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Towards Organic Rice: Present Status and Prospects for the Future

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ABSTRACT: Often when we hear of organic farming, we immediately associate it with avoiding or limiting the use of synthetic fertilizers, pesticides, growth regulators, and other additives to livestock feed. By establishing a healthy agroecosystem, we can produce healthier foods and maintain soil biological activity and biodiversity, along with the agroecosystem itself. Currently, India is poised to export organic rice to markets around the world with huge potential. The agricultural and processed food products export development authority (APEDA) served as a channel for the export of 46, 30, 463.14 MT of organic basmati rice from India during 2020-2021. India exports basmati rice to 132 countries in the world. A good rice crop can be produced using organic farming, but there are many challenges, such as lack of water, nitrogen stress during critical growth stages, weed competition, and a lack of organic resources. There are a number of organic nutrition sources that can be utilized in an organic rice planting system, such as vermicompost, chicken manure, green manures, and bio-fertilizers. It is imperative to choose rice varieties that are organically developed, resistant to diseases, strong responders to nutrient inputs, and capable of competing with weeds so that the crop can be protected from the possibility of crop failures. The greenhouse gas emissions from organic rice fields have been observed to increase non-significance, which is important for environmental sustainability (GHGS). We need to highlight the norms and practices associated with current organic rice production in order to avoid the use of synthetic fertilizers in our endeavour to increase the quality of the product as well as the productivity with organic rice production in order to be able to successfully eliminate the use of chemical fertilizers. The purpose of this study is to examine the status of organic agriculture worldwide and in India and to discuss nutrient management and pest management for organic rice cultivation.

Keywords: Agriculture, Biotic, Crop, Dose, Organic, Methane, Nutrients, Pest.

INTRODUCTION

In organic farming, efforts should be made to reduce reliance on chemical inputs (fertilizers, pesticides, antibiotics, and genetically modified organisms), as well as to use the land free from the use of chemicals for more than three years. More than 186 countries of the world now practice organic agriculture or organic farming in a total area of 71.5 million hectares. The number of organic farms keeps increasing every year. During the period of the green revolution, chemical fertilizers and pesticides were widely used, which eventually contributed to the contamination of the soil, water, and air. In order to overcome this problem, organic farming practices should be used to reduce the damages caused by chemical fertilizers. When chemical fertilizers are used, they reduce soil fertility, productivity, and biological activity. In increasing numbers, organic foods are becoming increasingly popular around the globe. It is estimated that there are approximately 2.8 million organic farmers all over the world. Despite the fact that the majority of Asian countries lack access to organic market statistics, we can assume that the organic market will continue to expand. The organic farming system is also seen as being a sustainable one since it uses fewer inputs from outside the farm, is solely based on traditional methods, and benefits the environment tremendously. Using organic agriculture, we can help to mitigate the problem caused by intensive conventional farming, thus reducing the negative effects. In fact, the word "organic rice cultivation" has existed for quite some time and is not a new one. A vast majority of farming communities in India have been practicing this technique for many years, especially in Punjab, Haryana, Manipur, Sikkim, Arunachal Pradesh, and Uttarakhand. More than 95 percent of organic agriculture is thought to be based on crop varieties produced for the conventional high-input industry (Lammerts van Bueren *et al*., 2011).

Nevertheless, the production of rice in organic farming is much lower when compared with conventional farming. There have been instances of insect pest outbreaks in rice farming practices in the past. Natural enemy density was lower in the organically-farmed paddy plot than in the control treatment (Kajimura *et al*., 1993; Kajimura *et al*., 1995).

As of right now, we use a large number of insecticides and pesticides, which will have an impact on rice productivity, so it is needed to overcome this problem. However, in organic farming, there will be no adverse effects on crops due to the overuse of these chemicals. A study has shown that the yield obtained from organic farming is less than the yield obtained from conventional farming. One of the reasons can be attributed to pest management and nutrition deficiencies. In addition to all the cereal crops, rice is one of the most effective crops to be grown in organic farming. The soil types, environments, and cultivars used by organic farmers are different from those used by conventional farmers. As a result, organic farmers must select varieties that are suitable for low-input fields. Although, organic rice farming improves the appearance quality of rice grains, the cooking quality, and the amount of protein that is contained in the rice grain. It has been observed that certain factors are affecting grain yield in organic farming, such as yield-limiting factors, crop-weed competition, a lack of input, not enough nutrients (mostly nitrogen), pest and disease damage, etc.

World Scenario of Organic Farming. It is expected that the Organic Agriculture Research Institute (FIBL) and IFOAM will be presenting an overview of current global organic agriculture data in Friedrichshafen, Germany, on 12 February 2020 - 2018 was yet another record-breaking year for organic agriculture around the globe. According to the latest FiBL report on organic agriculture, worldwide, organic farmland has grown by 2.0 million hectares in the last 10 years, and organic agriculture is rapidly expanding throughout the world, with organic agriculture already being practiced in over 186 countries (statistics as of the end of 2018). Over 71.5 million hectares of farmland are certified organic throughout the world for the year 2018 based on a recent survey conducted by the Organic Trade Association. Approximately 35.7 million hectares of land are used for organic agriculture, based on USDA figures. As a result, organic agriculture occupies a large portion of the land in Australia, China (3.6 million hectares), and Argentina (3.6 million hectares). It is estimated that half of the organic agricultural land in the world is located in Oceania (36.0 million ha) and the second-largest area is in Europe (15.6 million ha). The total globe agricultural land, which is organic, is 1.5 percent. The percentage share of total agricultural land in Oceania is the highest, 8.6%, followed by Europe at 3.1% and Latin America at 1.1% (Fig. 1).

Organic farming is not a new concept for Indian farmers; it has existed for a long period. Because of the use of chemicals since the period of the Green Revolution, this demand has been steadily declining over the years. In some mountainous areas and tribal areas, the people do not know what conventional farming is and they use a traditional method of growing crops. Crop residue management can be helpful in rice-based cropping systems in the tropics, for nutrient cycling and also improved soil productivity (Singh *et al*., 2007). It is reported that various states of India cultivate rice according to organic methods, such as Punjab, Haryana, Uttar Pradesh, and other states. As per the Department of Agriculture, Government of India's latest Kharif sowing report released on September 27, 2019, the country's total acreage of paddy for the current year is estimated to be 382.34 lakh hectares. As you all know, each of the Indian states has a different area of paddy cultivation compared to another. This information is shown in Fig. 3.

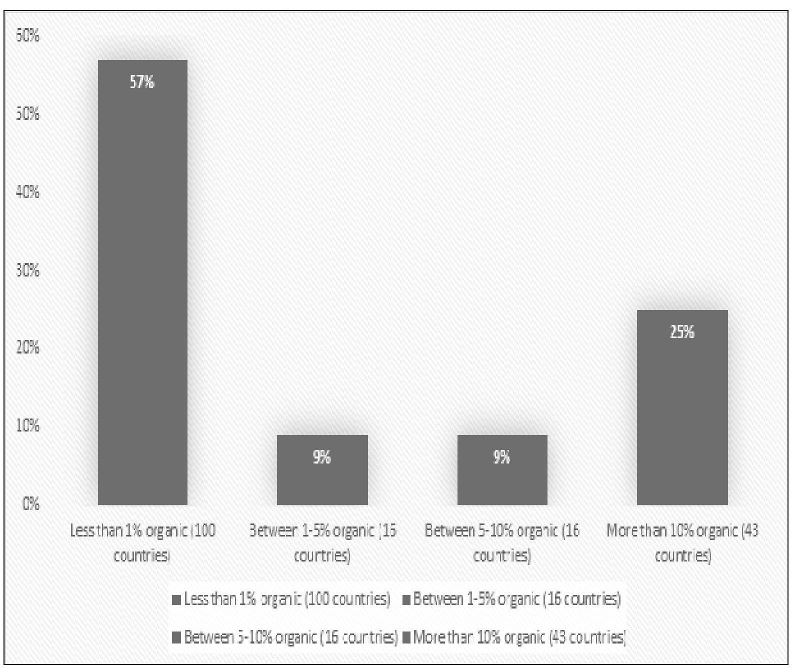
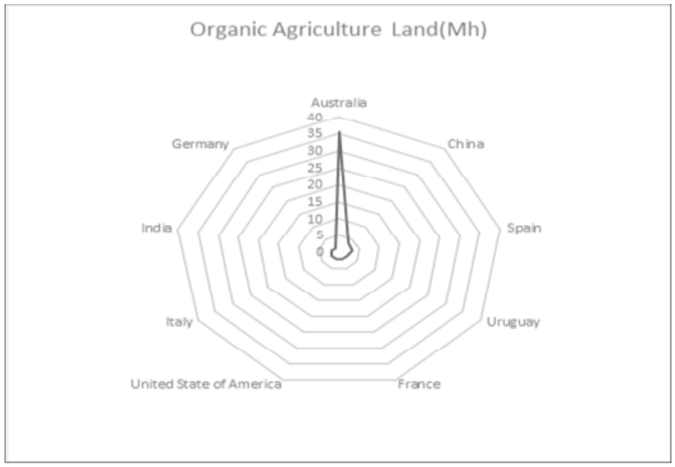


Fig. 1. Graphical Representation of Ten Countries with Largest Areas of Organic Agricultural Land.



India Present Status of Organic Farming

Fig. 2. Representing World, Organic Land and Total Agricultural Land Share (2018).

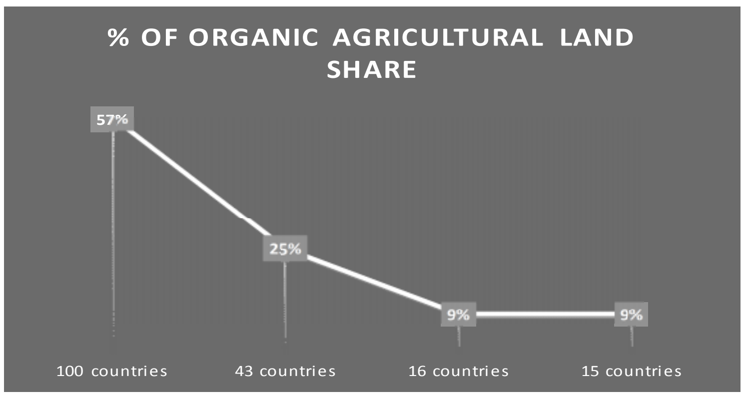


Fig. 3. Organic Agriculture and Land Share.

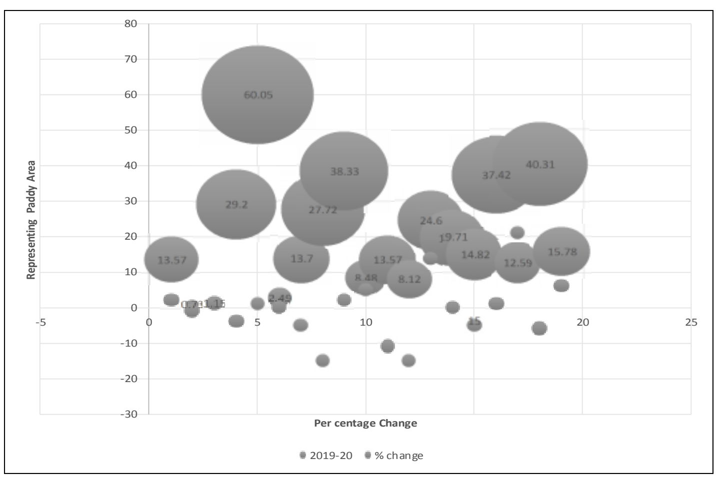


Fig. 4. Representing Paddy Area.

Indian organic rice is exported to a large number of countries around the world. The Agricultural and Processed Food Products Export Development Authority (APEDA) enables India to produce and export basmati rice, fragrant rice, and other rice varieties (Agricultural and Processed Food Products Export Development Authority). It is true that some states in India, such as Punjab, Haryana, and Uttar Pradesh, are producing large amounts of organic rice and exporting it to various countries. We consume a wide variety of rice varieties in our country such as Basmati, White, Red, Brown, Jasmine, Parboiled, and Sticky Rice. White rice and Basmati rice are the most common types of rice produced in our country. The main crop that is planted in the United States is rice, which is the type of crop that is extensively planted with pesticides and fertilizers, so pest and nutrient management for organic rice farming are major challenges.

Nutrient Management in Organic Rice Farming. It is extremely important to control the nutrient levels during the organic rice growing process. Many plant nutrients are required for high-yielding rice crops, especially those that are high in yields. Organic farming does not use conventional inputs and nutrients; therefore, it is important to regulate the number of nutrients available throughout the harvesting process of the crops. The provision of organic matter throughout the critical growth period is a critical component of an organic rice production system because it is at this time when the crop is most vulnerable to nutrient stress. The sustainable use of organic fertilizers and organic nutrients is heavily dependent on crop demand because organic manures release nutrients at a slower rate than fertilizers derived from inorganic sources. It has been found that nitrogen is the most limiting nutrient in irrigated rice production, especially in organic farming systems. In organic rice cultivation, it is frequently difficult to feed nitrogen to rice plants according to their requirements. The mineralization of N in soil is inhibited under conditions of flooded aerobic rice cultivation. There is a major improvement in the rate of nitrogen mineralization in the rice intensification (SRI) system, owing to the fact that the non-flooded aerobic state along with the secretion of enzymes increase the activity of microorganisms in the soil is maintained. During the growing season, rice soils with organic N are typically less likely to release Nitrogen (N). In general, rice's response to phosphorus in submerging conditions is unfavourable because flooding reduces soil phosphorus sorption and increases phosphorus diffusion, resulting in a larger phosphorus supply to rice (Dobermann *et al.,* 2000). In addition, phosphorus uptake by rich soils that have been flooded with alkaline soils has been improved by calcium and calcium carbonate release due to a decrease in pH caused by flooding (Fageria *et al.,* 2011). During the 1970s, it was discovered to increase the oxidation level of the soil, thereby improving organic phosphorus mineralization, compensating for the negative impact flooding has on phosphorus availability. Nakajima *et al.* (1993) compared 13 pairs of paddy soils managed organically and conventionally, discovering that organic management resulted in lower Truog-P. I believe that Hasegawa *et al.* (2005) discovered that there was no significant difference in Truog-P levels between organic and conventional rice soils in the study. As a result, P-related stress in organic rice production is difficult to detect. Under N-limiting conditions, however, "Liebig's law of minimum" could be used to explain why organic rice systems phosphate uptake is greatly limited. It is now regarded as important that mycorrhizae act as intermediaries for the absorption of phosphorus by plants. A variety of rice differs in the amount of nitrogen, phosphorus, and potassium it can absorb. The absorption of nitrogen, phosphorus, potassium, and sulphur by fine-grain rice varieties was found to be lower than that of coarse-grain rice varieties.

Crop Management Practices in Organic Rice Production

Nutrient supply in organic rice production: It is vital to have the soil provided with adequate nutrients when it comes to organic farming since the quality of the organic matter in the soil is one of the most crucial factors when it comes to the quality of the food. It has been found that a number of methods are effective, including green manures, *Azolla* spp., biofertilizers, crop residue incorporation, and the use of composts. Green manure and biofertilizers not only contribute to the increased organic matter content of the soil but also help prevent weeds from growing in the rice fields. In addition, Mian, in 2002 reported that when Azolla is used as a biofertilizer for irrigated rice, the use of urea is decreased by 30-40%. In general the effects of organic matter management in paddy fields on organic matter buildup, nitrogen sources in the soils, and rice development (Shiga *et al*.,1985).

It is a well-known fact that on organic farms, we use natural manure and on-farm by-products to enhance soil consistency. In order to fix the soil's pH, it may be necessary to lime the soil. Farmers can make compost using animal manures and by-products. The use of vermicomposting in organic farming is also becoming increasingly popular. When the compost is applied to the fields, it is helpful in killing any unwanted bacteria and weed seeds before the compost is applied. This is why monitoring organic inputs within the rice ecosystem are crucial. In fact, organic material differs according to the number of nutrients it contains, the rate at which nutrients are released, and the C: N ratio (Venkateswarlu *et al.,* 2008). According to the type of soil, input quantity, paddy variety, and time of application, organic agriculture can vary greatly. It is strongly recommended that nitrogen be applied in split applications when critical growth stages have been reached with organic manures that are rich in N, such as vermicompost and hen manure. As far as organic rice cultivation is concerned, organic manures such as animal manure, vermicompost, fly ash, compost, farm, and straw are widely used. As far as phosphorus, potassium, and zinc are concerned, they were only given at the basal stage, maxima tillering, and panicle initiation stages. Because of the results shown by the experiments, researchers concluded that when plant nutrients are provided from a single organic source (i.e., only green manure, only FYM), in comparison to the fertilizer requirement rate, it has an approximately 8 percent effect on rice grain production. In addition, we calculated that by integrating multiple organic input sources into the system, the agricultural yields could be increased by about 10%, which means that inorganic fertilizer rates can be reduced. The rate of organic nutrient input is calculated by comparing the equivalent rate of N to the organic nutrient input rate (Murmu *et al.,* 2013). Rice plants benefit from both legume-based crop rotations as well as green manure, which can be an efficient way of supplying plant nutrients for the growth of rice plants. It has been shown that legumes are responsible for managing up to 30-50 percent of the nitrogen requirement for rice plants (Preston, 2003), as well as for controlling weeds. In order to aid in the organic rice production system, various types of biofertilizers are available which can give nutrients to rice crops. Examples of such biofertilizers include Rhizobium, Azotobacter, Azospirillum, phosphate-solubilizing microorganisms (PSMs), and Azolla. Azolla, in comparison to the other biofertilizers, decomposes more rapidly, produces a higher amount of nitrogen for the rice plants than the other biofertilizers (Waseem *et al*., 2012) and can increase rice production by up to 1.4-1.5 tons per hectare (Waseem *et al.*, 2012). The market is currently experiencing a high demand for aromatic rice, which includes fine-grain aromatic rice in addition to basmati rice. Research studies have shown that organic produce is healthier, tastier, and safer than conventional farm produce.

Pest and Disease Management in Organic Rice Production. Traditionally, organic farming has relied only on the use of bio pesticides and natural botanicals to control pests and diseases. Herbicides, consequently, should be avoided as much as possible. An organic rice farming system has many factors that cause the yield of rice to reduce. Of all these factors, pest populations are the most important. On the other hand, if you use the correct pesticide at the right time, you could be able to reduce pest pressure during the period during which the plant goes through its most critical growth period. There have been numerous reports on the fact that by applying more than the recommended amount of chemical fertilizers or pesticides, there is some toxicity impact on the plant apparent, but this is not the case with organic pesticides. Based on a survey completed by the Organic Farming Research Foundation (OFRF), there is a strong consensus among organic farmers in the United States that weed management should be prioritized as a research project (Walz, 1999). In herbicide-restricted organic farming systems (Hokazono and Hayashi 2012), weeds pose a key problem, and they are widely regarded as the second most significant yield-limiting factor, behind insufficient soil nitrogen availability under organic production. It is important to adjust the planting schedules and locations of crops in organic farming to avoid serious pest problems. This is one of the most important aspects of organic farming. As part of our other methods of pest management, we grow host crops to assist in attracting beneficial insects to our main crop, which in turn does not allow them to attack our main crop. However, in some cases, if there is a pest outbreak that cannot be controlled by beneficial insects, this means that we have to use organic or natural insecticides, such as products containing neem (1% Nethrin/Nimbecidine) which are low in toxicity to humans and other animals and have a low persistence in the environment. Various methods can be used to control pest/insect problems in different field crops such as pheromone traps, Trichogramma parasites, and so on. It has also been demonstrated that this type of field experiment was conducted at the Indian Agricultural Research Institute, New Delhi, and many other places where organic farming is being practiced and that there is no serious attack of any insect pest or disease on organically grown rice plants. Organic farming has the advantage of containing soil-borne pathogens by applying a higher amount of organic manure, which also increases the quality of soil as well (Van Bruggen *et al.*, 2016). The majority of diseases and pests can be prevented by improved soil quality and increased microbial activity in plants (Chaubey *et al.*, 2017; Birkhofer *et al.*, 2008). Rice produced organically is usually grown with bio-pesticides that are primarily used for the control of disease and insects. During a recent study, researchers found that foliar applications of vermiwash, neem oil, aqueous garlic, and Annona leaf extract reduced the population of Gandhi bugs (*Leptocorisa varicornis*) (Mishra *et al.*, 2015).

CONCLUSION

It is concluded that the demand of organically grown food is increasing day by day. As a result, the area under organic farming is also increasing every year. To increasing organic rice, farming it is most important to emphasized nutrient management and pest management practice. For better rice cultivation under organic farming is to supply adequate amount of nutrient to the plant at critical growth stage and enhance the productivity of organic rice systems in the future, application of nutrient-rich manures must be thoroughly researched. To control pest and disease it should be proper monitoring the pest population and apply required dose of organically developed insecticide and pesticides.

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Conflicts of interest. None.

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