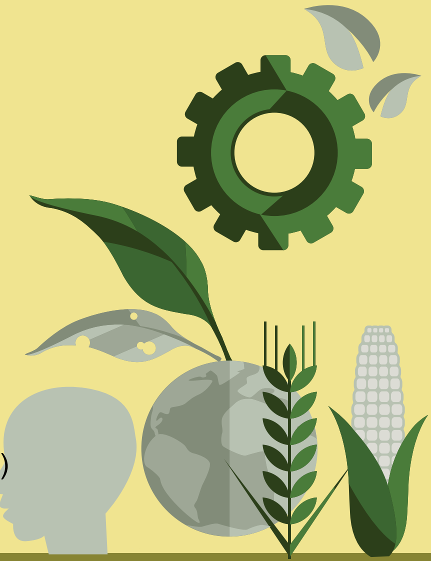
Policy Brief

Agricultural Policies and Investment Priorities for Managing Natural Resources, Climate Change and Air Pollution



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International Maize and Wheat Improvement Center (CIMMYT)
Indian Council of Agricultural Research (ICAR)
CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)
World Bank Group

The Context

Agriculture is an engine of inclusive economic growth as a major source of livelihood for millions of smallholder farmers and other rural residents in India. Having made significant strides in food production, through the Green, White, Yellow, and Blue Revolutions, Indian agriculture is now at a cross road. Deterioration in the quality of natural resources (soil, water and air), together with the adverse effects of climate change, pose significant threats to the sustainability of agricultural production and farmers' incomes. The situation in the Green Revolution corridors of India is especially daunting with severe problems of hydrological imbalance, soil degradation, and water pollution. In addition, the problem of air pollution from crop residue burning has emerged as a major cause for national and international concern because of its enormous environmental and health costs across the Northern plains of India. These worrying trends have led policy-makers to recognize that past strategies adopted for agricultural growth need to be re-adjusted, with the benefit of the same far-sighted vision as in the case of Green Revolution, to address these emerging complex challenges, fully exploit the potential opportunities for inclusive but sustainable growth, and promote rural prosperity.

The Round Table Dialogue

To outline an action plan and priorities for investments that address the key challenges holistically, a one-day round table dialogue on "Options and Investment Priorities for Conserving Natural Resources, and Addressing Climate Change & Agricultural Pollution" was organized on 9 April 2018 at NASC Complex, Pusa, New Delhi. The dialogue was jointly organized by the Trust for Advancement of Agricultural Sciences (TAAS), International Maize and Wheat Improvement Center (CIMMYT), Indian Council of Agricultural Research (ICAR), the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), and the World Bank Group. A total of 50 senior policy planners from NITI Ayog, Ministry of Agriculture & Farmers Welfare, Department of Agriculture Research & Education, Chairpersons of Farmers Commissions of Punjab and Haryana, senior policy planners from the state governments, research leaders from ICAR, State Agricultural Universities, CGIAR Centers (CIMMYT, IFPRI, ICARDA, ICRISAT), Advanced Research Institutions, NGOs, agricultural experts, and the potential donor organizations including World Bank, NABARD, IFAD, ACIAR, participated in the Round Table Dialogue and deliberated upon issues that addressed the following objectives:

- To consider the potential options and investment priorities for sustainable intensification and resilient growth in Indian agriculture in accordance with the Paris Agreement and the UN Sustainable Development Goals (SDGs).
- To identify the areas of analyses for articulation of the strategies, policies and technology options with potential tangible benefits that address the agriculture-water-energy-environment nexus, and specifically the urgent problem of air pollution.
- To identify opportunities for scaling conservation agriculture for sustainable intensification through partnerships/networking.

The Challenge

The land available for cultivation has no scope for further horizontal expansion in India. With continued rise in population, current agricultural practices are severely stressing the natural resource base, with rapid declines in soil health, water availability and quality, loss of biodiversity, and rising air pollution. The natural resources in India are estimated to be 3-5 times more stressed compared to the rest of the world. The extent of land degradation is alarming (114-145 million ha). A large fraction of agricultural soils in the Green Revolution belt now considered to be practically infertile, with their native productive capacity declining below the estimate threshold level for sustainable agricultural production. India ranks at the top in the world in terms of withdrawal of fresh water from aquifers (761 km^3 per year). And with a replenishment rate well below the withdrawal rate, especially in north-west India, many districts have experienced a decline in the water table of over 0.50 meters per year, reaching critical levels. Inefficient use and mismanagement of land, water, energy, and agro-chemicals jeopardize soil fertility, and adversely affect the quality of both water and the environment. It is well recognized that existing policies to provide free water and energy, subsidized fertilizers, and the continued reliance on the food distribution system promote inefficient use of inputs and resources, and drive the environmental degradation. Further, climate change and agriculture are closely interrelated, and the projected impacts of climate change-induced weather variability are a serious threat to agricultural production, food security, and livelihoods of farming communities in all agriculture dominated economies.

While adaptation to climate change is necessary to ensure food security and protect livelihoods of farmers, mitigation of greenhouse gas (GHG) emissions is critical to lessening the future impact of climate change. It is also evident that improved agricultural practices can help mitigate GHG emissions without compromising food production goals. India is the third largest GHG emitter in the world, and agriculture is responsible for 18 per cent of it's total emissions. India's Nationally Determined Contributions (NDCs) to United Nations Framework Convention on Climate Change (UNFCCC) pledges to reduce emission intensity of its GDP by 33-35 per cent by 2030 from 2005 levels (http://www.moef.nic.in/climate-change-docs-and-publications). Accordingly, India has rightly identified agriculture as one of the priority sectors to reduce emissions in its Nationally Determined Contributions (NDCs). This requires a clear strategy and action plan to address specific aspects of the agriculture-water-energy-environment nexus. A number of scientifically robust, climate-smart, sustainable agricultural intensification technologies and practices are available, which need to be scaled-up urgently with the adoption of appropriate policies and strategies backed by appropriate investment options.

Technological Options

A number of technological innovations exist for more sustainable management of natural resources, build resilience to climate change, and dramatically reduce agriculture sourced air pollution. Among these, conservation agriculture (CA) with the principles of zero tillage, soil-cover using organics, and diversified crop rotations are well developed and validated with proven multiple benefits. The scope for scaling–up CA-based systems in both the irrigated as well as rainfed cropping systems is vast. For agricultural diversification, low water-use crops are available that provide higher farmers' incomes while having a positive effect on natural resources.

Similarly, technical options are available to address the problems of indiscriminate use and over pumping of ground water, which results in the rapid depletion of water resources threatening agricultural sustainability. Efficient water management systems such as pressurized irrigation systems (sprinkler and drip irrigation) as well as automated irrigation management systems can lead to substantial saving of water. Even in flood irrigation systems, the traditional methods of land-preparation cause significant loss of water, which in turn leads to poor crop establishment, reduced efficiency of inputs, and lower agronomic yields. The laser-assisted precision land-leveling is a proven technology with significant potential for scaling-up.

Balanced application of nitrogen and other fertilizer nutrients can optimize food production while reducing GHG emissions. Efficient and appropriate use of fertilizer nutrients in smallholder farming systems is possible with decision support tools, sensors, and precision management methods that can be adopted and applied with significant potential benefits. Increase in fertilizer-use efficiency combined with improvement in soil health and soil organic carbon (SOC) concentration can substantially reduce use of fertilizers and decrease emissions of GHG, while increasing and sustaining agricultural production.

Finally, several options are also available to reduce agriculture biomass burning, which has emerged as a major contributor to air pollution and soil degradation. The best option to address this consistently with the goal of sustainable agriculture, though improved soil health, is to utilize the crop residues on the field itself. The Happy Seeder technology coupled with Super Straw Management System (SMS) mounted combine harvesters is an innovative and potentially scalable solution to achieve this. For increasing farmers' profits, conserving natural resources and building resilience while attaining food and nutrient security, science-based integrated farming systems must be developed, validated and scaled-out on priority for their large-scale adoption.

Based on a pan-India study by CIMMYT-CCAFS-ICAR-University of Aberdeen, it is roughly estimated that the technical mitigation potential of Indian agriculture is 85.5 Mega tons CO2-e which represents a significant share (approx. 20%) of the total emission from agriculture. To achieve this, technical mitigation potential, supportive policies and investments are needed to promote viable solutions and widespread adoption by farmers.

Policies and Investment Priorities

The concerns of sustainable management of natural resources (soil health, quality of water, air, etc.) need urgent attention. The current status and trends in soil health, water availability and air quality are far below desirable standards to nurture and sustain healthy lives. Soils in the Indo-Gangetic Plains are severely degraded with soil organic carbon (SOC) content estimated at or below 0.1 per cent, which is far below the critical threshold of 1.5 to 2.0 per cent needed for healthy soils. If this declining trend is not checked and reversed on a priority basis, the implications for food security and environmental quality may be catastrophic in terms of productivity decline. Looking at investment opportunities, the technological options indicated above need to be scaled-up through supportive policies, institutions and incentive structures that would help reduce agriculture's environmental footprint, conserve natural resources, and ensure sustainability of food production. Among these, the following policies and investment priorities merit consideration:

- The current focus on doubling farmers' incomes marks a paradigm shift in India's approach to agriculture, which requires to be more productive, sustainable and resilient. This can be achieved by scaling-up conservation agriculture practices, promoting appropriate and competitive agricultural diversification, and adopting an integrated farming systems approach that considers socio-economic and bio-physical trade-offs, and promotes climate-smart agriculture.

- Efficient use of water and nitrogen will help to simultaneously attain higher productivity and reduce agriculture's environmental footprint. A policy decision to ban flood irrigation and broadcast application of fertilizers in a phased manner should receive immediate attention of the government. Also, there is an urgent need to reconsider policies, especially on incentives and subsidies that promote the overuse of water and nitrogen, and discourage the uptake of tools and practices (micro-irrigation-cum-fertigation, minimum tillage, laser land leveling, mechanical drilling/banding of fertilizers, sensors and decision support tools for automation of nutrient and water application, etc.) that will promote greater resource use efficiency on farms.

- Restoring soil health at scale requires a focused national initiative on soil carbon sequestration. This initiative would necessitate strengthening the capability, efficiency and infrastructure of laboratories undertaking soil health analysis for desired nutrient and water management. Therefore, as a part of the carbon farming initiative, setting-up of state-level automated referral laboratories is urgently needed. Also, state level soil health reports for farmers should be prepared on a five-yearly basis to facilitate the adoption of corrective measures on farms.

- Mining of clay for brick making needs to be restricted to appropriate sites with deeper soil depths and strongly discourage the use of top soil from agricultural lands. The site selection for mining clay can be decided with the support from the Bureau of Soil Survey and Land Use

Planning along with the Department of Geology at the state level.

- An effective solution to control open burning of crop residues is to promote *in situ* recycling and management of crop residues. The current design of mechanical harvesters (combines), the narrow window of time available for planting the subsequent crop, and the high cost of labor create the incentives for farmers to burn the residues. *In situ* management would not only control air pollution but provide much-needed organic matter to restore soil health. A technical solution to this problem is the concurrent use of Straw Management System (SMS) with combine harvesters, followed by Happy Seeder for planting the next crop. Wider use of these machines needs a viable business model and a careful assessment of the farm level constraints (and trade-offs) to its scaling-up.

- Investing in climate-smart agriculture (CSA) is a high priority not only for restoring soil and conserving natural resources but also to achieve the goal of doubling the farmers' income. There is large untapped potential for increasing productivity under rainfed agriculture by bridging the yield gap sthrough Natural Resource Best Management Practices (NRBMPs).

- Investments in "Scale Appropriate Farm Mechanization" should be promoted all along the agricultural value chain, i.e., planting, harvesting, processing, and marketing, within a broader sustainable farming systems perspective. Viable business models to scale-up such technologies and services need to be promoted by motivating and attracting youth in agriculture (MAYA). This requires skills development, entrepreneurship training, and leveraging financial institutions. Government initiatives on small farm mechanization need to be complemented with efforts to overcome the farmers' information gaps and induce behavior change for faster adoption of mechanization by farmers.

- The whole process of technology development, adoption, and scaling needs to be made more socially inclusive to ensure relevance and acceptance under farmers' own circumstances. Concerted efforts are also needed to re-orient knowledge management and sharing digital technologies and artificial intelligence can be used for better, faster and more cost-effective identification and dissemination of natural resource management (NRM) and climate-smart solutions at scale. A key element for building climate resilience in agricultural management decisions, better manage climate risks, improving production efficiency and conserving natural resources is near real-time, targeted and actionable dissemination of weather/agriculture advisories to farmers. Since NRM calls for the concerted approach at the landscape level, mobilizing social entrepreneurs/stimulants/village *jankars* to stimulate the necessary community action and achieve scale for impact will be needed.

- The current system of subsidies can be repurposed to promote sustainable practices that restore our natural resource base. A suitable incentive mechanism for rewarding farmers for provisioning of ecosystem services and in the larger national interest of environmental stewardship, therefore, merits serious consideration. In this regard, quantification and payments through a mechanism like carbon trading, as practiced in advanced countries, would help in faster scaling of innovations of conservation agriculture based sustainable intensification (CASI). Accordingly, for adoption of CASI technologies, incentives in the form of payment for environmental services that are mainly in the national interest, has to be in place. In this context, to promote an estimated SOC sequestration of 0.33 metric tons per hectare per year, payment for environmental services to farmers at the rate of of Rs. 2,500/hectare/year need to be considered. A "National Initiative on Payments for Ecosystem Services to Farmers" need to be established.

- Studies on the economic returns to investments in major soil health and natural resource management technologies should be undertaken to draw implications both at the micro level (to assess their financial attractiveness for farmers to adopt them), and at the macro level (to assess the socio economic trade-offs), including positive and negative environmental externalities. Maximizing the impact of investments necessitates a focus on technologies with multiple benefits, with high priority on those providing triple wins (in terms of farmers' incomes – through improvement in productivity and efficiency; sustainable use of natural resources for better climate adaptation; and creating co-benefits in terms of mitigation.

- Since agriculture is a state subject in India, the investment needs so carried-out by the State Governments should be met on priority either by Central/State initiatives or by seeking funding support, from Overseas Development Agencies (ODAs). Accordingly, the policy support should be seen as a bottom-up initiative that is geographically differentiated and flexible in its implementation to address the problems relating to agriculture and beyond.

- Strengthening the technical, institutional and financial capacities of farmer producer groups, farmer producer organizations and agri-entrepreneurs with a focus on women farmers can necessitate farm-based collective action towards effective implementation and monitoring of eco-friendly solutions.

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