

Can Organic Farming Feed the Future World Population?

The projected global population is expected to be about 9 billion by 2050. It is estimated that the current agriculture production (that includes food, feed, fodder, fuel) needs to be doubled to meet the growing global demand for food and feed. With increased incomes and changing food habits, the daily food needs of people is likely to diversify, and the demand for animal-based foods (meat, milk, and milk-based products) is bound to increase. Along with food security, better nutrition is equally important, hence it adds another dimension to the demand and supply of quality food in adequate quantities to meet the WHO recommended standards for better health globally.

Considering the adverse effects of chemical pesticides and fertilizers on environment and human health, many organic farming proponents claim that organic agriculture is the only way for sustainability of future agriculture. However, we need to understand that organic agriculture is not a panacea, and a cure for all ills of modern agriculture. Without going into the benefits or otherwise, we would like to argue that there are reasons why organic agriculture alone, in its present form, will not be able feed the future global population. Organic agriculture is suitable for some groups of farmers in some agro-ecologies, and has its own niche where OA can be practiced profitably. There cannot be blanket recommendations or advisories concerning organic agriculture for all farmers and in all farming systems and situations. The crux in following OA is soil fertility (soil organic carbon and essential macro and micronutrients), soil structure and soil moisture. The drylands of arid and semi-arid tropics of the world have soils with low soil fertility, high air and soil temperatures, coupled with low and erratic rainfall, and farmers cultivate land that have low soil fertility. In these areas, the resource-poor smallholder farmers harvest the crop residues to feed their cattle, or it gets grazed by stray cattle during the summer months. Hence, soil organic matter is low, and also degrades fast due to high temperatures. Being poor, many smallholder farmers cannot afford external inputs and hence follow traditional farming practices (also called organic-by-default) that are no different from what people term as organic farming. We need to break this vicious cycle and empower smallholder farmers to improve crop yields through sustainable agricultural practices (SAP), while maintaining and enhancing the soil fertility.

Although the green revolution technologies improved the food security in many countries, concerns about yields plateauing, reduction in total factor productivity, and the resultant negative environmental impacts such as soil health deterioration, greenhouse gas emission, groundwater depletion and pollution of water in lakes and rivers, and loss of crop and biodiversity have been raised. These concerns are valid and we need to ensure that we make our recommendations for agricultural practices context-specific, as the generic (one-size-fits-all) solutions may lead to further deterioration of farming systems and ecological conditions. Contemporary agriculture now faces the challenge of developing and mainstreaming sustainable agriculture practices (SAP) that can maintain food production increase, while ensuring that the environmental impacts are positive.

Are Organic foods safe and tasty?

Globally, there is increased demand for “Organic food” that has led to further increase in area devoted to organic agriculture. One report states that the area under organic farming was more than 37 million hectares (out of 870 million crop area) in 2011. Europe, North America, followed by Australia and South America (mostly Argentina and Brazil) have higher proportion of OA, but

overall it is about 9% of global area. The proportion of area devoted to organic farming in Asia and Sub-Saharan Africa is less than 1% of the total area. Apart from Europe, North America, Australia, Argentina and Brazil where organic certification is well established, one is circumspect of what is sold as 'organic produce' in the streets in many developing countries, including India.

Claims of organic farming protagonists that that organic food tastes better are not supported by evidence. It seems to be people's perception of taste rather than a fact that can be measured. Nevertheless, truly organic foods have been shown to have little chemical/toxic residues and thus may be considered safer than those produced with intensive use of fertilizers and chemicals. At the same time it must be noted that there is really very limited information on actual health benefits with consumption of organic products. We do not know enough to say that organic food is better than the conventional foods.

Organic Farming

As per ancient literature, agriculture originated in the hilly regions of Caspian basin of West Asia and the adjoining Iranian Plateau, dating back to 7500-6500 BCE. It moved east towards India and China via the Harappan and Vedic civilizations. Agriculture was practised in India and China for many centuries, as far back as 4000 years. All of this agriculture must have been organic farming, which somehow got lost along the way when we entered the nineteenth century and population pressure and increased frequency of famines forced people to look for alternatives including chemical fertilizers and pesticides. Revival of organic agriculture began in the early part of the twentieth century in Europe and later in the United States, and subsequently in other continents.

There are umpteen definitions of organic farming. Some people define organic agriculture as one that relies on use of farmyard manure, compost, and green manuring for adding nutrients to soil (that eventually is taken by plants) and use of biological control or use bio-pesticides to manage pests and diseases. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony. Organic farming practitioners avoid chemical fertilizers, herbicides, fungicides, pesticides and other chemicals such as plant growth promoters.

As per literature reviews, organic agriculture has quite a few advantages:

- (i) Enhancing crop diversity: organic farming involves multiple cropping, and it provides insurance against risks associated with weather (rainfall) and pest attack, and provides a diversified food basket to the farming family. In addition, most organic farmers tend to cultivate older local varieties and landraces thus enhancing crop varietal diversity.
- (ii) Improving and sustaining soil health and fertility. Since organic farming involves addition of organic matter (green manure, compost, crop residues, etc.) the rhizosphere is rich in microbial activity and helps in sustained release of nutrients and managing soil-borne pests.
- (iii) Managing weeds. Organic farming integrates agronomic management, and use of biological and mechanical interventions to manage pests (weeds, insect pests, and diseases).
- (iv) Managing pests and diseases. Organic farming uses biological pesticides (biopesticides) such as fungicides derived from bacteria and fungi to manage some

- of the plant pathogens. These are benign and do not adversely affect either the ecology or the human health
- (v) Enhanced biodiversity. Naturally occurring biodiversity is reported to show improvement in organic farming, as a result of not applying herbicides and pesticides in organic agriculture systems.

However, there are a few disadvantages with organic farming:

- (i) Crop productivity. One of the major limitations of organic farming is that yield/ ha is low compared to traditional/ commercial agriculture. Many studies have been reported, but results are inconclusive. An FAO report in 2007 stressed that one could not feed the current population by organic farming, let alone the future projected increase in population.
- (ii) Profitability: Profitability of organic agriculture (OA) is entirely dependent on price premiums offered to organically produced food. Since yield levels (at least in annual grain crops) in OA are up to 80% (of modern agriculture yields) in developed countries and up to 60% in developing countries, farmers will profit only if the price premiums are good. Marketing OA produce for individual farmer is difficult in developing countries where certification and traceability issues have not been standardized or not being properly implemented.
- (iii) Labour requirements. Organic agriculture is both labour and knowledge-intensive system. The increased labour cost results in organic food becoming more expensive. On a different angle, the increased demand for labour by organic farming can also provide more jobs to unemployed and land-less labour compared to conventional agriculture. Considering that labour is becoming expensive and scarce in India and other developing countries, OA will cease to be profitable, unless price premiums are commensurate. Many countries in Europe subsidize OA to support farmers who practice organic farming. If the subsidies are stopped, then profits disappear as well.
- (iv) Environmental impacts. Although organic products required less energy, they need more land. Organic farming leads to higher nitrogen leaching, nitrous oxide and ammonia emissions, compared to conventional farming.

If one analyses the organic farming practiced world side, the following can be summarized:

- (i) most of the certified organic agriculture is concentrated in developed countries and very limited in developing countries and countries in transition;
- (ii) organic agriculture is feasible in countries where cultivable land is in plenty and farmers can follow the recommended fallows and crop rotations;
- (iii) much of organic farming is practiced in areas where soils are highly fertile and soil organic carbon content is very high;
- (iv) organic farming is feasible and practical in perennial horticulture crops such as fruit orchards (apple, peach, orange, etc., and plantations (coffee, tea, rubber, cocoa, coconut, etc.) that are commercial crops and profits are high;
- (v) farmers in areas with good and reliable rainfall are able to practice organic agriculture for annual crops such as staple food grains and pulses; and
- (vi) farmers in arid and semi-arid regions (characterized by degraded soils and low and erratic rainfall) either cannot afford or risk applying external inputs (chemical

fertilizers, pesticides, etc.) due to the low-input, subsistence farming they practice normally.

From this analyses we can conclude that organic agriculture is feasible and profitable for farmers in some agro-ecologies and under certain farming situations and contexts.

Organic farming vis-à-vis other farming methods

For all practical purposes, traditional farming practised by most of the resource-poor smallholder farmers in the developing countries can be equated as organic agriculture (organic-by-default), since they cannot afford the use external inputs. Given the conclusion that OA is contextual and depends largely on price premiums or governmental subsidies, farmers can practice other sustainable and profitable farming methods that are suitable to their soils and agro-climatic conditions.

Conservation agriculture (CA) is an approach that advocates the concept of sustainable intensification of production by choosing the best possible options that farmers can practice. It involves: (i) Minimum soil disturbance or if possible, no tillage; (ii) Permanent soil cover/ mulch using crop residues; and (iii) Crop rotations or/and associations, and farmers choose what is best for them. Soil does not get disturbed with zero/ minimum tillage, and carbon loss to the atmosphere is less leading to more soil organic carbon. It enhances rainwater infiltration, and reduces run-off and erosion. However, CA will need machinery that can help farmers to sow seeds under no-tillage conditions and herbicides to manage weeds.

A further modification of CA is Resource Conserving Technologies (RCT) that combines the principles of conservation agriculture and modern agriculture: (i) zero or minimum tillage;(ii) use of crop residues for soil cover and as organic manure; (iii) manage weeds using herbicides as necessary; and (iv) manage pests and diseases (using a combination of biological methods, biopesticides and minimal use of chemical pesticides) to ensure that crop is healthy and farmers do not incur crop loss.

Conclusions

Organic agriculture was practiced during ancient times. With burgeoning population globally, the demand for food was met by modern agriculture practices using external inputs (chemical fertilizers, pesticides, etc.). However, over-use of chemical fertilizers and pesticides resulted in ecological and environmental problems. This led to the Organic Agriculture movement in the US and European countries, and much later later in many other countries. While OA has many advantages with regard to environmental concerns, we are of the opinion that it alone cannot feed the increasing world population, with the impending climate change scenarios. The researchers involved in agricultural research for development, policy makers, and the farmers need to join hands to develop a basket of technological options for “**sustainable agriculture practices**”(SAP) and empower the farmers to choose appropriate farming practices that are suitable for their farms, agro-ecologies and economic conditions.