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INTRODUCING IMPROVED TECHNOLOGY IN WHEAT CROP AND TO ASSESS ITS IMPACT ON WATER PRODUCTIVITY UNDER TRIBAL AREA OF JABALPUR

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ABSTRACT

Demonstrations (Improved Practice) on wheat variety GW-273 were conducted on farmers' fields in Villages Bichhua and Sanjari of Kundam Block of Jabalpur district during rabi season of the year 2014-15. Prevailing farmers' practices were treated as control for comparison with recommended practices. About 29.98 per cent higher grain yield was recorded under demonstrations over the farmers' practices. The study found, the yield of wheat in IP under irrigated conditions ranges from 24.20 to 42.20 q/ha whereas in farmers' practices it ranges between 16.72 to 38.93 q/ha. The per cent increase in yield with Improved Practice over farmers' practices was recorded in the range of 0.05 to 76.68. The data revealed that improved wheat technology given additional average yield of 7.06 quintal per hectare as yield parameter of the area. Water productivity of farmer practice varies from 0.82 to 1.22 Kg/m^3 whereas water productivity of demonstration of improved practice ranging between 0.97 to 1.32 Kg/m^3.

Keywords: *Improved Practice (IP), Water productivity, Farmers' practices (FP), Tribal area*

INTRODUCTION

Water is indispensable for human, animals and plant life. Water demands are increasing every year while resources are becoming more and more limited. About 40% increase is expected in water demand over the period of next two decades. Substantially increasing the productivity of water in agriculture will play a vital role in easing competition for scarce resources, prevention of environmental degradation and provision of food security. The increase in water demand is a contribution of various factors including growing population, increased agricultural needs, industrial use of water and water needed for electricity production. The argument for this statement is simple by growing more food with less water; more water will be available for other natural and human uses (Rijsberman, 2001). Increasing productivity of water is particularly important where water is a scarce resource.

In the dry farming, water is the most limiting resource for improving agricultural production. Maximization of yield per unit of water, not yield per unit of land, a better strategy for dry farming systems. Under such conditions, more efficient water management techniques must be adopted. Water deficiency and low availability of nutrient often limit crop growth and production potential in agro-ecosystems because most crops are sensitive to water and nutrient deficits during different critical stages. Excessive use of water can increase the production cost and pollute the environment (enhancing fertilizer leaching). So enhancement of water productivity in agriculture is very important. It is widely believed that an increase in agricultural water productivity is the key approach to mitigate water shortage and to reduce environmental problems. In agriculture, we want to produce more with less water, because water is a limiting factor in many parts of the world. Water productivity is a useful indicator for quantifying the impact of irrigation scheduling decisions with regard to water management. Water productivity is a useful indicator for quantifying the impact of irrigation scheduling decisions with regard to water management.

Water productivity' may carry different meanings to different people, and may differ between but also within groups of water users. Productivity is a ratio between a unit of output and a unit of input. The term water productivity is used exclusively to denote the amount or value of product over volume or value of water depleted or diverted. The value of the product might be expressed in different terms (biomass, grain, money). Agricultural scientist can use water productivity in different aspects: leaf water productivity (leaf photosynthetic rate per transpiration rate), whole plant water productivity (the ratio of above ground biomass or dry matter per unit area to water use), yield water productivity (crop grain per unit area to transpiration) (Hong-Xing et al., 2007). In crop production system, water productivity (WP) is used to define the relationship between crop produced and the amount of water involved in crop production and expressed as crop production per unit volume of water. Crop production may be expressed in terms of total dry-matter yield or seed/grain yield (kg) or monetary units. (kg ha-1cm-1)

Agricultural water productivity at the farm level is achieved by using improved crop varieties, applying precision agriculture, using modern irrigation, diversifying cropping patterns and most importantly, improving water management. In this article therefore highlighted the measures or possible ways to improve water productivity in irrigated and dry land agriculture. The term 'increasing or improving water productivity' implies how we can most effectively improve the outcome or yield of a crop with the water currently in use. The three main pathways for improving water productivity (Passioura, 2006) is (i) transpire most of the supplied water (minimization of unwanted loss), (ii) exchange transpired water for CO_2 more effectively in producing biomass and (iii) convert most of the biomass into grain or other form of harvestable product.

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On-farm water use efficiency and water productivity can be improved by moving to a more efficient irrigation system. Sprinkler and drip irrigation can save water loss. Minimization of water loss during land preparation in rice cultivation leads to lower total water requirement and enhances water productivity. Modernization and optimization of irrigation systems can contribute to increase water productivity (Playan and Mateos, 2006). The technical aspects of modernization include water management, system operation and upgradation of structures and equipments. (Meena S.K. et al., 2006).

Most of India's 'so called' rain-fed areas are in central India and the peninsular region. Of these, the central Indian belt deserves special mention. This region is dominated by tribes, who are the first or second generation agriculturists (Phansalkar and Verma 2005). In spite of abundant natural resources, by and large, the population in this region is not able to improve their farming considerably, owing to their peculiar cultural and socioeconomic conditions. Instead, they mostly practice subsistence farming and grow most crops under rain-fed conditions. Development of water resources for irrigation is poor in these regions; the use of modern farming practices including the use of fertilizers and pesticides and crop technologies is extremely low. The result is that the productivity is low for cereals, and the total factor of productivity growth is also very poor. The other food grain crops grown extensively in this region have a low productivity (Amarasinghe et. al., 2005). Hence, this region is characterized by agricultural backwardness.

Improved soil water management practices for rainfed regions include reducing runoff, rainwater harvesting and recycling and conserving rainwater in the root zone by reducing evaporation losses, and optimal nutrient management. The low WP in farmer's fields compared with well-managed experimental sites indicates the need for more efforts to transfer water saving technologies to the farmers. In future we need to increase scientific understanding of the effects of agronomic management on WP across various soil and climate conditions; improve irrigation practices (timing and amounts) and methods (drip and sprinkler) based on real-time monitoring of water status in soil-crop systems; and maximize WP by managing water resources and allocation at regional scales in wheat-based cropping systems.

Many technologies to improve Water Productivity and the management of scarce water resources are available. A single approach would not be able to tackle the forthcoming challenge of producing more food and fibre with limited or even reduced available water. The technological assets include a number of high yielding crop variety, package of improved agro techniques and management of input use as well as resource management technologies which are still paying much towards enhancing productivity of wheat crop.

Keeping the importance of demonstration, we had laid out demonstrations of wheat crop on farmers' field in Bichhua and Sanjari villages of kundam block of Jabalpur district under irrigated situations during *Rabi* 2014-15 with following specific objective i.e. to introduce improved technology and to assess its impact on water productivity.

MATERIALS & METHODS

The experiment was carried out during rabi season of 2014-15 to study on introduction of improved technology and to assess its impact on water productivity in tribal area. The study area is Sanjari and Bichhua village of Kundam block of Jabalpur district about 54 km and 24 km from the headquarter respectively. Selection of farmer was based upon their size of land holding, awareness about new technologies, source of irrigation and willingness to do according to the new concept and ideas. Farmers were contacted personally to collect the desired information in Performa prepared for survey. To collect sufficient factual and reliable information about present cropping system a questionnaire was prepared. It was designed to collect information regarding variety used, sowing method seed rate, tillage practices, fertilizer use, irrigation related queries, plant protection and yield of crop etc. On the basis of these informations, the water productivity were identified for both practices i.e. Farmer practice (FP) and Improved Practices (IP).

A diagnosis procedure is an examination to identify shortcomings of existing cropping pattern in order to determine a condition. After the analysis of farmers view about existing cropping pattern, treatments/demonstration for the improvement of their production and water productivity shall be prepared on the basis of technology gaps identified in the Performa survey. The difference between demonstration package and existing farmers practices are given in Table 1.

Water productivity is defined as the 'crop production' per unit 'amount of water used' (Molden, 1997). Concept of water productivity in agricultural production system is focused on

Table 1: Comparison between Demonstration package and existing farmers Practices under Wheat crop

S.NO.	Particulars	Wheat	
		Farmer practice (FP)	Demonstration/Improved Practice(IP)
1	Farming situation	Flood Irrigation	Sprinkler irrigation
2	Variety	Sujata/322	GW-273
3	Time of Sowing	Oct-Nov	November
4	Method of sowing	Nari/Broadcasting	Line sowing
5	Seed Treatment	Without seed Treatment	Thirum 3 g/Kg of Seed
6	seed rate	200-220 kg/ha	100-120 kg/ha
7	Fertilizer dose	N:P:K (60-20-00)	N:P:K (80-40-00)

'producing more food with the same water resources' or 'producing the same amount of food with less water resources'. It is the ratio of crop yield to the amount of water applied (Irrigation applied + Rainfall) to produce it and express as kg/m^3.

$$\text{Water productivity (WP)} = \frac{\text{Yield (kg/ha)}}{\text{Total depth of water (cm)}}$$

Note: Unit of total depth of water in centimeter (cm).

RESULTS AND DISCUSSION

As mentioned earlier the study area Bichhua and Sanjari are tribal populated with meager source of irrigation. Due to work on ground water recharge, it could be possible to drill three tube wells which were utilized for irrigating crops. The soils of the area are not rich organic matter and most of the fields are stone infested as well as farmers are lesser educated about adoption of new technologies. All this led to lower crop yield even in demonstration plots. Reasons behind low productivity are use of low quality seeds, improper field preparation (due to stony soil), and limited resources for mechanization, no use of fertilizers and absence of irrigation sources. Following interventions were identified and trials on each were taken to demonstrate the improvement.

- Use of high yield variety of seed
- Timely sowing
- Seed treatment
- Seed rate
- Method of sowing (line sowing)
- Sprinkler irrigation method
- Proper dose of fertilizer
- Use of Insecticide and herbicide

From Table 2 and Table 3 it can be calculated that use of improved technology has higher water productivity than farmer practices. The per cent increase in yield with Improved Practice over Farmer's practice was also recorded during observations. (Table 4)

Table 2: Water Productivity of Farmer Practice (Control)

S. No	Name	Area (ha)	Village	Yield (q/ha)	Depth of irrigation (cm)					No. of irrigation	Depth of water applied	Water productivity (kg/m^3)
					1	2	3	4	5			
1	Gyan Singh Kulaste	0.45	Bichhua	31.4	6	5	6	5	6	5	28	1.12
2	Nanhe Singh	0.30		25.6	6	8	0	6	6	4	26	0.98
3	Rajesh Singh	0.60		38.9	6	7	6	7	6	5	32	1.22
4	Suresh Premlal	0.30		29.2	6	5	5	6	5	5	27	1.08
5	Mulayam Singh	0.35		32.8	6	6	6	6	6	5	30	1.09
6	Ashok Singh	0.30		26.5	7	6	7	0	7	4	27	0.98
7	Bhangi sigh	0.45	Sanjari	29.5	6	6	5	5	5	5	27	1.10
8	Tevar Lal	0.21		22.9	7	0	5	7	7	4	26	0.88
9	Name sigh	0.46		28.5	6	4	5	5	7	5	27	1.06
10	Dhanuva	0.40		24.8	6	7	0	6	7	4	26	0.95
11	Budhiya bai	0.40		20.5	6	0	7	6	6	4	25	0.82
12	Kajlo bai Mohan	0.40		21.8	7	6	0	7	6	4	26	0.84
13	Siya bai Amar Singh	0.40		21.4	8	0	5	5	8	4	26	0.83
14	Hernam Samna Singh	0.40		31.3	6	6	5	6	6	5	29	1.08
15	Gyan Singh	0.45		24.5	6	7	0	7	6	4	26	0.94
16	Ram Singh manna	0.40		23.5	5	0	8	8	5	4	26	0.91
17	Rajkumar /Sambhu	0.40		22.8	8	7	0	4	7	4	26	0.88
18	Baldev Singh/ Bhaddu	0.32		25.4	7	8	4	0	7	4	26	1.0
19	Bhuralal	0.40		22.8	6	6	0	6	6	4	24	1.0
	Average			**26.53**								**1.04**

Table 3: Water Productivity of Improved Practice (Demonstration)

S. No.	Name	Area (ha)	Village	Yield (q/ha)	Depth of irrigation (cm)					No. of irrigation	Depth of water applied	Water productivity (kg/m^3)
					1	2	3	4	5			
1	Gyan Singh kulaste	0.45	Bichhua	36.7	6	6	6	6	6	5	30	1.22
2	Nanhe Singh	0.30		31.9	6	5	6	5	6	5	28	1.14
3	Rajesh Singh	0.60		42.2	7	6	6	7	6	5	32	1.32
4	Suresh /premlal	0.30		29.3	6	5	5	6	5	5	27	1.09
5	Mulayam Singh	0.35		35.7	6	6	6	6	6	5	30	1.19
6	Ashok Singh	0.30		35.3	6	6	6	6	6	5	30	1.18
7	Bhangi sigh	0.45	Sanjari	40.1	7	6	6	7	6	5	32	1.25
8	Tevar Lal	0.21		40.6	7	6	7	6	6	5	32	1.27
9	Name sigh	0.46		35.3	6	6	6	6	6	5	30	1.18
10	Dhanuva	0.40		37.8	6	6	6	6	6	5	30	1.26
11	Budhiya bai	0.40		28.1	5	6	5	5	5	5	26	1.08
12	Kajlo bai Mohan	0.40		26.3	5	5	5	5	5	5	25	1.05
13	Siya bai Amar Singh	0.40		29.3	6	6	5	5	5	5	27	1.09
14	Hernam Samna Singh	0.40		39.1	6	6	7	6	6	5	31	1.26
15	Gyan Singh	0.45		29.2	6	5	5	6	5	5	27	1.08
16	Ram Singh manna	0.40		33.8	6	5	6	6	6	5	29	1.17
17	Rajkumar /Sambhu	0.40		34.2	6	6	5	6	6	5	29	1.18
18	Baldev Singh/ Bhaddu	0.32		29.1	5	5	5	6	6	5	27	1.08
19	Bhuralal	0.40		24.2	5	5	5	5	5	5	25	0.97
	Average			**33.60**								**1.23**

Table 4: Yield of Wheat (GW-273) under farmer practice FP (control) and Improved practice IP

Name of Farmer's	Area (ha)	Seed yield (q /ha)			% increase over control
		Potential	Demons-tration (IP)	Control (FP)	
1	2	3	4	5	6
Gyan Singh kulaste	0.45	45	36.70	31.42	16.82
Nanhe Singh	0.30	45	31.90	25.60	24.61
Rajesh Singh	0.60	45	42.20	38.93	8.41
Suresh /premlal	0.30	45	29.30	29.29	0.05
Mulayam Singh	0.35	45	35.70	32.83	8.73
Ashok Singh	0.30	45	35.30	26.56	32.91
Bhangi sigh	0.45	45	40.10	29.58	35.56
Tevar Lal	0.21	45	40.60	22.98	76.68
Name sigh	0.46	45	35.30	28.50	23.86
Dhanuva	0.40	45	37.80	24.80	52.45
Budhiya bai	0.40	45	28.10	20.52	36.94
Kajlo bai Mohan	0.40	45	26.30	21.88	20.20

Siya bai Amar Singh	0.40	45	29.30	21.47	36.50
Hernam Samna Singh	0.40	45	39.10	31.33	24.80
Gyan Singh	0.45	45	29.20	24.55	18.94
Ram Singh manna	0.40	45	33.80	23.53	43.65
Rajkumar /Sambhu	0.40	45	34.20	22.89	49.41
Baldev Singh /Bhaddu	0.32	45	29.10	25.45	14.36
Bhuralal	0.40	45	24.20	16.72	44.71
Average	**0.52**	**45**	**33.59**	**26.25**	**29.98**

CONCLUSION

On the basis of the results obtained in present study it can be concluded that, the crop productivity of studied villages are low. It was found to be 12-17 g/ha for wheat. The water productivity of wheat was found as low as 0.82 kg/m^3. Bichhua and Sanjari villages are resources poor and having low crop productivity due to adoption of low yielding varieties of crops, improper method of sowing inadequate use of fertilizer and non adoption of suitable irrigation method. On adoption of different improvement interventions the wheat productivity increased to 1.23 kg/m^3. The water productivity was found significantly correlated (1%) with grain yield and water applied. The use of improved technology has higher water productivity than farmer practices. Water productivity of farmer practice varies from 0.82 to 1.22 Kg/m^3 whereas water productivity of demonstration of improved practice ranging between 0.97 to 1.32 Kg/m^3. It means use of high yielding variety seed, Proper dose of fertilizers and sufficient irrigation has considerable impact on water productivity.

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