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Water: Heart of Agriculture

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Abstract

Water is a crucial commodity for agricultural production that contributes an efficacious role in food security. Irrigated agriculture represents 20% of total cultivated land and bestows 40% of the total food produced worldwide, besides, on average; it is at least twice as productive per unit of land as rainfed agriculture, thereby allowing for more production intensification and crop diversification. Worldwide, the application of water and its controlled utilization has been an essential factor in raising crop productivity and ensuring predictability in outputs. Water is fundamental to bring forth the potentiality of the land and to enable improved varieties of both plants and animals to make full use of other yield enhancing factors. By raising productivity, sustainable water management especially when combined with adequate soil husbandry helps to ensure better production both for direct consumption and for commercial disposal, thereby enhancing the generation of necessary economic surpluses for uplifting rural economies.

Introduction

Due to population explosion, urbanization, industrialization and rapid climate change, competition for water resources is anticipated to accelerate day by day, imposing a drastic influence on agriculture. The expected increase of population over 10 billion by the end of 2050 will demand certain enhancement in food and fibre production to meet their basic requirements. Consolidated with the improved consumption of calories and more complex food items, accompanying income growth in the developing countries, it is estimated that agricultural production will need to expand by approximately 70% by 2050. However, future demand of water by all the sectors will require as much as 25 to 40% of water to be re-allocated from lower to higher productivity and employment activities, particularly in water stressed regions. In most cases, such reallocation is expected to come from agriculture due to its high share of water use. Currently, agriculture accounts on an average 70 percent of all freshwater withdrawals globally and even higher share of consumptive water use due to the evapotranspiration of crops. Since the 1960's, global food production has at least kept pace with world population growth, providing more food per capita at generally declining prices, but at a cost to water resources. At the close of the 20th century, agriculture used a global average of 70% of all water withdrawals, and FAO estimates that global abstractions for irrigation will grow by some 14% by 2030. While this is a much slower rate than experienced in the 1990's, water scarcity stress is projected to grow locally and, in some cases, regionally, constraining local food production. In the coming years, about 80% of the food production that will be required to feed the ever increasing population will

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depend on irrigated agriculture (FAO, 1995) which is expected to produce much more food in the near future using less water than it uses today. Improved agricultural water use in irrigated and rainfed agriculture will play a key role in coping with the expected water scarcity stress. Improving water use or water productivity is often understood in terms of obtaining as much crop as possible per volume of water *i.e.* "more crop per drop". Thus in a broader sense, increasing productivity in agriculture can result in more benefit for every unit of water withdrawn from natural water sources.

Agricultural Water

Agricultural water is used to grow fresh produces like different types of crops, fruits, flowers, tree crops, fodder, fibres, vegetables etc. and also makes it possible to raise or sustain livestock, which constitute the two most important part of our diet chart. Agricultural water is mainly used for irrigation purpose, pesticide and fertilizer applications, crop cooling, as well as to save plants from frost injury. According to the United States Geological Survey (USGS), irrigation water accounts for approximately 65 percent of the world's freshwater withdrawals excluding thermoelectric power (U.S. Geological Survey, 2000). When agricultural water is utilized with efficacy and safety, crop production is positively impacted, besides, the implementation of better management strategies are the most important way to improve agricultural water use and maintain optimal production and yield that also enhance water use efficiency and water productivity without decreasing yield.

Where Does Agricultural Water Come From?

Agricultural water comes from a variety of sources. Typical sources of agricultural water include:

- Surface water;
- Rivers, streams, and irrigation ditches;
- Open canals;
- Impounded water such as ponds, reservoirs, and lakes;
- Groundwater from wells;
- Rainwater;
- Locally collected water such as cisterns and rain barrels;
- Municipal water systems such as city and rural water.

Role of Water for Growth and Development of Crops

- Water is a constituent of protoplasm.
- It acts as a solvent. Plants can absorb nutrients when these nutrients are dissolved in water.
- Water is used for transpiration carrier of nutrients from the soil to green plant tissues.
- They are used for photosynthesis and the end product is also conveyed through water to various plant parts.
- Water forms over 90% of the plant body by green or fresh weight basis.
- Plants can synthesis food through photosynthesis only in the presence of water in their system.
- It helps to maintain the turgidity of cell walls. Water helps in cell enlargement due to turgor pressure and cell division which ultimately increase the growth of plant.
- Water is essential for the germination of seeds, growth of plant roots, and nutrition and multiplication of soil organism.
- Water is essential in hydraulic process in the plant. It helps in the conversion of starch to sugar.
- Water helps in the transpiration, which is very essential for maintaining the absorption of nutrient from the soil.
- It regulates the temperature and cools the plant.
- Water helps in the chemical, physical and biological reaction in soil.

The Dominance of Agricultural Water Use

Irrigation is a vital component of agricultural production in many developing countries. In 1997-99, irrigated land provided two-fifths of crop production in developing countries, and accounted for about one-fifth of the cultivated area. Food production in developing countries is increasing in response to the demands of an expanding population and rising prosperity. Some of this demand will be met by increased productivity of rainfed agriculture, some by increased imports, but irrigated agriculture will be a major contributor.

- Agriculture is the largest user of water in all regions of the world except Europe and North America. In 2000, agriculture accounted for 70 percent of water withdrawals and 93 percent of water consumption worldwide, in contrast to industry, which accounted for 20 percent of withdrawals and 4 percent of consumption worldwide, and household use, that assumed 10 percent of withdrawals and 3 percent of consumption. The water requirements of agriculture are large relative to water requirements for other human needs. The human body needs about 3 litres of water per day;
- For domestic uses people use approximately 30-300 litres of water per person per day;
- To grow their daily food, people require 3000 litres of water per person per day.

Economic Characteristics of Water

Water provides goods such as drinking water, irrigation water etc. and services like hydroelectricity generation, recreation and amenity that are utilized

by agriculture, industry and households. Provision of many of these goods and services is interrelated, determined by the quantity and quality of available water. Management and allocation of water entails consideration of its unique characteristics as a resource. Water used for irrigation can be pumped from reserves of groundwater, or abstracted from rivers or bodies of stored surface water. It is applied to crops by flooding, via channels, as a spray or drips from nozzles. Crops also obtain water from precipitation. Water infiltrates into the soil, evaporates, or runs off as surface water. Of the water that infiltrates the soil, some is taken up by plants (and later lost through transpiration) and some percolates more deeply, recharging groundwater. This water can be polluted with agrochemicals (fertilizers, herbicides and pesticides), with salts leached from the soil and with effluent from animal waste. However, pollution can be attenuated as the water moves through the ground by processes that include sorption, ion exchange, filtration, precipitation and biodegradation. Aquifers can also be the sources of pollution. Pollutants can be released into groundwater from pockets of contaminants or natural materials (e.g. sources of fluoride) within the aquifer. When river levels are low and groundwater levels are high, groundwater can recharge the levels of surface water, which creates a two-way linkage between resources of surface and groundwater.

Importance of Water Management in Crop Production

Water is one of the most important inputs essential for the production of crops. Plants need it continuously during their life in huge quantities. It profoundly influences photosynthesis, respiration, absorption, translocation and utilization of mineral nutrients, and cell division besides some other processes. Both its shortage and excess can affect the growth and development of a plant directly and, consequently, its yield and quality. In India, however, rainfall is notoriously capricious, causing floods and droughts alternately. Its frequency distribution and amount are not in accordance with the needs of the crops. Artificial water supplies through irrigation on one occasion, and the removal of excess water through drainage on another occasion, therefore, become imperative, if the crops are to be raised successfully. Water management in India, thus, comprises irrigation or drainage or both, depending considerably on the environmental conditions, soil, crops and climate. Water affects the performance of crops not only directly but also indirectly by influencing the availability of other nutrients, the timing of cultural operations, etc. Water and other production inputs interact with each other. Water is a costly input when canals supply it. The construction of dams and reservoirs, the conveyance of water from storage points to the fields, the operation and the maintenance of canal systems involve huge expense. On the other hand, the misuse of water leads to the problems of water logging, salt imbalance, etc. thus rendering agricultural lands unproductive. Hence, a proper appreciation of the relationship and economic utilization of water resources for maximum crop production is mandatory on an urgent basis.

Possible Options for Action

1. Technologies such as conservative agriculture should be popularized, as it is known to increase water use efficiency.

2. Practicing conservation agriculture on a large scale has the added advantage of conserving soil moisture, improving soil nutrient status, soil texture, less weeds, among others.

3. Water pricing for the agriculture sector should be reviewed and revised.

4. Watershed development must be planned to pave way to safeguard the surface and ground water recharge mechanisms.

5. Increase awareness to enhance water use efficiency in the agriculture sector.

6. Declining water tables results in an increase in the cost of pumping, salinization, presence of heavy metals etc., thus raising questions about the cost of crop production and quality of the produce.

7. Introduce clearer incentive structure that improves the water use efficiency in the agriculture sector thus ensuring long term sustainability of this natural resource.

8. Strengthening cross-sectoral water governance that includes the agriculture sector for a better co-ordination and resolving conflicts.

9. Ensuring sustainable financing/ subsidies to ensure the maintenance of existing public irrigation infrastructure.

10. Indian government has tried to inculcate new policies and schemes like Pradhan Mantri Krishi Sinchai Yojana (PMKSY) by restoring the original flexibility of Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) to improve agricultural productivity, while simultaneously increasing WUE.

11. Priority must be given to the completion of on-going irrigation projects through strengthening of programs such as Command Area Development Programme (CADP) and Accelerated Irrigation Benefits Programme (AIBP).

12. Promotion of alternative planting methods such as a system of rice production intensification and direct seeded rice can lead to water saving and productivity increases.

13. Water productivity can be improved by adopting the concept of multiple water use, which is beyond the conventional sectoral barriers of the productive sectors.

14. There is scope for increasing income through crop diversification and integration of fish, poultry and other enterprises in the farming system. The multiple water use

approach can generate more income benefits, and decrease vulnerability by allowing more diversified livelihood strategies and increasing the sustainability of ecosystems.

15. Emphasis should be given on water resources conservation through watershed development in suitable areas and development of micro-water structures for rainwater harvesting.

16. The promotion of water conservation efforts has direct implications for water resources availability, groundwater recharge, and socio-economic conditions of the population. The effective water management is critically linked with the performance of local level water institutions. Therefore, institutional restructuring in favour of participatory irrigation management and water users associations (WUAs) also needs to be strengthened.

Conclusion

Presently, India is facing a decrease in available water resources that has implications on agriculture sector. If water use efficiency does not improve, the country could suffer under water scarcity in the next 1 to 2 decades. It is exceedingly important that the agriculture sector contributes to prevent the exacerbation of the situation by making best use of the available technologies and resources to increase WUE. Improvement of policies, strategies and regulatory measures to prevent the water misuse should be taken into consideration. Awareness and orientation of water users in the agriculture sector to switch to more water efficient production methods can help the country to combat water scarcity.

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