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## Current status, challenges and technological breakthrough of organic agriculture with a focus on Pakistan

Qaisar Abbas\*

Entomological Research Sub-Station, Multan, Punjab, Pakistan

\*Corresponding author's email: [abbas603@gmail.com](mailto:abbas603@gmail.com)

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### Abstract

The world's population growth and environmental deterioration pose a threat to food production, and it is urgent to find suitable solutions. Organic farming is an environmentally beneficial method of agricultural production that guarantees food safety, minimizes health issues, encourages environmental preservation, and creates job possibilities for nearby people. Biopesticides are biological pest control agents that manipulate living things. Microbial pesticides, biochemical pesticides, and plant-incorporated protectants are all types of biopesticides (PIPs). Microbial biopesticides are substances made from microorganisms that can be used to treat plant diseases and insect pests that harm agricultural crops year after year. In the global economy that is reliant on agriculture, they can be crucial for crop security. It is essential right now to

encourage farmers all around the world to employ these microbial biopesticides. In Pakistan's national economy, organic agriculture is extremely important. The year-round cultivation of valuable crops, fruits, and vegetables is made possible by the geographic and biological diversity of the region. To make organic farming practical, it is vital to pay attention to the farmers' objectives for alternative approaches. In Pakistan, the adoption of organic farming could have a beneficial and notable impact on farmers' livelihood in terms of profitability, compatibility, productivity, and sustainability. Organic certification is absolutely necessary to raise the market value on both a national and worldwide scale. © 2022 The Author(s)

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### Introduction

Because of limited access to modern technologies, low productivity, and frequent natural disasters, poverty had spread to many parts of the world by the end of World War II (Yoshino, 2010). The emergence of "modern" technology led to a decrease in the need for physical labour as traditional cultures turned away from agriculture-based activities and toward industry and services. As a result, labor-intensive, inefficient organic farming became demonized as being outmoded (Yoshino, 2010). Certain health issues, environmental deterioration, contamination of surface and groundwater, and increasing production costs are all partly attributable to the overuse of agrochemicals in recent years (Badgley et al., 2007; Timprasert et al., 2014; Ferdous et al., 2018). As a result, there is an increase in the demand for food produced without the use of synthetic chemicals among consumers globally, and organic farming is becoming more popular (Abouzienna et al., 2009). Attractive premium pricing for organic produce also contribute to this increase (Ramesh et al., 2010; Panneerselvam et al., 2012).

Organic farming has a stronger potential for niche and export markets than conventional farming because of the price premiums, notwithstanding the early 1960s-era penetration of agricultural modernization. Due to its potential to address several significant challenges, including as environmental degradation and the loss of biodiversity, it is grown in some regions of the world (Yoshino, 2010). 71.5 million hectares (m ha) of certified agricultural land was used for organic farming in 2018, accounting for 1.4% of all agricultural land on earth. Oceania (35.9 mha), Europe (14.6 mha), Latin America (8 mha), and Asia (6.1 mha) have the most land area that is used for organic farming (Willer & Lernoud, 2019). Organic farming's potential to feed the globe is still up for debate. According to Badgley et al. (2007), yields from organic farming are 92.2% of those from conventional farming, compared to 180.2% for poor nations. This suggests that organic farming might be able to supply enough food for everyone. However, other scientists disagree with these results (Connor, 2008; de Ponti et al., 2012). The obligatory transition period needs special consideration with the move to organic farming. The minimum transition period is typically three years, and productivity may be impacted until the switch from conventional to organic farming is complete (Chase et al., 2009).

Certain regional nations, like Bangladesh, Bhutan, Sri Lanka, the Maldives, and even some African governments, including Kenya, Tanzania, Uganda, and Rwanda, have more recently enacted organic rules with appropriate certification and labelling processes (Willer, 2018). Organic farming has both private and public benefits, which indicate that it should be encouraged to support sustainable farming methods (Husnain et al., 2017). The organic agricultural and food production system is becoming increasingly important to both national and global economies in the modern market economy. Only a small portion of all studies on organic farming has been published in the scientific literature, especially in less developed nations (Röös et al., 2018). Government organizations can play a crucial role in building a reliable supply chain in the context of developing countries (Ngwa, 2022). In developing nations like India, Hungary, and Brazil as well as in Brazil specifically, where the government promotes the procurement of organic goods for public sector organizations and nutrition programs through policy frameworks, government support is also notable in the development of organic farming and marketing (Edwardson & Santacoloma, 2013).

In addition, Hsu et al. (2016); Mughal and Faisal (2020) draw the conclusion that the development and expansion of the organic food business depend on cooperation between the government, producers, and other chain participants. They also include a number of measures, including (a) training and promotion to ensure its accessibility and address food safety concerns in a safe setting. (b) Reducing certification fees to encourage farmers to expand their farmed land. (c) To create an organic farm for tourists in order to increase customer confidence in production practices and traceability and so shape their attitudes and purchase intentions. Such methods can raise farmers' incomes, which might draw in more young farmers and possibly aid in rural development. Röös et al. (2016) also found that traditional attitude by many people and organizations create significant cultural prejudices against the meanings of organic agriculture, which restricts the adoption of its techniques. Röös et al. (2016) added that farmers should be included in policy tools to support organic farming.

### **Significance of organic farming**

The majority of large farms in Pakistan are managed by absentee landowners; in such cases, the land is cared for by the workers, who lack any sense of ownership over the level of production or profit margin. On the other hand, small landowners who work on farms are constrained from investing in a large number of risky inputs and must diversify their investments. They typically cut back on agricultural inputs to mitigate risk, but they are unable to cut back on environmental deterioration, such as soil erosion, pollution, excessive water use, water logging,

perennial weed control, etc. A farmer who practices organic farming not only controls his farm's environmental costs but also pays his workers more. Inorganic fertilizers, pesticides, and herbicides are eliminated, and soil erosion is decreased in order to save production expenses. Conventional food may contain carcinogens, which are compounds that can lead to a variety of illnesses, including cancer. Additive processing could further activate carcinogens. Nitrates, other preservatives, or the highly carcinogenic nitrosamine may be present in this product. Traditional farmers spend more money on fertilizer and pesticide input, and these wastes end up in the environment, particularly the ground water. The industrial production, processing, and distribution system that this kind of farming is a part of adds additional chemicals along the entire chain. The costs of this industrial approach to agriculture are astounding and far-reaching, yet they go unnoticed since industrial farming, which uses more chemicals and machinery, results in food that is cheaper, more aesthetically pleasing, more chemically poisonous. Local high-value, unconventional, indigenous, and local agricultural items like medicinal herbs, traditional agriculture, and non-timber tree products have the potential to find niche markets thanks to organic farming. The size of conversion funds is significantly connected with farmer trends toward switching to organic farming. The current subsidies for conventionally produced food only allow organic agriculture to expand to the extent of the market that is prepared to accept a higher price from the customer. Despite the restricted availability of organic products and their market outlets, premium prices could expand the market.

### **Organic agriculture global statistics and trends**

The agri-food system's market for organic farming has grown significantly (Crandall et al., 2010). The organic market is worth more than €80 billion globally (Willer, 2018). Germany, France, China, Canada, and the UK are in second place, behind the US. Around 13 percent of food sales are made in Denmark, which has the largest market share for organic food products. The exponential rise of the market is so undeniably demonstrated. Organic food has a huge potential market in Asia, as evidenced by the expanding demand for it in the EU and US, as well as the growing consumer awareness and per capita income of Asian nations (Willer et al., 2014). Additionally, the promotion of organic food systems is particularly important for Asian nations because it helps with issues like food security, safe food supply, health concerns, sustainable rural and agricultural growth, and environmental protection (Partap, 2010). In order to strengthen the role of farm governance as an alternative form of production, the sustainability of organic agriculture systems may be appropriate.

### **Ecologically-based organic model in Brazil**

Elite rural farmers and other people with a background in agriculture are responsible for Brazil's advancement in

environmentally friendly agriculture (Brandenburg, 2002). Strong political systems involved in the advancement of a new social model, one that is linked to equity and justice, have pushed for the adoption of farming practices that are ecologically focused. The middle class makes up more than 55% of the Brazilian population. It has been noted that small farmers in Brazil produce 70% of the food that is consumed. Brazil has achieved great success in increasing food production while minimizing environmental damage and land use expansion. This can be used as a weapon to combat ecological imbalance and climate change. Elimination of subsidies, enough financing and resources provided for R&D, and agro-based industries in rural areas are Brazil's key tools for agricultural productivity (Madre & Devuyst, 2016). Additionally, the development of local markets, cooperatives, family business promotion, and contact farming are all crucial. In the areas of market security and direct selling systems, small holding farmers were encouraged. With a campaign against monoculture, the loss of genetic diversity, particularly agro-biodiversity, coupled with soil erosion, water contamination, and capital loss in the rural sector, Brazil's modernization of agriculture began in the southern states throughout the 1970s (Pereira, 2012).

### **Organic agriculture in Pakistan**

An important part of Pakistan's national economy is agriculture. Its geographic and ecological diversification gives it a competitive edge for the year-round growth of valuable crops, fruits, and vegetables, especially those that are natively or by default organic across the many regions (Musa et al., 2015; Anjum et al., 2016). In Pakistan, there are approximately 1.51 million hectares of organic land, compared to 22.6 million hectares of inorganic land (Musa et al., 2015). However, Pakistan has only 45,299 ha of globally certified organic agriculture land, which is significantly less than other Asian nations and only 0.1 percent of the total land area, despite having vast naturally organic regions (Willer, 2018). While a significant amount of food that has been certified as organic is sold on international markets.

One of the main causes of Pakistan's unorganized organic food business is the lack of organic food rules, which are currently being developed (Lernoud & Willer, 2017) and were unable to be concluded for a number of unrecognized reasons. Therefore, Pakistan's organic food industry and legislation are challenging, much like in many other countries. Certain regional nations, like Bangladesh, Bhutan, Sri Lanka, the Maldives, and even some African governments, including Kenya, Tanzania, Uganda, and Rwanda, have more recently enacted organic rules with appropriate certification and labelling processes (Willer, 2018). The benefits of organic farming, both private and public, indicate that it should be promoted to support sustainable farming methods (Husnain et al., 2017). In the

modern market economy, organic agriculture and the food production system are becoming increasingly important to both national and global economies.

### **Role of marketing towards organic food policies and practices**

In Pakistan's economy, agriculture has played a crucial role in both corporate growth and export. Pakistan's rich agricultural geography and diversified climate provide it a competitive edge in the sustained cultivation of naturally organic crops. When public organizations must perform better for the benefit of the public, marketing can be helpful (Serrat, 2010). Several respondents stated that in contrast to other agricultural initiatives like drip irrigation, tunnel farming, solar system installation, etc., organic agriculture should also be promoted through private public partnerships. Wherein farmers and other participants in the supply chain might receive incentives and subsidies for technological advancement. As a result, we can argue that the marketization process, which converts public-sector efforts into commercial marketing in the private sector by exposing goods and services to market forces, can help the organic food business grow and prosper (Buurma, 2001). Additionally, for the past thirty years, the field of public management has been using the operating style of marketization to operate government like a business, particularly when it is intimately connected to consumer and entrepreneur markets (Molander et al., 2018). Due to the competitive forces of the commercial marketplace, marketization may allow the public sector to transfer organic farming activities to the private sector. As a result, marketing strategies may play a significant role in promoting organic farming among stakeholders (Buurma, 2001).

### **Organic food policies and practices in Pakistan**

Government institutions appear to have a problem with innovation, shifting demands, new technologies, and aggressive competition. While it is challenging to change existing policies once they are in place (Schuck, 2014), it is considerably more challenging to do so. Our findings also lend credence to the idea that, in the age of modern global competition and numerous environmental issues, policymakers must learn how to analyze economic, social, and cultural threats to the marketing environment, particularly when it comes to issues that directly affect consumers and market participants. Micro and macro divisions of the marketing environmental study for the organic food sector are also possible (Kotler & Armstrong, 2010). The ability of the microenvironment to serve the public is influenced by a number of elements, including businesses, growers and the providers of their inputs, market intermediaries, domestic and international marketplaces, and particularly international competitors in the organic food markets. At the macro level, however, policymakers must take into account the consequences of major societal forces when formulating their plans, including economic, political, technical, cultural, and

ecological causes, as well as national demographics and health statistics.

These results made it necessary to look more closely at the part that strategic marketing played in the creation of organic food policies and practices. The promotion of sustainable development depends heavily on public policy. It creates signals, institutional frameworks, and regulatory frameworks for reformatory, promotional, and participative roles that encourage all players' actions (Lobo et al., 2014).

### **Governance and management review**

In order to increase farmers' knowledge, skills, and ability, scientists must be involved in research and development (decision-making; effective extension and outreach infrastructure must be engaged). Similar to this, Tiraeyari et al. (2017) found that sustainable methods are required; as a result, it has been an important component of the Malaysian government's aim to encourage small-scale growers to invest in organic farming as a practical way to raise their farm income. Such methods ultimately aid in environmental protection and may assist the nation's exports. In order to develop, expand, and reform the organic food system in the long-term interests of all stakeholders, the government must play a positive role. As a result, this research investigates how Pakistani agricultural scientists, agricultural economists, and policy officials perceive organic agriculture.

### **Marketing communication in agri-organizations for executing organic agriculture**

Overwhelming data supported the idea that agriculture organizations' "marketing communication" was insufficient for connecting with interested parties, including farmers, businesses, NGOs, exporters, consumers, civil society, and other stakeholders. Additionally, there were insufficient promotional efforts, few PR initiatives, and programs to raise stakeholder awareness. As a result, farm departments were unable to work together effectively to elicit attitudes and behaviors from the market due to a lack of communication, collaboration, and coordination. Global demand for food and farmland is expanding quickly as a result of a number of causes, including a growing world population, rising meat consumption, urbanization, competing land uses for non-food crops, and changes in the appropriateness of land for crop growth brought on by climate change. While changing people's diets, enhancing infrastructure and transportation, reducing food waste, and growing aquaculture are all significant mitigating measures against rising demand. It has been stated that in order to provide the food needed for the predicted over nine billion people by 2050, agricultural productivity must rise internationally.

Logically, there are two ways to increase supply: either through intensification, which involves raising output over the same area, or through extensification, which involves

putting more land under agricultural production. It is undeniable that the loss of biodiversity, which is primarily being caused by land use change and agricultural intensification, has a significant impact on wildlife and the ecosystem. Currently, two opposing landscape-level scenarios are hotly debated with regard to maintaining food production and protecting biodiversity. In a situation where land is sparingly used, the available land in a landscape is divided into sections that are devoted mostly to maintaining biodiversity and ecosystem services and parts that are specialized for producing primarily agricultural products. In doing so, it is possible to manage the spare land expressly for other services while allowing the agricultural area to be farmed intensively for high yields.

### **Organic agriculture and economy**

In Pakistan's economy, agriculture has played a crucial role in both corporate growth and export. Pakistan's rich agricultural geography and diversified climate provide it a competitive edge in the sustained cultivation of naturally organic crops. When public organizations must perform better for the benefit of the public, marketing can be helpful (Serrat, 2010). According to a number of respondents, private public partnerships should also be used to promote organic agriculture, in contrast to other agricultural initiatives like drip irrigation, tunnel farming, and solar system installation. Wherein farmers and other participants in the supply chain might receive incentives and subsidies for technological advancement. As a result, we can argue that the marketization process, which converts public-sector efforts into commercial marketing in the private sector by exposing goods and services to market forces, can help the organic food business grow and prosper (Buurma, 2001). Additionally, for the past thirty years, the field of public management has been using the operating style of marketization to operate government like a business, particularly when it is intimately connected to consumer and entrepreneur markets (Molander et al., 2018). As a result, marketing strategies may play a significant role in encouraging organic farming among stakeholders. Through marketization, the public sector may transfer organic farming operations to the private sector to better withstand the competitive forces of the market. Food markets have seen a significant transition as a result of the rise in food consciousness from multiple perspectives, with the organic food market growing significantly both domestically and internationally. The organic agriculture system, its practices, market, and importance, however, continue to be highly contested among Pakistani agricultural economists.

### **Contribution of organic agriculture**

Low yields and a lack of organically appropriate fertilizers are the main arguments against the idea that organic agriculture can considerably increase the world's food supply. We assessed whether both statements were ubiquitous. For the first claim, we evaluated the average yield ratio of several food

categories using the developed and developing worlds based on yields of organic versus conventional or low-intensive food production for a global dataset of 293 samples. The average yield ratio for the majority of food categories was slightly below 1.0 for trials conducted in wealthy nations and above 1.0 for those conducted in poor nations. The worldwide food supply that could be produced organically on the available agricultural land base was modelled using average yield ratios. The existing human population and maybe an even bigger population could be fed using organic farming techniques, according to model projections, without using up more agricultural land.

The quantity of nitrogen that could be fixed by leguminous cover crops used as fertilizer was assessed by Badgley et al. (2007). Leguminous cover crops may be able to fix enough nitrogen to replace the quantity of synthetic fertiliser now used, according to data from temperate and tropical agroecosystems. These findings suggest that organic farming has the potential to make a significant contribution to the world's food supply while minimising the negative environmental effects of conventional farming. The evaluation and review of this research have brought up significant concerns regarding crop rotations in organic versus conventional agriculture. The forum editorial for this issue has a discussion on these topics that is still going on. The world's population growth and environmental deterioration pose a threat to crop productivity, and it is urgent to identify remedies for abiotic stress, pests, and pathogens. Biopesticides are an eco-friendly management strategy that can replace synthetic chemicals. Biopesticides are biological pest control agents that manipulate and entangle living organisms. Microbial pesticides, biochemical pesticides, and plant-incorporated protectants are all types of biopesticides (PIPs). The chemicals made from microorganisms known as microbial biopesticides are useful and can be used to treat plant diseases and insect pests that harm agricultural crops year after year. In the world's agricultural sector, microbial pesticides can be crucial for crop protection. It is urgent to encourage farmers everywhere to utilize these microbial biopesticides (Thakur et al., 2020).

The sustainability of food production as well as the maintenance of terrestrial and aquatic ecosystems and the benefits they bring to society face enormous challenges as a result of the projected doubling of global food demand over the next 50 years. Farmers are the primary administrators of the world's arable lands and will likely permanently alter the Earth's surface during the next few decades. If we are to satisfy the demands of increasing yields without compromising environmental integrity or public health, new incentives and policies for guaranteeing the sustainability of agricultural and ecosystem services will be essential (Tilman et al., 2002). Agriculture production takes up a substantial amount of the earth's land area. Aside from acting as a habitat for creatures and

supporting the services they offer, agricultural land meets a variety of societal needs such as supplying food, fuel, and fibre. Food production and biodiversity conservation must coexist in harmony; production must be sustainable, while conservation cannot entirely come at the expense of crop productivity. We looked at the correlation between crop output and species density and abundance of significant taxa in winter cereal fields on conventional and organic farms in lowland England in order to determine the advantages and disadvantages of agricultural management. Five of the eight investigated species groups had a negative correlation with agricultural yield, albeit the nature of this correlation differed among taxa.

### **Organic farming and climate change mitigation**

Organic farming techniques that improve soil fertility and encourage the use of natural substrates have the potential to reduce greenhouse gas emissions. The methods used in organic farming include the use of soil cover techniques, mixed and integrated agricultural systems, and sustainable agronomic practices as appropriate strategies for adaptation and mitigation (Food and Agriculture Organization [FAO], 2011). Pakistan was one of the three countries most afflicted by severe climate dangers in 2012, according to a report by the environmental think group German Watch (Naeem, 2013).

### **Conclusion**

Health concerns are rising sharply as a result of the contamination of food products caused by chemical pesticides and fertilizers. Additionally, these compounds are harmful to animals and other beneficial species like earth worms, which enhance the health of the soil. Composting and organic fertilizer are the best ways to repair the soil that has been saline due to local natural organic matter being used as a ground cover. Livestock is the main source of the organic fertilizer and compost production that is important to Pakistan's economy. It is essential for supporting family income and employment opportunities for women, smallholders, and landless people in rural areas. Organic food provides the necessary vitamins, minerals, enzymes, and micronutrients for human nutrition. Pakistan must produce more food grains to satisfy the growing population's dietary needs. According to reports, hazardous pesticides sprayed on crops by farmers contaminated between 10 and 15 percent of food during storage, leading to post-harvest losses.

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