

Potential of organic farming

in rainfed areas of India

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Rainfed agriculture is predominant in arid, semi-arid and sub-humid regions of the country and has a crucial role to play in sustaining the economy and food security of India. At present, about 51% of the net sown area is rainfed contributing 41% of the total food production and supports 40% of human and 60% of livestock population. Still a vast majority of farmers in rainfed areas practice low or no external input farming, which is well integrated with livestock, particularly small ruminants. Based on several surveys and reports, it is estimated that up to 30% of the rainfed farmers, particularly in many remote areas of the country do not use chemical fertilizers and pesticides. Thus, many resource poor farmers are practicing organic farming by default. The Government of India task force on organic farming and several other reviewers has identified rainfed areas and regions in north-east as more suitable for organic farming in view of the low input use.

Keywords: Crop yield, Organic farming, Rainfed areas, Soil properties

THERE has been a significant increase in the area under certified organic farming during the last 10 years. With less than 42,000 ha under certified organic farming during 2003–04, the area under organic farming grew by almost 25 fold and during the next 5 years, to 1.2 million ha during 2008–09. Later, however, the area under certified organic farming has fluctuated between 0.78–1.1 million ha. Presently, about 2.65 million ha area is under certified organic cultivation and India ranks 5th in terms of total land under organic cultivation in the world. The countries with the largest areas of organic agricultural land are Australia, Argentina, Spain, USA and India (in order). During 2019, India had the largest number of organic producers of about 1.36 million and accounted for 3.46 million tonnes of certified organic produce. India exported 888179 million tonnes (MT) and agri-export realization was around ₹707849 lakhs.

Organic farming in rainfed areas

Adoption of soil and water conservation measures, a key component of rainfed farming is also one of the pillars of organic farming. Crop production with the use of alternative sources of nutrients such as crop rotation, residue management, organic manures and biological inputs, mulching or mulch cum manuring, green leaf manuring, cover cropping are the strategies followed that not only conserve moisture but also

improve nutrient use efficiency. The use of FYM or other organic nutrient sources during aberrant rainfall years in particular have an additional advantage of protecting the crop from drought besides the nutritional benefits (critical in drylands). Even though the input uses are low, some crops receive higher attention like cotton, hybrid sorghum and millets, groundnut, pigeon pea use relatively higher levels of chemical fertilizers and pesticides throughout the country. This is mainly because of the need due to varietal replacement and also greater accessibility of farmers to surface or ground water for protective irrigation. Thus, it becomes essential to delineate different regions and crops within rainfed areas depending on the nature and level of input use, so that a proper research and policy initiative can be taken up for identifying prospective regions/commodities.

Focus on niche areas and commodities

Rainfed areas are reported to have a relative advantage for organic farming primarily due to low level of input use, shorter conversion period and smaller yield reductions compared to irrigated areas. However, large-scale conversion to organic farming cannot be expected to happen because of several limitations, particularly the availability of organic amendments. The inherent advantages of rainfed areas should be capitalized by encouraging organic farming in highly

Table 1. Selected list of commodities with potential for organic production in rainfed regions

Commodity	Scope/opportunity	Potential area
Cotton	Demand for organically produced lint to cut down on chemical use	Maharashtra, Andhra Pradesh, Karnataka, Gujarat
Sesame	Demand for organic sesame seed for medicinal and confectionery uses	Gujarat, Rajasthan
Niger	Demand for niger seeds produced organically for bird feed in Europe	Tribal areas of different states, particular in Odisha and Chhattisgarh
Lentil	Preference for Indian lentil in world markets	Uttar Pradesh
Safflower	Growing market for safflower petals as natural food dye and herbal products	Maharashtra
Finger millet	Scope to export finger millet flour as health food ingredient	Karnataka, Odisha, Jharkhand
Ginger/turmeric	Demand for residue free spices/natural colours	Odisha
Groundnut	To produce residue/toxin free table varieties	Gujarat
Soybean	Demand for organically produced de-oiled cake for livestock feed	Madhya Pradesh

selected areas and commodities with edapho-climatic and price advantages. The primary focus should be on commodities which have export potential with price premiums (Table 1).

Research on organic farming

Conventional varieties have been developed with the aim of combining high productivity and standardized product quality under high-input conditions. The consequence is that organic farmers have to depend on varieties for cultivation with high external inputs. The amount of stress on the crop is expected to be more under organic management than input-intensive conventional farming. The stress may be in the form of available nutrients, weed pressure, insect-pests and diseases. Hence, varieties that can respond to sub-optimum conditions (typical of organic farming conditions) are needed. Level of resistance to diseases and insect pests must be a criterion while selecting the variety for organic farming. Yield, quality, and market acceptability also have to be considered while selecting crop varieties. Suitable varieties of different crops have been identified for rainfed organic farming.

Supply of nutrients to barnyard millet (*Echinochloa frumentacea*) exclusively through organic sources adequately supports the crop growth and yield, due to comparatively low nutrient requirement of the crop.

At Ranichauri (Uttarakhand), vermicompost (VC) + wild apricot-cake (WAC) (50% N from each source) + *Azotobacter* on an average produced statistically similar yield (1.78 tonnes/ha) as RDF treatment (1.92 tonnes/ha). In the absence of any premium price for the organic produce, however, the net returns and benefit to cost ratio were highest with RDF followed by VC + WAC + *Azotobacter* treatment. At Hyderabad, organic production system in sesame involving application of FYM 3.7 tonnes/ha + neem cake 900 kg/ha + ash 75 kg/ha + bone meal 75 kg/ha + elemental sulphur (ELS) 20 kg/ha + PSB 5 kg/ha (soil application) + *Azotobacter* 5 kg/ha, and pest management with *Trichoderma* (0.4%) seed treatment + neem oil spray thrice at 15, 30 and 45 DAS, and *Azadirachtin* (0.03%) spray at 30 DAS gave 18% lower seed yield in 2005, 22% in 2006 and 20% in 2007 compared with conventional farming.

On the other hand, organic farming in groundnut produced 18.2% and 22.1% higher dry pod yield and kernel yield over inorganic farming (2970 and 2345 kg dry pod and kernel yield/ha, respectively). Groundnut crop in organically amended plot did not show moisture stress during the period of dry spell of 38 days due to greater moisture conservation. On the contrary, groundnut in inorganic farming showed moderate to severe moisture stress during same initial dry spell period. At Indian Institute of Soil Science, Bhopal,



Finger millet (VL Mandua 315)



Lentil (VL Masoor 103)

during the first year, conventional farming resulted in 11% higher yield, gross income and benefit cost ratio compared to that of organic farming. In the second year, both conventional and organic farming resulted in comparable yields (851–863 kg/ha) and almost similar economic returns. However, in the third year, organic farming recorded higher yields (1338 kg/ha), gross income (₹16056/ha) and benefit cost ratio (1.87) compared to the conventional farming. Among different organic manures, application of poultry manure was found better, which gave 17.5% higher yield than the chemical fertilizers.

At ICAR-Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad in general, pigeonpea seed yield (721–737 kg/ha) was similar under both organic and integrated production systems compared to control (672 kg/ha). In greengram, the seed yields were higher under integrated production system during initial 5 years, whereas organic system recorded marginally higher yields during last 5 years compared to other treatments. However, integrated production system recorded higher seed yield of sunflower in all the years except during last 2 years, where seed yield was marginally higher under organic production system than other treatments. After 10 years, plots under organic management recorded significantly higher soil organic C (0.57%) compared to inorganic and integrated production systems. Whereas, plots under integrated management being on par with inorganic (control) recorded significantly higher available N (205.2 kg/ha) and P (26.5 kg/ha) compared to organic management. Plots under organic management being on par with integrated production system also recorded significantly higher available K (244.8 kg/ha) compared to control. Similarly, plots under organic management recorded significantly higher Cu (2.08 ppm), Fe (13.8 ppm), Zn (0.68 ppm), Mn (29.9 ppm), dehydrogenase (5.86 µg TPF/g soil/h) and microbial biomass carbon (317.3 µg/g soil) compared to other production systems.

Most of the tuber crops are grown by small and marginal farmers in rainfed and tribal areas and hence, use of chemical fertilizers and insecticides is limited except in the case of cassava in the industrial production areas of Tamil Nadu and Andhra Pradesh. Tuber crops in general and aroids in particular, like an elephant

foot yam respond well to organic manures and there is considerable scope for organic production in these crops. Further, tropical tuber crops are well adapted to low input agriculture. They are less prone to pest and disease infestations. Three years of experimentation has indicated that organic farming is a viable proposition in elephant foot yam. In another experiment, three species of yam/*Dioscorea* (*D. rotundata* (var. Sree Priya), *D. alata* (var. Sree Keerthi and *D. esculenta* (var. Sree Latha)) were tested under three production systems, viz. conventional, traditional and organic farming. *Dioscorea rotundata* produced higher yield in conventional practice (19.20 tonnes/ha), which was on a par with organic farming (17.81 tonnes/ha). In the case of *D. alata*, all the production systems were on par; traditional practice (20.64 tonnes/ha) resulted in slightly higher yield than organic (19.46 tonnes/ha) and conventional practices (19.04 tonnes/ha). In *Dioscorea esculenta*, organic farming proved superior (8.58 tonnes/ha).

The organically grown medicinal plants fetch higher price in the international market and demand for organic product is increasing day-by-day with increase in awareness of the side effects of the synthetic drugs. In a field experiment conducted at CRIDA, highest Senna leaf, biomass of *Andrographis* and *Ashwagandha* root yields were recorded with the application of vermicompost, neem and castor cakes, respectively. Application of castor cake also improved the quality of *Andrographis* with respect to andrographolide content in roots.

Organic farming and climate change

Climate change and variability are a considerable threat to agricultural communities, particularly in India. This threat includes the likely increase of temperature, extreme weather conditions, increased water stress and drought, and desertification. Farmers need tools to help them adapt to these new conditions. Organic farming is one such option which has both climate change mitigation and adaptation potential particularly in rainfed agriculture. It emphasizes recycling techniques and low external input and high output strategies. It is based on enhancing soil fertility and diversity at all levels and makes soils less susceptible to erosion. Emissions of nitrous oxide (N₂O) are directly linked to



Performance of greengram and sunflower under organic management

the concentration of easily available mineral nitrogen in soils. High emission rates are detected directly after fertilization and are highly variable. In organic systems, the nitrogen input to soils, and hence the potential N_2O emissions, are reduced. Inputs like animal manure, compost and green manures are found to increase soil carbon levels substantially. Many field trials across India show that organic fertilization compared to mineral fertilization results in increasing soil organic carbon and thus, sequestering large amounts of CO_2 from the atmosphere to the soil.

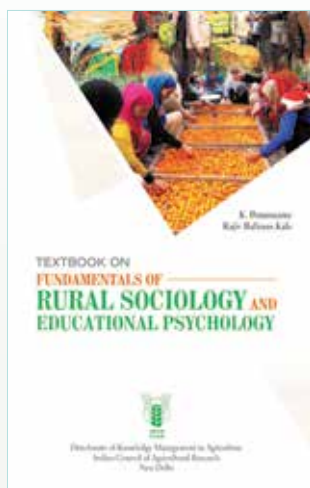
Farming practices such as organic agriculture that preserve soil fertility and maintain or even increase organic matter in soils are in a good position to maintain productivity in the event of drought, irregular rainfall events with floods, and rising temperatures. Soils in organic agriculture capture and store more water than soils of conventional cultivation. Soils under organic management practices are also less prone to erosion. Hence, organic agriculture production is expected to be less prone than conventional cultivation to extreme weather conditions such as drought, flooding, and water logging.

SUMMARY

India is bestowed with a lot of potential to produce all varieties of organic products due to its various agro-climatic regions and traditional knowledge. Due to low input demand, rainfed areas are potential hotspots to produce organic products. As the export potential is increasing, overcoming the hurdles in rainfed area, developing cost-effective production system and adequate scientific research will help India emerge as a good exporter of organic products and increase farm net revenues. Farming practices such as organic agriculture that preserve soil fertility and maintain or even increase organic matter in soils are in a good position to maintain productivity in the event of drought, irregular rainfall events with floods, and rising temperatures. Soils in organic agriculture capture and store more water than soils of conventional cultivation. Therefore, organic agriculture is one of the adaptation strategies that can be targeted at improving the livelihoods of rural populations that are especially vulnerable to the adverse effects of climate change and variability.

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TECHNICAL SPECIFICATIONS

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