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INDIAN AGRICULTURE: THE TRANSITION TO SUSTAINABILITY

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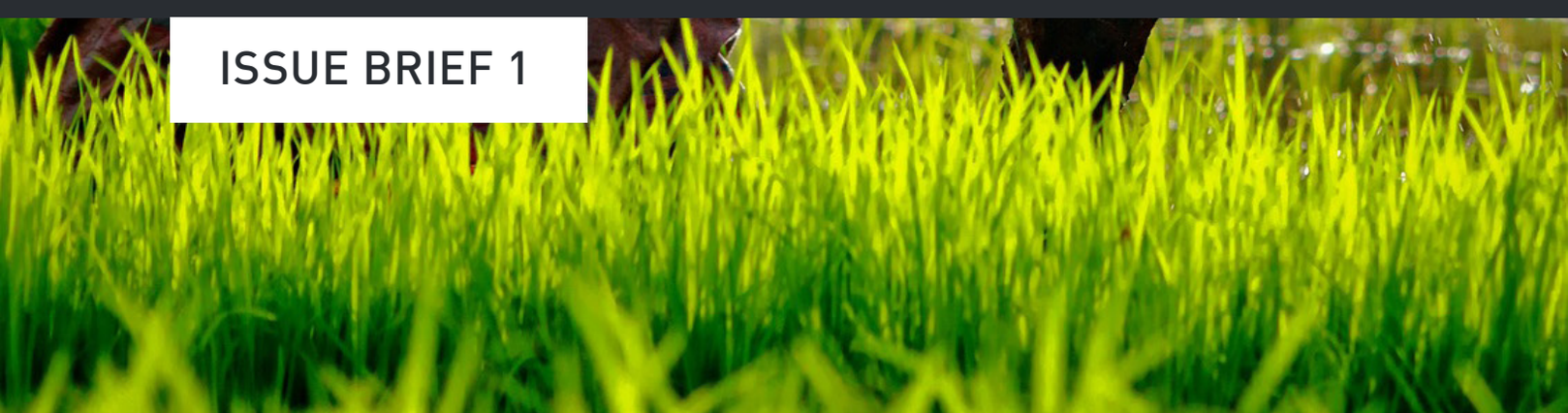
ISSUE BRIEF 1



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This is the first in a series of SPRF issue briefs on sustainability concerns in Indian agriculture.

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CONTEXT

Since the Brundtland Commission report (1987) defined its broad contours, sustainability and sustainable development have been integral to the global processes and understanding of production and growth. Rooted in the concept of shared responsibility, the Brundtland report defined Sustainable Development as: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (World Commission on Environment and Development 1987: n.pag.)

The report posited the need to encourage production and consumption standards that do not endanger the natural systems that support life on Earth, and at the same time, ensure equitable access to natural resources. The idea of sustainability, thus, contains within itself a need-based approach to the utilisation of resources to maintain a certain level of growth in the present, without exerting pressure on ecosystem services for the future.

Historically, agriculture has had a close relationship with the development of the human species. Food security, made possible by the advent of agriculture and allied activities, essentially kickstarted the process of development leading to the rise of civilisations and eventually, modern industrial society. During this time, agricultural production also progressed from being a subsistence-oriented activity to a large scale, yield-oriented and resource-intensive activity.

Given the nature of agriculture today, and its impact on soil health, water availability, and livelihoods across the world, the question of sustainability has taken centre-stage in agricultural practice and policy-making. This question looms larger in countries like India, where the agriculture sector is dominated by small and marginal farmers caught in a vicious cycle of rising input costs and debts, prevalence of water-intensive crops such as rice and sugarcane, decreasing soil fertility, and increasing climate extremes. This issue brief looks at sustainability concerns in Indian agriculture from three standpoints - the ecological impact of agricultural practices, farmer incomes, and impact of climate change on yields.

SUSTAINABILITY IN INDIAN AGRICULTURE - KEY ISSUES

1. Environmental Implications of Industrial Agriculture

The green revolution marked the beginning of industrial agriculture in India. It brought the country out of the severe food shortages of the 1960s, making it one of the world's top producers of rice, wheat, pulses, sugarcane and cotton. Over time, however, it led to proliferation of unsustainable on-farm practices such as the use of high-yielding resource-intensive (often genetically modified) varieties of seeds, large-scale diversion of water for canal irrigation, excessive groundwater use, and intensive use of pesticides and chemical fertilisers.

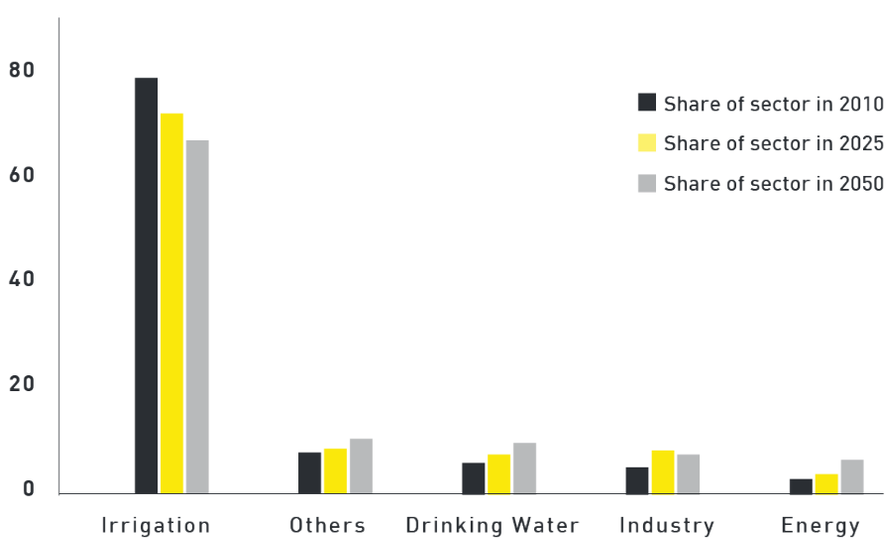
A recent collaboration between Harvard researchers and the Hyderabad-based Centre for Sustainable Agriculture has tried to quantify the impact of agricultural practices on ecology across major states in India through an analysis of publicly available data. As per the study, states like Punjab and Haryana, with the

highest percentages of cultivated land in the country, also have low soil organic carbon content (SOC)[1], high nitrate levels in their groundwater, quickly depleting groundwater, and high pesticide usage and electricity consumption (Veluguri et al. 2019: 24). Overall, the study finds that 14 out of the 29 states in the country have low SOC. The study also indicates high levels of groundwater development[2] in states where there is a high percentage of irrigated paddy cultivation, for instance Karnataka, Tamil Nadu, Telangana, Andhra Pradesh, Punjab and Haryana (Veluguri et al. 2019: 24).

Earlier, the Government of India's Committee on Doubling Farmers' Income had reported that the SOC in the Indo-Gangetic plains declined from 0.5% in the 1960s to 0.2% in the early 2000s (Committee on Doubling Farmers' Income 2017: 17). The report attributed this decline to a gradual decrease in the application of organic manure, crop residue burning and intensive cultivation of rice and wheat. The report also claimed that at least 60% of the area of Punjab suffers from some form of soil degradation, primarily due to agricultural practices started during the Green Revolution (Committee on Doubling Farmers' Income 2017: 11).

Water use is another major problem confronting Indian agriculture. At present, about 80% of water available for consumption goes to agricultural use, and projections show that it will remain this way in the future, as can be seen in figure 1 below (Sharma et al. 2018: 2). Interestingly, out of a net sown area of 140.1 million hectare (mha) in the country, 68.4 mha is irrigated and 71.7 mha is rain-fed, meaning more than half of the country's agricultural land lacks critical irrigation infrastructure (MoAFW 2018: 333). This further means that water use in agriculture lacks equitable water availability, not only in terms of sector-wise usage, but also in terms of presence of modern irrigation systems.

Figure 1: Sector-wise share of water consumption in India (Sharma et al. 2018: 2)



1 Soil organic carbon content, or the amount of carbon stored in soil, is a widely used measure of soil health that determines the ability of the soil to sustain productivity over time. Farm practices greatly affect SOC, which is why it can also be used to study the relative sustainability of different modes of farming.

2 Groundwater Development is the annual rate of groundwater extraction divided by average annual groundwater recharge. This metric is used to calculate the extent of groundwater usage in an area.

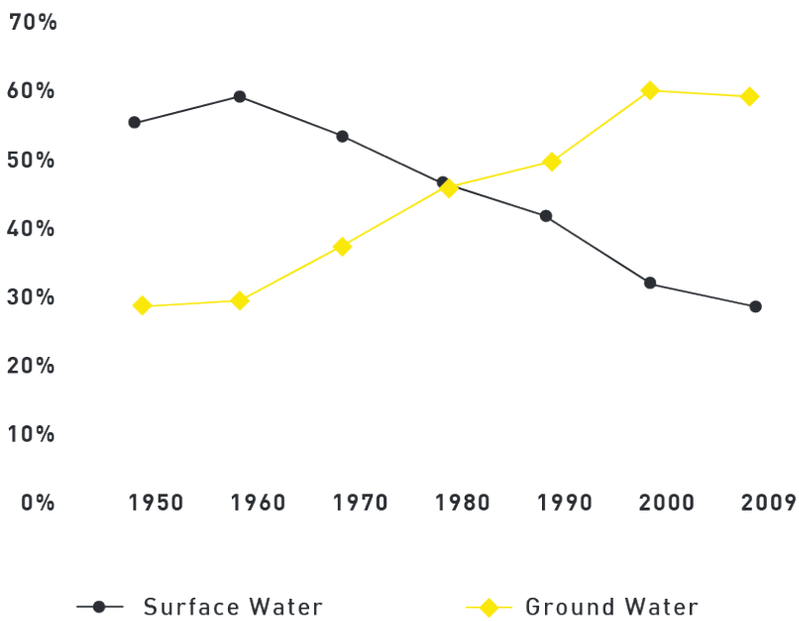
However, over 60% of water available in irrigated regions goes to water-intensive crops like rice and sugarcane (Sharma et al. 2018: xx). Together, three major crops - wheat, rice and sugarcane - consume more than 80% of water available from irrigation, while occupying 40% of total cropped area (Sharma et al. 2018: xxi). Table 1 shows the poor water-use efficiency in India compared to some major countries.

Table 1: Country comparison - water use in agriculture (Suhag 2016: 8)

Crop	Average water needed in countries (cubic metre/tonne)			
	Brazil	India	China	US
Sugarcane	155	159	117	103
Wheat	1616	1654	690	849
Cotton	2777	8264	1419	2535
Rice	3082	2800	1321	1275

The problem of inefficiency in water use is compounded by the fact that 61.6% water for irrigation comes from groundwater sources (Suhag 2016: 4). This means that, not only does the country have a dysfunctional canal irrigation infrastructure, it is also overly dependent on groundwater to grow crops like rice and sugarcane. In fact, India is the largest consumer of groundwater in the world. This overdependence is attributed in part to a steady proliferation of tubewell irrigation across the country. Owing to a flat-rate electricity tariff regime based on tubewell pump power and massive subsidies on power usage, the number of electric tubewells rose, from 1 million in 1980, to 15 million in 2010 (Gandhi 2018: 131-132). Figure 2 shows the shift in irrigated agriculture from surface water to groundwater.

Figure 2: Dependence on surface and groundwater for irrigation (Suhag 2016: 4)



As a result of this, states with some of the highest agricultural production in the country have reached critical levels in groundwater usage. For instance, in Punjab, Haryana and Rajasthan, groundwater development stress is a staggering 149%, 135% and 140% respectively, meaning these states are pumping out groundwater at a rate much faster than the annual groundwater recharge rate (Veluguri et al. 2019: 24). Comparatively, states like Gujarat (68%), Karnataka (66%), Uttar Pradesh (74%) and Tamil Nadu (77%) are not that far behind. This unchecked extraction of groundwater is incubating catastrophic consequences for soil moisture, fertility, salinity, and overall water availability in a country where 600 million people face extreme water stress (NITI Aayog 2018: 15).

2. Sustainability of Agricultural Incomes

As per the National Bank for Agriculture and Rural Development's (NABARD) Rural Financial Inclusion Survey 2018, the average monthly income of an agricultural household in India is INR 8,931 (see table 2) (NABARD 2018: n.pag.). According to the same survey, 52.5% of agricultural households have some outstanding debt and comparatively higher debt liability than that of non-agricultural households. Clearly, farming in India is not a remunerative profession, as most people dependent on it reel under back-breaking debt.

While the average farm household income is low, it also varies dramatically across states, showing the skewed nature of agricultural development in the country. As per the National Sample Survey Office's (NSSO) 70th assessment survey 2012-13, average annual farm household incomes varied from an alarming low of INR 44,172 in Bihar to INR 217,450 in Punjab (NSSO 2014: A-11).

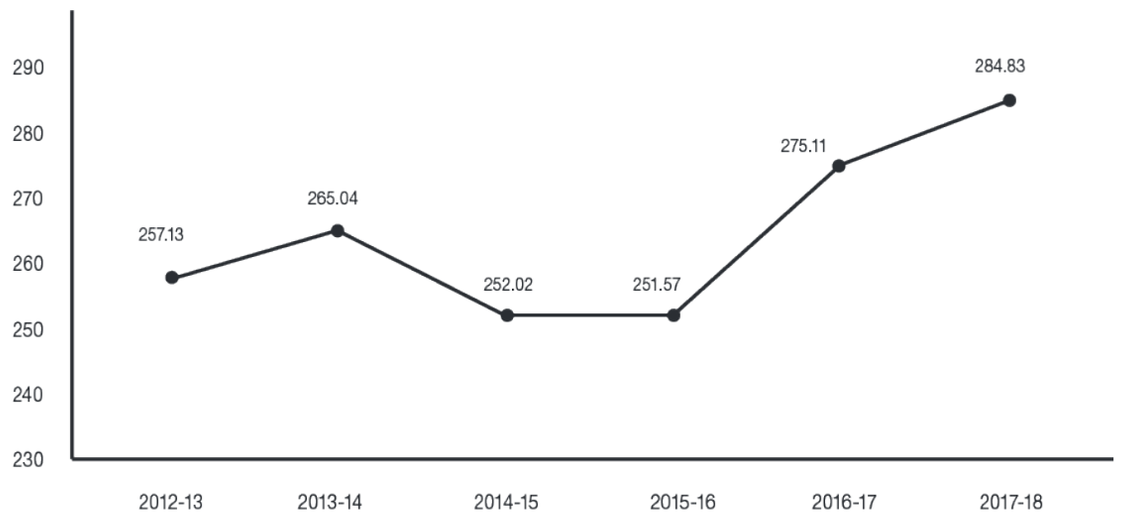
Table 2: Average monthly rural household income by source of income (NABARD 2018: n.pag.)

Source of Income	Agricultural Households	Non-agricultural Households	All Households
1	2	3	4
Cultivation	3140 (35%)	NA	1494 (19%)
Livestock Rearing	711 (8%)	NA	338 (4%)
Other Enterprises	489 (6%)	851 (12%)	679 (8%)
Wage Labour	3025 (34%)	3940 (54%)	3504 (43%)
Govt./Pvt. Service	1444 (16%)	2326 (32%)	1906 (24%)
Other Sources	122 (1%)	152 (2%)	138 (2%)
All Sources Combined	8931 (100%)	7269 (100%)	8059 (100%)

As farming has become non-remunerative, the agricultural workforce has also declined. In fact, employment in agriculture in India has been continuously decreasing over the last quarter of a century. Agricultural employment as a percentage of total employment was about 63% in 1991, compared to 44% in 2017 (World Bank 2017). It is no surprise then that the Annual Status of Education Report 2017 released by the NGO Pratham found that just 1.2% of rural youth aspire to be farmers (ASER Centre 2018: 74).

But the decrease in agricultural incomes and employment has not affected agricultural production, as can be seen in figure 3 below.

Figure 3: Food Production Statistics (Million Tonnes)



Source: Department of Agriculture, Cooperation and Farmers Welfare (2018); PIB (2018).
Note: 2014-15 and 2015-16 were drought years.

This is the paradox of Indian agriculture today. Even though production is at an all time high, Indian farmers, most of whom are small and marginal landowners, do not earn decent incomes and are moving away from farming. The challenge of income sustainability and making farming remunerable is compounded when one adds the variable of climate change to the equation.

2. Agriculture and the Climate Crisis

Increasingly, communities around the world are experiencing adverse impacts of the climate crisis in the form of prolonged droughts, frequent flash floods, and intense heatwaves, among others. These extreme climate events are already affecting crop yields, farm incomes, and water availability. It is a foregone conclusion, then, that the issues currently plaguing Indian agriculture will be exacerbated when the long-term impacts of the climate crisis kick in.

As per the IPCC's fifth assessment report (2014):

- In low latitude countries like India, climate extremes have been followed by periods of increase in food prices, thus indicating a sensitivity of markets to such events.
- Extreme daytime temperatures around 30°C are affecting crop yields across regions.
- In the absence of timely interventions to make agriculture climate adaptive in tropical regions where local temperature increases of 2°C or more are predicted, the production of crops like wheat, maize and rice will be affected negatively.
- In the Indo-Gangetic plains, increased heat stress could lead to a decrease of about 50% in high-yielding wheat areas.
- Higher average temperatures will lead to lower rice yields because of shorter growing periods.

This predicted decline in yields, in the context of ongoing environmental degradation and a slow exodus of farmers from agriculture, means that the worst is yet to come for India's farmers. In a business-as-usual scenario, as per the Economic Survey 2017-18, farm incomes will decline further. Based on an analysis of temperature and precipitation data from the Indian Meteorological Department (IMD), the survey has predicted that:

- Extreme climate events will impact yields in irrigated and unirrigated/rainfed regions differently (see table 3). Rainfed regions will see a much greater impact of climate extremes compared to irrigated regions, owing to their high dependence on rainfall.

- In the absence of policy responses to projected rise in temperatures, given the trends in India's precipitation levels, there are going to be between 15-18% losses in farm incomes, on average, and upto 20-25% for rainfed regions (Ministry of Finance 2018: 95). This translates to a loss of more than INR 3,600 per year for the median farm household at the current level of farm incomes.

Table 3: Impact of weather shocks on agricultural yields (% decline)
(Ministry of Finance 2018: 92)

Season and Region		Extreme temperature shocks	Extreme rainfall shocks
Kharif	Average	4%	12.8%
	Irrigated	2.7%	6.2%
	Rainfed	7%	14.7%
Rabi	Average	4.7%	6.7%
	Irrigated	3%	4.1%
	Rainfed	7.6%	8.6%

CONCLUSION

India's population is projected to cross the 1,600 million mark in 2050 (UN DESA 2019). This will inevitably increase the demand for agricultural produce, primarily food, in the country. Facing the combined threat of increasing water scarcity, decreasing soil fertility, and climate extremes, the agriculture sector is in dire need of appropriate short-term and long-term policy responses to be able to sustain yields without compromising on ecological health. Simultaneously, agriculture policy needs to make farming profitable for the average farmer in order to contain the gradual exodus of people from the sector, which will further impact production.

What has been the policy response to this crisis of sustainability in Indian agriculture? What are some key government schemes as part of this response? How impactful are such schemes? We will explore these questions, and more, in the second part of this SPRF issue brief series on agriculture in India.

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