Agriculture Water Pollution, Gaps and Mitigation Measures in India

POLICY BRIEF

South Asia hosts more than one-fourth of the global population. Nearly 60 per cent of this population is engaged in agriculture. The largest country in the region, India, extends over 3,287,260 sq. km, of which approximately 55 per cent of land is used for agricultural purpose to achieve food sovereignty for millions of people. With a population of over 1.27 billion, India generates an alarming rate of water pollution due to anthropogenic and agricultural activities. These non-point sources of pollution are from landmass and farm gates.

Like other countries in the region, water pollution poses a threat to sustainable development goals in India. It is estimated that half of India's morbidity problem arises out of poor water quality. In many parts of the country, large stretches of rivers are both heavily polluted and devoid of flows to support aquatic ecology, cultural needs and aesthetics. What makes the challenge more compounded is low consciousness about the overall scarcity and economic value of water results in its wastage and inefficient use.

In India, approximately 70 per cent of surface water and groundwater is contaminated. The causes of water pollution are manifold, including unbridled and mismanaged disposal of industrial effluents, domestic sewage and untreated water. Moreover, fertilisers and crop residues have been contributing to water pollution. All these lead to a spurt in toxic organic and inorganic pollutants that affect availability of safe drinking water and irrigation water.

Surface water and groundwater pollution: the double whammy

The Central Pollution Control Board (CPCB), based on its analysis in over 1,700 sites, has found both organic and inorganic contamination in water bodies to be more than the permissible limit. This is happening at a time when the demand for freshwater is surpassing supply. Besides, increasing level of groundwater pollution—which remains unnoticed—also poses a severe techno-managerial challenge in cleaning up and dissipating pollutants.

In 2015, the United Nations (UN), including the Department of Economic and Social Affairs (DESA), adopted the 2030 Agenda for Sustainable Development that includes 17 Sustainable Development Goals (SDGs). Under Goal 6, which focuses on ensuring availability and sustainable management of water and sanitation for all, the world aims at achieving universal and equitable access to safe and affordable drinking water for all, which was globally recognised as a basic human right back in 2010.

This policy brief provides recommendations to address existing gaps in policies and legal instruments on mitigation of land-based non-point source of water pollution (from agriculture and sewage) in India, which, in turn, would take the country closer to achieving SDGs.

Pesticides and nitrogen fertilisers drive water pollution

India's agriculture sector—which aims at meeting food security of growing population and doubling farmers' income by 2022—is up against a stiff challenge of increasing the

quantum of crop production. It has made the sector susceptible to aggressive use of inorganic inputs and intensive farming with rampant use of agrochemicals, pesticides and livestock growth promoters, vaccines, etc. As a result, increasing levels of nitrates and phosphorus are evident in fresh surface water bodies affecting flora and fauna that depend on them. The schematic diagram demonstrates leaching of nitrogen and phosphorus fertilisers owing to overuse.

The table below demonstrates decade-long consumption of fertiliser in lakh tonnes in India. It is evident that government's policies and subsidies make farmers apply fertilisers more than the recommended dose.

NITROGEN FERTILIZERS ↓↓ applied to land surface → *Surface Runoff*
leaching ↓↓ loss to groundwater → *Interflow / tile drains*

PHOSPHORUS FERTILIZERS ↓↓ applied to land surface
← ← leaching ↓↓ loss to groundwater

(Source: www.fao.org)

Fertiliser consumption: A profile (lakh tonnes)

	Urea	DAP	SSP	MOP	NP/NPK	Total+
2003-04	197.67	56.25	25.44	18.41	47.57	353.13
2005-06	222.98	67.64	27.56	27.31	66.94	420.73
2007-08	259.63	74.97	22.88	28.81	65.71	459.06
2009-10	266.73	104.92	26.51	46.34	80.25	533.05
2010-11	281.13	108.70	38.25	39.32	97.64	574.41
2011-12	295.65	101.91	47.46	30.29	103.95	589.93
2012-13	300.02	91.54	40.30	22.11	75.27	537.72
Apr-Jan 12-13*	253.58	76.69	34.09	17.96	62.88	-
Apr-Jan 13-14*	263.89	58.27	33.00	17.47	59.03	-

* Includes ammonium sulphate, mono-ammonium phosphate and other fertilisers; *Sales.

Source: The Fertiliser Association of India, New Delhi

ALL - INDIA FERTILISER RETAIL SALES (LAKH TONNES)

	2018-19	2019-20	%Growth
Oct	48.37	45.17	-6.62
Nov	63.26	73.84	16.72
Dec	70.86	87.08	22.89
Jan	58.04	64.5	11.13
Feb	30.39	46.61	53.37
Mar	24.6	28.96	17.72
Apr	14.17*	20.56 **	45.1

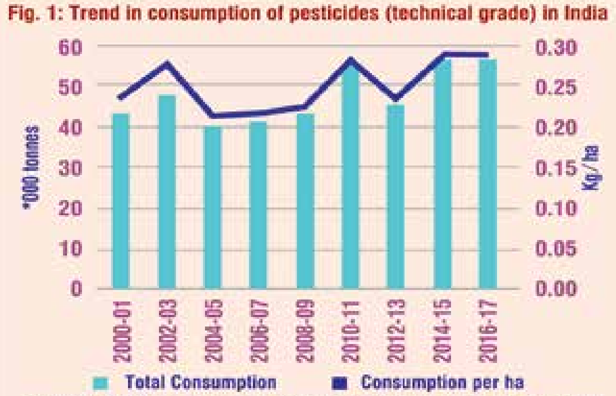
*April 2019, **April 2020. Source: Department of Fertilisers

Growing Use

Source: Fertiliser Association of India (FAI)

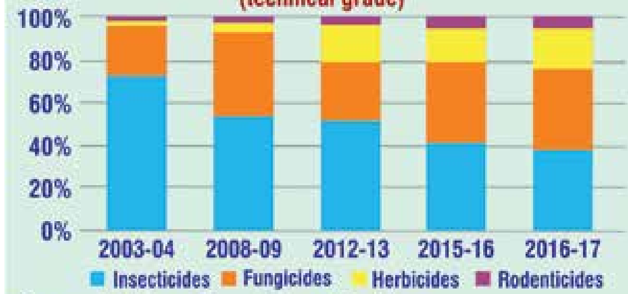
In addition, pesticides, insecticides and herbicides made out of highly concentrated chemicals are used to control pests and diseases that damage crops during growth stages. Insecticides and fungicides dominate pesticide production in India, followed by herbicides and rodenticides. When these chemicals enter water bodies, in addition to synthetic pesticides, they cause fat solubility and bioaccumulation, affecting non-target plants and living species. Figure 1 and 2 capture the trend of pesticides use in India.

Fig. 1: Trend in consumption of pesticides (technical grade) in India



Source: Based on data from Ministry of Chemicals and Fertlizers

Fig. 2: Share of pesticide groups in total pesticide production (technical grade)



Source: Ministry of Chemicals and Fertilizers.

Both Central Insecticides Laboratory and State Pesticides Testing Laboratories have the mandate to control and regulate sale of spurious pesticides in the market. Since 2018, over 20 pesticides were banned for sale in India. However, they are made available to the farmers illegally. To overcome pesticides-induced environment pollution and enhance the scope for biopesticides sale, more than 14 biopesticides have been registered as per the Insecticides Act, 1968 in India. Their sale crossed over 5,000 MT during 2015-16.

Recommendations on prevention and mitigation

1. **Ensure rational nitrogen application:** The rate of nitrogen (N) fertiliser to be applied needs to be calculated on the basis of the "crop nitrogen balance" by taking into account the plant needs and amount of N in the soil. Similarly, the Ministry of Agriculture should make Soil Health Card mandatory by charging a minimum fee and provide timely recommendations on dosage for the crops to be cultivated before every cropping season.
2. **Maintain vegetation cover:** Keep the soil covered with vegetation to prevent build-up of soluble nitrogen by absorbing mineralised nitrogen and also leaching during periods of rain.

3. **Manage the period between crops:** Organic debris produced during harvesting is mineralised into leachable N. Planting of “green manure” crops and delaying ploughing of straw, roots and leaves into the soil can reduce leaching.

4. **Adopt rational irrigation:** Precision irrigation is one of the least polluting practices that reduces net cost of supplied water.
5. **Optimise other cultivation techniques:** High yields with minimum impact on water quality require optimisation of practices such as weed, pest and disease control, liming, balanced mineral fertilisers, including trace elements, etc. (Source: www.fao.org)

Policy gaps that inhibit action on water pollution

- Multiple ownerships of water: Rivers and water have been entangled in layered constitutional clauses, which make them both central and state subject. The agencies such as the Central Water Commission, Central Ground Water Board, CPCB and the Ministry of Environment, Forests & Climate Change have respective mandates to protect the environment from degradation and water pollution. However, legal battles on water continue for decades due to lack of consensus and cooperation between the states and the Centre. Efforts on surface and groundwater management are fragmented and lack coordination.
- Prioritisation of water availability over water quality: Reviews of Acts, guidelines and laws of the states and the Centre reveal that efforts are being made to improve availability of water resources. However, adequate attention is not given on enhancing their quality, including meeting standards, identifying contaminants, strengthening treatment processes, and ensuring access to safe water. Hardly any policy and law related to resource management gives importance to dealing with pollution.
- Lack of focus on household and agriculture-generated water pollution: The laws are largely limited to controlling industrial water pollution. The CPCB has prepared a list of polluting industries in the country, but there is no regulation on water pollution emerging from households and agriculture sectors. Two of the eight missions under the National Action Plan on Climate Change, which deal in water and sustainable agriculture, are myopic in their vision. There is total neglect of

non-point sources of water pollution leading to the growth of new water-borne vectors and diseases affecting public health and environment.

- No conjunctive management of surface and ground water: The need for conjunctive use and integration of groundwater and surface water laws has not been addressed since independence. Groundwater and surface water are interconnected from ecological perspective and it's a concern that their integration is neglected.
- Local communities losing control over traditional water bodies: Unscrupulous exploitation of groundwater at an aggregate level has led to a phenomenal depletion of water table. Moreover, local communities are increasingly losing control over water commons like tanks, ponds and lakes, leading to their defunct state and failure of the commons. While organisations or structures have been suggested for managing river basins or water resources, absence of adequate legislations and executive responsibilities renders these organisations ineffective.
- Ad-hoc resource allocation: Allocation of water resources is ad-hoc and not based on changing resource patterns and situations.
- Institutional structures: The prevailing practices in managing water resources by the state and central government do not squarely address the current and future water challenges. Though the national water policy has suggested an integrated approach to water resource management, this demands concerted actions from the policymakers to ensure that the approach gets reflected in laws and institutional structures.

Recommendations on bridging policy gaps

Laws should include measures to manage land-based sources of water pollution, integrate the management of surface and groundwater usage and advocate reuse of treated wastewater. Awareness trainings should be provided for appropriate technical interventions to improve irrigation practices and choice of crops. Water conservation measures should be incentivised and water should be priced so that its usage is managed.

Institutional linkages for addressing cross-sectoral issues need to be established to ensure that scarcity and pollution issues are addressed simultaneously. There is a need to set up conflict resolution mechanisms to resolve these issues from a resource perspective and not political. Data management and information sharing will be useful in alleviating the problem of water scarcity and minimising land-based water pollution.

To improve water availability, it is recommended to upgrade and maintain water supply infrastructure, devise and enforce cropping patterns based on agroclimatic zones, and strictly regulate water use. It is also important to choose the right technology for reusing **wastewater** and improving water use efficiency. Israel is a good example. Despite low levels of water availability compared to India, it has made effective use of technology to increase **water use efficiency**.

Australia and West Africa also demonstrate how water availability can be improved through **water governance** structures: the former at the national level (outcome-

based commercial utilities; variable pricing and subsidies; business models for sustainability; transparent operations and management; skilled workers; separation of service delivery and regulation) and the latter at a transboundary level through West Africa Water Resource Policy **(integrated approach; community/ multi-stakeholder participation).**

Success stories (Field Case study)

Effect of Biochar on reducing land and water pollution in Madurai district, Tamil Nadu

Some places in Madurai district had been receiving uneven and high-intensity rainfall, which was causing leaching of nitrate and phosphate that enter into water bodies and cause eutrophication. There was a pressing need for reducing applications of hazardous chemical fertilisers, pesticides and herbicides. On that note, 10 experimental trials were conducted in Peraiyur and Thirumangalam blocks of Madurai district. The aim of the experiment—which was conducted from October 2019 to October 2020—was not only to understand the effect of using biochar along with soil organic supplements on physical and chemical properties of soil, but also to see whether biochar acts as a bioremediation for land and water pollution in the rain-fed tracts of Madurai district.

Among the 10 experimental trials, five trials were conducted on barnyard millet during Kharif season and five on coriander during Rabi season. Along with biochar, with four types of organic supplements—farmyard manure, vermicompost, ganajeevamirtham and neem cake—were applied on the farmlands to know the best combination of organic supplement with biochar for both soil properties and crop productivity in rain-fed cropping ecosystem in Madurai district, Tamil Nadu.

The results of the experiment are encouraging. There has been a marked improvement in water holding capacity of the soil across the trial plots in the range of 5 per cent to 9 per cent. This increase in water holding capacity of the soil due to the use of biochar, farmyard manure and vermicompost not only suggests good crop growth even during the dry spells of the cropping season, but also indicates reduced runoff. Hence, it reduces the scope for land-based pollution of nearby water bodies due to nitrate leaching, pesticide losses, and other pollutant losses.

The experiment also led to increased nutrient retention in soils, which again, reduces potential for nitrogen leaching into groundwater and runoff into surface water. The study concludes that further research is required to understand the full effect of applying biochar and organic supplements in the soil in reducing land and water pollution, including the quantum of reduction in water pollution.

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