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Organic Farming for Sustainable Agriculture in Northern India

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Abstract:

Since India's independence, one of the most critical challenges has been producing enough food to meet the demands of its growing population. This led to the widespread use of high-yielding crop varieties, supported by irrigation, fertilizers, and pesticides. While this high-yield production technology has helped India achieve a food surplus, it has also raised concerns about soil health, environmental pollution, pesticide toxicity, and the long-term sustainability of agriculture. As a result, scientists and policymakers are now revaluating agricultural practices, focusing more on biological inputs instead of the heavy reliance on chemical fertilizers and pesticides. Organic farming offers a way to produce high-quality food without harming soil health or the environment. However, there are concerns about whether large-scale organic farming can produce enough to feed India's vast population. India currently produces a variety of certified organic products, including basmati rice, pulses, honey, tea, spices, coffee, oilseeds, fruits, cereals, herbal medicines, and their value-added derivatives. In addition, non-edible organic products such as cotton, garments, cosmetics, functional foods, and body care products are also produced. The review of organic crop and product production focuses on sustainable agriculture in northern India.

Key Words: Organic Farming, Sustainable Agriculture, Northern India.

1. Introduction

The origins of the organic movement in India trace back to the work of Sir Albert Howard (1), who formulated many of the principles later embraced by those active in this movement. Organic farming is a production system that avoids or significantly reduces the use of synthetic fertilizers, pesticides, growth regulators, and livestock feed additives. It is rooted in the goals of environmental, social, and economic sustainability (2). Key practices of organic farming include maintaining long-term soil fertility through preserving organic matter, promoting biological activity in the soil, and minimizing mechanical interventions. Nitrogen self-sufficiency is achieved through the use of legumes and biological nitrogen fixation, while crop residues, livestock waste, and organic materials are effectively

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recycled. Weed, disease, and pest control are managed primarily through crop rotation, natural predators, biodiversity, organic manures, and resistant crop varieties.

A strong emphasis is placed on maintaining soil fertility by returning organic waste, particularly through composting, to close the gap between the addition and removal of nutrients like nitrogen, phosphorus, and potassium (NPK) (3). However, growing population pressures have pushed many countries to rely heavily on chemical fertilizers and pesticides to increase farm productivity and meet rising food demands. Prolonged use of these chemicals has led to human health risks, soil degradation, and environmental pollution. Consequently, farmers in developed countries are being encouraged to transition to organic farming.

Consumer demand for organic food is primarily driven by health awareness and a willingness to pay a premium for high-quality produce. Organic consumers are typically affluent, educated, and health-conscious, motivated by environmental concerns and the perceived health benefits of organic products. This rising demand, along with price premiums and environmental considerations, has led many conventional growers to adopt organic farming practices. In Europe, government policies are actively supporting the organic sector through subsidies, consumer education, and initiatives in research, education, and marketing.

India's agricultural traditions date back more than 4,000 years, and organic farming is deeply rooted in the country's history. As referenced in the Arthashastra, farmers during the Vedic period had a good understanding of soil fertility, seed selection, plant protection, crop rotation, and sustainable agricultural practices (4). Ancient Indian farmers followed natural laws, which helped them maintain soil fertility over extended periods (5).

2. Organic Sources of Plant Nutrients

At present, most optimistic estimates show that about 25–30 percent of nutrient needs of Indian agriculture can be met by various organic sources. Supplementation of entire N through FYM sustains crop productivity at more than use of conventional N fertilizers. Since the estimates of NPK availability from organic sources are based on total nutrient content, efficiency of these sources to meet the nutrient requirement of crops is not as assured as mineral fertilizers, but the joint use of chemical fertilizers along with various organic sources is capable of sustaining higher crop productivity, improving soil quality, and productivity on long-term basis [3]. These organic sources besides supplying N, P, and K also make unavailable sources of elemental nitrogen, bound phosphates, micronutrients, and decomposed plant residues into an available form to facilitate the plants to absorb the nutrients. Application of organic sources encouraged the growth and activity of mycorrhizae and other beneficial organisms in the soil and is also helpful in alleviating the increasing incidence or deficiency of secondary and micronutrients and is capable of sustaining high crop

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productivity and soil health [6]. The farmers can in turn, get good remuneration from organically produced crops and if included in high value crop rotations, that is, aromatic rice (*Oryza sativa* L.), table pea (*Pisum sativum* L.), and onion (*Allium cepa* L.) [7] Due to their heavy demands in domestic, national, and international markets. Nutrient concentrations in FYM are usually small and vary greatly depending upon source, conditions, and duration of storage. The N, P, and K contents of fresh FYM range widely from 0.01 to 1.9 percent on dry weight basis due to variable nature of manure production and storage [8, 9]. Tandon [10] reported that on an average, well-rotted FYM contains 0.5 per cent N, 0.2 per cent P_2O_5, and 0.5 per cent K_2O. Gaur [11] stated that an application of 25 t ha^{-1} of well-rotted FYM can add 112 kg N, 56 kg P_2O_5, and 112 kg K_2O ha^{-1}. Several researchers all over the world have shown various benefits of the application of FYM on soil properties and productivity of crops [12]. Farmers generally use straw of the harvested crop as animal feed or bedding. In most cases, straw is used as bedding to trap urine to increase N cycling. Wet straw and manures from the animal sheds are collected every day and stored or composted on the farmer's premises. The composted manure is applied either immediately or stored until the next crop season depending upon farmer's socioeconomic conditions. In particular, soil, water, and nutrient management strategies, such as reduced tillage and use of raised beds, that avoid the deleterious effects of puddling on soil structure and fertility, improve water- and nutrient-use efficiencies, and increase crop productivity, may be appropriate [13].

3. Effect of Organic Nutrition on Crop Productivity

Addition of organic matter in the soil is a well-known practice to increase crop yields. Sharma and Mitra [14] reported that the application of organic materials increased grain and straw yield of rice. Ranganathan and Selvaseelan [15] found that application of spent mushroom and rice straw compost though comparable with FYM increased rice grain yields by 20 per cent over NPK fertilizer. Singh *et al.* [16] reported that the application of 7.5 t FYM ha^{-1} produced significantly more grain, and straw yields over unfertilized fields. The entire yield attributing characters of rice increased with increasing rates of FYM. Organic farming with dhaincha (*Sesbania aculeata* L.) made considerable improvement in grain yield of rice and Chickpea [17, 18]. Stockdale *et al.* [2] narrated the benefits of organic farming to developed nations (environmental protection, biodiversity enhancement, and reduced energy use and CO_2 emissions) and to developing countries (sustainable resources use, increased crop yield without over reliance on costly inputs, and environmental and biodiversity protection). Many researchers reported that in an organically managed field activity of earth worm is higher than in inorganic agriculture [19]. In the biodegradation process earthworms and microbes work together and produce vermicompost, which is the worm fecal matter with worm casts. Vermicompost provided macro-elements such as N, P, K, Ca, and Mg and microelements such as Fe, Mo, Zn, and Cu [20]. The vermicompost contained 0.74, 0.97, and 0.45 per cent nitrogen, phosphorus, and potassium, respectively [21]. In low-input agriculture, the crop productivity under organic

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farming is comparable to that under conventional farming. Tamaki *et al.* [22] reported that the growth of rice was better under continuous organic farming than with conventional farming. Agro-economic study of practices of growing maize with compost and liquid manure top dressing in low-potential areas showed significantly better performance than those of current conventional farmer practices of a combined application of manure and mineral fertilizers. Maize grain yields were 11–17 per cent higher than those obtained with conventional practices [23]. Productivity of the crop during the initial year in an organically managed field is lower than in subsequent years as soil fertility levels increase over time as organic materials are added in the organic management system [24]. Similarly, Surekha [25] revealed that a gradual increase in grain yield with the use of organic fertilizers over a period of time was observed. Chan *et al.* [26] showed that the input of organic rice production in three different regions was 46, 25, and 22 per cent higher than conventional rice production, but rice yield was only 55, 94, and 82 per cent of conventional rice production, respectively. However, the cost of lower yield with higher inputs is compensated by the higher premium prices of organically crops in the markets [26]. Vegetables are highly responsive to organic sources of nutrients and profitable to farmers. Kalembasa [27] reported that vermicompost application of 15 kg per square meter gave the highest yield in tomato crop. Singh *et al.* [28] studiedthe response of chilli (*Capsicum annuum* L.) to vermicompost and observed that the application of vermicompost increased the microbial activities. Vermicompost has a positive effect on the performance of crops due to a higher number of branches and fruits [28]. Tomar *et al.* [29] recorded the highest yield (97 g plant^{-1}) through vermicompost in brinjal (*Solanum melongena* L.). Kalembasa and Deska [30] obtained significantly higher yield of sweet pepper (*Capsicum annum* L. var. grossum) with vermicompost. Reddy *et al.* [31] recorded maximum plant height at harvest, days to first flowering, and branches plant^{-1} with the application of vermicompost (10 t ha^{-1}). Similarly, Tomar *et al.* [29] reported that the application of vermicompost significantly increased leaf area in carrot (Daucus carota L.) plants. Manjarrez *et al.* [32] conducted an experiment on chili receiving 1.25, 2.0, 3.0, 4.0, 6.0, or 10.0 g of vermicompost kg^{-1} of soil under greenhouse conditions and reported that the foliar area and photosynthetic rate rose with increasing vermicompost application, and the highest photosynthetic rate (12 μ mol CO_2 m−2 s $^{-1}$) was observed with vermicompost at 10 g kg^{-1} soil. Atiyeh *et al.* [33] observed that when 20 per cent commercial horticultural medium was replaced by vermicompost there was significant increase in plant height and root and shoot biomass in tomato crop. Ribeiro *et al.* [34] observed that dry matter content increased with increasing the vermicompost dose up to 400 g kg^{-1}soil in sweet pepper cv. Nacional Ag. 506. Atiyeh *et al.* [33] conducted an experiment in which tomatoes were grown in a standard commercial greenhouse container medium (Metro-Mix 360, Manufacturer: Sun Gro Horticulture Canada Ltd., 770 Silver Street Agawam, MA, USA, 01001), considered as control, substituted with 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100 per cent (by volume) pig (*Sus scrofa* L.) manure vermicompost. They obtained highest marketable yield (5.1 kg per plant) with substitution of Metro-Mix 360 with 20 per cent vermicompost. Substitution of Metro-Mix 360 with 10, 20, and 40 per cent vermicompost reduced the proportion of fruit that were nonmarketable and produced more large size (diameter > 6.4 cm) than small size (diameter < 5.8 cm) fruits. Shreeniwas *et al.* [35] conducted a field experiment on ridge gourd (*Luffa acutangula* L. Roxb.) and observed that the increasing levels of vermicompost (0, 5, 10, and 15 t ha^{-1}) increased the fruit weight and fruit volume. Rao and Sankar [36] observed that the effect of organic manure on leaf number, leaf area index, dry matter production, and other growth characters was significantly better than those of inorganic fertilizer in brinjal. Samawat *et al.* [37] reported that vermicompost had a significant effect on root and fruit weight of tomatoes. In 100 percent vermicompost treatment, fruit, shoot, and root weights were three, five, and nine times, respectively more than control. Where vermicompost was applied at at 5 t ha^{-1} or at 10 t ha^{-1}, increased shoot weight and leaf area of pepper plants (*Capsicum annuum* L.) compared to inorganic fertilizers [38]. Choudhary *et al.* [39] obtained the highest yield and available N of tomato cv. S-22 and cabbage (*Brassica oleracea* L.var. capitata) cv. Golden Acre with vermicompost at 200 g/plant + FYM at 250 g/plant, while maximum K and soil organic carbon was obtained with vermicompost at the rate of 100 g $plant^{-1}$ + FYM at 500 g $plant^{-1}$. Hashemimajd *et al.* [40] revealed that the treatment vermicompost produced from raw dairy manure (RDM) along with some other compost (sewage sludge + rice hull) assimilated higher shoot and root dry matter (DM) of tomatoes than the control (soil + sand). Patil *et al.* [41] reported that total potato (*Solanum tuberosum* L.) tubers yield was significantly higher with the application of vermicompost at 4 t ha^{-1} and FYM at 25 t ha^{-1}. Sawicka *et al.* [42] reported that the cultivation system had the strongest effect on the share of commercial potato tubers and tubers of a diameter of 4–6 cm in the total yield. Haase *et al.* [43] suggested that tubers from organic potato cropping may be expected to have sufficiently high tuber dry matter concentrations (19%) for processing into French fries without impairing the texture of the fries when concentration exceeds 23%. Dry matter concentration of tubers for crisps (cv. Marlen) fell short of the required minimum of 22% when a combined N and K fertilizer was applied. Mourao *et al.* [44] found that organically grown potato cv. Virgo yielded 66% of the conventional crop, whereas Raja yielded 46.6%. The nitrogen uptake of organic crop (tubers and foliage) was 37.0 kg/ha for Raja and 50.5 kg/ha for Virgo compared to that of 21.1% and 27.8% of nitrogen uptake, respectively, with mineral fertilizer. Addition of organic amendments and casting of earthworms to soil also proved effective in controlling diseases in pea (*Pisum sativum* L.), mustard (*Brassica juncea* L. Coss.), and chickpea (*Cicer arietinum* L.) during winter season. Nitrogen, phosphorus, potassium, calcium, and magnesium accumulation also increased with increasing doses of vermicompost as well as with fertilizers [45]. Singh [46] observed that the application of vermicompost at 13– 20 q ha^{-1} increased yield of pea (23.62 q ha^{-1}) and groundnut (*Arachis hypogaea* L.) (12.16 q ha^{-1}). The principal findings of Jat and Ahlawat [47] revealed that the application of 3 t vermicompost ha^{-1} to chickpea improved dry matter accumulation, grain yield, and grain protein content in chickpea, soil nitrogen and phosphorus and

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bacterial count, dry fodder yield of succeeding maize (*Zea mays* L.), and total nitrogen and phosphorus uptake by the cropping system over no vermicompost. Baswana and Rana [48] reported that the highest pod yield (93.96 q/ha) of pea was recorded when farm yard manure (1 t ha^{-1}) + poultry manure (1 t ha^{-1}) along with mulch treatment was applied followed by farm yard manure (2 t ha^{-1}) + biofertilizers with mulch treatment. Similar trend was also observed for biological yield and harvest index. Dayal and Agarwal [49] observed that the seed yield of sunflower (Helianthus annus L.) was increased with the higher rate of vermicompost (10 t ha^{-1}); the best combination was 5 t ha^{-1} vermicompost. Somasundaram *et al.* [50] reported that the study revealed that increased soluble protein content and nitrogenase activity of maize, sunflower, and green gram (*Vigna radiata* L.) was estimated with biogas slurry. Increased nitrogen accumulation at all growth stages on maize, sunflower, and green gram was observed under biogas slurry with panchagavya. Higher yield of maize and sunflower was recorded under biogas slurry with panchagavya (a preparation of 5 cow products (dung, urine, milk, ghee and curds)). Silwana *et al.* [51] reported the importance of organic manure and its long time usefulness in increasing productivity of maize-bean (*Phaseolus vulgaris* L.) intercrop for small-scale farmers in Eastern Cape of South Africa. Sangakkara *et al.* [52] found that the organic matter incorporation increased soil water retention in soil and hence enhanced root growth, culminating in high yields of maize. The impact was greater in maize than in cowpea, especially with gliricidia leaves. Seo and Lee [53] reported that soil organic nitrogen increased considerably by hairy vetch. Dry matter yields of maize increased more in hairy vetch than ammonium nitrate with N rates over 160 kg ha^{-1}. Adiku*et al.* [54] revealed that the fertilized maize-grass and maize-pigeon pea (*Cajanus cajan* L. Millspaugh) rotations were identified as those that sustained relatively high maize yields, returned large residue amounts to the soil, and minimized soil carbon loss. Oliveira *et al.* [55] reported that the highest average head weight (700 g) and yield (38 t ha^{-1}) in cabbage cv. Matsukaze was produced with the application of earthworm compost at 27 and 29 t ha^{-1}, respectively. Datta *et al.* [56] confined that the inoculation of seed with *Rhizobium leguminosarum* bv. phaseoli and incorporation of FYM one week before sowing of rajmash (*Phaseolus vulgaris* L.) increased yield. Similarly, inoculation of seed enhanced N fixation and incorporation of FYM left a net positive balance of 42 and 84 kg N, respectively, with regards to control (no seed inoculation and no FYM incorporation in soil). A higher accumulation rate of available N at all the growth stage of rajmash was observed with incorporation of FYM and inoculation of seed over control (no seed inoculation and no FYM incorporation in soil). In all four of the years studied, the organic and conventional farming systems did not show significant differences in marketable yields for any vegetable crops, namely, tomato, bean, cabbage, and zucchini (*Cucurbita pepo* L.).The yields in organic farming were 10 per cent and 3 per cent, respectively, higher than conventional farming [57]. Sarangthem and Salam [58] reported that the application of decomposed urban waste with total nitrogen 0.58– 1.9 per cent, available phosphorus 0.45–0.67 per cent, and available potash 1.4–1.8 per cent increased the yield of bean to 228 gm/pot from 53 gm/pot. The response on growth and yield of bean (228 g/pot) was recorded higher in the decomposed manure enrich with vermiculture. Renuka and Sankar [59] reported in tomato that the yield increased two and half times with the application of organic manures in comparison with inorganic fertilizer (18.44 tonnes). Likewise, Samawat *et al.* [37] reported that vermicompost had a significant effect on the number of fruits in tomato. In 100 per cent vermicompost treatment, fruit numbers were four times more than the control treatment. Arancon *et al.* [38] reported that when vermicompost applied at 5 t ha^{-1} or 10 t ha^{-1}, the marketable tomato yield in all vermicompost treated plots were considerably greater than yield from the inorganic fertilizer plots. The total and marketable fruit yield of pepper also increased with vermicompost compared with inorganic fertilizers. Thanunathan *et al.* [60] reported that soil + mine spoil + coir pith vermicompost (1 : 1 : 1) significantly increased plant height, number of leaf, and root length in onion (Allium cepa L.). Lopes *et al.* [61] reported that the application of vermicompost at 10 t ha^{-1} significantly increased nodulation and dry matter yield of cowpea (*Vigna sinensis* L.) over its lower levels, namely, 0 and 5 t ha^{-1}.

4. Effect of Organic Nutrition on Quality Parameters of Crops

Yadav and Vijayakumari [62] carried out an experiment to assess the effect of vermicompost vegetable waste on the biochemical characters of chilli and found that the protein was higher at 60 (113 mg g^{-1}) and 90 DAS (79 mg g^{-1}). The carbohydrate content was higher in vermicompost treatment at 60 DAS (15.34 mg g^{-1}). Chlorophyll (2.61 mg g^{-1}) and total chlorophyll (3.62 mg g^{-1}) contents were observed at 60 DAS, while chlorophyll a (1.01 mg g^{-1}) was higher at 90 DAS as compared to inorganic fertilizers. In another experiment, Haase *et al.* [43] suggested that tubers from organic potato cropping may be expected to have sufficiently high tuber dry matter concentrations (19 per cent) for processing into French fries without impairing the texture of the fries when concentrations exceed 23 per cent. Similarly, application of FYM at 10 t ha^{-1} alone increased the economic yield and quality parameters like hulling percentage, milling percentage, and protein and amylose content of rice cv. Saket4 [63]. Mourao *et al*. [44] found that organically grown potato Virgo yielded 66 per cent of the conventional crop, whereas Raja yielded 47 per cent. The nitrogen uptake of organic crop (tubers and foliage) was 37.0 kg/ha for Raja and 50.5 kg/ha for Virgo, respectively, 21 and 28 per cent of nitrogen uptake by same cultivars grown with mineral fertilizer. Although foliage nitrogen content was increased for the conventional crops, difference between N content of organic and conventional tubers were not significant, as well as for K, Ca, and Mg. Maheswari *et al.* [64] studied the effect of foliar organic fertilizers on the quality and economics of chilli and observed the highest ascorbic acid content (175.23 mg/100 g) with vermiwash : water at 1 : 5 ratio.

5. Effect of Organic Nutrition on Soil Fertility

Minhas and Sood [65] also reported that the organic matter after decomposition release macro- and micronutrients to the soil solution, which becomes available to the plants, resulting in higher uptake. Organic farming was capable of sustaining higher crop productivity and improving soil quality and productivity by manipulating the soil properties on long term basis. It was reported that organic and low-input farming practices after 4 years led to an increase in the organic carbon, soluble phosphorus, exchangeable potassium, and pH and also the reserve pool of stored nutrients and maintained relativity stable EC level [66, 67]. Normal composting takes a long time leading to considerable loss of organic materials as CO_2 or does not contribute to the organic pool [68]. Bulluck *et al*. [69] reported thathe use of compost raised soil pH from 6.0 without compost to 6.5 with compost and reduced the broadleaf weed population by 29 per cent and grassy weed population by 78 per cent. Degradation of soil organic matter reduced nutrient supplying capacity, especially, on soils with high initial soil organic matter content in rice-wheat cropping system [70]. Organic farming improved organic matter content and labile status of nutrients [71] and also soil physicochemical properties. Addition of carbonaceous materials such as straw, wood, bark, sawdust, or corn cobs helped the composting characteristics of manure. These materials reduced water content and raised the C: N ratio. However, under Indian conditions, joint composting of the manure slurries with plant residues was more viable and profitable than its separate composting. Use of FYM and green manure maintained high levels of Zn, Fe, Cu, and Mn in rice-wheat rotation [72]. Laxminarayana and Patiram [73] concluded that the decline in soil reaction might be due to organic compounds added to the soil in the form of green as well as root biomass which produced more humus and organic acids on decomposition. Urkurkar *et al.* [74] reported that supply of 100 per cent nitrogen, that is, 120 kg/ha for rice and 150 kg/ha for potato in a rice-potato cropping system 1/3 each from cow dung manure, neem cake, and composed crop residue appreciably increased the organic carbon (6.3 g kg^{-1}) over initial value (5.8 g kg^{-1}) as compared to supply from inorganic fertilizers alone. However, availability of phosphorus and potassium did not show any perceptible change after completion of five cropping cycles under organic as well as integrated nutrient approaches.

6. Impact of Organic Nutrition on Soil Biological Properties

Compost contains a variety of microorganisms, including bacteria, actinomycetes, and fungi. When compost is added to soil, it not only introduces these microorganisms but also stimulates their activity (75, 76). Additionally, compost plays a key role in controlling plant nematodes and mitigating the effects of pesticides through a process called sorption. Sorption, a critical interaction between soil organic matter and pesticides, limits both the degradation and transport of pesticides in the soil. Pesticides that bind to soil organic matter or clay particles become less mobile and bioavailable, but they are also less accessible for microbial degradation, making them more persistent (77–79).

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Composting materials provide an abundance of carbon, increasing the populations of heterotrophic bacteria and fungi, which enhances the activity of soil enzymes responsible for converting nutrients into forms that plants can utilize. For example, the application of farmyard manure (FYM) along with rhizobium, or co-inoculation of phosphate solubilizing bacteria (PSB) with rhizobium, has been shown to increase soybean (Glycine max L. Merr.) production (80). Agricultural practices significantly affect soil's biological and physicochemical properties, with studies showing that bacteria, protozoa, nematodes, and arthropods are more abundant in soils under organic farming compared to conventional farming (81). Research by Bulluck et al. (82) indicated that organic fertility amendments enhance beneficial soil microorganisms, reduce pathogen populations, increase total carbon, improve cation exchange capacity, and lower soil bulk density, thereby improving overall soil quality. The National Academy of Agricultural Sciences (NAAS) has recommended a holistic approach for India that includes integrated nutrient management (INM) and integrated pest management (IPM) to enhance input efficiency, while promoting region-specific cropping systems as part of an organic farming strategy. They suggest beginning with high-value crops such as spices, medicinal plants, fruits, and vegetables (83).

Singh and Bohra (84) reported that a rice-pea-black gram (Vigna mungo L.) cropping system supported a higher population of bacteria, actinomycetes, and fungi than a rice-wheat system. Field experiments with phosphate solubilizing microorganisms (PSMs) like Aspergillus awamori, Pseudomonas striata, and Bacillus polymyxa significantly increased yields in wheat, rice, and cowpea (Vigna sinensis L.), while reducing the need for phosphate fertilizer by 30 kg P_2O_5 ha^{-1}. Vegetable crops also responded positively to Azotobacter inoculation, and yield increases of 0-31% were observed in crops like wheat, maize, sorghum (Sorghum bicolor L. Moench), cotton (Gossypium spp.), and mustard (85).

In low-input agriculture, crop productivity under organic farming can be comparable to conventional farming. For instance, the integrated use of rice straw compost with Azotobacter and PSB showed better results than using rice straw alone (86). Azotobacter produces growth-promoting substances that improve seed germination and root system development. It also produces polysaccharides that enhance soil aggregation (87). Seed inoculation of chickpea with rhizobium and PSB increased dry matter accumulation, grain yield, grain protein content, and overall nitrogen and phosphorus uptake by the cropping system, outperforming treatments with rhizobium alone.

7. Conclusion

Organic farming can provide quality food without adversely affecting the soil’s health and the environment. There is need to identify suitable crops/products on regional basis for organic production that has international market demands. The whole region as such cannot afford to go for organic at a time because of its commitments to insure food and nutritional security. This will provide ample opportunity for employment and bring prosperity and peace in the region.

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