More crop per drop

Water-saving technology in rice production would be an efficient method to keep the South Asian underground water table at a safe level.

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Growing population, increasing urbanization and shrinking renewable freshwater resources have become crucial concerns for South Asia in its combat against food insecurity. "More crop per drop" is the new mantra to achieve sustainable food production in the region.

Climate change, characterized mainly by increasing mean temperature and unfavourable weather patterns with recurring spells of droughts and floods, has made those concerns even more serious. The primarily agrarian economy of South Asian countries is highly dependent on monsoons, which have become erratic in the last two decades. This has increased food and water security woes in the region. Around 90 per cent of freshwater in the region is consumed by the agriculture sector with around 40 per cent of total arable area under irrigation.[1] Sadly, irrigation water efficiency is quite poor in South Asia when compared with other developing regions like Central and South-East Asia.[2] With countries like Bhutan, Maldives and Nepal respectively having just 13.79, 26.33 and 28.75 per cent of their total land area as agricultural land, the pressure to produce the maximum yield per unit of arable land is a matter of paramount concern (Table).

Water stress grows

Except for Maldives, where the major crop is coconut, all other South Asian countries primarily have cereal-based cropping systems, rice and wheat being major staples. Apart from Bangladesh, Bhutan and Sri Lanka, the cereal productivity in the remaining region is below 3,000 kg/ha. Higher productivity is mainly dependent on higher seed replacement rate, better and improved varieties, continuous irrigation and sustainable soil management practices. Of these, irrigation is a critical input, which decides the productivity of crops. For example, in Bangladesh, rice production over the last decade increased considerably due to irrigated Boro rice, which accounts for 55 per cent of the total rice production in the country. Similarly, irrigation was the significant component, along with promotion and adoption of high yielding varieties of seeds and chemical fertilizers, which took India's cereal production to higher levels after the adoption of the green revolution.

South Asia is expected to experience a rise in temperature, floods and droughts as per the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) published in 2014. Given the agrarian economy of the region, these climate

Table

Agricultural land and water availability in South Asia

Country	Agricultural land (% of land area) 2014	Cereal yield (kg per hectare) 2014	Renewable internal freshwater resources (billion cubic metres) 2014	Renewable groundwater (billion cubic metres) 2014	Annual freshwater withdrawals, agriculture (% of total freshwater withdrawal) 2017
Afghanistan	58.07	2017.5	47.15	10.65	98.62
Bangladesh	69.90	4618.4	105	21.12	87.82
Bhutan	13.79	3130	78	8.1	94.08
India	60.41	2984.1	1446	432	90.41
Maldives	26.33	2405.1	0.03	0.03	0
Nepal	28.75	2747.9	198.2	20	98.14
Pakistan	47.03	2750.3	55	55	93.95
Sri Lanka	43.70	3801.9	52.8	7.8	87.34

Source: World Development Indicators (2014, 2017)[3], Aqua stat (2014)[4]

vagaries will have implications on water resources and food production systems. Thus, sustainable water management is the key to ensure food security of the mounting population.

Blame for the stress on both surface and ground water resources in the region must go to the dominance of water guzzling rice-wheat cropping system. Selection of the cultivated crops should be based on agro climatic conditions prevailing in the location, but, quite often, farmer's expertise, availability of labour, government incentives and market support play a decisive role in this. Cotton and wheat used to be the traditional crops in Punjab and Sindh Provinces of Pakistan. In the recent past, however, more and more farmers have shifted to sugarcane because of government induced subsidies, which ultimately led to the advent of sugar mills supported by a strong sugar lobby. Similarly, government procurement of rice and wheat in India through the minimum support price (MSP) scheme has given an assured market for these crops. Hence, they are grown widely even in the semiarid regions of India.[5]

Furthermore, the cereal based cropping systems of the Indo-Gangetic Plains was supported by well-developed canal irrigation systems in the past. Over the years, due to negligence and poor maintenance of these canals, farmers have switched to ground water resources. Farmers in Punjab Province, in both India and Pakistan, resort to over extraction of ground water even when there is a diversified network of canals. Surface irrigation through big irrigation projects has failed mostly due to siltation and lack of regular repair and maintenance of the irrigation infrastructure. Poor cost recovery mechanisms, as a result of inactive Water User Associations (WUAs), and diversion of water from the head end of the canal for both agricultural and non-agricultural uses have also contributed to the dearth of surface irrigation systems. Additionally, the latter practice has deprived irrigation water for tail-end farmers.[6]

In India's Punjab, groundwater exploitation and surface water underuse is mainly because of attractive subsidies for acquiring submersible pumps and free electricity for water extraction. Since over-exploitation leads to receding groundwater levels, Punjab farmers have started using submersible pumps with higher capacity to draw water from deeper aquifers. In Pakistan, farmers pay for extending cables from the main power lines to the tube well, whereas in India the State Electricity Board bears this cost. In Indian states where electricity is not subsidised, farmers resort to diesel pump-sets. On the other side, given the level of awareness about saving water in Bangladesh, fossil fuel subsidies have benefited smallholder farmers without over-exploiting water resources. This is quite unlike the energy subsidies, in the form of cheap electricity, in the drier parts of India.[7]

Sustainable water management is the key to ensure food security of the mounting population.

Water-saving technology in rice production would be an efficient method to keep the South Asian underground water table at a safe level. Instead of flood irrigation, alternate wet and dry (AWD) methods of irrigation can be used. In addition, surface water should be reserved in ponds and small rivers in the rainy season and mainly used for Aman rice cultivation, especially during the flowering stage. Bangladesh Rice Research Institute (BRRI) has developed a rainwater harvest technology for rain-fed Aman cultivation during the flowering stage to mitigate drought.[8] This kind of conjunctive use of water is also recommended for Sri Lanka's dry zone, which comprises about 70 per cent of its land. This would improve the livelihoods of those dependent on agriculture.[9]

Agricultural practices like System of Rice Intensification (SRI), double transplanting[10], direct seeding of rice and laser levelling make efficient use of irrigation water. Zero tilled wheat cropping, following the harvesting of rice, is also getting popular in parts of Bangladesh, India and Nepal. However, such practices have to be promoted widely by the state and civil society organisations for the farming communities to truly benefit from them. Any effort to improve water use efficiency would have implications in energy saving as well. Axial flow pumps, micro irrigation techniques and solar pump-sets are also energy efficient. Small, mobile diesel engines that are demountable and can be used for a range of applications, including powering of irrigation pumps, have increased food production and economic returns to farmers.[11] At the moment, these practices are localised among progressive farmers. They need to be scaled up to make them widespread. Awareness generation and capacity building of farmers is crucial to achieve this.

Policy implications

Small and marginal farmers of South Asia are vulnerable to the adverse effects of climate change. Most of them either face drought or floods almost every year. Given the complexities of the water, energy and food nexus, it is important to develop a comprehensive contingency plan, with adequate policy support. The objective here is to build the resilience of the farmers.

> Water, energy and food nexus demand a comprehensive contingency plan with adequate policy support.

There is a need to strengthen research on hardy, climate resilient nutritious crops like millets and pulses. Varieties catering to the need and taste of farmers will have to find a place in their cropping system. Proper value addition will create a demand for products from these crops, thus, enhancing their market value. Based on local demand and preferences, pulses and millets should also be included in the government's Public Distribution System procurement scheme. This may cause the water intensive cropping system to change for the better.

Revival of existing surface irrigation system will definitely cut down the dependency on ground water resources. Proper cost recovery mechanisms would lead to better maintenance of the canals. An innovative example can be taken from the irrigation project of Barind Multipurpose Development Authority (BMDA) at Godagari *upazila* of Rajshahi District in Bangladesh. Here the river water is reserved in a canal and the farmers access it using a prepaid card with a prepaid meter. After the specific period allocated to the farmer, the machine gets shut down automatically.[12] Water tariff on the basis of volume, rather than area based or crop based, and reinvesting the proceeds in the operation and maintenance of the canal system, would improve the overall functioning of surface irrigation systems.

Better governance of surface water systems can also be envisaged through participatory irrigation management. Today, Water Users Associations are inactive in most places mostly due to faulty implementation.

Rational pricing of electricity for agricultural purposes, through metering, would check the exploitation of groundwater. In other words,

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a major shift in the outlook of government policies regarding ground water management is necessary. The Sub Soil Conservation Act of 2009, in Punjab, India, is a commendable step as it regulates paddy transplantation beyond a notified date, which comes in June. It needs to be seen if such regulation is necessary for ground water management for Boro rice cultivation as it is solely dependent on groundwater irrigation.

Water saving technological interventions like laser levelling, zero tillage, solar pump sets and axial flow pumps and micro irrigation require capital investments. Hence, capital subsidies on related machineries would make them accessible to small and marginal farmers. Moreover, these machineries can also be made available to farmers through farmer cooperatives/producer companies. Custom hiring is another option, which is widely adopted in many parts of South Asia. Agro-service centres at the local level should take care of service delivery and maintenance and repair of the equipment.

Capacity building of farmers on water saving technologies and practices is essential to improve water use efficiency. Strengthening of extension services by government and civil society organizations should go hand in hand with awareness generation. Progressive farmers can act as change agents in this respect. Informal social networks enabling farmer-to-farmer learning are found to be more effective than trainings and demonstrations by extension departments. Incentives for adopting water conservation practices and savings in electricity bills for irrigation would also scale out the adaptability of these practices.

Conjunctive use of water needs to be adopted wherever possible. Water harvesting structures and storage tanks assure lifesaving irrigation in drought affected areas. Watershed management would reduce runoff and induce in-situ moisture conservation and, hence, should be an integral component of planning development work at local government levels. Several parts of India and Sri Lanka receive short spells of heavy rainfall leading to runoff loss. A vast area in Bangladesh and India, however, is subjected to drought and annual floods necessitating watershed management.

Clubbing irrigation subsidies with water saving practices would ensure efficient use of the resource. For instance, in Rajasthan subsidies for solar-powered irrigation is clubbed with micro irrigation. Such bundling of polices ensure water conservation as well as water use efficiency.

Owing to the variation in availability, demand and possibility of recharge across aquifers, it is useful to have aquifer-level planning. This should not be limited to only at national level planning. A regional strategy is needed to enable sustainable use of groundwater from transboundary aquifers.

Three-pillar strategy

Sustainable use of water resources is an integral part of sustainable intensification of agriculture. Since water use efficiency is closely linked with crop management and energy policy in the South Asian context, a holistic approach needs to be followed while developing a regional strategy for sustainable intensification of agriculture. Similar agro-climatic regions and food production systems existing in immediate border areas would enable cross-border learning and adoption of good management practices and policy initiatives. Joint research and development for crop management strategies, participatory approach for designing irrigation projects and a more inclusive policy making are the three pillars which will determine sustainable water use in South Asia in future. ■

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Notes

1. Figures from FAO Stat http://www.fao.org/faostat/en/
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9. IWMI. 2010. *Sri Lanka: Issues and Opportunities for Investment*. IWMI Water Issue Brief 7. Colombo, Sri Lanka: International Water Management Institute (IWMI). 4p. DOI: 10.5337/2010.220
10. In double transplanting of rice, 4 kg of seed is sown in a 40 m^2 nursery area. Seedlings are transplanted when 21-25 days old@8-10 seedlings per hill in close spacing of 5-8 cm in a small area (400 m^2). The second transplanting is done 30-35 days after the first transplanting using normal spacing at one seedling per hill in the main field
11. Steele, P. E. 2011. *Agro-Mechanization & the Information Services Provided by FAOSTAT*. Rome: United Nations Food and Agriculture Organization.
12. *ibid*. Note 6.