JKAU: Met., Env. & Arid Land Agric. Sci., Vol. **32** No. 1, pp: 97 - 115 (1444 A.H./2023 A.D.)
DOI: 10.4197/Met. 32-1.6

Organic Agriculture and Foods for Sustainable Food Production and Safety, An updated Review

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Abstract. recently, a great deal of concern has been offered to develop safe and environmentally friendly alternatives to harmful agricultural chemicals. As a result, organic agriculture, or organic farming, has gained increasing popularity in recent years and is increasingly distinguished as an integral part of global food production. By definition, organic agriculture is natural agriculture without using chemicals, pesticides, fertilizers, or genetically modified seeds. Instead, the primary goals of organic farming are to maximize the efficient use of soil and its organic elements to improve its sustainability and properties naturally and reduce the demand for chemicals. Furthermore, several epidemiological studies have demonstrated the safety of organic products with a positive relationship between organic food consumption and health. However, before exploring the concept of organic farming in-depth, some questions need to be addressed: What is organic farming? How do conventional and organic farming systems differ? What are the types of organic products? And what is the impact of organic agriculture on food safety? What are the objectives and advantages of organic agriculture? What are organic agriculture's disadvantages and challenges, and what are the solutions? We address these questions and clarify crucial organic farming concepts in the current literature review.
Keywords: *organic farming, foods, feeds, food safety, food security, human nutrition*

1. INTRODUCTION:

The steady increase in the global population necessitated the search for practical solutions to provide adequate food. This dictated finding solutions to increase crop productivity, the most important of which is the use of pesticides to control pests and diseases. Modern farming has become increasingly dependent on agricultural practices, including pesticides, to increase crop yields eight times better than in 1940. Failure to use pesticides can result in losses of up to 78, 54, and 32% of fruits, vegetables, and cereals, respectively (Ali et al. 2021, Cai 2008). In the agricultural sector, synthetic chemicals destroy soil, groundwater, air, wildlife, and non-pest organisms. Pesticides are connected with a high risk of non-native organisms being exposed to pesticides through the air and water. Pesticide resistance

also complicates the problem, further disturbing the ecological balance and requiring more pesticide use.

Furthermore, chemical residues compromise food safety as well. It is common for food to contain harmful chemical residues that can lead to poisoning, congenital disabilities, nerve damage, and even death. The body also accumulates many synthetic pesticides when it is unable to break them down. Upon entering an organism's body, they are permanently stored; for example, at every level of the food chain, pesticides like DDT exhibit a phenomenon known as biomagnification. It was found that only 2% of food commodities worldwide exceeded the maximum limit recommended in the AICRPPR Pesticide Safety report 1999 (Gupta 2017).

Several decades ago, organic food was seen as a "fashion" or trend for people obsessed with staying healthy. However, this type of food is considered elitist and affluent due to its high price and limited availability. It is only sold in a limited and selected group of food stores that are often only bought by the wealthy classes. Today, the scene is different, albeit relatively, as organic food is a daily and common choice for millions worldwide. Of course, we cannot claim that it is accessible to all classes and social groups. Still, it has largely abandoned its elitist character, with several surveys revealing that 82 percent of Americans buy some organic food. Undoubtedly, the availability of this type of food in many food shops, especially for the middle class, has effectively contributed to expanding their consumption. Furthermore, the growth of the list of organic foods to cover a wide range of foods consumed routinely after a limited number of agricultural products was restricted. The relative decline in their prices - which are still relatively high compared to conventional and organic foods - was also a critical factor in the development of the organic food sector. Despite this, organic foods do not cover all daily requirements, even for those who accept them. According to some estimates, organic foods cost 20 percent more than conventional foods, making organic shoppers, especially middle-class people, reluctant to consume them often (Singh 2021).

The primary goals of organic farming are maximizing the use efficiency of soil and its organic elements, naturally improving its properties and sustainability, and avoiding the need and demand for chemicals. First, however, some questions are addressed in an attempt to understand the concept of organic

farming fully: What are the advantages and challenges of organic agriculture? What are the differences between conventional and organic agriculture systems? Answers to these questions and more are provided in the current literature review, as well as clarification of key concepts related to organic farming.

Collection of literature and sources of information

The literature search was done with the assistance of the research team utilizing the Web of Science platform, including the Web of Science Core Collection, plus Biological Abstracts, BIOSIS Citation Index, CABI, Current Contents Connect, Data Citation Index, Derwent Innovations Index, BIOSIS Previews, Korean Journal Database, Medline, Russian Citation Index, SciELO Citation Index, google scholar, and Zoological record. Several iterations of the search strategy were tested to maximize the sensitivity of the search. The sensitivity was examined against several investigations in narrative reviews on this topic.

Studies in peer-reviewed journals, government reports, and published abstracts published before December 2022 and accessible via open-access online sources, library resources, or interlibrary loans were selected for the review. Studies were uploaded into Endnote X9, reference management software (Clarivate Analytics).

Study selection and data extraction

Studies were selected based on the relative and exclusion criteria in two stages, title and abstract screening and then full-text screening. Data were extracted using forms developed and grouped by the focus of the study (organic agriculture, organic farming, food security, food safety) and sample type (human health, pesticides, herbicides, toxicity, antibiotics, genetically modified foods, threat, safety and/ or hazards).

Concept of Organic Agriculture

In recent years, organic agriculture, or organic farming, has grown in popularity and is now considered an essential component of global food production (Peng 2019). Organic agriculture is without chemicals, pesticides, fertilizers, or genetically modified seeds. As a result of the organic relationship between soil, water, plants, and soil organisms, it is possible to produce healthy and safe plant and animal products based on virgin or clean land that was used in conventional agriculture (Hou et al. 2022, Marasteanu and Jaenicke 2019). It also covers the relationship between animals and plants, the relationship between beneficiaries and agribusiness, and the control

of insects, weeds, and other pests. This maintains production by sustaining natural plants, manure, and wildlife. Plant leaves produce carbohydrates, which are later converted into sugar, starch, cellulose, lignin, etc. It is also possible to improve soil fertility by adding organic fertilizers, which are organic materials mixed with byproducts from nature that are rich in carbon, nitrogen, phosphorus, and potassium (Latruffe and Nauges 2014). As livestock produces nitrogen, there is no need to add chemical nitrogen fertilizer to the plant for growth (Willer et al. 2020).

Different types of organic products

According to the national organic program (NOP), a program of the United States Department of Agriculture (USDA), there are four categories of multi-ingredient packaged organic products, as illustrated in Fig. 1 and presented in the following (Conner and Christy 2004, Treadwell and Swisher 2008):

1. 100% organic: this type contains 100% certified organic components, excluding salt and water.

2. Organic: this type contains at least 95% certified organic components, excluding salt and water. In addition, not more than five percent of non-organic ingredients are included among those listed ingredients in the National List of Allowed Substances.

3. “Made with” organic ingredients: this type contains at least 70% organic components.

4. Specific Organic Ingredient: this type contains less than 70% organic components, so it is not classified as an organic product, and its contents must be declared.

Fig. 1. An infographic illustration for the categories of organic products. (Adapted from the USDA Agricultural Marketing Service, https://www.ams.usda.gov/publications/content/whats-behind-organic-seal-organic-labels-explained)

The advantages of organic agriculture

Numerous studies have cited many benefits of organic farming, including soil conservation, less water use, and less reliance on industrial chemicals. However, a question arises: Are these advantages sufficient to increase the area of land devoted to organic cultivation and thus increase the share of organic food in total world food production? In the latest survey of organic farming and its development globally, it was found that there

was an increase of 1.1 million hectares of land devoted to growing organic products. This enabled retail sales of organic foods to grow in 187 countries worldwide (Singh 2021).

Organic foods are generally considered safer than conventional foods because organic regulations and food safety assessments follow the precautionary principle. Among the reasons for ensuring high standards of product safety in organic foods are a) reducing nitrogen applications (which reduces nitrate concentrations), b) banning pesticides (resulting in almost no residues from pesticides), c) banning prophylactics and requirements that animal production systems have twice as many retention times (to reduce residue concentrations of medicines). As a result, human pathogens may not acquire resistance genes from animal production systems, which reduces the incidence of cancer and the transfer of genes associated with resistance. Furthermore, compared to conventional farming systems, organic food appears to have a higher agri-food system safety due to a) labeling of organic food, which provides more information, and b) less environmental impact (Spiertz 2009). In addition, several studies have shown that decomposition is slower in organic crops, which means they are better stored after the winter (Bulling 1987). A list of the advantages of organic agriculture are as follows:

1. Decreasing environmental pollution by reducing synthetic chemicals used in plant and animal production
2. Using less energy and reducing crop failure risks compared with conventional farming
3. Optimizing the use of natural resources for short-term benefit and helping preserve them for future generations.
4. Enhancing soil's chemical and physical properties, fertility, and organic matter.
5. High nutritional and health value compared to conventional agriculture and excellent value.
6. Maintaining a sustainable level of agricultural production.
7. Enhancing biodiversity

Objectives of Organic Farming

1. Enhancing the sustainability of the agricultural sector.
2. Improving genetic biodiversity.
3. Promoting the use of natural pesticides.
4. Ensuring proper soil cultivation at the appropriate period.
5. Maintaining and improving soil structure and fertility.

6. Maintaining pests, pathogens, and weeds under control.

How Can Organic Farming Be Successful?

Farmers who practice organic farming avoid using some of the more convenient chemical instruments available to other farmers. Special attention is given to crop rotation and tillage practices to reduce or mitigate crop problems. Because of their low pests pressures and nutritional requirements, growing organic cereal and forage crops is relatively easy. Corn is growing more frequently on organic farms, but weed control and fertility must be carefully managed. In addition, meeting nitrogen requirements is challenging. Organic livestock products are also available for sustainable animal production and health, reducing pollution, and improving product quality Animals must only be fed organic feed. Mammalian, avian, or fish byproducts are not permitted in feed, and neither are all genetically modified organisms and substances. In general, antibiotics, growth hormones, and insecticides are prohibited. In some emergency cases, antibiotics are used to save an ill animal's life, even though treated animals must be separated from the organic livestock herd and cannot be sold for organic meat products. Vaccinations are permitted when other disease control methods are ineffective (Attia et al. 2022, Attia and Serena 2022, Hashem et al. 2021, Rahman et al. 2022).

In general, the precautions recommended for organic agriculture success are listed below:

1. No chemical fertilizers

In nature, microorganisms use the organic residues of plants and animal waste as an energy source and produce natural organic nutrients that increase fertility and soil properties. Therefore, organic agriculture depends on plant residues, municipal compost, straw, and farm waste for fertilization without employing chemical fertilizers. It is well known that conventional agriculture causes negative impacts on humans, animals, plants, and soil remains for a prolonged period in mud and runs to groundwater, causing environmental challenges.

2. No herbicides

Weeds are considered one of the challenges of organic farming due to the banning of chemical herbicides in organic agriculture. Still, it can be replaced by natural means such as straw mulching and dumping, which controls weed growth in the fields.

3. No pesticides

Pesticides are used in agriculture to control diseases and reduce the risk of infection,

which reduces agricultural losses. However, the organic farming approach prevents synthetic pesticides and allows organic pesticides and biological controls to produce safe and healthy food for humans and animals.

4. Maintain health and production

Maintaining soil health is essential for achieving agricultural and environmental sustainability through animal production, vegetable cultivation, using green manure, green leaf residues, and crop rotation (agricultural rotation). And, also compost (the product of the decomposition and fermentation of organic matter) and loading or inter-cropping with more than one crop.

Organic Agriculture Requirements

For an organic agriculture project to be successful and profitable, several prerequisites must be met (Fig. 2), including the following:

1. Virgin land

Organic farming is good in virgin lands or those not grown with traditional crops or used pesticides and chemicals for five years before planting; eliminating the harmful effects of conventional agriculture takes a long time.

2. Organic fertilizer

Compost provides essential nutrients to plants and soil microorganisms over time. Organic fertilizers include farm waste, vegetable oil residue after extraction, insect frass, biological waste, animal waste, and bones.

3. Biological pest control

Maintaining natural pests is essential to reduce harmful pesticides. However, organic pesticides, such as neem, tobacco, and other therapeutic plants, may be used when necessary. In addition, some microbes, such as *Bacillus Thuringiensis*, may also be used as pesticides because they contain toxic substances for insects, not animals or humans. Therefore, it is essential as integrated biological control of pests to improve soil quality.

4. No-chemical weed control

Usually, the mechanical strategy (hoeing-plowing-turning) and manual purification are used to control weeds to reduce their numbers due to the need for organic weed control, a mechanical reinforcement.

5. Application of good agricultural practices

Increasing crop productivity required several practices, including pruning and applying green manure to improve the soil’s physical and structural properties. Additionally, using legumes to improve the crop composition and benefit from the nitrogen-fixing streptococcus bacteria in the soil.

6. Alley Crop

This term refers to combining windbreak and intercropping in sustainable farming practices. In this procedure, different crops are cultivated in distinct rows, surrounded by several trees. The agricultural production is also grown along with the harvest of long-term trees to contribute an additional source of income to the farmers. As in the US when planting corn between rows of walnut trees.

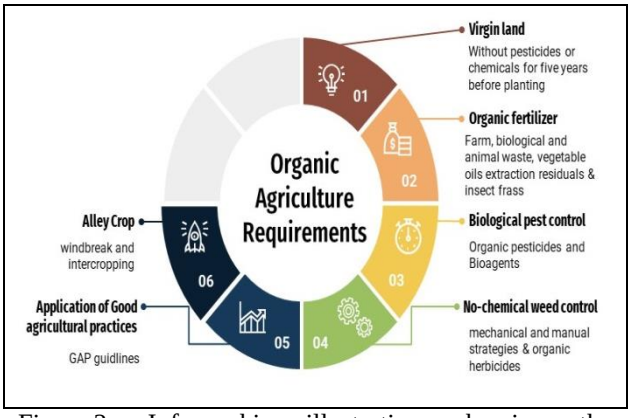

Fig. 2. Infographic illustration showing the requirements of organic agriculture

Techniques involved in Organic Farming

1. Crop rotation

This means growing varieties of crops in the same area progressively according to the seasons.

2. Green fertilizer

It refers to dead plants that are uprooted and turned into the soil to work as a nutrient and improve the soil's condition.

3. Biological Pest Management

This method uses living creatures to control pests with or without pesticides.

4. Compost

It is a recycled organic matter used as a crop fertilizer and is high in nutrients.

5. Soil Conservation

Organic farming is all about soil management. It is common knowledge that the farm's soil loses most nutrients and fertility after a single harvest. Soil management is replenishing the soil with all of the nutrients it requires. Natural methods of increasing soil fertility are used in organic farming to recharge nutrients in the soil. Animal wastes are increasingly being used to replenish the soil with the nutrients it requires, where the microorganisms found in animal excrement help re-fertilize the soil.

Economics of Organic Agriculture

The economics of organic agriculture are favorable if organic yields, production costs, and price premiums are favorable to small farmers. However, depending on the system and year, all these factors can vary significantly. Furthermore, organic inputs are often cheaper, and overall production costs are lower, which results in higher prices for organic farmers. However, there are high entry costs associated with organic

production, including higher labor requirements that are often beyond the reach of household resources. There are many reasons for this, including increased knowledge and training requirements, substantial certification costs, and the need for expensive organic inputs. It is also apparent that the cost of organic farming is exaggerated during the transition to organic farming as prescribed by organic standards - during this period, sustainable practices are implemented, but organic products cannot yet be sold at a premium. Accordingly, the net effect of organic cultivation on production costs is determined by whether the typically reduced input costs outweigh the typically increased labor and certification costs. Compared with conventional farming, organic farming has lower total production costs, but the lower input costs do not always offset the higher labor costs. Therefore, the cost of conversion and certification is not always covered by high prices, even though they are sometimes required (Bolwig et al. 2009, Chongtham et al. 2010, Eyhorn et al. 2007, Marasteanu and Jaenicke 2019, Panneerselvam et al. 2010, Valkila 2009).

Despite organic products' higher prices, the rapid growth of organic and green markets has been driven by consumer concerns regarding health, the environment, and food safety (Pagiaslis and Krontalis 2014, Peng 2019). In general, organic food products cost between 10% and 40% more than comparable traditional foods (Winter and Davis 2006). It is also important to note that consumers' attitudes toward purchasing organic foods are also affected by negative factors such as high prices, a lack of confidence, and poor marketing (Atkinson and Rosenthal 2014). Even though global economic growth has slowed, sales of organic products are steadily rising. While organic farming is becoming more popular worldwide, North America and Europe remain the biggest markets for organic food. Around 96% of the global organic market is accounted for by these two continents (Cunha and Moura 2004). About 52% of all US organic consumers are now Millennials, according to the Organic Trade Association (OTA).

Additionally, these buyers encourage their family members to do the same. American parents between 18 to 34 are among the most prominent organic buyers. There is a high frequency of organic purchasing in US households, and the ratio varies from 69% to 92%. In developing countries, organic food cultivation and market development are still in their infancy, but they might have a bright

future if they continue to develop at the current pace. The list includes countries in Latin America, South Asia, and Africa, as well as Brazil, Chile, and Peru in Latin America (Hou et al. 2022, Peng 2019).

Impact of Organic Agriculture on Food Safety

It has been shown that consumers who buy organic food regularly are more physically active and less likely to smoke, even though few epidemiological studies adequately link organic food consumption to health (Eisinger-Watzl et al. 2015, Kesse-Guyot et al. 2013, Mie et al. 2017). Several studies have shown a lower allergy and/or atopic disease prevalence in children whose families consume organic foods (Fagerstedt et al. 2016, Stenius et al. 2011). According to a prospective study (Kesse-Guyot et al. 2017), high consumers of organic food had a lower risk of obesity than low consumers of organic food over time. In comparison with non-consumers, organic food consumers (occasional and regular) experienced a reduced incidence of hypertension, type 2 diabetes, hypercholesterolemia (in men and women), and cardiovascular disease (in men). In another study examining cancer risk overall, organic food consumption was not associated with it. Still, participants who usually/always consumed organic food significantly reduced non-Hodgkin lymphoma (Baudry et al. 2015, Mie et al. 2017).

According to the Organic Packaged Food Association of America, USD 30.2 billion was spent on organic packaged foods in 2018. In recent years, the global consumption of organic packaged foods has steadily increased, as illustrated in Fig. 3. Due to changing lifestyles, the demand for packaged food is expected to grow. Additionally, organic packaged food's growth is predicted to be aided by the growing awareness of health benefits among urban populations and by an increasing number of dieticians' recommendations globally (Singh 2021).

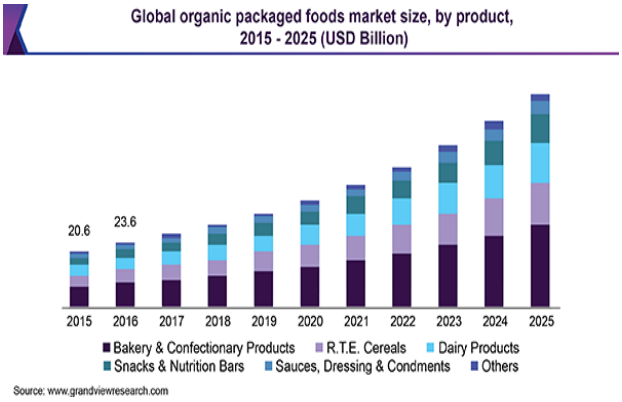

Fig. 3. The global organic packaged foods market size. (source: www.grandviewresearch.com)

In many investigations, it has been shown that organic vegetables and fruits taste and smell better. (Rembiałkowska 2007). A comparison

of organic milk and meat quality with conventionally produced ones, as examples of popular organic products, is presented in the following table.

1- Comparison of organically and conventionally produced milk (Lund and Algers 2003):

- More calcium, vitamin C, and dry matter
- A higher concentration of tocopherol and beta-carotene
- regularly higher levels of conjugated linoleic acid, omega-6 fatty acid
- Lower somatic cell count, indicating a lower possibility of cow udder inflammation
- The presence of more coliform bacteria during milking indicates a poor hygiene regime

2- Comparison of meat quality from organically and conventionally reared animals (Hansson et al. 2000, Olsson et al. 2003):

- More polyunsaturated fatty acids are found in organically raised beef compared to conventionally grown beef.
- Meat content was higher, and abdominal fat was lower in organic chickens (leaner meat).
- Organic chicken meat contains more polyunsaturated fatty acids of the n-3 series, which are derived from grass-based diets, which is a rich source of polyunsaturated fatty acids
- In organic chicken meat, cooking losses were higher, but breast muscles were more easily evaluated by sensory

Another critical issue that indirectly affects food safety is the health of animals from organic production. Chemical analysis also showed that animals prefer organic fodder more often when both conventional and organic fodder meet their physiological needs (Rembiałkowska 2007). Consequently, the organic feed may benefit animal health, especially regarding reproduction and pregnancy outcomes. In addition, several generations of organically fed animals have shown an increase in fertility and condition, which is crucial in civilized countries in view of the decline in human fertility (Williams 2002).

Based on several extensive studies that compared dairy cow health in organic and conventional systems (Hansson et al. 2000, Hardeng and Edge 2001, Karwowska 1999), conclusions can be drawn as follows:

- Organic herds produce significantly less milk
- There is a higher prevalence of parasitic afflictions in organic herds

- Organic herds have lower incidences of metabolic diseases: abscesses, arthritis, milk fever, ketosis, and liver disease.
- While the number of somatic cells in organic milk is not significantly different from conventional milk, heavy mastitis is substantially less common in organic herds.
- Organically raised cows have a better immune system, which makes them more efficient at fighting disease

The food safety issue in organic agriculture must consider the chemical composition of food products and potential microbiological hazards. Composted animal manure is the most common fertilizer in organic farming. It significantly reduces pathogen levels but does not eliminate all microbes. No guarantee composting will destroy fecal pathogens (especially *E. coli*), potentially threatening food-borne illnesses and spore-formers like *Clostridium* sp. It is also possible to transmit animal infections (zoonoses) to humans through food. Mycotoxins may be more prevalent in organic foods due to the lack of antifungal pesticides. In recent studies, however, no evidence has been found that organic foods are more likely to contain mycotoxin contamination. Since organic production systems rely on outdoor rearing and do not use prophylactic veterinary drugs, they are particularly vulnerable to parasites. As a result, parasites are a significant problem in organic livestock production (Kouba 2003).

Disadvantages of organic farming

It has been questioned whether organic farming is more productive than conventional farming. A limited number of reports have indicated the possibility of feeding the entire population with organic farming. However, several recent studies have shown that organic farming yields are far lower than conventional. In addition, according to USDA survey data from 2011, organic farming would require 14.5 million acres more to equal conventional farming's production of 14 staple crops. In the same context, an analysis of the average yield of organic crops as a percentage of traditional crops for five European countries is presented in Table 1 (Gupta 2017).

Table 1 Average yields of organic crops as % of conventional crops according to Gupta, 2017.

	Switzerland	Austria	Germany	Italy	France
Wheat	64-75	62-67	58-63	78-98	44-55
Barley	65-84	58-70	62-68	55-94	70-80
Oats	73-94	56-75	-	88	-
Grain Maize	85-88	-	70	55-93	66-80
Oil seeds	83	78-88	60-67	48-50	67-80
Potatoes	62-68	39-54	54-69	62-99	68-79
Pulses	88	83-85	49-73	73-100	83

Based on the above information on the impact of organic agriculture on food safety, there

are also examples of reduced product safety in organic products. For example, mycotoxins can accumulate in organic cereals when stored improperly, and *Salmonella* and *Campylobacter* infections are caused by prolonged exposure to outdoor conditions. Nevertheless, there are ways to reduce these risks. There are many regulatory requirements related to organic food processing, including a 5% limit on non-organic components and bans on irradiation, coloring agents, sweeteners, synthetic additives, flavoring, GMOs, and trans fatty acids (Rembiałkowska 2007).

Conventional food is cheaper than organic foods because it reflects the actual costs of growing the food: labor-intensive management rather than chemicals, whose health and environmental impacts are borne by society. On the other hand, organic foods are priced based on the costs involved in growing, harvesting, transporting, and storing them and processing and packaging expenses in processed foods. Among these costs are those associated with cleaning polluted water and removing pesticide contamination. All these steps are more stringently regulated for organic foods, which tend to be expensive compared to conventional farms (not always). However, as more evidence accumulates, organic foods would cost the same, or more likely, be cheaper than traditional foods when all costs associated with conventional food production are considered (Singh 2021). Other benefits of organic food are shown in the infographic illustration in Fig 4.

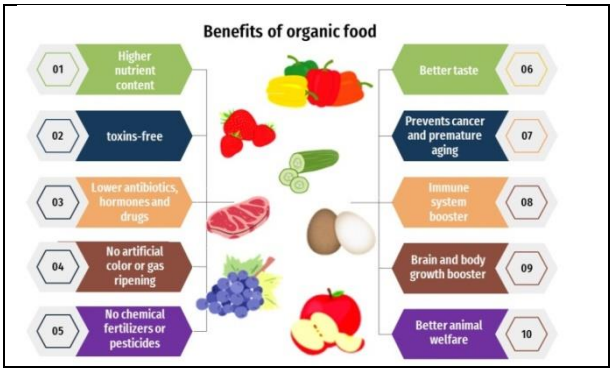

Fig. 4. Infographic illustration of the benefits of organic food

Organic farming challenges

Organic food markets grow rapidly in a global economy with changing economic structures. Although consumer demand for organic products continues to rise, market growth has slowed since 2008 (Peng 2019). The decline in market expansion poses many challenges, but the most important one is the disequilibrium between the supply and demand of organic food (Kearney 2010). Another major challenge for the organic industry is food inflation (Winter and Davis 2006). Finally, it remains a challenge to maintain standards and certifications. Without harmonized standards, international trade remains hampered for organic food products.

A lack of real and practical support severely limits organic farming. Approximately 1.5 percent of all agricultural lands are used for organic farming globally. A lack of government support will result in organic agriculture and organic products remaining more expensive than conventional ones. Organic farming takes three to five years to produce 95 percent of the output of traditional crops. Considering natural capital, including natural resources, as part of economic evaluation will lead to organic farming being more profitable than conventional farming over the long run. The lack of strong government support for organic agriculture has weakened the growth of organic farming systems and led to a shortage of organic food products. Due to all these issues, some farmers and producers are hesitant to participate in organic agriculture and production **(**Peng 2019**).** A list of challenges to organic farming growth can be summarized as follows:

1. The shift to organic farming generally leads to a significant decrease in productivity, especially when the transition from traditional to organic agriculture is rapid.
2. High prices of organic products.
3. Lack of adequate awareness about organic products and their benefits.
4. Limit buyers' numbers of organic products.
5. The used land for organic farming can be transferred easily to conventional farming directly, But the reverse transition takes a long time, perhaps five years.
6. Weak organic farming practices controls take 3-5 years to eliminate conventional agriculture residuals and reduce their adverse impact.

Solution

Providing safe food is an ongoing challenge for food manufacturers. Consequently, testing and analysis costs increase, and many batches are rejected, resulting in lost time, resources, food, and energy. However, the food processing industry can facilitate food safety if it follows farmers and explains to them good farming practices (GAP) and middle path so that they are more knowledgeable about GAP (Gupta 2017, Mie et al. 2017). In addition, experts believe that organic agriculture needs to be included in international efforts to protect the environment. Despite this, organic producers receive relatively limited assistance from wealthy economies, particularly in comparison to the billions provided to support agriculture (Blackman and Naranjo 2012).

To achieve food security and safety simultaneously, we need to find a middle path. It can be achieved by rotating crops, managing crop residues, using animal manure, managing off-farm organic waste, applying mineral-grade rock additives, mobilizing nutrients and protecting plants with a biological system, and preventing nutrient imbalances by using limited chemicals after soil testing. In addition to reducing costs, this approach will ensure that food is safe since only a fraction of chemicals will be used. This will also reduce the amount of environmental depletion. Lowering costs and a higher yield will encourage farmers to grow healthy and sustainable food. Compared to persistent pesticides, non-persistent pesticides pose fewer potential environmental hazards. In the future, agricultural scientists should develop technology that can be used in organic farming to ensure food security through purely organic farming (Gupta 2017).

Conclusion

Organic agriculture improves soil fertility and properties using more sustainable and eco-friendly methods. Furthermore, organic manure's movement and mineral, physical, and organic properties enhance soil fertility and properties. The benefits of organic farming include positive impacts on human health and food safety, as well as new opportunities for investment and employment based on plant and animal products, soil properties, and fertility. In addition, it reduces the transfer of pesticides and chemical residues, making it possible to achieve agricultural and environmental sustainability goals.

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الزراعة والأغذية العضوية لإستدامة إنتاج وسلامة الغذاء، دراسة مرجعية محدثة

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مستخلص. في الآونة الأخيرة، زاد الاهتمام بتطوير بدائل آمنة وصديقة للبيئة للمواد الكيميائية الزراعية الضارة. نتيجة لذلك، اكتسبت الزراعة أو الفلاحة العضوية، شعبية متزايدة في السنوات الأخيرة وأصبح يُعترف بها بشكل متزايد كجزء لا يتجزأ من إنتاج الغذاء العالمي. طبقاً لتعريف الزراعة العضوية، فإنه لا يسمح باستخدام المواد الكيميائية، أو مبيدات الآفات أو الأسمدة أو البذور المعدلة وراثيًا في أنظمة الزراعة العضوية. تتمثل الأهداف الأساسية للزراعة العضوية في تعظيم الاستخدام الفعال للتربة وعناصرها العضوية لتحسين استدامتها وخصائصها بشكل طبيعي وتقليل الطلب على المواد الكيميائية الضارة. علاوة على ذلك، أظهرت العديد من الدراسات الوبائية سلامة المنتجات العضوية مع وجود علاقة إيجابية بين استهلاك الأغذية العضوية وصحة الإنسان. ومع ذلك، فإن هناك العديد من الأسئلة التي تحتاج إلى إجابات شافية قبل التعمق في استكشاف مفهوم الزراعة العضوية، تتضمن ما يلي: ما هي الزراعة العضوية؟ كيف تختلف أنظمة الزراعة التقليدية والعضوية؟ ما هي أنواع المنتجات العضوية؟ وما هو تأثير الزراعة العضوية على سلامة الغذاء؟ ما هي أهداف ومزايا الزراعة العضوية؟ ما هي عيوب الزراعة العضوية وتحدياتها، وما هي الحلول؟ الدراسة المرجعية الحالية تساعد في تقديم إجابات لهذه الأسئلة، بالإضافة إلى توضيح المفاهيم الرئيسية للزراعة العضوية بهدف زيادة الوعي بها وتشجيع الاستثمار وانشطتها المختلفة.

الكلمات المفتاحية: الزراعة العضوي، الأغذية، الأعلاف، سلامة الغذاء، الأمن الغذائي، تغذية الإنسان