Environmental and Food Quality Aspects of Organically and Conventionally Grown Cereals and Pulses

by

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① Farming ② Environmental aspects

DEDICATED

TO

MY PARENTS

CERTIFICATE

This is to certify that the thesis entitled," **Environmental and Food Quality Aspects of Organically and Conventionally Grown Cereals and Pulses"** being submitted by **Ms Rekha** to the Indian Institute of Technology, Delhi for award of Doctor of Philosophy is a record of bonafide research work carried out by her under my guidance and supervision in conformity with the rules and regulations of Indian Institute of Technology Delhi. The research report and results presented in this thesis have not been submitted in part or full to any other university or institute for the award of any degree or diploma.

I certify that she has pursued the prescribed course of research.

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(REKHA)

ABSTRACT

Recovering from the euphoria of green revolution, world is now battling from residual effects of extensively used chemical fertilizers and pesticides. Conventional farming is characterized by ready made plant nutrients, broad range of chemical pesticides and hybrid seeds which resulted in higher production at the cost of environmental degradation, thereby threatening the sustainability of agriculture itself as well as the health of people consuming its products. Indiscriminate use of chemicals and intensive cropping has mined the soil of nutrients, contaminated soil, groundwater and food.

The answer to the above problem lies in organic food. Organic cultivation views the entire system i.e. plant, soil, air, water and micro-organisms in totality, with the ultimate objectives of producing healthy, nutritious, and quality food in sufficient quantities. Given the significant increase in consumer interest in organic food products, there is a need to determine, to what extent, there is a scientific basis for claims made for organic produce. Henceforth, a comprehensive study was required to distinguish organic and conventional production system. In the light of these facts, the present study was undertaken with the following specific objectives: I) To analyze and compare the quality of cereals and pulses obtained through organic and conventional systems and ii) Environmental impact analysis of organic and conventional food production systems.

The thesis entitled "Environmental and food quality aspects of organically and conventionally grown cereals and pulses" has been organized in 7 chapters, starting with a brief introduction on the theme, presents extensive literature survey on relevant aspects and results and discussion (R & D). Details on experimental site and methodology are presented in chapter 3. Experiment and observations are presented in chapter 4. It is followed by analytical results of soil, water and food quality in chapter 5. All the data was statistically analysed and discussed. Environmental and economic impact evaluation of both agricultural production systems is presented in chapter 6. Finally, overall research findings alongwith salient results as well as significance of the present study are presented in chapter 7.

For the comparative evaluation of soil, irrigational water and food quality of organic and conventional production systems, two agricultural farms in Haryana (India) were

selected. A field of 25 acres (1 hectare = 2.5 acre) was taken for the study. The soil, crop (grains) and irrigational water samples were collected from the selected fields each year from 2002-2004. A total of thirty six sampling locations were selected for soil and crop sampling within the area of twenty five acres of each farm. Irrigational water samples were collected in order to study the impact of soil management practices on water quality. Crop samples were collected at harvest to study physical, sensory, nutritional quality. Heavy metals and residual pesticides were also determined in soil, water and crop products.

Soil quality in the study area was evaluated on the basis of its physico-chemical characteristics and its macro and micro nutrient status. Organic soils showed higher retention of moisture content than conventional soil. Cation exchange capacity (CEC) of organically managed soil was found to be higher (14.6 me /100 g) than conventional farm (12.60 me /100 g). Increase in organic matter (2.70-2.82%) was observed in organic soils from 2002 to 2004 whereas in conventionally farmed soils, it remained almost constant (0.75%) over the same period. Increase in nitrogen content in organic farm soil was observed from 2002-2004 from while its content decreased over this period in conventional farm. Arsenic was not detected in any of the soil sample under organic management but it was found in all soil samples of conventional farm (0.1-0.2 mg/kg).

The pH of irrigational water was alkaline at both organic (8.6) and conventional farm (8.6) indicating no effect of agricultural practices on water pH. No salinity or hardness problem was observed in the present investigation as chloride and magnesium ion concentrations were within permissible limits (70 mg/l organic farm and 20 mg/l in conventional farm). Among heavy metals, only copper (Cu) (0.01 mg/l) was observed in both the water samples. Contamination of groundwater with α endosulfan in organic farm water sample (0.006 ng/l) and conventional farm water (0.008 ng/l) was also observed. The concentration of β endosulfan was 0.006 ng/l for both conventional and organic farm water samples. The presence of these pesticides could be attributed to the indiscriminate use of pesticides in these fields over the past.

This investigation of organically and conventionally produced cereals and pulses depicts the difference in food quality. Moisture concentration of conventional farm wheat (10.7%) was more than organic farm wheat (9.48%). Nitrogen concentration of

organically grown wheat was 1.92 % while it was 1.95% in conventional wheat in the year 2002. Nitrogen concentration for organically grown rice (1.66%) was slightly less than conventionally grown rice (1.7%) but this trend was not statistically significant. Similar trend was observed for potassium and protein content. Organic crop products were found higher in essential amino acids. On the basis of sensory quality, organic produce were preferred over conventionally grown products.

Yield of organic farming system for different crops was lower e.g. wheat (3875 kg/ha) compared to conventional (4750 kg/ha) farm but financially, the organic system performed better than conventional agricultural system. The net return was higher in organic wheat production (Rupees 30125 /ha) than conventional system (Rupees 14962.50 /ha) because of governmental premium price policy for organic produce. The energy input for cultivation of wheat crop was found significantly higher on conventionally managed farm (17857.68 MJ) than on organically managed (5063.29 MJ). The findings of this study revealed that organically managed agricultural farm differs from conventional agriculture farms, particularly in terms of economic, environment and food quality aspects. It was also observed that different cultivation practice affect soil and product quality.

In view of the decreased quality and fertility of soil under conventional system, policies could be adopted to promote the application of biological and chemical fertilizers in a balanced way, so as to maintain soil structure and sustain crop yield. Promotion of legume crop cultivation, agro forestry and raising livestock appears to be appropriate strategies for improving biological fertilization of soils. Some efforts have been made in India recently to promote ecological agriculture in the interests of sustainability and long-term well-being of the people. In this regard, the ecological agriculture being promoted by Agricultural and Processed Food Products Export and Development Authority (APEDA) is a pioneering endeavor aimed at making agriculture environmentally sound, economically viable and socially acceptable. In the changing paradigm of agriculture, the present work is a humble contribution in the direction that leads us to live in the harmony with nature.

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