

Can crop diversification be widely adopted to solve the water crisis in Punjab?

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The disquieting water crisis in Punjab – the food bowl of India – is threatening its agricultural sustainability, necessitating effectuation of pragmatic policy measures. Conventional agricultural practices, especially the paddy–wheat (highly water-intensive crops) cropping system, are fuelling the growing water challenges. Large-scale crop diversification is being recommended by experts for the past four decades as one of the most potent solutions for attaining water and agricultural sustainability. Despite its merits, crop diversification in the state could not bear fruits and remains almost inconclusive. The present article collates empirical studies to ascertain handicaps associated with crop diversification in Punjab for framing an indefectible crop diversification policy. Such a policy cannot be implemented in isolation but requires multifaceted policy action with the Government playing a key role.

Keywords: Agricultural sustainability, crop diversification, paddy, policy measures, water crisis.

INCREASING consciousness about growing challenges of water sustainability, and the subsequent socio-economic and ecological vulnerabilities: life sustenance, agricultural sustainability, food availability and livelihood generation, is fostering a constructive discourse on sustainable use of global water resources^{1–4}. An urgent need for viable solutions to mitigate unsustainable water use is universally acknowledged, and suitable measures are being taken the world over^{5–7}.

Unpropitious agricultural practices have been fomenting groundwater deterioration in India. The Indo-Gangetic Plains in northwest India is facing aggravated challenges of groundwater depletion due to excessive and inefficient use of water in agriculture. The situation has reached alarming levels in Punjab which is the pioneer of green revolution in India that was driven by paddy–wheat cultivation. In contrast to historical records of agriculture in the villages of Punjab that show a large number of crops being grown by farmers in the past⁸, the post-green revolution period exhibits a decline in crop diversity⁹. Majority of farmers in the state continue to prefer paddy–wheat cultivation^{10,11}. Thus, the area under paddy continues to increase, from 0.39 million ha in 1970–1971 to 3.1 million ha in 2018–2019.

Dominance of paddy–wheat cropping system that fostered food self-sufficiency in India is now being impacted on account of intensive water requirements. In particular,

paddy crop is blamed for increasing groundwater exploitation and ever-rising agri-water challenges in Punjab. Paddy consumes more water compared to any other crop¹². Moreover, the conventional practices of paddy irrigation are water-inefficient¹³. Thus, given the semi-arid soils of the state, cultivation of paddy is increasingly being considered detrimental to its groundwater and agricultural sustainability.

Overdependence of current agricultural practices on groundwater is manifesting a dire water situation in the state. Groundwater aquifers in about 79% of the total area of Punjab are overexploited¹⁴. Empirical evidence highlights that if this existing trend continues, the state is headed towards a ‘water crisis’ with impending desertification¹⁵. Of the total 138 development blocks in Punjab, groundwater resource is overexploited in 109 blocks, critical in 2 blocks and semi-critical in 5 blocks, thus, pointing towards an alarming groundwater situation. Average depth of the water table has intensified over time, from 7.32 m in 1998 to 12.79 m in 2012 (ref. 16). Groundwater in Punjab is depleting at a startling rate of 0.37 m/yr (ref. 17). This trend is widely expected to adversely affect agricultural productivity and will be deleterious to the pace and pattern of future agricultural development in the state¹⁸. It is an established fact that Punjab’s agriculture has the largest contribution to India’s food stock, thus, making the state’s agriculture indispensable to the nation’s food security. Therefore, the threat that water challenges pose to Punjab’s agricultural sustainability necessitates adding new dimensions – that focus on water sustainability – to the policy narrative of its growth trajectory.

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Crop diversification: an optimistic solution to water crisis

Crop diversification, that aims at replacing water-guzzling paddy – currently cultivated on over 85% of the cropped land – with less water-intensive crops, is being viewed as a felicitous strategy to mitigate agri-water challenges in Punjab^{19–22}. The literature indicates several benefits of crop diversification: groundwater conservation, revitalization of soil through cultivation of nitrogen-fixing crops, improved productivity, resource use efficiency, ecological gains, strengthening of rural non-farm sector and employment generation, and sustainable agriculture^{23–27}. In the past, various expert committees have advocated crop diversification as the most potent solution^{28,29}. The recently constituted high-level committee led by Montek Singh Ahluwalia (2020) also suggested crop diversification for achieving water sustainability and revival of the agriculture sector in Punjab³⁰. The state targets to shift 1.2 million ha paddy (out of total 3 million ha) to alternative crops for groundwater conservation²¹. However, most of the efforts for crop diversification since mid-1980s have not yielded any success^{31–36}.

Despite the potential of crop diversification to improve sustainability of both water and agriculture, majority of farmers in Punjab are reluctant to adopt it. This article highlights multiple challenges to expansive adoption of crop diversification in Punjab along with essential constructive policy actions based on empirical research literature.

Factors discouraging crop diversification

Widespread crop diversification seems to be a far-fetched idea for Punjab agriculture, *cetris paribus*. Experts often stress that populous policy environment of Punjab agriculture, fashioned by both State and Central Governments, has constricted change in agricultural practices. The currently effective policies of minimum support price (MSP) and assured procurement, free electricity, easy and subsidized purchase of submersible pumps and fertilizers, give an impetus to the dominant and age-old wheat and paddy cropping pattern^{37,38}. Considering alternative crops, as of now, even the policy-endorsed ones discernibly lack such support, especially price and procurement support. Inadequacies of facilitative measures have created an inimical environment for widespread adoption of crop diversification³⁹.

MSP and public procurement are crucial points of contention when it comes to promotion of crop diversification at the national level⁴⁰. Studies show that of all the crops with MSP in the country, only a few are effectively procured⁴¹. Possibility of abatement in profitability – the prime fear of farmers manifesting from the policy push for other crops – has held back farmers for long from

experimenting with crops that are not backed by assured procurement. In the case of Punjab, mainly wheat and paddy are procured⁴², while other crops have suffered at the hands of private companies due to lack of effective implementation of MSP⁴³. Public procurement of crops other than paddy and wheat is non-existent in the state. Thus, farmers consider the adoption of alternative crops as an unconvincing option. Despite the annual announcement of MSP for 24 crops by the Government, many farmers are unaware of the very existence of MSP for alternative crops. A study revealed that only 53% and 49% of farmers in Punjab were aware about MSP of all *rabi* and *kharif* crops respectively⁴⁴, thus explaining the unpopularity of alternative crops.

Additionally, many studies have highlighted that infra-structural insufficiencies and inadequate public and private investments in agricultural infrastructure hinder crop diversification^{45,46}. It is noteworthy that almost all the marketed surplus of paddy and wheat in the state is procured by the Government. Thus, there is no need for farmers to arrange for storage facilities. However, alternative crops, especially fruits and vegetables, require large storage facilities, specifically cold storage. The fact that only 2–3% of India's horticulture output is stored in cold storage facilities and 30% of the horticulture produce goes waste due to inadequacy of such facilities highlights the rationale behind not adopting crop diversification⁴⁷. Insufficient and uneconomical storage space for potato farmers is a common story in Punjab. According to the NITI Aayog Report of the Task Force for Agricultural Development in Punjab⁴⁸, post-harvest losses for fruits and vegetables, which were around 20%, and post-harvest handling and management inefficiencies, like lack of grading, standardization, and scientific packaging, are major bottlenecks to the adoption of high value crops (HVCs) in the state. Naturally, this would engender anxieties regarding cultivation of any crops other than wheat and paddy. Therefore – in the absence of public procurement for alternative crops – the lack of storage space constrains the potential for profitability as farmers would suffer post-harvest losses, and would be unable to undertake staggered sales. Furthermore, requirement of increased capital investment for machinery and paraphernalia for alternative crops is also a common constraint.

Additionally, weak forward linkages of agriculture, particularly agri-processing industrial units, have withheld widespread adoption of crop diversification in the state²⁷. According to NITI Aayog, lack of agri-processing and value addition in the state is confining crop diversification⁴⁸. Agricultural processing, in both organized and unorganized sectors, accounts for merely 2.2% of Punjab's agricultural production. Limitations in widespread development of value-adding industries in the state restrict marketing avenues for alternative crops. Furthermore, unlike wheat and paddy, which are staple food for most of the country, alternative crops suffer from a lack

of comparable demand and easy marketability. Not to mention, markets for such crops are often riddled with imperfections^{49,50}.

Crop diversification: a point in case for large landholdings

Theoretical and empirical evidences suggest that viability of crop diversification is limited to small farms alone. The literature points towards an inverse relationship between landholding size and diversification^{51,52}. Shergill⁵³ reported that cultivation of multiple crops per season is an inherent trait of subsistence farming 'it is the natural outcome of the autarkic state of a subsistence farming'. The study highlights that crop diversification is highly incompatible with modern commercial farming that comprises large farm sizes (>2 ha) that require specialization in crops for profit-making. In addition, the macro market structure promotes specialization in a single crop by large commercial farms with sufficiently large marketed surplus. With monoculture staying put, the study argues that the ramifications of monoculture, like declining water table and environmental degradation, need to be tackled by legislative measures.

The beneficial entailments of a multidimensional policy approach towards crop diversification, the major one being its improved acceptability among farmers, will not be exclusive to any particular strata; rather it has the potential to effect a widespread change among the farming community in general. Nonetheless, widespread adoption of crop diversification needs to be encouraged among farmers with landholding more than 2 ha, who comprise majority of the agricultural households in the state and with maximum contribution in its marketable surplus.

Pathways to widespread adoption of crop diversification

The foremost policy measure in this regard would be to design optimal crop plans which recommend cropping patterns that would maximize net returns and ensure significant groundwater saving²¹; and also assuring remunerative prices or MSP, and mandating effective public and private procurement on the stipulated prices, which would further encourage a shift to new crops⁵⁴. MSP for fruits and vegetables announced by the Government of Kerala, is an initiative in this direction. Institutions like Gram Panchayats, NGOs and cooperative societies can be engaged to assist the Government in implementing and delivering on planned patterns of regional cropping⁵¹. Noticeably, given the stringent water–energy nexus of paddy cultivation, a shift away from this crop would generate positive externalities that can be accounted in terms of water and electricity savings⁵⁵. The savings so generated, if passed onto the farmers through incentives for

adoption of alternative crops, would be a win–win situation for all. Subsidizing inputs, at least initially, would be invaluable towards providing the required impetus to crop diversification. Also, easy or cheaper credit availability for diversification is an essential monetary motivation⁵⁶. In addition, subsidized crop insurance is of paramount importance to foster crop diversification⁵⁵. A study in Odisha by Basantray and Nancharaiah⁵⁷, highlighted the relationship between cooperative societies and crop diversification. It was found that farmers who were dependent on cooperative societies for credit were practising diversification more than those who borrowed from other sources. Further, extensive training and awareness campaigns regarding technical and financial aspects of crop diversification would encourage wilful acceptance⁵⁸.

A report by NITI Aayog suggests legislative reforms and reorientation of policies for development and strengthening of agricultural marketing⁵⁹. Identification and strengthening of supply chains and value chains to create ample market for recommended crops, and delivering profitability to farmers is critical for Punjab^{22,60,61}. In this direction, setting up of processing and other supplementary industries in rural areas would generate value for the agricultural sector, and also boost rural non-farm employment^{62,63}. Furthermore, horizontal diversification backed by state or regional-level crop planning, and vertical diversification – in the form of rural industrialization – would usher in a climate of economic optimism that could induce a breakaway from rooted agricultural practises. Experiences of a number of Asian countries, like South Korea, Indonesia and the Philippines – with relatively smaller farm sizes than those of India, but better agricultural income – indicate the significance of vertical and horizontal diversification in comprehensive development⁵¹. However, the dilemma of precedence – whether markets and industries for alternative crops need to be established first, or widespread cultivation of such crops – is a 'chicken-and-egg problem'. This presents the danger of policy planning going around in circles, which should be strategically avoided by policymakers. Since crop diversification has been established as a vital instrument for achieving water and agricultural sustainability. It becomes incumbent on the Government to promote a shift towards less water-intensive crops, and also propel water-use efficiency in the existing and recommended alternative crops.

To conclude, crop diversification can be a solution to the water challenges in Punjab. Nonetheless, effective policies that would ensure remunerative commercial farming – produce not to be procured at less than MSP – of alternative crops, create marketing infrastructure, strengthen market information and intelligence, increase public and private investment in rural infrastructure, propel research and extension services, and provide credit assurance and risk insurance for recommended alternative crops and varieties are quintessential for the transformation

of traditional monoculture towards less water-intensive crops and more water-efficient agricultural practices. That it is crucial for farmers to realize the impending threat to agricultural sustainability, and act towards aver- sion of consequent catastrophic results while contributing towards macro goals, is beyond doubt. Concurrently, it is imperative for policymakers to provide a firm foundation, both socio-economic and political, giving impetus to the economic well-being of farmers. In the end, this may well be the decisive factor that empowers Punjab's farmers to make an impactful contribution towards environmental sustainability.

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