



ISSN (E): 2277-7695  
ISSN (P): 2349-8242  
NAAS Rating: 5.23  
TPI 2023; 12(5): 3728-3731  
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Received: 23-02-2023

Accepted: 30-03-2023

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## Organic farming of cocoa

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### Abstract

Organic farming is an agricultural system that promotes healthy products free from harmful components to humans and nature. This is accomplished by using mechanical methods for on-farm agronomic, bio-based, and excluding all synthetic off-farm inputs and standards for organic farming. In cocoa farming, robust, healthy trees can be maintained by balancing sunlight availability, air, water, shade, and nutrients. This will help prevent diseases, without the use of pesticides and synthetic fertilizers, which is one of the pillars of organic farming. The importance of cocoa, the nutrient compounds of cocoa, the definition of organic cultivation practices research gaps, constraints in organic farming, and standards are discussed.

**Keywords:** Organic farming, cocoa plantation biofertilizers, organic standards, biopesticides

### Introduction

Cocoa (*Theobroma cacao*) is cultivated for the dry bean, the main ingredient in chocolates. More commercial cultivation is being noticed in its native region (Amazon region of South America). Africa, Latin America, and Asia are the other places where cocoa cultivation is catching up under the shade of palms and under the canopy of cleared forests.

Cocoa was introduced in India at the start of the 20<sup>th</sup> century, while large-scale cultivation was started in the 1970s. Today, in India, it is cultivated on 65,500 hectares as a component crop in plantations like areca nut, coconut, and palm oil plantations. Its production in India is estimated at 13,400 metric tonnes (DCCD, 2013) [12]. It is mainly cultivated in four southern states: viz., Karnataka, Kerala, Tamil Nadu, and Andhra Pradesh. Among the states, Andhra Pradesh accounted for the most area, while Karnataka registered the highest production. The production, productivity, and quality of cocoa in India are lower and not comparable with those in other major cocoa-producing countries because of prevailing agro-climatic and socio-economic factors. There is enormous potential for cocoa area expansion because of heavy demand in the Indian chocolate industry and confectionaries which is portrayed as 60,000 MT for the year 2025.

### Definition

Organic agriculture is a production system that promotes soil health, ecosystem health, and human well-being by accounting for ecological processes, biodiversity, and biogeochemical cycles (tailored to local conditions) rather than using harmful inputs. Organic agriculture combines tradition, innovation, and science to benefit the shared environment and promote fair relationships and good quality of life for all involved (Migliorini *et al.*, 2017) [18].

According to the IFOAM (previously known as the International Federation of Organic Agriculture Movements), organic production methods are those where at least 95% of the ingredients of agricultural origin are organic. In 1998, IFOAM adopted basic standards for organic farming and processing.

Traditionally, organic farming promotes the application of non-chemical-based fertilizers and pesticides; it integrates the use of mulches, compost, manures and catch cropping as well as agroforestry (Bouagnimbeck, 2008) [10]. The farming system manages plant genetic resources, crop species and variety better and therefore strengthens farmers' resilience to changing climate as well as solves their food and livelihoods security problem. The flora abundance provides diverse food sources and income diversification (Neudeck *et al.*, 2012) [19]. The issue of whether farmers who set aside their conventional practice to concentrate on organic farming appreciate the socio-economic gains is of interest.

Organic farming is depending on techniques such as follow of crop rotation, incorporation of green manure, application of compost and biological pest control.

It also involves in production of standards for cultivation, marketing *etc.*, and development of certification methods. Depending on definition used, organic farming uses fertilizers and pesticides (herbicides, insecticides and fungicides) if they are considered natural (such as bone meal from animals or pyrethrin from flowers), but it strictly limits the use of several methods (including synthetic petrochemical fertilizers and pesticides; plant growth regulators such as hormones; antibiotic use in livestock; genetically modified organisms; human sewage sludge; nano particles) for reasons including sustainability, openness, independence, health, and safety

### Environmental benefits of organic farming of cocoa

To improve soil nutrient status and reduce degradation, organic farming is often considered one option for ecological augmentation (Halberg *et al.*, 2015) <sup>[15]</sup>. Organic farming methods are also applauded for lowering greenhouse gas emissions. Finally, organic farming encourages on-farm agrobiodiversity, through the diversity of plant varieties cultivated (Seufert and Ramankutty, 2017) <sup>[25]</sup>, and improved farmer's profitability (Jouzi *et al.*, 2017) <sup>[17]</sup>. Organic farming aims at creating a sustainable agricultural production system, including economic, environmental, and social sustainability (Rigby and Cáceres, 2001; Padel, 2001) <sup>[13, 21]</sup>.

### Concerns of organic farming in cocoa

Soil fertility, air quality, biodiversity loss (Gockowski *et al.*, 2013; Ntiamoah and Afrane, 2008; and Asare, 2006) <sup>[14, 20, 2]</sup>, deforestation; 'misuse' of pesticides are among the environmental concerns.

### Profitability of organic farming

Compared to conventional cocoa products, organic farming has the potential to increase profit through premiums from higher added value (Winter *et al.*, 2020; Bonisoli *et al.*, 2019; Berg *et al.*, 2018) <sup>[26, 9, 17]</sup>.

The sustainability of organic farming is one of the key challenges in farming. Cocoa production in Ghana often focuses on one dimension of sustainability (economic benefit only, does not consider the environment or social solidarity). Commercial cultivation of cocoa is being done in the Amazon region of South America, African, Latin American, and Asian countries under palm trees and partially cleared forests.

### Cultivation practices for organic cocoa production

Some farmers have shifted their crops out of the shade and into direct sunlight. This practice yields a greater quantity in a short period and at lower quality. Cacao trees with no shade tend to accumulate more weeds (Bentley *et al.* 2004) <sup>[6]</sup> as well as be more susceptible to diseases such as Witches Broom and Frosty Pod Rot. If the crops begin to accumulate pests, farmers use large amounts of herbicides to rid the crops of these pests. The herbicides used damage the land and the health of the sprayers applying the herbicide. Excessive spraying of pesticides can also cause the weeds and insects to build up a resistance which will eventually create more harm to the crops (Rice and Greenburg, 2000) <sup>[22]</sup> Sun cultivation of cocoa may require clearing overstory as well as understory, which contributes to deforestation and habitat loss.

**Use of green manures:** Growing green manure crops like *Calapogonium* and *Puevaria* along cocoa basins can provide

about 5-6 tonnes green manure per year. Border planting of *Glyricidia* would also supply an ample amount of green leaf manure.

**Use of organic manures:** The application of organic manures like FYM, Compost, coirpith, compost, oilcakes ash and bio-fertilizer will be useful in the early establishment period. After about three years we need not apply any fertilizer because the cocoa litter will be a nutrient source after three years. However, annual application of 10 kg organic manure with 100g N, 40g P<sub>2</sub>O<sub>5</sub> and 140g K<sub>2</sub>O per plant per year in two equal split doses is recommended. Coco peat can also be used as a soil amendment for good plant growth but it should be composted before application.

**Use of bio fertilizers:** Bio-fertilizers like Azospirillum, phospho-bacterium Trichoderma, *Pseudomonas fluorescens*, and *Vesicular arbuscular micorrhiza* (VAM) *etc.*, may be applied directly for availability of micro, macro-nutrients and growth promoters.

**Use of botanicals in organic production:** Use of bio-pesticides of plant origin for capsid control include extracts of *Azadirachta indica* (neem), *Jatropha* spp. and other local plants. The use of plant extracts will be helpful to reduce the environmental hazards associated with commercial insecticides. It is of interest to note that a small group of Ghanaian farmers, the Traditional Organic Farmers Association (TOFA) have identified themselves with an international organization called the IFOAM (International Federation of Organic Agriculture Movement) TOFA claims to produce organic cocoa.

**Table 1:** Capsid mortalities due to neem-based products in cocoa

Treatment	Control
20% neem seed water extract	93%
4.62% neem oil spray	80%

Organic farming performs better in terms of land degradation, greenhouse gases, profitability, and gender equity, compared to conventional.

### Future research potential in organic farming

Researches are less about the suitable shade tree for cocoa cultivation, Mechanization and planting techniques, composting of leaf litter of cocoa for carbon recycling, potassium, P solubilizing bacteria on cocoa plants *etc.*,

### Constraints in organic farming

Organic farming is more labour intensive and produces less yield than conventional farming. It is often viewed as a way to produce healthier and safer food while promoting environmental sustainability. Organic inputs like crop rotation green manure, and composting are a time-consuming process. Pest control in coca farmers relies on natural pest control methods such as companion crops. These methods may not always be effective leading to lower yield and reduced quality.

Less availability of trained farm labour, less availability of organic inputs, controlling pests and diseases by organic methods, and lack of scientific knowledge about organic farming practices were the constraints faced by organic cocoa farmers (Jaganathan *et al.*, 2015) <sup>[16]</sup>.

Cocoa farmers usually clear tropical forests to plant new cocoa trees rather than reusing the same land. That practice has spurred massive deforestation in West Africa, particularly in Ivory Coast. Experts estimate that 70% of the country's illegal deforestation is related to cocoa farming.

The concern about cocoa production and productivity in monoculture cocoa farming systems is accompanied by economic, social, and environmental challenges (Bandanaa *et al.*, 2021) [3]. At the economic level, there are concerns about issues with old cocoa farms (Cocobod, 2018; Dormon *et al.*, 2004) [11, 13] and lower cocoa bean prices at the producer level. The social issues include the concern for child labour in cocoa production (Berlan, 2013; Baradaran and Barclay, 2011; Schrage and Ewing, 2005) [8, 4, 24], the lack of labour for production activities, and gender problems (Anglaaere *et al.*, 2011) [1].

The cost of the organic products is high which only the elite and foreigners can afford. Moreover, people should verify organically certified products before buying. Organic growers are not in a position to spend money on organic certification. Organic marketing in most countries is still relatively small and on average it is less than half a percent of the total agricultural sector except in Germany and Austria, where 2-3 percent of their agriculture area is under organic production. There are a number of firms in India, which grow vegetables, fruits, plantation crops, spices, and tea organically and export them to various countries. Usually, farmers associated with big exporters do not have to worry about the sale of their products and their certification, small and marginal farmers are a harrowed lot. Several institutions and movements are making concerted efforts to promote organic agriculture in India and to bring changes in the policies favoring ecological agriculture. In June, 2001, the Director General of foreign trade issued a notification declaring the export of an agricultural product as organic would be permitted only if it was produced, processed, and packed under a valid organic certificate issued by a certifying agency duly accredited by either APEDA, coffee board, spices board and tea board in India.

Unfortunately, farming of cocoa in order to meet the extraordinary global demand for chocolate is actively harming the very environment. Chocolate is, in fact, one of the least environmentally-friendly foods we consume. Organic farming improves fertility and water retention and supports the resiliency of farms, boosting sustainability in the process. Biodiversity is key in regenerative agriculture: small animals called microorganisms naturally build up the soil, improve nutrition and protect plants.

The impacts of cocoa production on deforestation and biodiversity loss have been discussed widely. Deforestation for establishing cocoa plantations leads to land fragmentation, loss of wildlife corridors, and forest connectivity.

### Organic standards for marketing

Products sold, labeled, or represented as organic must have at least 95 percent certified organic content. Products sold, labeled, or represented as "made with" organic must have at least 70 percent certified organic content. The USDA organic seal may not be used on these products.

### Conclusion

According to FAO organic agriculture often earns higher prices and hence a better income for farmers are obtained.

Standards regulating production methods may be voluntary or legislated. More promotion of organic agriculture is similar to mono-cultivation but a diverse farming system will make the farm sustainable. Non-availability of labour, non-availability of quality organic inputs, difficulty in controlling pests and diseases by organic methods, and lack of knowledge about organic farming practices were the major constraints. Adaptation strategies are required to avoid the loss and also improve the conservation of biodiversity and provision of ecosystem services across the region. Strict organic farming is not suitable for poor

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