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REVIEW ARTICLE

The value of organic agriculture beyond contemporary food sufficiency in the developing world

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ABSTRACT

Understanding the value of organic agriculture beyond contemporary food sufficiency is crucial in addressing sustainable agriculture and the welfare of the community. Yet, economic analysis of agricultural output usually focuses on crop yield rather than other intangible values related to environmental health, which mainly encompass human health and the environment. The non-marketable value of the ecosystem services in organic agriculture is always higher than in conventional agriculture. When the non-market value is considered during yield assessment, the difference in crop yield between organic and conventional agriculture may be insignificant or even higher for organic. This paper aims to give a gritty overview of the intangible values of organic agriculture in comparison with conventional agriculture to account for other environmental and health benefits associated with organic farming. This is crucial because productive agroecosystems for sustainable development should be able to meet the needs of the present generation without compromising the ability of the future generation to meet their needs. It has been revealed that the application of ecological principles under organic agriculture brings several environmental and socio-economic benefits. Therefore, there is a need to explore some insights into the values of organic agriculture beyond the contemporary food sufficiency which are usually given less attention during economic analysis, for increased understanding and adoption of this kind of farming to harness the associated potentials.

Keywords: ecosystem, organic farming, sustainable agriculture, non-marketable values.

INTRODUCTION

Organic agriculture (OA) is the agricultural system that promotes ecological processes while discouraging the application of synthetic inputs such as agrochemicals. OA differs from conventional agriculture (CA) which relies on synthetic agrochemicals for increased crop and animal yields without considering the associated environmental and health effects. The movement towards OA was initiated by rural traditional groups in Germany and other United Kingdom that promoted organic fertilizers over synthetic fertilizers in the early twentieth century (Vogt, 2007). OA gained popularity in the late 1970s due to the negative impacts of CA on health and the environment (Lockeretz, 2007). However, up to 2015, OA accounted for only one per cent of the worldwide agricultural land, with about 70 million hectares of land (Willer and Lernoud, 2017). 'Why is OA still poorly adopted despite the various associated benefits'? What are the motives behind CA despite several environmental and health impacts associated with this type of farming? This paper gives some insights into the values of OA beyond the contemporary food sufficiency which are usually given less attention during economic analysis, leading to its poor adoption.

Economic analysis of the agricultural output by the majority of the farmers is measured by crop yields, ignoring the associated health and environmental effects. This is a significant constraint that may account for poor adoption of organic farming by the majority of farmers both at local and global levels. The analysis that considered the intangible values of OA found that it outperforms CA significantly (Sandhu et al., 2008; Durham and Mizik, 2021; Ikeh et al., 2023a). In addition, CA is influenced by business activities from various stakeholders and actors, including companies, which are involved in the manufacture of pesticides, herbicides, and fertilizers, together with those involved in breeding seed crops for different purposes. Manufacturers and dealers of conventional products have high convincing power of branding their products to ensure their acceptance in the market chains. In addition, the ability to meet the current needs of the people rather than agricultural sustainability is the major factor considered in CA. Most CA inputs have immediate effects in terms of yield optimization but with long-term adverse effects on the environment and health of both producers/workers and consumers.

Contrary to CA, several benefits are associated with OA, including food safety, biodiversity conservation, enhanced ecosystem services, reduced soil and water pollution, reduced pest incidence and pesticide resistance and reduced cost of production (Figure 1).

OA does not rely on synthetic agricultural inputs but rather on a composite of innovations originating from integrated agricultural approaches that encourage farm management over technology and biological/natural processes over artificial (chemical) methods. OA promotes environmental health and associated biodiversity and ecosystem services through appropriate farming techniques as seen in Table 1.

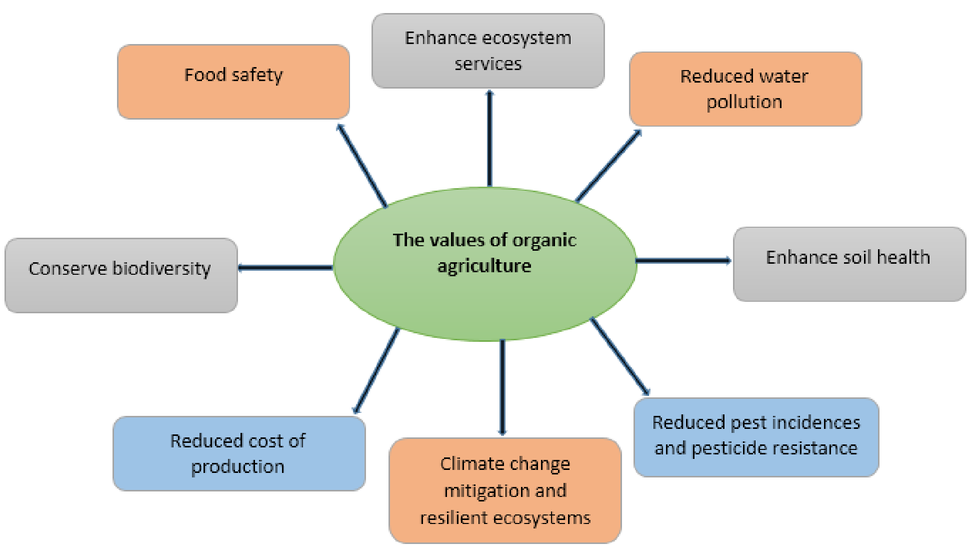

Figure 1. The value of organic agriculture beyond contemporary food sufficiency

Table 1. Recommended farming practices for organic agriculture

Farming practices	Required materials/ techniques	Prohibited materials/ techniques
Land preparation	No tillage	Tillage and use of herbicides
Weed control	Mulching, mechanical methods such as hoeing methods	Herbicides
Pest control	Biofertilizers, biocontrol agents	Synthetic pesticides
Soil fertilization	Manures, compost, mulching, crop rotation	Synthetic fertilizers
Seed varieties	Organic seeds and locally adapted varieties	Genetically modified seeds

Source: Modified from Meemken and Qaim (2018)

THE VALUE OF ORGANIC AGRICULTURE FOR THE PRESENT AND FUTURE GENERATIONS

More crop yield is obtained from an intensive agricultural system that uses high energy agricultural inputs including synthetic fertilizers, pesticides and herbicides (de Ponti et al., 2012; Seufert et al., 2012). However, these agro-inputs have adverse effects on beneficial organisms responsible for the provision of ecosystem services such as pollinators, biocontrol agents, and soil organisms. The declining trends in the provision of essential ecosystem services such as control of pests, diseases and weeds, crop pollination, soil formation, erosion control, decomposition of soil organic matter, and nutrient cycling within the agricultural land are associated with too much use of agro-inputs (Kassam and Friedrich, 2012; Faber et al., 2019; Rumschlag et al., 2020) and is a threat to the current and future food security (Reganold and Wachter, 2016; Sandhu et al., 2010). To meet the food demand of the growing world population sustainably and without harmful effects on human health and the environment, organic farming is very crucial. Below are some of the core values of OA beyond contemporary food sufficiency.

Organic agriculture enhances ecosystem services

The support of ecosystem services in different sectors is worth more than USD 33 trillion per year (Costanza et al., 1997). However, the global loss of ecosystem services due to anthropogenic activities and land use changes accounts for between USD 4.3 to 20.2 trillion per year (Costanza et al., 2014). Likewise, the evaluation of land use and land cover influence on biodiversity loss and ecosystem service value in the tropical coastal land reported a sequential decline in USD 80.4, 63.8 and 46.0 million in 2000, 2010 and 2016, respectively (Ligate et al., 2018). This trend shows the need to integrate sustainable farming practices that promote biodiversity and associated ecosystem services. In addition, Sandhu et al. (2008) found the economic value of ecosystem services in organically managed agricultural land in New Zealand to be approximately 1516 USD per hectare per year compared to 670 USD in conventional agriculture.

The intangible values of OA are not always considered when assessing the agricultural output just because the ecosystem services are not traded in the markets, hence no 'price 'tag'. OA helps to alleviate the majority of the effects attributed to CA, thereby promoting environmental health. There is an excellent connection between OA and sustainable crop production at enhanced ecosystem services. The quantification of the value of ecosystem services associated with agriculture for both CA and OA (Sandhu et al., 2008) is shown in Table 2. The findings show the non-marketable value of the ecosystem services in OA stands at 32% of the total economic value while CA is 18% (ie, almost half of the OA). The difference in crop yield between OA and CA may be insignificant or even higher for organic than conventional when the non-market value is considered during yield assessment. Biological pest control is among the ecosystem services that were found to be completely absent in the conventional fields (Table 2). This is due to the adverse effects of agrochemicals used in conventional farming to the survival of the natural enemies of insect pests.

Natural pest control is one of the key ecosystem services in agricultural land. The majority of insect pests are controlled by their natural enemies, such as predators, parasitoids, or entomopathogens. This is evidenced by classical biological control, where a new natural enemy is introduced in an area for permanent establishment following an accidental introduction of a pest without its natural enemy (Kenis et al., 2017; Seehausen et al., 2021). This indicates that synthetic pesticides are insufficient to suppress the pest population in agricultural systems, thus the need to introduce their natural enemies in the area for natural pest regulation, which is among the important ecosystem services.

Table 2. Economic value of ecosystem services in conventional and organic agriculture

Ecosystem services	Average economic value in US$ per hectare per year	
	Organic fields	Conventional fields
Biological pest control	50	0
Pollination	62	64
Nitrogen fixation	40	43
Mineralization of plant nutrients	260	142
Soil formation	6	5
Carbon accumulation	22	20
Food	3990	3220
Raw materials	22	38
Soil fertility	68	66
Hydrological flow	107	54
Aesthetics	21	21
Shelterbelts	880	200
The total economic value of ecosystem service	4600	3680
Non-market value of ecosystem service	1480	670

Source: Adopted from Sandhu et al. (2008)

Organic agriculture for biodiversity conservation

The sustainability and resilience of agroecosystems is based on the ability to maintain and enhance the on-farm biodiversity. On average OA is reported to increase up to 50% abundance of farm biodiversity compared to CA (Bengtsson et al., 2005; Mäder et al., 2002). Diverse groups of organisms such as birds, beneficial insects, soil organisms, and plants are more favoured in agroecosystems with less use of agrochemicals (Mkenda et al., 2019a) which is a practical phenomenon in organically managed systems compared with conventional ones. High species richness of different functional groups of organisms like predatory beetles, spiders, birds and vascular plants is also reported in organically managed farms (Freemark and Kirk, 2001). According to Crowder et al. (2010), OA increases the species richness of the biocontrol agents and promotes their evenness which is an essential ecological parameter. Generally, organically managed farms consist of diverse plants, arthropods, and soil organisms compared with conventional farms (Bengtsson et al., 2005). Conserved biodiversity in organic farms is essential for the timely provision of ecosystem services. For example, sufficient biological control agents early in the season may prevent early invasion and the subsequent establishment of pests and disease-causing organisms.

Organic agriculture for reduced pest incidences and pesticide resistance in farmland

Pest management in OA relies on a holistic approach to preventing pests and avoiding severe damage through the application of ecological principles, appropriate cropping techniques, and cultural, mechanical and natural processes. The holistic approach involves manipulation of the agroecosystems to favour the plant's health while intimidating pests. The pest management techniques and general farm management practices employed in crop farming distinguish OA from CA. It is documented by Benbrook et al. (2021) that OA minimizes reliance on synthetic pesticides and promotes environmental and human health, unlike CA, which primarily depends on synthetic pesticides to control pests and diseases. The limited use of synthetic chemicals in OA promotes nature-based ecosystem protection and increased survival of biological control agents for natural pest regulation (Blundell et al., 2020, Mkenda et al., 2019b). Due to this, several studies (Bengtsson et al., 2005; Muneret et al., 2018) report lower abundances of insect pests in organic compared to conventional farms. Soil-borne diseases and pathogens are also lower in organically managed soils than in conventional soil (Bailey and Lazarovits, 2003; Noble and Coventry, 2005).

Excessive use of pesticides in managing crop pests in the field promotes the development of pesticide resistance, which may either be target site resistance or metabolic resistance (Khan et al., 2020). Target site resistance occurs due to modification of the active site through mutation, thereby preventing the binding of insecticide for activation (Boaventura et al., 2020; Tmimi et al., 2018). Metabolic resistance involves an overproduction of enzymes which leads to the breakdown and detoxification of the pesticides, rendering the pesticides harmless to the insects (David et al., 2013). Pesticide resistance by insect pests has resulted from the overuse/misuse of pesticides and sometimes mixing of different pesticides during application. These practices consequently increase pest resistance to several pesticides, and it is currently a severe concern in CA. A bad thing with pesticide resistance is that it is not limited to a single pesticide but rather to all pesticides belonging to the same class, which have the same mode of action. One of the ways to overcome the pesticide resistance challenge is to switch to the use of non-synthetic pesticides such as cultural, mechanical, biological control and biopesticides in controlling pests. This will consequently lower the cost of production while promoting natural pest regulation.

Organic agriculture protects nature and human health

The quality of agricultural produce and food safety are influenced by the biotic and abiotic factors present in the environment. The abiotic factors refer to the presence or absence of toxic/ harmful materials in the environment that may be assimilated into various food chains through the plants growing in that area (Peralta-Videa et al., 2009). Biotic factors consist of living organisms such as insect pests, rodents, bacteria, or fungi that affect the quality of crop plants in a given area. Even though bacterial contamination is more reported in OA than in CA due to biological fertilizers, there is evidence that organically produced crops have more nutritive values than conventional produce (Reganold and Wachter, 2016; Lundegårdh and Mårtensson, 2003; Rembiałkowska, 2007; Lairon, 2010). In addition, crops grown organically have self-protection capability against insect pests due to abundant phytochemicals which act as natural insecticides (Renaud et al., 2014; Frias-Moreno et al., 2019). OA is against synthetic inputs and involves environmentally friendly farming practices (Table 1). Unlike organic, CA is characterized by high input technologies, including synthetic pesticides, herbicides, and fertilizers, which consist of harmful compounds responsible for air, water, and soil pollution. Consequently, pesticide residues in food crops are highly pronounced in conventional products due to environmental contamination by synthetic agro-inputs, thereby lowering the quality and safety of food to consumers. Pesticide residues in animal products such as milk are reported in Tasiopoulou (2007) to decrease significantly with increased uptake of organically produced food crops. Similarly, nutrient content for vitamin C, magnesium, iron and phosphorous was more abundant in organically grown crops than in conventional crops (Worthington, 2001), as shown in Table 4. Currently, organically produced food crops are gaining more market value compared with conventionally produced food crops, indicating the need to promote the adoption of OA.

Organic agriculture for reduced soil and water pollution

Soils are contaminated with pesticides (insecticides, herbicides or fungicides and nematicides) through direct treatment or by treating the above ground and aerial parts of the crop plants. Pesticides in the environment may be degraded (for biodegradable compounds), adhere to soil particles or be washed away by water into water bodies. More than 50 % of the synthetic pesticides in crops end up in soil and water sources through rainwater (Pérez-Lucas et al., 2019). Since majority of the synthetic pesticides are non-biodegradable, they persist in the soil or water for several years and affect the consumers through biomagnification along the food chain (Gupta and Gupta, 2020, Michalko et al., 2024). Excessive and inappropriate use of fertilizers in CA significantly affects soil and water. For example, excessive nitrogen fertilizer applied on agricultural land is washed into the water bodies, leading to the death of aquatic organisms through the eutrophication process (Reganold and Wachter, 2016; Ngatia et al., 2019; Ikeh et al, 2023b). The soil and water pollution challenge is less significant in OA as it relies on readily biodegradable biopesticides and organic soil amendments. Reduced use of synthetic agricultural chemicals by adoption of OA has the potential for reduced soil and water pollution.

Table 3. Preferred pest management techniques in organic agriculture

Control technique	Farming practices to achieve the technique	Effect on the pest	References
Cultural	Crop rotation	Reduces the buildup of pest populations in the area	Rusch et al. (2013)
	Appropriate crop variety	Some crop varieties are resistant to pest attacks while others are more susceptible	Gebremdein (2018)
	Timing of planting and harvesting	Too late or too early planting may increase the susceptibility of the plant to pests based on crop variety	Hesler et al. (2005); Abudulai et al. (2017)
	Irrigation and nutrient management	Induced plant resistance to pests	Van Antwerpen et al. (2011); Colella et al. (2014)
	Planting trap crop	Reduce damage at the field edge while providing food resources to beneficial insects	Cook et al. (2007); Khan et al. (2016)
	Intercropping	The intercrop plant may be repellent or more attractive to pests, thereby concealing the target crop from severe damage	Trenbath, 1993; Himmelstein et al. (2017)
	Enhances natural enemies of insect pests	Cultural methods create environmentally friendly conditions for the survival of natural enemies of insect pests	Schellhorn et al. (2000)
Mechanical/ physical control	Handpicking and hand-pulling of weeds	Highly infested crops are uprooted and removed from the field to reduce infestation to nearby plants	Biswas and Islam (2012); Mpumi et al. (2020)
	Mowing, hoeing, tilling and soil solarization	Eliminate the host plant and destroy the pest's life cycle by killing the early stages of insect pests	Skidmore et al. (2019)
	Use of sticky paper collars	Different insects are attracted to different sticky colours, which helps monitor insect populations	Muvea et al. (2014); Murtaza et al. (2019)
	Water pressure sprays	Dislodge insect pests such as aphids	Hansen et al. (2006)
	Insect vacuums	Remove insects from the plant surface	Vincent et al. (2003)
Biological control	Introduction of new 'pest's natural enemy in the area	Initiates natural pest control in new locations	Collier and Van Steenwyk, 2004; Perez-Alvarez et al. (2019)
	Rearing and release	Boost naturally occurring populations for pest control	Bader et al., 2006; Frank, 2020
	Conserving the local natural enemies in the field	Increased fecundity and survival of local predators, parasitoids and pathogens for pest control	Gurr et al. (2000); Jonsson et al. (2008)
Bio pesticide control	Spraying extracts of plants' origin for pest suppression	May either repel, interfere with 'pests' reproduction and survival or kill the pests	Mkenda et al. (2015); Rahman et al. (2016)
	Spraying extracts of animal origin for pest suppression	May either repel, interfere with 'pests' reproduction and survival or kill the pests	Montesinos (2003); Brar et al. (2006)

Table 4. Mean per cent differences in nutrient contents between organic and conventional crops

Vegetable	Nutrient content (%)			
	Vitamin C	Magnesium	Iron	Phosphorous
Lettuce	+17	+29	+17	+14
Spinach	+52	-13	+25	+14
Carrot	-6	+69	+12	+13
Potato	+22	+5	+21	0
Cabbage	+43	+40	+41	+22

The positive (+) and negative (-) signs indicate more or less in organic as compared to conventionally produced crops. *Source:* Adopted from Worthington (2001)

Organic agriculture for enhanced soil health

Effective fertilizer application requires 'feeding the 'soil' rather than feeding the 'plant'' (Figure 2), which is obvious in organic farming systems. Fertilizer application in CA directly feeds the plants by supplying essential soil nutrients, while fertilizer application in OA feeds the soil by provision of micro and macro-elements to the soil, and then the soil feeds the crops (Goulding et al., 2009; Ikeh et al., 2023c). Bacteria and fungi are among the soil organisms that play a crucial role in nutrient circulation in the soil. The organic materials added to the soil are made available for plant uptake after decomposition and mineralization by the soil organisms. A study by Marcos-Pérez et al. (2023) reported increased crop yield and soil fertility through mulching of crop residues in intercropped organic melon with cowpea. Organic fertilization is reported to be among the major sustainable soil management options globally (Strauss et al., 2023; Ikeh et al., 2023b).

The atmospheric nitrogen is made available to plants as nitrates after nitrogen fixation by various soil microbes (Romanyà and Casals, 2020). The performance of soil organisms in soil fertility is affected by synthetic pesticides and fertilizers, leading to soil degradation. Soil organisms are abundant in organically managed soil as compared with conventional soil due to differences in the organic matter contents, soil pH and type of the soil. (Stott et al., 2018). The farming practices employed in OA encourage the survival of diverse beneficial organisms both below and above the soil, with enhanced soil organic nutrients which are the major characteristics of healthy soil.

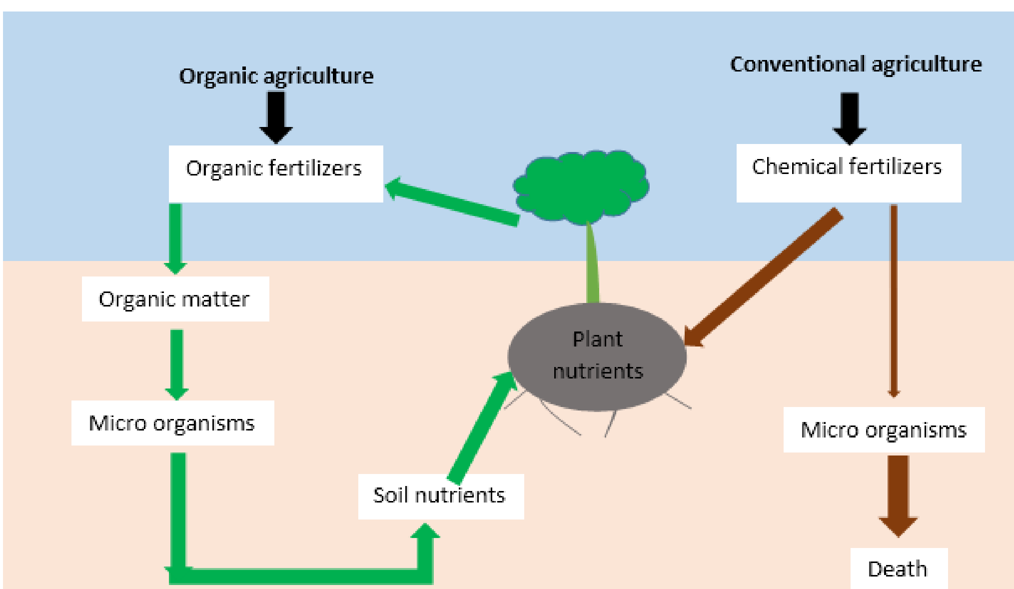

Figure 2. Feeding the soil vs feeding the plant in organic and conventional farming, respectively

Organic agriculture for climate change mitigation and resilient ecosystems

Agriculture is responsible for both mitigation and promotion of climate change, and itself is affected by climate change. It is reported by Muller et al. (2012) that agriculture is responsible for 20-30% of global greenhouse gas emissions, from both direct and indirect agricultural emissions. However, when sustainable agriculture practices such as reliance on natural inputs are implemented, may lead to climate change mitigation and adaptation. A systematic review that was complemented with meta-analysis by Boschiero et al. (2023) found OA to have a better environmental performance compared with CA despite having low yield. The environmental performance parameters assessed were climate change, ozone layer depletion, human and environmental health, eutrophication, acidification and efficient use of resources. OA offers a multifaceted approach to climate change mitigation by overcoming greenhouse gas emissions and enhanced carbon sequestration for climate resilience within agroecosystems.

Carbon sequestration through organic agriculture

Soil organic carbon sequestration occur as a result of increased soil carbon when the rate of carbon input in the soil exceeds the rate at which it is decomposed by the soil organisms (Leifeld and Fuhrer, 2010; Lorenz and Lal, 2014). This involves the incorporation of the plant remains and other organic matter into the soil to build up the soil organic carbon. Several factors govern the soil organic carbon sequestration including the use of cover crops, crop rotation, organic soil amendments and reduced soil disturbance. The farming practices employed in OA including the use of natural inputs like manure, compost and cover crops contributes to multifaceted approach towards climate change mitigation and adaptation (Farooqi et al., 2018). The soil organic matter also enhances the water-holding capacity with increased soil biodiversity which are important characteristics of a healthy soil, especially in the changing climatic conditions. Understanding of the contribution of organic agriculture in the current changing climate is crucial for increasing its adoption among the farmers.

Reduction of greenhouse gas emissions

By foregoing the use of synthetic chemicals in crop farming, OA reduces the carbon footprint, thus mitigating the industrial emissions associated with the production of such chemical inputs (Squalli and Adamkiewicz, 2018; Venkat, 2012). Methane is one of the potent greenhouse gas that contribute to about 20-25% of global warming (Singh and Strong, 2016, Yusuf et al., 2012). Agriculture is one of the major sources of methane through several practices including the use of chemical fertilizers which affect oxidation process of methane by the methanotrophic bacteria that rely on methane as a source of carbon for their metabolic activities. Therefore, the use of synthetic chemicals in agriculture affects the soil organisms including the methanotrophic bacteria that play an important role oxidation of methane (Syamsul et al., 1996). Despite the fact that methane is produced naturally as well as from human activities, the consumption of methane through decomposition process is important to avoid its greenhouse effect in our environment. A study by Singh and Strong (2016) reported the significance of biological fertilizer as a biological tool in mitigation of methane. Nitrous oxide is also among the important greenhouse gases reported to be significantly reduced in organic farming as compared to non-organic farming (Skinner et al., 2019). However, it is also reported that certified organic agriculture does not necessarily reduce greenhouse gas emissions from agricultural production (McGee, 2015). The ncreased understanding of ecological intensification which include organic farming with appropriate farming practices is important for reduced climate change effects and for resilience of agroecosystems.

YIELD COMPARISON BETWEEN ORGANIC AND CONVENTIONAL CROPPING SYSTEMS

The review of several studies (de Ponti et al., 2012; Seufert et al., 2012; Idem et al, 2012; Ponisio et al., 2015) worldwide to compare the yield of different crops under organic and conventional farming systems reported an average of 87% yield in organic compared to the yield obtained from conventional practices, although there was a substantial variation of about 21%. The differences varied significantly based on the type of crop, crop management practices employed, the farming type, location and seasonality. According to Mudare et al. (2022) and Ikeh et al. (2023d), leguminous crops (cowpea, groundnut, soybean etc.,) have minimal yield differences compared to cereals, root and tuber crops. This is due to the sufficiency of soil nitrogen obtained from natural nitrogen fixation in the roots of leguminous plants. It is reported an increased crop yield when cereal crops are intercropped with legumes (Mudare et al., 2022), necessitating the need to intercrop cereal with legumes in organic farming to minimize the yield difference when compared with conventional farming.

The primary reason for the low yield in OA is insufficient nitrogen during the early stages of plant development. Organic nitrogen is usually not readily available and the mineralization process takes time to make it available (Askegaard et al., 2011; Mkonda and He 2017). The slow development of crop plants may lead to the rapid growth of weeds which compete with the growing crop plant in terms of nutrients, space and light. The limitations of plant development at early growth stages may contribute significantly to low yield. However, appropriate farming practices like crop rotation with optimized fertilization time may help to overcome such challenges (De Notaris et al., 2018; Knapp et al., 2018). A study by Badgley et al. (2007) has reported the possibility of OA to feed the current world population and even beyond, within the available agricultural land, indicating its potential contribution in attaining food sufficiency for the current and future population.

PRINCIPLES OF ORGANIC AGRICULTURE FOR SUSTAINABILITY IN AGRICULTURE

Sustainable agriculture is the main principle of OA. It requires production practices that consider the needs of the current generation but without compromising the future generation's ability to achieve their needs (Francis and Porter, 2011; Carlisle et al., 2019). According to the International Federation of Organic Agriculture Movements (IFOAM), as explained by Luttikholt (2007), OA stands on four major principles; ecology, health, fairness and care. The principle of ecology implies that OA should be rooted in live ecosystems and adapted to local conditions (Luttikholt, 2007; Jackson et al., 2021). The principle relies on less use of inputs, focusing more on reuse, recycling, and efficient utilization of ecosystem services for increased environmental quality and resource conservation. The principle of health points out that a healthier ecosystem (soil) produces healthier crop plants for healthy individuals and the community (Jackson et al., 2021). Therefore, OA should enhance the health of the micro and macro-organisms below and above the soil to produce quality and nutritional food products free from chemicals. The principle of fairness is characterized by equity, justice and stewardship of the current and future generations at all levels, from farmers, workers, processors, distributors/ traders, and consumers of organic products (Milovanov, 2019). Fairness emphasizes social and ecological sustainability and fair use of natural resources to meet the needs of both the current and future generations. The principle of care considers OA as a living system that should be managed with precautions to avoid risks from adopting current agricultural technologies. Scientists should thoroughly assess the inappropriate and unpredictable genetic engineering technologies to overcome negative consequences. The principles of OA justify its contribution to the environment and human health for agricultural sustainability.

CONCLUSION

OA is still poorly adopted in many countries despite of various benefits associated with it. The major benefits of OA include; an ecologically sound environment and human and animal health. Some other benefits are food safety, biodiversity conservation, enhanced ecosystem services, reduced soil and water pollution, reduced pest incidence and pesticide resistance, and reduced cost of production. Consideration of the intangible values of OA reveals that the system outperforms the conventional one significantly. In addition, OA requires less input and once established, it becomes more sustainable than CA. However, only one per cent of the worldwide agricultural land is under organic farming. Contrary, CA is more practiced due to narrowed assessment concerning contemporary food sufficiency as the main focus with limited consideration of the future generation. Increased adoption of OA through awareness raising is necessary for enhanced agricultural sustainability with reduced impacts of climate change associated with too much use of agrochemicals in CA.

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CONFLICTS OF INTERESTS

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AUTHORS' CONTRIBUTIONS

All authors contributed to the study's conception and design. The first draft was prepared by Prisila Andrea Mkenda. Elly Joseph Ligate and Msafiri Yusuph Mkonda refined the study to the final draft. All authors read and approved the final manuscript.

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