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Faculty of Organic Agricultural Sciences,
University of Kassel,
Nordbahnhofstrasse 1a,
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Germany.

Email: *editorialboard@fofj.org*

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Table of Contents

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ISSN-Internet 2197-411x OLCL 862804632

Editorial

Prof. Dr. Dr. hc. mult. Angelika Ploeger, Head of the Editorial Board FoFJ

Dear readers, authors, and members of the editorial board,

A year has passed, and I would like to thank you for your loyalty to reading and writing research results in our International Journal on agriculture, food and society.

As you all know, around the world, tremendous crises had and still have to be managed, ranging from health problems such as Covid 19 infections, droughts and floods, and landslides as a result of climate change as well as war, e.g. in Ukraine. Political meetings worldwide try to establish stable economic conditions, food security, and medical support. We observe worldwide immigration between countries and continents to escape hunger and war. As it was pointed out in the opening speech at COP 15, a silent war is going on – humans against nature.

Think of the red lists for endangered species. Think of food-producing areas in place because ecosystems such as old forests have been cut or bogs and wetlands were drained. Sometimes we need to estimate how technology might influence ecosystems and species such as insects. Although scientists are productive in research projects, considering the multi-anthropogenic pressures and the numbers of e.g. pollinator diversity -approximately 350 000 species (1) - one can imagine that not sufficient results of interactions are known and proven by science. Therefore, we have to act according to the principle of precaution. Since 1999 the essential role of pollinators in sustainable agriculture and ecosystems has been recognized internationally (Sao Paolo Declaration of Pollinators- (2), insect pollinators have been protected under international agreements. In COP 15 in Montreal, the role of pollinators will be an especially relevant topic. The goal is the negotiation of "A Post-2020 Global Biodiversity Framework". One of the topics being discussed is synthetic biology (3) and its direct impact on pollinators and the conditions of their survival. "Gene drive organisms are expressly designed to spread, to create large-scale changes in natural populations and thus to transform entire ecosystems". Considering the importance of pollinators for our plants and food security we, as scientists as well as consumers, should observe the discussions going on. An appeal signed by policy experts and prominent scientists calls upon the Parties and Signatories to the UN Convention on Biological Diversity to oppose the deployment in nature of genetic biotechnologies at international, regional and national levels (4).

As UN secretary-general's COP15 speech pointed out on Decembre 7th: "Humanity has become a weapon of mass extinction" and the goal for the future is "to live with nature in peace".

We all should work as scientists and consumers to make this happen, to make the new year 2023 a "happy new year"

ISSN-Internet 2197-411x OLCL 862804632

(1) https://wildlife.ca.gov/Science-Institute/Pollinators

(2) https://www.cbd.int/doc/ref/agr-pollinator-rpt.pdf

(3) https://www.nature.com/articles/s41467-020-20122-2

(4) Third World Network Information Service: TWN Info Service on Biodiversity 3 December 2022; Civil Society Organisations Around the Globe Demand a Moratorium on Genetically Engineered Gene Drives at UN Biodiversity Conference; www.twn.my

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Research Paper

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The Relevance of the Keduk'an System to the Realization of Food Sovereignty: A Study in Juku Batu Village, Indonesia

AHMAD ZAZILI[1,*], DEWI SEPTIANA[1]

[1]Faculty of Law, University Of Lampung, Bandar Lampung, Indonesia

* Corresponding author: ahmad.zazili@fh.unila.ac.id

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Keywords

keduk'an system; profit sharing; food sovereignty

Keduk'an system is a profit-sharing system for agricultural products in Juku Batu Village, Banjit District, Way Kanan Regency, Lampung Province, Indonesia. However, the pattern of the system differs from the profit-sharing system in other areas. The purpose of this study is to find the characteristics of the keduk'an system and its relationship with food sovereignty. This research is essential because it is related to efforts to fulfil food for the poor society. The research method used is Socio–Legal, with a descriptive approach to explore information from the parties in the keduk'an system. The research location is Juku Batu Village, Banjit District, Way Kanan Regency, Lampung, Indonesia. The research findings revealed three critical aspects that were relevant to food sovereignty, namely: first, the status system of economic values, cultural and social values, and religious values. The keduk'an system can also be adopted at another place to realize food sovereignty.

1. Introduction

Indonesia has globally been recognized as an agrarian country with a major dependence on agriculture. This was also noted by a renowned international body-Food and Agricultural Organization (FAO) of the United States (FAO, 2018; Pradana, 2019; Anna Fatchiya, et.al, 2018). The agricultural sector is one sector that provides many sources of life for the Indonesian people and is important in economic growth (Ekanopi Aktiva, et al, 2017). Agriculture is part of the community's culture which has long been practiced as a community tradition. Social tradition is also a part of the culture. This statement is in line with Chris Jenkes who stated that tradition is a social inheritance that develops the functions of life based on emotion and intelligence (Chris Jankes, 1993). This view is also stated by Mudji Sutrisno who declared that a tradition refers to social reality based on values, mentality, and life order (Mudji Sutrisno, 2009).

A social tradition is formed of a life pattern conserved and inherited from generation to generation in society. Society needs to follow and continue the tradition of the previous generation because they feel that there are good values and practices needed in their life (Kara & Pickering, 2017; Lee, 2012). Agriculture, as part of the culture, gives birth to a cultural and social system in the form of values, norms, and regulations. This is the agricultural product-sharing system, also known as the profit-sharing system (Wahyudi David, et al, 2012). The development of this agricultural production sharing system is strongly influenced by the ownership of agricultural land factor. Based on the pattern of ownership, farming land is classified into three types, namely: self-owned land, leased land, and profit-sharing land (Hayami & Otsuka, 1993). In terms of land ownership, there are three groups of farmers, namely: established farmers (Farmers) who

have large agricultural land; small farmers (peasants) who have an agricultural land area of less than 0.5 ha; and farm labourers who do not own any land at all and work on other people's land (Koeriatmanto Soetoprawiro, 2016).

In the research location, the emergence of the keduk'an system is influenced by the level of income of smallholders who do not have sufficient income to cater to their daily needs. There are two patterns of the keduk'an system, namely the agreement between the cultivator and the owner of the field, and the agreement between the tenant of the field and the tenant. Several studies related to the status system have been conducted, including:

a. Fauzi, Hariyati, and Fauzan noted that the masking system that occurs in rice commodities in Jember Regency, is only obliged to provide labour for harvesting and get 20% of the grain produced (Fauzi, Hariyati, & Aji, 2014).

b. Kedokan system in Lumajang Regency has a slightly different pattern, the pengdok (farmer) is obliged to provide costs for seeds, fertilizers, tractor rental, and irrigation costs with different profit-sharing proportions depending on farming conditions (Malik et al., 2018).

c. Mohammad Rondhi and Ad Hariyanto Adi, namely the research of the kedokan system in Jatimulyo Village, Jenggawah District, Jember Regency. The Farmer called "pengedok" only has obliged to paddy maintenance and energy allocation (Rondhi, M. et. Al., 2018).

Unlike the previous research, this research investigated numerous elements of cultural, social, economic, philosophical, legal, and religious principles from the Keduk'an system and their connection to food sovereignty.

2. Materials and Methods

This type of research is empirical legal research with a socio-legal approach to examine the cultural phenomena of farmers in cultivating or processing agricultural land in order to find philosophical values, religion, and socio-economic implications for efforts to realize food sovereignty. In addition, this research also uses a statutory approach to examine the laws and regulations related to the agricultural production sharing system, a conceptual approach, and a philosophical approach to examine aspects of justice in the agricultural production sharing agreement system.

Research data were obtained from various sources using comparative analysis data collection techniques with the aim of obtaining data accuracy (Rahmawati & Yusuf, M., 2020). Data were obtained through interviews and direct observation by researchers to obtain data accuracy and meaning about keduk'an system (Kara & Pickering, 2017; Lee, 2012). This research was conducted on rice farmer families with the category of farmers who share the results after harvest (cultivators) and other parties who have a relationship with the implementation of the keduk'an system in Juku Batu, namely government officials. Based on the results of information from the interviewed parties, it was then analysed to gain an understanding of the values that underlie the implementation of the duk'an system.

3. Discussion

3.1. Implementation of Keduk'an System in Juku Batu Village, Banjit District, Way Kanan Regency, Lampung, Indonesia

Juku Batu Village has an area of 7700 ha, with details of 7000 ha of land and 700 ha of rice fields. Located at an altitude of ± 200 above sea level and rainfall of ± 200 mm, the average air temperature is 28° - 32° Celsius (Juku Batu Village Profile 2020). The Juku Batu area can see in figure 1.

The population of Juku Batu Village is 3150 people, most of whom are farming, especially in the agricultural and plantation sectors (Juku Batu Village Profile 2020). The population of Juku Batu is seen from the aspect of welfare is still low (Juku Batu Village Profile 2020). The level of community welfare can be seen in table 1.

Based on the table above, it can be seen that most of the residents of Juku Batu Village are not yet prosperous. This condition has an impact on meeting the needs of daily life, and this condition also affects the birth of the status system. Meanwhile, the employment conditions of the residents of Juku Batu village can be seen in the table 2.

ISSN-Internet 2197-411x OLCL 862804632

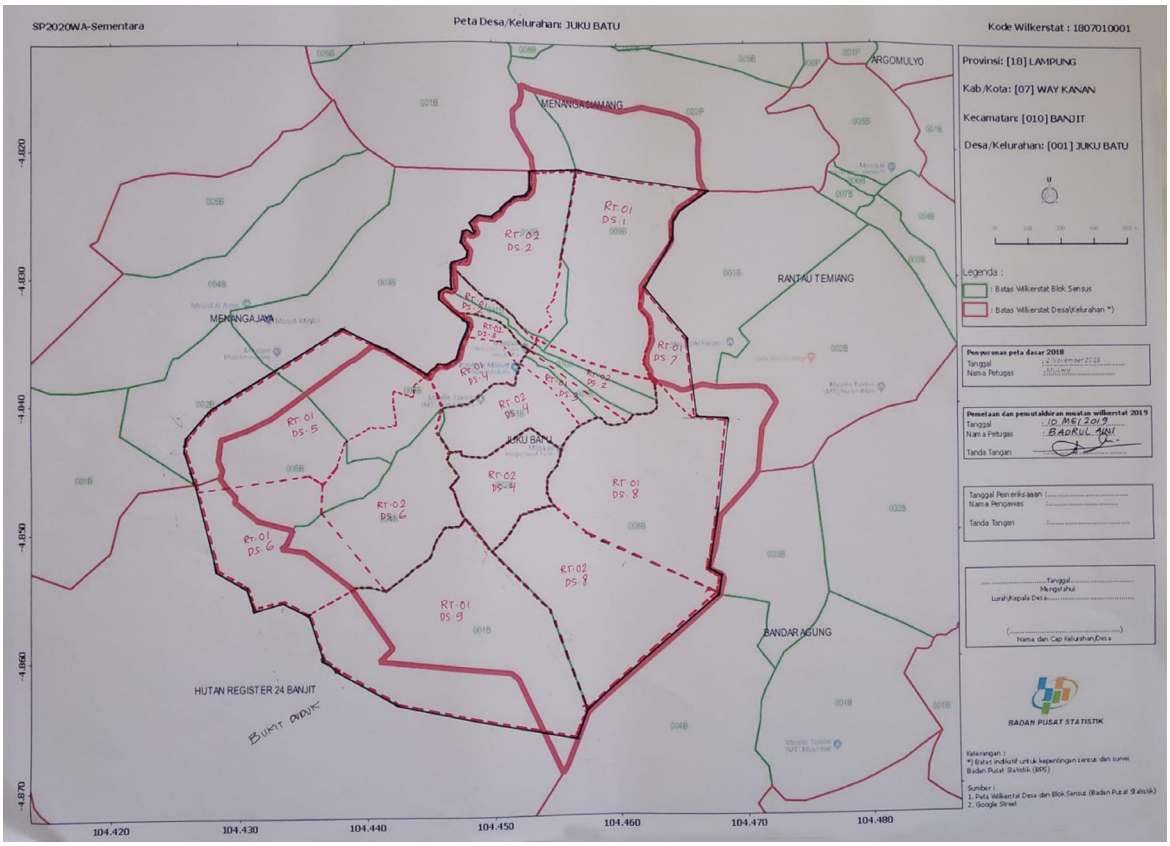

Figure 1. Juku Batu Village Area Maps

Table 1. Conditions of Community Social Conditions in Juku Batu Village

The Kinds Of Family	Account
Pra-Prosperous family	236
Prosperous family I	324
Prosperous family II	100
Prosperous family III	110
Prosperous family III Plus	65

(Resource: Juku Batu Village Profile 2020)

Table 2. Kinds Of Job in Juku Batu Village

The Kinds Of Job	Account
The Farmer owner plantation	188
The Farmer Paddy	115
Share farmer	70
Worker Farm	560
Trader	98

(Source: Juku Batu Village Profile 2020)

Based on the table above, it can be stated that most of the populations of Juku Batu Village work as farmers. This condition is the background for the birth of keduk'an system because many people have small incomes, which are not sufficient to meet the needs of daily life. In order to increase their income in the form of rice, many are farmers working in paddy fields.

Information regarding the implementation of the keduk'an system between tenant farmers and the owners or renters of paddy fields was collected through interviews with farmers and government officials in Juku Batu Village. The parties interviewed included the following:

a. Megawati explained that she is a smallholder farmer who has been a cultivator for a long time. According to her, through the positioning system, she can produce about 2 quintals of rice in one harvest season. The rice is used for the food needs of the family, either for daily consumption or for other purposes.

b. Mr. Karim, who explained that he is the owner of the rice fields that he cultivates himself, feels helped by the existence of keduk'an system, on the aspect of labour. According to him, under the keduk'an system, all planting and harvesting are carried out by cultivators or pengkeduk, so there is no need to pay wages during the planting and harvesting stages. In addition, it was stated that finding labour during the planting or harvest seasons was extremely difficult because the cultivators already owned their respective arable lands. That is the primary reason he uses the keduk'an system to cultivate his rice fields. Pak Karim explained that he was a bit overwhelmed when harvesting because the cultivators who were cultivating their fields suddenly resigned despite the fact that the rice had turned yellow and needed to be harvested immediately or it would all collapse from the stalks. The rice farmer suddenly resigned due to his family problems' his young children could not be left to work in the fields. To overcome this, Pak Karim sought assistance from his extended family.

c. Abdulsamadexplained that his wife is a pengkeduk (farmer) and that he has cultivated many rice fields. He also explained that this keduk'an system has been used by almost all farmers and that the number of people who want to become cultivators is due to the fact that the results are quite large depending on the size of the paddy fields being cultivated. The larger the area, the more results are obtained. The distribution of the results of cultivation in keduk'an system is 8:1, commonly known as the 8/1 community, which means that from eight cans of rice, the distribution is 7 cans for the owner of the rice field, and 1 can for the farmers. Besides, all rice zakat is distributed to the farmers at a rate of 10:1. The meaning is that for every 10 cans of rice, 1 can is given to the farmer. Similarly, if the land gets 100 cans, then 10 cans are given to the farmer as zakat fitrah.

d. As the government apparatus of Juku Batu Village, Badrul explained that this zakat fitrah is one of the motivations for people to want to become pengkeduk, and that even if the pengkeduk and the owner of the paddy field have a close relationship, additional rice is usually given as a gift.

e. Mat Imran, the owner of a 2-hectare rice field, stated that his rice yields range from 800-900 cans at one time and that there are 4 pengkeduk (farmer) in his rice field due to the large area of rice fields he owns. He also stated that at the time of planting, there were 60 people who planted rice and the planters are members of the pengkeduk group. According to the provisions of the keduk'an system, the profit sharing pattern is 8:1, which means that for every 8 cans, 7 cans belong to the rice field owner, and 1 can belongs to the pengkeduk. Mr. Mat Imran also stated that the keduk'an system gave him pleasure and satisfaction because he was able to help pengkeduk (farmers).

Based on the above information, the pattern of legal relations in the duk'an system can be stated as follows:

1. There is an initial communication between the pengkeduk and the land owner/tenant of the paddy field. At this stage, they agree to use keduk'an system for the harvest season.

2. Next, determining when to plant rice seeds is important in order to prepare everything needed on the day of planting, for pengkeduk the time or day of this implementation is important to invite his friends to plant in the fields. Meanwhile, for land owners, determining the importance of planting to prepare seeds in advance, as well as to prepare consumption as a ban-

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quet because there will be a lot of people who will attend. In practice, the consumption provided is in the form of snacks or snacks as well as coffee or sweet tea, while the staple food in the form of rice is usually the farmers who will plant their own. Rice seeds are planted in one day.

3. The third stage is the harvest. At this stage, the land owner determines when the harvest will be carried out. The harvest time is determined by the condition of the rice; if it has turned yellow- it indicates that it is time to harvest, and in such cases, the land owner will inform the pengkeduk. The pengkeduk will then contact his friends and inform them that the harvest will be carried out in the fields in his keduk. The friends of the pengkeduk are friends of fellow pengkeduks who long ago had joined the social gathering at work or in the Semendo language called Sakhiyan or daily.

4. The fourth stage is the distribution of the harvest. After all, the rice has been sifted and then pounded or separated from the stalks and then gathered, the final stage begins, namely the distribution of the harvest. The pattern used is 8:1, meaning that for every 8 cans of rice, 7 cans belong to the land owner, and 1 can belongs to the farmer. The more the harvest, the more the results obtained by both parties.

5. The last stage is giving agricultural zakat. After all of the rice harvested is divided between the rice field owner and the mourner, agricultural zakat is paid if the results are harmonious. For instance, in the case of 100 cans, only10 cans of zakat will be paid. The recipient of this zakat is the rice farmer.

6. The profit-sharing arrangement is normally terminated by the individual who previously agitated the rice field again.

3.2. Analysis Of The Position System From Legal, Social Economic, Religious, And Philosophical Perspectives.

3.2.1. Rights and Obligations of the Parties in the Dignity System

According to Wiradi, kedokan is a system of work relations or work agreements between land owners/ controllers and farm labourers in which both parties agree that for one or more parts of the rice fields, the workers are ready to undertake certain jobs for wages rather than pay, in order to organize a harvest with a certain outcome distribution (Wiradi, 2009). In order for the distribution of land products between owners and cultivators to be carried out on a fair basis and in order to ensure a proper legal position for cultivators, it is necessary to emphasize the rights and obligations of both the cultivators and owners (Saleh, K. W. 1987). Sharecropping arises when an individual, who requires land for cultivation, agrees to submit part of the crop to the Landowner in terms of some agreed share. Further, it presumes that the shares vary from area to area and that they may also depend upon the type of crop grown and the yield of the harvest (Hooker, M.B. 1978). The results of the study obtained information about the rights and obligations of the parties in keduk'an system in Juku Batu Village, presented in table 3.

Table 3. Rights and Obligations in Keduk'an System in Juku Batu Village

Parties	The Rights	The Duties
Land Owner	Receive much as 80% harvest paddy or seven cans paddy of each 8 cans	o Supply: seed, fertilizer, pesticide, and other cost productions. o Bear all production risks
Pengedok	Receive much as 20% from the total harvest paddy or one can of each 8cans	o Planting and harvesting

(Resource: Result Of Research Keduk'an System, 2021)

The kedokan system is a revenue-sharing cooperation system in which the farmer gets one-seventh of the production, while the rest belongs to the land owner. The profit sharing proportion is 1 can belonging to the pengkeduk, 7 cans are owned by the rice field owner, and this formula continues to be used until the harvest is distributed, while the pengkedok is obliged to carry out planting and harvesting. All these tasks are carried out by the pengkedok himself. The advantage for the dockers is that they do not bear any production risk at all. In contrast to other profit-sharing systems such as maro and sakap where cultivators must still provide some of the production inputs and bear some of the production risk (Mohammad Rondhi, Ad Hariyanto Adi, 2018).

According to the theory of justice, the profit-sharing model scheme with the duk'an system is fair because the cultivator only expends energy, whereas the landowner expends a significant amount of money or capital in the implementation of the duk'an system. Hence, the results should be distributed so that the field owner receives a larger share, namely 80% of the harvest, while the cultivator receives a smaller share, 20% of the harvest. (Al-Daghistani, 2016; Hadrich et al., 2017; Key, 2019; Kumar et al., 2017; Yasa, 2015).

3.2.2. The Keduk'an System in Economic, Social, and Cultural Perspectives

In keduk'an system, the economic perspective that influences the community to carry out a profit-sharing culture includes: obtaining harvests, reducing production costs, profits earned, individual income, costs incurred, individual entrepreneurial spirit. Meanwhile, from a cultural perspective, agricultural production sharing agreements with keduk'an system in Juku Batu Village have become a habit that is carried out continuously and obeyed by the community. The profit-sharing system carried out by rural communities in general is based on a mutual agreement between capital owners and tenants according to local customary law. The profit-sharing agreement that occurs is usually carried out verbally with mutual trust between members of the community. As a consequence of the difference in status as farmers who own land capital with sharecroppers in the management of a plot of land, of course, it will be divided according to the agreement of each party and the habits that generally apply in an area. (Thévenot et al., 2013).

A culture of mutual trust (honesty), a culture of mutual assistance (helping each other) and cooperation, and a simple and practical culture all exhibit cultural values. According to Elly M. Setiadi (2007), "culture is a complex whole which includes knowledge, belief, art, morals, science, law, customs and other capabilities and habits acquired by humans as members of society." So, in this study, culture refers to the habits of the people of Juku Batu Village in interacting and engaging in community activities such as planting rice and harvesting rice in order to form an inner bond that helps each other. Hence, culture, in this case, refers to people's habits to maintain good relations with other members of the community (Witoro, 2018). This highlighted that human efforts to gain access to food are carried out in the following ways: "direct entitlement, namely "rights to food obtained through relationships in food production process activities"; exchange entitlement, namely "rights and access to food. This is obtained through the exchange of services or expertise"; trade entitlement, namely "the right to food obtained through the sale and purchase relationship of self-produced commodities; and social entitlement, namely "rights and access to food obtained through social exchange among members of the social community". In the perspective of justice proposed by Amartya Sen, research on agricultural production sharing is part of a special entitlement to direct entitlement, namely "the right to food which is obtained through relationships in the activities of the food production process" (Amartya Sen, 1981).

3.2.3. The Kedukan System in Sharia Perspective

In addition to the socio-cultural, economic, and philosophical values, it was discovered in the duk'an system in Juku Batu Village that there are religious values, specifically rules regarding zakat payment. The existence of this religious aspect is because the majority of the population in Juku Batu village is Muslim. Zakat is an Islamic teaching which is the third pillar of Islam, namely paying zakat.

The provisions regarding agricultural Zakat are contained in Article 14 of the Regulation of the Minister of Religion, of the Republic of Indonesia, Number 52

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of 2014. This concerns Terms and Procedures for Calculation of Zakat Mal and Zakat Fitrah and Utilization of Zakat for Business and stated:

(1) The nisab of zakat on agriculture, plantation, and forestry is 653 kg of grain.

(2) Zakat on agriculture, plantation, and forestry is 10% if rain-fed or 5% if irrigation and other treatments are used.

(3) In the muzaki's yield exceeds the nisab, the zakat that must be paid is 10% if rain-fed, or 5% if irrigation and other treatments are used.

The rice fields in Juku Batu Village, which cover nearly 200 hectares, are all irrigated by the Way Umpu River and Nangsiamang River, and the tributaries or local people are referred to as "luang" (Little River). In addition, the costs incurred in processing rice fields from the initial stage to the harvest stage such as ploughing, seeds, seeding, weeding, fertilizers, pesticides, transportation, and others, nearly reach Rp. 5,000,000.

Thus, the percentage of agricultural zakat is 10% because it uses irrigation channels and other costs such as ploughs, fertilizers, pesticides, and others. The pattern used by the farming community in Juku Batu Village, is 10:1, that is, for every 10 cans of paddy rice, 1 can is issued for zakat.

3.2.4. Keduk'an System in the Perspective of Food Sovereignty

Food sovereignty is the right of every nation that can guarantee every people to be able to produce food independently (self-sufficiency). The concept of food sovereignty was developed in order to find an alternative policy based on the people's right to food. This is a re-definition by the people themselves towards food security advocacy which has failed miserably in reducing hunger (Erfan Paryadi, 2012).

Food sovereignty contains four dimensions, namely; 1) The food production process is adapted to the conditions and potential of local resources (define own food and agricultural system); 2) Cultivation or food production activities are carried out in an ecologically sound manner; 3) The role of food-producing farmers needs to be appreciated by increasing their welfare (farmer's welfare), not only as a form of appreciation for their services in providing food, but also so that farmers remain motivated to carry out their work of producing food; and 4) prioritizing sustainable food production processes, which can only be realized if the technical-agronomic, ecological/environmental, and socio-economic dimensions are harmoniously combined in every effort to optimize food production, distribution and consumption" (Hafsah, M. J., 2017).

Keduk'an system contributes to the poor obtaining sufficient food through a fair distribution of arable produce and the existence of gifts from rice field owners in the form of zakat on agricultural products. This model must be maintained as a form of local wisdom and can also be adopted elsewhere.

4. Conclusion

People in Juku Batu Village used the keduk'an system because of the benefits for cultivators or pengkeduk. The benefits for cultivators include receiving rice after harvest, both from profit sharing and from agricultural zakat given by rice field owners, while the benefits for land owners include assistance in business matters. From the planting to harvesting process, the owner of the fields does not need to pay for planting and harvesting. In addition to the economic benefits, there are also social benefits, namely the establishment of friendly relations between owners and residents. Economically, the duk'an system provides benefits for the parties, namely getting the harvest proportionally according to the sacrifices of each of these things in accordance with the principle of economic justice. Furthermore, the profit-sharing agreement with the duk'an system discovered religious values, including the payment of zakat from the land owner to the pengkeduk, which is appropriate from the standpoint of justice theory because the excess party helps the less party.

Conflict of interest

The author hereby declares no conflicts of interest in this research.

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Financing for the climate change adaptation of organic export agriculture in Peru

EDELINA COAYLA[1,*] AND LUIS JIMÉNEZ[2]

[1]Faculty of Economic Sciences, Universidad Nacional Federico Villarreal, Lima, Peru.
[2]Faculty of Economics and Planning, Universidad Nacional Agraria La Molina, Lima, Peru.

* Corresponding author: acoayla@unfv.edu.pe

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Financing; climate change; adaptation; agro-exports; organic food

The objective of this research is to analyse financing for the climate change adaptation of organic export agriculture using the methods of correlation and logarithmic regression, as well as exploring the sources of funding. In a context of high international demand, we find that Peruvian organic agro-exports grow in direct relation to the increase in the land area used for organic crops. From 2000 to 2020, exports of organic products achieved a continuous rise, and in 2020 they accounted for 7% of all agro-exports. However, so far little financing has been found internationally for the climate change adaptation of organic agriculture. Among the main financiers at the international level are the Green Climate Fund; IDB Invest, which finances an agro-export fruit and vegetable company in Peru; the FAO, which funds "Yachachiq–Kamayoq" network of women-led bio-businesses in actions to adapt to climate change in Peru; IFAD, which finances the agricultural project "Avanzar Rural" in the Peruvian highlands and Amazonia; and the Peruvian National Institute of Agrarian Innovation, which funds an association of farmers in the Piura region to improve the export of organic bananas to the Netherlands and Germany. It is recommended that policymakers in Peru implement adaptation options – among them, an increase in the land area used for organic production to promote food security, as well as accessible and innovative climate financing for the adaptation of small organic producers.

1. Introduction

Based on International Monetary Fund (IMF) projections of decreasing gross domestic product (GDP), the Food and Agricultural Organization predicted in its report "The State of Food Security and Nutrition in the World" that hunger could grow on a global scale, between 83 and 132 million people – that is, there could be 828 million affected individuals. Although the undernourished population is expected to decline in 2021, the figures are still forecast to be higher than before the pandemic (FAO, IFAD, PAHO, WFP, and UNICEF, 2020).

Agriculture is highly vulnerable to climate change (MINAGRI, 2020). Faced with adverse climate effects such as heat waves, droughts, heavy rainfall, and other extreme weather events, agricultural systems must adapt to negative impacts to ensure resilient food production. In this context, organic farms often maintain greater species diversity and grow locally adapted varieties that enhance the resilience of agro-ecosystems against adverse climatic conditions (FiBL & IFOAM EU, 2016). The Inter-American Institute for Cooperation on Agriculture (2017) supports the planning process for adaptation to climate change in order to

ensure the resilience, productivity, and competitiveness of the agricultural sector in Central and South America.

According to Campos et al. (2017), from 2011 to 2015, Peru's exports grew by 53%, which is a similar rate to other countries with a more significant share in the production sector in terms of land use and producer participation. Exports of agri-food products drive the growth of rural areas, but little is known about the role that exporters play in adapting to climate change; however, it has been noted that they need better information and more financial capital to face the phenomenon in the long term (Kasterine et al., 2015).

Arid desert covers much of Peru's coastal and south-western region, restricting agricultural cultivation to highland areas in the Andean Mountains or humid tropical lowlands. Rain patterns are heavily influenced by the El Niño-Southern Oscillation (ENSO). Although 71% of the world's tropical glaciers – a critical water source for agriculture – are found in Peru, the glacial volume has retreated by 40% since 1970 due to the increase in temperatures associated with climate change. In addition, the increased frequency of El Niño/La Niña events resulting from climate change can lead to a higher incidence of floods, droughts, soil erosion, landslides, and pests/diseases in mountainous and humid lowland areas (Prager et al., 2020).

The international trade in agricultural products is subject to regulations to protect plant variety and take care of human and animal health against pests and risks of additives, toxins, pathogens, or contaminants in food and beverages amid rising global demand for healthy food (MINAGRI, 2020).

Most financial institutions that grant loans to small agricultural producers lend two types of funds: working capital and investment, which have different characteristics relating to criteria such as payback period and the maximum amount that farmers can borrow (Pinzon, 2019). The contribution of the average agricultural credit over the total credit of financial institutions is 4.5% (Table 1).

Climate finance is used chiefly for mitigation actions, with an average of only USD 22 billion per year for adaptation (Tietjen et al., 2019); one of the main discussions in the realm of adaptation finance is the difficulty in distinguishing between adaptation and development projects since climate resilience and development are closely linked.

This study addresses three questions appertaining to the issue of climate change adaptation for organic products, respectively, as follows: What financing

Table 1. Agricultural credit disbursed by different financial institutions

Financial Institution	Total agricultural credit (thousands of USD)	% agricultural credit in total loans
Banks	1,753,076	2.8%
Financial institutions	135,179	4.8%
Municipal savings and credit institutions	249,832	5.0%
Rural savings and credit institutions	29,804	8.5%
Small and micro-enterprise development institutions	8,158	1.6%
Savings and credit co-operatives	NA	
Finance system	**2,562,226**	
% selected financial system	85%	

Source: Pinzon (2019). Appendix 2 (2018).

contribution has been made to the climate change adaptation of organic export agriculture in Peru? What progress has been made in financing the climate change adaptation of organic export agriculture in Peru? What options are available for Peruvian organic agro exports to adapt to climate change?

This study is justified because agro exports are the economic activity that generates the second-highest volume of foreign exchange in Peru. Even in these times of recession due to the pandemic, international demand for organic agricultural food continues to drive the industry's growth, provide livelihoods and employment to rural inhabitants, and, in turn, contribute both to the sustainability of Peruvian economic growth and to achieving several sustainable development goals (SDGs 1–3, 8, 12, and 13). Climate adaptation financing is crucial because the agricultural sector is very vulnerable to climate change, and organic agro exports are of particular importance for food security and global environmental security.

The study's objective is to analyse financing for adaptation to climate change in the case of organic export agriculture in Peru. Specifically, we will explore the advances made in providing financing channels for the climate change adaptation of organic agriculture and examine the options available for helping Peruvian organic export agriculture adapt to climate change.

2. Literature review

Nowadays, the world is facing a series of significant political, institutional, and financial changes in the global approach to adapting to climate change. Climate change adaptation and mitigation are essential to achieving the SDGs. The Adaptation Program for Small-Scale Agriculture (ASAP) of the International Fund for Agricultural Development (IFAD) is a multi-donor fund and, since its establishment in 2012, has pioneered resilience-building among highly vulnerable populations. So far, the ASAP has led to improved adaptive capacity for some 5 million smallholders in 41 countries. By 2020, ten countries were scaling up the activities and lessons learned from the original ASAP investments. (International Fund for Agricultural Development (IFAD) (2020).

Organic agriculture is more resistant to the impacts of climate change, partly because organic soils contain higher levels of carbon. As weather and rainfall patterns continue to change, organic farming will be better able to adapt. On the other hand, conventional agriculture is responsible for a significant portion of global and domestic GHG emissions. Opportunities can be created for farmers to transition to organic production through incentives such as carbon credits. Moreover, many organic practices can be incorporated into conventional farming methods to help reduce GHG emissions (Criveanu, & Sperdea, 2014).

Schader et al. (2021) used data from five crops in the seasons from August 2014 to March 2017 to assess the impacts of sub-Saharan African implementation of organic agriculture and smallholder organic management practices on 1,645 farms from five case studies in Ghana and Kenya, which they monitored for 24 months. They found significantly higher farm-level gross margins (144%) on organically managed farms than on conventional farms.

Financial flows are divided between the adaptation and mitigation of small-scale agriculture (Chiriac et al., 2020). Allocation of most small agricultural climate funds for adaptation is also in line with the increased vulnerability of operators in rural areas of Africa, Asia, and the Americas, due to the impacts of climate change on agricultural productivity, income, and food security there.

Using principal component analysis (PCA), Bedoya-Perales et al. (2018) showed that the quinoa boom in Peru resulted in an expansion of quinoa cultivation both in traditional areas and in new regions in the period 1995–2014, in many cases involving changes in land use. This meant that the number of hectares planted with quinoa in 2014 increased by 43% compared to what would have been expected without the boom mentioned above. Meanwhile, Arslan et al. (2020) evaluated sets of indicators related to income, resilience, food security and nutrition, and women's empowerment in a project to strengthen local development in the Altiplano and High Forest Zones of Peru.

The fight against climate change requires billions of dollars in financing to move towards a low-carbon economy and reach the goals of the Paris Agreement by 2050 (EU-LAC Foundation, 2020, p. 21). Accord-

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ing to empirical evidence, green bond markets are more prominent in countries with environmental commitments. Reducing information asymmetries is laudable; investors demand transparent information about the fate of green bonds and value sustainable investments in adaptation and mitigation. A green agricultural bond certified by FIRA was issued in Mexico (Fundación EU-LAC, 2020).

According to MINAM (2021), faced with the effects of climate change, adaptation means addressing adjustments to the current or projected climate as well as its impacts on human or natural subsystems to take advantage of the benefits and reduce or avoid the damage. With almost 50% of projects targeting adaptation activities, climate finance for small-scale agriculture has a more balanced distribution between adaptation and mitigation, compared to total climate finance; it is mainly international, 95% comes from the public sector, made up of government donors and multilateral and bilateral development finance institutions at 39%, 32%, and 16%, respectively (Chiriac et al., 2020).

Adaptation to climate change is a public good (Timilsina, 2021), and in this regard, information on financing for climate change adaptation and resilience is distributed among various sources. However, the contributions of developed countries to climate funds remain low. Compared to funding for mitigation, adaptation lacks sufficient financing (Watson & Schalatek, 2021).

Organic agriculture uses fewer inputs than conventional agriculture, has more tremendous potential for carbon sequestration, and is more adaptable to the climate, and is more resistant to extreme weather events (Shaetzen, 2019). On average, because of crop rotation and organic production practices, there is both more biodiversity and crop diversity on organic farms than on traditional farms (Müller & Gattinger, 2012).

Organic agriculture is more respectful of the environment than conventional agriculture and capable of addressing sustainable development goals through its use of ecological technologies, which generate economic, social, and ecological benefits (Cidón et al., 2021). Thus, organic agriculture represents a promising adaptation strategy.

3. Materials and Methods

This non-experimental, expo facto, correlational and explanatory study covers the universe of financing for the climate change adaptation of organic export agriculture in Peru. The unit of analysis is the agro-export of organic products. The study period is annual, from 2000 to 2020 (n = 21).

3.1 Materials

The study draws primarily on statistics from the Ministry of Agrarian Development and Irrigation (MIDAGRI), the Commission for Export Promotion (PROMPEX), the Comprehensive Foreign Trade Information System (SIICEX), and the National Institute for Statistics and Informatics (INEI), analysed using SPSS software.

3.2 Data collection

Secondary information was collected from PROMPEX, in addition to statistics from SIICEX. For the study period, it was necessary to obtain quantitative, objective, and reliable data (volume, monetary value of exports, and financing). First, we reviewed the present financing characteristics for organic agriculture in Peru. Second, we quantified the contribution of the main organic products to Peruvian agro exports as a whole, and then used Pearson's correlation and logarithmic regression for statistical analysis. Third, we analysed the current financing contribution for the climate change adaptation of organic export agriculture. The procedure consisted of comparatively exploring the contribution of financial institutions that finance organic crops, loans for adaptation to climate change of organic export agriculture, and in general, credit support from multilateral financial organizations aimed at farmers in vulnerable areas of Peru (Table 7). So, we examined the progress made in climate financing for organic crops. The information collected on agricultural and climate financing is analysed considering that the beneficiaries are primarily farmers who grow organic products for export. The amount financed in dollars by each financial institution covers partially or totally (in some cases) the projects to improve agricultural production.

Then, we inquired about the available options for cli-

mate change adaptation of organic export agriculture. Finally, we considered the findings and implications of the pressing need to increase climate adaptation credits for farmers engaged in organic export crops worldwide.

4. Results

4.1 Organic agro-exports and financing

Within the study period, the percentage share of organic products (as certified by Promperú, Peru's export promotion agency) in Peruvian agro-exports peaked in 2007, at 8.2% (Table 2), which represented a 60% increase from 2006.

Peruvian organic agro exports rose by 5186% from 2000 to 2020 (Figure 1). Despite only peaking as a share of overall exports in 2007, in absolute numbers, exports of organic products evolved positively over the period 2000–2020. In the latter year, the composition of organic exports within total agro exports was approximately 7% (Figures 1 and 2, Table 2).

Exports of organic ginger have had a substantial increase of 163% in 2020 despite the pandemic context in relation to 2019. Organic blueberries denote a promising agro export potential for the future (Table 3).

According to Promperú, 70% of the 2020 ginger exports are organic. 80% of organic products are export-

Table 2. Exports of organic products, Peru 2000–2020

Year	Agro-exports of organic products, FOB (Millions of US$)	% agroexports organic products / Total agroexports
2000	9.80	1.52
2001	15.16	2.35
2002	21.90	2.86
2003	33.23	3.92
2004	44.37	3.94
2005	69.87	5.22
2006	100.85	5.62
2007	161.32	8.18
2008	194.22	7.47
2009	162.09	6.58
2010	212.85	6.70
2011	326.05	7.21
2012	250.39	5.99
2013	263.50	6.23
2014	366.25	7.21
2015	384.07	7.48
2016	445.71	7.99
2017	435.58	7.29
2018	400.51	6.00
2019	394.00	5.54
2020	518.00	6.86

Source: PROMPEX (Sector Report, 2009; Annual Reports, 2010, 2013, 2015, 2018, 2020)

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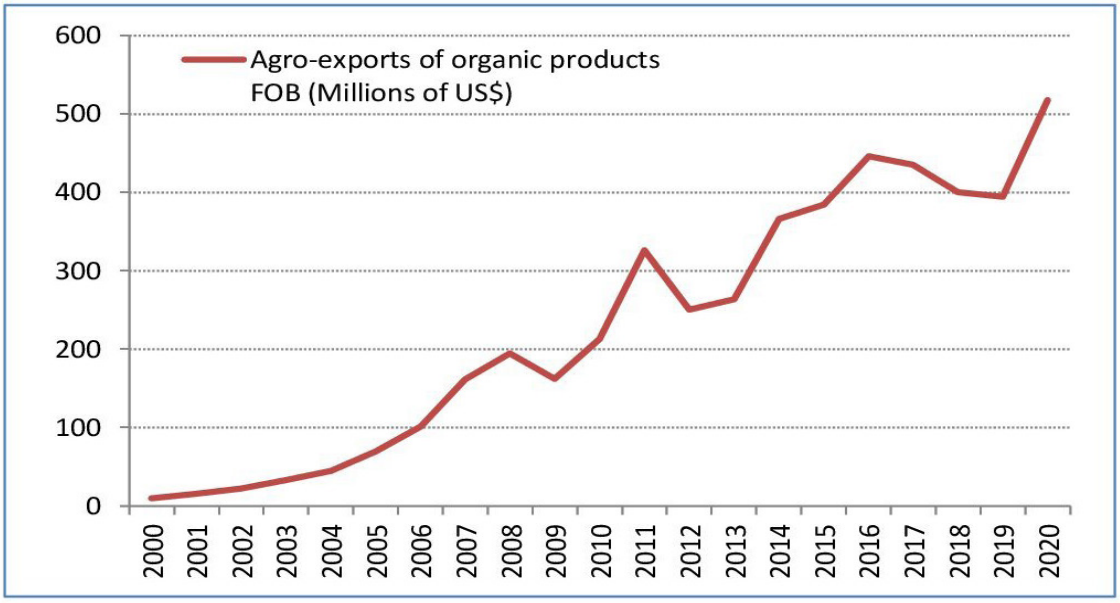

Figure 1. Evolution of agro-exports of organic products, Peru 2000–2020

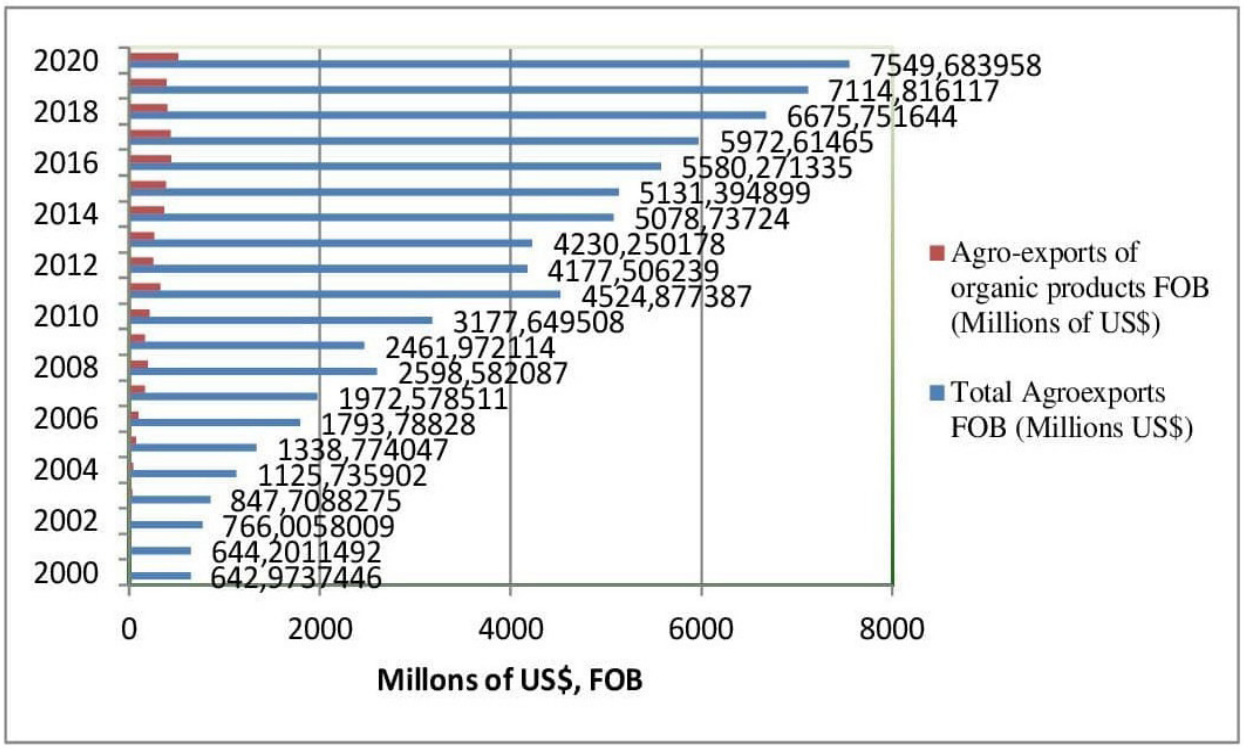

Figure 2. Agro-exports: organic products and overall, Peru 2000–2020

Table 3. Agro exports of main organic products, Peru, FOB (Millions of US$)

Product	2014	2015	2016	2017	2018	2019	2020	Variation % 2020/2019
Banana	119.40	144.63	152.09	148.50	166.50	153.00	152.00	-0.65
Cacao	77.86	78.97	56.65	48.98	28.05	20.00	20.00	0.00
Quinoa	60.75	49.20	38.78	52.36	55.11	60.00	61.00	1.67
Coffee	54.04	49.58	0.00	0.00	0.00	34.00	53.00	55.88
Maca	13.91	16.00	8.89	8.67	6.96	6.00	11.00	83.33
Ginger	11.08	11.13	12.91	32.67	28.43	27.00	71.00	162.96
Mango	5.25	7.49	7.04	6.99	9.93	12.00	15.00	25.00
Avocado	0.87	1.94	4.10	10.95	12.45	13.00	16.00	23.08
Blueberry						1.00	35.00	3400.00

Source: PROMPEX (Annual reports, 2015, 2018, and 2020). MIDAGRI–PLANAE (2021).

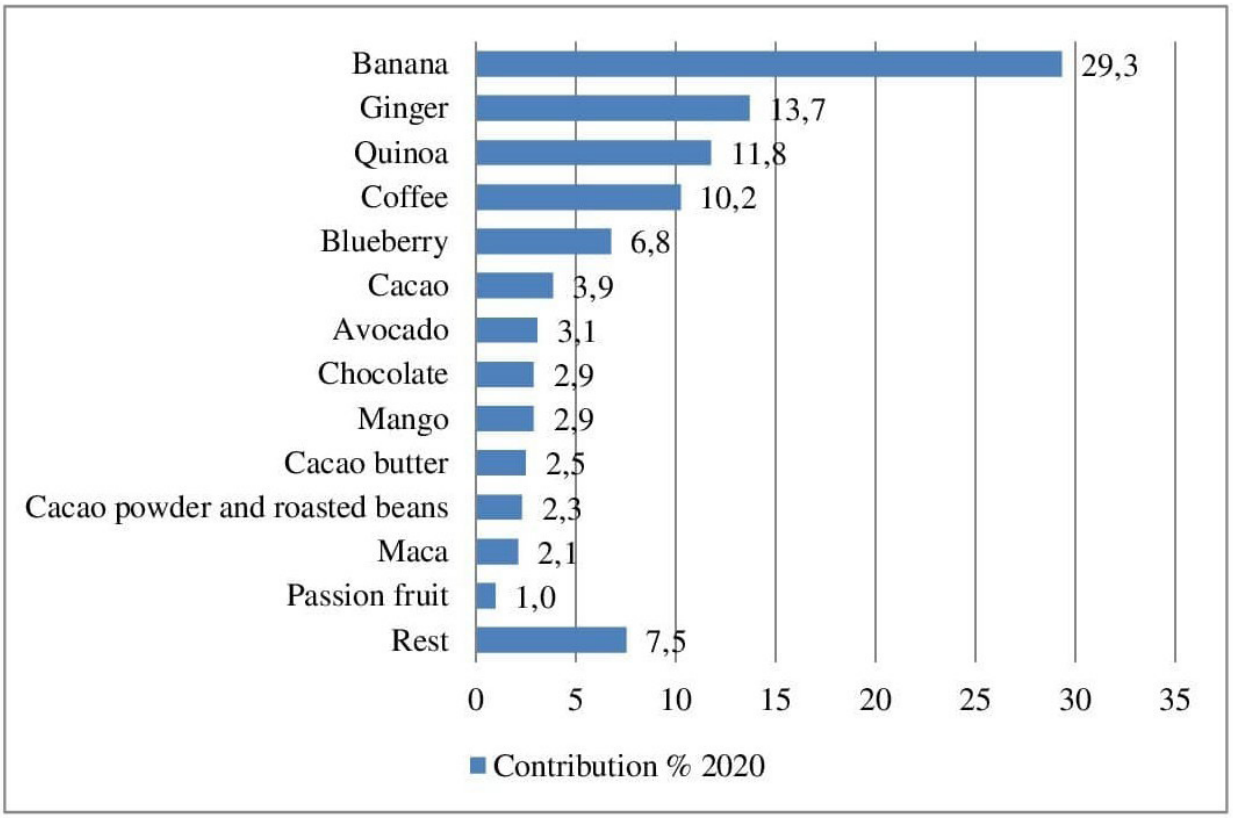

Figure 3. Contribution of main organic products exported Peru 2020, FOB (Millions of US$)

Source: PROMPEX.The organic foods that contributed the most to the FOB value of Peruvian organic agro-exports of organic products in 2020 were bananas, ginger, quinoa, coffee, and blueberries.

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ed to the European Union (MIDAGRI, 2021).

The main destination for Peruvian organic blueberries is the United States, which in 2020 amounted to US$ 30.7 million. The export of organic ginger in 2020 increased by 187.6% in FOB value compared to 2019. The main markets for organic ginger that same year were Europe, the United States, and Canada.

The land area under organic crops in 2020 has in-

Table 4. Planted area used for organic production, Peru 2006–2020

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Thousands of Ha	240.17	280.24	257.44	390.95	342.70	302.60	256.84	230.94	331.29	457.04	395.56	537.75	532.66	504.98	559.45

Source: INEI (2020). Peru: Yearbook of Environmental Statistics. SENASA (2021)

Table 5. Correlation: Organic agro exports and hectares of organic production, Peru 2006–2020

	Agro-exports of organic products, FOB (Mill. US$)	Area under organic crops (Thousands of Ha)

**. The correlation is significant at the 0.01 level (bilateral).

Table 6. Logarithmic regression: organic agro exports and hectares of organic production, Peru, 2006–2020

	Non-standardised coefficients		Standardised coefficients	T	Sig.
	B	Typical error	Beta		
Ln (Area under organic crops; thousands of Ha)	305.282	70.197	0.770	4.349	0.001
(Constant)	-1487.385	413.316		-3.599	0.003

R^2= 59.3%

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creased by approximately 11% compared to 2019, despite the Covid-19 emergency (Table 4).

According to the Sub-Directorate of Organic Production at the National Agrarian Health Service (SENASA), as of 2020, there were 107,000 producers with certified by SENASA, of which 94% are small farmers organised into 982 groups of operators. The most prominent organic crops certified in Peru are coffee, cocoa, quinoa, and bananas, while 90% of the country's organic production is exported. According to MIDAGRI (2021), the rise in organic production is due to high international demand, mainly from Europe (primarily the Netherlands, Germany, Belgium, France, United Kingdom, Italy, and Spain), United States, Japan, Canada, Russia, Australia, New Zealand, China, Mexico, Chile, South Korea, and Finland, among others.

The purpose of Table 7 is to compare the advances in agricultural financing and its adaptation to climate change by financial entities to answer the research questions. Among the financial contributors are the COP 25 Adaptation Fund, the Green Climate Fund, and the FAO which finance the strengthening of the climate resilience of crops and the livelihoods of rural communities. For its part, IDB Invest and the National Institute of Agrarian Innovation of Peru finance some organic crops for agro-export.

The Adaptation for Smallholder Agriculture Programme (ASAP) is IFAD's flagship climate finance program and applies rigorous quality control and monitoring systems. By the end of 2020, only 1.7% of global climate finance went to small-scale farmers in developing countries, despite their being highly vul-

Table 7. Agricultural and climate finance

Financing	Project/ Region	Amount / Entity	Details
Green climate Fund	- Strengthening the resilience of wetlands in the province of Datem del Marañón, Peru. FP001 - Latin America and the Caribbean, Africa. FP128. Arbaro Fund - Sustainable Forest Fund. Seven countries: Peru, Paraguay, Ecuador, Ethiopia, Ghana, Sierra Leone, Uganda. - Laying the Foundations for the Mitigation of GHG Emissions and Increasing the Resilience of Rice Production in the Framework of the NDC in Peru. Code: 5094-03. - Support for the Initiative " Improvement of Sanitary Management for the Implementation of the Agreement on Trade Facilitation " in Peru, Mincetur (Helvetas-IICA). Code: 5053-00.	- USD 6,240,000. 47% disbursed by 2021. PROFONAMPE. Designated National Authority: Ministry of Economy and Finance (MEF) - Total GCF funding: USD 25,000,000 PROFONAMPE, MEF. - Resources: USD N.A. Technical facilitation: Inter-American Institute for Cooperation on Agriculture (IICA) Executing entity: MIDAGRI. - Resources: USD 293,100. Framework: Be Competitive Program of the Swiss Cooperation - SECO. Executing entity: Mincetur.	- Approval Date: 02/27/2017 Start date: 03/10/2017 Duration: 10 years. Underway. Climate resilience and livelihoods of indigenous communities, reduction of GHG emissions due to deforestation (Def. Avoided 4,861 ha). - Approval date: 03/12/2020 Start date: 10/30/2020 Term: 10/30/2034. Underway. - Start: 02/01/2021 Term: 11/30/2021. Underway. Coordination of actors from the public and private sectors of the rice production chain to guarantee food security. - Start: 08/12/2020 Term: 04/30/2022. Underway. Technical Cooperation Project. Reduction in the operational costs of Peru's foreign trade.

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Continue table 7. Agricultural and climate finance

Financing	Project/ Region	Amount / Entity	Details
International Fund for Agricultural Development (IFAD)	- Sector: Rural development. Project for the Extension of Public Services for Local Productive Development (Avanzar Rural), Peruvian highlands and Amazonia. Proj. 2000002257 Part of Peru's National Post-COVID 19 Recovery Plan. - Sector: Rural development, Peru. Improvement of public services for Sust. Territorial development in the Apurímac, Ene and Mantaro river basins. Project 2000000897	- Total: USD 71.1 million; IFAD loan: USD 24 million; Peruvian government: USD 41.11 million. Beneficiaries: USD 6.35 million. Implementation: MIDAGRI. - Total project cost: USD 74.51 million; IFAD financing: USD 28.5 million; Backers: national government: USD 38.76 million. Beneficiaries: USD 7.25 million. MIDAGRI.	- Approved: December 23, 2019 Duration: 2019–2025 To improve the productive capacity of family farmers and access to markets in 101 districts in the departments of Amazonas, Ancash, Cajamarca, Lima and San Martín. - Approved: April 13, 2016 Duration 2016–2022. Includes 27 districts in seven provinces in the departments of Apurímac, Ayacucho, Cusco, Huancavelica and Junín, an area that encompasses various ecosystems from the low Amazonian jungle to the high Andean mountain range.
World Bank	- Peru. Adaptation of native Andean crops for food security in the face of climate change. P121136 - Integrated Forest Landscape Management Project in Atalaya, Ucayali Peru. P163023	- MIDAGRI. - USD 12.20 million	- Approved: July 21, 2010 Start date: September 2014 - Approved: January 4, 2019. Underway. Land users who adopt sustainable land management practices.
FAO (in Peru)	- Lima, Junín. Reducing the vulnerability of rural women and their livelihoods for resilient agriculture in a context of climate change in Ecuador and Peru. - Ica, Lambayeque, Piura. Strengthening the cotton sector through South–South cooperation. - Puno (Acora), Arequipa (Atiquipa), Apurímac (Huayana), Cusco (Lares), and Huancavelica (Laria). Sustainable management of agrobiodiversity and restoration of fragile ecosystems in Andean regions of Peru	- USD 240,451 (Peru). MIDAGRI. Agrorural - Financing: USD 1,327,777. MIDAGRI, INIA, APCI, ABC, IBA, Embrapa. - USD 9,369,864 in financing from the Global Environment Facility (GEF). Ministry of the Environment, MIDAGRI, Regional governments of Puno, Arequipa, Cusco, Huancavelica and Apurimac.	- Execution: 2018–2020. Consolidating the "Yachachiq - Kamayoq" network for implementation of climate change adaptation actions and the promotion of resilient local bio-businesses led by women. - Execution 2015–2019. Strengthening technical and institutional capacities to boost the competitiveness of small cotton producers by increasing productivity and income. - Execution 2018–2022. Conservation in situ and sustainable use of agrobiodiversity; conservation of traditional agricultural systems, comprehensive management of forest, water and land resources; and conservation of ecosystem services in the southern Andean region.
Inter-American Development Bank (IDB) Invest	- Sector: Agricultural-Peru.	- IDB Invest, loan USD 25 million over a 10-year term to Agrícola Pampa Baja S.A., a Peruvian agribusiness company. Co-financiers: Entrepeneurial Development Bank (FMO) and DEG Bank.	- IDB Invest partially finances the USD 85 million project. For expansion of the non-traditional production of the fruit and vegetable agro-export industry of Peru.

Continue table 7. Agricultural and climate finance

Financing	Project/ Region	Amount / Entity	Details
Inter-American Development Bank (IDB) Lab	- Sector: Agriculture and rural development, Peru. Cajamarca, Amazonas and San Martín regions. EcoMicro–Expansion of financing for adaptation to climate change in the Peruvian coffee production chain. PE-T1423	- IDB Lab, loan USD 800,500. Co-financing of the Nordic Fund, under the framework of the EcoMicro Program (RG-O1649). Counterpart (cash and in kind): US $ 600,700. Executing agency: Perales Huancaruna SAC (PERHUSA). 36 months of execution and 42 months of disbursements are established.	- Approval date: 03/31/2020. Project Stage: Implementation Ecological Financing for MSMEs and Low Income Homes (EcoMicro Program) in Latin America and the Caribbean. Piloting a new line of microcredit, based on precision agriculture and traceability systems, to increase the sustainability and climate resilience of small and medium coffee producers in Peru.
INIA-MIDAGRI	- Sector: Agricultural–Peru. Innovation project for agricultural management by farmers of the Oro Verde del Chira Producers Association, Piura region.	- Financing of PEN 230,000 (USD 60,526) through the National Institute of Agrarian Innovation (INIA) at MIDAGRI. Execution: National Program for Agricultural Innovation.	- Farmers improved the export levels of organic bananas through genetic quality, sending more than 1,400 tons to the markets of Netherlands and Germany. They also increased the commercialisation of this crop to 2,430 tons in the local and national markets.
Agroideas-MIDAGRI	- MIDAGRI/Agroideas Program (to 2021). 145 Business Plans for the technology adaptation for 5,491 small producers in 16 regions of the country, including Ayacucho, Puno, Junín, Apurímac, Huancavelica, La Libertad and Huánuco.	- Investment of PEN 51.7 million in the last 10 years by Agroideas, to promote native potato, quinoa, chia, cañihua, kiwicha, sacha inchi, cat's claw, and tarwi crops. Total investment of PEN 67.4 million. Contribution of agricultural organisations totalling PEN 15.6 million.	- Agroideas has co-financed, for example, the business plan to improve quinoa production of the BOJACI association of agricultural producers. The PEN 360 thousand investment included the acquisition of a tractor with agricultural implements, organic fertilisers, technical assistance, and organic certification.
FEPCMAC - BIOFIN	- The Peruvian Federation of Municipal Savings and Credit Banks (FEPCMAC), with the technical support of the UNDP Biodiversity Finance initiative administered by UNDP, has developed a new green microfinance product called "BioCredito".	- CMAC by 2021: USD 364 million of existing credits in agriculture.	- MINAM, FEPCMAC, the Association of Banks (ASBANC) and the Microfinance Association (ASOMIF) signed the green financing protocol for Peru in 2020. FEPCMAC and UNDP signed an agreement to strengthen the CMAC in the implementation of the Agenda 2030 and the SDGs.

nerable to climate change.

4.2 Adaptation options and implications

The prevailing options available to organic agriculture for adaptation to climate change are as follows:

1. Promotion among peasant communities of organic and agro-ecological crops for export.

2. Increase agricultural productivity and innovation in agro exports with climate-resilient agricultural practices.

3. Promotion of organic agriculture for the sustainable adaptation of ecosystems to the effects of climate change.

4. Increasing the land area used for organic production to favour food security. The production of biofuels using sugar cane, corn, palm oil, and rape competes with scarce natural resources such as land and freshwater required for organic production and hampers food security. Therefore, organic crops should be prioritised and only use marginal land for energy crops.

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5. Designing ecosystem-based adaptation (EbA) strategies for small organic producers.

6. Developing accessible climate finance innovation to adapt small organic producers dedicated to agro exports.

About three billion people worldwide have lost purchasing power to afford a healthy diet and the COVID-19 pandemic has pushed 115 million people into extreme poverty – the most vulnerable being the inhabitants of rural areas in developing countries, who are also essential contributors to food security. The global commitment to eradicating hunger (SDG 2: zero hunger) in the framework of the 2030 Agenda requires an inclusive rethink of new financing mechanisms, especially for those who grow, process, and distribute food (IFAD, 2021).

Countries must develop support plans for rural producers and build sustainable food systems, linking local needs with national development paths and international coordination; rural people in developing countries need affordable financing to introduce new crops and apply novel techniques to enhance their livelihoods (IFAD, 2021). Small-scale organic producers in Peru need accessible credit to adapt to climate change while contributing to global food security. As organic agriculture improves the climate resilience of small farmers, there is a great need for financial institutions to provide more loans aimed at climate adaptation of organic export crops globally.

5. Discussion

Within the 2000–2020 study period, the growth of Peruvian organic agro exports by 60% from 2006 to 2007 coincided with economic growth of 8.3% at the country level, in a context of the international financial crisis (2007–2008) and a global contraction of 2.9%. In 2020, despite the worldwide Covid-19 crisis, organic food exports continued to rise (by 31% compared to 2019). Indeed, even though the pandemic caused a global contraction of approximately 6.2% in 2020, following a 9.56% growth in Peruvian non-traditional agro exports between March 2019 and 2020 (Zhilkin et al., 2021). Therefore, organic agriculture improves the ability to adapt to the climate even in crises. Faced with shocks from the pandemic, Perrin & Martin (2021) showed that French farmers were more concerned about the risks of climate change on their farms than about health risks; they also confirmed the relevance of organic agriculture to improving the resilience of systems agricultural and food. Decentralised adaptation empowers the leaders or heads of local or communal farmers, and could therefore yield better results than top-down climate adaptation carried out by policymakers. According to DAR (2015, p.28), in Peru over the 2010–2014 period, 75% of international climate finance was loans aimed mainly at mitigation.

Schader et al. (2021) found that organic agriculture generated higher profit margins than conventional agriculture by monitoring the cultivation process for two years in sub-Saharan Africa. Consequently, the implementation and financing of organic crops ensure both farmers' livelihoods and healthy food for consumers around the world.

In July 2021, the Green Climate Fund accredited the Inter-American Institute for Cooperation on Agriculture (IICA) to compete in projects of a maximum value of USD 50 million in favour of climate adaptation and resilience initiatives in agriculture and rurality in the Americas. The "Increasing Resilience in Rice Production" project is part of the contribution that the IICA is making in Peru, in addition to projects in other Andean countries such as "Good Agricultural Practices for Quality Assurance" and "Safety of Corn" in Colombia and "Promotion of the Cultivation and Commercialisation of Sacha Inchi for the Economic improvement of Family Agriculture" in Bolivia.

Roberts et al. (2021) analysed the bilateral and multilateral financing flows using different methods to determine whether they are directed at climate objectives, estimating an average allocation of about US USD 100 billion per year to each commitment. In Peru, however, there is little climate financing targeted at the adaptation of organic crops or for the agro exports of organic products, despite the importance of organic food for food security, for a low-carbon or carbon-neutral economy, and for achieving various sustainable development goals.

6. Conclusions

In a context of growing international demand for organic food, Peruvian organic exports are increasing in close and significant correlation to the increase in land area used for organic crops. In the period 2000–2020, exports of organic products rose continuously. The share of organic products in Peruvian agro exports in 2007 was 8.2% during the international financial crisis, and 7% in 2020 in the context of a global health crisis. The organic products that contributed the most to exports, in FOB value, in 2020 were bananas, ginger, quinoa, coffee, and blueberries. In this study, little financing was found for adaptation to climate change of Peruvian agro-exports of organic products. Peru participates in the Green Climate Fund in projects to mitigate GHG emissions and develop resilience in rice production to guarantee food security. IDB Invest partially finances (USD 25 million) the expansion of a Peruvian fruit and vegetable agro-export company valued at USD 85 million, co-financed by Entrepreneurial Development Bank (FMO) and DEG Bank. FAO finances the "Yachachiq - Kamayoq" network for actions to adapt to climate change and promote resilient local bio-businesses led by women. In Peru, MIDAGRI's National Institute for Agrarian Innovation (INIA) finances PEN 230,000 (USD 60,526) for farmers from the Oro Verde producers association in Chira, Piura region, who improved the levels of organic banana exports to the Netherlands and Germany. For its part, FIDA granted a loan of USD 24 million to the project for the expansion of public services for local productive development (Avanzar Rural) in the Peruvian highlands and Amazonia to improve production capacity. At the global level, IFAD is also exploring the potential for public development banks to concede affordable financing for rural producers while helping shift investments to fairer and more environmentally sustainable systems.

It is recommended that policymakers in Peru implement adaptation options – among them, continue increasing the land area used for organic production to promote food security and innovative, accessible climate financing for the adaptation of small organic producers engaged in agro exports. There is an urgent need for financial institutions to provide more loans to improve the climate resilience of farmers engaged in organic export crops globally.

Conflict of interest

The authors declare no conflict of interest.

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Comparison of motives to buy organic foods among middle income urban consumers of the state of Mexico, Mexico

EMA MALDONADOM SIMAN[1], DIANA STEPHANY GARCÍA GARCÍA[1], PEDRO ARTURO MARTÍNEZ HERNÁNDEZ[1*], JOSÉ LUIS ZARAGOZA RAMÍREZ[1], RAYMUNDO RODRÍGUEZ DE LARA[1], CITLALLI CELESTE GONZÁLEZ ARICEAGA[1].

[1]Animal Production, University of Chapingo, Mexico.

* Corresponding author: pedroarturo@correo.chapingo.mx

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Keywords

consumer trust; organic food availability; benefits of organic foods; healthy consumption.

Expansion of organic food production requires increasing the number of organic food consumers. The aim of the study was to explore the relative importance of motives to buy organic foods in consumers of the state of Mexico by applying a 21-item questionnaire, each item with a set of fixed options, the consumer decided which of the options was closer to his/her own opinion. Frequencies expressed as a percent of respondents' buy option within an item were compared by Chi-square. The questionnaires analysed were 618. The decision to buy organic food was found in over 50% ($p<0.05$) of the respondents, indicating that there is a need to increase the visibility among consumers of the organic food advantages. Above 50% ($p<0.05$) of the respondents thought that organic foods were better than non-organic, this belief is a stronghold to gain organic food consumers. For 30% ($p<0.05$) of the respondents a major restrain to buying organic foods is that they are difficult to find and there was low availability; 80% ($p<0.05$) of the respondents buy organic food as a personal decision no matter other´s people opinion about organic foods; still there is a need to build up a social environment favourable to buy organic foods. Consumers' trust in all links of the organic food chain needs to be strengthened as there were around 40% ($p<0.05$) of respondents that their trust was not higher than average. It was concluded that drivers to increase the number of organic food consumers among the population of the state of Mexico are increasing availability, diversity, and visibility of organic foods, expanding the knowledge of the benefits of organic foods over non-organic and strengthening consumers' trust in all links of the organic food chain.

1. Introduction

Organic food has been defined as a food system production that provides healthy food to humans by applying environment-friendly management practices with no use of agrochemicals and harmful residuals and animal welfare considerations (Paul & Rana, 2012). Besides healthy food and environmental sustainability qualities, organic food production system expansion requires an increasing number of organic food consumers (Rodríguez-Bermúdez, et al., 2020). Some field research results provide information on consumers' driving factors to buy organic foods, which could lead to increased organic food con-

sumption and so the organic food production system (Sirieix, et al., 2011).

Perez-Cueto (2019) concluded that consumer´s food choices could be influenced; however, there was not a single major driver that works across people groups: age, nations, cultural backgrounds, income, previous experience, formal education level, rural or urban setting, and then specific field research should be done for target human groups or sub-groups.

Mexico and other emerging economy countries have shown a steady increase, from 2003 to 2018, in their population within the lower to upper middle-income group, which has meant an increase in buying power within domestic and international markets (World Bank, 2018). Higher family income allows larger food choices but not always better nutrient balance intake, selection of healthy food (Araujo, M. C. et al., 2013), or food from a production chain committed to environmentally friendly and animal welfare practices (Willett, et al., 2019).

Some consumer drivers to buy organic foods are environmental issues (Bai et al., 2019); organic food is healthier than non-organic (Zhang et al., 2018); ecological sustainability and animal welfare (Guido et al., 2010); consumers' reflection and personal attitudes (Saraiva, et al., 2020); social pressure, consumer attitudes and perceptions (Zagata, 2012); other people's judgment on the goodness of organic foods (Ruiz–de-Maya, et al., 2011); psychological, aspects about global life evaluation, satisfaction with specific aspects, physical health and nutritional concerns (Ares et al., 2015); and, healthier eating patterns compatible with the wellbeing concept (Ares et al., 2014).

Along with consumer's motives to buy organic food, research should be done on factors that prevent consumers from buy organic foods (Hansmann et al., 2020) among them are high prices, poor knowledge of benefits, distrust of organic labels and authorities, and unavailability in local markets (Hughner et al., 2007), uncertainty on shelf-life long (Traill et al., 2008), poor visibility on shelves and not enough amount for one-stop-shopping consumers and low family income (Hjelmar, 2011), poor accessibility and diversity (Urban et al., 2012).

The state of Mexico has in its urban areas a middle-income and high formal education level population that could be a target population to increase organic food consumers (Bai et al., 2019). Two previous studies in this same state showed that preference for organic food among consumers was based on environmental concern and animal welfare with no major impact on economic aspects (Escobar-López et al., 2017; Espinoza-Ortega et al., 2016). Kooijmans and Flores-Palacios (2014) found that urban and rural populations of the state of Mexico showed different perceptions regarding the significance of organic and natural foods.

The aim of this research was to explore the relative importance of motives to buy organic foods in consumers settled in any of the three major cities of the state of Mexico to identify consumers' specific motives to buy organic foods.

2. Materials and Methods

Field data came from an application of a questionnaire with a total of 21 questions: seven demographic related; four related to intention and attitude to buying organic foods; two about behavioural control; three on subjective norms; and, five on trust in specific organic food links. The questionnaire structure followed the recommendations of Bai et al. (2019).

All questions had a set of fixed options, the consumer was asked to decide which of the options offered was closer to his/her own opinion. The questionnaire was applied by face-to-face questioning; possible respondents were approached at the exit of supermarkets in three major cities of the state of Mexico, Mexico. Sampling was a convenience non probability one (Kalton, 1983), as respondents were those willing to provide all the answers to the questions made.

Data analysed were the frequencies of respondents in each option within each question; frequencies were expressed as a percent. Statistical analysis of frequencies within each question was by Chi-square (Stokes et al., 2010) under the null hypothesis that respondents were evenly distributed across all options within each question, to declare significant effect p-value was equal to or less than 0.05.

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3. Results

Of all the consumers interviewed, 618 of them answered all questions; the core (p≤0.05) of these consumers was made of urban residents, female, college degree, married, middle age (36-55 years old), and low and medium middle-class income, in charge of deciding and doing family´s purchase of food (Table 1).

Up to 45 and 52% (p≤0.05) of the respondents indicated some chance in the future or in the next shopping, respectively, to buy organic food while around 35 and 28% (p≤0.05) were not sure in terms of the future and next shopping, respectively (Table 2). The proportion of consumers with the intention to buy organic foods was larger than the undecided consumers, some work needs to be done to reinforce among consumers the intention to buy organic foods.

Around one-third (p≤0.05) of the respondents expressed that organic foods were difficult to very difficult to find at the supermarkets; while another one-third (p≤0.05) that organic foods were as easy to find as other food types; and, over 75% (p≤0.05) of the respondents indicated that once they made up their mind to buy organic foods they did (Table 3).

Over 70% (p≤0.05) of the respondents perceived a social environment around them that was from not-against up to very-positive about organic foods; however, over 80% (p≤0.05) mentioned that decision of buying organic foods was a personal one not determined by other people's opinion or suggestion (Table 4).

Close or above 70% (p≤0.05) of the respondents indicated average to absolute trust in any of the five links of the organic food chain shown to them; however, the organic food market still has some work to do to move trust from average to large in all links, if organic food market is to be expanded (Table 5). This improvement in trust should be focused mainly on the supervision of quality and technology of domestic and international organisms related to the retail sale of organic food.

Table 1. Distribution of respondents by some demographic characteristics (n=618)

Demographic characteristic	Value	Frequency (%)
Gender	Female	63.59a
	Male	36.41b
Age (years)	18 - 35	41.26b
	36 - 55	48.55a
	>55	10.19c
Educational level	Elementary to Junior high	5.34c
	High school	41.59b
	College or above	50.49a
	None	2.58c
Marital status	Married w/out children	3.56c
	Married with children	55.83a
	Single	33.01b
	Divorced	7.60c
Monthly income (MXN)	<1,875	29.61b
	1,876 - 9,375	48.06a
	9,376 - 13,125	9.23c
	13,126 - 16,875	8.25c
	> 16,876	4.85c

Continue table 1. Distribution of respondents by some demographic characteristics (n=618)

Demographic characteristic	Value	Frequency (%)
Place of residence	Rural	23.62b
	Urban	76.38a
Having at home people over 60 and children under 12 years old	Yes	59.87a
	No	40.13b

a, b, ..= percentages within demographic characteristics with at least one letter in common are not different (p>0.05)

Table 2. Distribution of respondents by intention and attitude aspects regarding the purchase of organic food (n=618)

Criterion	Frequency (%)
Intention aspects	
Possibility to buy organic foods in the short term	
High possibility	4.37d
Possible	14.89c
Some possibility	26.05b
Undecided	35.76a
No chance	18.93c
Would you buy organic foods in the next shopping?	
Definitive	5.83c
Most probably	13.92b
Almost sure	32.20a
Uncertain	28.32a
Not at all	19.73b
Attitude aspects	
Position about buying organic foods	
Strongly for	22.01b
Inclined to	36.41a
Borderline	37.86a
Not convinced	3.56c
Strongly against	0.16c
Organic food is better than non-organic	
Strongly agree	15.05c
Agree	34.95a
Without decision	25.73b
Disagree	18.61c
Strongly disagree	5.66d

a,b..=percentages within specific criterion with at least one letter in common are not different (p>0.05)

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Table 3. Distribution of respondents in two aspects of perceived behavioural control to buy organic food (n=618)

Aspect	Frequency (%)
Is it easy and readily available to buy organic food?	
Very difficult	5.66e
Difficult	26.70b
Same as other food types	34.30a
Easy	24.60c
Very easy	8.74d
Buying organic food is a decision entirely up to you	
Completely disagree	4.53e
Disagree	20.23c
Sometimes	37.22a
Agree	29.12b
Completely agree	8.90d

a, b, ..= percentages within the specific aspects with at least one letter in common are not different (p>0.05).

Table 4. Distribution of respondents in three aspects of subjective norms to buy organic food (n=618)

Aspect	Frequency (%)
Attitude of most people close to you toward buying organic food	
Very negative	3.88d
Negative	15.37c
Borderline	47.73a
Positive	27.83b
Very positive	5.19d
Influence of others on buying organic food	
Definitely against	4.69c
Against	18.77b
Borderline	44.82[a]
In favour	23.46b
Absolutely in favour	8.26c
Importance on you of other people's opinion to buy organic food	
None	25.24b
Little	29.13a
Some	29.94a
Big	13.75c
Definitive	1.94d

a, b, ..= percentages within specific aspects with at least one letter in common are not different (p>0.05).

Table 5. Distribution (%) of respondents by the level of trust in links of the organic food chain (n=618)

Link of the organic food chain	Level of trust				
	None	Some	Average	Large	Absolute
Farmers	4.53c	21.20b	35.76a	29.61a	8.90c
Processing companies	8.57c	23.79b	25.57b	37.70a	4.37c
Quality and technology of international and national organisms	16.02d	26.54b	35.76a	19.74c	1.94e
Certification institutions	4.36c	9.06c	35.60b	45.15a	5.83c
Organic food displayed	1.13d	10.68c	34.47b	44.01a	9.71c

a, b, ..= percentages within the same row with at least one letter in common are not different (p>0.05).

4. Discussion

The general profile of consumers interviewed agrees with the findings that the decision on buying or not organic foods depended on women college graduates, medium to high income with children (Singh & Verma, 2017; Zhang et al., 2018)) and urban residents (Hempel & Hamm, 2016). Approaching consumers at the exits of supermarkets might help explain this profile.

Intention to buy organic foods is strongly associated with a positive attitude toward organic foods (Bai et al., 2019; Urban et al., 2012). In this research (Table 2), over half of the respondents indicated a strong positive attitude towards organic foods in terms of whether it was good to buy organic foods and that they were better than non-organic foods. Building among consumers confidence in the benefits of organic food could move the proportion of consumers still undecided to have a positive attitude towards organic foods and then drive them to the intention of buying organic foods in the future. Ditlevsen et al., (2019) agree that one keystone factor for the growth of the organic food market is that consumers truly believe that organic food is better for their health than non-organic foods.

This study agrees with the findings of Hjelmar (2011) and Urban et al., (2012) that the limited availability of organic foods is a factor that restricts consumers from buying them; and, with the finding of Apaolaza et al., (2018) and Choo et al., (2004) that convinced organic food consumers to keep buying organic foods. It can be said that once consumers decide to buy organic foods they are very stable on that decision, expansion of the organic food market demands to get new consumers, once they turn to organic food buyers they stayed as organic food consumers.

Nuttavuthisit and Thøgersen (2017) agree with this study that personal decision was a major driver to buy organic food; however, a positive social environment toward organic foods should also be worked out as a factor to increase organic foods consumers and then the expansion of organic foods market.

Thøgersen (2000) pointed out that organic food market stability and expansion depended on gaining the trust of consumers on all links of the organic food chain. Farmers, wholesale, and retail chain stores should work together to gain the trust of consumers

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(Janssen & Hamm, 2011), consumers' concerns were focused on product and process-based qualities (Holt & Reed, 2006). Consumer trust could be build-up by both: validated benefits from buying organic food and being sure that products really come from an organic supply chain (Daugbjerg et al., 2014).

German consumers based their trust in organic food on reading certification labels on the product and when such labels were from a known origin (Janssen & Hamm, 2014), Noblet and Teisl (2015) pointed out that consumer's trust was stronger when certification labels were issued by a third party or specialized government agencies. Close monitoring of labels was emphasized as labels could influence consumer´s perception of the quality and taste of the product (Apaolaza et al., 2018), and such influence of labels varied among consumers, the same label was understood differently among different consumers (Jensen, et al., 2018).

Proper certification labelling in organic products built consumer trust from the primary production phase and all along the food chain (Albersmeier et al., 2010; Moussa & Touzani, 2008). Organic food certification protocols and agencies are then important components in the organic food market as through them consumer´s trust could be gained. Janssen and Hamm (2011) found that organic food without an organic certification logo widely known by consumers was not taken as true organic food and/or that lax application of production and processing standards were applied, and foreign agencies were not as trusted as domestic ones. Thøgersen et al., (2019) indicated that domestic produce, availability in local markets, and national certification agencies were factors in favour of stronger consumer trust in the organic food chain.

5. Conclusions

Middle-income consumers of urban areas of the state of Mexico are very aware of the organic food availability at local markets, large proportion of consumers have a positive attitude and intention to buy organic food, based on the belief that organic food is a healthier choice than non-organic. Buying organic food was mainly dependent on consumer's own decisions rather than influence from other people's opinions; however, the expansion of the organic food market should incorporate strategies that promote a positive social environment towards buying organic food, this approach could reinforce the decision of consumers to buy organic foods.

A stronghold of the organic food market is that once a consumer decides to buy organic food, he/she keeps buying organic foods. Supermarkets and organic food dealers should work toward increasing the availability, diversity, and visibility of organic foods if they want to increase organic food retail sales.

All links of the organic food chain should work together to gain consumers' trust and then build a stronger organic food market in the urban areas of the state of Mexico.

Consumers demand clarification and transparency under a reliable traceability information system of organic food from the primary production stage up to the commercialization sites. Coordinated efforts are required, especially from Mexican federal and state agencies to promote organic food, strengthen consumers' trust in private and public certification agencies and protocols, and be aware of differences from ethnic, regional, and environmental concerns.

Conflict of interest

The authors declare no conflict of interest.

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Research Paper

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Call home gardening for enhancing food in the urban area

CHOOI LIN PHOOI[1], ELISA AZURA AZMAN[1,*], ROSLAN ISMAIL[2,3] AND URAIWAN TONGKAEMKAEW[4]

[1]Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Malaysia
[2]Department of Land Management, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Malaysia
[3]Institut Tanah Dan Ukur Negara (INSTUN), Kementerian Tenaga dan Sumber Asli, Behrang 35950, Tanjong Malim, Perak Darul Ridzuan, Malaysia
[4]Faculty of Technology and Community Development, Thaksin University, Thailand

* Corresponding author: elisa@upm.edu.my

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Food is a basic need and essential for human beings. The COVID-19 pandemic challenges us with food and nutrition security, and thus resilient food system is necessary. Home gardening may improve our self-sufficiency and have a sustainable food system to cope with the challenging situation. There is no denying home gardening brings many benefits to human health, including physical, mental, and social. Nevertheless, the most significant challenges of home gardening, especially in urban areas, are the substrate properties, light intensity, and temperature. Therefore, further investigation should investigate the impact of food crop yield on a household level, especially in urban areas in different countries.

1. Introduction

COVID-19 continuously outbreaks across the world and brings death. The food security and nutrition of millions of people worldwide are threatened by the COVID-19 pandemic (Lal, 2020). Especially, urban people faced huge issues with food supply chain disconnection which led to hunger. It is not in line with SDG 2: Zero hungry. They are highly dependent on the rural people for food. Food insecurity brings a severe problem in developed and developing countries such as Latin America, Sub-Saharan Africa, the Caribbean, South Asia, and the Pacific region (Lal, 2020). Urbanization is growing more rapidly than in developed countries in the 21st century. The global urban population of 54% in 2020 is expected to be 60% by 2030 in this era of urbanization (UN/DESA, 2018).

Therefore, most people prone to undernourishment and malnourishment are in Asia and Africa, and COVID-19 worsens the previously severe problems of hunger (undernutrition) and hidden hunger (malnutrition) (Lal, 2020). Hidden hunger is lacking essential vitamins and minerals for human growth and development.

Before the COVID-19 pandemic, one out of eight people did not have adequate food even though more than enough calories were produced to meet basic dietary needs worldwide (Schipanski et al., 2016). Undernourished people have not decreased as unstable food-price volatility is greater in the least developed countries, notwithstanding global crop production. The global environmental change is mainly caused by agricultural activity and weakens productivity (Schipanski et al., 2016; Steffen et al., 2015). Concurrently, malnutrition and overconsumption are affected by the growing social and economic inequalities (Dixon et al., 2007; Schipanski et al., 2016). To tackle the intertwined worldwide challenges (e.g. limited energy and water resources, diet-related health problems, decreasing crop diversity, moves toward resource-inten-

sive diets, and persistent undernutrition), transformative and systemic solutions are needed (Schipanski et al., 2016).

Two-thirds of the world will be urbanized by 2030; 80% of them will be in low to middle-income countries. Yet, the cities are not well designed to provide sustainable sources of sufficient and nutritious food for a huge population. Food insecurity in 2020 was mainly due to the COVID-19 pandemic. The food price during the pandemic was not meet the demand of the growing population. Besides, the poor institutional support and weak infrastructure have worsened the problem. Thus, the reduction of food loss and food waste along the food supply chain would make the food systems more resilient and reinforce local agricultural capabilities through urban agriculture and home gardening (Lal, 2020). Therefore, the cooperation between government, city planners, and residents are vital to creating a high self-sufficiency level city.

Actions to manage or alleviate COVID-19 pandemics are now affecting world food supply chains. Lockdowns and mobility restrictions imposed by the government are, for instance, slowing harvests in some areas of the world. Millions of seasonal workers lose their source of income while also hindering the transport of food to markets. Thus, the subsequent loss of income and purchasing power has on people's food security, especially the poor (Béné, 2020). Due to COVID-19 severe outbreaks among workers, meat processing factories and food markets are being forced to close by the purchasing power in many places. Supply chain disruption and plummeting consumer demand as some farmers have been dumping milk or burying perishable produce. Consequently, urban people now strive to get fresh vegetables and fruits, dairy, fish, and meat (UN, 2020).

With a good harvest of food grains in 2019 in India and most staple foods being adequate, staple grains in global markets stay robust during the pandemic. Despite that, food security and nutrition remain highly vulnerable to disruption as most of the world's population takes its food from local markets. Food supply chains were disrupted and rose in panic buying en masse and hoarding of food by consumers during lockdown periods and causing more severe disruption, reducing food availability in the market. As the policies to contain the virus result in food production, processing, and transport being weakened. For instance, the time input for cultivating season was delayed due to transportation and market disruption, affecting yield and farmer income. Also, the movement restriction policy makes a workforce shortage. Furthermore, reducing the overall food demand and food-related services like restaurants due to the social distancing policies and illnesses brings up job, income, and livelihood losses (UN, 2020).

As a cost-saving measure, many households shift to inferior goods (i.e., shelf-stable goods for industrialized countries or less processed and more nutritious food). Food accessibility is challenging with high levels of unemployment, loss of income, and rising food costs. Without big-scale organized action, the functioning and sustainability of food systems were disrupted by the effect of COVID-19, mitigation measures, and the emerging global recession which bring severe health and nutrition for more than half a century (UN, 2020).

Furthermore, HLPE-FSN (2020) recommended improving local food products such as home gardens to enhance food resilience, minimize food waste and avoid overbuying to ensure equitable access to food for all community members. The government should provide food production, handling, and processing guidelines to prevent catching and spreading COVID-19. Globe food prices increased which stays at a 10-year peak. This situation also alarms us about the importance of food security. Therefore, food security can be strengthened by home gardening.

1.1 Food security

1.1.1 Concept of food nutrition and security

FAO (1996) defined food security in the publication of the World Food Summit - Plan of Action - Rome 1996 as follows.

"Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life."

Based on the following definition, 4 main dimensions of food security can be identified, which are (1) physical availability of food, (2) physical and economic get

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to the food, (3) food consumption, and (4) sustaining the stability of the other three dimensions (FAO, 2008; Maxwell & Smith, 1992). Food availability directs to the supplies of food security which defined the food production level, food supply levels, and net trade (FAO, 2008).

Adequate food supply at the household, national and worldwide levels corresponds to incomes, expenses, prices, and markets in achieving food security targets (FAO, 2008). However, adequate food supply also needs to look at the individual level since the body is a healthy individual. It should be looked at the individual level as in a household; many factors will also affect "sufficiency" such as eating preferences. Feeding practices, food preparation, diet variety, and inter-household distribution of food determined good biological utilization of food consumed (FAO, 2008).

Adequate food intake daily maintains the nutritional status. Sufficient calorie intake is not enough for an active and healthy lifestyle but also for protein, micronutrients, food quality, and safety (Maxwell & Smith, 1992). However, it is affected by adverse weather conditions, economic factors (e.g. rising food prices and unemployment), or political instability (e.g. conflict and war) (FAO, 2008). Typically, food security is defined as 2 typical types of food insecurity which are chronic food insecurity and transitory food insecurity. Chronic food insecurity is food not accessible food for the long term which is more than 6 months due to financial problems. Transitory food insecurity is short term food not accessible due to household income, food prices, and domestic food production. Sadly, nutritional standards in Malaysia were 14.1% below the world average, even though Malaysia's food affordability was in 25 category ranks compared to 113 countries The food security index in Thailand was ranked 51 over 113 countries as the micronutrient availability was 24.2% below the world average (The Economist Group, 2017).

Low sensitivity and high resilience of the environment and food supply system are crucial to maintaining our health and active lifestyle. Many agencies have risen since the 1940s, such as FAO and UNICEF (Maxwell & Smith, 1992). Overall, Singapore was ranked 20 on the food security index, however, the category of natural resources and resilience ranking was 53. Besides, Malaysia's sensitivity to natural resources and resilience was 24.4% far below the world average (The Economist Group, 2017). During the COVID-19 pandemic and lockdown, Malaysian also launched the White Flag Campaign or #benderaputih in June 2021 (Rodzi, 2021). The flying of the white flag showed the need for food. University students also created an online app, the Sambal SOS app, to help people to fast access the nearby food bank. This also showed that Malaysia has a highly sensitive and low resilience food system under environmental stress. The action is just an intermediated support and not sustaining.

1.1.2 Concerns about food and nutrition insecurity

The food system is typically operated under challenging conditions, such as inadequate infrastructures (e.g., road conditions, power accessibility, irrigation, and wholesale markets) leading to economic and geographic isolation, lack of access to services (e.g., training, credit, supplies), little opportunity to develop business, and high dependence on weather conditions especially in middle and low-income countries (>6.5 billion people), small-scale food producers, suppliers and logistic (Béné, 2020). The food supply cool chain is a vital concern during transportation. What if the food is transported safely but without proper storage conditions? The food is properly rotten, wasted, and even not arrived at the consumer level.

Furthermore, the effect of shocks and stressors are the current issues that directly reflect the inability of the local food systems to respond and recover rapidly. Actors involved in local food supply chains (e.g., food producers, merchants, shippers, etc.) are severely affected by local or mesoscale shocks (e.g. drought, flood) or stressors (e.g. local insecurity, corruption, seasonal road inaccessibility) and hence prevent most of them from operating efficiently. Economic and physical troubles of food supply operations resulted in food losses, food shortages, or price volatility in urban and rural areas for chronic and acute hunger and malnutrition the immediate and continuing consequences (Béné, 2020).

Not only that, uncontrollable factors such as weather and soil weathering are also bringing a drastic effect on our food and nutrition security. Soil quality also plays a vital role to produce nutritious food for us. Soil nutrition status can be indirectly reflected in the plant nutrient. Finding a sustainable way to enrich the soil

status for the next food growing is important. In the household aspect, food preparation and plate waste are always the best sources of soil amendment. However, the attitude toward food waste should be avoided to improve our food security.

Conflict and war between Russia and Ukraine lead to global food insecurity. Both Russia and Ukraine are the big wheat and sunflower oil production countries. This brought another panic buying after the COVID-19 pandemic. A country like Malaysia which is highly dependent on imported food will reduce its self-sufficiency level, increase currency outflow, and increase its carbon footprint. Carbon footprint is the total amount of greenhouse gases such as carbon dioxide and methane generated by an individual during their activity such as transportation. The seed bank is also playing a vital role to ensure our food and nutritional security. It is preferable to have a seed bank in each country to cope with unpredictable disasters including the COVID-19 pandemic.

1.2 Food resilience and sustainability

System resilience is the capacity of the system to withstand and adapt to disturbances, shocks, and external pressures such as unpredictable and not accounted risk over time by fulfilling its basic structure, processes, and functions, and offering its services or desirable results (Schipanski et al., 2016; Tendall et al., 2015). In addition, resilient systems have the buffering capacity that enhances their ability to adapt to changes, learn from past mistakes, and recover from shocks (Schipanski et al., 2016).

Generally, sustainability is the capability to achieve today's targets without negotiating the future to reach them. In contrast, resilience is the dynamic capacity to continue to achieve goals despite disturbances and shocks (Tendall et al., 2015). Therefore, resilience and sustainability are related concepts (Maleksaeidi & Karami, 2013). One of the requirements to preserve resilience is sustainability which reveals maintaining the capacity of a system to operate in the future.

Regardless of disturbances, resilience denotes the capacity to continue providing a function over time. Hence, sustainability is the measure of system performance, while resilience is a way to achieve it during times of disturbance (Tendall et al., 2015). Food system vulnerabilities could be reduced by applying resilience thinking to agriculture at multiple time scales, as well as continuing stresses, occasional shocks, and unexpected shocks (Schipanski et al., 2016). Continuing stresses are long term changes in food demand, for instance, shifting human diets and climate change. Whereas occasional shocks are short term alterations of food demand such as price volatility. Unexpected shocks occur under unforeseen conditions such as catastrophic weather events.

Tendall et al. (2015) suggested a food system resilience explanation that acknowledges the significance of the time dimension in resilience and highlights that resilience appears at the various levels of the food system (i.e., from individuals to national food systems) and global webs of value chains as follows.

"Food system resilience is the capacity over time of a food system and its units at multiple levels, to provide sufficient, appropriate and accessible food to all, in the face of various and even unforeseen disturbances."
A resilient food system excludes the threat of enhancing systems' resilience that produces undesirable outcomes, such as food and nutrition insecurity and environmental degradation. According to Tendall et al. (2015), food availability, accessibility, utilization, and stability over time reflect the importance of resilience for food security.

One of the significant inventions of Thailand's sufficiency economic physiology is to meet SDG goals and benefit the Thai people and even the country (Jitsuchon, 2019; Mongsawad, 2010). The physiology was rooted in Buddhism ideas and looped with three main concepts such as resilience, moderation, and reasonable with morality (action) and knowledge (application) (Jitsuchon, 2019; Mongsawad, 2010, p. 123). The physiology encourages people to shift their growth pattern from mono-cropping or cash cropping to integrated farming to food self-sufficiency. The New Theory of Agriculture encouraged Thai people to divide their land into rice production, vegetable and fruit production, water reservoir, and residential area (Mongsawad, 2010). The surplus food could be traded and further expanded to other products. This encouragement also keeps the Thai people away from poverty and food resilient, thus meeting SDG 1: No poverty

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and SDG 2: Zero hunger.

The concept could be utilized in different rural and urban areas and even countries. However, this theory is just limited to landed housing with a large area of the backyard. People living in tall buildings with limited space may also rely on the resources of those people. Hence, they may apply the part of the theory. For instance, use the window and balcony as microgreens, vegetables (e.g., leafy vegetables, including Chinese chives and bak choy, and fruit vegetables such as cucumber and eggplant), and short-term fruit production (e.g., tomato) space. Rainwater harvest for food production and cleaning purposes to reduce economic stress can partly improve food resilience and indirectly reduce the urban poor.

Besides Thailand, the Malaysian government also incentivizes a program to encourage people to have urban farming. For example, Selangor's government has hydroponic, household conventional cultivation, and community garden (Dewan Negeri Selangor, 2020). Universities like Universiti Putra Malaysia also held farming techniques and tips online (ITAFoS, 2021). However, the incentive is not fully immersed in the community.

To form a whole food system resilience-building process, four accessible entry points are (1) national or regional food systems, (2) individual food value chains ranging from local to global levels (3) individual interests and aspirations, and (4) tackling issues of gender equity, and social justice that shape access to all food system components (Schipanski et al., 2016). Considering these entry points are who is introducing, leading, and supporting the process, who is involved, the goals of the process, and the major issues in the food system of interest. The process then integrates two other levels in further steps, no matter which entry point is selected to capture cross-scale interactions and success in food systems (Tendall et al., 2015).

1.3 Home gardening

1.3.1 Home gardening enhanced food and nutrition security

Most adult Malaysians suffering food insecurity (Ahmad et al., 2020). Home gardening can contribute to food security (SDG 2: Zero hungry) if sound garden planning. It works well in the backyard garden, balcony garden, and kitchen garden. Rationally, food security ensures home gardening by providing an adequate food stock that allows direct food access daily, especially in Bangladesh (Bushamuka et al., 2005; Galhena et al., 2013; Schreinemachers et al., 2016). Home gardening could be done in small spots of homestead land, the edges of a field, vacant lots, roadsides, or containers. Therefore, impoverished, landless, or near landless people could practise nearly no economic resources by using locally available planting materials, "live" fencing, green manures, and local pest control methods.

A diversity of fresh foods that enhance the quantity and quality of nutrients available to the family could be provided. More than 50% of their food supply, such as secondary staples food as taro, cassava, and sweet potato, are obtained from home gardening. The home garden significantly increased by 16.5 g per person per day in vegetable production, vegetable consumption, and micronutrient supply (Schreinemachers et al., 2016). A substantial percentage of the suggested dietary allowance for protein (10 to 20%), calcium (20%), iron (20%), vitamin A (80%), and ascorbic acid (100%) will be provided from a tiny mixed vegetable garden (AVRDC, 1985; Galhena et al., 2013; Marsh, 1998). In contrast, no significant correlation between a home garden and food security was found in the Philippines (Cabalda et al., 2011).

The food variety in a meal is also important for us to improve our appetites and physical and mental health. If space is allowed, different types of vegetables and fruits should be planted. For instance, leafy vegetables (Brassica rapa), root crops (potato), and fruit crops (cucumber, tomato, melon) are providing different types of nutrients. To cope with this sudden pandemic, growing fast-growing crops such as Ipomoea spp., amaranth, and Brassica rapa is preferable.

1.3.2 Home gardening as an alternate income

During this COVID-19 pandemic, Malaysia's household income declined by around 10% from 2019 to 2020 (Department of Statistics Malaysia Official Portal, 2021). Home gardening is the primary source of additional income for poor town and countryside

households worldwide (Abdoellah et al., 2020). During periods of stress from the family household (e.g., long term unemployment, harvest failure, the preharvest lean season, health or other disabilities suffered by the farmer or family members) and market (e.g. economic disruption caused by war), the home garden may become the principal source of income and household food (Marsh, 1998). The home gardener has generated income from part of their production and thus reducing poverty in Bangladesh (Bushamuka et al., 2005). The supplementary income allowed the poorer to purchase other nutrient sources such as meat. It will have become the alternative source of income to cope with this pandemic as most people suffer economic issues.

1.3.3 Home gardening shifts the food preference

Food preference in humans is usually determined by flavour. Sour and bitter tastes are commonly found in vegetables which are vital for a balanced diet. In this scenario, children tend to eat fewer vegetables and not meet the level of nutrition recommendation. With the physical and social environment, children increased twice their willingness to try new foods and were more likely to eat vegetables and fruits that emerged from the Stephanie Alexander Kitchen Garden Program than in the comparison group (Gibbs et al., 2013). In the future, children's dietary diet may switch to a more healthy diet to reduce the prevalence of obesity and overweight among children. In addition, children's preferences may switch to homegrown and locally produced vegetables with the accessibility of gardening (Gibbs et al., 2013).

By using a minimum of 10 g consumption for each food group or applying the all-inclusive dietary diversity score, children from families with gardens had higher dietary diversity scores. They were significantly more likely to eat vegetables more frequently than children who lived in families without a garden. Possessing a home garden was linked positively with the child's diet diversity and vegetable consumption frequency. Furthermore, families without gardens may benefit from raising gardens to enhance diet quality (Cabalda et al., 2011). Children are more excited to accept and enjoy new food and are not choosy, thus less plate waste, which fulfils SDG 12 (sustainable consumption and production).

1.3.4 Home gardening empowers women

Gender inequality still happens even in highly educated urban people (SDG 5: Gender equality). Women are the ones who should stay home to do house chores and men should earn money. Formerly, women in Bangladesh need to have a son or age for decision-making power (Bushamuka et al., 2005). With gender inequality, women also face mental stress (Carmen, Russo, & Miller, 1981). Home gardening can be the medicine to relieve their stress.

Home gardening allows the whole family, especially women and children, to produce their own cheapest and safer nutrient-rich food from seed to cooked food just beyond their eyes (SDG 3: Good health and well-being). Home gardening empowered women as model farmers by sharing their experience and knowledge (Blakstad et al., 2020). Involving the income generation gardening activity and contributing economically to the household improves women's self-esteem and decision-making power in Bangladesh (Bushamuka et al., 2005). Hence, women can sell their surplus vegetables and cooked food to their neighbourhood to earn extra income and contribute to the home economy (SDG 1: No poverty and 8: Decent work and economic growth).

Besides, women also can have a gardening and cooking community to enrich their life. Thus, their life would not be only for their family. They can enlarge their social circle. Women should live for themselves and not others. The government may play a vital role here. Free gardening and cooking online and offline classes should be provided. Time-to-time consultation can be provided whenever they are facing any problems. This may also decrease the chances of being scolded by their husband and not reduce their excitement about gardening and cooking.

1.3.5 Home gardening improved gardening creativity

With the limited spaces in the household areas, gardeners are creative with the garden. They are using any recyclable and reusable container as a growing pot. Also, they are forming a beautiful balcony, kitchen, and even windows. Students in agriculture-related fields such as Universiti Putra Malaysia and Universiti

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Malaysia Sabah were growing some vegetables with farmyard manure during this pandemic. For instance, students from Universiti Putra Malaysia were growing vegetable towers and composting them in the middle of the tower. This project could be brought to the communities, especially urban people.

Gardening creativity is not only limited to home gardeners but also gardening tools and equipment suppliers. They also launched some user-friendly gardening tools for gardeners. For example, the auto watering systems and lighting systems. This tool allows the gardener to understand the principle to grow plants. Also, gardeners with budget considerations are more prone to learn the market available and modify it with recyclable and reusable materials. This also would trigger their knowledge enhancement and share with the community online. Hence, they may influence people around the globe.

1.4 Challenge of home gardening in an urban area

Most areas are urbanized, and thus food growing has just remained on the balcony and kitchen. However, it still has some issues such as soil properties and light to be a concern. Therefore, further study should be carried out to understand the effect of crop yield further.

1.4.1 Urban soil quality

The urban soil is formed during the urbanization process by anthropogenic activity and is hence closely related to the geographic bounds of the process. Urbanization contaminates the soil with anthropic solids such as wood metal, asphalt, glass, masonry, and plastic and creates particular soil problems such as soil compaction, consequently impeding root growth. Urban soil is a material more than 50 cm thick of non-agricultural and manmade surface layer produced by filling, mixing, or contamination of land surface in suburban and urban areas (Craul, 1985). The non-urban area does have highly disturbed land and is associated with soil material, such as strip-mine spoil banks. In contrast, soil-forming processes occur naturally with ice, gravity, wind, water, and heat.

Urban soil such as Hong Kong, Japan, Germany, the USA, the UK, Russia, and Australia has dumped materials (Jim, 1998; Tiller, 1992). When the soil is removed, stockpiled, respreads, translocation, and hence the mixing of soil material occurs, allowing the exposure of subsoil and eroding the soil. To backfill drains and foundation walls or construct berms, urban soil is filled by dumping and spreading soil material over an existing surface to raise it to a higher level. The soil structure has been modified and destroyed by reducing pore space, especially macro pores and thus leading to compaction. Besides, the frequency of structure-enhancing wet-dry cycles was lowered and subjected to water surface traffic, leading to compaction (Craul, 1985). The presence of a surface crust on bare soil tends to be water-repellent and damages the vegetation. Furthermore, soil reaction (soil pH) was modified and usually elevated.

Insufficient organic matter and clay colloids in urban soil reduce the cation exchange capacity, contributing to nutrient exchange sites. As a result, the soil has low cation holding capacity and an inability to keep nutrients for plant growth. Nutrient ion quickly leaches during heavy rainfall as ions fail to find a foothold on the colloidal surface. For tropical soil, exchangeable calcium (Ca), magnesium (Mg) and sodium (Na) are below the low rating threshold. In urban heat islands, elevated temperatures in an urban area also affect nutrient and water cycling and thus affect vegetative growth (Schatz & Kucharik, 2016). Organic matter is correlated with the base saturation percentage (Jim, 1998).

Lead (Pb) persists in the soil once lodged, mainly from the combustion of leaded petrol in transportation and transferred to the soil through wet or dry deposition (Jim, 1998). Due to controlled Pb fuel combustion, the concentration of Pb has been reducing over the last few decades in the environment. Over 126% decline in Pb concentrations in 2012 compared to 1941 was shown in bio-monitoring studies; however, the concentrations of nickel (Ni), cadmium (Cd), and chromium (Cr) content in 2012 were increased by 13, 10, and 16 times, respectively (Rodríguez Martín et al., 2015).

1.4.2 Lighting issues

Urban canyon shading is an important factor for urban plant growth since the plant is light-demanding. Shading and low light intensity affected plant growth

and development. For instance, shading affected plant photoperiod interruption, stomata conductance rate, carbon assimilation, flowering, leaf size, density, and colour in woody and herbaceous plants (Gebert et al., 2019; Jeong et al., 2009; Neverauskas, 1988; Vendrame et al., 2004). Deep shade significantly affects the plant morphology even though it can survive (Stanton et al., 2010). The low light intensity happened especially for the residents living in between tall buildings on a lower floor.

Light conditions and plants to be chosen are modulated by the face of a balcony garden (Bal & Pal, 2020) to reduce plants suffering from environmental stress. In the northern hemisphere, south-facing balconies are received direct sun rays for the more significant part of the day if there are no obstacles like adjacent buildings or big trees. In contrast, north-facing ones do not want such necessary sunlight. As a result, east-facing balconies receive fairly intense sunlight from morning to noon, whereas west-facing one receives total afternoon sun rays.

Plant tolerant to photoperiod would be more suitable for urban home gardening, such as Basella alba and Basella rubra. Therefore, the better option to grow vegetables in a tall building would be indoor farming with artificial lighting. Nonetheless, it would be increasing the home gardening cost for lighting. Home gardening should not be stressed in plant and human mental health and economy. Home gardening should treat mental health, especially in this pandemic that restricts movement.

On the other side, an urban area is also serious in light pollution. Prolonged light quantity significantly improved plant morphology and physiology (Neverauskas, 1988). However, the light quality and quantity varied from place to place (Kjelgren, 1995), and hence it was not easy to estimate the effect of the plant.

1.4.3 Urban heat island

Furthermore, anthropogenic land surface medication in urban induces the urban heat island effect. It significantly increased the evapotranspiration demand and eventually may impact the water, carbon, and energy cycle within the area (Zipper et al., 2017). It also affects the growing season, including the start, end, and total growing season, and eventually affects our food security (Schatz & Kucharik, 2016), especially growing in urban areas. Therefore, landscape planning and designing with urban green space are crucial to cooling space (Xiao et al., 2018).

In short, the challenge of home gardening in an urban area significantly affects plant growth and development. However, the government, urban landscape designers, environmentalists, and agriculturists could improve plant performance.

1.4.4 Food source variability limitation

Plant-based food is limited to leafy vegetables such as spinach and amaranth, fruit crops such as tomatoes and eggplants, and rooting crops such as carrots and potatoes. Fruit tree such as apple is not able to grow in apartment area due to the need for space and the supporting structure of the sky-scraping building. No livestock rearing is allowed in most of the sky-scraping housing areas such as apartments and condominiums. The policy is to take care of the well-being of the human being with a comfy home.

2. Conclusions and Recommendations

Food is our need, yet it is vulnerable to stress. The COVID-19 pandemic alarms us of the importance of a resilient food system as this event bring the most significant impact on our food security. Between, home gardening brings benefits such as food and nutrition sources, alternative income, improve food experience, empowerment of women, and gardening creativity. There are limitations for the urban home gardener. The urban area is limited by soil quality, lighting issues, temperature, and food source variation. Even though this pandemic ended, the next disaster may be coming and challenge our food system. To cope with the now and then situation and have a sustainable food system, home gardening may be the solution for us to improve our self-sufficiency level. Home gardening provided food and nutrient source for health. Government should play a vital role in policy and education as the Thailand king did.

Conflict of interest

The authors declare no conflict of interest.

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Assessment and Evaluation of Indira Canteen on Food Security and Food Safety in Urban Bengaluru

SANGEETA PANDEY[1,*], SUMA SINGH[2], AND SANA KOUSER[3]

[1]Department of Nutrition & Dietetics, Mount Carmel College, Autonomous, Bengaluru, Karnataka, India
[2] Department of Economics, Mount Carmel College, Autonomous, Bengaluru, Karnataka, India
[3] Department of Nutrition & Dietetics, Mount Carmel College, Autonomous, Bengaluru, Karnataka, India

* Corresponding author: pandey.sangeeta@yahoo.com

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Food safety; Food security; Cost-effective; Food handlers; Consumer

Food security is a major cause of concern in developing and underdeveloped countries. It is a serious challenge for governments to provide subsidized and safe food to deserving sections of society. Inspiration from the success of Amma canteen led to an initiative by the Karnataka government concerning the subsidized food program, Indira canteen. Food safety will determine the success or failure of the scheme; therefore, this study aims to assess the effectiveness of the canteen in terms of food safety and food security. Random sampling method was used to select 70 food handlers and 150 consumers from Bengaluru. The data was collected using a pretested questionnaire and using the interview cum observation technique. Results revealed that the majority (71.4%) of the food handlers have been trained in food safety before joining the job. A significant difference was observed between trained and untrained food handlers in following the food safety norms while handling the food ($p<0.05$). Results revealed that the majority of the consumers (87.3%) were male and only 12.7% were females. About 44% belonged to the lower middle class and only 1% to the upper-middle-class. It was observed that 70% of the consumers skipped at least one meal and 65.3% restricted variety in food due to the cost of the meal. About 97.3% of consumers were satisfied with the cost-wise quality of food served in the canteen. Overall acceptance of food in the canteen was 94.6%. Hence it can be concluded from the study that Indira canteen is a successful and effective venture for food security by the Karnataka government that is, capable of providing subsidized and safe food to consumers.

1. Introduction

The implementation of the public distribution system in India has been successful in combating hunger in the below-poverty-line population. According to a report on Global Hunger Index (2018), India is ranked in the 103rd position among 119 countries, which makes India stand among the 45 countries that have a serious level of hunger which is alarming. The public distribution system ensures food safety and food security which are intended for improving the nutritional status. This is based on the three main objectives i.e., to protect the poor, to enhance their nutritional status, and to generate moderate influence on the market price. The problem of food insecurity in India has been tried to rectify over the decades by both the central and the state governments through the Public Distribution System (PDS). Regulation of PDS is carried out by the central government which is responsible for procurement of the grains, their storage, trans-

portation, and the majority of the bulk distribution. The state governments carry out accountability for distributing the food grains to the consumers through the established network of ration shops or fair price shops.

Several studies have emphasized that poverty declines at a much lesser rate in urban setups when compared to rural setups (World Food Program 2010). The government of India has efficiently worked on two concerning issues to tackle the problem of food insecurity. The first issue is reducing poverty by providing employment and the other one is to provide subsidized food grains and essential items through a public distribution system. In addition to this many state governments have introduced schemes like food canteens which provide one or more meals at subsidized rates.

Food safety by Food and Agriculture Organization (FAO) has been defined as "the condition and measures that are necessary during the production, processing, packaging, storage distribution and preparation of the food to ensure that it is safe, sound, wholesome and fit for human consumption." The three main sources which affect food safety can be classified as physical, chemical, and biological agents. Their presence in food has the potential to cause adverse health consequences. Food subsidized canteens should take major precautions concerning food safety as it can either step towards the success or failure of the program.

Food handling with hygienic standards should be practiced and maintained. Food handler involved in the process of food handling plays a very crucial role in the safety of the food. Every individual involved in the food handling process must be well educated about food safety measures and their standards. The food handlers must be scrupulous in their knowledge, attitude, and practice about food safety. If there is a lack of knowledge and improper practice by the food handlers, it can be a major contributing factor to foodborne illness. Food handlers may be carriers of foodborne pathogens such as hepatitis, salmonella typhi, noroviruses, staphylococcus aureus, and Shigella species which may be present in the hands, mouth, skin, hair, nails, etc. Therefore, proper hygienic practices should be followed, such as hand washing, brushing, bathing, and clipping nails to avoid the contamination of the food. However, regular food safety training classes with recent updates and concepts of health, hygiene, and food safety standards must be taught to the food handlers as this will have a positive impact on their knowledge, attitude, and practice. Food hygiene practices must be improved in the community which is to safeguard the handlers against food-borne illnesses (Raphael et al., 2018).

The practice of safe food handling and storage is a very important step as during the process of receiving the raw ingredients if any contamination or moisture in the dry grains is present can lead to the growth of bacteria and cause spoilage of the food. The concept of FIFO (first in first out) where the items which are bought first should be out from the storage and be used first or FEFO(first expiry first out) where the items which have the closer expiry date should be taken out of the storage area and should be used before the expiry date are appropriate to follow. A study strongly emphasizes the need for a properly designed food safety public education campaign, to enhance food safety consciousness in customers and thus avoid foodborne disease (Vyas and Khuswaha, 2017).

Indira Canteen is the new initiative of the Karnataka government in continuation of the Anna Bhagya Scheme. For this project, a 100-crore fund was allotted. Indira canteen was based on the "HUB AND SPOKE MODEL" where each assembly constituency will have one kitchen which will, in turn, cater to the wards in its jurisdiction. The canteens were launched on 15th august 2017 (Indira Canteen – Apps on Google Play, 2020). They are spread throughout the Bengaluru zones (east zone, west zone, south zone). The main aim of these canteens is to provide food at subsidized rates to the population who is below the poverty line or to the economically backward sections of society which will help in food security promising food safety to prevent infections and malnutrition.

The canteen functions on all seven days of the week and provides all three major meals to its customers at subsidized rates as rupees 5 for breakfast and rupees 10 for lunch and dinner, respectively. There are 198 wards operated by two vendors, 100 wards by one vendor, and 98 by the other vendor. The canteen follows a weekly cyclic menu which is wholesome traditional meals. The menu items for breakfast include 8 items, whereas lunch and dinner include 9 items. This study

aims to evaluate the effectiveness of Indira canteens in terms of food safety and food security.

2. Materials and methods

2.1 Study area

A cross-sectional study was conducted in Bengaluru city. The duration of the study was from November 2019 to February 2020. Food handlers and consumers were assessed with the help of a pre-structured, in-depth questionnaire on food safety and hygiene. A survey was conducted among the consumers from the east, west, north, south, and central zone of Bengaluru city, who were consuming food from these canteens. This study was conducted to assess the effectiveness of Indira canteens in terms of food safety and food security. Two canteens were selected from each of the five zones for this study. From every canteen, 15 consumers and 7 food handlers were interviewed using a pre-structured questionnaire. A total of 220 subjects were studied, out of which 150 were consumers and 70 were food handlers. This study also included a visit to the centralized kitchen of the Indira canteen to study the functioning of the kitchen.

2.2 Tools and Techniques

The tool used for this research study was a questionnaire for food handlers and consumers. The method of interview cum questionnaire was used to collect the data. This questionnaire was divided into two-part, one for food handlers and another for food consumers of the Indira canteen.

The questionnaire for food handlers of the Indira canteen was divided into two sections. The first part had information about the consumers like general information, canteen setup, food security, cost-effectiveness, food quality, and quantity in Indira canteen. The other part included specific information on the assessment of knowledge and practice of food handlers regarding food safety and hygiene.

2.3. Data Collection

The main aim of this research was to assess food safety, food security, and the effectiveness of the Indira canteen. The study subjects were informed before administrating the questionnaire and were interviewed. A well-structured and in-depth questionnaire was used to assess the knowledge and practice of the consumers and the food handlers of the Indira canteen. The questions were asked in English, Hindi, Urdu, and Kannada. The data was collected from the 150 consumers and 70 food handlers belonging to Bengaluru's east, west, north, south, and central wards.

The data collected was compiled and the analysis of data was computed using various statistical tools.

3. Results

The majority of the respondents (36%) belonged to the age group of 25-40 years and out of that males (87.3%) outnumbered females (12.7%). Out of the total respondents, 58.7% were married and the maximum respondents (44%) belonged to the lower middle class following Kuppuswamy modified scale (Wani, 2019). About 62% of respondents were from rural setups (Table. 1).

It was observed from table (2) that 62% of the respondents regularly consumed food outside and 11.3% were not consuming food regularly. About 64% were regular customers of Indira canteen and only 8% were not regular to the canteen. The consumption of lunch was higher (51.3%) and the lowest consumed meal was dinner (2.7%). As the majority of respondents (70 %) consumed one meal in the canteen, they tend to skip other meals of the day as they could not afford them. Almost 50% of the respondents (52.7%) regularly consume one meal in the canteen. The maximum number of respondents (92.7%) agreed that canteen timing was appropriate as per their requirements. Most of the respondents (68%) answered that there is no alternative to this canteen at present.

Table (3) depicts that the majority (68%) of the respondents rated the taste of the food as very good. The quality of the food was rated as very good by 64% of the respondents. About 88% of the respondents agreed that the quantity of the food given was fulfilling. It was revealed that 65.3% of respondents rated food hygiene while serving the food as very good. The ratings for the hygienic conditions of serving equipment and utensils were also rated as very good (68%). It was seen that 88% of respondents agreed that food served in the canteen helped in meeting their nutritional requirements. About 89.3% of respondents

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UniKassel & VDW, Germany-December 2022

were satisfied with the menu of the canteen. The majority (97.3%) of the respondents were fully satisfied with the cost of the food with respect to the quality of food being served in the canteen when compared to other outlets.

Table 1. Socio-demographic characteristics of consumers

Socio-demographic characteristics	Category	Respondents	
		Number	Percent
Age group (years)	16-25	53	35.3
	25-40	54	36.0
	40-70	43	28.7
Gender	Male	131	87.3
	Female	19	12.7
Food habits	Vegetarian	50	33.3
	Non-vegetarian	100	66.7
Marital status	Unmarried	62	41.3
	Married	88	58.7
Religion	Hindu	116	77.3
	Muslim	26	17.3
	Christian	8	5.4
Socio economic status	Upper middle class	1	1
	Lower middle class	67	44
	Upper lower class	33	22
	Lower class	49	33
Type of family	Nuclear	64	42.7
	Joint	86	57.3
Place of Residence	Rural	93	62.0
	Urban	57	38.0

Table 2. Food habits of the respondents and convenience of the canteen

Characteristics	Response	Respondents	
		Number	Percent
Regularly eat outside food	Yes	93	62.0
	No	17	11.3
	Sometimes	40	26.7
Regularly eating in the specific canteen	Yes	96	64.0
	No	12	8.0
	Sometimes	42	28.0
Meals consumed in the canteen.	Breakfast	41	27.3
	Lunch	77	51.3
	Dinner	4	2.7
	All the above	28	18.7

ISSN-Internet 2197-411x OLCL 862804632

Continue table 2. Food habits of the respondents and convenience of the canteen

Characteristics	Response	Respondents	
		Number	Percent
Skip any of the meals	Yes	105	70.0
	No	30	20.0
	Sometimes	15	10.0
Frequency of eating in the canteen	Every day	79	52.7
	Alternative days	20	13.3
	Once a week	13	8.7
	Occasionally	38	25.3
Food availability whenever wants to eat in the canteen.	Yes	145	96.7
	No	5	3.3
Timing of the canteen is appropriate.	Yes	139	92.7
	No	11	7.3
Have an alternative meal option outside.	Yes	41	27.3
	No	102	68.0
	Sometimes	7	4.7

Table 3. Rating of the canteen on quality and quantity of food

Parameters	Response	Respondents	
		Number	Percent
Rating the taste of the food	Very good	102	68.0
	Good	37	24.7
	Average	11	7.3
Rating the quality of food	Very good	96	64.0
	Good	43	28.7
	Average	11	7.3
Feel the quantity of food served is sufficient.	Fully	132	88.0
	Partially	18	12.0
Rating the food hygienic for served food	Very good	98	65.3
	Good	43	28.7
	Average	9	6.0
Hygienic conditions of serving equipment and utensils	Very good	102	68.0
	Good	37	24.7
	Average	11	7.3
Feel food served will meet their nutrition requirements.	Yes	132	88.0
	No	7	4.7
	Maybe	11	7.3
Satisfied with a variety of food items served.	Yes	134	89.3
	Sometimes	16	10.7
Cost wise quality of food served in the canteen in comparison to other outlets	Yes	146	97.3
	No	4	2.7

ISSN-Internet 2197-411x OLCL 862804632

Continue table 3. Rating of the canteen on quality and quantity of food

Parameters	Response	Respondents	
		Number	Percent
Cost wise quality of food served in the canteen in comparison to other outlets	Yes	146	97.3
	No	4	2.7
Acceptance of subsidized food through the canteen	Yes	142	94.6
	No	4	2.7
	Maybe	4	2.7

Table 4 depicted the status of the food security of the respondents ,where 73.3% had enough food with the variety available however 3.3% had food often but not sufficient. About 68.7% of the respondents had enough food stored for 30 days for the whole family and 14.6% were not sure about it. Around 60% of the respondents were unable to afford a balanced meal for themselves and their families and 4.7% of the population could not afford a balanced meal once every week. The data also revealed that 77.3% of the respondents agreed that they were able to eat a balanced meal at both the places i.e., the canteen, as well as home whereas only 6.7% of the respondents, said they were able to eat a balanced meal only at the canteen. Similar results to this were seen in the case study of Annapurna canteen (TISS, 2020) where some respondents revealed that if the canteen was not functioning someday then they cannot eat food anywhere as they are unable to afford a balanced meal.

Tables (5, 6 & 7) revealed that the maximum (54.5%) respondents were in the age group 16-25 years. Association between age group and taste has been found significant at 5% level. The association between age groups and rating the food hygiene in the canteen revealed that 33.3% of the respondents in the age group of 16-25 years and 33.3% of the respondents in the age group of 25-40 years rated the hygiene as very good. However, no significant difference was observed in the association between age and rating of food hygiene. The association between age groups and the sufficiency in the amount of food served in the canteen shows that 37.1% of respondents in the age group of 16-25 years were fully satisfied and 55.6% of the respondents in the age group of 25-40 years were partially satisfied with the amount of food served in the canteen. However, no significant difference was observed in the association between age and the sufficiency in the amount of food served.

Table 8 showed that 80% of the respondents preferred idly with chutney/sambhar for breakfast whereas only 10%of each preferred Puliogare with pudina chutney and Pongal with tomato gojju respectively. The reason for the preferred breakfast showed that 62.7% opted for all the given factors i.e., cost, taste, quality, quantity, and timings whereas only 2.7% of the respondents preferred eating breakfast in the canteen for the quantity of the food provided. However, results showed in the case study conducted in the Annapurna canteen (TISS, 2020) where 73.4% of respondents who belonged to the informal sector and 47.78% of respondents who were migrants were regular to the canteen due to the cost factor.

Table 9 showed that the majority (82.7%) of the respondents in lunch preferred Anna-mixed veg sambhar and curd rice whereas, only 0.7% preferred Methya (fenugreek) pulao & curd rice. The reason for the preferred lunch showed that 57.3% opted for it because of all the given factors i.e., cost, taste, quality, quantity, and timings whereas, only 2.7% of the respondents preferred eating lunch in the canteen for the quantity of the food given.

Table 10 showed the socio-demographic character-

istics of the food handlers. It was revealed that the majority of the food handlers (54.3%) belonged to the age group of 20-29 years. Gender-wise distribution of food handlers shows that the maximum number of food handlers was male (70%). About 35.7% of the food handlers had completed their Pre-University College (PUC). The maximum number of food handlers was Hindus. The majority (82.9%) of food handlers were non-vegetarian whereas 17.1% of them were vegetarian. About 67.1% of the food handlers lived in a joint family. The majority (97.1%) of them were from the urban setup.

Table 11 portrayed that a maximum (51.4%) of the food handlers were involved in the serving of food. The work experiences of the food handlers revealed that 35.7% of them had an average work experience of below 1 year.

Table 12 revealed that 71.4% of the Food handlers had undergone food safety training before beginning their job and 62.9% of them had undergone training for 3 days and only 8.6% had undergone food safety training for 7 days. All the Food handlers were trained in the Bommanhalli central kitchen in Bangalore.

Association between training and food safety revealed the precautions taken by the subjects who had undergone food safety training (table 13). It was observed that 95% of the trained food handlers used precautions like closing vessels to avoid contamination whereas, this practice was observed only in 2% of the untrained food handlers. Similarly, practice like closing vessels and using different cutlery for different food items was observed in 58% of trained food handlers as compared to untrained food handlers (5%). A statistically significant difference ($p<0.05$) was observed between the practices followed by trained and untrained food handlers.

Table 14 indicated that 95.7% of the food handlers practiced covering the food properly to protect it from spoilage/contamination post-training sessions on food safety. The place where the food was stored was mainly the refrigerator as stated by 75.7% of the food handlers. The practice of using separate cutleries for serving different food items was practiced by 90% of the food handlers. About 95.7% of the food handlers had the knowledge that bacterial contamination can spread through the food.

It was observed from table 15 that 25% of the trained food handlers had practiced hand washing and only 14% of the untrained food handlers practiced hand washing before coming in contact with the food. Association between food handling during illness among the trained and untrained food handlers was depicted in table 3.11. It was observed that 96% of the trained food handlers did not involve themselves in food handling during illness whereas 80% of the untrained food handlers did not involve in handling the food. Similarly, the practice of handling food during illness was seen in 4% of the trained food handlers compared to 20% of untrained food handlers. A statistically significant difference ($\chi 2=43.20^*$, $p<0.05$) was observed between the association of practice followed by trained and untrained food handlers.

Table 4. Practice regarding food security

Aspects	Response	Respondents	
		Number	Percent
Statements define the food security situation	Enough food with the variety available	110	73.3
	Enough food without many varieties is available	6	4.0
	Often not enough	5	3.3
	Don't know	29	19.4
Total		**150**	**100**
Not able to afford a balanced meal	Once a week	7	4.7
	Once a month	10	6.7
	Never	43	28.6
	Don't know	90	60.0

ISSN-Internet 2197-411x OLCL 862804632

Continue table 4. Practice regarding food security

Aspects	Response	Respondents	
		Number	Percent
Total		**150**	**100**
Consume balanced meal	At canteen	10	6.7
	At home	24	16.0
	At Both places	116	77.3
Total		**150**	**100**

Table 5. Association between age and taste

Age group (years)	Sample (n)	Rating of the taste						χ2 Test
		Very good		Good		Average		
		N	%	N	%	N	%	
16-25	53	28	27.5	19	51.4	6	54.5	9.64*
25-40	54	40	39.2	10	27.0	4	36.4	
40-70	43	34	33.3	8	21.6	1	9.1	
Total	**150**	**102**	**100.0**	**37**	**100.0**	**11**	**100.0**	

Table 6. Association between age and food hygiene

Age group (years)	Sample (n)	Rating the food hygiene						χ2 Test
		Very good		Good		Average		
		N	%	N	%	N	%	
16-25	53	33	33.7	17	39.5	3	33.3	3.01 NS
25-40	54	33	33.7	18	41.9	3	33.3	
40-70	43	32	32.6	8	18.6	3	33.3	
Total	**150**	**98**	**100.0**	**43**	**100.0**	**9**	**100.0**	

Table 7. Association between age and sufficiency of the food

Age group (years)	Sample (n)	Sufficient quantity of food				χ2 Test
		Fully		Partially		
		N	%	N	%	
16-25	53	49	37.1	4	22.2	3.46 NS
25-40	54	44	33.3	10	55.6	
40-70	43	39	29.6	4	22.2	
Total	**150**	**132**	**100.0**	**18**	**100.0**	

*Significant at 5% level, $\chi2$ (0.05, 4df) = 9.488
NS: Non-significant, $\chi2$ (0.05, 2df) = 5.991
NS: Non-significant, $\chi2$ (0.05, 2df) = 5.991

Table 8. Food preference and reasons for breakfast consumption in the canteen

Aspects	Response	Respondents	
		Number	Percent
Food preference of breakfast in canteen	Idly with Chutney/sambhar	120	80.0
	Puliogare with pudina chutney	15	10.0
	Pongal with tomato gojju	15	10.0
Total		**150**	**100**
Reasons for preferred breakfast	Cost	16	10.6
	Taste	21	14
	Quality	8	5.3
	Quantity	4	2.7
	Timings	7	4.7
	All the above	94	62.7
Total		**150**	**100**

Table 9. Food preference and Reasons for lunch/dinner consumption in the canteen

Aspects	Response	Respondents	
		Number	Percent
Food preference of lunch/dinner in canteen	Anna (rice) -mixed veg sambhar and curd rice	124	82.7
	Tomato bhat (Tomato rice) & curd rice chutney	6	4
	Mustard chitranna (Lemon rice) & curd rice	2	1.3
	Vanitha (brinjal rice) & curd rice	5	3.3
	Bisi Bella bhat (Dal + rice) & curd rice	7	4.7
	Methya (fenugreek) pulao & curd rice	1	0.7
	Puliyograre (rice with spices & ground nut)& curd rice	2	1.3
	Vegetable pulao & curd rice	3	2
Total		**150**	**100**
Reasons for preferred lunch/dinner	Cost	29	19.3
	Taste	16	10.3
	Quality	5	3.3
	Quantity	4	2.7
	Timings	10	6.7
	All of above	86	57.3
Total		**150**	**100**

ISSN-Internet 2197-411x OLCL 862804632

Table 10. Demographic characteristics of food handlers

Demographic characteristics	Category	Food handlers	
		Number	Percent
Age group (years)	20-29	38	54.3
	29-39	14	20.0
	39-49	12	17.1
	49-59	6	8.6
Gender	Male	49	70
	Female	21	30
Educational level	Illiterate	7	10.0
	Primary	5	7.1
	Middle	9	12.9
	High school	24	34.3
	PUC	25	35.7
Religion	Hindu	51	72.9
	Muslim	15	21.4
	Christian	4	5.7
Food habits	Vegetarian	12	17.1
	Non-Vegetarian	58	82.9
Type of family	Nuclear	23	32.9
	Joint	47	67.1
Place of Residence	Rural	2	2.9
	Urban	68	97.1

Table 11. Classification of respondents by job involvement and work experience

Characteristics	Category	Respondents	
		Number	Percent
Job involvement	Cooking	8	11.4
	Cleaning	16	22.9
	Serving	36	51.4
	Pre-preparation	10	14.3
Work experience	Below 1 year	25	35.7
	1.0-1.6 years	21	30
	1.7-2.0 years	24	34.3
Total		**70**	**100**

Table 12. Food safety training/Workshop attended by food handlers

Characteristics	Category	Food handlers	
		Number	Percent
Attended food safety training before starting the job	Yes	50	71.4
	No	20	28.6

ISSN-Internet 2197-411x OLCL 862804632

Continue table 12. Food safety training/Workshop attended by food handlers

Characteristics	Category	Food handlers	
		Number	Percent
Total		**70**	**100**
Last training/workshop attended	3 days	44	62.9
	7 days	6	8.6
	None	20	28.5
Total		**70**	**100**

Table 13. Association between training and food Safety

Maintenance of Food Safety	Sample (n)	Attended training				$\chi 2$ Test
		Trained		Untrained		
		N	%	N	%	
Closing vessels to avoid contamination	20	19	95	1	2	60.61*
Closing vessels to avoid contamination and using different cutlery for different food items	30	1	58	29	5	
Other practices	20	0	0	20	40	
Total	**70**	**20**	**100**	**50**	**100**	

*Significant at 5% level, $\chi 2$ (0.05, 1df) = 3.841

Table 14. Food safety practices followed in the canteen after the training

Characteristics	Category	Food handlers	
		Number	Percent
Food covered properly to protect from spoilage/ contamination.	Yes	67	95.7
	No	3	4.3
Place to Store food	Refrigerator (5.6° C)	53	75.7
	Other	17	24.3
Different utensils used for different food items	Yes	63	90.0
	No	5	7.1
	Sometimes	2	2.9
Bacterial contamination can spread through food.	Yes	67	95.7
	No	3	4.3

ISSN-Internet 2197-411x OLCL 862804632

Table 15. Association between training, hands washing, and handling food during illness

Washing hands before coming in contact with food	Sample	Trained		Untrained		χ2 Test
		N	%	N	%	
Yes	12	5	25	7	14	
Sometimes	58	15	75	43	86	
Total	**70**	**20**	**100**	**50**	**100**	1.22 NS
Involved in handling food during illness	**Sample (n)**	**Trained**		**Untrained**		**χ2 Test**
		N	%	N	%	
Yes	52	2	4	4	20	
No	18	48	96	16	80	43.20*
Total	**70**	**50**	**100**	**20**	**100**	

NS : Non-significant, $\chi 2$ (0.05, 1df) = 3.841
*Significant at 5% level, $\chi 2$ (0.05, 1df) = 3.841

4. Discussion:

A similar study was conducted by (Nirmala and Seethamma, 2018) where the result showed that the majority of the respondents visited the canteen twice a day mainly for breakfast and lunch. Results similar to this were also shown in the case study done at the Annapurna canteen (Tiss.edu, 2020). Some respondents were chronically poor and they skipped their lunch if canteens were closed, as it was hard to pay for a meal anywhere else with their earnings. This study was conducted with the aim to know the perception of the beneficiaries towards "Anna Canteen" in the District of Visakhapatnam. The research study comprised of a sample size of 153 beneficiaries which was spread among 15 Anna canteens of Visakhapatnam District. The results revealed that it was very clear that" Anna Canteen" has a great positive impact on the labour class, middle class, and poor people who are living in the Visakhapatnam District (Uday Kumar and Manjula, 2018).

Similar results were seen in a study carried out by Osaili et al. (2013) where there was higher knowledge among the food handlers who had registered for the food safety training. Another study by Husain et al. (2016) showed that there was a significant improvement in the knowledge of personal hygiene and the rules for preparing safe food post-intervention. The overall mean score difference between the intervention and control groups was 0.67 (95 percent CI: 0.25, 1.09).

However, a meta-analysis study (Soon et al., 2012) showed results where training on food safety and intervention showed that the knowledge of hand hygiene among trained food handlers was significantly more than those of the untrained food handlers, with an effect size of 1.284 (95% confidence interval [CI] ~0.830 to 1.738) which revealed the strong evidence between food safety training and hand hygiene. It was also seen that the hand hygiene attitudes and self-reported practices were observed with an effect size of 0.683 (95%CI ~0.523 to 0.843). Food safety training increased the knowledge and improved attitudes among the food handlers toward hand hygiene practices. Behera and Penthoi, (2017) carried out a study that aimed to find the reasons for the status and the

ISSN-Internet 2197-411x OLCL 862804632

factors which were the causes of the food insecurity in the state of Odisha. The data collected through the secondary sources showed the significant cause behind the problem of food insecurity in the state of Odisha was inadequate power to purchase food.

5. Conclusion

India's malnutrition is to be combated at the earliest, as its ranking of India in the Global hunger index (GHI) is declining which is undesired for the development of the country. Malnutrition is also caused by growing inflation and unemployment. Therefore, the state government of Karnataka has initiated the project of subsidized food through the Indira canteen. However, the success rate of this canteen not only depends on providing subsidized food to the population but also depends on food safety and hygiene. Therefore, the knowledge and practice of food handlers have a significant role in delivering safe food to consumers.

Hence it can be concluded from the present study that the Indira canteen is a successful and effective venture by the Karnataka government as the canteens were capable of providing subsidized and safe food to the consumers. The lower socio-economic section of society was also able to be benefitted from the scheme. But this scheme should take measures in reaching out to the larger section of the deserving population in Karnataka. Therefore, irrespective of the political regime, schemes like these must be continued for the welfare of society and to tackle the food security status of the population.

Conflict of Interests

The authors declare that there are no conflicts of interest.

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Earth's lakes number is increasing, but is that really good?

The number of small lakes on our planet has increased substantially in recent decades, according to a unique global survey of 3.4 million lakes. However, these small lakes are emitting considerable amounts of greenhouse gas. Lakes act like greenhouse gas factories due to the mechanism of bacteria and fungi feeding. They feed on dead plants and animals at the bottom of a lake and emit vast amounts of CO2, methane, nitrous oxide, and other gases and some of these gases end up in the atmosphere. Freshwater lakes probably account for 20% of all global CO2 fossil fuel emissions into Earth's atmosphere.

Therefore, it is of great importance to know how many and how big these lakes are, as well as how they develop. Researchers from the University of Copenhagen, with collaboration with other universities have prepared the first accurate and detailed map of the world's lakes than has ever existed. Th map covers 3.4 million lakes and their evolution over the past four decades using high-resolution satellite imagery combined with artificial intelligence. The survey results reported that between 1984 and 2019, the area of global lake surfaces grew by over 46,000 km2, slightly more than the surface area of Denmark. In addition, the study's calculations showed that the annual increase of CO2 emissions from lakes during the period is 4.8 teragrams (10^12, trillion) of carbon.

"There have been major and rapid changes with lakes in recent decades that affect greenhouse gas accounts, as well as ecosystems and access to water resources. Among other things, our newfound knowledge of the extent and dynamics of lakes allows us to better calculate their potential carbon emissions," explains Jing Tang, an Assistant Professor at the Department of Biology and co-author of the study, which is now published in *Nature Communications.*
She adds:
"Furthermore, the dataset can be used to make better estimates of water resources in freshwater lakes and to better assess the risk of flooding, as well as for better lake management -- because lake area impacts biodiversity too."

1. Xuehui Pi, Qiuqi Luo, Lian Feng, Yang Xu, Jing Tang, Xiuyu Liang, Enze Ma, Ran Cheng, Rasmus Fensholt, Martin Brandt, Xiaobin Cai, Luke Gibson, Junguo Liu, Chunmiao Zheng, Weifeng Li, Brett A. Bryan. Mapping global lake dynamics reveals the emerging roles of small lakes. Nature Communications, 2022; 13 (1) DOI: 10.1038/s41467-022-33239-3

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New Italian discovery that can extend shelf life of fresh pasta by 30 days

Pasta is one of the world's most popular food and a significant business in Italy. However, there is a short shelf for fresh pasts. The fresh pasta is produced by industry in a process equivalent to pasteurization; then it is stored in a modified atmosphere packaging (MAP) where other gases replace oxygen. It will last 30 days if kept in the fridge.

The problem lies with the other factors that can go wrong and compromise the quality of the pasta and even the safety of the product, such as some bacteria that may survive thermal treatment and grow under the right conditions, such as too much moisture.

Another way to preserve the freshness of the pasta is the chemical preservatives, which is considered unpleasant for most of the consumers who prefer natural, 'clean label' products without artificial or synthetic ingredients. Therefore, the options available to extend the shelf life of fresh pasta are limited. New research was conducted by the researchers at the National Research Council (CNR), the largest public research institution in Italy, together with the University of Bari Aldo Moro, and in collaboration with the private chemical laboratory, Food Safety Lab. This new work developed a novel process that can prevent or delay spoilage by changing packaging protocols, as well as adding antimicrobial probiotics to the dough. This new method, in addition to extending shelf life up to 30 days, contributes to reducing food waste. This innovation depends on the packaging process as well as applying bioprotective probiotic cultures to the dough. This new protocol is considered 'clean-label' method to minimize spoilage problems. The researchers changed the ratio of MAP gasses and the combination of plastic films used in the packaging to enhance microbial growth and impermeability control. Finally, they added a multi-strain probiotic mixture to inhibit the growth of bacteria. Then, the scientists tested the new protocol in three different experiments using high-tech methods such as gene sequencing to identify microbial compositions and mass spectrometry to profile volatile organic compounds. After a few months, they found that the pasta that underwent the new protocol had the best shelf life of the three experiments.

"The results demonstrate that the MAP, together with a spray-dried probiotic bioprotective cultures, acted in a synergistic way to control the microbial spoilage of fresh pasta during refrigerated storage," said Dr Francesca De Leo, a researcher with the Institute of Biomembrane, Bioenergetics and Molecular Biotechnologies at the CNR.

Marzano, Marinella, et al. "Extension of the shelf-life of fresh pasta using modified atmosphere packaging and bioprotective cultures." Frontiers in Microbiology (2022): 4213.

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A 50 percent drop in honey bee life spans in our contemporary time.

U.S. beekeepers have been witnessing a colony loss and reduced honey production beekeepers in recent decades. To understand why, the University of Maryland researched different factors that affect the longevity of honey bees, such as environmental stressors, diseases, parasites, pesticide exposure and nutrition. The results show that the lifespan of honey bees kept in a laboratory environment is 50% shorter than in the 1970s. This study is the first to show that genetics may affect colonies' decreased lifespan apart from known stressors.

"We're isolating bees from the colony life just before they emerge as adults, so whatever is reducing their lifespan is happening before that point," said Anthony Nearman, a Ph.D. student in the Department of Entomology and lead author of the study. "This introduces the idea of a genetic component. If this hypothesis is right, it also points to a possible solution. If we can isolate some genetic factors, then maybe we can breed for longer-lived honey bees."

The researchers noted that while brooding the larva, the bees could be experiencing some level of viral contamination or even pesticide exposure. However, these suggestions are not wholly proven, as the bees showed no explicit symptoms of these exposures.

This research will be followed by another step that aims to compare trends in honey bee lifespans across the U.S. and other countries. If they find differences in longevity, they can isolate and compare potential contributing factors such as genetics, pesticide use and the presence of viruses in the local bee stocks.

Anthony Nearman, Dennis vanEngelsdorp. Water provisioning increases caged worker bee lifespan and caged worker bees are living half as long as observed 50 years ago. Scientific Reports, 2022; 12 (1)
DOI: 10.1038/s41598-022-21401-2

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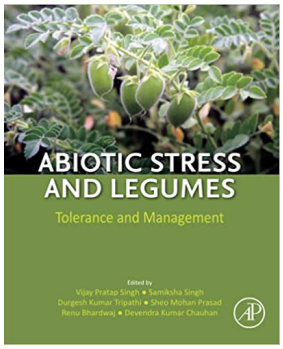

Abiotic Stress and Legumes: Tolerance and Management

A review by Diana Ismael

Authors (Eds.): Vijay Pratap Singh, Samiksha Singh, Durgesh Kumar Tripathi, Sheo Mohan Prasad, Renu Bhardwaj, Devendra Kumar Chauhan
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This book is the first book to present an inclusive overview the development of the abiotic stress effects managing in legumes and its means. The book consists of 16 chapters That highlight the development of new varieties that have more tolerance through high yield using transcriptomic, proteomic, metabolomic and ionomic approaches. Besides, it explores the supplication of external sstimulants such as plant hormones, nutrients, and sugars as a new strategy to enhance productivity under challenging environmental conditions.

Legumes in India play a significant role not only in the soil but also in humans. It can improve the nutritional status of the soil, and it is an essential source of protein to a large population of vegetarians. Moreover, as nature is currently facing complex conditions such as like loss of soil fertility, and fluctuating climatic factors, the first chapter discusses mines the importance of the plant growth-promoting rhizobacteria (PGPR) as a sustainable solution to all these problems. PGPR enhance the growth of almost all crops. However, its application in legumes have more significant effects in terms of the productivity of crops.

It is important to understand the valuable role of symbiosis in the coevolution of microorganisms. It plays a significant role in the plant's resistance to abiotic and biotic stresses helping to establish long-lasting associations. The second chapter details the mechanism of legume-Rhizobium symbiosis such as nodule organogenesis, and Rhizobium nodulation (Nod) factor signalling. The chapter describes molecular genetics of signal transduction as well as controlling feedback mechanisms of nod factor signalling.

Plant growth–promoting rhizobacteria (PGPR) is known for their positive effects on plant growth and physiology and their importance for sustainable agriculture and soil fertility. They exist in the soils worldwide. The third chapter explores the high importance of the PGPRs as a solution to achieve more sustainable agriculture and emphasizes the integrated management of plant nutrients. Moreover, studying the PGPR are getting s growing attention from researchers for their benefits of agriculture as environmental cleanup strategies, heavy metal detoxification, nitrogen fixation, defence against pathogens, and much more.

Some of the main reasons behind the heavy metal contamination in both soil and water are the countless domestic, industrial, and transportation activities of human as well as extraction of mineral resources, dumping of solid wastes, and emissions from vehicles. This contamination with heavy metals such as arsenic, chromium, copper, cadmium, nickel, lead, and zinc can seriously impact humans, plants and other organisms that have a main role in maintaining the ecological balance. The fourth chapter deals with the modulations of legume plants in response to heavy metals-induced stress. These heavy metals can accumulate in food chains and can further cause different types of toxicities such as mutagenicity, genotoxicity, teratogenicity and oxidative stress.

Sugars are biomolecules that constitute the main resource of carbon in plants, wich is a high important physiologically. Chapter five inspects the role of sugars in mediating abiotic stress tolerance in legumes and explores the mechanisms of sugar molecules in generating stress tolerance in plants. Moreover, the chapter discusses the late studies on sugar-mediated stress management in legume plants.

One of the direct or indirect reasons behind the abiotic stress that impact the legumes is the irregularity in the environment and climate change, which significantly impacts the global production and distribution of legumes. Legumes (Glycine max, Cicer arietinum, Phaseolus vulgaris, Pisum sativum) are vital crops cultivated globally. The circadian clock is the internal key that control the plant activities. This chapter, number six, highlights legumes' circadian regulation of abiotic stress tolerance. There is an association between the plants response to abiotic stresses such as light, heat, cold, drought, flood, etc., and internal circadian clock suggest a close correlation between both pathways. There are various research on the circadian clock regulations in legumes. However, it is still in its initial stage.

Chapter seven discusses the polyamines' importance as a promising strategy for imparting salinity stress tolerance in legumes. Salinity has a negative impact on crop yield. The harmful impact of salinity is related to the low osmotic potential of soil water and the increase in Na+ and Cl– ions in various plant tissues. Thanks to their ability to fix nitrogen in the root nodules through a symbiotic association with soil rhizobia, legumes are known for their significant benefits in the sustainability of agricultural systems. However, most legumes are salt-sensitive and salinity badly affects their productivity. Previous studies investigated the role of the plant polyamines (PAs) in easing the salt-induced harmful effects at physiological, biochemical, and molecular levels.

Legumes are well known for their nutritional and health benefits for a long time due to their high protein content. Moreover, they are considered as an alternative resource for meat production. However, these plants are also known for their sensitivity to unfavorable abiotic, such as temperature, inadequate nutrients in soil composition, heavy metal toxicity, or biotic stress, such as pest infestation. This stress affects the quality and quantity of production. Nevertheless, plants develop various defence-related responses to become tolerant and survive any stress. One of these responses is activated hormones. Hormones such as gibberellins, ethylene and abscisic acid, Brassinosteroids, Jasmonates are known to be activated under stress to help the plants cope with the stress conditions. The present chapter, chapter number eight, deals with the detrimental effects of various shapes of stress encountered by the legumes and the role of the signalling hormones through various cascades in making the legumes crops abiotic stress tolerant.

Chapter nine deals with the role of melatonin as an abiotic stress manager in legumes. Melatonin (MEL, 5-acetyl-5-methoxy trptamine) is a phytochemical that exists in all organisms. It plays many vital roles in plant growth and development as well as senescence, yield, fruit ripening, circadian rhythmes, and, more importantly, response to abiotic stresses. Under stress conditions MEL is accumulates sharply by regulation of its synthesis and varied metabolic pathways. Many studies showed that under abiotic stress condition such as salinity, heavy metal, water, and temperature, phytomelatonin production increases. The eighth chapter focuses on biosynthesis of MEL in plants, stressed-induced alteration in internal levels of MEL in legumes.

In addition to the previous factors, oxygen also plays a significant role in regulating abiotic stress tolerance in legumes. Legumes grown in areas with marginal soil fertility and are more frequently exposed to several abiotic stresses, such as drought or saline conditions. Several previous research investigated the role of ROS (reactive oxygen species) in abiotic stress responses in various plants, and increased levels of ROS generation are among one of the earliest stress responses. Chapter ten highlights the role of ROS in modulating abiotic stress responses in legumes. Understanding stress-induced changes in ROS-modulated abiotic stress responses in legumes will help to engineer future legumes with better adaptability, thereby ensuring global food security.

Chapter eleven continues with other factors that help the legumes face the abiotic stress. The chapter explore the role of metabolites in abiotic stress tolerance in legumes. Plant primary and secondary metabolites, are affected by environmental adversities and their assessment can give a clear picture of stress tolerance abilities of the plants. Various research studied the primary metabolites in plants, mainly carbohydrates, specifically for their roles in osmotic regulation in relation to abiotic stress management. Moreover, secondary metabolites including phenolics, flavonoids, various alkaloids, carotenoids were found to have a big role in inducing tolerance against stressful conditions.

The book is comprehensive and covers various aspects related to the tolerance management of abiotic stress in legumes. The rest five chapters also deals with different mechanisms of facing the abiotic stress. Chapter twelve reviews the Quorum sensing strategy used by rhizobacteria and by legume-associated bacteria. While chapter thirteen focuses on the role of the plant genes for abiotic stress in legumes.

The chapter explores how changing the morphology and structure of shoot apical meristem (SAM) in plants is one of its responses against abiotic stresses. Chapter fourteen goes through the role of the MicroRNAs and abiotic stress tolerance in legumes. As miRNAs play a vital role in multitude, of crucial biological and metabolic processes, maintaining genome integrity and in adaptive responses for environmental stresses. The last two chapters investigate two other mechanisms, which are the Quantitative trait loci (QTL) and Genetic engineering of legumes for abiotic stress tolerance.

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The book is considered the first one to highlight legume plants' ability to adapt effectively to environmental challenges. It is considered very valuable to understanding the methods and mechanisms that maximise the legume plant's productivity by increasing the capacity to survive and improving tolerance to abiotic stress factors, such as drought, temperature change, heavy metals and other challenges.

About the author:

Diana Ismael is a sensory specialist with a PhD in Food and Sensory Science/Consumer Behavior from Kassel University, Germany. Her research focuses on understanding the intention-behaviour gap in organic food consumption. Currently, she works as the Managing Editor at the Future of Food Journal: Journal on Food, Agriculture & Society.

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