Irrigation Water Quality vs Crop Quality

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Abstract: The parameters of water quality, namely pH, electrical conductivity, alkalinity, nitrate, phosphate, sodium, calcium, magnesium, TDS and TSS, have effect or adverse effect on irrigated agriculture. Impact assessment of adequate supply of usable quality water for the purpose of irrigation to influence the crop quality and marketability has a great deal with present art of agriculture. The influence of irrigation water quality on crop quality, marketability and mitigation options of adverse effect of unsuitable/ contaminated/ polluted/ waste water on agricultural produces needs more attention at present day of precision agriculture to maximize the net returns.
Key-words: Crop quality; water quality; crop productivity; groundwater and rainwater

Introduction

A number of water management technologies, for various crops have been developed over years to enhance agricultural production as well as profit. The area of crop(s) under irrigation was also increased substantially. The irrigation potential was created at the cost of huge amount of national exchequer. Still a large gap between the irrigation potential created and utilized. The water management technologies developed so far was not also being practiced at the actual users' end. There are some unidentified gaps in the existing system, which acts as constraints on adoption of water management technologies. Appropriate intervention(s) is required to provide corrected measures to address the problems at the farmers' field as end users of the technologies on adoption of water-efficient management practices for growing field crop(s). The influence of irrigation water quality on crop quality, marketability and mitigation options of adverse effect of unsuitable/ contaminated/ polluted/ waste water on agricultural produces needs more attention at present day of precision agriculture to maximize the net returns. The mass awareness on water saving technologies adopting micro-irrigation systems would create a favourable environment for sustainable agriculture.

Natural resources: Soil and water are two basic natural resources that need effective conservation and efficient management towards improving water productivity of crop(s). The lower Gangetic plain of West Bengal receives plenty of rainfall (>1500 mm/annum) and rich in groundwater status. Because of this, rice coverage is about 75% of gross cropped area of the region. Out of the total rice growing area, at least 25% is coming under rice-rice system. There is an increase of about 250% in summer rice area in West Bengal during the last 22 years. Amongst the crop sequence(s) followed by the farmers, rice-rice is most expensive for total water use. Increase in summer rice area with poor water management practices, over exploitation of groundwater under deep tube well irrigation system resulted groundwater depletion at faster rate having water table at below 9 m of surface during April-May is main concern of the today's agricultural. In deep tube well command, groundwater is becoming rich in iron and toxicity of iron and

imbalances of other nutrients particularly Zn, P and K is emerging as major nutritional problems for rice. Deposition of such iron as its oxides on oxidation ultimately is deteriorating the physical, chemical and biological health of soil. More than 70 blocks under lower Gangetic plains of West Bengal (at least 8 districts) are facing arsenic problems. The fluoride threats the similar. The iron toxicity would have come as an outstanding problem in coming years, if adequate attention could not be drawn. The mechanization leads towards faster deteriorating of soil structure. As such, rice productivity level was almost static since last few years. The water-nutrient productivity of the rice-based system is to be optimized by improving soil environment. Organic fertilizers could play an important role in this direction to develop and providing balance nutrition for rice and its subsequent crops and quality produce in Indo-Gangetic basin.

Present consumption trend: With growing incomes, people express preferences for higher-quality rice with preferred eating quality. The rice with short and roundish grain having low amylose content that became sticky after cooking, medium to long grain rice, with intermediate amylose and little aroma as well as parboiled long-grain with medium to high amylose content are mostly preferred. Market prices of rice are highly dependable on such quality parameters. As such, fertilizer application to crops for quality crop production has been modified to enhance in terms of the technical efficiency of fertilizer use increased in two-ways: (1) firstly by matching the nutrient supply as per actual crop demand (better timing of fertilizer application) and (2) by incorporating organic fertilizers alone or in combination with inorganic fertilizers to improve efficiency. Though, the application of nutrients from organic sources has been found to be higher than that of inorganic as having more effective prices of the organic sources. By which the long-term adverse effects of inorganic fertilizer on soil properties and the environment could be ameliorated under integrated nutrient management using organic sources. Organic fertilizers are often seen as a means of sustaining long-term soil fertility and also as means of enhancing the efficiency of chemicals fertilizers, could improve soil characteristics and yield gains.

Research needs: The main goal of the study should be to quantify the benefit of organic fertilizers on yield, growth and productivity of *kharif* rice under an integrated nutrient management programme and reduce total water requirement of rice-based crop sequence, as a system approach. The influence of organic amendments on soil physical, chemical and microbiological properties on short and long term basis as well as its effect on quality parameters (like CHO, fat and protein content along with par-boiling and elongation including market price), have to be evaluated scientifically. The organic amendments have on these characteristics. This transformation might be led to increase bulk densities, penetration resistance and sharing stress status of the soil. The organic fertilizers might have influence on the magnitude of porosity and may affect the size and rigidity of pores, which influenced root proliferation, gaseous exchange and water retention as well as evapo-transpiration from the crop field, affect the water use of the crop(s) directly.

The parameters of water quality, which have adversely affected on irrigated agriculture, definitely have affected the crop quality. Both ground and surface water have the differences in water quality within a same area in and within the parameter that also influenced by the cultural practices (particularly use of chemicals) adopted for crop cultivation.

Rice productivity has reportedly been affected negatively by waterborne pollutants both physical and or dissolved chemicals that caused toxicities. Pollutant concentrations in irrigation water have been increasing might be due to degradation of watersheds that replenish irrigation system and industrial pollutants discharged into river system or increased pumping of brackish groundwater. These factors driving into negative externalities and extract their impact on agricultural productivity. Studies on paddy soils shown arsenic levels were elevated in the areas where arsenic in groundwater used for irrigation was high and where the tube wells have been in operation for longer period of time. Use of groundwater for irrigation has ingestion of crops under irrigated agriculture could be another exposure to arsenic and other heavy metal contaminations wherein, there is every possibility of entering these toxins in food chain and might be become disastrous. They emphasized for evaluation of field grown rice and vegetables which should be prioritized to examine the mode of accumulation of such chemicals in edible portion of agricultural produces affected by irrigation water quality.

Influence of water regimes on nutrients availability in soils was established but how far this would affect the crop quality has required to be assessed as an addition to get value added agricultural produces. Nutrients in fertilizers can be leached and added to irrigation water being percolated in groundwater and be carried out by surface and sub-surface drain. That also might affect the quality parameters of the crop and market prices of the produces. Thus, impact of water management on water quality from groundwater of different tube well sources could be assessed further. This leads to work on influence of irrigation water quality on crop quality.

Surface as well groundwater used extensively for various purposes (drinking, agriculture, industrial and navigation) and those became not suitable of being used for the purposes of irrigation to the crops due to chemicals as well as biological contaminations. Which also be required to assess. Thus, the physical-chemical parameters of water used as irrigation for crop cultivation, its subsequent effect on crop quality vis-à-vis effect of contaminated, polluted, waste water used for irrigation and its subsequent effect on contents of such chemicals on edible portion of agricultural produces, its influence on market prices of the these commodities along with possible mitigation measures against adverse effect of such unsuitable quality of irrigation water has got importance on present art of agriculture to get value added agricultural produces.

Groundwater *vis-à-vis* Rainwater harvesting

Over extraction of groundwater leads to an imbalance in reserve as the withdrawal of water exceeds recharge. Agriculture, as largest stakeholder of water use sector might be responsible for this alarming situation prevailed. The monsoon usually breaks in the month of June-July and ends by October confined to few months only. The heavy amount of rainfall within a shortened time causes maximum river flows during this period. Thus the available water resources are ill-distributed resulting seasonal abundances. As the flows could not be utilized fully, it sometimes causes devastated flood in some areas that resulted wastage of the water resources. Ironically, Cherrapunji receives about 11,000 mm annual average rainfalls that also suffer from acute shortage of drinking water. Hence, it has got prime important to store such excess water during the period of heavy rainfall in the reservoirs for its subsequent uses.

Water harvesting is the activity of direct collection of rainwater that could either be used directly or could be recharged in to the ground. The activities of water harvesting not

only involved collection and storage of excess rainwater but also harvesting surface and groundwater, prevention of losses through evaporation and seepage with all possible hydrological studies and engineering interventions, aimed at conservation and efficient utilization of this limited water endowment of physiographic unit termed as watershed.

India is fortunate enough to receive an average rainfall of at least 1170 mm, higher as compared to global average of 800 mm. The average annual rainfall in a specific area/zone over the physiographic area is the basis commonly used as total water resource in that particular area/zone. The amount of water received in the form of rainfall over an area is called rainwater endowment of that area. The amount of water could be effectively harvested is called as water-harvesting potential. That could be computed with multiplying amount of rainfalls and collection efficiency.

Under these stated conditions, ground water recharge to be increased substantially assuring the greater recharge of the aquifers. This could only be possible by larger exploitation of ground water that might be resulted lowering down pre-monsoon ground water table. The upper limit of the ground water extraction should be not more that annual amount of recharge. But actually, introduction of intensive agriculture with high yielding fertilizer and irrigation responsive photo-insensitive short duration rice cultivars that grow three/four times a year that required high volume of water which are being extracted from the ground water. This, usually crossed its upper limit and posed severe problems lowering the water table. The problem of arsenic, iron concentration increased severely. The natural springs abolished from the farmers' field. The hand pumps are not workable at various places. The sands are coming with ground water extraction through submersible pumps. The deep tube wells are being inaction at several places. This is the serious concern of the farmers.

There was clear indication that several soil conservation and water-harvesting measures could increase the ground water recharge up to a certain limit. Ground water recharge from open wells and pits are very common practices in Orissa, Gujrat and Rajasthan. That's why greater exploitation of ground water prior to rainy season provided scope of greater quantity to infiltrate during high rainfall period. The use of surface water would become also to be more effective and helpful to mitigate the arsenic like problems. As the possibility of contamination of arsenic are very less in surface water; only the flowing surface water is the safest source that is free from arsenic. So there was an endeavor to add the ground water as much as possible taking all possible measures for its purification (avoiding all sorts of contamination following de-germs chambers to be constructed for the purpose) and taking off water at need without hampering the water table depletion.

Major concerns on the issues: Though irrigation potential was created at the cost of huge amount of national exchequer, there is still a large gap between the irrigation potential created and utilized. The water management technologies developed so far was not also being practiced at the actual users' end. Hence, there are gaps in the existing system, which acts as constraints on adoption of water management technologies and quality production.

Drinking Water Quality Standards

TABLE: WATER QUALITY PARAMETERS AND BIS STANDARDS FOR VARIOUS CHEMICAL AND BIOLOGICAL CONSTITUENTS

S.No.	Parameters	Drinking water IS 10500 : 2012	
		Permissible Limit	Maximum Limit
1	Odor	Agreeable	Agreeable
2	Taste	Agreeable	Agreeable
3	pH	6.5 to 8.5	No relaxation
4	TDS (mg/l)	500	2000
5	Hardness (as CaCO3) (mg/l)	200	600
6	Alkalinity (as CaCO3) (mg/l)	200	600
7	Nitrate (mg/l)	45	No relaxation
8	Sulfate (mg/l)	200	400
9	Fluoride (mg/l)	1	1.5
10	Chloride (mg/l)	250	1000
11	Turbidity (NTU)	5	10
12	Arsenic (mg/l)	0.01	0.05
13	Copper (mg/l)	0.05	1.5
14	Cadmium (mg/l)	0.003	No relaxation
15	Chromium (mg/l)	0.05	No relaxation
16	Lead (mg/l)	0.01	No relaxation
17	Iron (mg/l)	0.3	No relaxation
18	Zinc (mg/l)	5	15
19	Fecal Coliform (cfu)	0	0
20	E. Coli (cfu)	0	0

Conclusion: This is the prime duty of the researchers to address these problems and to bridge such research gaps and the issues of the thrust area of research on water management should be prioritized and that have major influence on the end users levels on adoption of water-efficient management practices for growing field crop(s) and socio-economic uplift of the farmers in general.