Green Revolution and the Yield Question

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By analysing the yield data in the post green revolution period, the connection between productivity and green revolution technology is contested. Based on research conducted by the Indian Council of Agricultural Research, it is argued that the green revolution could not have been the only option for India in the mid-1960s.

Richa Kumar's "India's Green Revolution and Beyond" (*EPW*, 24 August 2019) provides an insightful peep into Indian agriculture in the pre-green revolution period (including pre-independence period). This article along with Stone (2019) raises serious doubts on the "ship to mouth" story, unavoidability of PL480 imports and the viewpoint that green revolution was necessary. Relying on the Planning Commission data, it asks a valid question as to why "no one thought that there was (food security) crisis" in 2009 when more than 40 years of green revolution, food availability per capita per annum was 162.1 kg, while in the so-called "ship to mouth" years in the pre-green revolution period it was 171.1 kg in 1961? In fact, during the last 18 years, 1989–2007, for which data on per capita availability of foodgrains has been provided by the Planning Commission, in only eight years, it exceeded per capita food availability in 1961 and for the other 10 years, almost continuously since the late 1990s, it was lower than that (Planning Commission nd).

While this data appears to buttress the argument that the green revolution has not added much to food security, there is a catch. Food availability data is inclusive of foreign trade in foodgrains. Hence, lower per capita food availability in later years could as well be on account of higher exports and vic versa. Hence, to judge the impact of green revolution on food availability, one needs to remove foreign trade data and look only at domestic production data. When we look at production data, we find that the data on foodgrains production includes just cereals and pulses. Some clearly edible items like oilseeds, fruits and vegetables, plantation crops like tea, coffee and spices, and sugar cane are excluded from food production data. Also excluded from food calculus are milk, eggs, and other livestock products, fisheries, wild/forest food production and items like honey. While these "allied activities" not only contribute to the final food basket like agriculture does, these also compete for common resource with farming land. Then, there are non-food crops like cotton, jute, etc, and logging which also compete with production of food. So while looking at the food security question and the impact green revolution has on this, we must not confine ourselves to the production of cereals and pulses alone.

But how do we reduce the complexity of diverse food items to a common denominator? One plausible alternative is to look at the contribution of agriculture and allied sectors (that includes fishing and aquaculture along with forestry and logging) over time (at constant prices). This in turn could be affected by not only technology used in agriculture but also by land area diverted to non-agricultural usage. Moreover, the area under cultivation could be dependent on the kind of technology used in farming as over time farming methods could convert cultivable land to waste and vice versa.

Rather than grappling with these complexities, to determine the impact of green revolution, an easier alternative is to look at per acre productivity of specific crops. And the data clearly shows that post-green revolution productivity of not only rice and wheat but agriculture as such has improved (though at a different rates for different crops and at differential rate over time) (Stone 2019). However, all this increase in productivity cannot be attributed to green revolution technology. It is obvious that the expansion of irrigation, particularly exploitation of groundwater, and institutional changes, for example, public procurement regime would have also contributed to increase in productivity. To isolate the impact of green revolution technology, we need to take out the impact of all other contributory factors.[1] One can also work with macro

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data and try to apportion the improvement to different factors but this can also be done using control trials.

The Yield Data

Is such data available and what does it show? Before proceeding further, a caveat is in order. While yield is an important variable, it is not the only relevant or even the most important variable. Food is meant to provide nutrition and nutrition is not axiomatically coterminous with yield; the two could even have an adverse relationship. Then there is an issue of external impact and sustainability. As Kumar (2019) has noted, there is extensive literature on the adverse impact of green revolution on these counts. These caveats on the use of yield alone in judging green revolution are important but what does yield data show?

There are news reports about many organic farmers who are getting better or comparable yield (or profitability without any price premium). We can also cite our own recent study of 200 organic farmers in Haryana. However, here we will cite a study conducted by mainstream agricultural institutions. Indian Council of Agricultural Research (ICAR)–Indian Institute of Farming Systems Research (IIFSR), Modipuram, Uttar Pradesh has been running a "Network Project on Organic Farming" (NPOF) since 2004. Under NPOF, research is undertaken in 20 centres of 16 Indian states. Amongst other things, research on comparative analysis of three broad systems of farming—organic, inorganic/green revolution technology and integrated/mix of the two—is undertaken. The latest results available at the website of IIFSR pertain to the agricultural year 2013–14.[2]

Proceedings of its workshop on "Organic Farming: Concerns about Crop Productivity and Soil Health," 7 January 2016 note that

> Based on research studies in scientific organic management under ICAR-Network Project on Organic Farming, 18 crops responded positively to yield on par or higher under organic systems after the conversion period (2–3 years). Organic management of basmati rice, rice, maize, green gram, chickpea, soybean, cotton, garlic, cauliflower, tomato resulted in yield advantage to the tune of 4 to 14% over inorganic management … Yield reduction (after 8th cycle across the locations) of 5%–8% was observed in wheat, radish, potato etc. (IIFSR 2016: 1)

In fact, for crops like soybean and cotton, yield under organic farming was better than conventional farming from the beginning (IIFSR 2015: 21). In Sikkim, before it started its journey towards organic farming,

> the productivity of rice was 1.43 t/ha but 11 years later, that is, during 2013–14, it increased to 1.81 t/ha, and more interestingly, no yield reduction was observed during conversion period. Productivity increase in other crops was also noted to the tune of 11%, 17% and 24% in maize, finger millet and buckwheat, respectively. (IIFSR 2015a: 13)

So, rather than reduced productivity, NPOF results show that organic farming led to improvement in it. Moreover, it is noted that "net returns (at 20% premium price) [were] 17% higher under organic

production system compared to inorganic production system" (IIFSR 2015b: 3). This indicates minimal decline in yield and/or increase in the cost of cultivation. It is not too high a price to pay when numerous environmental benefits are observed:

> Continuous practice of raising the crops organically has good potential to sequester the C (up to 63% higher C stock in 10 years), higher soil organic carbon (22% increase in six years), reduction in energy requirement (by about 10%–15%) and increase in water holding capacity (by 15%–20%), thereby promoting climate resilience farming. (IIFSR 2016: 2)

To top it all, it is noted that "quality parameters of different crops were higher under organic management compared to integrated and chemical" (IIFSR 2015b: 4).

In Conclusion

These results in favour of organic farming are in spite of the fact that experimental design has taken a rather narrow view of organic farming, viewing it just as an alternative method of plant nutrition and protection with no changes made in other agronomic practices. Organic farming certainly implies non-usage of chemical fertilisers and chemical plant protection methods, but it is not just that. This is also recognised by NPOF as it recommends that "organic agriculture should naturally depend on ... mixed cropping, crop rotation, residue recycling, composting etc" (IIFSR 2016: 1). However, aspects like the experimental protocols and recommended package of practices (IIFSR nd) are ignored.[3] Not one centre conducted crop rotation experiments and only one reported results of mixed farming (IIFSR 2015b: 5).

If under monocropping conditions, and with a narrow view of organic farming, it can beat green revolution technology even in yield, imagine the results if all elements of organic farming like mixed cropping, livestock integration, crop rotation, trees, improved composting, reduced irrigation, etc, were to be practised. Fortunately, NPOF has taken some steps in this direction. Since 2013–14, NPOF has started developing "Integrated Organic Farming System Models" and in the very first year these models evaluated at Coimbatore and Dharwad increased "the net income by two to seven times over existing system" (IIFSR 2015b: 3).

If research by mainstream ICAR institutions shows, as NPOF results show, that even today traditional methods (there is nothing in the package of organic practices adopted in NPOF that is based on post-green revolution knowledge[4]) can outperform green revolution technology even in yield, how can one say that in the mid-1960s India had no alternative other than the green revolution?

NOTES

1 We also need to separate the impact of two interrelated but distinct components of green revolution technologies—seeds and fertiliser use.

2 Most of the material on NPOF used in this article is available on http://www.iifsr.res.in/npof/index.php?id=publication and was viewed on 15 November 2019.

3 However, now some centres have started few experiments in mixed cropping (IIFSR 2016).

4 One exception could be the seeds used; some of the seeds used may have been developed under the green revolution paradigm. But if seeds of high yielding varieties have delivered even without the use of chemical fertilisers, then that clearly demonstrates that the use of chemical fertilisers and pesticides, etc, was unwarranted.

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