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Editorial

How did sensory evaluations survive under the Covid-19 crisis challenging all the odds?

Dr. Diana Ismael is a sensory specialist with a PhD in Food and Sensory Science/Consumer Behavior from Kassel University, Germany. She has three master's degrees in Sustainable Management of Food Quality from Basilicata University, Italy; Nutritional Science from Montpellier University, France and Agricultural Economics from Tishreen University, Syria. Her research tries to understand more about 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.

Sensory evaluation is an experimental design that uses human senses to evaluate the consumer's reaction to a product. The test usually takes place in a specific booth inside a lab that is prepared according to international standards where light, sounds, temperature, smells and other conditions are controlled. It is considered a critical operation component both in food and non-food industries.

In 2020, the Covid-19 crisis forced global restrictions that negatively affected sensory evaluations and consumer testing. Many labs were forced to close down and stop indoor consumer testing, whether inside the lab or at a central location test. Therefore, sensory experts found themselves in a situation where they must start thinking outside the booth. They were eager to develop alternatives that guarantee the safely continuing sensory evaluation.

Here comes the new concept of remote sensory testing. Remote testing aims to organize the product evaluation outside the typical lab booth. It represented a trade-off between adequate control and the convenience of conducting testing out of the lab.

New methodologies of remote sensory tests were rapidly developed, such as Home use test (HUT) and Drive-up test. HUT is a test that takes place at the assessor's home or workplace under the live online supervision of the panel leader. In Drive-up testing, the participants will use smartphones to rate the samples in their cars. Consequently, guidelines were developed to assist panel leaders in setting up and controlling the evaluation sessions in remote testing conditions.

However, many challenges have arisen, as it is no secret that the sample control and presentation levels

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may be compromised with home testing. For example, how does a panel leader control the evaluation if panel members are all at home with children, parents and pets to contend with? Therefore, many studies were conducted to evaluate the effectiveness and validity of the sensory tests carried out remotely compared to the tests in a classical laboratory setting.

Now and after the world has started to recover from the consequences of Covid-19, the sensory test is back on track but with a very hard-learned lesson on rapidly adapting to difficult situations. New safety procedures are being taken, such as health screening for COVID-19 symptoms, infrared forehead temperature scan, modifying the traffic flow in a way that allows assessors to enter in one direction and leave on a different path to reduce exposure to infected individuals, hiring a smaller panel, sanitizing booths or panel rooms between evaluations, and installing plexiglass barriers to protect staff who are greeting participants. Moreover, portable and easily cleaned booths are used in larger conference rooms if the food can be delivered efficiently.

Sensory evaluation is developing rapidly, and new methodologies, technologies and approaches are being released yearly. During the Covid-19 crisis, sensory experts and researchers showed a high balance of creativity and proficiency that could push the wheel of sensory tests forward, successfully facing all the challenges of the lockdown and restrictions.

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Impact of COVID-19 pandemic on food price index in Nigeria

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COVID-19 pandemic, lockdown, food commodities, price differences, Nigeria

The economic effect of the COVID-19 pandemic and lockdown on food access/demand can lead to food price changes. This study was designed to evaluate the covid-19 influenced differences in food commodity prices. The study design captured eight urban markets in eight Nigerian states. A multi-stage sampling technique was employed. The number of sample points for each measure and commodity ranged from two to four per selected market. Local measures of commodities sold by traders were obtained and weighed using a calibrated weighing scale. The price equivalent of the weighted portions was obtained for three designated intervals; the pre -COVID-19 lockdown (September 2019), the peak of nationwide lockdown (May-June 2020), and post COVID-19 lockdown (March 2021). Results revealed that cereals/grains prices significantly increased (4.87-23.53%) during the lockdown and even further (38.68-65.16%) after the lockdown. Yam, sweet potato, and cassava flour (alagbo) experienced a double increase in the post-lockdown (96.32-117.5%) price. The market price for legumes/nuts increased during the lockdown (4.51-47.37%) and worsened post-lockdown (27.82-155.26%). Vegetables recorded a massive leap in price within the lockdown period (64.39-197.98%) than post-lockdown (-8.95% to 66.22%). Same was observed for goat meat (lockdown price – 30.0%; post-lockdown -12.38%). Egg and milk recorded a mild upsurge in the price during the lockdown (12.69-16.46%) and post-lockdown era (18.28-29.86%). Other essential commodities such as oil, salt, and sugar experienced a price upsurge as well (lockdown; 3.82 -17.07; post lockdown; 0.31-21.9%). Food prices increased during the lockdown and worsened afterward, efforts to eliminate food system disruptions will boost food production and enhance physical accessibility.

1. Introduction

The coronavirus pandemic has sparked not only a health crisis but also an economic crisis, which poses a severe threat to food security in low and middle-income countries (Swinnen & McDermott, 2020).

Due to the high rate of COVID-19 spread and the absence of a vaccine for its treatment/prevention in 2020, Nigeria adopted "lockdown" to reverse epidemic growth and reduce case numbers to low levels (NCDC, 2020). The lockdown strategy in Nigeria was characterized by restriction of social gatherings, closure of educational institutions, halting of all non-essential economic activities, and a ban on domestic and international travel (Seal of the President of the Federal Republic of Nigeria, 2020; Ewodage, 2020). Although most African governments consider food supply chains to be "essential" and have exempted them from lockdown policies, food systems are not immune to the effects of the pandemic. This is reflected in an estimated 18% drop in agri-food Gross Domestic Product during the five-week lockdown exercise in Nigeria (Thurlow, 2020).

Evidence has shown that COVID-19 induced lockdown affected food systems directly through impacts on food supply and demand (Paul and Chowdhury, 2020; FAO, 2020a), and indirectly through a decrease in purchasing power (Thurlow, 2020; Afridi *et al.,* 2021; Teachout and Zipfel, 2020; Iheme *et al.,* 2020), the capacity to produce and distribute food (IFPRI, 2020; FAO, 2020b; Stephens *et al.,* 2020) and the intensification of care tasks (Coke-Hamilton and Nkurunziza, 2020; WHO, 2020). These severe effects are expected to affect access to food and food demand which will consequently lead to downward pressure on agricultural prices (Torero, 2020; Espita *et al.,* 2020).

In Nigeria, attention has been focused on COVID-19 impact on health, livelihood, and food security in previous studies (Thurlow, 2020; Matthiew and Celine, 2020; FAO, 2020b; Ajibo, 2020; Babatunde *et al.,* 2020), with a dearth of evidence on COVID-19 influence on food price indexes in Nigeria (Beckman *et al.,* 2021; GAIN, 2020). This paper will explore the price differences in food commodities before COVID-19, the peak of lockdown, and post lockdown.

2. Materials and Methods

Study Design

A descriptive and cross-sectional study was employed to determine the COVID-19 influenced food price indexes in Nigeria.

Study Location/Profile of selected markets

The study was conducted across the Urban Markets in various zones in Nigeria. Markets play a vital role in the economic life of the people, and they are essential in the chain of commodity distribution (Adeyinka *et al.,* 2016). Trading is one of the most popular activities in the informal sector of the economies of Nigerian cities. There is a high volume of trade and other economic activities in urban Nigerian markets as people from different origins and regions come to buy, sell items or transact business. Markets in large metropolitan areas organize their marketing system for both domestically consumed and exported commodities as well as the distributing system for imported foodstuff (Adeyinka *et al.,* 2016).

The eight selected urban markets comprise; Ogbete Market Enugu State, Ubani Market Abia State, Magaret Umahi International Market, Ebonyi State, Bodija Market Oyo State, Kuto Market Ogun State, Katsina Central Market Katsina State, Gombe Central Market Gombe State, Jos Main Market Plateau State. The geographical distribution of the surveyed markets is shown in Figure 1.

Ogbete market is a daily market in Enugu North LGA. Male and female traders sell food and non-food commodities. It is also patronised by traders from neighbouring cities - Onitsha, Aguleri, Abakaliki and Aba. Ubani market is the central market in Umuahia following its relocation from Isi-gate Umuahia. Traders from within and outside Umuahia city patronize the market for food and other commodities. It is located within latitude (DMA) 5o 31 60N and Longitude (DMS) 7o 28"60E. It is bounded by Bende Local Government Area on the West, Isuikwuato Local Government Area on the South, Umuahia South on the North and Ikwuano Local Government on the East (Okezie *et al.,* 2017).

Following the dissolution of the Abakpa Main Market which was formally ranked amongst the oldest markets in the South-East and beyond, a new ultramodern market - Margaret Umahi International Market located along Abakaliki Ogoja Road on the West African Trans-Saharan highway was constructed. This new market is patronized by traders and consumers for food and non-food commodities.

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Bodija Market is a famous open-air market located in Bodija, Ibadan North, Oyo State, South-West Nigeria (Grace *et al.*, 2019). Bodija market is the central food-stuff depot of Ibadan city as it carries the employment burden of a large percentage of the over 5 million inhabitants of Ibadan (Abumere, 2002). The location of the market is close to the Oyo-Ogbomoso-Ilorin interstate road network (Wikipedia, 2020). This facilitates the movement of farmers and traders from Northern Nigeria and Northern Oyo State to transport their produce to the market. The market is a mixture of open space trading and concrete and wooden stalls. Many wholesalers gravitate towards ownership of the concrete stalls while retailers own most of the open space kiosks and trading locations (Wikipedia, 2020).

Kuto market is an urban daily market located in Abeokuta South Local Government Area of Ogun State. However, there is a unique market every five days when farmers from nearby villages bring their wares for direct sale to traders and consumers. The market which is set-out along the link road to Lagos State, the former capital city of Nigeria is bounded by the Federal Secretariat and a Government Reserved Area (Idris, 2005). It is widely patronized by the wealthy and the poor who purchase a various array of (agricultural and industrial) commodities from the market including traders from Lagos, Shagamu, Eghado and Ibadan who patronize the market regularly (Idris, 2005).

Katsina Central Market; the name implies, this market is centrally located in Katsina South LGA. It is a daily market with both men and women trading food and other non-food commodities. The market has permanent structures with lockable stores (Nan, 2021).

Gombe Central Market is a daily market located in Gombe State. It is one of the major urban markets and is patronized by consumers and traders from neighbouring cities and communities.

Jos Main Market, also known as Jos Terminal Market, was an ultra-modern market located in Jos, Plateau State Nigeria (Aiijah, 2014; KapaNews, 2020). It was known to be the largest indoor market in West Africa (KapaNews, 2020). Currently, about 70% of buying and selling take place in the terminus within the vicinity of the main market. The terminal market now consists of an estimated population of 850 Shop owners with 1,110 vendors recorded (Orewere *et al.*, 2019).

Sampling

A multi-stage sampling technique was employed. The urban markets in the studied zones/regions were purposively selected. A stratified sampling technique was used to categorize the selected markets into strata – each stratum representing a particular commodity/staple food. Also, the number of sample points for each measure and commodity ranged from two to four per selected markets.
Samples of commodities sold by selected traders were measured using the local measure obtained from the trader and poured into a polythene bag. This was then weighed using a scale calibrated in the metric system. Weight was recorded in kg and price equivalent (in naira) obtained from each sample point and the average calculated for each commodity.

Data Collection

Eight (8) investigators and twenty-four (24) research assistants trained on the use of the survey instruments were involved in the data collection. A pilot study was conducted in two urban markets that were not captured in the sampling frame, this was done to refine the content and approach of the survey instruments.
Preliminary visits were made to the L.G.A chairmen, community councilors, and market leaders to seek permission to conduct this survey.

Informed Consent

This study was conducted in accordance with the guidelines laid down in the declaration of Helsinki. Written informed consent was obtained, the objectives of the study, assurance of no harm, the confidential use of information supplied, and freedom to participate or withdraw from the study at any point were clearly explained to them.

Data Analysis

Descriptive statistics (frequency, percentage, mean and standard deviation) were computed for the continuous variables. Paired t-test was used to compare the impact of the COVID-19 lockdown on the price indexes of the staples during (May-June, 2020) and af-

ter the lockdown (March 2021). Pre COVID-19 food prices (September 2019) served as the baseline price for comparison. Significance was judged at $P<0.05$.

3. Results

Results revealed that the cost of cereals/grains significantly increased by less than a quarter (4.87-23.53%) during the lockdown, and the price difference increased even further (38.68-65.16%) after the lockdown.

In comparison to the baseline price (pre-COVID price), it was observed that the cost of yam doubled during (92.59%) and after (100.00%) the lockdown. The cost of alabo (cassava flour) and sweet potato increased remarkably after the lockdown (96.32-117.5%) than during it (16.56-47.50%). Other root and tubers crops, their market price increased in the lockdown season (6.26-47.5% and more beyond it (12.51-56.52%).

The market price for legumes and nuts slightly increased during the lockdown (4.51-47.37%), this price situation even worsened after the lockdown (27.82-155.26%). Melon reportedly had a mild (18.35%) decline in purchasing price during the national COVID-19 pandemic lockdown and a further elevation in price after the lockdown (6.96%).

Foods within the vegetable category (pumpkin, okro, tomato, onion, pepper, and carrot) had a huge leap in price within the lockdown period (64.39-197.98%) than post-lockdown era (-8.95% to 66.22%).

There was a significant ($p<0.05$) moderate rise in the cost of fish and meat products during (17.39-30.0%) and after the lockdown (12.38-30.57%). Unlike others, the market price of goat meat which increased to 30.00% during the lockdown, considerably dropped to 12.38%.

Other animal protein alternatives like egg and milk

Figure 1. Geographical distribution of the surveyed urban Nigerian markets

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also recorded a mild upsurge in the price during the lockdown (12.69-16.46%) and post-lockdown era (18.28-29.86%). Similarly, the price of groundnut oil and salt increased during the lockdown (8.03% and 7.64%) and even after the lockdown (21.90% and 17.81%), respectively. Palm oil and sugar commodities experienced a dip in the elevated market price of 17.07 and 3.82% (lockdown) to 3.17% and 0.31% (post lockdown).

Table 1: Price differences in food commodities

Food commodities	Mean weight (kg)	Baseline/ pre-COVID-19 price (₦)	COVID-19 lockdown price (₦)	% difference	Post lockdown price (₦)	% difference
Cereals/grains						
Rice	1.89	825.00	1019.12	23.53**	1144.12	38.68*
Wheat	1.90	449.64	518.57	15.22*	671.43	49.33*
Millet	1.73	401.82	496.36	23.53*	663.64	65.16*
Spagetti	0.50	194.62	215.39	10.67**	252.31	57.69*
Maize	1.86	326.43	387.86	18.82*	494.64	51.53**
Sorghum	1.52	317.27	332.73	4.87	382.73	20.63**
Bread	0.44	242.00	266.00	9.92**	277.00	14.46**
Starchy roots and tubers						
Garri	1.35	373.33	504.67	35.18*	524.00	40.36**
Alabo	0.91	163.00	190.00	16.56	320.00	96.32**
Fufu	0.30	44.44	47.22	6.26	50.00	12.51*
Yam	1.90	225.00	433.33	92.59**	450.00	100.00**
Plantain	1.02	418.18	600.00	43.48**	654.55	56.52*
Sweet potato	1.37	333.33	491.67	47.50**	725.00	117.50**
Irish potato	1.42	453.85	553.85	22.03**	661.54	45.76**
Legumes and nuts						
Beans	1.28	588.95	666.84	13.22**	908.42	54.24*
Soybeans	1.51	386.36	422.73	9.41*	563.64	45.88**
Bambara nut	1.90	542.86	800.00	47.37	1385.71	155.26*
Groundnut	1.33	604.55	631.82	4.51	772.73	27.82**
Melon	0.46	455.44	371.88	-18.35**	423.75	6.96**
Vegetables						
Pumpkin	0.20	94.29	155.00	64.39**	140.00	48.48**
Okro	0.16	120.00	203.85	69.88*	180.77	50.64**
Tomato	0.94	204.55	368.18	80.00*	340.00	66.22**
Onion	1.22	319.29	951.43	197.98**	290.71	-8.95
Pepper	0.17	99.29	181.43	82.73**	130.71	31.64**
Carrot	0.37	75.00	128.57	71.43*	122.86	63.81***
Fruits						
Orange	0.46	67.86	103.57	52.62*	92.86	36.84**
Banana	0.67	263.64	350.00	32.76*	368.18	39.65**
Watermelon	0.89	304.55	340.91	11.94	358.18	17.61*
Pawpaw	0.92	165.00	233.00	41.21**	260.00	57.58**
Pineapple	0.69	240.00	285.00	18.75*	305.00	27.08**

Continue table 1. Price differences in food commodities

Food commodities	Mean weight (kg)	Baseline/ pre-COVID-19 price (₦)	COVID-19 lockdown price (₦)	% difference	Post lockdown price (₦)	% difference
Animal protein						
Fish	0.70	747.06	920.59	23.23**	929.41	24.41**
Beef	1.00	1427.27	1800.00	26.11*	1863.64	30.57**
Goat	0.92	1500	1950	30.00**	1685.71	12.38*
Snail	0.48	575.00	675.00	17.39**	566.67	-1.45
Egg	3.00	1014.71	1181.77	16.46	1317.65	29.86**
Milk	0.25	783.13	882.50	12.69	926.25	18.28
Oil						
Groundnut oil	0.78	913.33	986.67	8.03**	1113.33	21.90**
Palm oil	0.92	946.15	1107.69	17.07**	1150.00	3.82*
Other essential foods						
Salt	0.40	69.41	74.71	7.64	81.77	17.81**
Sugar	0.95	395.00	407.50	3.17	396.25	0.31

** P-value is judged significant at 0.01

* P-value is judged significant at 0.05

4. Discussion

Study reported a significant increase in almost all the food commodities during the COVID-19 pandemic when compared to the pre-COVID-19 period. Similarly, the impact of the COVID-19 pandemic and lockdown on food price inflation has been reported/ estimated in other regions (Paul and Chowdhury, 2020; Espita *et al.,* 2020; Beckman et al. 2021; He *et al.,* 2020; Paslakis *et al.,* 2021; Akter, 2020).

The degree of COVID-19 influenced price inflation in this study ranged from as low as 3.17% increase in sugar price to as high as 197.98% in the market price of onion during the lockdown and 0.31-155.26% rise after the lockdown. This agrees with reports that the global average prices for a variety of food products increased by 2 to 9 percent, with half of the tracked goods rising by 7 percent or more (IFPRI, 2020). In some developing countries, an 80-133% rise in the price of several food products was reported (IFPRI, 2020).

It was observed that the degree of price inflation of vegetables and fish/meat products during the 'stay at home' restriction was higher than those observed in the post-lockdown period. This is consistent with findings from Akter, (2020) where COVID-19 lockdown resulted in an estimated point increase in meat, fish, seafood, and vegetables. An empirical examination of recently compiled FAO data confirmed a distinct increase in prices paid by the end-consumer during the country specific-lockdown period (FAO 2021a; FAO, 2021b).

With exception to foods within the vegetable and meat/fish categories, the difference in the pre-COVID 19 and post lockdown price of food commodities exceeds the pre-COVID 19 and lockdown price differentials. This is an indication that the longstanding impact of the COVID-19 pandemic on food commodity prices and the economy. Beyond the COVID-19 pandemic, several factors may be attributed to the high prices of food commodities in Nigeria. It has been shown that some farming communities and other food value chain stakeholders are caught in the triangle of conflict, climate change and ineffectual policies (GAIN, 2020; OCHA, 2020).

5. Conclusion

The price of food products increased dramatically

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during the nationwide lockdown and even worsened after the lockdown. The cost of yam, tomatoes, onions, pepper, and carrots experienced a massive (over 70%) increase in price during the lockdown. The enormous (over 70%) post-lockdown price differences were reported for alabo (cassava flour), yam, sweet potato, and bambara nut. Increased attention and support to eliminate/limit food system disruptions will boost food production, enhance physical accessibility and ultimately reduce food prices.

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Conflicts of Interest

The authors declare no conflict of interest

Ethics of human subject participation

This study was conducted according to the guidelines laid down in the Declaration of Helsinki. Written consent was obtained from the respondents after the study scope and objectives were communicated to them.
Authorship: G.O.I, A.D.A, I.M.E, O.E.K, and O.C.O formulated the research concept and design. All authors except G.O.I and O.C.O were involved in data collection. G.O.I, L.E.O, H.C.E compiled and analyzed the data, G.O.I, A.D.A, I.E.M, N.C.A and E.A.O drafted the manuscript while O.C.O, L.E.O and H.C.E critically reviewed the manuscript. The final version submitted for publication was read and approved by all authors

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Horsegram [*Macrotyloma uniflorum*]: an underutilized pulse crop as a sustainable plant-based protein

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The demand of consumers for plant-based protein is high and is anticipated to increase in the future due to various underlying health benefits. Moreover, the production of high-quality animal protein globally results in a challenging situation for the sustainability of the environment. Contemporary, to find new alternative protein sources, underutilized legumes are given more attention to meet the ever-increasing requirement for vegetable protein. One of the indigenous underutilized legumes is Horsegram (*Macrotyloma uniflorum*), having superior nutritional quality with better potency to adapt to rough environmental conditions. Horsegram is considered a wholesome food as it provides 23% protein, less than 1% of fat, and 60% of carbohydrates. However, due to the presence of anti-nutritional factors such as lectins, trypsin inhibitors, and phytic acid; the absorption and bioavailability of nutrients fall away. Optimal utilization of the nutrients can be achieved by conventional processing methods which increases the acceptability and nutritional quality of horsegram. Additionally, it provides several bioactive components in minimal quantities which has substantial metabolic and/or physiological effects. Therefore, the horsegram can be used as an underutilized sustainable protein source in the food industry for manufacturing plant-protein-based functional food.

1. Introduction

Protein is a dietary component that plays many constructive and agile roles in the body. In addition, protein-based ingredients play several different technical roles in processed foods and contribute to texture, colour, taste, and other food properties (Loveday, 2019). It is estimated that from 2010 to 2050, the world's demand for food will be doubled and as a result, the demand for animal-source protein will increase by 70%, especially for light meat (cattle, sheep, and goats) (Henchion et al., 2017). To fulfil this high upsurge in the proteinaceous food demand, the global pressure (yields and pastures) will increase and contribute to higher gas emissions (GHG). This is a major environmental challenge and therefore switching to a more stable diet and exploring other sustainable protein sources has been at the utmost forefront of 21st century food research.

In 1987, Brundtland World Commission reported "Sustainability is the development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs." Sustainability is generally defined by focusing on ecology, economy, and society and has various elucidations determined by the circumstances. Therefore, a sustainable diet does not certainly be defined evenly

for consumers, farmers, or food manufacturers (Sabate and Soret, 2014). Sustainable food is defined as a diet that improves the overall health and well-being of the individual; has low pressure and impact; is affordable, safe and equitable; and culturally acceptable' (Thakur et al., 2020). The principles of a sustainable diet are based upon the use of raw or processed foods, especially cereals, pulses, fruits and vegetables, milk, poultry, and fish in moderation and a lesser amount of meat from cattle, sheep, and goats.

Global change in our food cycle and system requires a combination of major changes in plant-based food patterns and significant improvements in food production activities. The need for trade should be recognized and at the same time, unintended consequences should be avoided which has often been linked with large gaps in our understanding of the sustainable credibility of alternate protein sources (Lonnie and Johnstone, 2020).

Proteins are indispensable components of the human daily diet which can be procured from either plant or animal sources. Although, animal proteins are higher in demand but are less environmentally sustainable. Consequently, a gradual transition of preference from animal protein to plant protein is seen to maintain the stability of the environment, ethics, food affordability, and food safety, fulfilling higher demands of consumers, and fighting protein-energy malnutrition. Plant proteins are an acceptable source of essential amino acids and significant macronutrients. Therefore, the main goal is to provide an overview of plant-based protein that helps in sustaining a better life for humans (Langyan et al., 2022).

On that account, we review a nutritionally important underutilized legume crop: *Macrotyloma uniflorum*, which is a pulse crop that has economic, agricultural, and medicinal importance and is highly drought-tolerant, yet less popular tropical legume commonly called 'Kulthi'. The major points about Horsegram are discussed here: (1) Morphology, (2) Cultivation, (3) Composition, and (4) Medicinal benefits. To strengthen Horsegram's prospects, future perspectives have also been highlighted.

Horsegram is an overlooked and under-valorised crop that has a great new potential to hold up small farmers by providing income, food, and nutritional security as well as sustaining the genetic resources required to confront present and future environmental challenges (Bhartiya et al., 2015).

1.1. Existing protein sources

Proteins are found in various food sources; this includes animal and plant origin foods as well as novel sources like algae or fungi (Figure 1). Determining the efficacy of a protein is achieved by determining its quality and digestion, where quality refers to the availability of amino acids it provides, and digestion

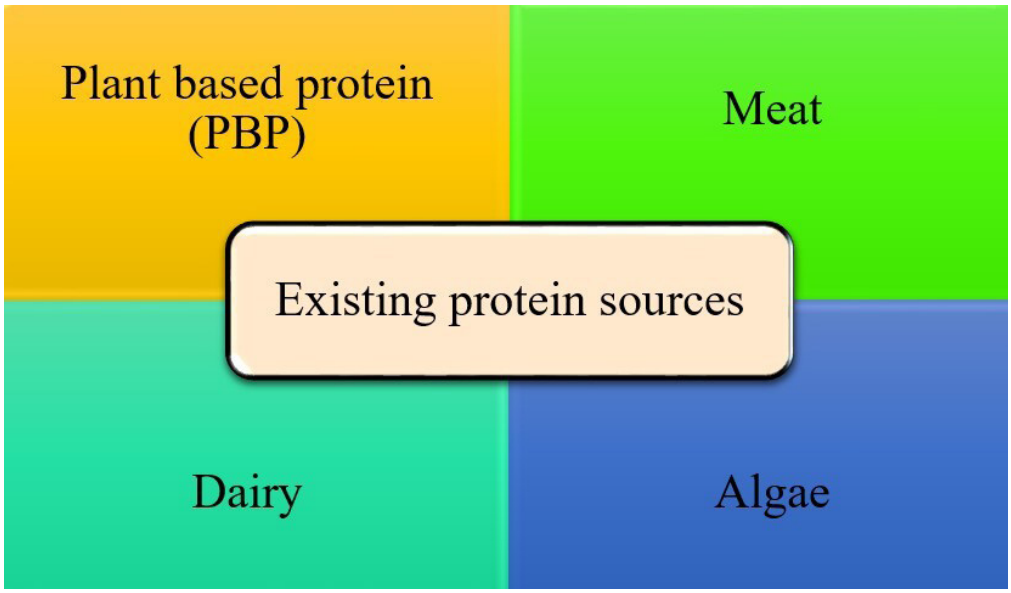

Figure 1. Existing sources of protein

determines how well protein is utilized by the body. Generally, all the sources of animal protein are considered complete proteins as they contain all the essential amino acids, while proteins from vegetable sources are incomplete because they often lack one or two essential amino acids. Therefore, a vegetarian is required to consume protein from different vegetarian sources like grains and legumes to ensure the intake of most of the essential amino acids (Hoffman and Falvo, 2004).

Contemporary, plant protein sources preside over protein supply globally with 57%, 18% with meat, 10% with dairy, 6% with fish and shellfish, and 9% by utilizing other animal products and making up the rest.

i. Plant-based protein: A variety of plants and their parts (e.g., seeds or leaves) are commonly available protein sources. Some of them have a long history of use as protein sources including soy and wheat, while others are currently emerging.

a. Pulses were considered the poor man's meat however over recent years; these have been considered as excellent sources of plant protein. The protein content in grain legumes ranges from 18 to 34%. Pulses have high lysine, leucine, aspartic, and arginine contents, although methionine, cysteine, and tryptophan levels are very low. Examples of protein-rich pulses and lentils are green gram, soybean, horsegram, etc.

b. Cereal grains and pseudo-cereals: Cereals generally contain 8-11% of protein. These proteins are rich in methionine, cysteine, and tryptophan however, levels of lysine and threonine are very low. The protein from amaranth, quinoa, and buckwheat have gained much attention because of their high nutritional and functional properties and are also suitable for patients with celiac disease.

c. Oilseeds: The end products of oil processing from oil seeds contain around 45- 65% protein depending on the ingredient and processing conditions. Examples of oilseeds are sunflower, canola, peanut, palm kernel, etc (Schweiggert-Weisz et al., 2020).

The advantages of plant proteins on long-term health have been a trending subject matter in current years. Several studies have explored the potential impact of plant proteins on reducing cardiovascular diseases, diabetes, and the incidence of cancer. Therefore, inevitably plant proteins are also studied for their potential activity as functional foods. Plant proteins help in reducing low-density lipoproteins, very low-density lipoproteins, and apolipoprotein B which help individuals with coronary heart disease. Various studies have also shown positive effects of plant proteins on postprandial glucose and ghrelin responses, and have improved the levels of HbA1c, fasting glucose, and insulin levels of people with diabetes. It is established that there are numerous constituents present in plants like carotenoids and flavonoids which help in conferring bioactive benefits for the health of the individuals (Hertzler et al., 2020).

ii. Meat: Meat is considered one of the most important protein sources, a wholesome and energy-rich food, consumed by humans to satisfy their daily protein requirements. Although, a number of research have highlighted a possible relationship between its consumption and the high risk of cardiovascular diseases, cancers, and various metabolic disorders. However, proteins from meat are an excellent source of essential amino acids and have high protein content which is easily digested and provides minerals (iron, zinc, and selenium) and vitamins (A, B9 & 12, D, and E). Chicken breast, beef, pork, mutton, and lamb are some of the sources of meat protein. Focussing on the presence of saturated fats in meat which can cause coronary heart disease and other metabolic disorders there is a point to be considered about its consumption as overuse can lead to serious health consequences. Therefore, plant-based meat processing methods are made with many of the products already on the market (Ahmad et al., 2018).

iii. Milk: Ingredients for milk control the protein market, mainly due to the highly developed global dairy industry and the quality of milk which helps to diversify through the production of vital product streams. They have practical and health benefits supported by scientific/medical studies, which form the basis for a balanced diet. The global milk protein market is complex, multifaceted, and driven by ever-changing markets and, more recently, healthy eating patterns.

iv. Algae: Aquatic plants like seaweeds and microalgae exhibit as a positive and innovative upcoming source of protein. Both seaweeds and microalgae are together called algae, although, seaweeds are the composite

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multicellular structure that grows in saltwater, on the other hand, microalgae are one-celled organisms that grow in a variety of environmental conditions. Examples of microalgae which is consumed by humans are Arthrospira spp, Spirulina spp, Chlorella spp, and Dunaliella salina. However, there are certain limitations related to toxicity, microbial load, and other sanitation issues. Nutritionally, microalgae are compared with plant proteins but because of high production costs and challenges in extraction, refining, sensory and palatability hamper its inclusion in food products.

Although focusing on the content of Eicosapentaenoic Acid (EPA) and Docosahexaenoic acid (DHA) of microalgae, they are being sold as health foods. On the other hand, red and green varieties of seaweed are very rich in protein (approx. 47%) and are referred to as sea vegetables with greater consumer acceptance. The presence of amino acids in seaweeds is compared to protein sources such as eggs or soybean.

There are regulatory restrictions on innovative food and revolutionary food ingredients and therefore food safety, nutritional and health claims can hold up the rate of market exploitation of algae.

However, overall, in the foreseen future, the technological establishment will continue to position plant-based protein as a beneficial course of action from a sustainability frame of reference (Henchion et al., 2017).

1.2. Emerging sources of plant-derived protein

Globally, plant-based proteins are very important and there is great interest in their ability to meet the growing demand for proteins. They are preferred over animal-derived proteins as they are associated with lower land use requirements, and it is widely acknowledged that plants produce lower levels of greenhouse gas (GHG), and are associated with climate change (Henchion et al., 2017). In addition, because of the high cost and limited availability of animal protein in several countries and consumer concerns about the health benefits of animal-derived proteins, increased attention is focused on the use of plant-based proteins as the most cost-effective protein source of food (Tilman and Clark, 2014). Among plants, pulses are considered an important source of dietary protein and other nutrients. In many parts of the world, pulses are a major source of protein in the diet where plant proteins are found in the cotyledon and the embryos of small seeds in the seed coat.

There has been an earnest investigation by the researchers on utilizing the alternative or underutilized plant species for multitudinous use (Thakur, 2020). Researchers also investigated that many protein-rich pulse crops in India are still unexplored and underutilized, one such plant protein source is the underutilized pulse crop i.e., horsegram (*Macrotyloma uniflorum*). This neglected and unpopular plant has great potential that can be used to support smallholder farmers' communities by providing income, food, and healthy food security and maintaining the needed genetic resources to address current and future environmental challenges (Gulzar and Minnaar, 2017). Thus, the underutilized pulse crops are better sources of a sustainable food system.

2. Horsegram as a sustainable source of protein

Horsegram (*Macrotyloma uniflorum* (Lam.) Verdcourt (Figure 2 and Figure 3) is a legume and crop used for animal fodder that is generally found in Southeast Asia and tropical Africa; however, Southern India is known for its origin (Chahota et al., 2013). It is a crop of semi-arid tropics. It is an annual herb, which grows to the height of 30- 40cm (Fuller and Murphy, 2017). It has three leaflets, 7–10mm long continual stipules, and typically a 3–7 cm long petiole. Leaflets are oval, round from base, acute or slightly pointed, usually 3.5–7.5cm long, 2–4cm wide, and length and breadth ratio of 1.5: 2.5. Flowers are stubby and immobile with 10–12mm in height (Fuller and Murphy, 2018). It is known by the names of various regions in India such as gahat or kulath, kurti kalai, kulith (Maharashtra, Uttrakhand, Himachal Pradesh), ulavalu (Andhra Pradesh), hurali (Karnataka), madras or gram beans (Chennai), kollu (Tamil Nadu) and muthira (Kerala) (Bhardwaj and Yadav, 2015) (Table 1).

Horsegram has been a lesser-known pulse species in terms of marketing and research, and it is very well adapted to marginal and stress conditions. Its ethnobotanical data and indigenous potential are well known to the people (Bhardwaj and Yadav, 2015).

Figure 2. Horsegram plant

Figure 3. horsegram seeds

Table 1. Scientific classification of Macrotyloma uniflorum (Bhardwaj and Yadav, 2015)

Kingdom	Plantae
Phylum	*Tracheophytes*
Class	*Dicotyledons*
Order	*Fabales*
Family	*Fabaceae*
Genus	*Macrotyloma*
Species	*uniflorum*

It is a plant that requires a long period of darkness and an average temperature of 20–30 °C, however, it cannot tolerate frost or waterlog. It is grown in areas with less than 980 mm annual rainfall or drought conditions and on poor soils with pH 5–7.5. It is a cheap and good source of protein, antioxidants, and minerals. Parts of the horsegram plant are utilized for therapies in the treatment of heart conditions, asthma, bronchitis, leucoderma, urinary discharges, and kidney stones. It is typically advised for persons having trouble with jaundice, common cold, cough, body pain, tiredness, and obesity. It is considered to be useful for people with iron deficiency and helps in maintaining body temperature in the winter season (Bhardwaj and Yadav, 2015).

Drought is one of the abiotic stresses that severely impairs pulse production. Thus, in the export-oriented market, dried legumes have gained a foothold. Although drought-tolerant and stable horsegram is still low in production. This is because less than 0.7 million ha area is under horsegram as compared to that of well-known legumes such as chickpea (6 million ha), soybean (7 million ha), and mungbean (1 million ha). This important legume crop is still unexplored apart from being drought tolerant.

Dry legumes such as horsegram have emerged as an important plant in combating such environmental stress. There is a need to increase the area and produce horsegram. Therefore, even in vitro cultivation of horsegram can be beneficial.

2.1. Consumption of horsegram

Horsegram is considered a legume with medicinal value in Ayurveda. Therefore, it is an important part of the kitchen. It is eaten as a whole seed, dhal, or in the form of sprouts by many people in the rural areas of India. The whole horsegram is either cooked

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or fried or used to prepare the curry. A thick soup of horsegram is prepared by soaking the seeds in boiling water and stirring occasionally to form a thick paste. This is often used in the treatment of cough and bronchitis in rural India. The cotyledon known as 'dhal' obtained after the removal of the husk of horsegram is consumed in various regions. It has a faster cooking time, increases digestion, and lowers anti-nutrient levels compared to whole grains. However, for split horsegram it can be soaked in water for 30-60 minutes and can be consumed in form of curry. Apart from this, it is often used to make special dishes that taste good by frying in oil with onions and other spices. The sprouted seeds are used for curries or either it is tempered with oil and onions, peppers, and other spices to make them more palatable. This preparation is commonly used as a side vegetable in many parts of India (Kadam and Salunkhe, 1985).

Horsegram flour is used to prepare certain ingredients by mixing it with other cereals. The addition of horsegram dhal and sesame flour (8%) significantly improves growth and protein-energy balance (PER) which promotes better utilization of protein. In addition to providing a protein-rich diet, horsegram provides the right amount of fibre and low ash content and is therefore used as both food and fodder for livestock.

2.2. Nutritional composition of Horsegram

Horsegram has a very important place in human nutrition as it is a nutritious and cheaper and abundantly available food source in developing countries. Table (2) explains the nutritional composition of horsegram.

The estimation of all the macronutrients i.e., protein, fats, and carbohydrates, and determination of ash and fibre content were carried out according to the method of AOAC 1990, for conversion of nitrogen to crude protein the factor of 6.25 was used. The seeds of horsegram were procured from Himachal Pradesh and were cleaned to remove any foreign particles, they were then stored in a cool and airtight container. To estimate the nutritional composition, the seeds were grounded to procure whole horsegram flour.
It has a high nutritional value parallel to other commonly grown pulse crops in all facets and is also an excellent source of iron, molybdenum, and calcium (Bhokre et al., 2012). Even so, various factors like genotype, soil, cultural practices, weather and climatic factors, and postharvest handling can exert influence on the nutritional quality. Seeds of horsegram have low-fat content and a great amount of protein, dietary fibre, a variety of micronutrients, and phytochemicals yet it has remained an underutilized legume, generally exhausted by the farming communities of remote areas and low-income groups (Bhartiya et al., 2015).

2.3. Proteins of horsegram

Horsegram seeds contain 23.6% protein which is higher in content as compared to whole egg protein

Table 2. Nutritional composition of whole horsegram

Nutritional composition	Value
Protein (%)	26.07
Fat (%)	1.1
Carbohydrates (%)	61.9
Crude fibre (%)	2.95
Ash (%)	4.3

which ranges between 7-13% (Kadam and Salunkhe, 1985). Although like other legumes; horsegram also cannot match the essential amino acid composition of egg protein. Compared to animal proteins, the consumption of legumes is low due to their low digestion and poor cooking quality. However, it has been found that the protein of unprocessed horsegram is found to be easier to digest than other legumes. The seed coat accounts for 13.7% of protein. Horsegram protein extraction studies have shown sodium chloride salt and sodium carbonate to be the best salts to extract protein. Water and oil absorption operations were found to be better after such extraction. The protein content in horsegram increased to a certain extent as an adaptive mechanism to combat drought stress conditions (Bhardwaj and Yadav, 2015).

2.4. Protein isolation of horsegram

Even though the nutritional and pharmaceutical potential of horsegram has been acknowledged, horsegram protein concentrate (HGPC) or isolates are not available for use in the food industry. Its eminent lysine content makes it an attractive protein source as most plant proteins are deficient in this essential AA. Horsegram protein concentrate (HGPC) with enhanced protein content and lowered anti-nutrients (like trypsin inhibitors) will find extensive applications in the food industry. Table (3) shows the essential amino acid composition of dehulled HORSEGRAM flour and HORSEGRAMPC (Lalitha and Singh, 2020).

Ghumman et al., 2019 also studied the amino acid composition of different varieties of Horsegram (Table 4).

2.5. Health benefits of horsegram

In the current scenario, people are now aware of the health benefits of an easily accessible underutilized, and cheaper source of protein. Horsegram is one such legume that is abundant in medicinal properties. Tests and clinical trials related to horsegram's cytotoxicity, antimicrobial and haemolytic activity were performed. Different extracts (ethyl acetate, dichloromethane, aqueous, and butanol extracts) of horsegram are to be non-toxic in a test for cytotoxicity concluding that they may be potential therapists. The release of ethyl acetate and dichloromethane showed antimicrobial activity while aqueous extraction with butanol did not show any significant activity. The extraction of 1-butanol per horsegram with an EC 50 value of 200 µg / ml of the haemolytic test was considered the most effective of all other extracts. Table (5)

Table 3. Amino acid profile of dehulled horsegram flour and horsegram protein concentrate (HGPC) (Lalitha and Singh, 2020)

Essential amino Acid	Dehulled horsegram flour	HGPC
Valine	5.20	6.47
Methionine	1.48	0.97
Lysine	6.84	8.13
Tryptophan	2.08	0.50
Histidine	3.24	3.24
Arginine	5.48	6.29
Threonine	3.19	4.26
Isoleucine	4.67	6.18
Leucine	7.99	9.07

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Table 4. Amino acid analysis of horsegram

Amino acid	Amount (in g)
Aspartic acid	1.18
Glutamic acid	1.63
Asparagine	0.54
Serine	2.05
Glutamine	6.06
Histidine	5.92
Glycine	5.64
Threonin	20.9
Citrulline	3.02
Arginine	2.84
Alanine	8.22
GABA	5.65
Tyrosine	16.8
Cysteine	0.50
Valine	0.35
Methionine	3.56
Phenylalanine	2.07
Isoleucine	2.64
Leucine	7.55
Lysine	0.24
Proline	2.73

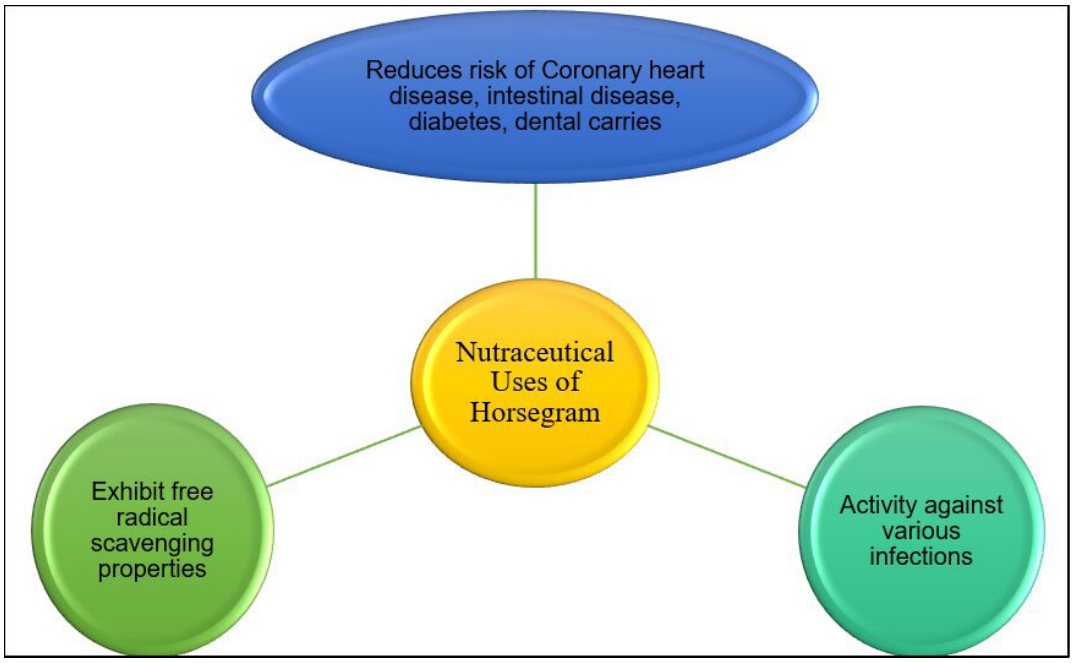

Figure 4. Nutraceutical uses of horsegram

below explains the health benefits of different parts of horsegram (Bhardwaj and Yadav, 2015).

3. Uses and future perspectives of horsegram as nutraceuticals

3.1. Ethno-botanical uses of horsegram

Horsegram is a legume with various functions to perform and has a variety of end uses as food, forage, or green manure. It is generally utilized to prepare gravies and is consumed with rice. It is also utilized as fodder

Table 5. Composition and health benefits of horsegram (Bhardwaj and Yadav, 2015).

Part of horsegram plant	Major components	Health benefits	Miscellaneous benefits
Seed coat	Insoluble dietary fibre	Improves bowel movements	Food and fodder
	Calcium	Strengthens bones	Food product formulations
	Phenolics	Reduces oxidative stress, related to heart diseases, cancer and inflammation	Endogenous antioxidants
	Ash content	Low ash content index of feeding quality	Livestock maintenance
Seeds	Carbohydrates	Slowly digestible starch, galactooligosaccharides help in the growth of intestinal bifidobacteria, linked with reduced risk of diabetes, obesity and heart diseases.	Oligosaccharides are used as prebiotics in various products as aerated drinks, candies, infant food, etc.
	Proteins	Cheaper and safer protein source on health grounds improves protein efficiency ratio, reduces plasma low-density lipoprotein	
	Lipids	Improves shelf life, used in weight restriction diets, possesses hypolipidemic activity	
	Vitamins	Overall growth and development	
	Minerals	Low sodium and high iron are advantageous for high blood pressure	
	Bioactive peptides	Antioxidant activity, antihepatotoxic activity	
	Trypsin inhibitors	Suppression of carcinogenesis	
Dark coloured seeds	Higher phenolics	High ferric reducing antioxidant power (FRAP)	Elevated levels of anti-oxidative enzymes
Soup of horsegram seeds	Isoflavones and glucopyranosides	Potential against cold, throat infections, fever generates heat and possesses anti lithic activity, inhibits calcium oxalate crystallization	

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and nutritious forage for livestock. Horsegram is also grown as a preparatory crop in South India in order to improve the fertility of the soil. People also prepare soups of horsegram and consume them to treat fever. In some parts of India, sprouted horsegram is consumed in the form of a vegetable (Aditya et al., 2019). South India is popular for various tasty preparations out of horsegram such as curry, pappad, and so on. Panch Dhani, which is a mixture of five crops namely, Horsegram, Indian bean, Cowpea, Niger, and castor is grown by farmers of Karnataka (Bhartiya et al., 2014).

3.2. Future perspectives of horsegram as nutraceuticals.

A nutraceutical is a dietary supplement or part of a diet that provides health benefits. The benefits of phytochemicals and nutraceuticals and/or active foods may be due to the complex combination of chemical and cellular interactions (Lakhanpal and Rana, 2005).

The clinical success of nutraceutical products coupled with increased health leads to the rapid global growth of nutraceuticals. The major chemical compounds which provide benefits to health are phenolics, flavonoids, alkaloids, carotenoids, prebiotics, phytosterols, tannins, fatty acids, terpenoids, saponins, and soluble and insoluble dietary fibre. The horsegram plant exhibits astringent, diuretic, and antioxidant properties. It is used to treat many health problems, especially diarrhoea, bleeding during menstruation, and abdominal pain, and in the treatment of leukorrhea and bleeding during pregnancy. Regular intake of horsegram helps to get rid of worm infections, it also regulates the digestive system and maintains acidity and gastric issues. Horsegram also helps to lower cholesterol levels (Patangare et al., 2019). Horsegram fractions with a variety of fibre content can be found for the application of a variety of specialty food products for a specific target age group. Phenolic compounds that inhibit the activity of α-amylases and proteases provide an attractive goal in developing potent therapeutic agents to treat various diseases. Researchers have studied the polyphenolic properties of various underutilized legume seeds and reported that they contain powerful properties for healthy eating. Therefore, this could further augment nutraceutical research for underutilized pulses. Consumption of horsegram and its products is limited due to the presence of anti-nutrients and poor digestibility. Enzymatic therapy can be used to improve the function of horsegram to facilitate its use as an active food ingredient. Fractions of horsegram with high trypsin inhibitor (TIA) activity can be used as an effective dietary supplement similar to soy concentrate. Furthermore, seed coat fractions of legumes with high fibre and low protein may be useful in food product formulations. Horsegram has various future applications in the manufacturing of nutraceuticals, functional foods, and therapeutics (Figure 4) (Bhardwaj and Yadav, 2015). Extracts from horse gram seeds have shown significant activity against Bacillus subtilis, Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa.

4. Market trends

The global plant protein market is expected to grow rapidly due to its high protein content and the many health benefits of plant protein. Vegetarians and non-vegetarians need to supplement their protein sources and ensure that they get all the essential amino acids. Most plant proteins are extracted from seeds and vegetables.

Plant proteins are lower in saturated fats and cholesterol and are a good source of fibre, vitamins, and minerals. Thus, with the increasing consumer popularity of plant-based foods, food producers are creating plant-based foods with a vegan claim to affect market demand.

The market for plant-based food and beverages does not show signs of flagging. As per the Plant-Based Foods Association (PBFA), U.S. retail sales of plant-based foods grew by 11.4% in 2019, bringing the total market value of plant-based crops to $ 5 billion. Even with the COVID-19 epidemic, sales have not slowed down. Even the food retailers surpassed the growth of plant-based foods during the epidemic, indicating that more consumers are turning to plant protein during the crisis (PBFA 2020). In mid-March, plant food production increased by 90% compared to sales last year. In all four weeks following a major panic attack, total sales of plant-based foods grew by 27%, which is 35% faster than the total plant-based food sales. (Institute of Food Technologists, 2020).

5. Conclusion

Plant proteins play significant contributions if current health protein recommendations are reviewed upward. It becomes an obligation to conduct research to identify and evaluate other less expensive methods that are not compatible with the horsegram for the future. Horsegram is underutilized but nutritious and is one of the most important plants. Its cultivation is inexpensive and economical. Horsegram is a sturdy and nutritious plant that has been overlooked for many years. Its current state of use cannot undermine its many beneficial functions. Our relentless obsession with not separating it as a major food crop needs to be reduced by showing it as a large pulse and therefore it is imperative to conduct research and explore other less expensive crops like Horsegram. It is a valuable store of a variety of therapeutic and life-sustaining qualities. The health benefits of the horsegram have been recognized in the western world recently, but it has been known for its ability to prevent and treat various diseases in the Indian "Ayurvedic" system for centuries. In addition, there is a scope of this legume to be studied for its chemical profile, pharmacology, biological testing, toxic effects, health-promoting properties, and many of the phytochemical screening that has not yet been discovered and there is a need to encourage and support this protein sustainable crop to address food and nutritional security.

To meet the global demand for protein, the sustainable crop- horsegram should be promoted for cultivation and utilization by researchers, plant breeders, technology providers, as well as by consumers who have been neglecting the usage of the crop. The benefits of the legume should be communicated to the community to increase the usage of the underexploited pulse crop.

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Research Paper

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Sustainability Assessment for Asparagus Farms that Work with a Community-Supported Agriculture Model in Turkey

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sustainability, small farms, community-supported agriculture, asparagus farms

Due to the diversified nature of agricultural systems, it is difficult to handle the sustainability aspects of different farming practices. With an intention to evaluate the sustainability of the community-supported agriculture (CSA) model in Turkey, the current study focuses on asparagus farms and designs farm-specific sustainability indicators that would be helpful for the farmers. The framework developed for this purpose consists of 20 environmental, 8 economic, and 17 social sustainability indicators derived and adopted from extensive literature. The indicators are then used to form survey questions to gather data directly from the farmers. The results show that these farms are sustainable in some aspects, mostly from a social sustainability perspective, and not in others. In order to be fully sustainable, they need to make alterations in some of the agricultural practices on the farm, diversify their production, measure their environmental impacts on air, soil, and water, and most importantly define successors for their farms in order to keep asparagus production for the years to come.

1. Introduction

The concept of sustainability is a complex matter. The definition specifies the intention of meeting "the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Commission, 1987). When applying this concept to different fields, it takes different forms. In agriculture, sustainability is mainly assessed through indicator-based tools. This provides the researcher with a deeper understanding of a farm's sustainability. Due to the diversified nature of agricultural systems especially on small family farms, it becomes difficult to apply the same set of tools to evaluate different types of farming practices.

This study tries to overcome the aforementioned struggles by focusing on a specific type of farm, asparagus farms in Turkey, which fits the definition of family farms and runs with a CSA-like system. Designing sustainability indicators that are farm-specific will prove to be helpful for the farmers in order to assess the sustainability of the farms and take necessary measures to maintain their existence. The framework developed for this purpose consists of 20 environmental, 8 economic, and 17 social sustainability indicators. The indicators are used to form survey questions to gather data directly from the farmers.

This paper aims to answer the following research question: How do subscription-based CSA-like family farms in Turkey achieve and maintain sustainability?

The focus of the paper is on the two asparagus farms, located in Muğla and Eskişehir provinces of Turkey. Based on the sustainability indicators developed in line with the purposes of this study, the sustainability aspects of these farms are evaluated and compared with each other. The two farms selected as case studies are highly representative of asparagus farming at the national level as 1079 tons of asparagus were produced in 2020 according to the Turkish Ministry of Agriculture and Forestry, and the surveyed producers accounted for more than 90% of the total production in the same year.

The target of this research is to develop a useful tool for the asparagus farmers, for them to gain awareness about the sustainability measures, and to extend farm life by passing the farm business to next generations. To the best of our knowledge, this research is the first one of its kind on the sustainability of the CSA model in Turkey, especially with a focus on asparagus farms, as the literature on this subject is extremely limited. The study highlights the sustainability indicators as well as the findings and possible suggestions for the further development of small asparagus farms.

The paper is designed as follows: The remaining parts of the Introduction section discuss the working principles of community-supported agricultural farms, their advantages, and disadvantages, followed by their adaptation in Turkey. The following sections include a literature review on the sustainability of CSA farms, a materials and methodology section featuring the indicators designed for the assessment of asparagus farms, and a results section that discusses the findings related to the sustainable actions in the asparagus farms in Turkey as well as the shortcomings of the study. Finally, the conclusion section summarizes the research and provides some suggestions and reflections on maintaining sustainability.

1.1. Definition of community-supported agriculture

Community-Supported Agriculture (CSA) is a type of arrangement between a farm and its members or subscribers, where they purchase a share of the products harvested each season for a "guaranteed market" where the production costs and any non-predictable risks involved are shared by both parties (Cone & Myhre, 2000). CSA program is a leading example of how we can create a locally sourced alternative to the globalized ways of sourcing our food. In the CSA model, the community develops a close relationship with their food and the person producing the food, which is perceived as an alternative way to food production (Watson, 2019). In many of the forms of definitions made for CSA, the most significant points are the benefit and risk-sharing factor and the close relationship established between the producer and the community.

Everyone involved with CSA understands that there is no specific equation to this model. Every farmer that adopts the CSA model, develops their own formula based on their targets, resources, and expertise and moves from that point on (Groh & McFadden, 1990). There may be written agreements between the farmer and the community, or it may rely on mutual trust and verbal agreements. The total payment may be made in advance, or they may be collected in instalments. Based on this information alone, it can be concluded that this is a process that varies from farm to farm (Lamb, 1994).

Essentially, CSA is defined as the direct relationship between the consumer and the producer (CSA Network, 2018). It is a practice that has grown tremendously all over the world since it first appeared in Switzerland in 1978. In this modern age of grocery shopping at the supermarket, CSA provides a piece of reality as to where our food really comes from and who exactly produces it.

1.2. Advantages and disadvantages of community-supported agriculture

Most of the research done on CSA model farming indicates two main advantages. The first one is that these farms produce high-quality, highly nutritious foods and promote sustainability. The second is that there is a direct relationship between the farmer and the consumer, with no middlemen to increase the prices or cause a delay in the receiving end of the fresh produce, as farm to table is the key factor in this type of farming.

McMurray et al. (2017) indicates the benefits of physical participation involved in a CSA model farm that allows the consumers to witness the growing process. This enables consumers to help the farmer with their

share of the farm as well as gain a first-hand experience in the farming business. CSA not only provides a close and first-hand connection between the farmer and the consumer, but it also allows consumers to actually witness where and how their food comes to their tables. This first-hand experience also allows like-minded shareholding consumers who share similar values and interests to interact with each other. Together they support their local community and economy (McMurray et al., 2017). CSA model has become an applicable system that supports the consumption of locally produced foods such as fruits and vegetables. CSA's significant impact on the individuals entails them making healthy food choices and gives them a chance to support their local producers and contribute to their financial wellbeing as well as creating an environmental impact (MacMillan Uribe et al., 2012).

Establishing this connection between food and the community through the CSA model will require that the risks and rewards of the farm will be shared equally. Through the membership system, individuals can benefit by purchasing a portion of the harvest, when the farm has a particularly good season and they also share the risks in the case of crop failure (Lamb, 1994; Cone and Myhre, 2000). Research on CSA reveals a few drawbacks that result in high turnover rates among the members. These drawbacks include factors such as a limited variety of products, produce only available in its respective seasons, a limited amount of produce offered, inconvenient pick-up times, therefore waste resulting from missed pick-ups as well as not knowing how to process the excess amount of the same type of produce (Cone & Myhre, 2000; Cooley & Lass, 1998). In the case of courier services, there is also a wastage resulting from the packaging, not to mention the carbon footprint occurrence resulting from using these types of services.

Another challenge is that building a CSA farm requires some sort of previous research in order to attain success for the farm. The most fundamental information for this structure is for the farmer to know what kind of food products the nearby community needs, and what kind of financial limits they have. It is also important to know how much financial support the farm needs in order to stay sustainable. A pledge between the farmer and community members needs to be established. The community also needs to understand the farmers' needs in order to form a relationship that will be beneficial to both parties (Lamb, 1994). One of the economic challenges a CSA farmer faces is to price the shares accurately. The price of a share needs to be affordable for the members and has to include all the necessities a farm has, including the purchase of all the supplies and the wages of the farm owner and workers (DeMuth, 2008).

CSA farms are generally established on lands that are in close proximity to their members, in urban and suburban areas. This need results in higher costing land that adds to the challenges of the CSA farm (Nehring et al., 2006). Since land is the most fundamental necessity for a farm, farmers struggle to decide whether to rent or own a farm that is large enough to finance its operations as well as provide enough food for the community. CSA farms diversify the way they cultivate the land with a focus on intensive farming. This results in higher value and labour-driven yield to provide farm sustainability even on a smaller piece of land (Tubene & Hanson, 2002). Additionally, CSA farms may borrow loans to finance their operations, which may result in a downfall if the anticipated crop yield is not sufficient.

1.3. Community-supported agriculture model applications in Turkey

Turkey has a population of 84.7 million as of 2021. The surface area of the country is 785.40 sq km, out of 383,270 sq. km is dedicated to agricultural land. The value of production in agriculture in 2019 is close to 196 billion, and agriculture still provided work for 18.4% of the total workforce (Turkstat, The Summary of Agricultural Statistics Publication & World Bank Country Profile, 2020).

Agricultural farms in Turkey, whether small family farms or large industrial farms sell their products to a wholesale company, which organizes the marketing and distribution of the produce to open-air markets and supermarkets. The end consumer visits one of these distribution channels to shop without ever meeting the farmer and knowing where the food is coming from. Introduction of models close to community-supported agriculture was a revolutionary development in Turkey, especially for the urban population. Consumers have become more conscious of their food consumption and concerned about sus-

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tainability, specifically young families with newborn babies. Small farms that directly reach the consumers that produce organic or natural products became the height of produce shopping for the aforementioned urban families.

The first examples of CSA started through the Buğday Association. Their first project BAHÇE was launched in 2005 on land allocated to the association. The project's scope aimed to create an accurate production-consumption model in Cumhuriyetköy near İstanbul on a 30-acre land, providing fresh seasonal produce to the nearby community. The produce, that is the outcome of the project, was shared among all the shareholders and the participants. Shareholders followed the project all throughout the year and received packages from the farm's fresh produce. CSA continued to grow slowly around Turkey. There was another initiative in Ankara, called Güneşköy, which started in 2006 and continued for a few years.

The CSA initiative that started in Turkey also flourished among small-scale family farms, where the initial system of membership was introduced but not continued in the following years. The URGENCI report generated in 2016 refers to these types of farms as CSA-like systems or CSA-like initiatives. The significant aspect of CSA is that a direct relationship between the consumer and the producer remains intact; however, the agreement between the two parties relies on a subscription model and mutual trust. The major disadvantage of the CSA system practiced in Turkey was the fact that the consumers only share the benefits from the farm but do not get affected by the negative consequences and undertake no responsibility towards the farm owner (URGENCI, 2016).

The CSA initiative got on a strong start in Turkey. However, the ownership system did not last long. The newer farms established in the new millennium adopted the subscription system that grew mainly by word of mouth among like-minded consumers who all want to have access to natural foodstuff that is produced by someone they can interact with.

2. Literature review: Three pillars of sustainability in community-supported agriculture

Community-supported agricultural farms are very important in terms of their contribution to sustainability. Hansen (1996) documented that their size and the nature of the work make it imperative that the three pillars of sustainability, namely environmental, economic, and social pillars, all carry equal weights when considering the well-being of the farms as well as their contribution to nature and to society. Furthermore, maintaining a sustainable agricultural business requires a balanced equation, where the farm helps protect and boost nature, provides food for human consumption, and must be economically viable. This will ensure that the farms are sustainable and can provide a livelihood for the farmworkers as well as the community surrounding it (Hansen, 1996). The multifaceted nature of sustainability should be examined from the perspectives of the farm being an operation that generates profit (economic pillar), the equal and fair distribution of the profit among all the employees including the farm owners (social pillar) and being a part of the ecosystem without harming the environment (Gómez-Limón & Sanchez-Fernandez, 2010).
The sustainability of agricultural farms requires the combination of all three pillars of sustainability when being assessed. Each pillar adds a different dimension to the sustainability factor. Environmental sustainability is insignificant if farms are not well-linked to the community, which is a component of social sustainability and vice versa (FLINT Project, 2015). Economic sustainability has direct relations with both environmental and social sustainability, especially when it comes to agricultural practices or creating employment. Production of goods and services, which are part of economic viability of a farm, is not sustainable if social and environmental costs are high (FLINT Project, 2015).

2.1. Environmental sustainability

It is fundamental to understand that farms need to maintain their livelihood while preserving environmental sustainability in their use of natural resources (CSA Network, 2018). CSA advocates argue that, by re-establishing the relationship between food economics and society, CSAs will reinstate the home agricultural economy by moving towards an ultimate achievement of ecological sustainability and pulling back from the global supermarket (Schnell, 2007).
Natural resources are vital to human existence. Especially in the case of food production, the long-term,

irreversible damages to nature cannot be fixed or replaced by any monetary means. The farmers who do not take the long-term damage they are causing to the environment into account need to be monitored and coached by an outside agent. The beginning of the 20th century marks the time when sustainability became a consideration for society hence giving birth to the concept of environmental sustainability. The initial environmental sustainability assessment was measuring the impact of agricultural practices on nature (Valtýniová & Křen, 2011).

According to Hamrin (1983), natural resources and the environment are the foundations on which future economic activity will be built. If we seriously take this explanation into account, preserving the environment while trying to keep economic sustainability will be crucial in order to maintain and improve farming activity on sustainable grounds.

Environmental sustainability is to protect the natural resources while maintaining good farming practices that do not harm the environment including people (Goodland, 1995). This concept is referred to as "limits to growth", which creates a balance between how the soil is maintained to produce our food, and how much food is produced. This ensures that the land is not over-cultivated and depleted from its nutrients and minerals, and the farm adheres to traditional farming practices which are agro-ecological (Paul, 2016; Meadows et al., 1972). On this subject, OECD implies certain criteria that require efficient use of renewable and non-renewable resources that do not exceed the land's long-term uses and the assimilative capacity of the hazardous substances into the environment (OECD, 2001).

In order to promote environmental sustainability, the practices of conventional agriculture that include the use of chemicals, soil degradation, decline of farming communities, surrendering the old-fashioned agricultural values, and lack of safety of the farmers need to be abandoned and alternative farming practices needs to be established through the CSAs. Also, the number of CSAs needs to increase, allowing for many smaller farms rather than a few larger farms which tend to do more harm to the environment (Dahlberg, 1991).

2.2. Economic sustainability

The UN Food and Agricultural Organization's SAFA (Sustainability Assessment of Food and Agriculture Systems) Guidelines (2014) sheds a light on sustainability factors including economic sustainability. The guide focuses on a few aspects starting with the investments. Investment is the starting point for any business. Investments help build the businesses and ensure their growth both physically and economically. This growth opens the channels for social development and the protection of natural resources.

The subject of investment is vital both on the community end and on the farmer end. The farmer has to invest in a piece of land, workforce, equipment, and raw materials. Their initial expenditure will be large and the return on investment will be long-term. On the other hand, the pre-payments received from their shareholders will be their initial earnings but on the consumer end, they are considered the community's investment in the farm (FAOSAFA Guidelines, 2014). Financial profitability is another major issue to ensure the economic sustainability of the farm. Therefore, the critical issue here would be to follow the right pricing strategy for the shares. The price of a share should cover all the base costs, as well as retain a profit for the farmer. This requires the farmer to make a budget and divide the total costs by the number of shareholders. This type of pricing is called cost-plus pricing. Another type of pricing strategy is competitive-based pricing which allows the farmer to decide on their share costs based on other farmers. The farmer may decide to stay competitive by offering cheaper prices or equivalent prices. The last type of pricing is customer-based pricing where the customers' willingness to pay determines the cost of the shares (FAOSAFA Guidelines, 2014; McMurray et al. 2017). A farm's ability to stay sustainable in economic terms relies on the farm owners and the community surrounding it.

2.3. Social sustainability

Social sustainability could be referred to the well-being of the farm members and the community surrounding the farm, along with the whole of the society with which the communities reside (CSA Network, 2018). Both the farming community and the surrounding community share the same common values; therefore, social sustainability is the most important

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and the most long-lasting sustainability factor that includes social values, associations, integrity, and establishments. It is vital for the survival of the communities both in the past and the present (Black, 2004; Diamond, 2005).

Present-day communities' associate agriculture with conserving the traditions and practices of a region which can be directly related to the social sustainability factor. Suffice it to say that, regardless of the importance of social sustainability within the society of a region, the literature covering this topic is very limited (Gaviglio et al., 2014). Increasing awareness towards ecological issues causes environmental assessment in agriculture to hold greater weight, compared with economic and social sustainability. Therefore. while the framework developed to assess the environmental issues is corroborated, the economic and social sustainability factors lack such a framework (Chatzinikolaou and Manos 2012).

CSA provides a direct consumer and producer relationship that is declared a contemporary model of food provision (Balázs et al., 2016). We can also concur that building a symbiotic relationship with a farmer and procuring high-nutritious, high-quality food directly from the farm is in fact a lifestyle that the CSAs are providing. In return, the community is providing support for the farm (Lamb, 1994; DeLind, 2003). CSA provides cost-effective ecologically safe food to urban consumers, which helps farms to make a decent income without getting involved with third-party distribution channels (Möllers & Bîrhală, 2014).

3. Materials and methods

There are two main approaches to assessing sustainability. The first is the "bottom-up" approach where systematic participation is mandatory to understand the key sustainability indicators (Spohn, 2004). The second approach is the "top-down" approach that defines the overall structure of sustainability and it is further categorized into groups of indicators (Spohn, 2004). This research focuses on a "top-down" approach with indicators developed by the authors specifically for asparagus farms.

These methods help researchers to assess the sustainability performance of the farms through a holistic approach, where the information is gathered through a wide range of indicators that serve the purpose of understanding the sustainability on the farm level (De Olde et al. 2016; FAO, 2013; Schader et al. 2014).

Generally, agricultural sustainability is measured with indicator-based tools (Gaviglio et al., 2017). Despite the fact that there are quite a few different assessment methods, conceptual and methodological problems are still recurring, especially when similar methods are applied to different types of farms. Therefore, designing an indicator tool that is specific to the type of farm would be more beneficial to measure the positions of sustainability. This will result in a more accurate measure of sustainability and could benefit the farmers on an individual basis.

There is a study that only examines the differences between various methods and their effectiveness on different types of farms. The accounting methods of indicators in the literature have focused on farms and their impacts on the environment, economy, and social life for various types of farming including agricultural farms, livestock farms, and forestry (Girardin et al., 2000). It provides enough information to the researcher when the decision needs to be made on which sustainability method should be used in future research.

Compared to the existing literature, the present study is based on a set of sustainability indicators, inspired by the indicators designed and summarized by Gaviglio et al. (2017) among others. The indicators used for this research were revised to fit the conditions of the farms in Turkey and were applied to the farms that produce asparagus. The indicator-based framework has been adopted for the evaluation of the environmental, economic, and social sustainability of the family-owned asparagus farms. The data was collected directly from the farm owners via conducting surveys, due to the time constraints of the farmers and the ongoing intensity of the asparagus season. Although the farm owners were the primary source of information, they were reluctant to share certain information and, in some cases, did not have the accurate information. A family farm, as described by the Food and Agricultural Organization (FAO), is a way of life. It is an operation that combines the family members with the

farm while incorporating functions of sustainability (FAO, 2014). "Family farmers have the potential to promote the environmental sustainability of agricultural systems thanks to their understanding of local ecologies and land capabilities, and to their preservation of seeds and other genetic resources" (FAO, 2020, p.4-5). Based on these definitions the two asparagus farms were evaluated for their contribution to the environment, increasing food security, providing employment, and reducing poverty aligning with United Nations' sustainable development goals.

Family farms of today represent the sustainable food economy. They are the models for advocating a healthy lifestyle through naturally produced agricultural products. Each family farm possesses different qualities in terms of products, agricultural practices, and natural resources. Each farmer's products meet the different needs of consumers who are critical and demanding. Among many other qualities, a family farm should have professional integrity. Their responsibility to employees and consumers lies in sustaining the family farm for future generation farmers and consumers. Therefore, the sustainability indicators were developed to consider the social as well environmental and economic sustainability (Ikerd, 2006). If developed and used effectively they may impact the good farming practices in a positive way, enabling the farms to meet the needs of current farm owners without compromising the needs and uses of the future generation farmers. In this regard, explaining and promoting good farm practices through the use of relevant and well-developed sustainability indicators that take into account the three pillars of sustainability, will prove to be helpful.

The revised indicators used for this research were categorized into three sustainability themes, followed by components and indicators. Finally, indicators were detailed further with sub-indicators. Each indicator and sub-indicator were checked for precision, recurrence, and constituents and refrained from requiring sensitive information from the farmers. The number of indicators was kept to a necessary minimum to be able to collect a sufficient amount of information that only focuses on sustainability. These indicators were used in formulating survey questions that were used to gather data from the farmers.

The research executed by Gaviglio et al. (2017) on Italian farms, has listed the technical limitations that have burdened them during their research. These limitations may hold true for any research that is done on small-scale family farms. The first limitation is based on the data collection. Data collection relies on interviews carried out with the farmers who do not always provide sufficient or measurable information. This was also a valid limitation for the current research on asparagus farms. The second problem is that since each type of farm, dairy, produce, and meat; is different the same sustainability indicators may not give the same or similar results that will aid with the sustainability research. Finally, the agricultural systems applied are different which also results in variances in how sustainability may be measured based on the type of farm. As an example, the management of livestock effluents is a valid indicator for an animal farm but not for a produce farm. Yet the effluents will also differ whether the farmhouses cattle or poultry. To overcome the final two limitations, farm-specific indicators were designed (Gaviglio et al., 2017).

3.1. Environmental Indicators

Operating in line with the principles of nature and preserving the agricultural operation systems have been the main focus of scientific literature when assessing the environmental sustainability of a farm (Gaviglio et al., 2017). However, components of environmental impact may not be measured at the farm level. In certain cases, the farmers may not be aware of the wide-ranging consequences of their agricultural systems, such as greenhouse gas emissions, soil erosion, and water and soil contamination.
Agrosystem sustainability is important in agricultural research therefore it is also important to develop ways to measure the environmental impacts (Tellarini, Caporali, 2000). Indicators were developed to measure different aspects that are affected by these negative impacts mentioned in the previous paragraph (Bockstaller, Girardin, 2003). In an effort to create awareness among the farmers, they should be encouraged to manage their own farms based on the environmental sustainability indicators, which will allow them to realize any wrongful practices and take corrective measures (Valtýniová & Křen, 2011).

EN1 – Diversity of crops. This component tries to

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identify the plant diversity at the farm. In terms of growing different types of asparagus or planting a different species that would benefit the soil for asparagus growth, may be helpful to keep the soil nourished as well as utilizing the farm during off-seasons.

EN2 – Space and land management. Ownership of the land poses an important criterion in terms of the sustainability of the farms. Also, in terms of soil quality, identifying and taking precautions for possible erosion zones needed to be addressed in order to understand how the farmland is being managed.

EN3 – Agricultural practices (Gaviglio et al., 2017). All the sub-indicators under this component have a direct effect on the sustainability of the soil and the environment. Inadequate agricultural practices damage the soil the most in the long run, therefore the correct assessment of these indicators will identify how environmentally sustainable the farm is.

EN4 – Natural resource (Gaviglio et al., 2017). Water usage and management are very important indicators for any type of farm therefore it is a vital measurement of sustainability. This should be analysed together with the type of irrigation systems used on the farm.
EN5 – Energy (Gaviglio et al., 2017). The soil-heat cultivation system is used for asparagus. Hence pointing to the utilization of both thermal and electrical energy. It is important to indicate the amount of energy used on the farm as well as the usage of renewable energy if available.

EN6 – Pollution and emissions. This component will indicate whether asparagus farming yields any waste material, as well as greenhouse gas emissions and whether the asparagus plant or the farming practices associated with it have a tendency to pollute the soil.

Table 1. Environmental Sustainability Indicators

EN1	**Diversity of crops**
EN1.1	Crop diversity
EN1.2	Asparagus diversity
EN1.3	Crop quality
EN2	**Space and land management**
EN2.1	Farmland ownership
EN2.2	Ecological buffer zones
EN2.3	Environmental and landscape safeguard
EN3	**Agricultural practices**
EN3.1	Seed provisions
EN3.2	Fertilization
EN3.3	Pesticides
EN3.4	Proper tillage practices
EN3.5	Soil protection
EN3.6	Irrigation systems
EN4	**Natural resources**
EN4.1	Water resource management
EN4.2	Organic matter management
EN5	**Energy**
EN5.1	Energy dependence
EN5.2	Usage of renewable energy
EN6	**Pollution and Emissions**
EN6.1	Organic waste disposal
EN6.2	Waste disposal
EN6.3	Emissions / Greenhouse gases
EN6.4	Soil contamination

3.2. Economic Indicators

The essential survival of agricultural farms depends on economic sustainability (Lien et al., 2007). The farms discussed in this research utilize a CSA-like model, although they do not receive any economic support from the consumers. Farm expenses solely rely on the earnings and possible government loans and subsidies. Farms must continuously keep their operations growing in order to survive against the competition and also need to come up with other ways to create earnings that might set them apart from the rest.

EC1 – Economic viability (Gaviglio et al., 2017). The Farm's earnings derived from the total amount of goods and services sold is the deciding factor for the viability of the farm.

EC2 – Endurance. This component considers the employment of the family members and the earnings for the employees to measure if they can endure the farm work and sustain their living standards with the income received from the farm.

EC3 – Autonomy. Farms receive loans and subsidies from the government and bank loans. These pose a constraint for the farmer, especially if these loans are used for a new investment to grow the farm business and increase production. For example, the increasing demand for asparagus, of both individuals and commercial businesses, may force the farm to lease more land to increase asparagus production capacity, resulting in taking a loan from the bank.

EC4 – Diversification (Gaviglio et al., 2017). This component measures whether the farm can follow innovation and adapt to the new technology to be more productive. Also diversifying the farm activities may be beneficial in increasing the income for the farm.
EC5 – Multi-functionality (Gaviglio et al., 2017).

This component will help determine looking at the farm from a different perspective and incorporating non-agricultural activities that will economically improve the farm. As an example, harvest activities will benefit the farm economically in the short run and in the long run by building a customer base of individuals and chefs that have a chance to witness the growth and harvest of asparagus at first hand.

3.3. Social Indicators

A farm's integration with the surrounding landscape and society is one of the main factors in accessing its sustainability (Zahm et al., 2008). The small farm is a reflection of the family, and the family is a reflection of the local community, which is a part of the whole society. The farm's position is very important within the local community, especially in the case of cultivated asparagus. Asparagus is widely known or consumed in neither of the asparagus farm locations. Establishing a connection with the local community both as a

Table 2. Economic Sustainability Indicators

EC1	**Economic viability**
EC1.1	Value of production
EC2	**Endurance**
EC2.1	Farm ability to generate income
EC2.2	Income per family worker
EC3	**Autonomy**
EC3.1	Economic autonomy
EC3.2	Loans and leases
EC4	**Diversification**
EC4.1	Diversification of the production
EC4.2	Business diversification
EC5	**Multi-functionality**
EC5.1	Multi-functionality

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business and as a farmer is an important indicator to measure the sustainability of the farm in the social aspect. Initiating the social relationship also aids in the economic and environmental aspects of the farm.

SO1 – Quality. This component takes into consideration the qualities that will make a farm product and the production technique stand out from the competition. Additionally, historical architecture located on the farmland would add a social value to the farm, overall affecting all the stakeholders.

SO2 – Family ownership. A family farm is owned and operated by the family and the employees also become a part of that family. An important fact to consider is the intergenerational succession of the farm to determine sustainability in the long run. It is imperative to measure the vitality of the farm through the family members and continue to prosper with the continued support from the community.

SO3 – Short supply chain and related activities (Gaviglio et al., 2017). Building a consumer base is one of the challenges a small farm faces especially if its products are sold directly to the end-user. The short-supply chain requires marketing skills to be able to promote the product to the right target group. Building the customer base and participating in activities such as fairs, assemblies, community-supported events, and the like will aid in introducing the product and receiving attention.

SO4 – Work and employees. One component of being a part of the local community involves employing the local workers and providing them a high quality of life to be able to sustain their employment and decrease a possible turnover. Training of the employees will likely affect the work and the final product. This is vital in the case of asparagus farms as harvesting is fragile and requires close attention. For this purpose, female temporary agricultural workers are preferred for their ability to handle asparagus. This component will also provide information about the demographics and the background of the farm employees.

SO5 – Social development (Gaviglio et al., 2017). Cooperating with other small farms, cooperatives, and marketplaces may be useful in reaching a larger consumer base. Being a part of an association or an organization helps the small farms get together to exchange ideas, discuss new trends and innovations, and aid the farm owners to gain a wider spectrum of the changes taking place in the agricultural sector.

SO6 – Education and Culture (Gaviglio et al., 2017). This component focuses on the social acceptance of the farm product, namely asparagus, within the society. Teaching the nutritional benefits of asparagus and accrediting a cultural significance to the product will profit the farmer.

4. Results and discussion

4.1. Findings related to the environmental indicators

The farm located in Eskişehir (Farm A) has a larger farm area and production compared with Farm B located in Muğla. Both farms are mono-crop plantations with the difference being that Farm A grows two kinds of asparagus, purple and green, and additionally sells products derived from asparagus such as canned or frozen asparagus. Based on their sizes the quality of the products is improved differently. Farm A complies with the Global Good Agricultural Practices (GLOBALG.A.P.) standards, which is an international farm assurance program. Farm B improves its standards by complying with organic food production standards and with traditional farming practices.

Asparagus is viable on the same land for ten years, after that time the land has to fallow for two years in order to regain fertility. In order to continue farming, both farm owners will seek to lease neighbouring lands to continue with production.

Farm A sows green manure plants for soil cover to provide natural nitrogen for the asparagus. In times of insufficiency, herbicides, insecticides, fungicides, as well as chemical fertilizers, are used in compliance with GLOBALG.A.P. standards. Farm B only uses organic waste material such as animal effluents provided by the neighbouring cattle farms and does not use any pesticides.

Farm A and Farm B both use proper tillage and have proper drainage in the soil. Both farms have implemented drip irrigation systems in their farms to prevent water loss. The wastewater accumulated in neither farm is used for other purposes, therefore it is

Table 3. Social sustainability indicators

SO1	**Quality**
SO1.1	Quality of the products
SO1.2	Rural buildings
SO1.3	Stakeholders
SO2	**Family ownership**
SO2.1	Family ownership
SO2.2	Community
SO2.3	Farm successors
SO2.4	Vertical farming practices
SO2.5	Internal and external threats
SO3	**Short supply chain and related activities**
SO3.1	Short food supply chain
SO3.2	Related activities
SO4	**Work and employees**
SO4.1	Sustainability of the employees
SO4.2	Demographics of the employees
SO4.3	Training
SO5	**Social development**
SO5.1	Associations and social implications
SO5.2	Cooperation
SO6	**Culture and education**
SO6.1	Educating the consumer
SO6.2	Cultural significance of products

treated as waste, which does not contribute to sustainability.

Energy usage did not receive sufficient information. Compared with the heated soil used to grow asparagus in Germany (Soode et al., 2014), the farms in Turkey do not use thermal energy to grow asparagus. The only energy usage relies on electricity that is limited to the season.

It can be deduced that based on the answers given to the pollution and emissions questions, there is not a consensus among the farmers regarding their greenhouse gas emissions (GHGE). This may result from different farming practices. Neither of the farms has officially measured the amount of GHGE; therefore, this section does not provide sufficient information regarding the farm's contribution to pollution and emissions. Product carbon footprint that is derived from distribution channels such as courier services and the waste resulting from the packaging of asparagus is not reported either.

4.2. Findings related to the economic indicators

Based on the economic indicators both farmers have stated that they are earning profits and are able to plough back the profits in order to grow the business. They are both eligible to receive subsidies from the government, but the subsidies were either not received or were not sufficient to help them economically. Complete economic autonomy is not yet achieved in Farm A.

The multi-functionality indicator showed that both farms are willing to increase their economic viability through non-agricultural activities that would not only bring in more income but also is a means to educate the consumers and increase their participation in this type of farming system.

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4.3. Findings related to the social indicators

Asparagus is a niche product and is not very widely known. When these farms first established their businesses, asparagus was not consumed nor produced by anyone within the community (or in the country for that matter). Both farmers, when they first built their farms, started as an individual; therefore, neither of the farms was inherited as a family business, which does not mean in the future that it will not become a family business for the next generations. On this matter, neither of the farms has identified a successor for the farms which questions the long-term viability and the sustainability of the farms.

The farms, as all agricultural operations are directly affected by climate change and have to take necessary precautions to protect their products. Farm A also mentioned the political and economic instability that might impact the farm business.

The great advantage that both farms hold is the short supply chain. By omitting distribution channels, and reaching the consumers directly via direct sales, online sales, and specialized farmers' market sales, they reach their consumers and educate them on the benefits of their products and offer them healthy and nutritious food. Collaborating with cooperatives and like-minded e-commerce businesses also provides a wider platform to introduce this product to a wider consumer base.

Survey questions for the work and employee's indicator reveal that the farm work is seasonal and almost all the work is performed by female workers. The provided answers also affirm that the quality of life in general based on the asparagus farm work is high, this is clearly visible from the low turnover, and the wages received. The training process is handled by the farm owners. Since employees all come from farming backgrounds this training does not take a long time and there isn't a specific training system in place.

4.4. Discussion

A new set of sustainability indicators were developed and tested on asparagus farms in Turkey. The answers provided by the farmers were not quite sufficient to answer the question of the sustainability of asparagus farms thoroughly. Yet, on a component level, the answers to the survey questions provided a general scheme of the practices of the asparagus farms and their contribution to sustainability.

The survey did not provide enough information to indicate the farm's contribution to environmental sustainability. GHGE resulting from farming activities, wastewater management strategies, and the use of chemical materials on the soil were not reported by the respondents as the farm owners did not participate in any official measurement practices to find out their damage to the environment. On this matter, they have both mentioned asparagus as a product suffering from climate change.

Economically, neither of the farms has total control over their operations, but both make a profit and provide a living for their families. Considering these findings, as a business operation, they seem to be sustainable. Economic sustainability is very much dependent on government policies. In the future, any changes in policies that would aggravate agriculture could jeopardize the farm business, regarding not only asparagus but all small farms.

Social sustainability indicators reveal that both farms are in good standing within the community. They both provide work for the locals, especially women workers that make up the majority of the workforce. They both have a wide consumer base made up of health-conscious consumers who want to know where their food comes from. The short supply chain and the CSA-like approach are helpful in connecting with a larger community. Based on the answers provided for the social component, both farms are sustainable with one exception regarding the dimensions of social sustainability. Both farms apply agricultural practices to be able to sustain their farms as businesses as long as the current farm owners are running the operation. Not having a successor identified for both farms raises the question of the long-term sustainability of the business and the farm itself.

5. Conclusion

Community-supported agriculture is a relatively new concept in Turkish society. The concept has transformed into a new model in Turkey. This model con-

sists of a short supply chain between the farmer and the consumer without the shared outcomes of negative nature. The community converted to the consumer and support converted into the promise that the consumer gives to the farmer for the continued business. In Turkey, there is only a limited number of consumers who embrace the idea of staying connected to the person that produces their food. They utilize this system because sustainability is the main locomotive. They believe in protecting the small farms and are cautious about where their food comes from. This belief is also connected to a better and healthier lifestyle.

Asparagus farms in Turkey is an example of family farms that adopt a CSA-like model and reach directly to the consumers. As most of the world's food supply depends on small family farms, their sustenance is very important for food production. Developing sustainability indicators that are farm-specific helps to measure sustainability in a comprehensive way. The results of the survey revealed that the selected asparagus farms in Turkey are sustainable in some aspects and not in others. In order to be fully sustainable, they need to make alterations to some of the agricultural practices on the farm and, most importantly, define successors for their farms in order to keep asparagus production for the years to come.

The current study has several limitations. Most of the issues pointed out by Gaviglio et al. (2017) are also relevant to the case of the asparagus farms in Turkey. One of the most important issues in conducting this research was the time constraint of the farmers and the ongoing intensity of the asparagus season. That's why the farm owners were surveyed using questionnaires instead of in-depth interviews. Yet, they provided answers to the best of their abilities during the busy and time-consuming asparagus season. Besides, even though the farm owners were the primary source of information, they were reluctant to share certain information and, in some cases, did not have the accurate information. Although the answers were not sufficient to provide an in-depth assessment of the sustainability of the farms, they provided a broad picture of the environmental, social, and economic impacts of asparagus farming executed in a CSA framework in Turkey.

To the best of our knowledge, this research is the first sustainability assessment in the area of asparagus farms in Turkey. The sustainability indicators were specifically developed to gather information on the agricultural practices of such farms to identify whether the farms are sustainable or unsustainable in economic, environmental, and social aspects. It is the authors' wish and anticipation that this study will provide a basis for future research on the same subject.

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Adoption and effectiveness of hermetic storage bags to reduce staple food postharvest loss for sustainability in the Ejura-Sekyedumase Municipality, Ghana

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Postharvest loss is a major problem facing agricultural households in the global south. It is in this context that the introduction of hermetic storage bags is viewed by many as a key solution to averting postharvest loss, especially for grains which are essential to food security. While there have been policy efforts to increase the availability of hermetic storage bags for farmers, little is known regarding the extent of its adoption and effectiveness in reducing grain loss. This study fills this empirical vacuum by examining the extent of the adoption of hermetic storage bags and their effectiveness in reducing grain loss. The study uses a mixed-methods approach, combining data from a cross-sectional survey, in-depth interviews, and field observations. The result shows that the majority of respondents have moved away from chemical and traditional grain storage methods and are using hermetic storage bags. The result also shows that the hermetic storage bags were effective in improving seed viability, reducing moisture level, reducing grain loss, and reducing grain damage. The authors recommend periodic training and sensitization activities for farmers to improve awareness and ultimately adoption of hermetic storage bags by all farmers.

1. Introduction

A staple food can be said to be a food that is mainly eaten in such quantities that it becomes a dominant portion of that person, family, community, town, or country's standard diet. Staple foods in the tropics are mainly grains or cereals. Food grains are the most commonly stored food commodities in the tropics and sub-tropics. The grains are usually stored as food for humans and livestock while seeds are stored for planting for the ensuing cultivation period. The major grains cultivated in the tropics and subtropical countries are maize, rice, wheat, sorghum, cowpea, soybean, pigeon pea, kidney bean, black gram, and lentil (Asif et al., 2013). Stored food grains are essential for most households in countries in tropical and sub-tropical regions. They sustain the livelihoods of agricultural households by reducing postharvest loss and guaranteeing food security for most countries (Grote et al., 2021).

Globally, "around 14 percent of food produced is lost from the post-harvest stage up, but excluding, the retail stage" (FAO, 2019; 22). Postharvest losses are thus, a major cause of concern worldwide, yet only about 5% of research funding has been allocated to addressing this problem (Rajashekar et al., 2012). Postharvest loss comprises crop loss across the agriculture value chain from harvesting of crops until their consumption (Aulakh et al., 2013). According to Aulakh et al.

(2013), food loss is defined as food that is available for human consumption but is not consumed. The losses can generally be characterized as weight loss due to spoilage, quality loss, nutritional loss, seed viability loss, and commercial loss (Boxal, 2001). The magnitude of postharvest losses in the food supply chain varies among different crops and geographical regions. Averting postharvest losses has therefore become a priority and requires investment into methods and technologies that will ensure high returns rather than just increasing crop production to meet food demands. Doing this is important because postharvest losses caused by insect and pest infestation are a major problem for farmers, who lose about 20%-50% of food grains annually across Africa (Aboagye et al., 2017). The food security problem in West Africa is largely due to the inability to preserve food surpluses during the main harvest period. This affects the economy of developing countries because agricultural production is seasonal (Rajashekar et al., 2014).

Agriculture is the backbone of the economy of most Sub-Saharan African countries and contributes significantly to the GDP of the country. Grains play a major role in the food production and diet of people in Ghana. Almost all the households in Ghana eat one or more grains in their daily meal, which makes grain production and storage important to ensure that the country is food secure (Aboagye et al., 2017). Figure 1 below shows the total estimated production values of maize and cowpea in Ghana between 2008 and 2020 in metric tons. The figure shows increased production between 2019 and 2020, indicating that grain production is contributing substantially to the country's economy.

Unfortunately, inadequate postharvest facilities and inappropriate storage methods have hampered Ghana's efforts in sustaining grain yields. This situation has resulted in a considerable loss of agricultural produce and reduced earnings for most farming households. The usual practice for farmers is to store grains temporarily for a month or two before transferring them to a storage structure after harvest (Adejumo, 2007). Those without storage facilities have to sell the grains straight away in the market. Farmers who store the grains before selling experience postharvest loss. For instance, farmers in Ghana lose about 5% - 20% of their cereals through postharvest loss (Sugri et al., 2021) and this affects the country's food security situation.

In 2008, the Ministry of Food and Agriculture introduced hermetic storage bags (Super Grain bags, GrainPro-Cocoon) to grain farmers across Ghana. Farmers use these hermetic storage bags to store their seedlings to control insect infestation and preserve the quality of the grain without using chemicals. Farmers also use hermetic bags to store their commodities for

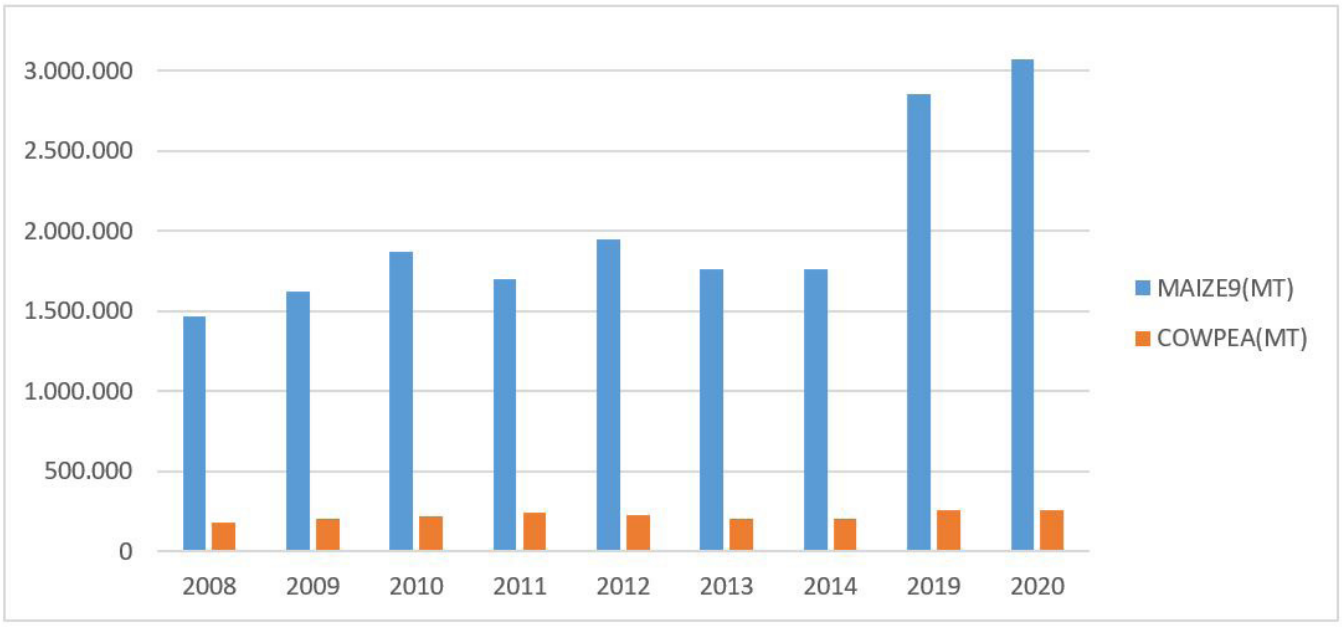

Figure 1. Estimated Production values for Maize and Cowpea (2008-2020) Source: MOFA SRID, 2020

the long period and sell them during the lean season (FAO, 2017). Undoubtedly, hermetic storage bags could be key to reducing postharvest loss of grains in Ghana, and it is for this reason that knowledge about its acceptability and adoption by farmers is critical to policy efforts aimed at improving the use of this storage method to enhance food security in Ghana. There are few studies on farmers' adoption and the effects of hermetic storage bags in Ghana. For instance, Fusseini (2015) indicates that farmers in the Techiman Municipality who adopted the hermetic bag technology have improved food security in their households and obtained higher prices for their produce during the lean season. While this is insightful, there is a need for further studies on the adoption of hermetic storage bags in other agriculturally-based regions or communities in Ghana to provide much breadth and understanding of the impact and effectiveness of this storage technology, especially from the perspective of farmers. Aside from this, there is also the need to understand how the adoption of hermetic storage has affected traditional or other previously known methods of grain storage. This study seeks to contribute to research on farmers' adoption of hermetic storage bags in Ghana. The objective of this study is to examine the extent of adoption of hermetic storage bags among farming households and the effectiveness of their use. The study is conducted in the Ejura-Sekyedumase Municipality, which is an important farming region in Ghana and also regarded as the 'cone basket' of the Ashanti region.

2. Study Area and Methods

2.1 Study area

Ejura-Sekyedumase is located in the northern part of the Ashanti region. It shares a boundary with Atebubu Amantin District and Nkoranza North in the north and Nkoranza South in the north-eastern section of the municipality. Ejura-Sekyedumase Municipality also shares a boundary with Mampong Municipality, Sekyere South District, and Offinso Municipality to the east, south, and west respectively (refer to Fig 2). The location of Ejura-Sekyedumase gives it a unique identity as a geographical area that traverses the semi-deciduous and middle-belt vegetation zones. The rainfall pattern of the Municipality is characterised by the bi-modal rainfall pattern (GSS, 2014). This rainfall pattern is unique to the forest and deciduous regions of Ghana while the uni-modal rainfall pattern is also unique to the middle-belt and savannah regions of the country. The vegetation and climatic features of the Municipality have also influenced the soil type in the area which is predominantly Savannah ochrosol soils (Adjei-Gyapong & Asiamah, 2002). This type of soil is suitable for agriculture, and it is noted to support the bulk of the country's food crops.

According to GSS (2014), the population of the Municipality is about 85,456. The proportion of the working-age population (15 to 64 years) is about 55%, with 41% of the population below the age of 15 years (GSS, 2014). Agriculture is the main source of employment in the Municipality, employing about 70% of the population. Crop production constitutes the major agricultural activity. A sizeable proportion of the population is migrants (34%) who have migrated to the Municipality to engage in agriculture. It was reported that 32% of the migrant population has lived in the area for not more than 5 years (GSS, 2014).
Some of the main reasons for choosing this study area were based on the objective of the study, and in particular, access to the study population who engage in cereal farming where the incidence of postharvest losses was reported to be of concern to farmers and marketers. It should also be noted that this district was selected for the study because it was one of the districts in Ghana which was targeted by the government to disseminate the use of the hermetic storage device.

2.2. Research design

The study adopted a mixed-methods research approach. The mixed-methods research approach involves the use of qualitative and quantitative approaches and seeks to reduce the limitations that would have been present in a study if either qualitative or quantitative research approach was used for such a study (Creswell & Plano Clark, 2007). According to Onwuegbuzie & Leech (2005) using mixed methodologies in the same study provides an opportunity to delve deeper into a study and allows for cross-validation of different datasets. By this, knowledge generated often reflects the complexity of the problem under investigation. It is in this light that Creswell (2009) argues that the adoption of mixed methods by social science researchers reflects the need to understand the complexity of social reality. More so, Creswell (2014)

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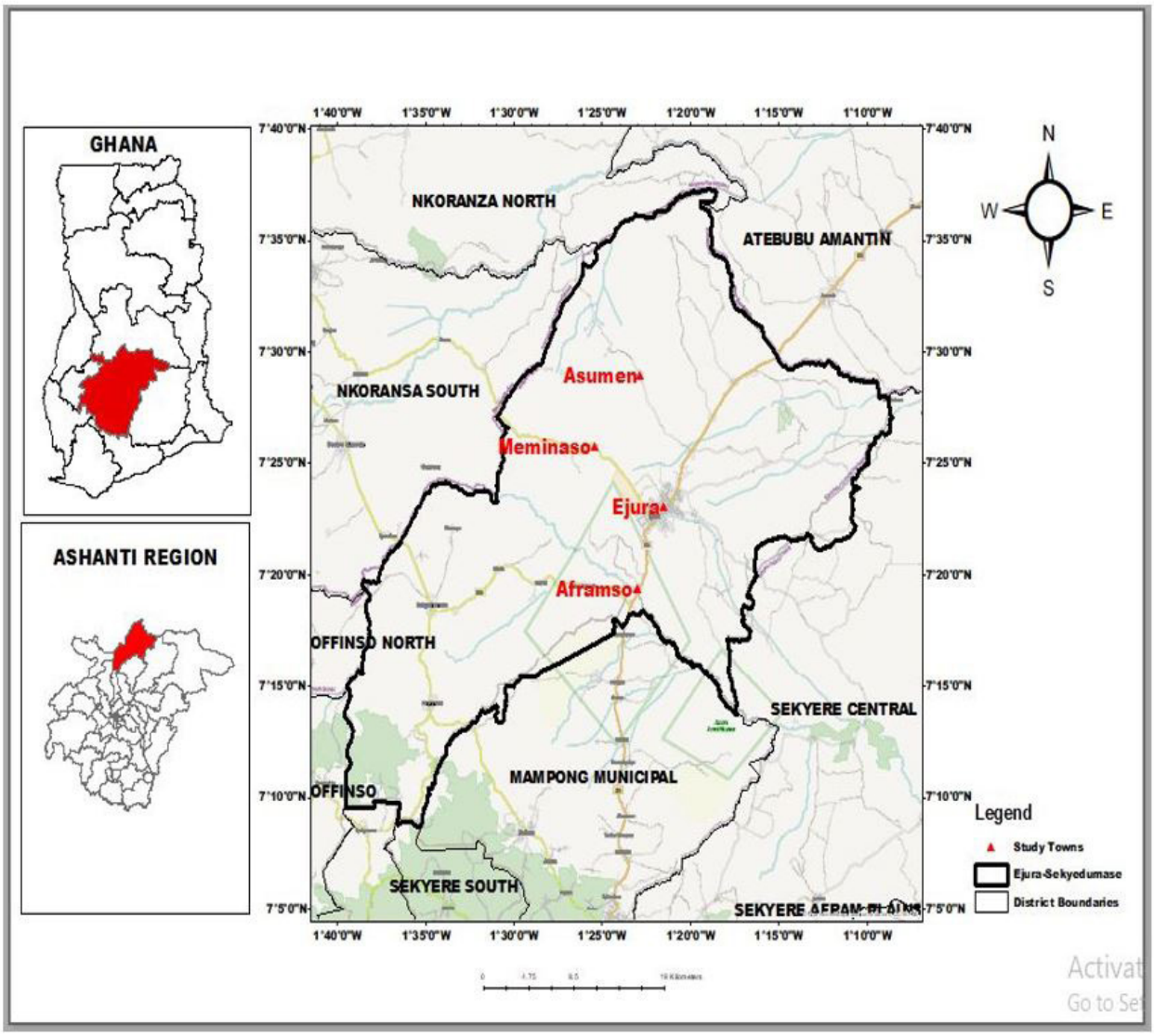

Figure 2. Location of Ejura-Sekyedumase Municipal in Ghana. Source: Ejura-Sekyedumase District Assembly, 2016

argues that the choice of research approaches, including the mixed-methods approach, is based largely on the research objectives and goal.

Aside from the research approach which provides the broad research direction and orientation, the convergence parallel mixed-methods design was used. With this design, both quantitative and qualitative data sources used for the study were collected at the same time and merged in the data analysis (Creswell & Plano Clark, 2007) to provide a comprehensive understanding of the adoption of hermetic storage technology and the effectiveness in their usage from the perspective of farmers. The design strategy enabled the researchers to comprehend the data well as they have been collected at the same time. It also allowed the researchers to quickly notice areas in the data where there were convergence or contradictions.

2.3 Target population and sample size determination

The population for the study was farmers who are into crop production in both rural and urban areas of the Municipality. The reason for sampling both rural and urban communities was that 86% of the rural population are engaged in food crop production and most farmers are into the cultivation of more than one food crop including cereal crops. Also, most farmers sell the crop to marketers in urban areas. Thus, there was a high probability that close to 90% of farmers in the communities who would participate in the sur-

vey, were also more likely to be involved in cereal crop production and marketing. Respondents were heads of farming households.

Regarding the sample size, a total sample of 180 respondents was sampled from three rural communities in addition to Ejura. The researchers arrived at the sample using a confidence level of 95%, an associated margin of error of 7%, and an estimated household number of 3000. This was the estimated household number given to the researchers by the municipal statistical officer. The sample was calculated using the formula below:

$$n = \frac{N}{1 + N(e)^2}$$

Where n is the sample size, N is the population size, and e is the level of precision.

2.4. Sampling technique

In the absence of a household list that would have been used as a sample frame from which the survey data would have been collected, the researchers used the dwelling units in the three rural communities and Ejura suburbs as the sample frame. The number of houses in the communities were generated through a count of the housing units in the study communities using the Google Earth application. The researchers arrived at an estimated housing unit of 400, approximately 130, 115, and 105 were used for Saboline in Ejura, Asumen, and Aframso communities respectively. All houses were listed, and 60 houses were randomly sampled from each community in the generated list of houses. One household head was then sampled from the houses and a final sample figure of 180 was arrived at for the communities.

2.5. Selection of qualitative interview participants

In terms of the qualitative data, a focus group was organized for the farmers in Saboline (Ejura) and Meminaso to gather data from the respondents. The participants in the FGD were mainly large, medium and small scale farmers cultivating maize. Only people seen as knowledgeable to provide information concerning the adoption of the new technology were selected. For the focus group, six (6) large-scale farmers, four (4) medium-scale farmers, and two (2) small-scale farmers were used. Additionally, four (4) agricultural extension experts in the Ejura-Sekyedumase Municipality of the Ministry of Agriculture were also interviewed. Information on reasons for adoption, usage pattern, and perceived effectiveness compared to the traditional methods in reducing postharvest loss in grain storage were solicited from them.

2.6. Data analysis

Data collected through the survey were coded, cleaned, and prepared for analysis using the Statistical Package for Social Sciences (SPSS). Both descriptive statistics in the form of tables and frequencies were used to describe the extent of adoption, and effectiveness of hermetic storage technology. Similarly, interviews were recorded using a tape recorder and transcribed into English. The transcribed interviews were coded and processed with N-Vivo software. Themes linked to the study objectives were generated from the transcripts and quotations emanating from the themes were presented together with the survey results. The quotations provided further insight and also corroborate the survey result.

3. Results

3.1. Background of respondents

Table 1 shows the demographic background of respondents using variables such as gender, age, educational level, and marital status. The result shows that majority of the respondents were males (68%), compared to females (32%). The reported results for gender are not surprising given the predominance of male-headed households in the study area (see GSS, 2014), and to a large extent the male-dominated agricultural households in the country (GSS, 2020). The majority of respondents were between the ages of 26-35 years (50%) and 36-45 (20%). The results show that household heads were within their youthful age, which can be beneficial to agricultural output since this also shows an active labour force. The age distribution also reflects largely the age structure of the district and the country as a whole. Further, the majority of farmers surveyed were married (77%).
Regarding the level of education, the result shows

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Table 1. Demographic characteristics of respondents

Variable	Categories	#	%
Gender	Male	123	68.3
	Female	57	31.7
Age	18-25	15	8.3
	26-35	90	50.0
	36-45	36	20.0
	46-55	21	11.7
	Above 56 yrs.	18	10.0
Educational	No Formal education	78	43.3
	Basic school	45	25.0
	Secondary/A-level	27	15.0
	Diploma/Degree	30	16.7
Marital status	Single	27	15.0
	Married	138	76.7
	Divorced	9	5.0
	Widowed	6	3.3

that majority of respondents had no formal education (43%), while a quarter of the respondents had just basic education as their highest level of education (25%). Only 15% of respondents had secondary level education. The finding on the level of education is not surprising because it is only recently that there has been increased enrolment in basic schools in Ghana, especially in the rural areas due to the implementation of national policies to improve enrolment in basic schools. Most farming communities were not given much attention in the past regarding basic education with a large part of the lives of people revolving around agriculture.

3.2. Crop cultivation and storage by farmers

Table 2 shows cereal crops cultivated by respondents. Two main cereal crops were found to be the most dominant in the municipality. They are maize and cowpea. Maize was however found to be the major cereal crop cultivated in the municipality (52%). Nevertheless, almost two-thirds (35%) of respondents cultivated both maize and cowpea.

In terms of storage, the study found that about half of the respondents (48%) store grains of between 6-10 tons per season, while a quarter of respondents (25%) store between 1-5 tons during every farming season. A few of the respondents do store grains above 10 tons per season. The size of cereal crops stored demonstrates that agricultural households are smallholder farming households. Further, the results show that, predominantly, the duration of grain storage among the farmers was in the range of 5-8 weeks (48%) and 9-12 weeks (35%).

3.3. Extent of adoption of hermetic storage bags for grain storage

Results in Figure 3 show that hermetic methods of grain storage were not only common but also predominantly used as the preferred storage method for cereal crops in the municipality. Indeed, 98% of respondents indicated that it is highly used. Regarding the other storage methods, the result indicates that chemical methods of grain storage is not being used anymore, with about 93% of respondents indicating that its usage was low. Similarly, traditional forms of grain storage such as open-air, use of sisal and jute storage bags, and underground pit were common storage practices but are now on the decline.

Providing some reasons for the preference for hermetic bags, a medium-scale farmer from Saboline in

Table 2. Crop cultivation and storage durations

Variable	Categories	#	%
What type of grains do you cultivate?	Maize	93	51.7
	Cowpea	24	13.3
	Both	63	35.0
What quantity or average tonnage of grains do you store per season?	<1 ton	21	11.7
	1-5 tons	45	25.0
	6-10 tons	87	48.3
	>10 tons	27	15.0
How long do you store grains after harvest?	1-4 weeks	3	1.7
	5-8 weeks	87	48.3
	9-12 weeks	63	35.0
	13-16 weeks	24	13.3
	More than 16 weeks	3	1.7

Ejura points out that "*I usually sell my produce immediately after harvesting due to lack of space and means of storing my grain but with the introduction of the hermetic storage technology, I now sell my produce only when I need money*". A small-scale farmer, however, points out that "*I do not sell my crops in the market, so I still use the traditional method of storing my maize in the barn. I can't afford the price of the bag*". During the interview, the officials from the Agricultural ministry pointed out that, they discourage the farmers from using chemicals to store their grains due to the inherent problems associated with it like, misuse or wrong use due to illiteracy. One of the chemicals they use is phostoxin. This is supplied in tablet form of aluminium phosphide.

The study further sought to get more information regarding the adoption of hermetic storage methods among respondents. Table 3 shows that the majority of respondents use Purdue Improved Crop (PIC) bags. The qualitative interviews indicated that it was the most widely available hermetic bag, which was lower in price and offered much protection for their cereal crops. Informants indicated that the PIC bags offered much protection against physical damage to their crops and are also suited for storing grains. The study also further sought to find out the regularity of use of the PIC hermetic bags by farmers. The result shows that 60% of respondents opined that they often use the hermetic bags, while 25% of respondents opined that they sometimes used the bags. The rest pointed out that they scarcely use them.

Table 3 also shows that majority of farmers used the PIC bags to store maize (47%), while about a third of the respondents (37%) used PIC bags to store both maize and cowpea. Apparently, these are the two main cereal crops cultivated in the municipality. The majority of respondents opined that they use 100kg hermetic bags to store their cereals. Indeed, the capacity of a PIC bag differs depending on the scale of operation of the farmer or the one storing the grain.

3.4 Effectiveness of the use of hermetic bags for grain storage

This section evaluates the effectiveness of hermetic bags in reducing postharvest loss in the Ejura-Sekye-

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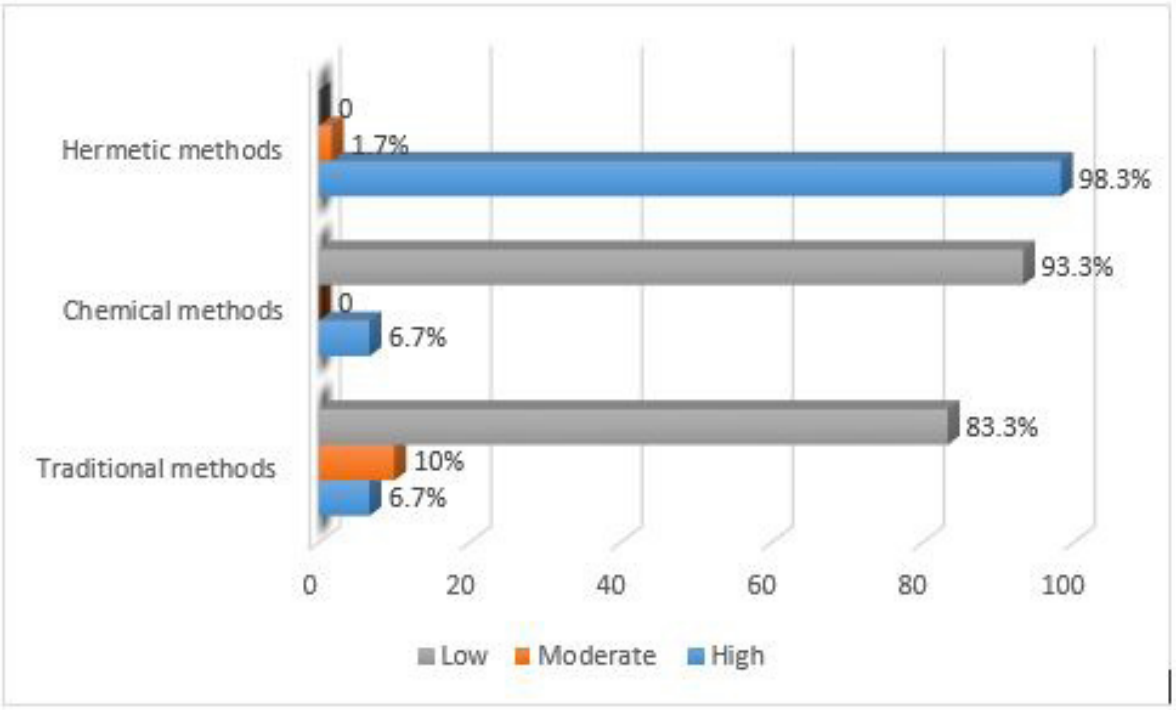

Figure 3. Main grain storage methods used by farmers.

Table 3. Types and usage level of hermetic storage bags by farmers

Variable	Categories	#	%
What types of hermetic bags do you use?	Super grin bag	15	8.3
	PIC	165	91.7
How often do you use the hermetic bags?	Often	108	60.0
	Sometimes	45	25.0
	Scarcely	27	15.0
Which type of crops?	Maize	84	46.7
	Cowpea	30	16.7
	Both	66	36.7
What size of the hermetic bags do you use?	50kg	15	8.3
	100kg	156	86.7
	150kg	9	5.0

dumase farming communities. The results shows that 98% of farmers reported that overall storage losses were low after using the hermetic storage bags (see Figure 4). Moreover, responses for improved seed viability were high (88%), suggesting that the use of hermetic bags indeed effectively reduces postharvest

loss. The result also shows that grain damage was low following the use of hermetic storage bags (97%). Further, the responses show that the moisture level of stored grains in hermetic bags was also low (97%) as well as low pest infestation (92%) following the use of hermetic storage bags. Overall, the results clearly show that hermetic storage technology is potent in reducing postharvest loss in the municipality.

Figure 5 shows respondents' answers on postharvest losses of grains before the adoption of hermetic storage technology and after its adoption. The result shows that about 78% of the respondents reported high loss of grains before the adoption of the technology. This amounts to 8 out of 10 people reporting high losses, which is a significantly high figure. Thus, the result shows that postharvest loss of grains was a challenge to farmers prior to the adoption of the hermetic storage bags.

The situation of postharvest loss of grains seems to have plummeted following the introduction of hermetic storage bags. As can be observed from Figure 5, about 75% of respondents opined that postharvest loss of grains has reduced following the adoption of the hermetic bags. The finding shows the profound impact of the use of this technology. This point is corroborated by the quote below which provides insight into farmers' experience with the use of this new technology: According to Kofi, a participant in the study from Meminaso, "*The use of the bag helps to maintain the quality of the stored grains. The important thing I like about the bag is its ability to protect the cereal from rodents and moulds.*"

Respondents also highlighted how the use of hermetic storage bags has reduced exposure to insects and fungus. Indeed, an overwhelming 93% of respondents indicated that they have not experienced insect and pest infestation of grains following the adoption of the technology. This point was also corroborated by one farmer in Ejura-Saboline as captured in the quote: "*before I started using the PIC bags, I lost a lot of grains because of the insect and pest. Even when I kept the grains in a warehouse (using jute bags) there were some that got damaged as a result of pest infestations. But this time things have improved for me as I do not experience losses as a result of the use of this new technology*"

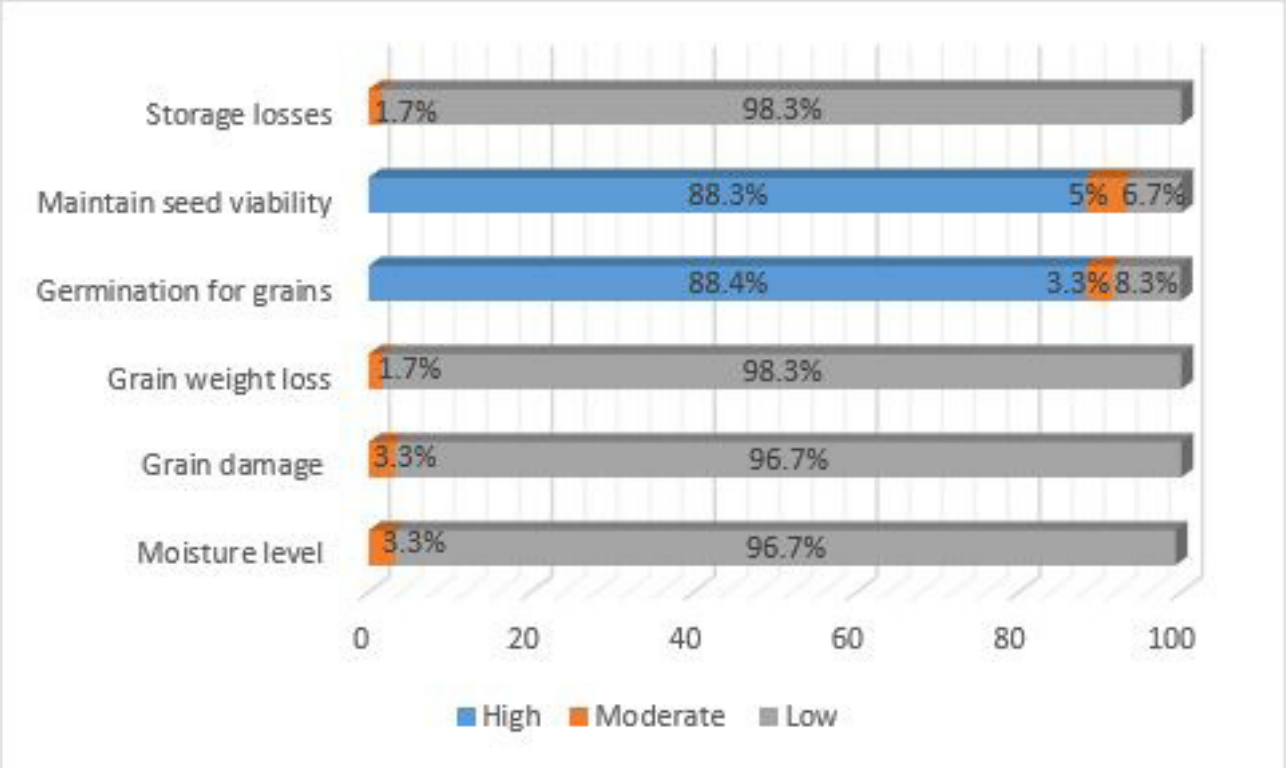

Figure 4. Effectiveness of hermetic storage technology in grain storage

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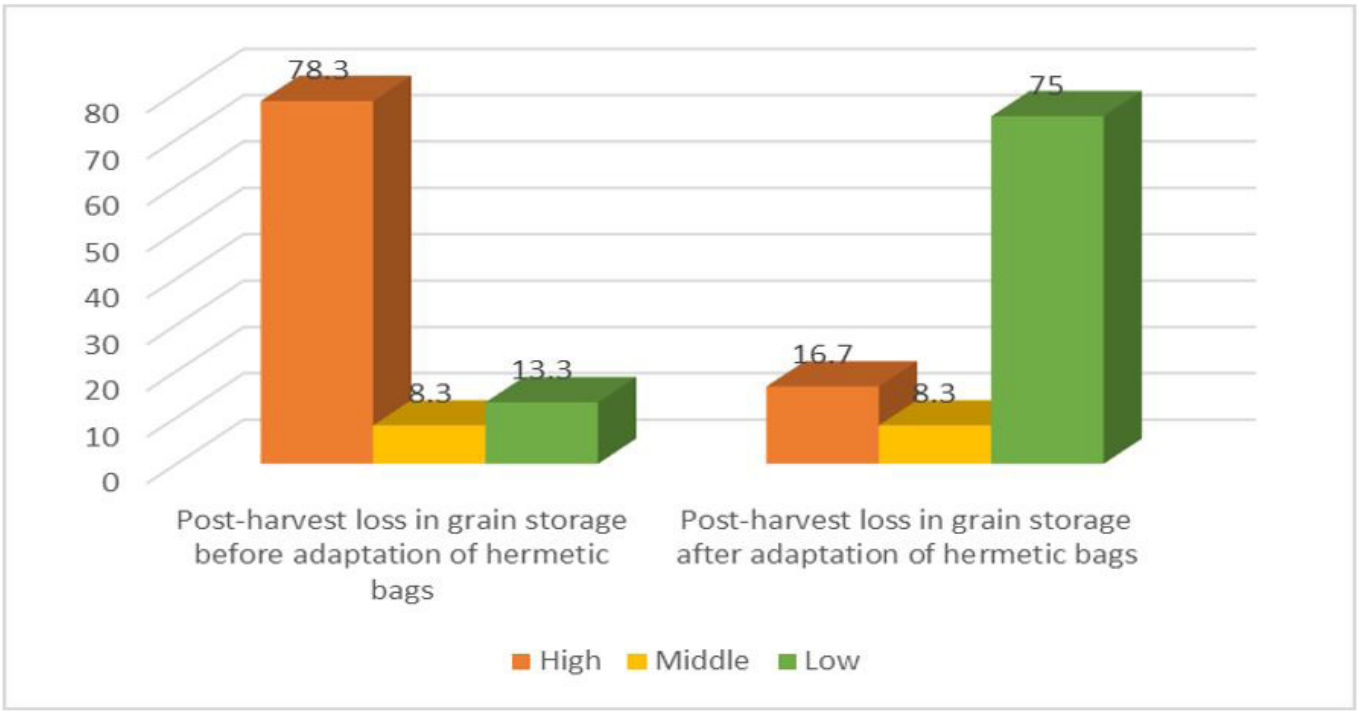

Figure 5. Postharvest loss of grain before and after the adoption of Hermetic bag

4. Discussions

Cereal crops constitute an important staple in the diets of many Ghanaians. Maize for instance constitutes about 80% of all staple foods consumed in the country. There is thus the need to increase its cultivation and yield to ensure food security. About 50% of rural households and 20% of urban households cultivate cereal crops under rain-fed agriculture (Quiñones & Diao, 2011). It is therefore not surprising to see majority of the respondents cultivating maize. Cowpea is also produced in all parts of Ghana due to its edible seeds that can be consumed by both humans and animals for protein. Cowpea production is strategic in Ghana due to its nutritional, agronomic, environmental, and economic advantages. It contributes to enhancing food security and the livelihoods of many households and the economy as a whole (da Silva et al., 2018). In addition to the above, the municipality as noted earlier has a favourable condition both climatically and topographically that makes it a hub for the cultivation of maize and cowpea. Its location in the sparse derived deciduous and middle-belt zone with savannah-like conditions provides a conducive ecological condition for the cultivation of many food crops including the two food crops in this study.

The study findings show that majority of farmers are moving away from using chemical and traditional methods of storing grains such as polythene bags, cribs, mud houses, and underground pits and are adopting hermetic storage bags. The findings thus contradict arguments by Obeng-Ofori (2010) that the use of traditional storage methods and chemical pesticides continue to dominate grain storage in most parts of Africa. Our findings similarly contradict Komen et al. (2006) who suggested that farmers in sub-Saharan Africa still adopt the traditional and chemical storage methods and techniques which are not effective to protect stored maize grains from storage losses. The findings from the study corroborates a recent study by Bandyopadhyay (2019) who argues that the adoption of hermetic bags for grain storage is increasing, and farmers are receptive to this new form of storage.

Results on the low usage of chemicals in storing grains indicate respondents' recognition of the harmful impact it has on their grains. This finding is well in synch with suggestions by Obeng-Ofori (2010) and Kimanya (2015) on the need to reduce the use of pesticides and other chemicals in storing grain crops. The main chemical used by farmers to store their grain before

the large-scale introduction of the hermetic storage bag was in the form of dust, tablet, spray, or fumigant forms. Those in dust form were usually mixed with the grain when they were being bagged. The dust chemicals are the organophosphorus ones like actellic and pyrethroids. The tablets are wrapped and added to each bag of grain. The spray types are sprayed with knapsack machines on the layers of the bags to prevent insects from developing while the fumigants are used to kill insects in airtight containers like gallons or the crops are bagged with jute bags and covered with tarpaulins to make them airtight.

Indeed, the use of traditional storage methods and chemical pesticides have dominated grain storage in Africa (Adejumo & Raji, 2007; Obeng-Ofori, 2010) but the introduction of the hermetic storage technology is expected to gradually bring a shift from traditional and chemical storage methods to the adoption of the hermetic storage method as shown in our study. The findings here shows that the adoption of the hermetic storage method has been a conscious effort on the part of authorities, through extension services to create awareness of the new storage method (i.e., hermetic storage method). These efforts as were observed from interviews with officials from the Ministry of Agriculture in the municipal assembly[1] have paid many dividends, as evident by the extent of adoption. This current study is pointing out that, most farmers and maize marketers are now using improved methods of storage like hermetic devices. This suggestion resonates with Baributsa et al. (2010), who claimed that the adoption of the hermitic bag by farmers will contribute to improved farmers' incomes as well as increase the availability of high-quality, insecticide-free grains in the market. This implies that a key driver of the hermetic bag adoption is the gains that the farmer perceives to receive. Widespread adoption of this technology will assure food safety and security in the country. Let's not forget that food safety, especially the increased amount of aflatoxin in grains is a factor leading to the low export of Ghana's crops to neighbouring countries and abroad.

The three to four main types of hermetic storage bags which are in the market to be used by farmers include the Organic-Hermetic storage which is also known as the Purdue Improved Crop Storage (PIC), the Vacuum-Hermetic Fumigation" (V-HF), SuperGrain bags and Gas-Hermetic Fumigation (G-HF). In Ghana, two main brands of hermetic bags are being marketed. They are the Purdue Improved Crop Storage (PIC) bags and SuperGrain bags. The farmers in our study were noted to opt for the PIC bags. Due to the cost involved in the acquisition of these storage bags, farmers prefer the one that typically resembles their traditional method of storing grains, which is the 50kg supper grain bag which is the organic hermetic storage device. This finding corroborated Baributsa & Cristine (2020), who opined that PIC bag is very simple to use and low-cost which can be applied on a large scale to store maize and other cereal products by peasant farmers. It is only the plantation or large-scale farmers who can afford the other bag varieties due to their size. For instance, the Mega Cocoon and the TranSafeliner are big storage bags that can only be used by rich farmers. Even though a large proportion of farmers are using the small 50kg bags, not all farmers had the means to purchase these bags. This suggests that some farmers may still be using other means of storage which can derail efforts aimed at reducing postharvest loss and increasing farmers' income.

The main reason for using hermetic bags is their effectiveness in reducing postharvest loss. The main themes that emerged from this study are that farmers were able to decrease storage loss; maintain the viability of their seeds; increase the germination of the grains; decrease grain damage and decrease the moisture level of the crops as a result of the use of the hermetic bags. Authors like Donovan et al. (2019), Suleiman & Rosentrater (2015), and Obeng-Ofori (2010) all observed the benefits of using hermetic bags to store grain for future use. In effect, this finding is re-enforcing the claim that the use of hermetic storage bags improves the sustainability of grains (Donovan et al., 2019) and ensures that farmers are not fleeced off their income. The farmers are thus able to store the crops and sell them at higher prices during the lean season for profit. The use of the bag, therefore, reduces the reliance on 'middlemen' or 'market mummies' who have advanced means of storing the grains and reap heavy profit at the expense of the farmers. Compared with the traditional methods of storing grains,

[1] The municipal assembly is the local governing unit in the municipality. It comprises of the Municipal Chief Executive, administrative officials, and elected representatives of electoral areas in the municipality

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once the grains are put in the airtight hermetic storage bags, even if there is an egg or larvae in the grain, as the days roll by, the oxygen in the sack would be used up. After the oxygen is gone, the insects cannot survive in the bags leading to their extinction. It should be noted that, the hermetic bags work perfectly well when seeds are well dried or to their storage moisture content level. If they are not well dried, moulds would likely develop leading to an increase in aflatoxins and the cereals would not meet the standard required in the market. The shelf life of stored grains is thus increased with this technology. This claim by farmers in our study is thus not new. What is new is its widespread usage to increase income and food security in the study area. This argument supports Fusseini (2015) who said that farmers who adopted the hermetic bag technology improved their food security and the income of their entire households due to the higher prices that they will get from selling their produce during the lean season. It is of interest to know that sustainable development goal two is to have zero hunger and this can be achieved through food security in the form of reducing postharvest loss. There are a lot of limitations in the agricultural processes and value chain in Ghana and the world at large. Combating postharvest loss is challenging however, widespread usage of hermetic storage bags can help fight hunger in Ghana and other countries as a whole. It was also found in this study that the use of hermetic storage bags by farmers is also leading to better income, which is the goal of sustainable development one. Better income comes with good health and well-being and all other goals will follow.

5. Conclusion

The study sought to address the following objectives: (1) examine the extent of adoption of hermetic storage bags for grain storage, and (2) examine the effectiveness of the use of hermetic bags for grain storage. The findings showed that the majority of respondents have shifted from using traditional storage methods like polythene bags, silos, mud houses, or use of cribs to widespread use of hermetic storage bags to store their crops. Regarding the effectiveness of hermetic storage bags, the study found that hermetic bags reduce postharvest losses by ensuring the sustenance of the quality of the grain, promoting longer shelf life, and preventing storage pests. Further, the effectiveness of hermetic storage bags resulted in the reduction of postharvest losses when compared to the past when respondents did not use hermetic storage bags. It can thus be concluded that, widespread adoption and use of good technology like the hermetic storage bags can help achieve most of the sustainable development goals like goal one-no poverty, goal two-zero hunger, goal three-good health and well-being, goal four-quality education, goal six-clean water and sanitation to mention only a few. The use of hermetic storage bags by farmers to store their grains will thus lead to sustainability. There is a need to increase training and sensitization activities for farmers to improve awareness and ultimately adoption. The more farmers are aware of the benefits and use of hermetic technology, the higher their level of adoption and use in the storage of grains. The study also found that the cost of hermetic bags is high, and the appropriate sizes for grain storage are not readily accessible in the Ejura-Sekyedumase Municipality. This greatly impedes the adoption of the technology and ultimately erodes the gains of reducing postharvest losses. Hence, the issues of affordability and availability of hermetic bags to farmers must be addressed by appropriate authorities. First, the Government of Ghana should subsidize the cost of hermetic bags to promote adoption and use among farmers. Second, agencies should assess farmer needs and provide appropriate hermetic bag sizes to farmers to facilitate adoption.

Conflict of Interests

The authors declare that there are no conflicts of interest in the gathering of data and preparation of this paper.

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Icing the Cake: A Lifestyle-based Benefit and Preference Analysis on Online Grocery Shopping

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Germany has not kept pace with the global development of online grocery shopping (OGS) and despite a pandemic-related increase remains on a moderate level. This phenomenon may reflect infrastructural benefits of stationary retailing, personal and household preferences, and perceptions of OGS services. To this end, this study investigates the determinants of OGS benefit perception addressing the interconnection between personal and household benefits and situational conditions based on qualitative data analysis. Data in three consumer lifestyle segments are gathered from a total of twelve German consumers. The study's theoretical structure resorts to the theory of planned behaviour (TPB) to cluster beliefs and assess the impact of situational conditions. The study's findings reveal large knowledge gaps and different individual preferences in service usage across the groups. We then reflect these preferences in the circumstances of the pandemic. We propose that retailers should increase advertising and consumer education efforts in some consumer segments while enhancing service transparency to consolidate consumers' trust. On a mid-term level, further structural investments will be necessary to successfully compete in the future and serve a perspectively growing market.

1. Introduction

As of 2018, almost every second customer in Germany indicated an interest in buying food online (Donath 2018), yet the current share of revenue in the segment remains at a mere 2.0 percent in 2020 (HDE, 2021, p. 8). To add some more context: The overall market volume of online commerce in Germany is estimated at EUR 577 billion of which EUR 204 billion relate to the food segment as of 2020 (HDE, 2021, p. 8). At the same time, the segment is expanding at an annual growth rate of almost 60 percent from 2019 to 2020 (HDE, 2021, p. 9) outpacing the overall e-commerce performance (estimated at 17 percent for 2021; HDE, 2021, p. 6). This renders OGS an economically attractive market segment prone to dedicated marketing activities and a fruitful research area to study adoption patterns of digitalisation within the complex category of food products. Despite a tremendous increase in demand during the COVID-19 pandemic, OGS was not able to move out of its niche position in Germany.

OGS services in Germany are mainly operated via home delivery by pure online market participants (e.g., Amazon) and stationary retailers (e.g., REWE) supplementing their existing offline channel (Piroth, Rüger-Muck, & Bruwer, 2020). The slow OGS adoption in Germany may depend on various country / culture-specific factors: Germany records the highest supermarket density in Europe (Nielsen, 2018, p.

215), fairly liberal opening hours, and its consumers largely agreeing to be "happy with the status quo" of grocery retailing (Seitz, Pokrivčák, Tóth, & Plevný, 2017). Dannenberg, Fuchs, Riedler, and Wiedemann (2020) however, pointed out the infrastrastructual weaknesses of OGS, particularly in rural areas, and van Droogenbroeck and van Hove (2017) highlighted household-level analysis as food shopping is found to be influenced by the individual household set-up.

Hereinafter, this study explores the perceived advantageousness of OGS services for three specific archetypal customer segments. We understand perceived advantageousness as the moment where a consumer may be inclined to completely substitute their stationary food shopping via online channels. Many researchers have conducted qualitative research in OGS with different methodological approaches (Elms, Kervenoael, & Hallsworth, 2016; Hand, Dall'Olmo Riley, Harris, Singh, & Rettie, 2009; Piroth, Rüger-Muck, & Bruwer, 2020; Ramus & Nielsen, 2005; van Droogenbroeck & van Hove, 2020a, 2020b). This study's methodological set-up is grounded on earlier research successfully applying qualitative measures in countries such as Denmark and the UK (Hand et al., 2009; Ramus & Nielsen, 2005). This article concludes with recommendations to retailers to adequately attract and market to these consumer segments to increase the overall accessibility of OGS services. To our knowledge, it is the first study that combines individual advantageousness and strives to show the value of in-depth data and interpretation stems from its ability to contextualize quantitative research and illustrate "everyday" consumer behaviour in online food shopping, generating actionable advice to practitioners.

2. Literature review and research questions

Preference analysis has been performed within OGS since the early market developments (Jukka, Jukka, Timo, & Kristiina, 1998; Morganosky & Cude, 2000, 2002; Raijas & Tuunainen, 2001), given its implications for customer segmentation. For instance, Wilson-Jeanselme and Reynolds (2006, p. 539) recommend "a segmentation of consumers based on understanding their expressed preferences as opposed to more traditional segmentation methods" as consumer groups may be similar in certain preferences despite their differing characteristics. Brand, Schwanen, and Anable (2020) argue that there is no "average online grocery shopper" due to heterogeneity in consumer preferences. Many of these advantages can be linked to targeting consumer segments such as mobility-impaired customers, the elderly and disabled (Jukka et al., 1998; Seitz et al., 2017), time-savvy families, and "double Income no Kids" households (Raijas & Tuunainen, 2001). These groups seem to particularly benefit from OGS services; however, they face different individual obstacles, as shown by van Droogenbroeck and van Hove (2017) when comparing personal and household-level adoption of OGS services. This can be easily illustrated using the example of its distributional set-up. Retail operates online food purchases via two main distributional approaches: click-and-collect and home delivery. The individual benefit of, and subsequent satisfaction with OGS service usage is found to be trip (Chintagunta, Chu, & Cebollada, 2012) and shopping mode (Nilsson, Gärling, & Marell, 2017) dependent. The two distribution approaches have been shown to generate different consumer values across customer segments (Vyt, Jara, & Cliquet, 2017). Previous studies agree on convenience and time-saving as primary determinants of OGS service usage (Morganosky & Cude, 2000; Picot-Coupey, Huré, Cliquet, & Petr, 2009; Raijas & Tuunainen, 2001; Ramus & Nielsen, 2005; Seitz et al., 2017).

The individual benefit of OGS service offerings seems related to a consumer's personal preferences and situational conditions. Many quantitative studies focus on the assessment of individual OGS usage motivation (Hansen, 2008; Hansen, Møller Jensen, & Stubbe Solgaard, 2004; Piroth, Ritter, & Rueger-Muck, 2020); however, OGS adoption may be "related (at least in part) not to personal but to household characteristics" (van Droogenbroeck & van Hove, 2017, p. 258). The authors argue that ability and motivation may not necessarily coincide as a (tech-savvy) household may be able to resort to OGS but refrains from doing so as long as one person in the family can do the grocery shopping in-store (ibid.). However, the very same household set-up has a potentially higher advantage in using click-and-collect service offerings related to "research online, buying offline" customer segments (Vyt et al., 2017, p. 146) and has the potential to substitute in-store grocery shopping. Different value predispositions and benefits have been illustrated by various levels of advantageousness when comparing the impact of socio-demographic attributes on a personal (e.g., age, income) and household level (e.g., household

size, the existence of dependent children) (Hansen, 2005; Hiser, Nayga, & Capps, 1999; Hui & Wan, 2009). These phenomena are in line with previous findings on changing situational conditions (such as changes in job or family configuration and health issues) as initial triggers of OGS usage (Hand et al., 2009). These triggers affect the beneficial predisposition of the service by altering the personal and/or household advantageousness. Preference-based consumer segmentation analysis has received increasing attention in the literature, including cluster analysis (e.g. Brand et al., 2020). Studies on consumer segmentation in OGS generally find three to five cluster solutions. Hand et al. (2009, p. 1213), for instance, propose a three-cluster solution with a health-and-kids-focused segment, highlighting the influence of situational conditions in the adoption process.

Consumer and market segmentation and their success potential have arisen as topics of interest in the literature (Jukka et al., 1998; Shea & Zivic, 2011). Wilson-Jeanselme and Reynolds (2006, p. 539) highlight the importance of the interaction between, and the attributional combination of, consumer expectancies toward OGS.

Hence, we propose the following research questions (RQ):

RQ1. How do consumer target segments differ in their individual knowledge?

RQ2. How do consumer target segments differ in their individual benefits?

RQ3. Which relational (personal, household) conditions influence individual perceptions of the benefits?

The next section will explore the theoretical framework used to examine consumer beliefs and benefit perceptions of OGS services.

3. Materials and methods

3.1 Theoretical Framework

Ramus and Nielsen (2005) apply the Theory-of-Planned-Behaviour (TPB) approach as introduced by Ajzen (1991) to evaluate consumer beliefs amongst users and non-users of OGS services in Denmark and the UK based on focus group data. They translate the attitude, social norm, and perceived behavioural control dimensions from the TPB construct to an outcome, normative, and control beliefs, respectively. Attitude describes the individual perception of a specific behaviour's advantageousness, social norm reflects the pressure to perform a certain behaviour, and perceived behavioural control describes the individual capabilities to perform a given behaviour (Ajzen, 1991; Ajzen & Fishbein, 1980).

Ramus and Nielsen (2005, p. 348) report that "*experienced and inexperienced internet shoppers did not differ very much in their pool of stated outcome and control beliefs*" and a "remarkable overlap in positive and negative beliefs (…)" toward OGS was reported. TPB is grounded on the argumentation that attitude, social norm, and perceived behavioural control constitutes one´s individual intention to use a service, proposing that intention may result in behaviour. However, Donath (2018) shows that even though almost 50% of German consumers state the intention to use OGS, the actual usage rate is drastically low. In this article, we argue that both situational conditions and household characteristics influence the OSG usage intention and behaviour (see Figure 1).

TPB approaches are a common methodology in OGS research and have found application in both qualitative (Kureshi & Thomas, 2019; Ramus & Nielsen, 2005) and quantitative (Hansen et al., 2004; Hansen, 2008; Piroth, Ritter, & Rueger-Muck, 2020; Troise, O'Driscoll, Tani, & Prisco, 2021) research set-ups.

3.2 Approach and Procedure

Following Ramus and Nielsen (2005), we propose an exploratory design for focus group sessions in which participants were able to freely express their experiences and expectations with OGS. Krueger (1994) found that participants were more willing to share their experiences in homogenous groups. We created such groups based on their socio-demographic features and living situation but adopted different views (in line with the above-mentioned score) on the matter, enabling some controversy in the discussions. We also followed suggestions by Freitas, Oliveira, Jenkins, and Popjoy (1998, 12f.) to include strangers and balance groups in terms of gender.

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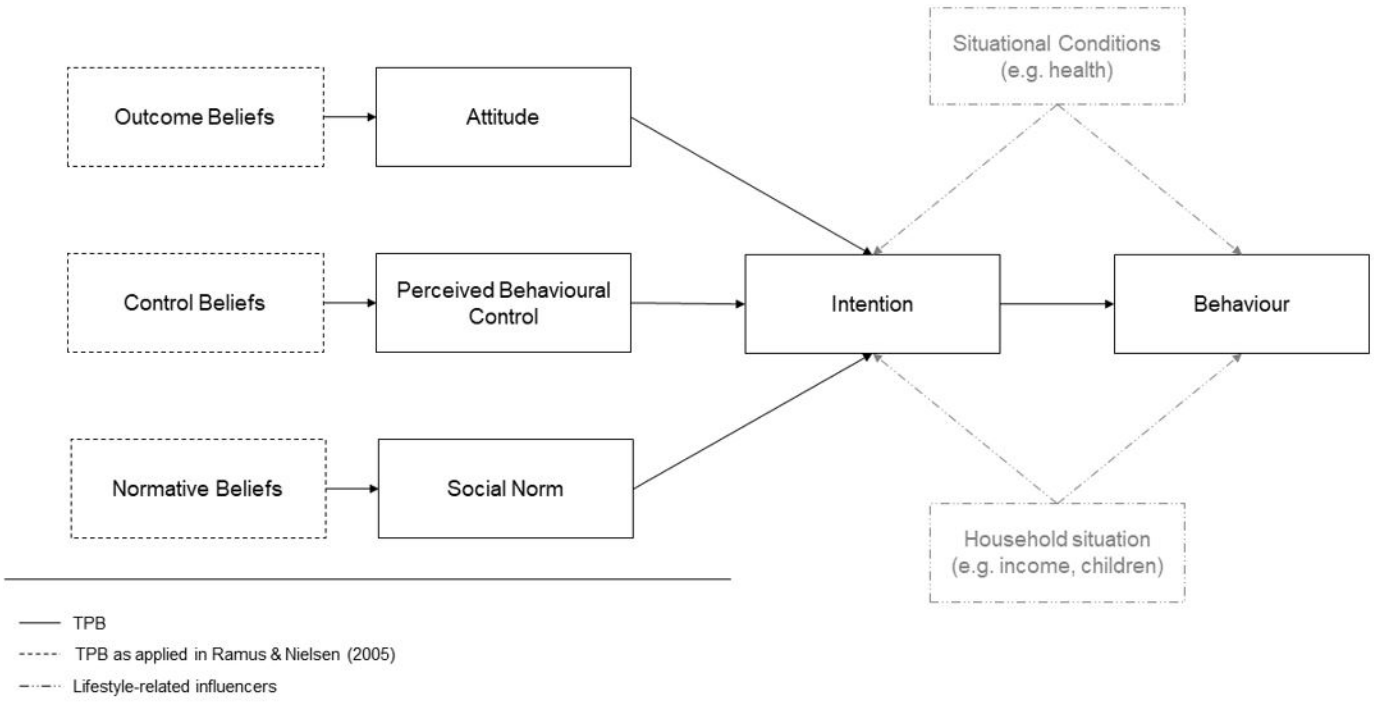

Figure 1. Theoretical Framework

This study used single (D. L. Morgan, 1996) mini focus groups (Kamberelis & Dimitriadis, 2011) with dual moderation (Krueger & Casey, 2015). Each focus group's session duration and group size were set between one and two hours for four participants, in line with academic recommendations (Krueger, 1994; D. Morgan, 1997; Vaughn, Schumm, & Sinagub, 1996). Each focus group discussion was sequenced as follows:

- A short introduction to the topic via video presentation;
- Participants shared their previous experience with OGS services in an open discussion;
- Participants evaluated their most crucial preferences and benefits as well as obstacles and concerns with the service in an open discussion;
- Each session concluded with participants sharing their expectations for future OGS activity and usage intention.

The moderation of the focus group was based on a lightly structured questionnaire. We only resorted to the guidelines when the discussion came to an end to provide enough conversational space for the participants. All focus group sessions were recorded using a multidirectional table microphone and then transcribed. Participants were encouraged to freely share their OGS experiences, individual preferences, and expectations with the group as all data were anonymized to comply with data privacy concerns. We provided coffee and light refreshments to create a welcoming and relaxing atmosphere during the sessions.

3.4 Data Analysis

We facilitated transcript-based qualitative content analysis using MAXQDA Vers. 2020 (Verbi GmbH). All transcripts were coded based on the TPB framework by two researchers; the remaining issues on unclear and inconclusive coding were discussed and resolved among the involved scholars. Each dimension of beliefs was first reviewed within each focus group session and then across group sessions.

3.5 Participant Selection

Participants were selected based on their suitability for the study by answering an online pre-study questionnaire distributed to 98 people via e-mail at a research facility in Southern Germany. Suitability was

assumed if the participant had a) prior purchasing experience with OGS and b) a notable opinion towards the matter. Using a scoring approach (five-point scale ranging from "strongly like it" to "strongly dislike it"), potential participants were classified into three distinct groups based on similar living conditions (e.g., household set-up) but different opinions toward OGS. A total of 22 replies were received, and 12 participants finally agreed to partake in the study. The low overall return rate may be explained by the relatively long duration of the sessions and an overall lower interest in OGS services in Germany. Their opinions were measured for a second time at the end of the session to account for, and report changes in opinion induced by the focus group session itself. Seitz et al. (2017) and Jukka et al. (1998) identified and discussed three consumer segments of OGS users that underline a consumer life-cycle approach to adoption research. All three identified segments were shown to have an interest in OGS usage (Seitz et al., 2017, p. 1251) and were, therefore, used in this study.

3.6 Focus Groups

Young consumers with urban and suburban lifestyles were included in the first focus group, referred to as Young Professionals (YP). The average age in this group was 24 years (*SD=1.87*), and the gender ratio was 50%. Most participants (75%) lived in a flat arrangement with a domestic partner, while one participant lived in a flatshare. The living location of all participants could be described as urban and suburban. The group generally had a positive opinion toward OGS, and the conversation share was equally distributed within the group (*range=6.97%*). The YP group had an average household income of approx. EUR 2,000 per month. In terms of education, two participants had finished apprenticeships, one had completed general qualifications, and one participant was working as a foreman. Besides the foreman, all three participants were enrolled as students.

The second focus group consisted of four female participants between 33 and 50 years old (*M=38 years; SD=7.4*) in different family arrangements (two with more than one child, two with one child, one as a single parent). They lived in mixed locations and had fairly diverse opinions toward OGS. This group earned slightly more than the younger group, EUR 2,050.40 per month, and will be referred to as Family (F).

The third focus group had an average age of 58.25 years (*SD=2.17)* and a gender ratio of 50%. Both the living situation and location varied across participants. The average household income in the group was approximately EUR 2,700 per month, and the mindset toward OGS could be described as indifferent for the group (with two participants in favour and two against). In terms of education, this group could be described as above average (with three participants with an academic background). As the term Best Ager has been largely recognized in the German literature and linguistic area, this group was referred to as BA. However, the terms silver surfer, golden ager, and over 50´s are used more or less synonymously in the literature. The complete socio-demographic characteristics of the study's participants are summarized in Table 1 alongside the conditions of each focus group session.
Table 1. Descriptive Statistics of Participants and Session Conditions

All participant names were anonymized to ensure data privacy. The full anonymized transcripts in German are available upon request. All focus group sessions took place in early to mid-2018.

3.7 Focus Group Sessions

The intensity of the focus group discussions varied across sessions (Table 1). We also reported that four participants changed their opinion toward OGS during the focus group sessions. The majority of those who changed their mind was in the BA focus group, indicating problematic opinion leadership within the group (Marg, 2014). Three of the four participants who changed their minds left the discussion with a more favourable opinion toward OGS (see Table 1), hinting at potential gaps in consumer knowledge and awareness, as well as the crucial influence of peers (Piroth, Ritter, & Rueger-Muck, 2020; Ramus & Nielsen, 2005).

4. Results

The first part of this section provides the descriptive analysis of the focus group data and the dimensions that will subsequently be supplemented with a qualitative assessment. The largest sections of the focus group discussion related to outcome beliefs and motivational aspects of the OGS service usage. Within this dimension, we were able to extract six thematic

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sub-sections that showed striking similarities with the reported data structure in Ramus and Nielsen (2005). As expected, the importance of the motivational aspects varied across target segments. For instance, younger consumers were more concerned with OGS pricing levels, while elderly consumers perceived the charges to be adequate for the added convenience. The findings were then divided into subsections for each belief dimension, for which detailed consumer remarks are reported.

4.1 Outcome Beliefs

Six distinct groups of outcome beliefs regarding the usage of OGS services were identified:
1) Convenience and ease of life;
2) Shopping experience and enjoyment;
3) Pricing and cost;
4) Social responsibility and sustainability;
5) Product range and service availability;
6) Impulsiveness.

Convenience and ease of life. Across all focus groups,

Table 1. Descriptive Statistics of Participants and Session Conditions

Participant / Session	Age	Gender[a]	Net Household Income in €	Household Configuration[b]	Living Location[c]	Att[d] (Pre)	Att[d] (Post)	Speaking Contribution[e] (in percent, incl. mod.)
Hannah, YP	24	F	1,001 – 2,500	C	U	+	+	18.42
Ben, YP	23	M	2,501 – 4,000	FS	U	-	-	14.80
Emma, YP	27	F	< 1,000	C	SU	+	+	19.41
Jonas, YP	22	M	1,001 – 2,500	C	U	+	+	18.42
Mia, F	38	F	1,001 – 2,500	SP	SU	++	++	6.98
Amelie, F	50	F	1,001 – 2,500	F	SU	+	+	12.56
Anna, F	31	F	1,001 – 2,500	SP	U	--	++	16.74
Emily, F	33	F	2,501 – 4,000	F	SU	0	+	21.40
Elisabeth, BA	61	F	2,501 – 4,000	C	SU	-	-	21.96
Wolfgang, BA	58	M	1,001 – 2,500	S	U	+	++	23.51
Ida, BA	55	F	2,501 – 4,000	F	RU	-	+	8.53
Peter, BA	59	M	> 4,000	F	SU	+	-	20.41

Notes:
[a] Gender: M = Male; F = Female.
[b] Household situation: S = Single; FS = Flat Share; C = Couple flat (no children); F = Family with one or more children; SP = Single parent.
[c] Living location: U = Urban, SU = Suburban, RU = Rural.
[d] Attitude was measured before the session (pre) and shortly after the session had taken place (post). A total of four changes in attitude have been registered and are highlighted in bold font. Ratings: ++ = very positive (+2); + = somewhat positive (+1); 0 = indifferent (0); - = somewhat negative (-1); -- = very negative (-2).
[e] Speaking Contribution of each participant. Moderation to be included for 100 per cent.

ease of life aspects was perceived to be crucial, with convenience being the primary influencer. All focus groups saw significant advantages in delivering groceries, particularly heavy goods (such as beverages), to the doorstep. In this context, the wide range of deliverables was highlighted using the example of *Flaschenpost*, a German online retailer invested in the sole distribution of beverages. All groups agreed that OGS improved the convenience and shopping experience at busy times. All groups perceived OGS as particularly relieving to young families or lone parents in their daily life routines. A BA group participant stated: "*I am temporarily mobility impaired and live on the fifth floor; so, why should I do the carrying myself?*" (Wolfgang, BA). All groups highlighted the utility of OGS to maintain autonomy in specific situations (e.g., sickness and job changes) or in the advanced age. In terms of timesaving, YP and BA groups perceived OGS to be only partially viable. The YP group argued that the full potential of timesaving would only be realized through same-day delivery, reflecting a preference for flexible shopping options.

Shopping experience and enjoyment. Both YP and BA groups described grocery shopping trips as "relaxing" (Wolfgang, BA; Emma, YP) and associated them with positive emotions. Wolfgang, BA stated: "*I actually enjoy going food shopping, (…) and just pray for a bit.*" F and BA focus groups emphasized social interaction during grocery shopping, while this aspect played a marginal role for the YP group. While group F preferred social interaction, the BA group perceived OGS as potentially threatening toward social interaction. Wolfgang, BA illustrated this aspect using the example of the Home Depot delivery systems: "*I would not even have to keep in with the neighbours anymore. I would not like that.*"

Pricing and cost. Cost appeared to be the most crucial issue for the YP group. They would be more likely to use OGS in the absence of additional charges, while BA consumers were easily willing to accept the extra costs: "*For me, the additional five euros are easily worth it as I save myself the struggle of shopping*" (Wolfgang, BA). YP participants described their willingness to pay the extra charge as circumstantial:

"*When I had stressful times during work, I was in no mood for grocery shopping, so I had it delivered. I still go to the supermarket mostly, though, because I do not want to spend the extra money on fees.*" (Ben, YP)

"*(…) if you buy in bulk, for a party or with your flatshare, where the costs are shared, it is not too bad*" (Jonas, YP)

Lower price sensitivity was observed in all focus groups for special products that were difficult to obtain (e.g., specialties) or had to be imported from abroad.

Social responsibility and sustainability. The BA group significantly differed from the YP and FS groups in this respect. BA participants strongly emphasized the need for social responsibility with OGS. They perceived it to cause the demise of rural stores, providing poor working conditions for OGS employees (specifical drivers), and adopting unclear data collection policies. Participants in the BA group were also more likely to support local farms and shops (such as bakeries, among others). The YP and FS groups perceived OGS as positive in terms of the potential for innovative companies to successfully address niche markets (Emma, YP), thus resulting in future job creation. The sustainability aspect, consisting of the sub-themes of packaging, wastage, and energy footprint, was also addressed. While the BA group did not seem to be worried about the packaging material, both groups agreed on a severe problem with packaging waste:

"*What I found to be negative was that you are left with a lot of packaging material.*" (Ben, YP)

A potential solution for this issue was discussed in the YP group, where service offerings were preferred, as they were believed to facilitate recycling, and pick up of the used packaging material. However, the needed appointments decreased the advantageousness of this solution drastically.

The BA and YP groups agreed on the importance of reducing grocery wastage, and the energy footprint was of similar importance for both groups. They discussed the possibility to pool trips to stores, especially in rural areas:

"*In this village live (…) probably fifty people and they all drive to the market one by one. It would be economi-*

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cally beneficial if only one van would do the trip, right?" (Hannah, YP)

Product range and service availability. Product variety, niche products, and local shopping options were discussed. The BA and YP groups showed very different perceptions of OGS and stationary retailing, providing insights into the different levels of consumer knowledge:

"*The online store has a way larger assortment range.*" (Jonas, YP)

"T*he spectrum of products you have in a shop, (…) you just do not have that online.*" (Elisabeth, BA)

All groups agreed on the easier availability of niche products via OGS, such as "*special Whiskey for a tasting*" (Wolfgang, BA), and innovative concepts within these niche segments, such as "sustainable meat from an innovative company" (Peter, BA). The F focus group was affected by availability in a slightly different way. The group found that the high supermarket density restricted the relative advantageousness of OGS: "*It is just easier for me to go to the store than to start up my laptop*" (Anna, F); "*I cross like ten grocery stores on my way home from work*" (Mia, F). The YP and BA groups highlighted the relevance of OGS for rural areas with weaker infrastructure; however, Ida, BA, criticized the weak market coverage: "*Especially because all the markets that offer this service [OGS] are not close to me so they do not deliver to me.*"

Impulsiveness. All participants perceived OGS as a particularly structured and planned approach toward grocery shopping that reduced impulsive buying and helped consumers educate themselves about the product range:

"*When I buy groceries online, I check my storage as I order. (…) With stationary grocery shopping, I always end up buying 15 items I did not need but forgetting about the five I did need.*" (Hannah, YP)

"*(…) that I just browse through the assortment a little bit more aware and able to inform myself and compare products.*" (Hannah, YP)
However, this decrease in impulsive buying was not necessarily seen as desirable. Both YP and F groups argued that, with OGS, the potential for "*spontaneous*" (Mia, F) and "inspired" (Jonas, YP) shopping would decrease. Jonas, YP argued: "*I always go to the supermarket and let myself get inspired with the products they offer.*"

4.2 Control Beliefs

We identified two distinct beliefs regarding individual control over the service usage:

1) Confidence in service and product quality;
2) Transparency and flexibility.

Confidence in Service and Product Quality. In three focus group sessions, product and service quality were the most likely determinants of OGS service usage. The F group held higher quality expectations toward OGS: "*I am way pickier when I ordered online compared to when I bought the products myself (Mia, F).*" Both the BA and YP groups were convinced that online grocers delivered equal or even higher product quality than in-store to avoid dissatisfied customers. BA and YP groups allocated similar importance to the haptic inspection of groceries before the purchase. Another largely discussed topic within F and YP groups was the return of mistakenly delivered or damaged products and the associated effort. Participants expressed their need for adequate online customer service, at least similar to the service offered by physical shops. OGS retailers' product replacement policies elicited mixed feelings:

"*When they did not have the beer I ordered, they sent a similar one that I ended up enjoying just as much.*" (Jonas, YP)

"*I would just prefer them to credit my money instead of an alternative product that I might not like.*" (Emma, YP)

All groups agreed that online grocery retailers had superior knowledge and means for ensuring cooling with the distribution chain, even under unusual conditions such as "*midsummer time*" (Emily, F).
All three focus groups agreed on the importance of choosing short time windows for the delivery to en-

[1] If the originally requested item is not in stock, OGS retailers occasionally replace the item with a more or less similar alternative.

sure flexibility. "*That would be stressful for me – if I had to commit to being home from 9 to 5 like with a craftsman. I do not like committing to such long-time frames.*" (Hannah, YP). Amelie, F highlighted the impact of having kids: "*It has to be there on time. There is no point in saying they will deliver at seven, I have three kids, and they are all hungry (…). If the food then arrives at nine, I still need to cook.*" All groups agreed that the order reliability needed to be assured. In terms of product quality, the groups differentiated between perishable and non-perishables. For perishables, the YP and F groups argued that the online goods were not as fresh as in offline stores. They did not trust the retailer with choosing the "*right*" (Ben, YP) goods. These factors were not considered essential for non-perishables; however, general scepticism toward the product quality remained. The YP group argued that wrong expectations on the product quality could be the result of euphemistic product presentation on the website. "*I like to see the goods before I buy (…)*" stated Hannah, YP, highlighting the need for haptic validation before the purchase. All groups agreed that packaging material should only be used to provide a stable cool chain and preserve the integrity of the goods:

"*Just for tomatoes (…), you need special packing materials to ensure that you actually receive tomatoes - not passata.*" (Jonas, YP)

Transparency and flexibility. The flexibility issue was not distinguishable by further sub-themes. All focus groups felt constrained by a long delivery time and the necessary planning attached to OGS purchases:

"*Personally, I feel limited if I know that the grocery delivery is coming, and I cannot do anything else for that time frame.*" (Anna, F)

"*When I order groceries online, I am kind of stuck with eating them, but what if I do not fancy noodles two days after the delivery?*" (Jonas, YP)

The BA focus group was least concerned about availability in general but criticized the earlier closing hours at local and rural stores, a problem that OGS could potentially solve: "The bakery in my village closes at 12, so it is just hard luck" (Ida, BA). At the same time, the BA group showed the most significant knowledge gaps regarding the delivery timing options.

4.3 Normative Beliefs

Regarding normative beliefs held in the focus groups, we identified one main belief: Referral and information exchange. All groups highlighted two main peer groups involved in the OGS usage decision process: household members were named as the primary group and family, friends, and colleagues as secondary information sources. The YP group expressed their willingness to refer OGS services to relevant peer groups, mainly elderly family members incapable of or limited in conducting their grocery shopping. "*We educated my grandparents to use it, however, ended up doing the ordering for them, but they still handle the delivery, so it is still less work overall*" (Hannah, YP). Similar beliefs were expressed by the F group. Participants in both groups were, to some degree, involved in the caretaking and grocery shopping of elderly family members. The recommendations of OGS services for elderly consumers seemed particularly relevant as they decreased the necessary effort for all involved parties.

5. Discussion

In this section, we would like to discuss our findings with regard to the proposed research questions. First, we were curious to see whether there were knowledge gaps between the target segments (RQ1). This can be confirmed given that, we found varying levels of knowledge across the groups. Knowledge gaps were found regarding the possibility to select time slots for the delivery, the price levels, product range, and availability, and the potential delivery of goods that could not be purchased via a different retailing channel (e.g., specialties). These knowledge gaps were differently distributed across the focus groups. While young participants were sceptical about the price level and "*right*" choice of products offered by the retailers, elderly consumers argued that retailers could not afford to not meet their quality expectations.

Regarding RQ2 we found similar belief structures across the target segments (see also table 3). General trust was observed toward the technology and services across all groups; however, specific preferences were found across living situations and household characteristics, as suggested by van Droogenbroeck and van Hove (2017). Elderly consumers emphasized the social interaction associated with the shopping experience, while this aspect did not play a vital role for

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the YP and F focus groups. The integration of social interactivity (e.g., via social and task-oriented chatbots) within online food delivery environments has been investigated, indicating an effect of these bots on perceived social presence and enjoyment (Cicco, Silva, & Alparone, 2021). Some researchers have proposed designs to address user behaviour in OGS using neuro-economical approaches (Benn, Webb, Chang, & Reidy, 2015). Similar studies on social interaction might explain actual behaviours within OGS shops, allowing retailers to tailor their service offering toward different consumer demands. While OGS was perceived to be reducing impulsive buying patterns in this study, Munson, Tiropanis, and Lowe (2017) found that most items in OGS baskets resulted from "*disruptive activities*" such as using the search bar or interacting with the retailers' promotional content. This study's findings mostly confirm earlier research by Ramus and Nielsen (2005), as we found strong support for both security and social interaction beliefs.

In RQ3 we questioned which individual circumstances on a household level would affect benefit perception. We found that those younger consumers while living in the city, and therefore having higher accessibility to the service, may not be inclined to use the service due to higher costs. Elder consumers report low accessibility as a result of their rural living circumstances. Participants in family set-ups were inclined to use the service, however, due to regular commuting they had a number of options to use stationary shopping. We also replicated previous findings on the crucial importance of situational factors (Hand et al., 2009) as all groups emphasised usage during difficult circumstances (such as illness, etc.).

Many of the considered success factors in this study were strongly affected by the COVID-19 pandemic, that increased demand for OGS services on a global scale. With long queues in front of supermarkets due to customer traffic limitations and impulsive

Table 2. Beliefs across consumer segments.

	YP	F	BA
Outcome Beliefs			
Convenience and Ease of Life	✓	✓	✓
Shopping Experience and Enjoyment	✓	✓	✓
Pricing and Cost	✓		
Social Responsibility and Sustainability	✓		✓
Product Range and Service Availability	✓	✓	✓
Impulsiveness	✓	✓	
Control Beliefs			
Confidence in Service and Product Quality	✓	✓	✓
Transparency and Flexibility	✓	✓	
Normative Beliefs			
Referral and information exchange	✓	✓	

Notes:

YP = Young Professionals, F = Family Situation, BA = Best Ager.

stockpiling behaviour in the early stages of the pandemic, OGS services in Germany were fully booked for weeks ahead. These developments highlight the necessity of local food structures, particularly in rural areas. The Dutch company Picnic successfully operates such a "milkman" principle in some areas in North Rhine-Westphalia. Dannenberg et al. (2020) doubt that the COVID-19 pandemic fundamentally transitioned food retail in Germany, despite opening a "window of opportunity".

5.1 Theoretical Implications

As mentioned above, this study confirmed earlier findings that applied qualitative in-depth data analysis to OGS usage adoption and motivation (Hand et al., 2009; Ramus & Nielsen, 2005) for a sample of German consumers. We were able to replicate a similar belief structure as in the Ramus and Nielsen (2005) study with regard to the overall TPB structure. Qualitative data analysis might further contribute to this research area, adopting cross-cultural and ethnographic approaches (Elms et al., 2016). Further quantitative and qualitative research in this area is required. The presented findings should also be enriched with changes in consumer perception and behaviour due to the pandemic.

5.2 Practical Implications

Online grocery retailing should focus on increasing transparency, especially in the delivery process and the choices of products. While most retailers offer the possibility to limit the delivery time frame, it is unclear why live tracking options are not enabled in OGS services, as this would drastically increase transparency and scheduling abilities for consumers. Similar systems operate at online food ordering services (such as Lieferando). This study confirmed the findings by Ramus and Nielsen (2005) in terms of the social interaction of OGS; however, this aspect was mainly stressed by elderly consumers. Therefore, we recommend using customer feedback and evaluation options and potentially integrating social media pages to allow consumers to engage in social interaction online. Other online communities may help facilitate necessary infrastructure and/or inspiration.
This aspect highlights the importance of connected databases across platforms and may be of particular interest for pure online players, as they already possess the necessary digital infrastructure. Retailers should leverage the general appreciation toward OGS service offerings by precisely informing consumers about these offerings and filling the existing knowledge gaps. While the influence of situational factors remains crucial, this aspect can be addressed by advertising and marketing strategies, as well as concepts aimed at improving rural delivery coverage. In the light of demographic changes and sudden surges in demand (as illustrated in the light of the COVID-19 pandemic), this aspect is of importance and future relevance for the adoption of OGS in Germany.

5.3 Limitations and Future Research Recommendations

We conducted three focus group discussions to evaluate the opinions and reasoning behind the behaviours of consumers in the German eGrocery market. The main limitations of this study lie in its small sample size and geographical restrictions. Since OGS is not as accessible in rural areas or small cities as in large cities, our focus group assessments may be biased. Furthermore, this study is limited due to its relatively low overall return rate of the considered participants. As the COVID-19 pandemic marks a potential shift in OGS perception that may also affect our findings, as data was collected prior to the pandemic. However, it appears that many of the stated benefits may very well have increased in importance as a result of shopping restrictions and overall higher caution when going out for grocery shopping.

To understand possible cultural differences between consumers, we recommend international focus groups and quantitative validation to address this large usage disparity. Research on OGS usage adoption should also include measuring perception at the individual level. Previous studies have already addressed this topic by investigating the influence of consumer values (Hansen, 2008), personality traits (Piroth, Ritter, & Rueger-Muck, 2020), and neuro-economic applications on OGS (Benn et al., 2015). Combining different approaches may help deepen the current understanding of the various determinants of OGS behaviours.

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A new study reveals an unpleasant correlation between pesticides and cancer

Researchers at the University of Idaho and Northern Arizona University have found a correlation between agricultural pesticides and cancer in western states. Two studies were conducted, one that examined correlating data in 11 Western states and one that took a closer look at data in Idaho specifically.

The results revealed a potential relationship between agricultural pesticides, particularly fumigants such as metam, and cancer incidences. The study analysed data about pesticides that was pulled from the U.S. Geological Survey Pesticide National Synthesis Project database, while the cancer data was gathered from National Cancer Institute State Cancer Profiles, according to the study.

Although many studies examined correlations between socioeconomic factors, like poverty and cancer incidents, this study goes further by looking for an initiating factor. In this case, the data suggested a higher usage of fumigants like metam is correlated with higher cancer incidence rates.

The next steps for this study is to expand the data research to a nationwide scale and further examine whether there is a cause behind the correlation between pesticides and cancer. While neither UI nor NAU have the laboratory capabilities to prove or disprove the correlation, the researchers hope to eventually find a lab to collaborate with and get funding to continue the research.

The news were retrieved from:

https://sustainablepulse.com/2022/07/11/university-of-idaho-researchers-find-correlation-between-pesticides-and-cancer/?utm_source=newsletter&utm_medium=email&utm_campaign=glyphosate_gmos_and_pesticides_weekly_global_news_bulletin&utm_term=2022-07-17#.YtUgCXZBw2x

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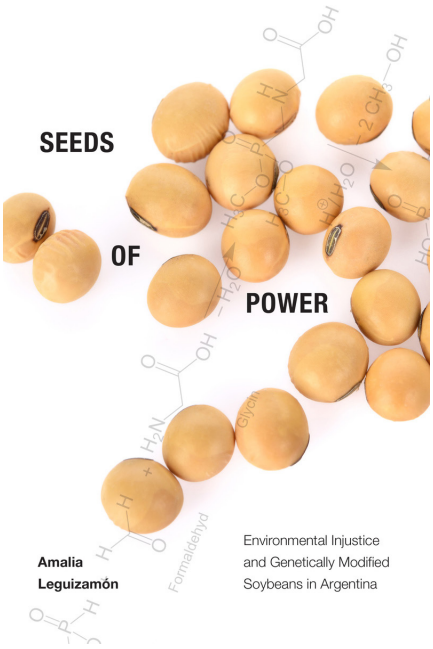
UniKassel & VDW, Germany-July 2022

Seeds of Power: a new book handles the adopted Genetically Modified Soybeans in Argentina



In 1996, Genetically modified (GM) soy was introduced into Argentina in order to produce crop that tolerates being sprayed with herbicides. Now the genetically modified crop covers half of the country's arable land and represent a third of its total exports.

Alongside the modernization and economic grow the new adoption provided, there was tremendous social and ecological harm, such as rural displacement, concentration of landownership, food insecurity, deforestation, violence, and the negative health effects of toxic agrochemical exposure.
In this new book, Seeds of Power, Amalia Leguizamón gives more insights into why Argentines still strongly support GM soy despite the widespread damage it creates. She reveals how agribusiness, the state, and their allies in the media and sciences deploy narratives of economic redistribution, scientific expertise, and national identity to elicit compliance among th
e country's most vulnerable rural residents.

Moreover, the book explores how the GM soy is being used as a tool of power to obtain consent, legitimate injustice, and quell potential dissent in the face of environmental and social violence.

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The 8th International Slow Food Congress marks the beginning a new era

Meet Edward Mukiibi , a young Ugandan farmer, social entrepreneur and the new president of Slow Food.

https://www.slowfood.com/

On July 16, 2022, Slow Food hosted its 8th International Congress in Pollenzo, Italy.
This date represents a milestone for the organization as it marks a new phase of change and regeneration. For our organization, founded 30 years ago, was led Carlo Petrini and today it gets a historic turning point as Edward Mukiibi , a young Ugandan farmer and social entrepreneur, will take over to be the new president of Slow Food.

The international delegates today elected a new international board that will best address the environmental, climatic, political and social challenges that affect our movement, which is active in 160 countries.

"The role of our food system in the unfolding environmental disaster is increasingly clear. Our movement, which has been working for over 30 years to revolutionize that food system, must have the courage to take a leading political role in the fight to ensure a change of course and avoid catastrophe," said Carlo Petrini. "And for that we need a new governance led by the next generation. We must show our ability to combine innovation and tradition, and an awareness that the path that we have taken so far has delivered once seemingly-unattainable achievements, allowing us to grow into the movement we are today. However, the world is profoundly different now, compared to the way things were when our movement began. There's a need for the direction, creativity and intuition of a new team capable of interpreting our present situation, outlining a trajectory and achieving our future goals, which at their core, remain the same: to guarantee good, clean and fair food for all."

At the heart of these new perspectives is the new leadership of Slow Food by **Edward Mukiibi.** As a young African farmer, his journey began exactly in 1986, when the famous protest against the opening

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of a McDonald's branch in Rome also launched the Slow Food movement.
The roots of Edward Mukiibi's professional career lie in a family-run farm in a small African village, where he was a pupil of the Kisoga Trading Center in the Mukono district of Uganda. Today, he is helping to shape the future of regenerative agricultural crops and is making history with his role as President of Slow Food.

"Even the small activities and actions of our communities give concrete cause for hope and show positive effects on our lives, because we are like one big family as far as one of us is concerned, it also affects everyone else, regardless of geographical, social and cultural differences. As an organization, Slow Food needs to be aware that even small, local activities can have a big impact on other corners of the world," **Mukiibi** said. "As a results-oriented movement that evolves itself and at the same time contributes to the regeneration of the whole planet, now is the right time to refresh, strengthen and renew our efforts as a movement. With the aim of creating a world, we all need in terms of nutrition and the environment. I personally call for as many young activists as possible to become part of the Slow Food movement, which cares as much about getting the earth back on track as it is for them."

Tropical agronomist Edward Mukiibi is an educator in food and agriculture with a bachelor's degree in agriculture and land use management from Makerere University in Kampala-Uganda. He holds a Master's degree in Gastronomy from the University of Gastronomic Sciences in Pollenzo, Italy. Mukiibi is a social entrepreneur and, as of this month, he is officially the president of the large Slow Food community.
Edward Mukiibi has been awarded many awards for his selfless contribution to a sustainable, fair and just food system. He has received awards, including Dillard University's Ray Charles Black Hand in the Pot Sustainability Award and a Detroit City Council honor. Recently, Edward Mukiibi was listed in the Educators category at the 50 Next Awards for young people under the age of 35 who are helping to shape the future of gastronomy.
In addition to the presidency, the new international board of Slow Food, the organization's highest decision-making body, was also appointed. The composition reflects the diversity of the movement.
In the course of the congress, the newly elected members explain their understanding of the leadership of Slow Food:

Marta Messa, new Secretary General:
Marta Messa (Italy), new Secretary-General
"From my more than 10 years serving Slow Food, I have learned a lot about the unique aspects of our movement: We've seen this shining so far, including during the pandemic. As a group we want to make the most of the movement's strengths, with an awareness of its imperfections and what we need to improve. As we celebrate the remarkable accomplishments of Carlo's legacy work and welcome Mukiibi's new leadership, we are also growing, just like any other organization. Our goal is to keep fighting for the right of every single individual to good, clean and fair food, to elevate the incredible wealth of knowledge of grassroots communities and to facilitate the uptake of sustainable food systems the world over."

Richard McCarthy (USA)
"How can we engage people in everyday life? The development of thematic networks has proven to be a strategic asset for the Slow Food movement, deeply engaging a relevant diversity of targets able to impact food systems by catalyzing the processes of change through mutual exchange and collaboration on issues deeply linked with their daily lives and interests, as well as mobilizing specific new resources. I believe that thematic networks also offer an opportunity to test new experiences for aggre-

gation within Slow Food."

Dali Nolasco Cruz (Mexico)
"Indigenous peoples are examples of resilience and defense of life on Earth, repositories of ancestral knowledge. Indigenous women and youth around the world struggle for the recognition of their role as guardians of food systems, land and biodiversity. The regeneration of Slow Food is an opportunity to continue to build from the collective and for it to position itself as the best and most recognized organization in food issues."

Jorrit Kiewik (Netherlands)
"I was born just short of 20 years after the Club of Rome published its "Limits to Growth." I grew up in the middle of a climate disaster. In the past 30 years I've experienced first hand how the loss of biodiversity has a terrible impact on our planet. My generation and the generations to come are suffering from the lack of action in the past 50 years. I believe that Slow Food has the key to reversing these challenges. I believe that our movement, uniting producers and consumers, and everyone in between, can change our world for the better. I am honored to take this role and can't wait to start working with the global network of grassroots activists, making a change for the better. Changing the food system, one step at a time."

Megumi Watanabe (Japan)
"I would like to remember the focus on joyfulness which is the core identity of Slow Food. We need to regenerate relationships between ourselves within the movement, as well as with the outer world, so we can truly become a collective voice. We should keep reminding ourselves that this movement is for all humankind, therefore we need to make an effort to go beyond boundaries, to get out of our comfort zone."

Francesco Sottile (Italy)
"If biodiversity has been our goal for 30 years, today a regeneration effort must also address our approach to biodiversity itself. We have said many right things in the past, we have supported an international network capable of demonstrating how much biodiversity there is around the planet and how much we are losing and will lose if we do not find the key to conservation through rural communities. Today we must support an ecological transition, mitigate climate change and regenerate resources and rural areas by fighting poverty and restoring food sovereignty to rural communities. We must make every effort for biodiversity and agroecology to be at the center of food policies, and to demonstrate that from diversity comes resilience."

Nina Wolff (Germany)
"The world needs guidance in order to slow down, and this reinforces our responsibility to make the Slow Food message shine; in view of the current crises and human rights violations, the political focus of our work must grow. Advocacy can be a tool for realizing our heartfelt hunger for food justice. It's a necessity for Slow Food in the global north to make the effects of our food systems on the global south understood. This international board is a great team of reliable and dedicated individuals ready to serve the movement."

"Cohesion as a network and global food movement is crucial to making a lasting impact on our food system, which has become a burden on our planet," said Edward Mukiibi as he prepared for his first Terra Madre event as Slow Food President." Terra Madre 2022 and the hashtag #REGENERACTION symbolize a moment of renewal and opening up for the global Slow Food network," Mukiibi continued.

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Terra Madre Salone del Gusto, the largest international event around food policy, sustainable agriculture and the environment, takes place every two years and will be held this year in a hybrid format where participants from around the world can participate both physically and digitally in the organization's upcoming #REGENERACTION campaign.

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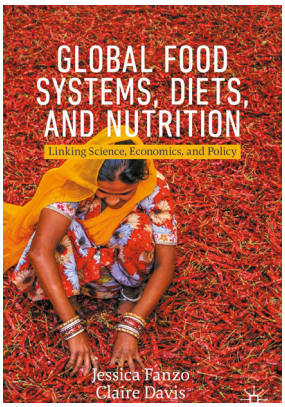

Global Food Systems, Diets, and Nutrition; Linking Science, Economics, and Policy

A review by Nayram Ama Doe

Authors (Eds.): Jessica Fanzo and Claire Davis
Publisher: Springer Nature Switzerland AG
Published year: 2021
Language: English
ISBN: 978-3-030-72763-5
Length: 224 pages

Food is a basic need of significant value for various reasons. Aside from the primary need for basic survival, it is also significant for the health and nourishment of individuals, growth of economies through the food supply chain, peace and success of a nation and existing cultures and traditions. However, food systems describe every process involved with food, from production to consumption. The functionality of these food systems depends on government and policies, relationships between countries, and global trends. This thrilling book discusses various topics such as food systems, nutrition, healthy diets and their contribution to human health, food policy and governance, the effect of food policy on diets and nutrition and finally, challenges to achieving healthy diets for nutrition. It also poses question such as who influence food policy and governance and who influences food systems.

This book is introduced by showing the importance of the food system, depicting how every individual engages daily with the food system through making choices that influence them in various ways. However, a constantly growing human population, the environmental degradation, the changes in diets, and climate change threaten food security due to the pressures placed on the food systems. Therefore, creating, investing, and implementing effective policies are crucial to strengthening sustainable food systems for advanced nutrition and diets with these restrictions and challenges.

Chapter one of this book highlights food and its significant role in society. Food as a necessity limits people to various dietary choices. These dietary choices describe an individual's identity, aspirations and habits. However, food choices are guided by beliefs, values, desires, preferences and the relationships people have with the food origin. Food has many societal roles, such as nourishing and growing the economy, tradition representation, and cultural preservation through eating practices and gastronomic knowledge.

Chapter two explains the concept of food policy and governance. It emphasises the effect of food policies on food system operations and the decision-making process by manufacturers, customers and other investors. Food policies are strategies that influence organisations, establishments, governmental and private institutions, and stakeholders working in food systems. These policies act as a guide for decision-making processes to ensure accountability. On the other hand, food governance encompasses establishing and implementing food policies by actors such as NGOs, producers, governments, consumers and business institutions. In recent times, food policies have changed to mirror evolving global trends. Because of this, activists such as civil society groups and consumers vouch for an all-inclusive food policy incorporating policies from different sectors and areas essential for the food system.

Chapter three of this book focuses on diet concepts and the impact of diet on human health. Various factors affect the diets of individuals. For instance, individuals who consume healthy diets meet their nutritional needs and are overall healthy. Diets comprise nutritious or less nutritious foods that make humans healthy or unhealthy when consumed. Nutritious foods include fruits and vegetables, nuts and seeds, whole grains, fish and seafood, dairy and dairy products, and legumes and beans.

On the other hand, less nutritious foods include junk foods and highly processed and packaged foods such as sausages, hot dogs, bacon, ham, chips, crackers, breakfast cereals, instant noodles and pastries. In conclusion, less nutritious

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and unhealthy diets are the leading causes of cardiovascular diseases and deaths.

The concluding chapter describes the influence of policies on diet, nutrition, and the overall flood supply chain. Food policies outline the kind of foods to be produced and the movement along the supply chain at local, regional, and global levels. The supply chain encompasses all processes and activities involved in food movement from farm to fork. Various players and actors are responsible for creating, implementing, and executing these policies. An efficient and operative food supply chain supplies adequate nutritious and safe food for people locally, regionally, and all over the world.

Overall, this book was informative and educative as it discusses and enlightens readers on the global food system, diets and nutrition. In addition, it discusses the concept of food policy and governance, various diet concepts and the impact on human health and, finally, how food policies affect nutrition and health.

About the author:

Nayram Ama Doe is a master's student at the University of Kassel and Fulda University of Applied Sciences, Germany, studying International Food Business and Consumer Studies. Her research focuses on food sustainability, international food legislation, agriculture, and food systems, and she is very passionate about food security and food supply chain issues.

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