Argumentation by Misrepresentation

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In this response to Chris J Perry and M Dinesh Kumar's critique of the authors' co-authored paper, "Water and Agricultural Transformation in India: A Symbiotic Relationship —I" by Mihir Shah, P S Vijayshankar and Francesca Harris (*EPW*, 17 July 2021), the authors seek to respond to a distortion of their views as well as what they claim is a ridiculing of powerful solutions to India's water and agrarian crises.

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In their critique (Perry and Kumar 2022) of our co-authored paper "Water and Agricultural Transformation in India: A Symbiotic Relationship—I" by Mihir Shah, P S Vijayshankar and Francesca Harris (*EPW*, 17 July 2021), Perry and Kumar repeatedly misrepresent our core arguments, while also casting them in a partial, distorted, and incomplete manner. In doing so, they ridicule very powerful solutions to India's water and agrarian crises without offering any alternative ways forward.

Correcting the Misrepresentations

In the very first paragraph, Perry and Kumar state: "the authors argue that the crisis in India's water sector ... can be solved through agricultural transformation" (Perry and Kumar 2022: 58). This is a gross oversimplification and misstatement of the core proposition of our paper, which is

> that solving India's water problem requires a paradigm shift in agriculture and that the crisis in Indian agriculture cannot be resolved without a paradigm shift in water management and governance. (Shah et al 2021: 43)

We therefore highlight the deeply interconnected nature of the twinned crises of water and agriculture in India, arguing that neither crises can be resolved without a paradigm shift in both the sectors. Our paper outlines the constituent elements of each of the existing paradigms of water and agriculture, explains why they need to be transformed, and then describes the nature of the paradigm shift required in both areas. The first part of the paper argues that the paradigm shift in agriculture requires shifting cropping patterns to include crops suited to each agroecological region, a movement from monoculture to poly-cultural crop biodiversity, a decisive move towards agroecological farming, and greater emphasis on soil rejuvenation. The second part of the paper describes the paradigm shift needed in water, which includes rejuvenation of catchment areas of rivers, a shift towards participatory approaches to water management, a focus on green water and protective irrigation, the widespread adoption of water-saving seeds and technologies, while building transdisciplinarity and overcoming hydro-schizophrenia in water governance. Thus, unlike what Perry and Kumar attribute to us, solving India's water problem requires all these reforms to be put in place, which are described in detail in our paper but completely ignored by Perry and Kumar in their response.

A similar example of misattribution by Perry and Kumar is their statement:

> The paper narrates a series of problems in the agriculture sector ... These outcomes are attributed to "*continued blind adherence" to green revolution technologies*. A paradigm shift is proposed, characterised by a change from a "fine-cereal" (wheat and paddy)-dominated cropping pattern to one in which a mix of less water-intensive crops, including nutri-cereals, predominate. (Perry and Kumar 2022: 58) (emphasis added)

Here again, we find several distortions by Perry and Kumar of what we actually say in our paper, where we refer to a "continued blind adherence to the Green Revolution approach" (Shah et al 2021: 51).

First, they fail to understand that the green revolution was not merely a matter of technology but an "approach" with several constituent elements, described in detail in our paper, each of which needs to undergo transformation. We argue that the green revolution approach needs to be replaced by a completely different paradigm, with multiple constituent elements, including: (i) crop diversification through broadening of the public procurement portfolio to include crops suited to the agroecology of diverse regions; (ii) moving away from monoculture towards polycultural biodiversity; (iii) rejecting the commodity-centric approach of the green revolution based on total factor productivity (TFP) and adopting a vision of total system productivity (TSP) instead; (iv) moving towards an agroecological approach to farming, as is being advocated

by the Food and Agriculture Organization (FAO) and adopted the world over; and (v) rejecting the view of the soil as an input–output machine, where the soil was seen essentially as a stockpile of minerals and salts, just a base with the physical attributes necessary to hold roots and moving decisively towards a vision of "living soils," popularised most prominently by World Food Prize winner Rattan Lal. Additional muscle to our argument is provided by a recent paper, which argues that

> the potential of soils to store carbon, has hitherto not received enough attention. Indeed, the earth's soils contain about 2,500 gigatons of carbon, more than three times the amount of carbon in the atmosphere and four times the amount stored in all vegetation ... Soil organic carbon content is important for climate change mitigation, but it is equally important for farmers and biodiversity. Increasing soil carbon has the effect of drawing down carbon from the atmosphere, while simultaneously improving soil structure and soil health, soil fertility and crop yields, water retention and aquifer recharge. A soil must have at least 5% organic matter to be considered healthy. (Ravikanth et al 2022)

This further underscores the need to move beyond the green revolution paradigm towards agroecology.

In addition to this multipronged paradigm shift in farming, we also build a strong case for a paradigm shift in water, without which the paradigm shift in farming would remain incomplete, if not impossible. Thus, unlike what Perry and Kumar suggest, we speak of twin paradigm shifts, in both water and agriculture, both of which are multipronged and not merely centred on a shift in cropping patterns, as claimed by them. We can go on multiplying the many other instances of misrepresentation of our arguments by Perry and Kumar but that would become too tiresome for the reader. So, we now turn to a careful examination of the critique they provide of those arguments that they selectively focus on.

Response to the Critique

Perry and Kumar summarise their critique of our paper as follows:

> The solutions proposed by them, nutri-crops, no doubt have a place in India's agricultural future, but they will neither revolutionise India's agriculture sector nor minimise the water and soil problems listed. In the absence of large subsidies, they are an unattractive option for the typical small farmer; the reduced yields associated with these crops will undermine India's food security and require substantial imports; water savings (except to the extent that sugar cane is abandoned) will be minor. The interventions required to promote these crops would be immensely expensive for the central government in terms of subsidies to procurement prices and additional imports to replace lost cereal production. (Perry and Kumar 2022: 60)

Our responses are detailed here.

Pulses and Oilseeds

First, Perry and Kumar reduce our many propositions to just one—nutri-cereals! But our paper does not only speak about the need to include nutri-cereals in India's cropping patterns. We place equal emphasis on the reinclusion of pulses and oilseeds, of which India has a rich and variegated repository. Given the repeated crises of pulse production in recent years, our proposal for enhancing the research and development (R&D), as well as procurement support for pulses requires urgent attention. There is an even greater urgency now to our proposal regarding oilseeds, given the latest policy moves to promote palm oil monocultures in India, which could have potentially disastrous outcomes, both economic and ecological, and is completely egregious when we are blessed with a multitude of oilseeds perfectly suited to the agroecologies of diverse regions.

Aligning Cropping Patterns

Second, in our paper, we specifically examine and rebut the argument that these crop replacements will endanger food security, where we acknowledge that yields of our replacement crops are currently lower than the water-guzzling crops. But, we note that in recent times, the productivity of nutri-cereals has been going up because of which, despite a sharp reduction in the acreage under nutri-cereals, their production has not declined. In fact, between 2000–01 and 2014–15, the yield of nutri-cereals has gone up significantly by about 3.8% per year. This is a positive sign leading us to believe that with greater R&D investments in nutri-cereals, their productivity can be further improved. The arguments Perry and Kumar make are typical of the circular line of reasoning of those in favour of maintaining the status quo in any context. This is how, in the context of climate change, advocates of fossil fuels argue that green alternatives remain unaffordable, unavailable, etc, totally ignoring the default setting of massive subsidies and support structures bolstering fossil fuels and the absence of comparable support for the alternative, which is urgently required given the catastrophe we are heading towards on a planetary scale. This is exactly the case with water and farming in India. For any transition towards sustainable solutions, we need to address the regime of heavily subsidised fossil fuel-based mainstream agriculture, which is currently able to easily outcompete any alternative. If the real economic, as well as the ecological, costs of green revolution farming were to be factored into the calculation, the agroecological paradigm would win hands down in comparison.

Further, nowhere in our paper do we advocate an abandonment of rice and wheat, or even sugar cane. All we are arguing for is a greater alignment of cropping patterns with regional agroecology. We are arguing for diversity, not for replacing one monoculture with another. Our proposal for aligning cropping patterns with regional agroecology includes raising the share of eastern India in procurement of water-intensive crops like rice. Eastern India is naturally suited to paddy cultivation. While West Bengal is one of the leading states in India in terms of rice production, not even 10% of its total output is procured by the government. Ironically, even though this region has abundant water resources, it depends on groundwater-scarce regions for its supply of foodgrains. It has been correctly pointed out that

> Eastern states which are safe in their groundwater reserves and net importers, also have the highest yield gaps and therefore the greatest unmet potential to increase production. (Harris et al 2020: 9)

Raising the share of rice procured from eastern India would greatly help to move in this direction, as would tweaking electricity tariffs there (Sidhu et al 2020).

Hence, we are all for raising rice production in regions where it should be naturally grown. And we advocate key policy reforms that would enable such an outcome. Thus, unlike what Perry and Kumar suggest, the new paradigm we advocate will only enhance food security, not endanger it.

Underscoring the need for this paradigm shift, we further point to the rapidly deteriorating water situation in Punjab and Haryana, which increasingly poses a very serious constraint to maintaining the productivity levels of water-intensive crops like wheat and rice in these states. An extremely important recent study concludes that

> given current depletion trends, cropping intensity may decrease by 20% nationwide and by 68% in groundwater-depleted regions. Even if surface irrigation delivery is increased as a supply-side adaptation strategy, cropping intensity will decrease, become more vulnerable to inter-annual rainfall variability, and become more spatially uneven. We find that groundwater and canal irrigation are not substitutable and that additional adaptation strategies will be necessary to maintain current levels of production in the face of groundwater depletion. (Jain et al 2021)

Thus, crop yields of water-intensive crops are going to start decreasing anyway if groundwater runs out. Hence, it would be fallacious to assume that output levels of water-intensive crops could be sustained indefinitely in heavily groundwater-dependent states like Punjab and Haryana.

Of course, we also draw comfort from the fact that food stocks over the last decade have greatly exceeded the "buffer norm," which is around 31 million tonnes for wheat and rice. Indeed, even after all the additional offtake following the COVID-19 pandemic, the central pool still had 91 million tonnes in stock in July 2021 (*India Data Hub* 2021)—yet another contextual indicator that this is, indeed, an opportune moment for moving towards crop diversification in India.

Further, Perry and Kumar completely ignore our argument that food security is not the same as nutritional security. The nutritional content of the crop mix we are proposing is definitely superior, which becomes critical in the context of India's twinned "syndemic" of malnutrition and diabetes. India has the world's second highest number of diabetics, first being China. A major contributor to this syndemic is the displacement of whole foods in the average Indian diet by energy-dense and nutrient-poor, ultra-processed food products largely based on rice, wheat, and sugar (Basu 2022). According to the Indian Council of Medical Research, foxtail millet has 81% more protein than rice. Millets are climate-resilient crops suited for the drylands of India. They also provide a higher content of dietary fibre, vitamins, minerals, protein and antioxidants, and a significantly lower glycaemic index. Providing nutri-cereals in school midday meals and anganwadi centres could reduce iron-deficiency anaemia, while the increased consumption of pulses could reduce protein-energy malnutrition (DeFries et al 2018).

Addressing Degradation

Third, Perry and Kumar completely ignore all the evidence cited in our paper regarding the impact of green revolution farming on soil quality, water tables and water quality, each of which demand a move away from the current soil depleting, water-guzzling and water contaminating agricultural paradigm towards agroecological farming, as is happening the world over. As we argue, soil organic matter (SOM) is an indicator of soil health and should be about 2.5%–3% by weight in the root zone, while the soils in Punjab, Haryana, Rajasthan, Delhi and many parts of central and southern India now contain less than 0.5% SOM. According to the FAO, generating 3 centimetres of topsoil takes 1,000 years, and if current rates of degradation continue, all of the world's topsoil could be gone within 60 years.

There is growing evidence of a steady decline in water tables and water quality. The most important element of the green revolution in India has been the galloping extraction of groundwater across aquifer types, including in hard rock regions, with very low rates of groundwater recharge. At 250 billion cubic metres (BCM), India draws more groundwater every year than any other country in the world. India's annual consumption is more than that of China and the United States (the second and third largest groundwater-using countries) put together. As a result, at least 60% of India's districts are either facing a problem of overexploitation or severe contamination of groundwater (Vijayshankar et al 2011). The single most important factor leading to the drying up of India's peninsular rivers is the overextraction of groundwater in their catchment areas. There is a clear evidence of fluoride, arsenic, mercury and even uranium and manganese in groundwater in some areas, reflecting the depths to which groundwater extraction is taking place.

The intensive overuse of chemical inputs under the green revolution has led to increasing levels of nitrates and pesticide pollutants in groundwater, which have serious health implications. The major health issues resulting from the intake of nitrates are methaemoglobinaemia and cancer. And, the rapid increase in pesticide use activates the major health hazards of pesticide intake through food and water, including cancers, tumours, skin diseases, cellular and DNA damage, suppression of immune system and other intergenerational effects. A study of farmworkers in Punjab found a significantly higher frequency of chromosomal aberrations in peripheral blood lymphocytes of workers exposed to pesticides, compared to those not exposed (Ahluwalia and Kaur 2020). Is this not evidence enough (and much more is cited in our paper) for Perry and Kumar to acknowledge that the green revolution has precipitated a major crisis of lives and livelihoods in India?

Financial Sustainability

Fourth, one of the most shocking arguments made by Perry and Kumar is that the paradigm we are advocating will prove "immensely expensive for the central government" (Perry and Kumar 2022: 60), completely overlooking the humongous burden the current model of agricultural growth places on the national exchequer due to the alarming growth in subsidies on account of fertilisers, irrigation and power supply to agriculture. The fertiliser subsidy is estimated to be around ₹1.38 lakh crore in 2022–23, making it the third year in a row at

around this level, up from an already unaffordable ₹70,000–₹80,000 crore for a few years before that (Sahu 2022). Surely, all alternatives such as agroecological farming advocated in our paper need to be strongly pursued to address this financial and ecological emergency.

Water-saving

Finally, our calculations show that through a degree of crop diversification, it is possible to save 18%–36% of irrigation water in the 11 major irrigation water-using states. As we have mentioned in our paper, since water-intensive crops currently occupy over 30% of the gross irrigated area in these states, the amount of water saved annually is considerable. This water could be used to provide critical and supplementary irrigation for millions of small and marginal farmers, while also reducing the pressure on rural drinking water sources.

Perry and Kumar question our calculations by arguing that the "total water footprint" (TWF) is the "correct measure of the impact of crop production on the hydrological system" (Perry and Kumar 2022: 59), and not the blue water footprint (BWF) that we have used. We would argue that different water use/footprint indicators have their own advantages and disadvantages, and are more or less suitable, depending on the question sought to be answered, availability of robust data, etc. For the purposes of our paper, which seeks to build illustrative scenarios of possible water savings under different crop combinations, using location-specific data for each state, we would suggest that BWF is a more appropriate indicator.

There is in fact no such thing as a "correct measure." Green water—which is included in total water use—would still be used by the natural vegetation if agriculture was not there. However, blue water use is entirely driven by human intervention, that is, irrigation. Green water use carries less opportunity cost, as in areas with large green water availability there is no need to reduce green water use, whereas reducing blue water in all contexts can provide economic and societal benefits.

In any case, whether we use TWF or BWF, they need to be used together with other indicators such as those of water quality, which also measure the impact of crop production on water systems. We agree with Perry and Kumar that using TWF would provide an indication of the total water savings. However, since green water use is driven predominantly by yields, and thus strongly correlated with total land use, the use of green water could potentially run into several conceptual problems and end up overestimating the human impact on the environment. In our paper, we illustrate the potential for farmers to reduce irrigation water use, without increasing or decreasing land use. We believe that we have provided an initial indication of potential water savings, which can become the basis for further work on this question.

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