# A Review on Organic Farming: Issues and Strategies

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## ABSTRACT

*The use of pesticides and fertilizers in modern agriculture causes a negative impact on the environment. This occurs mainly with an increase in toxic residue through the food chain and animal feed, triggering numerous health problems. With such adverse implications, the farming community is becoming increasingly aware of alternative agriculture systems such as organic farming. This review paper attempts to bring together different issues in recent developments in organic farming by employing non systemic literature review. The key issues emerging in organic farming include yield reduction in conversion to organic farming, lack of raw materials for organic fertilizer production, lack of awareness of technical skills among farmers, soil fertility enhancement, certification constraints, and marketing and policy support. It has been argued that organic farming is productive and sustainable, but there is a need for strong support for it in the form of subsidies, agricultural extension services and research. Therefore, adopting organic farming as a gradual process by establishing proper strategies to ensure an adequate supply of organic fertilizer through increased production and availability by a well-developed distribution mechanism in the country is suggested.*

***Keywords:*** *Environment, Organic agriculture, Organic fertilizer, Sustainability, Yield*

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## Introduction

The food system of Sri Lanka is expected to provide safe and nutritious food to ever growing population that is currently estimated to be 22.2 million (Central Bank, 2021). Consequently, Sri Lanka's food production has continued to concentrate on rice, to be self-sufficient in grain. This indicates that local food production could not keep up with the changing overall demand for food as per transformation in consumption or dietary patterns (Weerahewa, 2017). On the other hand, the agriculture sector also provides livelihoods for millions of people that mostly dwell in the rural and estate sectors, accounting for over 27 percent of the country's labour force (Central Bank, 2021). Further, the agricultural production system occupying nearly 51 percent of the total land extent of the country has also a large environmental footprint (DOA, 2020), far more than any other human activity.

With successive governments' continued interventions and support in opening up new lands for crop cultivation, initiating irrigation and settlement schemes, establishing research and development for different crop varieties, and market interventions for agricultural products since independence, the country's agriculture sector gained significant growth. The impacts of the green revolution in the 1960s and 70s, such as the introduction and promotion of high-yielding varieties, farm mechanization, inorganic fertilizer and agrochemicals for increased crop productivity and effective pest and disease control, also made the productivity of crop production sector high. However, presently, the high input of conventional agriculture has posed significant threats to human health and ecological balance and become highly vulnerable to the impacts of changing climate, pest outbreaks and other forms of biotic and abiotic stresses, thus, the sustainability of the current crop production systems are highly questionable (FAO, 2017). With the increased use of inorganic agrochemicals and fertilizers in agriculture, acute environmental hazards have been created especially in developing countries. Loss of biodiversity, water pollution and soil degradation are the major issues arising from it. This situation has become a threat to a healthy food supply for humans (Padmajani *et al.*, 2014). The government's agricultural policy has identified the importance of expanding the organic agriculture sector in the country (GoSL, 2019). The organic agriculture sector in Sri Lanka is still in its early stages of development. The sector supplies about six percent of the total agricultural production (TAMP, 2020).

To make the agriculture sector sustainable, it is imperative to formulate policies addressing three key challenges: feeding the growing population, providing livelihoods for rural communities, and protecting the environment. With the increasing population, there is immense pressure to increase the efficiency of food production from the limited land resources available. Thus, moving to organic farming is required to achieve agricultural sustainability while addressing the challenges of the

sector. This article intends to address some concerns on the current situation, the issues and the challenges in moving to organic farming.

The objective of this research is to review the existing literature on the discussion concerning organic farming in Sri Lanka, issues and challenges faced by farmers when adopting organic farming strategies and effective implementation. This paper has used a non-systematic literature review () adopting the techniques used by Bandara, *et al.*(2021) for organic farming in Sri Lanka.

## Issues in Adopting Organic Farming

### *Maintaining Food Security while Balancing Organic Principles*

A majority of high-yielding seasonal and perennial crops grown in Sri Lanka are found to be highly fertilizer-responsive. There is a widespread belief that organic inputs produce lower yields, whereas chemical inputs have the opposite effect. Analyses in other countries indicate that the mean yield reduction of crops in organic agriculture is 19-25 percent (Meemken and Qain, 2018). With the yield decline by immediate shifting from conventional systems to organic systems, many food products would not be accessible to a larger community due to less availability, and less affordability due to higher prices.

Due to lower average yields and high labour inputs, organic production is associated with higher costs per unit of output and consequently higher output prices. Higher prices only apply to a small segment of the certified organic market, but total conversion to organic agriculture would mean significantly higher food prices in the entire market. In developed countries, most consumers are economically well-off, thus, higher food prices would not jeopardize their food security. However, many poor households in developing countries spend over 50% of their income on food. In such situations, food price increases are associated with higher levels of food insecurity and undernutrition, especially in urban areas (Ecker and Qain, 2011; Meemken and Qain, 2018).

To maintain the same food security levels in the country, the food production system must produce the same quantity of food with a limited extent of agricultural land. Therefore, efforts should be made to improve the average productivity levels under organic agricultural systems while the soil nutrition levels are maintained adequately for the given crop. Also, pests and diseases should be properly managed to minimize post-harvest losses. Developing locally applicable agronomic solutions to production constraints, such as weeds and soil fertility depletion, is essential. In this background, Meemken and Qain (2018) concluded that organic farming is not the paradigm for

sustainable agriculture and food security, but smart combinations of organic and conventional methods could contribute towards sustainable productivity increases in global agriculture.

### *Impact of Organic Fertilizers on Crop Yields in Sri Lanka*

A study on the long-term application of organic manure and chemical fertilizers on rice productivity and fertility of soils in the Kurunegala district by Sirisena, *et al.* (2016) revealed that combined application of organic manure and chemical fertilizer produces the highest yield. Organic manure was applied after the first ploughing and application rates were 5 t/ha straw, 1 t/ha green manure and 4 t/ha cattle manure. The average yield from the organic manure-only plots was reported to be 4.04 t/ha in the *Yala* season and 3.5 t/ha in the *Maha* season. The average yields of chemical fertilizer and organic manure-treated plots are 5.54 t/ha in *Yala* and 5.46 t/ha in *Maha* seasons. The increase in average yield due to organic manure over the control was 30 per cent, while it was above 70 percent and 92 percent for chemical fertilizer and chemical fertilizer + organic manure treatments in two seasons, respectively. The above results reveal the importance of the combined application of organic manure and chemical fertilizer not only to obtain higher grain yield in the long run but also to maintain soil fertility levels.

### *Inadequate Input Supply for Organic Framing to Meet the National Demand*

Sri Lanka has a long history of undertaking crop cultivation with organic fertilizers before introducing inorganic fertilizers in the latter part of the 20th century. After adopting the high-input conventional agricultural practices, composting in Sri Lanka first started as a method to replace synthetic fertilizers with organic fertilizers in small-scale farms or at the household level. Composting provided an opportunity to recycle crop residues and farm waste, enabling farmers to recycle nutrients at the farm scale. Generally, the input materials of compost are decomposed crop residues, cattle manure, wood ash, grass clippings, some soil or compost, and rice straw-like crop residues. Despite the intensive campaigns made by the Department of Agriculture to popularize compost production, it remains less popular among farmers. Seasonality and spatial heterogeneity in the distribution of materials required for composting and labour requirements have been among the reasons for the weak adoption of composting technologies in Sri Lanka.

With the increased availability of compost produced by different entities at different scales in the market, the need for controlling quality has become a matter of concern. Standards for compost produced from municipal solid waste (MSW) and agricultural waste were introduced in 2003 (SLSI 1246: 2003) by the Sri Lanka Standards Institution (Bandara, 2010). The guidelines for packaging and marking standards have also been established. However, there is a great need for revisiting these to ensure the

quality and safety of products because the nature of materials used for composting and the scale of operations have greatly increased since its introduction. Especially composting unsorted MSW, which consists of a wide variety of materials, raises several concerns regarding the quality and safety of the compost produced (Hettiarachchi *et al.,* 2020).

An enormous quantity of organic fertilizers and bio-fertilizers needed to be produced within the country to supply the crop nutrient demand. Currently, about 3500 tons of municipal organic waste are generated daily and about 2-3 million tons of compost could be produced annually, provided strict sorting procedures are in place to ensure that non-organic elements are filtered out. However, for organic paddy cultivation alone, nearly four million tons of compost is required at a nominal rate of five tons per hectare. For tea plantations, this figure could be well over another 3 million tons. However, the country is currently producing only 0.22 million tons of compost through Department of Agriculture registered producers and local government bodies (Dharmakeerthi, 2021). Therefore, present local compost production cannot meet the high demand. As such, the country needs to expand commercial-scale organic fertilizer production urgently. Increasing organic fertilizer production to meet the requirements of all crop varieties may not be possible immediately (Dandeniya, 2021).

Weerarathne (2021) stated that two tons of compost would be required to supply the same amount of nitrogen provided by 100kg of urea. Furthermore, compost is a slow-release fertilizer and is low in phosphorus. Even the available phosphorus in compost is not released in a short time to meet the requirement for short-term crops, such as rice, other field crops (OFCs) and vegetables. Compost contains about 1-2% nitrogen, depending on the raw materials used to make it, and out of this only about 3% is immediately available for absorption by plants, and the rest of the nitrogen is released only for 3-5 years. Similarly, the phosphorus content of compost is around 1% which is also a slow-release fertilizer and not favourable for short-term crops.

According to Wickramathunga (2021), one kg of urea contains 460g of nitrogen or 46 percent whereas one kg of compost contains 30g of nitrogen unless the manufacturer "adds" urea solution during manufacturing. The farmer has to add 15 times more manure to obtain the same quantity of nitrogen that is given by urea. Moreover, only 3 percent of the nitrogen applied through compost is readily available to the plant. The balance of 97 percent will have to be broken down by soil microorganisms, which could take 12-18 months. The same scenario prevails with the other major nutrients, phosphorous and potassium. The best compost manure can have an NPK ratio of 3:2.5:1.5 unless inorganic fertilizers are added.

Studies show that organic systems are limited in nitrogen and phosphorus (Berry *et al.*, 2002, Oehl *et al.*, 2002; cited in Meemken and Qain, 2018). The release of plant-available nitrogen from organic sources is slow and often cannot keep up with the

nitrogen demand during peak crop growth periods (Seufert *et al,* 2012; cited in Meemken and Qain, 2018). The amount of phosphorus provided in organic systems is sometimes insufficient to replenish the quantities lost due to harvest (Oehl *et al.*, 2002; cited in Meemken and Qain, 2018). In general, providing the right mixture of nutrients to support plant growth optimally is more complicated in organic systems because the nutrient ratio of organic inputs can only be influenced to a minimal degree (Seufert and Ramankutty 2017; cited in Meemken and Qain, 2018).

Since different soils have different nutrient retention and supply abilities, the proportion of N, P and K in any given organic fertilizer does not always match the proportions a crop needs. Indeed, it is very rare to be able to supply all plant nutrient needs from only one organic material. Consequently, most organic fertilizers have to be used in combinations. It must be noted that Sri Lanka has fourteen major soil types scattered around the country (Mapa, 2020).

Calculating the organic fertilizer requirement for a particular crop is complicated because a combination of organic fertilizers such as compost and animal manure is usually needed to fulfil the plant nutrient requirement. Therefore, all fertilizer recommendations should consider soil pH, residual nutrients, and inherent soil fertility as well as the needs of the crop to be grown. Fertilizer recommendations based on soil analyses are best in determining the right amount of fertilizer without over- or under-fertilizing (Hettiarachchi, *et al.,* 2020).

Despite the government's efforts to promote hazard-free, environmental-friendly farming methods, including organic farming by way of substituting chemical fertilizers and pesticides, the current status of biofertilizer and biopesticide use in the country and limitations of adapting and expanding biopesticides and biofertilizers have not been taken into consideration (TAMAP, 2020). Small and medium-scale producers are major contributors to the commercial organic fertilizer market in the country and only a limited number of large-scale producers are engaged in this sector (Dandeniya and Caucci, 2020). To meet the country's compost requirement, larger-scale compost production facilities are needed. Sri Lanka Standards Institute has introduced a set of quality standards for compost. Based on the standards, the Centre of Excellence for Organic Agriculture -Regional Agriculture Research and Development Center in Makandura issues an annual quality certification for compost producers. However, as this quality certification process is not compulsory for compost production and marketing in Sri Lanka, a large number of producers operate without such certification.

Application of compost and other forms of organic fertilizers to the soil over a long period creates long-lasting positive and/or negative impressions on soil characteristics. Therefore, the safety concerns related to organic fertilizers should be viewed holistically, particularly from the handling of raw materials to the production

of compost to the consequences of end applications of the product (Dandeniya and Caucci, 2020). Further, the quality of the raw materials used in organic fertilizer production is crucial to producing an environmentally safe organic fertilizer (Dharmakeerthi, 2021).

Trials in compost production from organic community waste have shown poor results in Sri Lanka. The C/N ratio is usually a problem and composts are contaminated with heavy metals due to the poor quality of the original material. Proper selection of waste (separation of organic material from all other materials) is a major problem. Compost production needs to be done by competent, experienced entities and subject to strict supervision as well (TAMAP, 2020).

Recent research findings indicate that compost can be a carrier of potentially toxic trace elements, organic pollutants, and determinants of antimicrobial resistance to the environment and along the food chain (Dandeniya and Caucci, 2020). The progressive accumulation of toxic trace elements such as Pb and Cd in soils has been reported in several studies where long-term application of compost produced from MSW was applied (Garcia-Gil, *et al.*, 2000; Smith, 2009; cited in Dandeniya and Caucci, 2020). The contamination of food items with potentially toxic trace elements and human pathogens due to the application of compost to crops has been reported in the literature (Deportes, *et al.*, 1995; Johannessen, *et al.*, 2004; Smith 2009; Maffei, *et al.*, 2013; cited in Dandeniya and Caucci, 2020).

Poultry litter is one of the most commonly available organic fertilizer sources, next to compost. They contain chicken manure rich in nitrogen and waste feed with high phosphorus. However, recent scientific evidence confirms that antibiotic traces are present in poultry manure and antibiotic resistance is being developed in soils amended with them. Therefore, caution needs to be exercised to ensure that what's used is safe farm animal manure sans threats to human health (Hettiarachchi, *et al.*, 2020).

Furthermore, there are short and long-term environmental impacts regarding the land application of farmyard manure. As poultry manure contains uric acid, it is acidic. Therefore, the direct application of poultry manure could harm the plants. Furthermore, phosphorus runoff and its potential role in accelerating eutrophication and leaching of nitrogen to groundwater are major environmental issues associated with the direct landfilling of farmyard manure (Marambe and Nissanka, 2019).

## Strategies to Overcome Challenges

Though many define organic agriculture as farming without synthetic pesticides and chemical fertilizers, it must include supportive exercises such as improvement of soil and water health, an increase of green cover, an increase in the crop mix, changes in crop types, improvement of water management and significant changes in value-chain management. Switching to organics requires a holistic approach to improving base material health (soil and water), making multi-crop farming profitable, changing crop mixes towards crops that respond well to organic inputs, increasing green cover and improving ecosystem services.

An island-wide mechanism should be developed to produce sufficient organic fertilizer to meet the local demand. Consequently, organic fertilizer production should be promoted at the village level and provide awareness and technology to farmer organizations. Further, it directs entrepreneurs to the compost production industry by providing credit facilities through financial institutions and arranging insurance schemes and other facilities.

Attempts should be made to avoid problems with compost produced from urban solid waste, which may result in a significant amount of compost—combining the organic fertilizer industry with the renewable energy industry to provide biomass. Plants such as *Gliricidia sepium* can be grown to make compost. Its stalks could be used to produce renewable energy (dendro power). For this purpose, an economic model to collect leaves and stems should be introduced. Identifying organic farming methods that are most appropriate for each agro-climatic zone should be experimented with through scientific analysis and studies. The introduction of suitable recommended organic farming packages for each area and each crop variety is necessary. Integrated farm models should be introduced with crop diversification and animal husbandry required for efficient nutrient recycling. Soil tests should be done before applying any fertilizer. However, it is essential to develop quality standards to maintain the uniformity of organic fertilizers and constantly monitor the quality of organic fertilizers to minimize degradation monitor the quality of organic fertilizers to minimize degradation.

Using the existing extension structure is advisable to create awareness among farmer organizations about the benefits of organic farming. The technical know-how of preparing good quality compost and other forms of organic fertilizers to provide sufficient nutrients to crops can also be disseminated to the farmers through the field-level extension officers. A handbook/training module containing all the information should be developed by experts in relevant agricultural institutions to use in training and awareness programs. Though the module would be designed for field extension officers, the same could be produced in very simple language for farming

communities. As the first step, trainers (TOT) training for extension officers and field Officers should be conducted.

A Model farm should be established in each Agrarian Services Centre area, through which practical training and awareness for farming communities can effectively be conducted. This intervention should be made with the participation of different state agencies, the Agrarian Services Centre (Department of Agrarian Services), the Provincial Department of Agriculture, and the extension arm of the Provincial Department of Agriculture, Mahaweli Authority of Sri Lanka. This model farm can be converted into a facilitation centre that provides other organic and non-chemical inputs to the farming communities at concessionary rates.

## Conclusions

It is widely accepted that a circular economy, organic agriculture, renewable energy, sustainable production and consumption will significantly move the world forward in preparing for and mitigating food, energy, finance, health, and climate disasters. Given the serious economic downturn Sri Lanka is experiencing due to the pandemic, a rapid shift to organic farming in agriculture would require a careful, thoughtful and incremental introduction of such a system. The government needs to implement a plan by analyzing different aspects of yield reduction, farmers' income, food security, food production, imports, availability of land and labour in the country. Its implications for consumers, livelihoods of farmers, and other stakeholders including those who have invested in agriculture and related sectors are vast.

Hence, adopting organic farming as a gradual process by establishing proper strategies to ensure an adequate supply of organic fertilizer through increased production and availability by a well-developed distribution mechanism in the country is needed. Importing compost will affect the biodiversity of the country and there is a need to ensure the production of eco-friendly pesticides (bio-pesticides) available in the country to control pests, diseases and weeds that are prominent in crop fields at present. All these should be supported by a robust research and development network that finely integrates with Sri Lankan farming conditions to make the country self-sufficient in food production. As a prior approach, before adopting a blanket ban, it is important to identify the special zones/regions in the country as organic zones to convert organic farming by providing subsidies for those farmers ensuring premium prices are suggested. This document addresses some concerns and a set of suggestions with short-term and long-term strategies that can be implemented with minimal risk to farmers, consumers and other interest groups.

Reorienting and redesigning agriculture in a more sustainable and organic direction requires different functions, actions and strategies that complement and reinforce each other. It especially demands the involvement of the private sector. Policy design and

implementation should be done in a public-private partnership with a multi-stakeholder approach. Extensive cooperation and dialogue among the stakeholders in the whole food sector, from consumers to decision-makers, from farmers to scientists, is essential. Their participation in strategic decisions is fundamental for success. Government support will have more leverage and effectiveness in the implementation if it relies on the existing structures and expertise of the private and public sectors. Hence, a holistic strategy that encompasses all of the considerations should be set up and executed with a strong communication strategy that takes in both the supply and demand side. Implementation of a five-year roadmap for the development of organic farming is essential with an annual review.

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