Is There a Trade-Off between Agricultural Development, Adaptation and Mitigation?

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India may resist inclusion of agricultural mitigation in global climate negotiations, but it cannot afford to avoid the mitigation needs at the domestic level, especially when adaptation and development are closely linked with and dependent on mitigation actions. However, effective implementation of these strategies would necessitate bundling of policies and interests to internalise the transaction costs and ensure social acceptability

INDIA'S LONG-standing official position in global climate negotiations has been that any discussion on agriculture must be held in the realm of adaptation, not mitigation.[1] The government considers the sector a clear out-of-bounds sector with respect to emissions reduction as agriculture is a sensitive issue and pursing mitigation may produce negative impacts on peoples' livelihoods. Is this apprehension sound? Is there any trade-off between agricultural development, adaptation and mitigation?

Indian Agriculture and Climate Change

Even after decades of industrialisation, India still remains an agricultural country. While there is a global trend of decline, according to Worldwatch Institute, agricultural populations in India has grown by a whopping 50 per cent over 1980-2011. On the contrary, agriculture's share in the GDP has seen a secular decline since independence. Nonetheless, agriculture has far more important role in Indian economy and policymaking than its share of GDP suggests. It employs about half of the workforce, provides livelihood to about two-third of the population, and food has been the largest contributor to inflation for several years, contributing to staggering poverty.

While India has emerged as a net exporter of agricultural products, it is still dependent on imports for essential food items like pulses and cooking oil. Though food self-sufficiency is not a distant goal, food security at micro level remains a formidable challenge. Unswerving slowdown in performance of the sector is a cause of concern in the overall agenda for food & income security and rural poverty eradication.

Being a climate change hotspot, embryonic impacts in form of extreme weather events seem to be further aggravating the agrarian distress in India. About 70 per cent of arable land in the country is estimated to be prone to drought, 12 per cent to floods and eight per cent to cyclones. At the same time, temperature rise would result in significant reduction in agricultural yield. The latest IPCC AR5 claims, with medium confidence, that higher temperature will reduce rice yields in Asian countries as a result of shorter growing period. Indo-Gangetic plains of South Asia could face a decrease of about 50 per cent in the most favourable and high yielding wheat due to heat stress at 2x CO_2. Similarly, sorghum yield in India is projected to decrease by 2-14 per cent by 2020, which will

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further worsen by 2050 and 2080.[2] With about 250 million populations being food insecure, the challenge is to produce enough food 'sustainably' to meet the increasing demands, with shrinking resource (land, water and energy) availability.

While the sector is most vulnerable to climate change, agricultural production contributes considerably to the problem, accounting for 17.6 per cent of total emissions in India. If we attribute agricultural consumption related emissions, involving energy use and fertiliser production, the sector's contribution to GHG emissions rises to 30 per cent (See Table 1). Thus, as an economic activity, agriculture emerges as not only less productive but also highly carbon intensive which is not a sustainable scenario.

Table 1: GHG Emissions from Agricultural Production and Consumption (in MtCO2e)[3]

Agricultural Production Related (Direct) Emissions ($MtCO_2e$)	
Livestock	212.10
Rice Cultivation	69.87
Soil Management	43.40
Burning of Crop Residues	6.61
Manure Management	2.44
Sub-Total	***334.41***

Agricultural Consumption Related (Indirect) Emissions ($MtCO_2e$)	
Use of Electricity	130.63
Use of Other Energy	33.66
Energy Use in Fertiliser Production	20.57
Sub-Total	***184.86***
Grand Total	**519.27**

Current Strategies

Has agriculture received due importance in India's low-carbon development strategy and action? Keeping with the global trend, India has been prioritising electricity, industries and transport sectors for low-carbon development.

Under the provisions of National Action Plan on Climate Change, a dedicated Mission- National Mission for Sustainable Agriculture (NMSA)- has been set up to promote 'sustainable agriculture', seeking to "transform Indian agriculture into a climate resilient production system through suitable adaptation and mitigation measures in the domain of crops and animal husbandry".

NMSA has been partly successful in identifying the challenges faced by agriculture and how they will be exacerbated in a changing climate. Yet, it has failed to bring in innovation in finding solutions for these challenges. With an approach to promote resource efficient technology, it has missed to address unhealthy agricultural practices. While water use efficiency is emphasised, skewed use of chemical fertilisers is ignored; the latter is a major driver of rising irrigation water demand. Moreover, many of the proposed strategies target the big farmers, who can afford newer equipment, while the small and marginal farmers are left vulnerable.

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Though the mission is technology-driven, it neither clarifies how the technologies will be governed nor addresses the weak agricultural extension services. Furthermore, absence of adequate credit and insurance facility, particularly for the large number of small and marginal farmers, would be a bottleneck for wider adoption of these technologies. Finally, weak institutional and human capacity will be a key challenge for effective implementation of agricultural policy. Such an obscure strategy, that merely addresses a few adaptation concerns, certainly falls short of a sustainable pathway for agricultural development.

Other schemes targeting water and energy use efficiency have not been much successful. Government initiatives to promote micro irrigation technologies, that have a huge potential to reduce water demand in agriculture, are dispersed and have very limited success in few states. While the state governments have made provision for substantial investment subsidies, owing to high transactional costs in accessing those subsidies, there is low incentive for the farmers to adopt such technologies.

Under the National Mission on Enhanced Energy Efficiency, India has launched the Agricultural Demand-Side Management (AgDSM) programme to limit agricultural electricity demand. Considering significant contribution of electricity consumption to agricultural GHG emissions, it is essential to tame the demand. However, taking another narrow and technology-centric approach, the programme seeks to improve pump efficiency by replacing existing pumps with five-star-rated energy efficient pumps. Can these new pumps save energy? The goals seem to be far from the reality.

Considering the past experiences in Indian electricity, we are not very optimistic about the replacement of 18.5 million irrigation pumps installed across India. The proposed Energy Service Companies (ESCO) model of investment seems unrealistic and financially unviable; the energy service companies (potential investors) are taking their hands off actual implementation. Even if India manages to implement the AgDSM programme, there is no hope for energy saving. The new pumps being promoted are claimed to be capable of drawing more water with the limited electricity supplied to Indian farmers. Considering the fact that farmers need water, not electricity,

and water demand is much higher than the current extractable quantity, improving pump efficiency will increase water use and thus, cause further depletion of groundwater table. We must not forget that a depleted water table requires raising the horsepower of irrigation pumps to draw water from further below. The addition of each horsepower means an increase in electricity consumption.[4]

Way Forward

In the coming decades, feeding growing population will require ingenuity and innovation in agriculture to produce more food with less resource in more sustainable ways. Agriculture must therefore transform to adapt to changing climate and lower emission intensities per output. Therefore, a climate-responsive development strategy is required in Indian agriculture to achieve the triple wins of development, adaptation and mitigation.

An effective adaptation strategy would seek to raise their resilience by preparing the communities to deal with resource scarcity and extreme events through alternatives and resource use efficiency. Likewise, mitigation in agriculture would require improved efficiency in resource consumption so that climate change induced stress, extreme events and their intensity can be reduced.

The major climate threat to agriculture comes in form of increased stress on already scarce resources and thus raising vulnerability of agriculture dependent communities. An effective adaptation strategy would seek to raise their resilience by preparing the communities to deal with resource scarcity and extreme events through alternatives and resource use efficiency. Likewise, mitigation in agriculture would require improved efficiency in resource consumption so that climate change induced stress, extreme events and their intensity can be reduced. In that sense, both adaptation and mitigation have same goals, seeking to achieve sustainability in agricultural consumption and production.

Converging agricultural development with mitigation and adaptation actions poses new challenges and requires better capacities, interventions and creative manoeuvres. To achieve the objective, India needs to reorient its agricultural development policy and strategy weighing its social, political, economic and environmental settings directly against each other, instead of thinking of them as separable.

This calls for a broader and embedded approach towards agricultural development. While it may be politically infeasible and socially unacceptable to take up a 'mitigation first' approach, India can plan a 'development first' strategy for agriculture with clear adaptation and mitigation 'co-benefits'. Following three broad strategies would be useful for achieving the much needed agricultural development while accruing adaptation and mitigation co-benefits.

Livestock Management

Livestock is the major emitting sub-sector accounting for about 40 per cent of embedded emissions in agriculture, but somehow not much discussed in the policy domain. However, simple interventions like feed quality improvement and health and reproduction management can reduce much of the emissions while improving productivity. More than two-third of livestock related emissions come from dairy animals that can be easily targeted. Improvement of the digestibility of the diet, which can be achieved by feed processing and addition of improved forages, will result in additional lactation and enhanced farm income and at the same time in the reduction of methane emission. Additional lactation resulting from improved feed is also expected to neutralise the adverse effects of climate change and warming, and thus, contribute to adaptation. Reduced herd size, through health and reproduction management, with a larger proportion of healthy and productive animals in dairies will increase productivity and at the same time reduce emissions. Gerber et al. (2013) claim that in South Asia that a 38 per cent reduction in emission is achievable in mixed farming systems if measures are taken for improving feed quality, animal health and husbandry.[5]

Water is What Matters

Water is a crucial input for agriculture. While current availability of irrigation water is inadequate and going to be more unobtainable in coming years, a significant part of agricultural emission comes from prevailing irrigation patterns that is predominantly flooding and highly dependent on electricity and diesel for pumping. In this context, a convergence of the three goals can be achieved by improving irrigation water management. While substantial water demand can be reduced by adopting efficient irrigation technologies like drip and sprinkler, much of the remaining demand can be met by revitalising and extending surface

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While these initiatives will raise resilience to water scarcity situation without compromising productivity, co-benefits include significant reduction in agricultural energy consumption and methane emissions from flood irrigation.

Restoring Agricultural Practices

Although modernisation is crucial for development, some traditional practices must be retained for better efficiency. For example, land levelling, mulching and crop diversification are some traditional agricultural practices that reduce the need for input resources like water and fertiliser. However, farmers often ignore these practices largely to avoid extra labour required and partly due to limited awareness pertaining to the benefits. While these inexpensive practices reduce the need for inputs, they also reduce erosion, preserve soil nutrients, supress weeds and increase fertility. Crop residues that are largely being burnt in field, contributing to emissions and local air pollution, can be used productively as mulch. Further, on field plantation of trees that can transfer nitrogen to soil would not only reduce requirement of chemical nitrogen fertiliser, but also can sequester carbon.

In addition, modern practices like soil fertigation and systemic rice intensification can further improve resource use efficiency and improve productivity.

Realigning Wider Agricultural Policies

The state can facilitate execution of these measures at farm level through creating effective incentive mechanisms at wider level. Moreover, there is a consensus that agricultural electricity and fertiliser subsidies in India, though lower than global standards, have contributed to significant inefficiencies. This calls for realigning the wider agricultural subsidy policies and food procurement policies to incentivise resource use efficiency and conservation in agriculture. For example, offering better support price for water efficient crops and varieties may foster their adoption, while substituting regressive energy and fertiliser subsidies with subsidies for efficient irrigation technologies can benefit the poor farmers more.

Based on a conservative estimation, these climate-smart measures together could result in reduction of a quarter of embedded emission in the sector, while increasing productivity. Postponing these low-hanging opportunities for triple wins is short-sighted. India may resist inclusion of agricultural mitigation in global climate negotiations, but it cannot afford to avoid the mitigation needs at the domestic level, especially when adaptation and development are closely linked with and dependent on mitigation actions. However, effective implementation of these strategies would necessitate bundling of policies and interests to internalise the transaction costs and ensure social acceptability. Moreover, it would require intervention of state agencies as a facilitator at multiple levels.

Endnotes

1 Swain, A K & Charnoz, O (2013): 'Agriculture- An Undervalued Sector for Climate Mitigation', *Financial Express*, 4th January, New Delhi.

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3 INCCA (2010): *Climate Change and India: A 4x4 Assessment- A Sectoral And Regional Analysis For 2030s*. New Delhi, Indian Network for Climate Change Assessment and Ministry of Environment and Forests, Government of India.

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5 Gerber, P. J., H. Seinfeld, B. Henderson, A. Mottet, C. Opio, , J. Dijkman and G. Tempio (2013): *Tackling Climate Change through Livestock: a Global Assessment of Emissions and Mitigation Opportunities*. Food and Agriculture Organization of the United Nations, Rome. ❑

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