and precipitation **(Gleick, 1993).** Only 2.5% of the Earth's water is fresh water of which, 98.8% of water is present as glaciers and groundwater. Less than 0.3% of the total freshwater is present in rivers and lakes, and an even smaller amount of the Earth's freshwater (0.003%) is conserved within biological bodies and manufactured products **(Gleick, 1993)**.

There is an unambiguous correlation between access to pure water and GDP . Conversely, many observers have estimated that by 2025 more than half of the world population will be facing water-linked vulnerability **(Kulshreshtha, 1998).** A recent report suggests that by 2030, in some developing regions of the world, water demand will exceed supply by 50% (**2030 –Water Resource Group, 2009).** It is important to note that that approximately 70% of the fresh water used by humans goes to agriculture **(Baroni *et. al.*, 2007)**.

Five decades before, the ordinary perception was that water was a never-ending resource. On the other hand, the competition for the fixed amount of water resource is much more intense at present time **(Gleick, 2010)**.

In future, even more water will be required to produce food and fulfill the demand of the earth's population because the Earth's population is forecast to rise up to 9 billion by 2050 **(United Nations Press Release, 2007)**.

International Water Management Institute in Sri Lanka conducted an assessment of water

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management in agriculture in 2007 to see if the world had required water to provide food for its growing population (Molden, 2007). It was observed that more than 1.2 billion people in the world, live in areas of physical water scarcity, where there is not enough water to meet all demands. Further 1.6 billion people live in areas experiencing economic water scarcity, where the lack of investment in water or insufficient human capacity makes it impossible to satisfy the demand for water. The report found that it would be possible to produce the food required in future, but that continuation of today's food production and environmental trends would lead to crisis in many parts of the world. To avoid a global water crisis, farmers will have to strive to increase productivity to meet growing demands for food, while industry and cities will have to find ways to use water more efficiently (Chartres and Varma, 2010).

Keeping all these in view, a Farmers' Participatory Action Research Programme (FPARP Phase II) on water management was carried out by Krishi Vigayan Kendra Sonitpur, Assam funded by Ministry of Water Resources, Govt. of India under AICRP on water management, Assam Agricultural university (AAU),Jorhat-13 during 2011-12 with an objective to increase water use efficiency vis-à-vis better employment in the farm sector.

MATERIALS AND METHODS

Rural Development by proper management of precious natural resource water was tested in FPARP Phase II funded by Ministry of Water Resources, Govt. of India under AICRP on water management, AAU, Jorhat-13 at two different locations of Sonitpur district of Assam by Krishi Vigyan Kendra, Sonitpur, Assam.

Improvement of traditional rain water harvesting structure: Assam has rich tradition of water harvesting which is evident from the number of old ponds located throughout the state. Unfortunately many of the traditional water harvesting structures have fallen into disuse due to expansion of government water supply schemes. Therefore, there is a great possibility of using these rainwater harvesting structures for supplementing irrigation during *rabi* (dry) seasons to increase their economic utility. Government of Assam through the draft water policy (section 9.7.4) declared that effort would be made to modernize the traditional rain water harvesting method through proper input of modern science and technology. **For Improvement of traditional rain water harvesting structures following steps were followed.**

1. Suitable site selection for pond.
2. Determination of size and depth of pond.
3. Harvesting of rain water during rainy season
4. Estimation of loss of harvested water
5. Amount of water required for irrigation and day to day use + 20% water was considered to be the volume of water harvesting tank.

For example: to irrigate two crops in 1 ha land with 5 cm irrigation for two times the volume of pond should at least be 2400 m^2 (40 m length x 30 m width x 2 m depth)

The following management practices were followed to enhance water retention during dry season.

1. 20: 5:1 Mud :Na_2CO_3 : NaCl was used to plaster the pond bottom
2. After 10 days of sun drying , the pond bottom and sides of the pond up to 15 cm height was plastered with a mixture of 10: 1: 1 (Clay Soil: Chopped rice husk: Cow dung)
3. To prevent the soil erosion from the dyke, barriers using locally available bamboos have been constructed in the initial stages.
4. The dyke of the pond was pasted with heavy top soil along with grass to prevent erosion.

Multiple use of water: Rural household system of Assam traditionally encompasses different crops, fruit plants, and livestock and fish ponds with different technology packages. Altogether nine technology packages on integrated farming were so far being developed for NE region that involves multiple use of water with a basic objective to increase the water productivity. One among them that includes horticultural crops, fish and poultry has good acceptance and potential where bio-waste from poultry is recycled into the fish pond to substitute fish feed by promoting the growth of aquatic plants and providing nutrients for horticultural crops through nutrient rich pond irrigation water as was used in our study.

RESULTS AND DISCUSSION

The programme was undertaken covering 2 villages with 14 numbers of beneficiaries in Sonitpur district of Assam with following technologies provided by AICRP centre,AAU,Jorhat-13 *ie.* Improvement of traditional Rainwater harvesting structure and multiple use of water

Technology on Improvement of traditional rainwater harvesting structure and multiple use of water was demonstrated in two locations of Sonitpur District viz. Koroioni Bengali Village and Sootea. Where, one number of defunct traditional rainwater harvesting structure has been completely renovated in each location for supplement irrigation during *rabi* season thus increasing its economic utility. Before renovation there was hardly any water in the ponds during *rabi* seasons. The ponds have been renovated in such a way that could provide year round water availability to a group of farmers for IFS activities well as a source of irrigation water for *rabi* crops thus increasing the WUP up to 40.5 kg/ha.cm (Fig 1). Good works have also been conducted in NE India Improvement of traditional rainwater harvesting structure **(Kumar, *et. al*, 2011).** Multiple use of water aims to increase water productivity by adopting IFS model using fish-duck- horticulture as three basic components. At first, renovated farm ponds have been amended with lime. Thereafter, fish fingerlings were released in properly developed ponds. Duck houses were constructed above the water body to utilize their litter as pond manure. Nutrient rich pond water is used to irrigate horticultural crops grown on the bank. Comparison of the two systems is presented in Table 1. Perusal of data reviles that benefit cost ratio in multiple were 4.17 compared to 3.2 in traditional system. The daily per capita availability of energy in (K cal) was recorded to be 551.97 in conventional system and 851.14 under multiple use of water (Table2). Many workers have reported better efficiency of multiple use of water compared to traditional systems **(Van *et al.*, 2009; Sikka *et al.*, 2010). Channabasavanna and Biradar (2007)** reported that IFS consumed 36% higher water than the conventional system of rice-rice but the water use efficiency was 71% higher in IFS than

Table 1
Multiple use of water (Average data for 2 locations. Calculations made for 0.13 ha pond)

Sl No.	*Items*	*Traditional Practice (Before intervention)*			*Multiple use of water (Probable outcome after a year after intervention)*		
		Production	*Cost*	*Income*	*Production*	*Cost*	*Income*
1	Eggs	-	-	—	3680 Nos	2400.00 @60/duck	Rs. 18400.00 @ Rs.5.00/egg
2	Live duck	-	-	-	40 kg		12000.00 @ Rs.300/duck
3	Fish	250.0 kg	5375.00 (Rs.21.5/ kg fish)	25000.00	600.00 kg	7860.00 (Rs. 13.1/ kg fish)	60000.00@ Rs.100/kg
4	Horticultural crop				Banana=50q (0.13 ha)	Rs.18530.00	Rs.40000.00 (Rs.8/kg)
					Assam lemon = 6000 nos (40 plants)	Rs.5670.00	Rs.12000.00 (Rs.2/kg)
					Turmeric= 4q/0.03 ha	Rs. 600.00	Rs.4000.00 (Rs.10/kg)
5	Total		5375.00	25000.00		35060.00	146,400.00
6	B:C ratio			3.2			4.17

Table 2
Daily per capita availability of food, Energy and protein

Food item	*System of water use*	*Daily Per Capita Avail. (g)*	*Daily Per Capita Energy Avail. (Kcal)*	*Daily Per Capita Protein availability(g)*
Rice	Conventional	120.2	416.03	8.18
	Multiple	190.1	657.96	12.95
Pulse	Conventional	15.0	51.70	3.15
	Multiple	34.5	118.93	7.25
Banana	Conventional	0	0	0
	Multiple	72	53.89	0.76
Vegetables	Conventional	0	0	0
	Multiple	4.0	4.09	0.695
Fish	Conventional	136.2	84.24	3.51
	Multiple	8.8	9.02	1.53
Eggs	Conventional	0	0	0
	Multiple	4.0	7.25	5.56

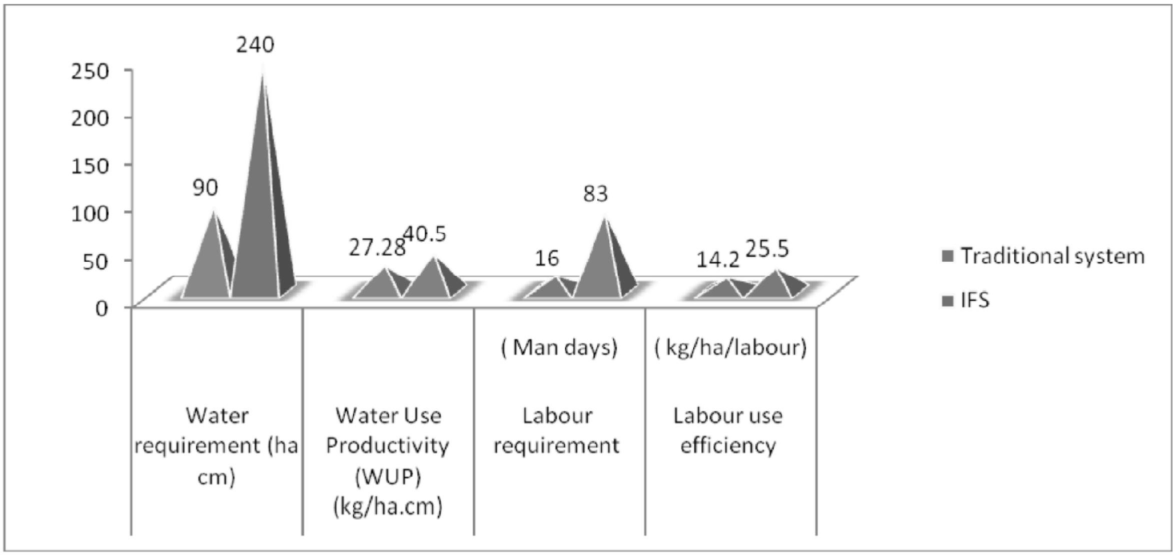

Figure 1: Relative efficiency of water and labour in traditional system and IFS

conventional system. Earlier, **Jayanthi *et al.* (2000)** indicated that integrated farming requires less water per unit of production than mono-cropping systems.

CONCLUSION

The technologies under FPARP have received considerable attention and acceptance of the farmers and have fitted well for the purpose of increasing water use efficiency and water productivity. The renovation of traditional rain water harvesting structures using farm ponds provided a low cost irrigation facility and scope for multiple water use. Considering horticultural crops, fish and duck farming as components of an Integrated Farming System (IFS) module demonstrated in two locations in Sonitpur district of Assam fetched a higher income for the farmers.

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