# Conventional Farming VS Self-reliant organic farming

**Rajinder Chaudhary**,
Former Professor, Department of Economics,
MD University, Rohtak (Haryana)
rajinderc@gmail.com

## ABSTRACT

Farming is critical for two reasons: it provides food which is the basis of human life and involves important interface with nature. Current chemical farming methods have been called exploitative even by promoters of so called green revolution in India. Official reports document extensive soil degradation, water pollution and unsafe food because of conventional farming methods. Even without harmful residues, nutritional content of farm produce has declined over time. Heavy reliance on external inputs leads to high energy use and thus contributes to climate change and environmental degradation.

Faced with these consequences of conventional farming, two different paths have appeared on the horizon- one that of genetically modified seeds and soil-less farming etc. leading to further corporatisation of farming and the other one that of various strands of organic farming. While it is generally recognised that organic farming is environmentally safer, provides healthier food and is sustainable, yet it is widely doubted if it can provide qualitatively better food in enough quantity too.

The paper discusses these two aspects in sequence; first it discuss how self-reliant organic farming can provide solution to the problems created by chemical farming as well as provide better food. Thereafter, it examine the yield question. Three different sets of data- international, national and local clearly show that organic farming is not low yielding either. In spite of its own experimental results, ICAR is not recommending mainstreaming of organic farming. But if environment and health is to be protected, then chemical farming has to go and organic farming is the way to go. Besides literature review, based on a decade long experience of Haryana, a core area of 'green revolution' I seek to establish that there already exists a viable –economically, environmentally and socially viable alternative and it does not have to invented de novo.

**Keywords:** agriculture, chemical farming, green revolution, nutrition, organic farming, sustainable farming, yield.

## Introduction: Conventional Farming Adversely Impacts Environment, Energy and Health: Self-reliant organic farming contributes to protection of all

In the context of developmental as well as environmental sustainability, agriculture is very important for two obvious reasons: FAO's "World agriculture: towards 2015/2030" notes that "Agriculture accounts for the major share of human use of land. Pasture and crops alone took up 37 percent of the earth's land area in 1999. Over two-thirds of human water use is for agriculture. In Asia the share is four-fifths. Crop and livestock production have a profound effect on the wider environment" (FAO 2002). Secondly, major product of agriculture is food which is the basis of life. Hence, critical evaluation of farming is important.

Authors associated with M.S. Swaminathan Research Foundation, named after pioneer of 'green revolution' in India, claim that Swaminathan rather than naming chemical farming methods 'green revolution' referred to it as 'exploitative agriculture'(Kesavan and Malarvannan 2010). Report of a committee set up by Planning Commission, (GOI 2001) also labelled the conventional agriculture "the exploitative agriculture" which has resulted in damaging impacts on environment, human and animal health, soil and water resources. The intensive chemical agriculture that has been followed after green revolution successes is causing heavy pollution of our food, drinking water and air. The life expectancy has improved but the quality of life has substantially

deteriorated. The rural economy is in ruins because of over-dependence of outside inputs in agriculture such as seed, fertilisers, pesticides, growth-promoting chemicals etc.

Adverse impact of present farming methods was again highlighted by "Report of the Steering Committee on Agriculture and Allied Sectors for Formulation of the Eleventh Five Year Plan (2007-2012)" (GOI 2007) which noted that "(l) and resources are getting degraded through soil erosion, salinity and alkalinity, and chemicalization. Productive capacity of land is declining due to nutrient mining, imbalance in the application of soil nutrients, neglect of micro nutrients and inadequate application of organic fertilizers". Due to all these reasons, it reports that "on the basis of the information provided by the Department of Land Resources in the Ministry of Rural Development it appears that nearly two third of our agricultural land is degraded or sick to some extent and only about one third is in good health". It also notes that "modern agricultural practices are contributing to genetic uniformity of crops with vast tracts of lands sown with the same genotype extending into even neighbouring countries… [which] makes agriculture *highly vulnerable to unforeseen weather and pest/pathogen situations"* (emphasis added).

Indian experience is not unique. Story is repeated at world level too. Crop and livestock production "are the main source of water pollution by nitrates, phosphates and pesticides. They are also the major anthropogenic source of the greenhouse gases methane and nitrous oxide, and contribute on a massive scale to other types of air and water pollution" (FAO 2002). Moreover, "Agrochemicals ... disrupt key ecological processes such as pollination, harm beneficial micro-organisms and cause health hazards to farm workers. Modern monoculture using synthetic inputs often harms biodiversity at the genetic, species and ecosystem levels. The external costs of conventional agriculture can be substantial" (FAO 2002). As per recent report of Intergovernmental Panel on Climate Change, direct contribution of agriculture to average greenhouse gas emissions between 2007-16 was about 12% and if indirect contribution including industrial production of farm inputs and food transportation etc is included, it was between 21-37%, which is fairly high (IPCC 2020). So, adverse environmental and health consequences of conventional chemical farming have been known for a long time. However, majority of mainstream agricultural scientists think that there is no alternative to it as without chemicals it is not possible to feed growing population. A renowned agriculture scientist Norman Borlaug opined that "Even if you could use all the organic material that you have—the animal manures, the human waste, the plant residues—and get them back on the soil, you couldn't feed more than 4 billion people. … don't tell the world that we can feed the present population without chemical fertilizer. That's when this misinformation becomes destructive" (Bailey 2000). Norman Borlaug was not alone in questioning the yield potential of farming without agro-chemicals (Chaudhary 2008). We need to critically examine this thesis. A close examination of literature and a decade long work with organic farmers of Haryana, a core area of so called 'green revolution' shows that at least in the case of farming TINA- There Is No Alternative- does not apply. Better alternatives are available and don't have to be invented *de novo*.

In the next section we describe alternative of chemical farming and its multifarious advantages. Third section deals with the most critical charge against the alternative farming system. Last section deals with some other charges against organic farming along with listing its limitations and obstructions.

**II- Alternatives of chemical farming and its advantages**

Faced with the agricultural crisis, two different paths have appeared on the horizon- one that of genetically modified seeds and/or soil less farming leads to further reliance on external inputs which in turns clearly going to involve corporate control over farming. The other alternative is various strands of organic farming. There is a wide diversity in - what is promoted under organic farming. "Organic agriculture is not homogeneous. Its multiple expressions range from subsistence producers committed to health and environmental values to input-substitution entrepreneurs attracted by lucrative markets" (Scialabba 2007). Organic farming certainly implies non-usage of chemical fertilizers and chemical plant protection methods (along with non-use of genetically modified seeds and sewer water etc) but it is not limited to just that. A distinction within the organic farming that is particularly important is the one between self-reliant organic farming with no or very limited external/non-farm inputs and

organic farming that heavily relies on external/non-farm inputs. These are practically two different paradigms of organic farming, but for the source of nutrition, external input - dependent organic farming is closer to conventional chemical farming as it is more likely to follow other agronomic practices of conventional chemical farming. But if organic farming is to be practiced without reliance on external inputs, then besides stoppage of chemicals, other agronomic practices also have to undergo extensively change and the extent of such changes will become clear as we proceed. My firsthand experience in Haryana is that of self-reliant organic farming. To differentiate it from other approaches of organic farming, I will be calling it natural farming.

It is widely (though not universally) recognised that organic farming is environmentally safer and sustainable and hence, it can contribute to climate change mitigation as well as adaptation to climate change. Moreover, it can provide safer and more nutritious food. In rest of this section I will elaborate on this claim. An FAO study notes that: Organic agriculture has considerable potential for reducing emissions of greenhouse gases. Organic agriculture in general requires less fossil fuel per hectare and kg of produce due to the avoidance of synthetic fertilizers. Organic agriculture aims at improving soil fertility and nitrogen supply by using leguminous crops, crop residues and cover crops. The enhanced soil fertility leads to stabilization of soil organic matter and in many cases to a sequestration of carbon dioxide into the soils. This in turn increases the soil's water retention capacity, thus contributing to better adaptation of organic agriculture under unpredictable climatic conditions with higher temperatures and uncertain precipitation levels. Organic production methods emphasizing soil carbon retention are most likely to withstand climatic challenges. Soil erosion, an important source of $CO_2$ losses, is effectively reduced by organic agriculture. Organic systems are highly adaptive to climate change due to the application of traditional skills and farmers' knowledge, soil fertility-building techniques and a high degree of diversity.

Benefits of organic farming are corroborated by another study that "based on a comprehensive review of peer reviewed scientific literature concludes that organic agriculture has much to offer in both mitigation of climate change through its emphasis on closed nutrient cycles and is a particularly resilient and productive system for adaptation strategies." (FiBL 2008). "It was found that water capture in organic plots was twice as high as in conventional plots during torrential rains ... This significantly reduced the risk of floods, an effect that could be very important if organic agriculture were practised on much larger areas."

I will conclude this discussion by citing a study critical of organic farming: "Agriculture is a major contributor to global greenhouse gas (GHG) emissions and must feature in efforts to reduce emissions. … we assess the consequences for net GHG emissions of a 100% shift to organic food production in England and Wales using life-cycle assessment… Direct GHG emissions are reduced with organic farming" (Smith et al. 2019). Estimate is that total shift to organic farming would lead to 20% lesser emission GHGs in crop production. This study however goes on to argue that due to lower yield, organic farming will end up contributing to climate change due to increase in cultivated area and imports etc. However, in the next section, I show that organic farming can be equally productive and shift to organic farming need not end up with a lower yield.

Besides wide-ranging environmental benefits, organic farming also makes economic sense. An extensive review of literature summarises the economic significance of organic farming as follows:

> …the strongest feature of organic agriculture is its reliance on locally available production assets and, thus, *its relative independence from crude oil availability* and increasing input prices. Working with natural processes increases cost effectiveness and resilience of food production. By managing biodiversity in time (rotations) and space (mixed cropping), organic farmers *use their labour (the most readily available capital they have) and environmental services* (e.g. predation, pollination, soil nutrient cycling) to intensify production sustainability. These low cost farming practices reduce cash needs and, thus, credit dependence. (Emphasis added. Scialabba, 2007)

Out of this, there is a long list of benefits of organic farming, freedom from fast depleting petrochemicals warrants particular attention. As chemical fertilisers are fossil-fuel derivatives and because mono-culture farming involves long journey from farm to table, FAO (2007) emphasises the 'need to devise food production strategies based on fossil-fuel independence and localized food systems' which organic agriculture ensures.[1] It reports studies that show that organic systems decreased use of fossil fuel-related input by 10-70 % in Europe and by 29-37 % in the USA. Organic agriculture also contributes to climate change mitigation through doubling soil 'carbon sequestration' as compared to conventional systems, and by decreasing greenhouse gas emissions, e.g., 48-60 % less $CO_2$ emissions, lesser nitrogen losses because of less mobile soils etc. (FAO 2007). Similar results have been reported by recent ICAR researches. One such report notes: 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)

Moving on from environmental, economic and resiliency benefits of organic farming, to health benefits of organic farming, there are numerous media reports of food being contaminated with residue of agro-chemicals beyond safe limits. So, I will not labour this point. What is not often realised is that even when the food is not contaminated with hazardous chemicals, even if 'good agricultural practices' (GAPs) as recommended by scientists are adopted, nutritional composition of food is no longer what it used to be. GAPs can make food safe but food may still not be good enough. "A comparison of the mineral content of 20 fruits and 20 vegetables grown in the 1930s and the 1980s (published in the UK Government's Composition of Foods tables) shows several marked reductions in mineral content. …. The water content increased significantly and dry matter decreased significantly in fruit" (Mayer 1997). A study from USA evaluated "possible changes in USDA nutrient content data for 43 garden crops between 1950 and 1999 and found that the 43 foods showed declines (ranging from 6% for protein to 38% for riboflavin) for 6 nutrients- protein, calcium, phosphorous, iron, riboflavin, ascorbic acid"(cited in Shiva 2011:66). Another American study of 13 fruits and vegetables shows similar decline in mineral content" (Shiva 2011:67). It is pertinent to mention that this is not a comparison of organic with non-organic but decline in nutritional quality of chemically grown food overtime. Similar comprehensive exercise for India is possible but is yet to be done. However, preliminary analysis by 'Down To Earth' reports comparison of the latest "report of the National Institute of Nutrition with its previous report published in 1989 for the values of seven nutrients in 10 types of food. The snapshot analysis shows that most cereals, pulses and vegetables now have less carbohydrate, protein and micronutrients, but more fat. Micronutrients have significantly reduced in fruits, while protein is now low in milk and eggs" (Varshney 2017). *No wonder fortification and nutritional supplement market is growing rapidly!*

As regards, comparison of nutritional composition of organic and conventional farm produce, there have been claims that there is no difference between the two. However, a 2014 British Journal of Nutrition publication based on review of 343 peer reviewed publications including even those studies that formed the basis of earlier review that showed that there was no nutritional difference between organic and chemical farm produce, "concludes that organically grown crops – e.g. fruit, vegetables and cereals – contain significantly higher concentrations of nutritionally desirable antioxidants and lower levels of undesirable cadmium (a toxic heavy metal) and pesticide residues....Organic crops (primarily cereals, vegetables and fruit) and processed foods (e.g. bread, baby food, fruit juice and wine) have significantly higher concentrations of nutritionally desirable antioxidants/ (poly) phenolics compared with their conventionally produced counterparts. These include phenolic acids (19% higher), flavanones (69% higher), stilbenes (28% higher), flavones (26% higher), flavonols (50% higher) and anthocyanins (51% higher)." (Baranski *et al*. 2014)

While 'Health per acre' (Shiva 2011:64-6, and Agarwal and Gupta 2021) reports show that organic produce has relatively better nutritional composition, some simple home tests for better nutritional composition of organic food have also been anecdotally reported. Given a choice of organic and chemical feed over couple of weeks, birds and dogs first eat organic feed. Weight for volume for grains of same variety grown organically and

chemically differ by about 5%, with organic being weightier and hence denser. Without any post-harvest preservatives shelf life of organic fruits and vegetables is reported to be much better than conventional farm produce.

I may end this discussion on health benefits of organic food by citing recent ICAR research that reported that "quality parameters of different crops were higher under organic management compared to integrated and chemical" (IIFSR 2015b: 4). But that is not all. "Organic agriculture also has social benefits. It uses cheap, locally available materials and usually requires more labour, thereby increasing employment opportunities. This is a considerable advantage in areas where, or at times when, there is a labour surplus. By rehabilitating traditional practices and foods, organic agriculture can promote social cohesion" (FAO 2002). Another FAO report puts a number to this additional labour use, 30 % more labour input per hectare (FAO 2007**).** So, I can conclude that organic agriculture has huge environmental, health, economic and social benefits. Its reduced environmental foot print is valuable contribution to meet challenge posed by climate change. Moreover, it is also labour intensive, so has a potential to generate more employment. As it is knowledge intensive, it privileges owner-cultivator over absentee land lords and hence small scale over large scale. As it minimises the use of external inputs, it can favour decentralised decision making and development, enhance village self-sufficiency and thus reduce regional inequity as well as check migration to urban areas. All in all, health, environmental and social benefits as well as independence from non-renewable and fast-diminishing petro-chemicals, add up to imply partial reversal of process of development of past few centuries, a truly revolutionary prospect.

But can it feed the world? Can nutritious food be as abundant as food is now?

**III- Yield question**

'International Conference on Organic Agriculture and Food Security' organized by the Food and Agriculture Organization of the United Nations in 2007 "Recognizing the need to increase agriculture productivity by 56 % by 2030, the Conference evaluated whether organic agriculture could offer an alternative system. … A presentation specifically addressed the question: "what if the world converted on large scale to organic agriculture" (FAO 2007). It concluded that 'organic agriculture has the potential to secure a global food supply, just as conventional agriculture today, but with reduced environmental impacts' (Scialabba 2007). Chaudhary (2008) reports many more such national and international studies. Indian Council of Agricultural Research (ICAR) affiliated Indian Institute of Farming Systems Research (IIFSR), Modipuram, Uttar Pradesh has been running a "Network Project on Organic Farming" (NPOF) since 2004 in 20 centres of 16 Indian states[2] undertaken a research on comparative analysis of three broad systems of farming - organic, inorganic/green revolution technology and integrated/mix of the two. 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)[3]

Infact for crops like soybean and cotton, yield under organic farming was better than conventional farming from the very 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 increased productivity. Moreover, it is also 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. Perhaps it is not too high a price to pay when numerous environmental, social and health benefits of organic produce have been observed.

These results are in spite of the fact that these studies take a rather narrow view of organic farming. Only source of plant nutrition and protection was changed. There was no change in other agronomic practices. This narrow approach was adopted in violation of recommendations of NPOF scientists themselves who do note that organic farming involves 'mixed cropping, crop rotation, residue recycling, composting'. In addition to these agronomic practices, organic farming also involves reduced irrigation, integration of animals and trees in farming, seed treatment, mulching and many more things. Moreover, all these are not optional elements of self-reliant organic farming but are essential elements of organic farming as revealed in practice of any successful organic farmer (Alvares 2009).

Wide ranging changes in agronomic practices are not incidental to natural farming. To illustrate, while chemical farming seeks to feed the plant, organic farming seeks to nourish the soil with healthy soil in return taking care of nourishment of the plant. These two different nutritional strategies lead to whole lot of different agronomic practices. If you are to externally feed and protect the plant, then you have to go for mono-culture as nutrition and plant protection methods are specific to the crop. Mixed-cropping involving crops, with different nutritional and protection requirements, will just not gel with chemical farming involving external feeding. Approach of organic farming, if it is not to be heavily dependent on external inputs, is opposite of it; it has to avoid mono-culture and go for mixed farming and crop rotation as these are required for crop nutrition and crop protection purposes. So, mixed farming and crop rotation are not optional but essential elements of self-reliant organic farming system. Similarly, trees are essential to organic farming because in modern market economy, in which organic farmers right now operate, nutrient cycle cannot avoid leakage of soil nutrients; crops sold, take away soil nutrients to distant places and which are not returned to the same soil. Under these conditions, biomass of trees is essential to make up for this leakage of resources by capturing minerals from deep down through their deep roots. These deep resource reserves tapped through tree biomass are not available to shallow rooted field crops. So, to maintain productivity levels, trees are essential to organic farming. On the other hand, 'green revolution' with attendant mono-cropping and mechanization has led to uprooting of trees as they come in the way of farm machinery. Use of heavy machinery in turn contributes to deterioration in physical properties of soil and hence to deterioration of soil health, the essential pillar of organic farming. While conventional farming relies on ever more powerful tractors, many iconic organic farmers are avoiding huge tractors and reverting to use of bullocks or smaller machines like power tiller (Alvares 2009).

So, organic farming is not just an alternate system of plant nutrition and protection but can (and at least self-reliant organic farming *does*) involve a completely different paradigm, involving a different set of agronomic practices. This, as mentioned above, is not reflected in experimental protocols and package of practices recommended by NPOF except in very few cases (IIFSR n. d.). IIFSR experimental protocols make it clear that equivalent NPK is provided through organic inputs.[4] This is just unnecessary addition to the cost of organic farming. If there is bio-diversity, we do not have to provide all nutrients externally. Soil microorganisms and companion crops will take care of some of it. This fact is also evident in some NPOF experiments. It is reported that 'all the crops registered higher yield under reduced application of manures (75% nutrients only through organic manures with total organic management) compared to 100% nutrients supply through organic manures. The yield increase was found to be 18, 12, 14, 7.4 and 6% for cotton, maize, chillies, sunflower and beetroot respectively at Coimbatore' (IIFSR 2015a:7). *That means when rather than full doze of nitrogen only 75% was supplied through organic route, often yields were even better!* Even when lower organic inputs lead to lower

yields, 'yield difference observed between 75 and 100% nutrients application … was only 4.8, 1.2, 2.5, 5 and 1.8% in soybean, durum wheat, mustard, chickpea and linseed respectively' (IIFSR 2015a:7).
And all this is just under mono-cropping conditions. Imagine the savings in input costs and yield increase if all elements of organic farming like mixed cropping, crop rotation, trees, improved composting etc were to be practiced. Whole farm economics would be different. Moreover, rather than crop to crop comparison between organic and conventional farming systems, it is farm income over a year at the least or, better still, over a complete crop-rotation cycle should be compared.[5] NPOF has belatedly taken some steps in this direction and started developing 'Integrated Organic Farming System models'. In the very first year these models increased 'the net income by 2 to 7 times over existing system' (IIFSR 2015b:3). Actually, this experiment is a first real step in the direction of undertaking a 'Farming Systems Research'.

Organic farming can give comparable yield is also borne[6] out by farmer-field level experience of a voluntary, unfunded, *Kudarti Kheti Abhiyaan* (Natural Farming Campaign; henceforth KKA), Haryana.[7] Relying on results of FAO (2007) and Chaudhary (2008) that organic can give equal yield, KKA has been providing only training about methods and principles of self-reliant organic farming. There was no financial support; not even marketing support. In the circumstances, targeting comparable yield was essential component of its strategy. Without comparable yield those farmers whose livelihood mainly came from farming could not be expected to shift to organic farming and persist with it. A 2020 survey of 283 farmers practicing organic farming in Haryana, a core area of 'green revolution', negates the myth that organic farming is low yielding.[8] KKA collected yield data for wheat only as it had proved to be most difficult crop under organic farming. Most organic farmers sow C-306 variety of wheat, a variety preferred for domestic use in Haryana. This ICAR released variety, viewed to be a desi/traditional variety, has official average yield of 26 quintal per hectare (against official average wheat yield for Haryana which is slightly higher than 46 quintal) (Gupta et al. 2018 and Government of Haryana). So, in KKA survey, two benchmarks were used, 26 quintal for traditional/desi variety, whether C-306 or any other and 46 quintal for HYVs. In case of companion crops, money value of such crops at their respective MSP prices was converted to equivalent wheat yield at its MSP price. Based on these calculations, it emerged that 45% organic farmers were getting better than state average yield. In terms of HYV alone, which is generally sown by new and inexperienced organic farmers, who are yet to develop their loyal customer base, 18% farmers were getting better than state average yield of wheat. Earlier 2019 survey had in fact yielded better results (60% in all and 30% in HYV alone) though the total number of farmers was much smaller.
If in core area of intensive farming, in so-called 'green revolution' area organic farming can give yield comparable to chemical farming, then perhaps it can do so everywhere and anywhere. So, Borlaug was wrong in under-estimating the yield potential of organic farming and one can have both, nutritious as well as sufficient food.[9]But to get this level of yield, rather than taking a narrow view of organic farming and only changing the form of plant nutrition, a broader view of organic farming involving whole set of agronomic changes has to be taken.

**IV- Limitations of organic farming**

Besides arguing that organic farming is low yielding, critics of organic farming claim that enough organic input to enable wholesale shift to organic farming is not available. For example, it is claimed that the "most optimistic estimates at present, show that only about 25-30 % nutrient needs of Indian agriculture can be met by utilizing various organic sources" (NAAS 2005). How true is this charge? As per experience of KKA as reflected in its new manual (KKA 2021) prepared by experienced organic farmers of Haryana, dung and urine of one animal per acre per year is sufficient to get good/comparable yield. Official data shows that India has 0.87 bovines per net sown acre and if we add goats, sheep etc. too then it comes to 1.54 livestock per net sown acre (GOI 2020). So, there is no dearth of organic inputs even if the whole country were to shift to organic farming provided institutional arrangements are put in place for proper utilization of animal waste and farmers are trained and facilitated to do so. *However, an aspect of natural farming can be viewed to be its limitations by some though it could as well be viewed to be its advantage*. Natural farming, at least in its initial stages, is more labour intensive

as compared to chemical farming. However, due to mixed cropping this labour use is spread out round the year against periodic burst of intense labour use in chemical farming. This spreading out labour input over long period means farm requires continuous attention of farmer. So, natural farming has to be a full time occupation and cannot be a part time enterprise; natural farming is for hands on farmers. In an economy experiencing 'jobless' growth and extensive unemployment as well as underemployment, this may rather be viewed as a plus point rather than a limitation.

Now, that viability of organic farming even in terms of yield has been shown in even 'green revolution' areas, and that too without any external support, it is time organic farming is mainstreamed or at the least "experimentation and demonstrations on government farms on 50:50 area basis on organic farming and other forms of farming" is done as was recommended by report of the "Task force on Organic Farming" submitted way back in 2001(PIB 2001).

However, one is baffled to note that in spite of their own experiments showing results that favour organic farming, in policy recommendations of NPOF, organic farming is sought to be limited to 'niche areas and crops'. For 'intensive agricultural areas (food hubs)' recommendation is for 'Accelerated adoption of "towards organic" (integrated crop management) approach', which is just euphuism for retaining use of chemical fertilizers while adding organic manures (IIFSR 2016: 1).

If there is apathy for organic farming in the establishment, even critics of current development model neglect it. To illustrate, 'Political Resolution' adopted at the XIX Congress of the Communist Party of India (Marxist) had an extensive section on agrarian crisis, but did not even refer to alternative forms of agriculture. While 'Alternative Agriculture Policy' of CPI-M it did have a sentence or two on organic farming, it mainly focussed on promotion of safe and developed seeds, fertilizers, insecticides, control over fake fertilisers and insecticides, etc (AIKS and AIAWU, 2007: CPI-M, 2008). Similarly, in recent farmers' agitation, while farmers' organisations rightly took up marketing and institutional issues, yet there was hardly a critical look at farming methods and technologies.

**Conclusions**

To conclude, I reiterate that if environment, energy and health are to be protected, then chemical farming has to go and ecological farming is the way to go.[10] There is no alternative but to do farming in an alternative way and fortunately there is a viable –economically, environmentally and socially viable alternative, an alternative that is already being practiced. But the biggest challenge that organic farming faces is that the larger socio-economic dynamics is such that farming itself, whether organic or chemical, is a fall back option of the last resort (or post-retirement option for the very rich). Even successful organic farmer (with small landholding) would often prefer regular government job! But food, nutritious and healthy food, is and will always remain bedrock of human life itself. So, neglect of food production and producers will not do. But that requires wholesale change in development paradigm. Blatant celebration and promotion of consumerism has to go and equity- both across nations and within nations, and sustainability (or equity across generations) has to take centre stage. Without that it is not possible to either protect environment or human life itself. But as natural farming has shown, it is possible, there are alternatives.

**References:**

Agarwal, Priya and Srajesh, Gupta. 2021. (Eds) "*Nutritional Benefits of Naturally Grown Food Products"*, in Market Narrative Series, National Coalition for Natural Farming, Hyderabad, India.

AIKS and AIAWU 2007. *Alternative Agricultural Policy* (adopted by All India Kisan Sabha and All India Agricultural Workers' Union in 2003, CPI-M, New Delhi.

Alvares, Claude. 2009. (Ed.) *The Organic Source Book*. The Other India Press, Mapusa, Goa.

Bailey, Ronald. 2000. *Billions Served: Norman Borlaug* interviewed, http://www.reason.com/news/show/27665.html.

Baransky et al. 2014. *Summary for consumers and producers: Organic versus Non-organic.*https://research.ncl.ac.uk/nefg/QOF/crops/documents/Organic%20vs%20non%20organic.pdf

Chaudhary, Rajinder. 2020. "Green Revolution and the Yield Question." *Economic & Political Weekly*, Vol 55, no. 50. Chaudhary, Rajinder. 2008.(Eds) "Is Alternative Agriculture Revolutionary" *Alternate Economic Survey, India 2007-2008*- in *Decline of the Developmental State***,** Daanish Books, Delhi.

CPI-M. 2008. *Political Resolution* (adopted at the XIX Congress of the Communist Party of India (Marxist), March 29 to April 3, 2008 Coimbatore. www.cpim.org

FAO. 2002. *World agriculture: towards 2015/2030 Summary report* Food and Agriculture Organization of the United Nations Rome. https://www.fao.org/3/y3557e/y3557e.pdf.

FAO. 2007. 'Report of International Conference on Organic Agriculture and Food Security', held at Rome, 3–5 May. http://www.fao.org/organicage

FiBL 2008. "*Organic Farming and Climate Change"* (Research Institute of Organic Agriculture). https://orgprints.org/id/eprint/13414/3/niggli-etal-2008-itc-climate-change.pdf

GOI 2001. "*Report of the Working Group on Organic and Biodynamic Farming for the Tenth Five Year Plan*, Planning Commission", Government of India, New Delhihttp://planningcommission.nic.in/aboutus/committee/wrkgrp/wg_organic.pdf

GOI 2007. "*Report of the Steering Committee on Agriculture and Allied Sectors for Formulation of the Eleventh Five Year Plan (2007–2012)"*, Planning Commission, Government of India, New Delhi. http://planningcommission.nic.in/aboutus/committee/strgrp11/str11_1agri.htm

GOI 2020. "*Agricultural Statistics at a Glance 2020"*, Ministry of Agriculture & Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare, Directorate of Economics and Statistics, Government of India https://eands.dacnet.nic.in/PDF/Agricultural%20Statistics%20at%20a%20Glance%20-%202020%20(English%20version).pdf

Government of Haryana (nd): *Crop wise area, average yield and production of major crops in Haryana* http://agriharyana.gov.in/index.php?r=site%2Fstatistics

Gupta, A. et al. 2018. *Wheat Varieties Notified in India since 1965*, ICAR- Indian Institute of Wheat & Barley Research, Karnal.
https://www.aicrpwheatbarley.org/wp-content/uploads/2019/05/wheat-varieties-notified-in-india.pdf

IIFSR (nd): *Scientific Package of Practices (PoPs) for Organic Production of Crops in Cropping Systems*, http://www.iifsr.res.in/npof/data/uploads/files/package_of_practices.pdf.

IIFSR 2015. *Presentation in Second Meeting of Task Force on Organic and Non-chemical Farming* New Delhi, 30 July (unpublished).

IIFSR 2015a. *Network Project on Organic Farming, Annual Report 2014–15*, Modipuram, Meerut, ICAR-Indian Institute of Farming Systems Research, http://www.iifsr.res.in/npof/data/uploads/fi les/npof_annual-report_2014-15_fi nal.pdf

IIFSR 2015b. *Proceedings and Recommendations of X Annual Group Meeting, Network Project on Organic Farming*, http://www.iifsr.res.in/npof/data/uploads/files/NPOF_Proceedings_AGM_Udaipur_19-21%20August%202015.pdf

IIFSR 2016. *Workshop on Organic Farming: Concerns about Crop Productivity and Soil Health*, 7 January 2016, http://www.iifsr.res.in/npof/data/uploads/files/OF_Policy%20workshop_Proceedings.pdf

IPCC 2020. *Climate Change and Land - Summary for Policymakers* https://www.ipcc.ch/srccl/chapter/summary-for-policymakers/

Kesavan, PC and S Malarvannan. 2010. "Green to evergreen revolution: ecological and evolutionary perspectives in pest management" *Current Science*, Vol. 99, No. 7.

KKA. 2021. *Kudarti Kheti* Kudarti Kheti Abhiyan, Haryana https://archive.org/details/kudarti-kheti-third-edition.

Mayer, Anne-Marie, 1997. Historical changes in the mineral content of fruits and vegetables. British Food Journal, Vol 99, no.6, pp. 207–211.

NAAS 2005. *Organic Farming: Approaches and Possibilities in the Context of Indian Agriculture*, National Academy of Agriculture Sciences, India, Policy Paper 30, www.naasindia.org/Policy%20Papers/pp30.pdf

PIB (Press Information Bureau, GOI). 2001. *National Board for Organic Farming Mooted* http://pib.nic.in/archieve/lreleng/lyr2001/rnov2001/29112001/r2911200120.html

Rosset, Peter M. 2000. "Cuba: A Successful Case Study of Sustainable Agriculture" in: *Hungry for Profit: The Agribusiness Threat to Farmers, Food and the Environment*, edited by Fred Magdoff, John Bellamy Foster and Frederick H. Buttel (New York: Monthly Review Press, 2000). https://www.iatp.org/sites/default/files/Cuba_A_Successful_Case_Study_of_Sustainable_Ag.htm

Scialabba, Nadia El-Hage. 2007. "Organic Agriculture and Food Security" (presented in International Conference on Organic Agriculture and Food Security", held at Rome, 3 – 5 May 2007), http://www.fao.org/organicag accessed December 1, 2007.

Shiva, Vandana and Singh, Vaibhav. 2011. *Health Per Acre -Organic Solutions to Hunger and Malnutrition* Navdanya, New Delhi.

Smith, L.G., Kirk, G.J.D., Jones, P.J. et al. 2019.The greenhouse gas impacts of converting food production in England and Wales to organic methods. *Nature Communications,* 10, 4641. https://doi.org/10.1038/s41467-019-12622-7

Varshney, Vibha.2017. "Food basket in danger" https://www.downtoearth.org.in/news/health/food-basket-in-danger-5707928 February.

[1] Case of Cuba is particularly illustrative. After break down of USSR, when sugar trade with USSR could not be relied upon to ensure access to urea, primarily a petroleum derivative, and trade embargo imposed by USA denied access to other international markets, it resulted in situation where at least for Cuba, petroleum reserves were exhausted and perforce it had to shift towards organic farming (as has recently happened with Sri Lanka which on account of stoppage of tourist traffic, due to corona pandemic, did not have foreign exchange to import chemical fertilizers (Kumar 2021)). Cuban experience and resultant health and nutritional benefits are well recorded in two documentaries- 'Cuba: The Accidental Revolution (Part 1)' and the 'Power of Community: How Cuba Survived Peak Oil'. However, as Cuban agriculture went two changes simultaneously- one that of shift to organic farming and another institutional one from state farms towards peasant farming, former has not got enough public attention. May also see Rosset (2000).

[2] Some of this material is also reported in Chaudhary (2020).

[3] Thereafter, similar comparisons have not been reported; only results of individual experiments in various centres are reported separately.

[4] 'The individual centre has been advised to select organic sources of nutrients ... to fulfil (sic.) the entire requirement of nitrogen and 80-90% requirement of phosphorus and potassium for each cropping system' ( IIFSR 2015a:14).

[5] While for individual farmer it may be done at realized prices, which often do involve a premium for organic farmers, yet to examine yield potential this needs to be done at prices realized by chemical farmers, which usually are lower.

[6] Parts of this section are drawn from a paper submitted to Economic and Political Weekly.

[7] Author is actively associated with this campaign.

[8] Recent researches challenge the myth that there was no alternative but to go for 'green revolution' at that particular juncture in India's history including (Chaudhary 2020).

[9] In examining the question whether organic farming can feed the world, we have taken the worst case scenario and focused on yield alone. Improvements in distribution of food, curbing wastage and overeating, shift towards vegetarian diet, impact of improved nutrition, longer shelf life of food etc have not been taken into account. If these aspects are also taken into account, we may not even need so much production.

[10] Some people might suggest rational use of chemicals. Analysis here shows that it is not needed as we can do very well without this. Moreover, use of agro-chemicals in any amount will kill soil microorganisms which form the basis of soil health and fertility. Hence, by and large 'rational use of chemicals' is not rational.