VOLUME 8 NUMBER 3
SOMMER 2020

FOFJ

ISSN-INTERNET: 2197-411X
OCLC-NR.:862804632

THE FUTURE OF FOOD JOURNAL

JOURNAL ON FOOD, AGRICULTURE & SOCIETY

Publisher

VDW VEREINIGUNG DEUTSCHER WISSENSCHAFTLER

UNIKASSEL VERSITÄT | ORGANIC AGRICULTURAL SCIENCES

SFS Sustainable Food Systems & Food Sovereignty

Future of Food: Journal on Food, Agriculture and Society

Volume 8, Number 3
November 2020

Published 10 November 2020

Specialized Partnerships in Sustainable Food Systems and Food Sovereignty, Faculty of Organic Agricultural Sciences, the University of Kassel, Germany and the Federation of German Scientists (VDW)

ISSN Internet	**2197 411X**
OCLC Number	**862804632**
ZDB ID	**27354544**

open access

Address
Future of Food: Journal on Food, Agriculture and Society
Specialized Partnerships in Sustainable Food Systems and Food Sovereignty,
Faculty of Organic Agricultural Sciences,
University of Kassel,
Nordbahnhofstrasse 1a,
D- 37213 Witzenhausen,
Germany.

Telephone: + 49 5542 98 -1621
Fax: + 49 5542 98 -1604

Email: *editorialboard@fofj.org*

Official web page of the journal
www.thefutureoffoodjournal.com

Social Media of the journal
www.facebook.com/futureoffoodjournal

Table of Contents

Editorial

Microalgae as an alternative to improve nutrition

by Bárbara Franco Lucas 5-6

Research Articles

Children's dietary habit in food insecure area Madura island Indonesia
by Rian Diana, Annis Catur Adi, Dini Ririn Andrias 7-15

Food suggestions, meal frequency, and dietary diversity among pregnant women: a quantitative study in Madura
by Rian Diana, Dyan Fajar Chistianti, Faisal Anwar, Rendra Kusuma, Riris Dianarachmayanti, Ali Khomsan 16-27

Farmers' supply response and perception of riceprocurement program in Bangladesh
by Mst. Mili Khatun, Sourav Mohan Saha, Md. Akhtaruzzaman Khan and Md. Emran Hossain 28-39

Food traceability system awareness and agriculturaloperation: A Study of tea farms in Fujian, China
by Meiying Chen, Wenguang Zhang, Yi Zheng And Ji Lu 40-51

Evaluation of antioxidant activity and the phenoliccomposition of Syrian Arbutus andrachne L.
by Diana Hmaidosh, Mahmoud Ali, Rim Salame 52-58

News in shorts

The European Commission has today launched a public consultation on its future Action Plan on Organic Farming. 59

Have your say…… 60

BioFach 2021 61

TP Organics: Green Deal Call being published 62

Reviews

Routledge Handbook of Food Waste
by Yasmeen Ismael 63-64

ISSN-Internet 2197-411x OLCL 862804632

Special Issue on Sustainable Agriculture & Food Systems (Vol. 9, Number 1 2021) 65

Call for Papers: The multidimensional impacts of COVID 19 on the food systems 66

Call for Reviewers 67

Thank You Reviewers 68-69

Front Cover page -

- Designed by Rami Al Sidawi

Back Cover page - Photo Credits

- Thanachart Chuengyaempin : https://flic.kr/p/2isQ3b2
- cdr122300: https://flic.kr/p/xmzM9y
- Trong Khiem Nguyen: https://flic.kr/p/tJUAx1
- Hieng Ling Tie: https://flic.kr/p/eac6Un

ISSN-Internet 2197-411x OLCL 862804632

UniKassel & VDW, Germany-November 2020

Editorial

Microalgae as an alternative to improve nutrition

Bárbara Franco Lucas is a researcher in the Laboratory of Biochemical Engineering at the Federal University of Rio Grande, Brazil. She has experience as a food scientist in Brazil and Switzerland. She is a reviewer for several journals, including The Future of Food: Journal on Food, Agriculture and Society.

Nowadays, it is well known that by 2050 the number of inhabitants on the planet is expected to achieve almost 10 billion people. Based on this challenge, it is estimated that food production will have to increase by 70% (FAO, 2009). This information brings us to some questions: Will there be enough food for everyone? If yes, will those food have in their composition an adequate amount of nutrients?

Diets poor in nutrients such as vitamins and minerals contribute to increases in diseases (WHO, 2014). Thus, researchers have been focused on developing strategies to feed the rising population with an adequate amount and quality of nutrients, associated with sustainable food production and mitigations of CO2 emission. Among the alternatives, there is the production of cultured meat and upcycled foods. Furthermore, the use of underutilized leguminous, use of by-products from food processing, and the use of microalgae as food or food ingredient are also interesting strategies to feed the increasing population.

Microalgae as Spirulina and Chlorella have been explored and consumed for decades. The Food and Drug Administration recognizes these microalgae as GRAS (Generally Recognized as Safe) and nowadays its use is already established among consumers interested in healthier food. Microalgae do not need arable land for its cultivation; therefore, it does not compete with other food crops. Besides, its cultivation requires less water compared with some traditional foods.

Spirulina, for example, is capable of accumulating proteins (around 60%), healthy lipids, carbohydrates, minerals, and substances of high nutritional value such as carotenoids, phycocyanin, and phenolic compounds from the efficient use of solar energy and CO2. Its capability of biofixation of CO2 considers its cultivation a sustainable process. Spirulina has a high concentration of digestible protein, containing all essential amino acids, in addition to polyunsatu-

ISSN-Internet 2197-411x OLCL 862804632

rated fatty acids (PUFAs) such as docosahexaenoic (DHA) and eicosapentaenoic (EPA). The phenolic compounds and pigments present in this microalgae showed beneficial effects on oxidative processes that occur in the human body. The characteristics mentioned above make Spirulina an important raw material when aiming to supply healthy foods for the increasing world population. Another advantage is that microalgae biomass can be dried and transformed into a powder that can be conserved during long periods, an advantage when aiming to transport for long distances.

Among the interesting products already developed with microalgae aiming to improve the nutrition of consumers are cereal nutrition bars for schoolchildren, shakes for the elderly, and snacks extrudates. Moreover, pasta, cookies, and yoghurt have been nutritionally enriched with different microalgae. Recently, large food companies are establishing partnerships to use microalgae as ingredients in food.

Based on the presented, we need to focus on sustainable strategies to feed the population with health foods. Microalgae show a strong potential to serve this purpose in several ways. It has a rich nutritional composition with high amounts of bioactive compounds as well as the benefit of sustainability. However, to achieve this goal, consumer's awareness toward microalgae should be increased as well as investments in microalgae production. Another important point is that once microalgae are consolidated as an alternative to improve nutrition with rising demand, it should be available with accessible cost to reach the poor and undernourished populations.

References

Food and Agriculture Organization of the United Nations – FAO, 2009. How to Feed the World in 2050. http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf

World Health Organization – WHO, 2014. Countries vow to combat malnutrition through firm policies and actions. http://www.who.int/mediacentre/news/releases/2014/icn2-nutrition/en/

ISSN-Internet 2197-411x OLCL 862804632

Research Paper

Future of Food: Journal on Food, Agriculture and Society
8 (3) October 2020

Children's dietary habit in food insecure area Madura island Indonesia

RIAN DIANA[1]*, ANNIS CATUR ADI[1], DINI RIRIN ANDRIAS[1]

[1]Department of Nutrition, Faculty of Public Health, Universitas Airlangga

* Corresponding author: rian.diana@fkm.unair.ac.id

Data of the article

First received : 13 January 2020 | Last revision received : 12 July 2020
Accepted : 05 October 2020 | Published online : 18 October 2020
DOI:10.17170/kobra-202007201469

Keywords

Dietary habit, food habit, food-insecure area, food security

Objectives: Food insecurity and malnutrition are still a public health issue, particularly in developing countries. Household food security is a determinant factor of dietary quantity and quality. This study aims to analyse the correlation between household food security and children's dietary habit in food-insecure areas.
Methods: This cross-sectional study was conducted in Bangkalan District, Madura Island, Indonesia and included 89 households with children under five. The Food Insecurity Experience Scale (FIES) was administered to assess household food security status. The children's dietary habit was assessed using the Food Frequency Questionnaire (FFQ). Spearman's rank correlation was applied to analyse the correlation between children's dietary habits and household food security status in Madura Island, Indonesia.
Results: A high proportion of food-insecure households (71.9%) was found in this study. Children under five have low consumption of vegetables and fruits. There was no significant correlation between household food security status with children's dietary habits of staple food, and protein sources of food. There was a significant correlation between household food security status with children's dietary habits of vegetables and fruits.
Conclusion: Parents can provide food sources of carbohydrates and protein regardless of their household food security status. Nonetheless, parents need to encourage the consumption of vegetables and fruits for their children. Food insecure households can provide vegetables and fruits that were highly available and accessible such as water spinach, banana, and orange.

1. Introduction

Food insecurity and malnutrition are still a public health issue, particularly in developing countries such as Indonesia. Madura Island is one of the food insecure areas in Indonesia with a high poverty level and a high prevalence of stunting (Statistic Bureau of East Java, 2018). Household food security is a determinant factor of dietary quantity and quality (Agbadi et al., 2017; Kim & Oh, 2015). Studies in developing countries revealed that there was a correlation between a high poverty level and low access to nutritious food (McDonald et al., 2015). Food insecure households, particularly poor people, tend to have low dietary diversity (McDonald et al., 2015) and have lower consumption of healthy food (Araújo et al., 2018). Food availability is an important factor that influences dietary intake (Santiago-Torres et al., 2014). Low food availability in the food-insecure area can influence people's food habits. This habit is often hard to change until adulthood.

Several studies have explored the correlation between

household food security and children's nutritional status (Kandeepan et al., 2016; Mulu & Mengistie, 2017; Unisa et al., 2016). Nonetheless, a few studies discuss the correlation of household food security with children's food habits (Agbadi et al., 2017; Tomayko et al., 2017), particularly in food-insecure areas. Therefore, this study aims to analyse the correlation between household food security and children's dietary habit in food-insecure areas. The research hypothesis was that children in food-secure households would have healthier eating habits than food insecure ones. Understanding these food habits enable people to help children in food-insecure families to improve their diets and reduce the risk of malnutrition.

2. Materials and Methods

2.1. Study Participants

This cross-sectional study was conducted in Bangkalan District, Madura Island, Indonesia, in September-November 2018. The population was households with children under five years old in Bangkalan District. The sample size was determined by a formula to estimate the proportion in the population with absolute precision (Charan & Biswas, 2013). According to a previous study, moderate food-insecure households that received subsidised rice was 6% (Adi, Diana, & Andrias, 2018), confidence interval 95%, and absolute precision 0.05. A total of 89 samples were included in this study. The sampling procedure was conducted in two stages. The first stage was the selection of sub-districts and villages with the inclusion criteria of food-insecure areas. The second stage was the selection of the household who have children under five. A total of 89 samples were selected using simple random sampling. The ethical clearance was approved by the ethical committee of Faculty of Public Health, Universitas Airlangga, Indonesia (No 530/EA/KEPK/2018).

2.2. Measurements

A structured questionnaire obtained household and children characteristics. The Food Insecurity Experience Scale (FIES) was administered to assess the household food security status (Ballard et al., 2013). There were eight FIES questions, (1) Felt anxiety about having enough food at any time during the previous 12 months; (2) Not able to eat healthy and nutritious food because of lack of money or other resources to get food; (3) Consumed a diet based on only a few kinds of foods because of lack of money or other resources to get food; (4) Did not eat breakfast, lunch or dinner [or skipped a meal] because there was not enough money or other resources to get food; (5) Ate less than they thought they should because of lack of money or other resources to get food; (6) Household ran out of food because of lack of money or other resources to get food; (7) Felt hungry but didn't eat because there was not enough money or other resources for food; and (8) Went without eating for a whole day. The children's dietary habit was assessed using the Food Frequency Questionnaire (FFQ). The questionnaire surveyed food consumed during the previous 30 days. The FFQ consisted of 19 food items, categorised into five groups. Cereals and grains (4 items), fish, poultry, and eggs (3 items), legumes (2 items), vegetables (4 items), and fruits (4 items). There were seven options of food frequency consumption: more than once/day, once/day, 4-6 times/week, 3 times/week, once-twice/week, once in 2 weeks, and never. The food consumption then reclassified into three groups: never, seldom (>1-2/weeks), and often (>3-7/weeks).

2.3. Statistical Analysis

A descriptive analysis was presented in proportion, median, and interquartile range. Food security status categorised into food secure when the household did not experience one of the eight items of FIES, mild food insecurity (experience condition 1-3), moderate food security (experience condition 4-6), and severe food insecurity (experience condition 7-8) (Ballard et al., 2013). Spearman's rank correlation was applied to analyse the correlation between children's dietary habits and household food security status.

3. Results

In general, the age of the parents was categorised as a productive age. Most of the fathers were 31-50 years old. Meanwhile, mothers were 20-40 years old. Father's age was slightly older than the mothers. On the other hand, the parents had similar education levels. Most of them had a low education level (≤9 years). More than 70% of parents graduated from elementary school, and less than 15% graduated from junior high school. The low education level was closely related to the prosperity of the people. Children's age and sex were almost equally distributed in all categories. Most

ISSN-Internet 2197-411x OLCL 862804632

of the children were 2-4 years old, which consist of 38.2% 24-36 months and 37.1% 37-48 months. Meanwhile, there were higher female children (55.1%) involved than male children (44.9%) (Table 1).

The most popular job among men was a seller (31%) and for women (21.3%). Other occupations such as labourers (29.8%) and service providers (23.8%) were also common for men. Meanwhile, a housewife occupation (68.5%) was dominant among Madurese women. Based on the number of household members, most of the families were classified as a small and medium-sized family (Table 1). The median household income was 420,000 IDR/cap/month or equal to 30 USD/cap/month (1 USD = 14,000 IDR).
Household food security status was determined by the

Table 1. Household characteristics

Characteristics	**n=89**	**%**
Father's age		
20-30 years	21	25.0
31-40 years	33	39.3
41-50 years	24	28.6
>50 years	6	7.1
Mother's age		
20-30 years	42	47.2
31-40 years	36	40.4
41-50 years	11	12.4
Father's education		
Not enrolled in school	1	1.2
Elementary school	64	76.1
Junior high school	12	14.3
High school	4	4.8
Undergraduate school	3	3.6
Mother's education		
Not enrolled in school	6	6.7
Elementary school	68	76.4
Junior high school	13	14.6
High school	2	2.2
Father's occupation		
Jobless	2	2.4
Seller	26	31.0
Employee	11	13.1
Laborer	25	29.8
Service provider	20	23.8
Mother's occupation		
Housewives	61	68.5
Seller	19	21.3
Employee	3	3.4
Laborer	4	4.5
Service provider	2	2.2
Family size		
Small(≤4 people)	35	39.3
Medium (5-6 people)	32	36.0
Big (>6 people)	22	24.7

Table 1 Cont.

Characteristics	n=89	%
Food secure	25	28.1
Mild food insecurity	40	44.9
Moderate food insecurity	20	22.5
Severe food insecurity	4	4.5
Children's age		
24-36 months	34	38.2
37-48 months	33	37.1
49-60 months	22	24.7
Sex		
Male	40	44.9
Female	49	55.1
Household income (IDR/cap/month)		
Median	420,000	
Interquartile range (IQR)	386,429	

food insecurity experience scale (FIES) survey module. About 28.1% of households were food secure. Most of the households were food insecure (71.9%) at various levels, that consisted of 44.9% mildly food insecure, 22.5% moderately food insecure, and 4.5% severely food insecure.

Children's dietary habits were collected through the FFQ questionnaire. These food habits were divided into consumption patterns of food sources of carbohydrates, protein, vitamins, and minerals. Almost all children consume rice and rice corn, regardless of their household food security status (Table 2). Rice is an Indonesian staple food; therefore, most of them consume it daily. Rice corn is also a popular staple food in Madura Island. Many households provided and consumed rice corn more than three times a week. Another popular staple food is noodles. More than half of children who had food secure status consumed noodles 1-2 times/week. Another wheat-based food source of carbohydrate was bread. Nevertheless, bread was not consumed as a staple food in Madura Island but as a snack. Therefore, a lot of children seldom or never consumed it. The present study found no significant correlation between food sources of carbohydrate consumption with food security status ($p>0.05$).

Egg and fish were popular food sources of animal protein for children under five in all households with food-secure status (Table 3). More than 60% of children often consumed eggs (>3-7 times per week). Fish and chicken were also liked and consumed by children; however, their consumption was not as frequent as eggs. Children often consumed fish in mild and severe food-insecure households. Meanwhile, chicken was seldom consumed by children, particularly among children from severe food-insecure households. There was no significant correlation between food sources of protein and household food security status. Tempeh and tofu are soy-based foods that are very popular in Indonesia and often consumed by the people. Most of the children often consumed tempeh and tofu (Table 3).

In general, the consumption of vegetables and fruits were relatively low compared to animal and plant protein. Food sources of vitamin and mineral from vegetables that were often consumed by children were spinach and carrot (Table 4). Water spinach was seldom or never consumed by most of the children in the food-secure household. Meanwhile, there was a higher proportion of children who consumed water spinach in food-insecure households ($p=0.032$; $r=0.227$). On the other hand, fruits were seldom consumed by children. Fruits that were highly available (non-seasonal) with low prices were consumed by children regardless of their household food security status. On the contrary, fruits (watermelon and apple) with higher prices were more rarely consumed by children

ISSN-Internet 2197-411x OLCL 862804632

Table 2. Percentage of children who consume food sources of carbohydrate by food security status

Food sources of carbohydrate	Food secure	Mild food insecurity	Moderate food insecurity	Severe food insecurity	p-value
Rice					
Never	1 (4)	0 (0)	0 (0)	0 (0)	0.886
Seldom (>1-2x/weeks)	1 (4)	1 (2.5)	1 (5)	1 (25)	
Often (>3-7x/weeks)	23 (92)	39 (97.5)	19 (95)	3 (75)	
Rice corn					
Never	7 (28)	8 (20)	4 (20)	1 (25)	0.728
Seldom (>1-2x/weeks)	2 (8)	5 (12,5)	3 (15)	0 (0)	
Often (>3-7x/weeks)	16 (64)	27 (67.5)	13 (65)	3 (75)	
Noodles					
Never	1 (4)	2 (5)	2 (10)	0 (0)	0.571
Seldom (>1-2x/weeks)	15 (60)	27 (67.5)	13 (65)	2 (50)	
Often (>3-7x/weeks)	9 (36)	11 (27.5)	5 (25)	2 (50)	
Bread					
Never	6 (24)	20 (50)	8 (40)	3 (75)	0.087
Seldom (>1-2x/weeks)	14 (56)	17 (42.5)	9 (45)	1 (25)	
Often (>3-7x/weeks)	5 (20)	3 (7.5)	3 (15)	0 (0)	

Table 3. Percentage of children who consume food sources of protein by food security status

Food sources of protein	Food secure	Mild food insecurity	Moderate food insecurity	Severe food insecurity	p-value
Eggs					
Never	2 (8)	2 (5)	1 (5)	0 (0)	0.946
Seldom (>1-2x/weeks)	7 (28)	6 (15)	7 (35)	1 (25)	
Often (>3-7x/weeks)	16 (64)	32 (80)	12 (60)	3 (75)	
Chicken meat					
Never	2 (8)	4 (10)	6 (30)	1 (25)	0.076
Seldom (>1-2x/weeks)	17 (68)	23 (57.5)	11 (55)	3 (75)	
Often (>3-7x/weeks)	6 (24)	13 (32.5)	3 (15)	0 (0)	
Fish					
Never	4 (16)	1 (2.5)	1 (5)	0 (0)	0.254
Seldom (>1-2x/weeks)	11 (44)	14 (35)	10 (50)	1 (25)	
Often (>3-7x/weeks)	10 (40)	25 (62.5)	9 (45)	3 (75)	
Tempeh					
Never	0 (0)	1 (2.5)	1 (5)	0 (0)	0.280
Seldom (>1-2x/weeks)	6 (24)	1 (2.5)	1 (5)	1 (25)	
Often (>3-7x/weeks)	19 (76)	38 (95)	18 (90)	3 (75)	
Tofu					
Never	2 (8)	2 (5)	0 (0)	0 (0)	0.266
Seldom (>1-2x/weeks)	3 (12)	0 (0)	0 (0)	2 (50)	
Often (>3-7x/weeks)	20 (80)	38 (95)	20 (100)	2 (50)	

in food-insecure households than food-secure households. Spearman correlation showed that there was a significant correlation between watermelon (p=0.045; r=-0.266) and apple (p=0.012; r=-0.213) consumption with household food security status. This study revealed that a lower proportion of children in food-insecure households consumed watermelon and apples.

4. Discussion

A high prevalence of food-insecure households (71.9%) and low education levels were found in this study. Madura Island, particularly Bangkalan District, is a food-insecure area. Therefore, the prevalence of food-insecure households was high. Low food availability, food access, education level, and access to water,

Table 4. Percentage of children who consume food sources of vitamin and mineral by food security status

Food sources of vitamin and mineral	Food secure	Mild food insecurity	Moderate food insecurity	Severe food insecurity	p-value
Water spinach					
Never	12 (48)	19 (47.5)	4 (20)	2 (50)	0.032
Seldom (>1-2x/weeks)	12 (48)	16 (40)	10 (50)	1 (25)	
Often (>3-7x/weeks)	1 (4)	5 (12.5)	6 (30)	1 (25)	
Spinach					
Never	5 (20)	9 (22.5)	3 (15)	1 (25)	0.292
Seldom (>1-2x/weeks)	14 (56)	16 (40)	9 (45)	1 (25)	
Often (>3-7x/weeks)	6 (24)	15 (37.5)	8 (40)	2 (50)	
Cabbage					
Never	14 (56)	26 (65)	11 (55)	2 (50)	0.907
Seldom (>1-2x/weeks)	7 (28)	12 (30)	7 (35)	2 (50)	
Often (>3-7x/weeks)	4 (16)	2 (5)	2 (10)	0 (0)	
Carrot					
Never	5 (20)	3 (7.5)	2 (10)	0 (0)	0.377
Seldom (>1-2x/weeks)	12 (48)	20 (50)	11 (55)	2 (50)	
Often (>3-7x/weeks)	8 (32)	17 (42.5)	7 (35)	2 (50)	
Orange					
Never	6 (24)	7 (17.5)	5 (25)	4 (100)	0.175
Seldom (>1-2x/weeks)	15 (60)	24 (60)	13 (65)	0 (0)	
Often (>3-7x/weeks)	4 (16)	9 (22.5)	2 (10)	0 (0)	
Banana					
Never	16 (64)	19 (47.5)	13 (65)	3 (75)	0.310
Seldom (>1-2x/weeks)	8 (32)	15 (37.5)	7 (35)	0 (0)	
Often (>3-7x/weeks)	1 (4)	6 (15)	0 (0)	1 (25)	
Watermelon					
Never	10 (40)	20 (50)	14 (70)	3 (75)	0.045
Seldom (>1-2x/weeks)	13 (52)	16 (40)	6 (30)	0 (0)	
Often (>3-7x/weeks)	2 (8)	4 (10)	0 (0)	1 (25)	
Apple					
Never	14 (56)	37 (92.5)	16 (80)	4 (100)	0.012
Seldom (>1-2x/weeks)	11 (44)	3 (7.5)	4 (20)	0 (0)	
Often (>3-7x/weeks)	0 (0)	0 (0)	0 (0)	0 (0)	

ISSN-Internet 2197-411x OLCL 862804632

especially in the dry season, cause this region to become a food-insecure area (East Java Province Food Security Bureau, 2016). A study by Mulu and Mengistie (2017) in Western Ethiopia also found a high prevalence of food-insecure households with children under five. Smith et al. (2017) found that low levels of education, weak social network, less social capital, low household income, and being unemployed were determinant factors for food insecurity.

Spearman's analysis showed that children's food consumption habits of staple foods and animal and plant protein foods were not correlated with household food security status. Rice was a staple food and the highest source of protein intake among Indonesian people (Statistic Bureau, 2016). Rice contains a high amount of carbohydrate and enough protein (approximately 77.1 g carbohydrate and 8.4 g protein per 100 g edible portion) (Ministry of Health, 2018). A national socio-economic survey in 2016, showed that the most significant proportion of protein intake was rice (Statistic Bureau, 2016). Furthermore, rice also has a good quality of protein because it has a higher amino acid score (AAS=66%) than other staple foods (wheat AAS=38%; corn AAS=41%; sorghum AAS=40%) (Juliano, 1999). Rice corn, quite popular as a staple food in Madura Island, has high fibre content (Ministry of Health, 2018). On the other hand, food-based wheat flour (noodles and bread) can be a good source of iron and folic acid because of mandatory fortification of wheat flour in Indonesian (Minister of Health, 2003; Minister of Industry and Trade, 2001).

Animal proteins that are often consumed by children were eggs and fish. Meanwhile, plant proteins consumed daily were tempeh and tofu. These sources of protein are highly available and accessible by the household in this food insecure area. Eggs and fish are loaded with high-quality protein, whereas tempeh and tofu (soybean products) contain a good source of plant protein besides rice and peanuts (Brody, 1999). These soy-based foods have an essential role in providing protein for Indonesians (Statistic Bureau, 2016). Based on the national socio-economic survey in 2016, the primary source of protein of Indonesian people was rice, fish, tempeh, and tofu (Statistic Bureau, 2016). Indonesian balance nutrition guidelines suggested that children under five should consume 3-4 portions of animal protein daily (Ministry of Health, 2014).

This study revealed that the consumption of animal- and plant-based protein were not correlated with household food security status. High availability and many options of food sources of protein with affordable prices enabled the households to choose and provide any kind of protein food source for their children. Low consumption of vegetables and fruits were found in this study. The result of this study is in line with the study from de Araujo et al. (2018) which revealed a negative effect of food insecurity with healthy food such as fruit and vegetable consumption. Food sources of vitamin and mineral from vegetables that are often consumed by children were spinach and carrot (regardless of their household food security status). Water spinach was more prevalent in food-insecure households than food-secure ones. There was a higher proportion of children who consumed water spinach in food-insecure households ($p=0.032$; $r=0.227$). Water spinach contains 17 mg vitamin C, 5542 mcg carotene, and 2.3 mg of iron. Meanwhile, spinach contains 41 mg vitamin C, 2293 mcg carotene, and 3.5 mg of iron (Ministry of Health, 2018). Although water spinach has a lower content of vitamin C and iron than spinach, due to the high availability and low price of water spinach, it can be a good alternative for vitamins and minerals for children in food-insecure households.

Fruits that were often consumed by children regardless of household food security status were banana and oranges. A lower proportion of children in food-insecure households consumed watermelon and apples. Banana and orange have an adequate amount of vitamins. Banana contains 9 mg vitamin C and 37 mcg carotenes, and orange has 49 mg vitamin C and 190 mcg carotenes. Meanwhile, watermelon contains 6 mg vitamin C, 590 mcg carotenes, and apples have 5 mg vitamin C and 90 mcg carotenes (Ministry of Health, 2018). Therefore orange and banana can be a healthy choice of fruits for the children in food-insecure households. Non-seasonal fruit such as papaya and seasonal fruits such as jack fruit, snack fruit, sugar apple or sweetsop, rose apple, mango, and other inexpensive fruits which are highly available can be an alternative to orange and banana. Knowledge about the nutrient content in various fruits can be an advantage for the household so they can provide healthy

and cheap fruits for the children.

The present study revealed no significant correlation between children's food habits (food sources of carbohydrate and protein) with household food insecurity. Meanwhile, a higher proportion of water spinach consumption and lower consumption of watermelon and apples was significantly correlated with household food insecurity. Contrary to the research hypothesis, it seems that young children are protected from hunger and have a good and healthy food habit even in food-insecure households. A review by Berti (2012) revealed that children less than six years old in Ethiopia, Nigeria, Bangladesh, China, Nepal, Philippines, Ecuador, Guatemala, and Peru have an equal intrahousehold food distribution. A study of intrahousehold food distribution in China showed that young children tend to have a higher proportion of meat, dairy products, and fruits than another age group (Luo et al., 2001). In this study, more than half of the households were mild and moderate food insecure, and only 4.4% had severe food insecurity. Therefore, these results cannot represent children's food habits in families with severe food insecurity. Additional research is needed to explore the intrahousehold consumption and children's eating habits in families with severe food insecurity.

5. Conclusion

Households with food insecurity and low consumption of vegetables and fruits among children were prevalent in this study. There was no significant correlation between household food security status with children's dietary habits of staple foods, and protein sources of food. Parents can provide food sources of carbohydrates and protein regardless of their household food security status. Nonetheless, parents need to encourage the consumption of vegetables and fruits for their children. There was a significant correlation between household food security status with children's dietary habits of vegetables and fruits. The food insecure household can provide vegetables and fruit that were highly available and accessible such as water spinach, banana, and orange.

6. Acknowledgements

This study was funded by Universitas Airlangga, No 886/UN/2018.

7. Conflict of interest

The authors declare no conflict of interest. In addition, the funder had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

8. References

Adi, A. C., Diana, R., & Andrias, D. R. (2018). Validity of Diet Quality Index-International (DQI-I) in Assessing Diet Quality in Food Insecure Area Madura. Surabaya.

Agbadi, P., Urke, H. B., & Mittelmark, M. B. (2017). Household food security and adequacy of child diet in the food insecure region north in Ghana. PLoS ONE, 12(5), 1–16. https://doi.org/10.1371/journal.pone.0177377

Araújo, M. L. de, Mendonça, R. de D., Lopes Filho, J. D., & Lopes, A. C. S. (2018). Association between food insecurity and food intake. Nutrition, 54, 54–59. https://doi.org/10.1016/j.nut.2018.02.023

Ballard, T.J., Kepple, A.W., Cafiero, C. (2013). The Food Insecurity Experience Scale: Development of a Global Standard for Monitoring Hunger Worldwide. Technical Paper. Rome, FAO., (October), 1–38.

Berti, P. R. (2012). Intrahousehold Distribution of Food: A Review of the Literature and Discussion of the Implications for Food Fortification Programs. Food and Nutrition Bulletin, 33(3_suppl2), S163–S169. https://doi.org/10.1177/15648265120333S204

Brody, T. (1999). Nutritional Biochemistry Second Edition. San Diego, California: Academic Press.

Charan, J., & Biswas, T. (2013). Review Article How to Calculate Sample Size for Different Study Designs in Medical Research ? Indian Journal of Psychological Medicine, 35(2), 121–126. https://doi.org/10.4103/0253-7176.116232

East Java Province Food Security Bureau. (2016).

ISSN-Internet 2197-411x OLCL 862804632

Food Security and Vulnerability Atlas Village Level, East Java Province 2016. East Java Province Food Security Bureau.

Juliano, B. O. (1999). Comparative nutritive value of various staple foods. Food Review International, 15(4), 399–434. https://doi.org/10.1080/87559129909541197

Kandeepan, K., Balakumar, S., & Arasaratnam, V. (2016). Nutritional Status and Food Insecurity among the Children in Northern Sri Lanka. Procedia Food Science, 6, 220–224. https://doi.org/10.1016/j.profoo.2016.02.016

Kim, H. J., & Oh, K. (2015). Household food insecurity and dietary intake in Korea: Results from the 2012 Korea National Health and Nutrition Examination Survey. Public Health Nutrition, 18(18), 3317–3325. https://doi.org/10.1017/S1368980015000725

Luo, W., Zhai, F., Jin, S., & Ge, K. (2001). Intrahousehold food distribution: A case study of eight provinces in China. Asia Pacific Journal of Clinical Nutrition, 10(s1), S19–S28. https://doi.org/10.1046/j.1440-6047.2001.0100s1S19.x

McDonald, C. M., McLean, J., Kroeun, H., Talukder, A., Lynd, L. D., & Green, T. J. (2015). Correlates of household food insecurity and low dietary diversity in rural Cambodia. Asia Pacific Journal of Clinical Nutrition, 24(4), 720–730. https://doi.org/10.6133/apjcn.2015.24.4.14

Minister of Health. Wheat Flour Fortification, Pub. L. No. No 1452/ MENKES/SK/X/2003 (2003). Indonesia.

Minister of Industry and Trade. The Compulsory Application of Indonesia National Standard/SNI to Wheat flour as Foodstuffs (SNI.01.3751-2000/Rev.1995 and its revision), Pub. L. No. No 153/MPP/KEP/5/2001 (2001). Indonesia.

Ministry of Health. (2014). Balance Nutrition Guidelines.

Ministry of Health. (2018). Indonesian Food Composition Table 2017. Jakarta, Indonesia: Ministry of Health Indonesia.

Mulu, E., & Mengistie, B. (2017). Household food insecurity and its association with nutritional status of under five children in Sekela District, Western Ethiopia: a comparative cross-sectional study. BMC Nutrition, 3(1), 35. https://doi.org/10.1186/s40795-017-0149-z

Santiago-Torres, M., Adams, A. K., Carrel, A. L., LaRowe, T. L., & Schoeller, D. A. (2014). Home Food Availability, Parental Dietary Intake, and Familial Eating Habits Influence the Diet Quality of Urban Hispanic Children. Childhood Obesity, 10(5), 408–415. https://doi.org/10.1089/chi.2014.0051

Smith, M. D., Rabbitt, M. P., & Coleman- Jensen, A. (2017). Who are the World's Food Insecure? New Evidence from the Food and Agriculture Organization's Food Insecurity Experience Scale. World Development, 93, 402–412. https://doi.org/10.1016/j.worlddev.2017.01.006

Statistic Bureau. (2016). Consumption of calorie and protein of Indonesian population and province 2016. Jakarta, Indonesia: Indonesia Statistic Bureau.
Statistic Bureau of East Java. (2018). Number and Percentage of Poor, P1, P2 and Poverty Line By Regency / Municipality, in 2017.

Tomayko, E. J., Mosso, K. L., Cronin, K. A., Carmichael, L., Kim, K., Parker, T., … Adams, A. K. (2017). Household food insecurity and dietary patterns in rural and urban American Indian families with young children. BMC Public Health, 17(1), 611. https://doi.org/10.1186/s12889-017-4498-y

Unisa, S., Chattopadhyay, A., Fulpagare, P., & Sinha, A. (2016). Food Security and Nutritional Status of Children in Maharashtra, 3(May).

Future of Food: Journal on Food, Agriculture and Society
8 (3) October 2020

Food suggestions, meal frequency, and dietary diversity among pregnant women: a quantitative study in Madura

RIAN DIANA[1*], DYAN FAJAR CHISTIANTI[2], FAISAL ANWAR[3], RENDRA KUSUMA[4], RIRIS DIANA RACHMAYANTI[5], ALI KHOMSAN[3]

[1]Department of Nutrition, Faculty of Public Health, Universitas Airlangga, Indonesia
[2]Graduate School, IPB University, Indonesia
[3]Department of Community Nutrition, Faculty of Human Ecology, IPB University, Indonesia
[4]Department of Physical and Sport Education, STKIP PGRI, Sumenep, Indonesia
[5]Department of Health Promotion and Behavioral Science, Faculty of Public Health, Universitas Airlangga

* Corresponding author: rian.diana@fkm.unair.ac.id

Data of the article

First received : 15 January 2020 | Last revision received : 13 July 2020
Accepted : 02 October 2020 | Published online : 18 October 2020
DOI:10.17170/kobra-202007201470

Keywords

Dietary diversity; dietary habit; food suggestions; meal frequency; pregnant women; recommended food

During pregnancy, the nutritional requirement increases. Therefore, many nutritious foods (diverse food groups) are suggested for pregnant women. This study aimed to explore the association between food suggestions and meal frequency with dietary diversity among pregnant women. This research was a cross-sectional study conducted in 2017 in Sumenep Regency in the Eastern Madura Island, East Java Province, Indonesia. There were 282 pregnant women involved in this study. This survey presents a quantitative study of food suggestions for pregnant women. The minimum dietary diversity for women assessed dietary diversity. A coefficient contingency was done to analyse the association between variables. Most pregnant women eat 2-3x/day. More than half of pregnant women have a food suggestion (57.4%) and reach minimum dietary diversity (56%). There was a tendency that higher meal frequency contributes to higher dietary diversity but not significantly associated (p=0.214). There was a significant association between food suggestions and dietary diversity (p=0.003). Indigenous knowledge, such as food suggestions has a beneficial effect on pregnant women's diets. Pregnant women need to follow the food suggestions so they can have a good and diverse diet.

1. Introduction

Nutritious food is widely recommended for pregnant women to improve the health of the mother and their babies. However, in communities that still adhere to customs and beliefs related to food such as Madurese in East Java, Indonesia, food taboos still exist and are avoided by pregnant women. A qualitative study by Diana et al. (2018) showed that most pregnant women did not consume taboo food because they worried it could affect maternal and infant health. Indigenous knowledge shows that many nutritious foods are suggested for expectant mothers but do not contradict the prevailing taboo food in the area. These foods are usually recommended by families or communities who believe that certain foods can increase their nutrient intake and facilitate the process of pregnancy and birth (Diana et al., 2018).

During pregnancy, the nutritional requirements in-

crease to meet physiological and metabolic demands for both mother and the fetus (Danielewicz et al., 2017; Zeng et al., 2017). In many countries, it is challenging for pregnant women to have adequate intakes of macro and micronutrient (Asayehu et al., 2017; Bailey et al., 2019; Dubois et al., 2017; Madanijah et al., 2016; Nguyen et al., 2018). Therefore pregnant women should enhance their dietary quantity and quality (Danielewicz et al., 2017). Low dietary intakes lead to malnutrition among pregnant women, namely undernutrition, chronic energy deficiency (CED) and anaemia. CED (20.7%) and anaemia (48.9%) are still public health problems in Indonesia (Ministry of Health, 2019).

Enhancing dietary quantity and quality can be achieved through the increasing meal frequency (Murakami & Livingstone, 2016; Yeneabat et al., 2019). In general, in the early stage of pregnancy, women eat less frequently than at the end stage of pregnancy. Meal frequency contributes to adequate dietary intake for pregnant women (Danielewicz et al., 2017). Mothers in the first trimester, usually having nausea or vomiting (Bustos et al., 2017); therefore, they cannot consume a significant amount of food during one meal. They eat less but more frequent meals in their first trimester (Dubois et al., 2017). Dietary diversity has been considered to become a proxy for nutrient adequacy (Rathnayake et al., 2012). Dietary diversity is determined by the socioeconomic status, meal frequency, and food access (Desta et al., 2019; Yeneabat et al., 2019).

Various forms and reasons for food suggestions exist in several countries. For example, pregnant women in Madura Island, Indonesia were encouraged to consume fruits, vegetables, and drinks (coconut water) because it is believed their consumption could help in various ways. These foods are believed to eliminate toxins, ease the delivery process, support healthy newborn babies, and clean the baby's skin (Diana et al., 2018). Similarly, animal food rich in protein was also recommended for pregnant women in other countries (Nag, 1994). Food suggestions have the potential to support nutrition education for pregnant women, particularly in a region where food taboos still exist (Diana et al., 2018).

A study about the association of meal frequency and dietary intake was done in Ethiopia by Yeneabat et al. (2019). Dietary diversity determinants and their relationship with dietary intake were revealed by Kiboi et al. (2017). However, there are no studies about the association of food suggestions, meal frequency, and dietary diversity among pregnant women, particularly in Indonesia. Therefore, this study aimed to explore the association between food suggestions and meal frequency with dietary diversity of pregnant women.

2. Methods

This research was a cross-sectional study conducted in 2017 in Sumenep Regency in the Eastern Madura Island, East Java Province, Indonesia. This article presents a quantitative study of food suggestions for pregnant women. Meanwhile, the qualitative study can be seen in another publication (Diana et al., 2018).
The population of this research was all pregnant women in four community health centres, three sub-districts, 25 villages in Sumenep Regency, Madura Island, East Java. The sample size of the pregnant women was determined by a formula sample size to estimate the proportion in the population with absolute precision (Lwanga & Lemeshow, 1991). The total population was 411 pregnant women. The minimum number of samples required was equal to 282 pregnant women. The sampling data of pregnant women were obtained from the local community health centre and village midwives. From this sampling data, a simple random sampling with proportional allocation was used to choose the selected sample according to the inclusion criteria. The inclusion criteria were pregnant women aged 18-49 years, not having a special diet, and willing to participate in this study by signing informed consent.

Data collection (pregnant women characteristics, food suggestions, and meal frequency) was done by trained enumerators and supervised by researchers. Data were collected through interviews using a structured questionnaire by trained enumerators. Dietary diversity was assessed by Minimum Dietary Diversity for Women (MDD-W) that consisted of 10 food groups (grains, white roots and tubers and plantains, pulses, nuts and seeds, dairy, meat, poultry, and fish, eggs, dark-green leafy vegetables, vitamin A-rich fruits and vegetables, other vegetables, and other fruits) (FAO and FHI 360, 2016). Coefficient contingency was done to analyse the association between variables.

This research was approved by the Health Research Ethics Committee, Faculty of Public Health, Universitas Airlangga No. 1-KEPK. The research was performed in concord with approved ethical clearance. All participants had signed informed consent before the data were collected.

3. Results

Table 1 shows that most pregnant women categorised as middle-aged. In general, the respondents were experiencing a second pregnancy, except for those who were in their third trimester (having the first pregnancies). The education level of pregnant women was quite diverse. Almost half of them (46.1%) had a basic education, and 35.1% were graduated from high school. More than half of the respondents were classified as a small family, and more than a third of pregnant women classified as a medium family. The mean of total household expenditures were IDR 545,992/cap/month or equal to $39/cap/month (1 USD = 14,000 IDR).

Table 1. Characteristics of pregnant women [n (%)]

Characteristics	1st Trimester (n=37)	2nd Trimester (n=112)	3rd Trimester (n=133)	Total (n=282)
Age (years)				
- ≤20	6 (16.2)	17 (15.2)	22 (16.5)	45 (16)
- 21-35	31 (83.8)	86 (76.8)	98 (73.7)	215 (76.2)
- 36-40	0 (0)	8 (7.1)	11 (8.3)	19 (6.7)
- >40	0 (0)	1 (0.9)	2 (1.5)	3 (1.1)
History of pregnancy				
- First	11 (29.7)	39 (34.8)	56 (42.1)	106 (37.6)
- Second	20 (54.1)	52 (46.4)	48 (36.1)	120 (42.6)
- Third	5 (13.5)	12 (10.7)	23 (17.3)	40 (14.2)
- Fourth	1 (2.7)	5 (4.5)	5 (3.8)	11 (3.9)
- Fifth	0 (0)	4 (3.6)	1 (0.8)	5 (1.8)
Education (years)				
- Basic Education (≤9)	12 (32.4)	51 (45.5)	67 (50.4)	130 (46.1)
- Middle Education (10-12)	17 (45.9)	36 (32.1)	46 (34.6)	99 (35.1)
- Higher Education (>12)	8 (21.6)	25 (22.3)	20 (15.0)	53 (18.8)
Number of family members (persons)				
- Small (≤4)	23 (62.2)	66 (58.9)	78 (58.6)	167 (59.2)
- Medium (5-7)	14 (37.8)	39 (34.8)	45 (33.8)	98 (34.8)
- Large (>7)	0 (0.0)	7 (6.3)	10 (7.5)	17 (6.0)
Expenditure (mean IDR/cap/month)				
- Food	265,708	225,137	246,794	240,674
- Non-food	314,280	279,963	324,176	305,318
- Total	579,988	505,100	570,970	545,992

ISSN-Internet 2197-411x OLCL 862804632

3.1. Meal Frequency

Dietary habits can be reflected by the daily frequency of food consumption of a pregnant woman. The higher the eating frequency of the pregnant woman, the better it is because this habit can fulfil the increasing nutritional requirement. The eating frequency among the three groups of pregnant women had the same pattern (Table 2). More than half of the pregnant women reported eating 3 times/day, one-third of them ate 2 times/day, and few others had eating frequency <2x/day or ≥ 4x/day. A low proportion of pregnant women ate more quantities and more frequently in the first trimester.

The most influential person toward the food consumption of pregnant women in the first trimester was the husband (Table 2). In the first trimester, the role of a husband in determining the respondents' food consumption was more dominant (56.8%) compared to the respondents themselves (27.0%). The husbands' influence on pregnant women's food consumption decreases as the pregnancy progresses. Among the pregnant women in the second trimester, the level of influence begins to shift from husband (39.3%) to the pregnant women themselves (38.4%). Among the pregnant women in the third trimester, the role of a husband in determining food consumption decreases further. The pregnant women were more dominant in determining their food consumption compared to others (including their husbands). The influence of mother and mother-in-law toward the consumption was less significant in the first trimester but increased steadily in the following trimesters (Table 2).

3.2. Food Suggestions

Food sources of carbohydrates, proteins, vitamins,

Table 2. Distribution of pregnant women by dietary habit [n (%)]

Dietary habit	1st Trimester (n=37)	2nd Trimester (n=112)	3rd Trimester (n=133)	Total (n=282)
Meal frequency				
- <2x/day	1 (2.7)	2 (1.8)	2 (1.5)	5 (1.8)
- 2x/day	13 (35.1)	33 (29.5)	41 (30.8)	87 (30.9)
- 3x/day	19 (51.4)	67 (59.8)	74 (55.6)	160 (56.7)
- 4x/day	3 (8.1)	8 (7.1)	14 (10.5)	25 (8.9)
- >4x/day	1 (2.7)	2 (1.8)	2 (1.5)	5 (1.8)
The difference between a pre-pregnancy and while-pregnancy dietary habit				
More amount				
- Yes	10 (27.0)	50 (44.6)	69 (51.9)	129 (45.7)
- No	27 (73.0)	62 (55.4)	64 (48.1)	153 (54.3)
More frequent				
- Yes	12 (32.4)	51 (45.5)	64 (48.1)	127 (45.0)
- No	25 (67.6)	61 (54.5)	69 (51.9)	155 (55.0)
The most influential person toward the food intake of pregnant women				
- Husband	21 (56.8)	44 (39.3)	42 (31.6)	107 (37.9)
- Themselves	10 (27)	43 (38.4)	56 (42.1)	109 (38.7)
- Mother	3 (8.1)	21 (18.8)	25 (18.8)	49 (17.4)
- Mother in law	2 (5.4)	2 (1.8)	7 (5.3)	11 (3.9)
- Others	1 (2.7)	2 (1.8)	3 (2.3)	6 (2.1)

and minerals are widely suggested by the Madurese, especially for pregnant women. More than half (57.4%) of pregnant women had food suggestions across their pregnancy. This result suggested alternative food consists of food sources of carbohydrates, proteins, vitamins, and minerals. Carbohydrates are a source of energy needed by the human body. These compounds are present in various types of foods, especially in staple foods. Some pregnant women were likely to choose corn rice (nasi jagung) or white rice or a combination of both as a source of carbohydrates daily.

The types of animal protein suggested for pregnant women (Table 3) were generally fish and sea fish including skipjack tuna, milkfish, dorang fish (black pomfret fish), tamburan fish (amoy croaker), snapper, dukduk fish (toothed ponyfish), northern red snapper, pomfret fish, mullet fish, mossot fish (Sphyraena barracuda) and also tilapia fish. Other types of animal protein were egg, liver, beef, and shrimp. Meanwhile, plant proteins that were suggested for pregnant women were tempeh and tofu. There were no significant differences in food suggested for women in their first trimester and the second or third trimester. There was a tendency that the community suggests more food for women in their third trimester than the previous ones.

Vitamins and minerals derived from vegetables and fruits need to be consumed daily by pregnant women. Vegetables that were suggested (Table 4) for the women during pregnancy in this region were moringa leaves, bean sprouts, spinach, and carrots. Not many vegetables were avoided by pregnant women. Almost all types of vegetables were suggested for pregnant women.

In general, all fruits were highly suggested for pregnant women (Table 5). Apple was the most recommended for respondents. Orange, banana, papaya, and grapes were unseasonal fruits that were also suggested for pregnant women. There was a tendency for communities to suggest more fruits for women in their third trimester than their first and second trimester.

Table 3. Suggested animal and plant protein for the pregnant women

Animal and Plant Protein	1st Trimester (n=37)	2nd Trimester (n=112)	3rd Trimester (n=133)	Total (n=282)
Fish	6 (16.2)	6 (5.4)	14 (10.5)	26 (9.2)
Sea fish	1 (2.7)	9 (8.0)	8 (6.0)	18 (6.4)
Skipjack tuna	3 (8.1)	4 (3.6)	8 (6.0)	15 (5.3)
Egg	1 (2.7)	3 (2.8)	5 (3.8)	9 (3.2)
Anchovy	0 (0.0)	0 (0.0)	6 (4.5)	6 (2.1)
Milkfish	3 (8.1)	1 (0.9)	0 (0.0)	4 (1.4)
Liver	0 (0.0)	0 (0.0)	4 (3.0)	4 (1.4)
Beef	0 (0.0)	2 (1.8)	1 (0.8)	3 (1.1)
Shrimp	1 (2.7)	1 (0.9)	1 (0.8)	3 (1.1)
Salted fish	0 (0.0)	0 (0.0)	2 (1.5)	2 (0.7)
Others	0 (0.0)	1 (0.9)	1 (0.8)	2 (0.7)
Tempeh	0 (0.0)	0 (0.0)	1 (0.8)	1 (0.4)
Tofu	0 (0.0)	0 (0.0)	1 (0.8)	1 (0.4)

ISSN-Internet 2197-411x OLCL 862804632

Table 4. Suggested vegetables for the pregnant women

Vegetables	1st Trimester (n=37)	2nd Trimester (n=112)	3rd Trimester (n=133)	Total (n=282)
All vegetables	3 (8.1)	19 (17)	16 (12)	38 (13.5)
Spinach	4 (10.8)	8 (7.1)	12 (9)	24 (8.5)
Moringa leaves	3 (8.1)	6 (5.4)	12 (9)	21 (7.4)
Water spinach	4 (10.8)	4 (3.6)	7 (5.3)	15 (5.3)
Carrot	5 (13.5)	4 (3.6)	2 (1.5)	11 (3.9)
Cassava leaves	1 (2.7)	5 (4.5)	4 (3)	10 (3.5)
Cabbage	3 (8.1)	2 (1.8)	1 (0.8)	6 (2.1)
Mung beans	0 (0)	4 (3.6)	2 (1.5)	6 (2.1)
Chinese cabbage	1 (2.7)	1 (0.9)	3 (2.3)	5 (1.8)
Long bean	1 (2.7)	1 (0.9)	1 (0.8)	3 (1.1)
Sprouts	1 (2.7)	1 (0.9)	0 (0)	2 (0.7)
Others	0 (0)	2 (1.8)	1 (0.8)	3 (1.1)

Table 5. Suggested fruits for the pregnant women

Fruits	1st Trimester (n=37)	2nd Trimester (n=112)	3rd Trimester (n=133)	Total (n=282)
Apple	9 (24.3)	19 (17)	25 (18.8)	53 (18.8)
All fruits	3 (8.1)	9 (8)	12 (9)	24 (8.5)
Orange	4 (10.8)	4 (3.6)	8 (6)	16 (5.7)
Banana	4 (10.8)	4 (3.6)	7 (5.3)	15 (5.3)
Papaya	3 (8.1)	2 (1.8)	4 (3)	9 (3.2)
Grapes	1 (2.7)	1 (0.9)	3 (2.3)	5 (1.8)
Avocado	1 (2.7)	0 (0)	2 (1.5)	3 (1.1)
Pear	0 (0)	2 (1.8)	1 (0.8)	3 (1.1)
Lime	0 (0)	1 (0.9)	1 (0.8)	2 (0.7)
Dates	0 (0)	0 (0)	2 (1.5)	2 (0.7)
Others	0 (0)	2 (1.8)	4 (3.0)	6 (2.1)

During pregnancy, there were several types of drinks suggested for pregnant women (Table 6) such as mineral water, milk, coconut water, and jamu enggu. Coconut water and milk were the most suggested drinks for pregnant women (trimester 1-3). Pregnant women in the third trimester were also suggested to consume coconut water, milk, and mineral water. In addition, some people recommended pregnant women to consume vegetable oil or coconut oil and jamu enggu (a herbal drink) to facilitate the delivery process and for healthy babies. Madurese believe that only pregnant women in their third trimester consume jamu enggu because it could trigger contractions.

Table 6. Suggested drinks for the pregnant women

Drinks	1st Trimester (n=37)	2nd Trimester (n=112)	3rd Trimester (n=133)	Total (n=282)
Coconut water	5 (13.5)	13 (11.6)	17 (12.8)	35 (12.4)
Milk	5 (13.5)	10 (8.9)	7 (5.3)	22 (7.8)
Lime juice	5 (13.5)	1 (0.9)	0 (0)	6 (2.1)
Mineral water	0 (0)	3 (2.7)	3 (2.3)	6 (2.1)
Vegetable oil and coconut oil	0 (0)	0 (0)	2 (1.5)	2 (0.7)
Jamu enggu*	0 (0)	0 (0)	1 (0.8)	1 (0.4)
Coffee	0 (0)	0 (0)	1 (0.8)	1 (0.4)

*Jamu enggu is herbal drink made from the sap of the enggu plant (Ruta angustifolia Pers.)

3.3. Dietary Diversity

MDD-W represented dietary diversity. More than half (56%) of the pregnant women had a diverse diet (Table 7). In either the first, second, or third trimester group, more than 50% of the pregnant women had consumed ≥5 food groups. There was a tendency that the higher trimester had a lower dietary diversity. Pregnant women in the third trimester had lower consumption of eggs and other vegetables compared to the first and second trimester.

There were many pregnant women (59.6%) who consumed low nutrient density food groups. The consumption of animal food such as meat, poultry, fish, and other kinds of seafood was relatively high (more than 75% of pregnant women consumed it) compared to the consumption of eggs (the number of pregnant women consuming egg was around 39.8%-51.4%). It seems that milk is the only source of animal food that was rarely consumed by pregnant women. In total, only 11.7% of pregnant women consumed milk (Table 7).

All pregnant women consumed grains, and most of them also ate pulses, particularly in the form of tempeh and tofu. One-third of pregnant women consumed nuts and seeds such as peanut in the form of peanut sauce. This peanut sauce was used in many traditional dishes (Table 7).

Low consumption of vegetables and fruits was found in this study. Half of pregnant women consumed vegetables and fruits. Dark green leafy vegetables were the most favourable for them. Meanwhile, other vegetables, other fruits, vitamin A-rich fruits and vegetables were only consumed by less than 35% pregnant women (Table 7).

3.4. Association of Meal Frequency and Food Suggestions with Dietary Diversity

Table 8 revealed that most pregnant women ate ≤3 times/day. This low meal frequency was found in both groups (diverse and non-diverse diet). Therefore, there was no significant association between meal frequency and dietary diversity of pregnant women (p=0.214). Table 8 shows that in a diverse diet group (≥5 groups), pregnant women had significantly higher food suggestions than non-diverse diet group. Therefore, pregnant women who have food suggestions had better dietary diversity (p=0.003).

4. Discussion

More than half of pregnant women had adequate dietary diversity with a mean of MDD-W score 4.8±1.4. These findings were higher than in other studies in Ethiopia (Desta et al., 2019; Yeneabat et al., 2019) but lower than Kenya (Kiboi et al., 2017). The risk of anaemia in pregnant women who consumed low dietary diversity is higher than pregnant women who have a high dietary diversity score (Delil et al., 2018). Pregnant women are recommended to consume a high diversity diet to aid in the physiological demand of the fetus and mother. Dietary diversity is important

ISSN-Internet 2197-411x OLCL 862804632

Table 7. Distribution of pregnant women by dietary diversity [n (%)]

Variable	1st Trimester (n=37)	2nd Trimester (n=112)	3rd Trimester (n=133)	Total (n=282)
Percent achieving MDD-W				
- <5 food groups	13 (35.1)	49 (43.8)	62 (46.6)	124 (44.0)
- ≥5 food groups	24 (64.9)	63 (56.3)	71 (53.4)	158 (56.0)
- Mean±SD	4.9±1.4	4.9±1.6	4.7±1.5	4.8±1.4
Low nutrient density food groups (Sweets & Sweetened drinks)	22 (59.5)	64 (57.1)	82 (61.7)	168 (59.6)
Animal Food				
- Meat, poultry, fish and other seafood	31 (83.8)	85 (75.9)	109 (82.0)	225 (79.8)
- Eggs	19 (51.4)	51 (45.5)	53 (39.8)	123 (43.6)
- Milk and dairy products	10 (27)	12 (10.7)	11 (8.3)	33 (11.7)
Plant Food				
- Grains, white roots, and tubers, and plantains	37 (100)	112 (100)	133 (100)	282 (100)
- Pulses (beans, peas, and lentils)	23 (62.2)	75 (67.0)	95 (71.4)	193 (68.4)
- Nuts and seeds	13 (35.1)	36 (32.1)	44 (33.1)	93 (33)
Vegetables and fruits				
- Dark Green Leafy Vegetables	13 (35.1)	59 (52.7)	74 (55.6)	146 (51.8)
- Vitamin A-rich fruits and vegetables	11 (29.7)	37 (33)	35 (26.3)	83 (29.4)
- Other vegetables	14 (37.8)	42 (37.5)	38 (28.6)	94 (33.3)
- Other fruits	11 (29.7)	39 (34.8)	39 (29.3)	89 (31.6)

Table 8. Association of meal frequency and food suggestions with dietary diversity

Variables	Dietary Diversity		P value
	<5 groups	≥5 groups	
Meal frequency			
≤3 times/day	114 (91.9)	138 (87.3)	0.214
>3 times/day	10 (8.1)	20 (12.7)	
Food Suggestions			
Yes	59 (47.6)	103 (65.2)	0.003
No	65 (52.4)	55 (34.8)	

ISSN-Internet 2197-411x OLCL 862804632

because it can maintain and increase appetite. Dietary diversity is further influenced by the availability of food in nature, season, livelihood, household size, and gender (Powell et al., 2017).

Grains, white roots, tubers, and plantains were consumed by 100% of pregnant women. Madurese, like other Indonesians, consume starchy staples every day. Rice or corn rice (nasi jagung) were the staple food consumed 2-3 times a day. This study revealed no significant association between meal frequency with dietary diversity (p=0.214). Nonetheless, there was a tendency that pregnant women who ate more frequently had a higher dietary diversity. A study by Yeneabat et al. (2019) stated that increasing meal frequency improves pregnant women's dietary diversity.

Most of the pregnant women consumed meat and poultry, fish, and other seafood. For animal food, fish was the most frequently consumed, which is highly recommended for consumption because it is believed to strengthen children's cognitive development. Fish are abundant at the study site because most of them lived in coastal areas. Starling et al. (2015) stated that fish intake (one or more servings of fish per week) during pregnancy was associated with positive fetal neurodevelopmental (Starling et al., 2015). Another study by Gale et al. (2008) revealed that a higher frequency of fish consumption (<1/ week, 1-2/ week, and >3/ week) during late pregnancy was associated with a higher verbal Intelligence Quotient (IQ) among nine-year-old children born to mothers who consumed fish compared to those who did not.

More than half of pregnant women consumed pulses, particularly soybean and soybean products such as tempeh and tofu. At the same time, the consumption of nuts and seeds (particularly peanuts) was only found among 33.0% of pregnant women. Tofu and tempeh are very affordable so that they are widely consumed as a side dish. Additionally, some traditional mixed dishes also use tofu as a supplementary ingredient, such as "rujak" (traditional Madurese salad). Madurese "rujak" is made of compressed rice (lontong), boiled vegetables (bean sprout, water spinach), fruits (cucumber and jicama/ yam bean), and fried tofu with peanut sauce. Soybeans contain all of the essential amino acids necessary for human nutrition. However, when consumed alone, the protein quality is still below animal protein. Soybean has limited amounts of methionine. The chemical score of soybeans (47) is only half of that of an egg (100). Soybean has a lower protein efficiency ratio, biological value, and net protein utilisation than egg and fish (Brody, 1999). Therefore, soybean consumption should be combined with other plant-based proteins to complement the amino acid and to increase the protein quality. Soybeans are often recommended as a dietary substitution for higher-fat animal products because it is a complete source of protein, and it has lower cholesterol (Michelfelder, 2009).

Pregnant women in the first trimester had a more diverse diet than the second- and the third- trimester. This finding seems to be in contrast with the dietary quantity of pregnant women. Mothers in their first trimester eat less (amount and frequency) than in the 2nd trimester. Most pregnant women in trimester one have vomiting and nausea, which cause low appetite and low intake of nutrient (Bustos et al., 2017). Nonetheless, Table 7 shows that mothers in the first trimester consume more eggs, milk, and dairy products than the second- and the third- trimester.

On the contrary, consumption of low nutrient density food, pulses, and dark green leafy vegetables was higher in trimester 2 and 3 than trimester 1. Vomiting and nausea in the first trimester cause a low intake of nutrients in pregnant women. In their third trimester, more focus is placed on labour preparation and breastfeeding. Therefore, it is suggested that pregnant women consume more milk throughout the pregnancy so that nutritional requirements can be fulfilled. Pulses and dark green leafy vegetables are food sources of folate. Folate deficiency has been associated with anaemia during the pregnancy (Kominiarek & Rajan, 2016). Besides, pulses and dark green leafy vegetables are also believed to increase the production of breastmilk. Moringa leaf is a green vegetable that is widely recommended for pregnant women in Madura and easily found around their homes.

Consumption of animal protein could help the fulfilment of protein and micronutrients. The husband's support for the fulfilment of nutrient adequacy could be a key factor to avoid the low dietary quantity and diversity in the first trimester. This result is similar to studies from Bangladesh (Nguyen et al., 2017) and

ISSN-Internet 2197-411x OLCL 862804632

Ethiopia (Desta et al., 2019) which stated that husband support is a determinant factor in dietary diversity.
In this study, more than half of pregnant women had a food suggestion from the community either in trimester 1 or trimester 2 and 3. There was a tendency that the community suggests more food for women in their third trimester than the previous ones. Tables 3-6 record that mothers in trimester 1 were more often suggested to eat fish, all kinds of vegetables (particularly spinach and moringa leaves), apple and all kinds of fruits, and milk compared to women in trimester 3. The contingency coefficient discovers that there was a significant association between food suggestions with dietary diversity (p=0.003). Pregnant women who received diet suggestions had a more diverse diet than those not having diet suggestions.

Consumption of various kinds of food should be emphasised and promoted to pregnant women. The Indonesian Dietary Guidelines also strongly recommend the importance of consuming a variety of foods needed to fulfil the nutritional needs (Ministry of Health, 2014). However, at a social level, the main problem in consuming a variety of food is the lack of purchasing power and availability of such variety in the market (Desta et al., 2019; Yeneabat et al., 2019).

5. Conclusion

Pregnant women need to follow food suggestions so they can have a proper and diverse diet. Indigenous knowledge, such as food suggestions from the community be it from family, relatives, elders, or health officers has a beneficial effect on a pregnant woman's diet. The husband could be a key person in increasing the food consumption of pregnant women in the first trimester. Women in the third trimester should increase animal protein and decrease the consumption of low nutrient density.

6. Acknowledgement

The authors would like to thank The Neys-van Hoogstraten Foundation, The Netherlands for funding this research under Grant IN282.

7. Conflict of Interest

The authors declare that there was no conflict of interest. The funders had no role in the study design, the collection, analyses, and interpretation of data, the writing of the manuscript, or the decision to publish the results.

8. References

Asayehu, T. T., Lachat, C., Henauw, S. De, & Gebreyesus, S. H. (2017). Dietary behaviour, food and nutrient intake of women do not change during pregnancy in Southern Ethiopia. Maternal and Child Nutrition, 13(2), 1–10. https://doi.org/10.1111/mcn.12343

Bailey, R. L., Pac, S. G., Fulgoni, V. L., Reidy, K. C., & Catalano, P. M. (2019). Estimation of Total Usual Dietary Intakes of Pregnant Women in the United States. JAMA Network Open, 2(6). https://doi.org/10.1001/jamanetworkopen.2019.5967

Brody, T. (1999). Nutritional Biochemistry Second Edition. San Diego, California: Academic Press.

Bustos, M., Venkataramanan, R., Caritis, S., Pittsburgh, T. S., Sciences, R., Womens, M., & Sciences, R. (2017). Nausea and Vomiting of Pregnancy-What's New? Martha. HHS Public Access, 202, 62–72. https://doi.org/10.1016/j.autneu.2016.05.002.Nausea

Danielewicz, H., Myszczyszyn, G., Dębińska, A., Myszkal, A., Boznański, A., & Hirnle, L. (2017). Diet in pregnancy—more than food. European Journal of Pediatrics, 176(12), 1573–1579. https://doi.org/10.1007/s00431-017-3026-5

Delil, R., Tamiru, D., & Zinab, B. (2018). Dietary Diversity and Its Association with Anemia among Pregnant Women Attending Public Health Facilities in South Ethiopia. Ethiop J Health Sci, 28(5), 625–634.

Desta, M., Akibu, M., Tadese, M., & Tesfaye, M. (2019). Dietary Diversity and Associated Factors among Pregnant Women Attending Antenatal Clinic in Shashemane, Oromia, Central Ethiopia: A Cross-Sectional Study. Journal of Nutrition and Metabolism, 2019, 7–10. https://doi.org/10.1155/2019/3916864

Diana, R., Rachmayanti, R. D., Anwar, F., Khomsan, A., Christianti, D. F., & Kusuma, R. (2018). Food taboos and suggestions among Madurese pregnant women: a qualitative study. Journal of Ethnic Foods, 5(4). https://doi.org/10.1016/j.jef.2018.10.006

Dubois, L., Diasparra, M., Bedard, B., Colapinto, C. K., Fontaine-Bisson, B., Morisset, A. S., … & Fraser, W. D. (2017). Adequacy of nutritional intake from food and supplements in a cohort of pregnant women in Québec, Canada: The 3D Cohort Study (Design, Develop, Discover). American Journal of Clinical Nutrition, 106(2), 541–548. https://doi.org/10.3945/ajcn.117.155499

FAO and FHI 360. (2016). Minimum Dietary Diversity for Women- A Guide to Measurement. Rome: FAO. Retrieved from http://www.fao.org/3/a-i5486e.pdf

Gale, C. R., Robinson, S. M., Godfrey, K. M., Law, C. M., Schlotz, W., & Callaghan, F. J. O. (2008). Oily fish intake during pregnancy – association with lower hyperactivity but not with higher full-scale IQ in offspring. Journal of Child Psychology and Psychiatry, 49(10), 1061–1068. https://doi.org/10.1111/j.1469-7610.2008.01908.x

Kiboi, W., Kimiywe, J., & Chege, P. (2017). Determinants of dietary diversity among pregnant women in Laikipia County, Kenya: a cross-sectional study. BMC Nutrition, 3(1), 1–8. https://doi.org/10.1186/s40795-017-0126-6

Kominiarek, M. A., & Rajan, P. (2016). Nutrition Recommendations in Pregnancy and Lactation. Med Clin North Am, 100(6), 1199–1215. https://doi.org/10.1016/j.mcna.2016.06.004.Nutrition

Madanijah, S., Briawan, D., Rimbawan, R., Zulaikhah, Z., Andarwulan, N., Nuraida, L., … & Bindels, J. (2016). Nutritional status of pre-pregnant and pregnant women residing in Bogor district, Indonesia: a cross-sectional dietary and nutrient intake study. British Journal of Nutrition, 116(Supplement S1), S57–S66. https://doi.org/10.1017/S000711451600057X

Michelfelder, A. J. (2009). Soy: A Complete Source of Protein. American Family Physician, 79(1), 43–47.

Ministry of Health. (2014). Balanced Diet Guidelines. Jakarta: Ministry of Health.

Ministry of Health. (2019). Basic Health Survey 2018. Jakarta: Ministry of Health.

Murakami, K., & Livingstone, M. B. E. (2016). Associations between Meal and Snack Frequency and Diet Quality in US Adults: National Health and Nutrition Examination Survey 2003-2012. Journal of the Academy of Nutrition and Dietetics, 116(7), 1101–1113. https://doi.org/10.1016/j.jand.2015.12.012

Nag, M. (1994). Beliefs and Practices about Food during Pregnancy: Implications for Maternal Nutrition. Economic And Political Weekly, 29(37), 2427–2438. https://doi.org/10.2307/4401755

Nguyen, C. L., Van Hoang, D., Nguyen, P. T. H., Van Ha, A. V., Chu, T. K., Pham, N. M., … & Binns, C. W. (2018). Low dietary intakes of essential nutrients during pregnancy in Vietnam. Nutrients, 10(8), 1–13. https://doi.org/10.3390/nu10081025

Nguyen, P. H., Sanghvi, T., Kim, S. S., Tran, L. M., Afsana, K., Mahmud, Z., … & Menon, P. (2017). Factors influencing maternal nutrition practices in a large scale maternal, newborn and child health program in Bangladesh. PLoS ONE, 12(7), 1–17. https://doi.org/10.1371/journal.pone.0179873

Powell, B., Kerr, R. B., Young, S. L., & Johns, T. (2017). The determinants of dietary diversity and nutrition : ethnonutrition knowledge of local people in the East Usambara Mountains, Tanzania. Journal of Ethnobiology and Ethnomedicine, 13(23), 1–12. https://doi.org/10.1186/s13002-017-0150-2

Rathnayake, K. M., Madushani, P., & Silva, K. (2012). Use of dietary diversity score as a proxy indicator of nutrient adequacy of rural elderly people in Sri Lanka. BMC Research Notes, 5, 2–7. https://doi.org/10.1186/1756-0500-5-469

Starling, P., Charlton, K., Mcmahon, A. T., & Lucas, C. (2015). Fish Intake during Pregnancy and Fetal Neurodevelopment-A Systematic Review of the Evidence. Nutrients, 7, 2001–2014. https://doi.org/10.3390/nu7032001

Yeneabat, T., Adugna, H., Asmamaw, T., Wubetu, M., Admas, M., Hailu, G., … Amare, T. (2019). Maternal dietary diversity and micronutrient adequacy during pregnancy and related factors in East Gojjam Zone, Northwest Ethiopia, 2016. BMC Pregnancy and Childbirth, 19(1), 1–9. https://doi.org/10.1186/s12884-019-2299-2

ISSN-Internet 2197-411x OLCL 862804632

Zeng, Z., Liu, F., & Li, S. (2017). Metabolic Adaptations in Pregnancy: A Review. Annals of Nutrition and Metabolism, 70(1), 59–65. https://doi.org/10.1159/000459633

Research Paper

Future of Food: Journal on Food, Agriculture and Society
8 (3) October 2020

Farmers' supply response and perception of rice procurement program in Bangladesh

Mst. Mili Khatun[1], Sourav Mohan Saha[1*], Md. Akhtaruzzaman Khan[1] & Md. Emran Hossain[1]

[1]Department of Agricultural Finance and Banking, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh.

* Corresponding author: souravmohansaha@gmail.com

Data of the article

First received : 22 March 2020 | Last revision received : 20 July 2020
Accepted : 10 October 2020 | Published online : 18 October 2020
DOI:10.17170/kobra-202010131940

Keywords

Rice procurement program, supply response, perception, financial risk, Bangladesh.

Rice farmers in Bangladesh do not get proper returns due to lower market prices and many unexpected situations that affect the supply of rice. Hence, the government introduced the rice procurement program to minimise the financial risk of the farmers. This study tried to analyse the supply response to rice production and assess the farmers' perception of government procurement program, including their financial risk of rice production. Vector autoregressive (VAR) model was employed to analyse the supply response of rice using secondary data. Additionally, 100 Aman and Boro rice farmers were interviewed for assessing their financial risk and perception of the rice procurement program. The result reveals that production was significantly affected by the production of the last two years, rainfall and exchange rate. The financial risk was found more in Aman rice than that of Boro rice production, and this risk occurred due to a lower market price. It was also found that no farmers sold rice directly to the procurement centre, and they had no knowledge of the rules and regulations of the procurement program. Therefore, farmers were getting a lower price than the procurement price, that profited the middlemen. The study suggests direct rice collection from the farmers to make the procurement program effective, as well as the need to disseminate appropriate rules and regulations among the rice producers.

1. Introduction

Agriculture contributes 14.23 per cent of the total GDP of Bangladesh, and it is highly dominated by rice production (BER, 2018). Because of industrialisation, cultivated land decreased in some of the popular rice-growing regions (Rezvi, 2018). However, rural farmers tend to produce more rice by cultivating modern HYV varieties which are highly responsive to inorganic fertilisers and insecticides (Khan et al., 2012; Islam et al., 2017; Roy et al., 2020). The cultivation of these high yielding modern grain varieties of rice with effective soil management and water control helped the country to meet the increasing demand for food grain (Rasha et al., 2018). In FY 1972-73, total area and total production of Aman and Boro rice were 66.99 lac hectares and 76.57 lac metric tons respectively. Both the total area and production of Aman and Boro rice increased to 105.39 lac hectares and 335.69 lac metric tons respectively (Figure 1) over the last five decades (BBS, 2018).

The common characteristics of the price of rice are its instability and seasonal fluctuation (Rahman, 2019). In most cases, farmers get a comparatively lower price in the harvesting season (Nziguheba et al., 2010). Due to the risk of lower market price and unfavourable conditions of different factors, rice-producing farmers may not produce the same amount of rice the following year in their cultivated land. To resolve

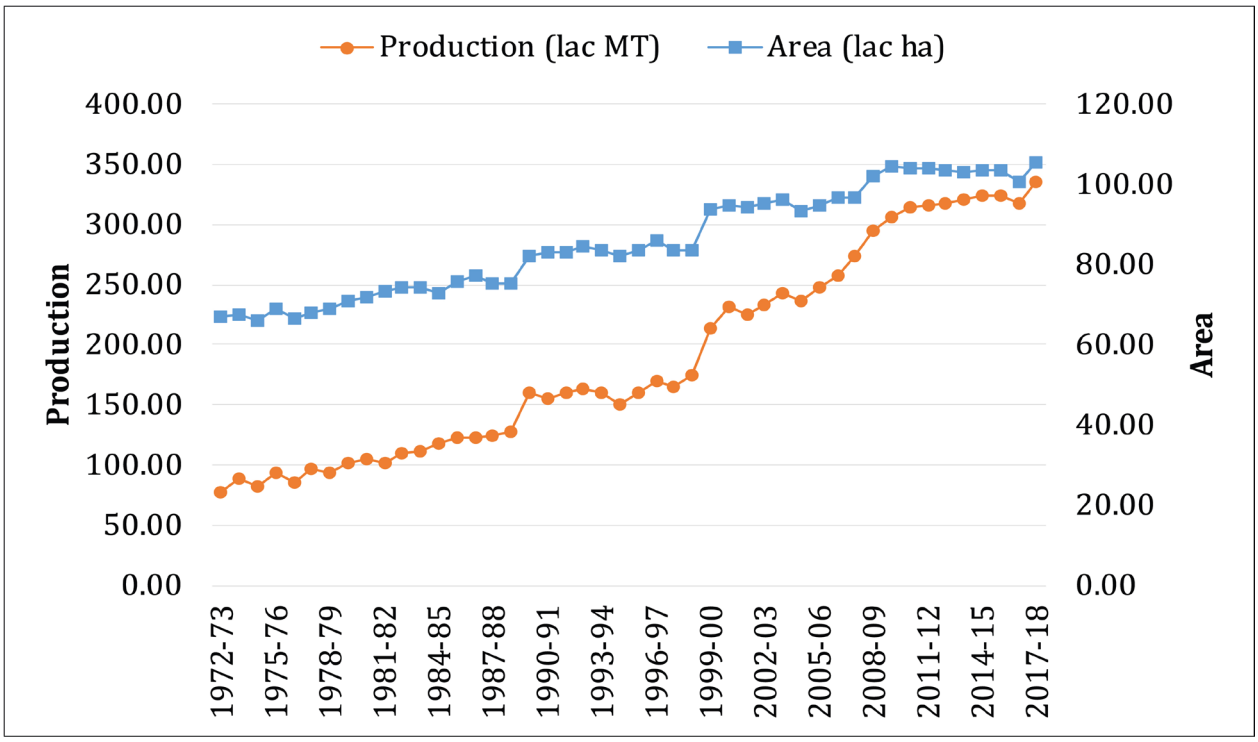


Figure 1. Area and production of rice (Aman and Boro) in Bangladesh, Source: BBS (2018).

this issue and support farmers against lower market prices, the government of Bangladesh has been procuring rice from the farmers since the 1970s (Alam et al., 2015). The government procurement program was formed to attain two goals. The first goal was to build rice stocks for the public food grain distribution system (PFDS), and the second was to provide income support to farmers (Alam et al., 2015). The procurement program would declare a price known as the minimum support price that takes all factors into account relevant to the production of rice. Procurement prices must be higher than the production cost to ensure a profit for the producers, which will embolden them to continue or increase rice production (Raha et al., 2013). Besides, the government has made several changes in the procurement program over the years to make it more effective such as listing farmers, increasing targeted quantity of procurement, procuring through a mobile app, etc. (Roy et al., 2019; Amin, 2020; Parvez, 2020). However, due to lack of information and communication, farmers do not get the benefits of this program, and intermediaries take advantage of this opportunity (Zahid, 2020). Incentives through procurement prices are based on the assumption that the market price of rice will be higher with a procurement program than without one. Besides, procurement centres were reported to collude with the millers and middlemen rather than buying from producers (Shahabuddin et al., 1999; Ali, 2010; Alam et al., 2020). So, if the procurement program fails in influencing the market price, the desired benefit will not be realised. Therefore, the effectiveness of procurement is a necessary condition for ensuring incentives to farmers.

However, farmers' supply response is mostly dominated by non-price factors over price factors (Krishna, 1962; Askari & Cummings, 1976; Gulati & Kelly, 1999; Ampadu-Ameyaw & Awunyo-Vitor, 2014). Non-price factors include the area of production, rainfall, import, exchange rate, etc. Because of the imperfect condition of such factors, farmers may become reluctant to grow more rice in the next production period. Different studies have been conducted on rice procurement programs and farmers' supply response. Khan et al. (2018) studied the supply response of rice in the Khyber Pakhtunkhwa province of Pakistan using time series data and found a positive effect of the lag market price on production. Ayinde et al. (2017) determined the responsiveness of rice supply to price risk in Nigeria and found that producers are more responsive not only to price and non-price factors but also to price risk and exchange rate. Edison (2015) analysed rice farmers' supply response, and input demand planting

rice in the Jambi Province was estimated using profit function analysis. Alam et al. (2015) examined the effectiveness of the rice procurement program and analysed the factors influencing farm level rice stocks. Shemu et al. (2013) assessed the effectiveness of the government Boro paddy procurement program in the Mymensingh district of Bangladesh. Kuwornu et al. (2011) analysed the responsiveness of rice production in Ghana, and they found significant effects of output, rainfall, and the real price of maise and real price of rice on the land area cultivated of rice. Rahji & Adewumi (2008) examined the supply response and demand for local rice in Nigeria using OLS and 2SLS techniques. Despite these studies, there are limited studies on farmer's perception of the rice procurement program, financial risk and their supply response in Bangladesh. Hence, the main objective of this study is to estimate farmers' response to rice production in Bangladesh and to analyse farmers' perception of government rice procurement program, including the financial risk of rice production. Since procurement programs are implemented worldwide to support the farmers, the insights of this study might also facilitate the procurement policy decisions in other parts of the world, where applicable.

2. Materials and Methods

2.1 Sampling procedures and data description

This study used both primary and secondary data to achieve the objectives. To analyse the supply response to rice production, secondary data were collected from the Bangladesh Bureau of Statistics (BBS) and the Bangladesh Meteorological Department (BMD). Data included total cultivated area, total rice production, average yield, average rice price, average rainfall, quantity imported and the exchange rate of 43 years (from FY1972-73 to FY2015-16). Primary data was collected to assess financial risk and farmers' perception of the government procurement program. A field survey of different farmers who produce Aman and Boro rice was conducted following a three-stage procedure. Initially, Natore district was purposively selected as it is one of the districts where a significant share of annual rice in Bangladesh is produced. Secondly, five Upazilas (sub-districts) from the Natore district were selected based on production for core study areas. Finally, lists of rice-producing farmers were collected from the Upazila Agriculture Offices, and a total of 100 farmers were selected through simple random sampling technique. A draft interview schedule was developed and pre-tested with a few sample farmers. Then the interview schedule was corrected and finalised according to the objectives. Cross-sectional data included information on socioeconomic characteristics of the farmers, costs and returns of rice production and their knowledge regarding the government procurement program.

2.2 Analytical techniques

This study employed both descriptive statistics and econometric analysis to fulfil the objectives. Different summary statistics like sum, percentage, average, ratios, etc. were estimated and presented in tabular and graphical illustration form to assess the financial risk and perception of farmers.

2.2.1 Vector autoregressive (VAR) model for rice supply response

Vector autoregressive (VAR) model is advantageous in macroeconomic forecasting (Karlsson, 2013). This model was widely used to estimate the supply response in several studies (Ayinde et al., 2017; Yixian et al., 2018). A p^{th} order vector autoregression can be written as follows (Hamilton, 1994):

$$Y_t = \alpha + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots + \beta_p Y_{t-p} + \varepsilon_t \quad (1)$$

where Y_t is an (n × 1) vector of a given realisation (at time t) of n variables, α is an (n × 1) vector of constants, β_j is an (n × n) matrix of autoregressive coefficients (with j having values from 1 to p), and ε_t is an (n × 1) vector describing noise in the data.

In supply response analysis, empirical work based on time series data assumes that the underlying time series is stationary. If a time series is stationary, its mean, variance and autocovariance remain the same no matter at what point they are measured; that is, they are time-invariant. When the non-stationary time series is used in any regression model, one may obtain significant relationships from unrelated variables. Stationary or non-stationary variables can be tested with the unit root test. Unit root test can be defined as follows:

Let the random walk model as:

ISSN-Internet 2197-411x OLCL 862804632

$$Y_t = \rho Y_{t-1} + \varepsilon_t \text{, where } -1 \leq \rho \leq 1 \quad (2)$$

Here if ρ = 1, then the unit root problem is faced, which is a situation of non-stationarity. In this case the variance of Y_t is not stationary.

The Dickey-Fuller and Augmented Dickey-Fuller test is commonly used to check the unit root of time series data. The Augmented Dickey-Fuller (ADF) test is more satisfactory to test for a more extensive and more complicated set of time-series models and to accommodate some forms of serial correlation. The Augmented Dickey-Fuller test has been used to test the stationarity for this study.

To get the idea of the ADF test, first, the method of the DF test is briefly discussed. Let the stochastic process be as follows:

$$Y_t = \delta + \rho Y_t + \varepsilon_t \quad (3)$$

Where ρ =1 corresponds to a unit root. To test the null hypothesis that : $H_0 : \rho = 1$ that against the alternative hypothesis $H_1 : |\rho| < 1$, the Dickey-Fuller test can be written as:

$$DF = \frac{\rho - 1}{se(\rho)} \quad (4)$$

Here ρ is the ordinary least square (OLS) estimator and se(ρ) represents the usual OLS standard error.
The testing procedure for the ADF test is the same as the Dickey-Fuller test, but it is applied in the model with:

$$\Delta Y_t = \beta_1 + \beta_{2t} + \rho Y_{t-1} + \delta_i \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \quad (5)$$

Where ε is a pure white noise error term and $\Delta Y_t = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$ etc.

In ADF, we test whether ρ=0. The ADF statistics, used in the test, is a negative number. The more negative it is, the stronger the rejections of the null hypothesis suggesting that there is a unit root at some level of confidence. Alternatively, the corresponding p-value of the test statistics can also be used to find the significance of the null hypothesis.

The number of lagged difference terms to include in the ADF test may be determined by minimising the Schwarz or Bayesian Information Criterion (SIC) or minimising the Akaike Information Criterion (AIC), or lags are dropped until the last lag is statistically significant. If the time series has a unit root (non-stationary), the first differences of such time series are stationary (Gujarati et al., 2003). Once time-series data exhibits the stationarity property, the statistical inferences can then be conducted on it. The result of the ADF unit root test is summarised in Table 1.

Using the ADF unit root test on the levels and first difference of the economic series, no variables were found stationary at the level. At the same time, virtually all were stationary at first difference. Natural logarithm was taken to linearise the variable for easy attainment of stationarity. Besides, the t-test and F-test were used for the test of significance, and Durbin Watson (DW) test was used to detect the first-order autocorrelation for this study. The result of Durbin's alternative serial autocorrelation confirmed that there was no serial autocorrelation. Therefore, the empirical model in this study was as follows:

$$Y_t = \alpha_0 + Y_{t-1} + Y_{t-2} + Y_{t-3} + yield_t + import_t + price_t + rainfall_t + exchangerate_t + \varepsilon_t \quad (6)$$

Where,
Y_t= total production; Y_{t-1}= previous year production; Y_{t-2} = two years back production; Y_{t-3}= three years back production; $yield_t$ = total yield of rice; $import_t$ = quantity imported of rice; $price_t$= price of rice; $rainfall_t$ = average rainfall; $exchangerate_t$ = exchange rate of Dollar and Bangladeshi Taka(BDT); ε_t= error term.

2.2.2 Financial risk analysis

The financial risk of rice was calculated as the difference between expected return and actual return, where the standard deviation and coefficient of variation were used to examine the level of risk (Barry, 1984). The coefficient of variation is expressed as the ratio of standard deviation and mean. A higher coefficient of variation indicates higher risk and vice versa.

3. Result and discussion

3.1 Rice farmers' supply response in Bangladesh

Table 1. Result of the ADF unit root test for level and 1st difference

Unit Root Test	Time Series Variables	Test statistics	1% critical value	5% critical value	Decision
Augmented Dickey-Fuller (lag=2)	Area in level	-0.889	-3.641	-2.955	Nonstationary
	Production in level	-0.701	-3.641	-2.955	Nonstationary
	Import in level	-1.248	-3.641	-2.955	Nonstationary
	Price in level	-0.337	-3.641	-2.955	Nonstationary
	Exchange in level	-2.763	-3.641	-2.955	Nonstationary
	Rainfall in level	-2.707	-3.641	-2.955	Nonstationary
	Area in first difference	-4.171	-3.648	-2.958	Stationary
	Production in first difference	-4.028	-3.648	-2.958	Stationary
	Import in first difference	-3.779	-3.648	-2.958	Stationary
	Price in first difference	-4.678	-3.648	-2.958	Stationary
	Exchange in first difference	-4.660	-3.648	-2.958	Stationary
	Rainfall in first difference	-5.623	-3.648	-2.958	Stationary

On analysing the data using vector autoregression, the supply output response of rice forms an equation with the production, producer price, yield, quantity imported, rainfall and exchange rate. The results of the vector autoregressive model for the supply response of rice in Bangladesh are presented in Table 2.

Results revealed that the production of the last two years had significant effects on the present year's production of rice. It implies that their previous two-year production influenced farmers' decision about the present year's production, but they could not recall more than two years back production in decision making. Rainfall had significant effects on the production of rice. That means the amount of rainfall in the previous year influenced farmers' decision on producing rice since it is a crucial component of rice production in Bangladesh. This result was also supported by Rokonuzzaman et al. (2018). The exchange rate also had a significant effect on the production of rice, which may have occurred due to an expected decrease in rice importation. The results are consistent with the studies of Ammani (2013), Tanko & Alidu (2016) and Ayinde et al. (2017). Though price is the most critical factor in supply response, it showed an insignificant effect. Most of the farmers in Bangladesh produce rice for consumption as well as commercial purposes (Ahmed, 2004). Therefore, farmers may not emphasise much on the previous year's price of rice in the present year's production plan during the rice season. However, their return depends on the market price, and it is relevant to analyse their financial risk to assess how market price affected their return.

3.2 Assessing the financial risk of the farmers

Price risk is the result of price uncertainty that affects producers when they make production, and the market price is remarkably lower than expected (Gemech et al., 2011). It may be downside when the actual price is lower than the expected price or upside when the actual price is higher than the expected price. Producers are more concerned about the downside risk due to apprehension of low income. However, upside risk also affects the farmers in a loss of opportunity for higher production and higher income (Mohan, 2007; Dick & Wang, 2010; Pasaribu, 2010; Wolf, 2012). Farmers always try to produce higher production, and they expect a higher return, but the actual situation becomes different. So, they fall at risk of not getting expected proper returns. The results of the financial risk analysis of Aman and Boro rice in this study are shown in Table 3.

Aman producing farmers' average expected return was BDT 67631 per hectare, and the average actual return was BDT 53204 per hectare. The financial loss/risk in Aman rice was BDT 14427 per hectare. On the other hand, Boro producing framers' total expected return was BDT 202311 per hectare, and the total ac-

ISSN-Internet 2197-411x OLCL 862804632

tual return was BDT 163113 per hectare. Therefore, its financial risk/loss was BDT 39198 per hectare. Results partially support the findings of Lucky et al. (2018) and Chanda et al. (2019). Standard Deviation of Aman and Boro rice was found 6806 and 9322, respectively, and the coefficient of variation (CV) for Aman rice was 76%, and for Boro rice, it was 35%. It implies that the risk in Aman rice production was higher than Boro rice production. Boro season is most suitable for rice production, and its production is higher due to proper operational management and weather condition (Rahman et al., 2013). Although the price is lower at times, higher production can cover the production cost of the farmers. However, the Aman rice season is affected severely by many natural hazards, mainly floods and droughts (Paul & Rasid, 1993; Mondal, 2010). Therefore, the production of Aman rice and the price of rice is simultaneously lower. For that reason, most of the farmers do not want to produce Aman rice as the same amount of Boro rice.

Consequently, the risk in Aman rice is higher than

Table 2. Result of vector autoregressive model for supply response

Variables	Coefficient
d-production L1	-0.8909***
	(0.1509)
d- production L2	-0.4551**
	(0.1917)
d- production L3	-0.1029
	(0.1515)
d-Lnprice	0.0001
	(0.0001)
d-Lnyield	0.0013
	(0.0012)
d-Lnimport	0.0000
	(0.0002)
d-Lnrainfall	0.0001**
	(0.0000)
d-Lnexchangerate	0.6814***
	(0.2550)
Constant	-0.6846
	(0.8313)

[Note: (***), (**), (*) denotes 1% and 5%, 10% significance level respectively and value in the parentheses indicates standard error.]

Table 3. Results of financial risk analysis of Aman and Boro rice

Items	**Aman**	**Boro**
Expected price (BDT/kg)	23.73	27.79
Actual price (BDT/kg)	20.33	23.84
Expected production (kg/ha)	2850	7280
Actual production (kg/ha)	2617	6842
a. Expected Return (Tk./ha)	67631	202311
b. Actual return (BDT/ha)	53204	163113
Financial risk (BDT/ha) (a-b)	**14427**	**39198**
Standard Deviation	6806	9322
Coefficient of Variation (%)	**76**	**35**

Boro rice. Because of this financial risk, the government procurement program was introduced to support rice farmers of the country. Thus, the following section discusses the existing procurement system as well as assesses the farmers' perception of the procurement program.

3.3 Present scenario of rural rice market and government procurement system

The price of rice is determined mostly by domestic factors rather than by international price fluctuations because rice is a non-exported good in Bangladesh (Talukder & Chile, 2014). There are substantial seasonal variations in rice prices in the rural markets. The seasonal variations could be attributed to local seasonal demand and supply responses. Rice syndicates work as intermediaries in the market between producer and consumers. Most survey respondents expressed the opinion that rice syndicates dominated the market in rural areas. These syndicates are a group of predominantly urban rice traders and merchants. They work in association with rural elites such as the managers of rural rice markets, political leaders, and local rice traders. They seized the opportunity from seasonal rice price changes, buying at the lower price during the peak seasons, and selling at a much higher price during the lean seasons. Therefore, they captured most of both producers' share and consumers' share. The supply chain of rice from the producers to the procurement centre and actors involved is shown in Figure 2.

The demand for rice decreases drastically during the peak season because all farmers consume their self-grown rice. But, the supply of rice significantly increases because all farmers sell rice for meeting their usual household expenditure and loan repayments, including small farmers, some of whom are predominantly net buyers, (Talukder & Chile 2014). These demand and supply responses jointly push rice prices down to achieve equilibrium in the local rice market. However, the main goal of this procurement price is to provide a support price higher than the cost of production to ensure that farmers do not produce at a loss. But this procurement program provides support to the middlemen rather than farmers. Middlemen such as traders at the local market, bepari (local wholesaler), miller, etc. purchase rice from farmers at a lower rate but sell it at a higher rate to government procurement centre. Moreover, setting procurement prices substantially above market prices encourages rent-seeking behaviour and corruption (Auriol et al., 2016).

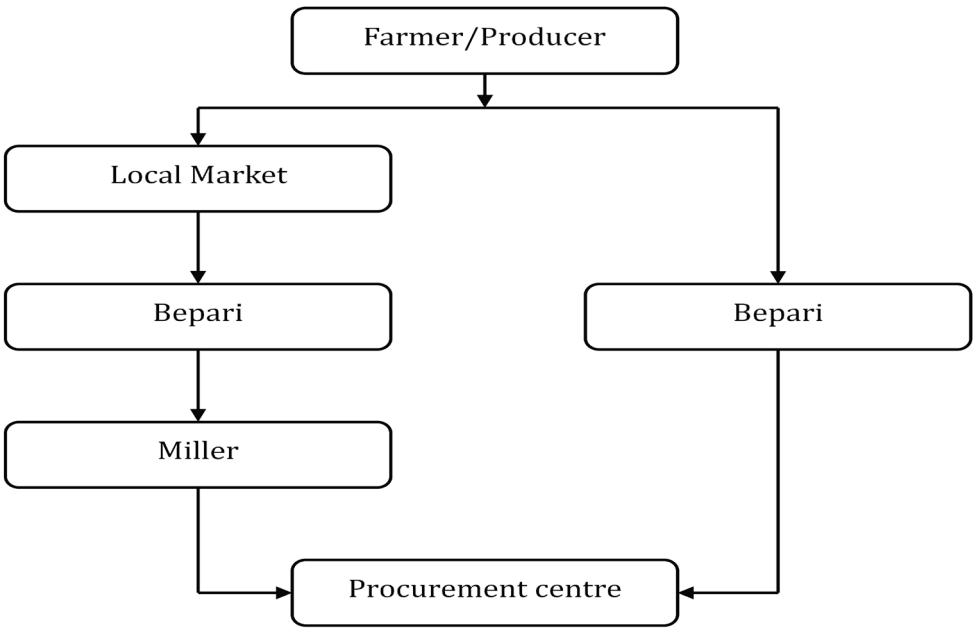


Figure 2. The supply chain of rice from the producers to the procurement centre.

ISSN-Internet 2197-411x OLCL 862804632

Table 4 shows that the average procurement price was higher than the actual market price in both Aman and Boro rice. Survey results revealed that the difference between the average procurement price and the market price was BDT 4.52 for Aman rice and BDT 6.01 for Boro rice. So, it is evident that rice farmers in Bangladesh are incurring losses through the existing procurement program. Alam et al. (2020) reported similar findings

3.4 Farmers' perception of the government procurement program

In the government rice procurement system, there are four groups principally involved: farmers, millers, government officials at the procurement centres and central government authority at the Ministry of Food (MoF). The last two groups are essentially the management service providers in the system, and the

Table 4. Average price difference between government procurement price and actual market price in last year

Particular	Aman (BDT/kg)	Boro(BDT/kg)
Procurement Price	24.85	29.82
Actual market Price	20.33	23.81
Difference	4.52	6.01

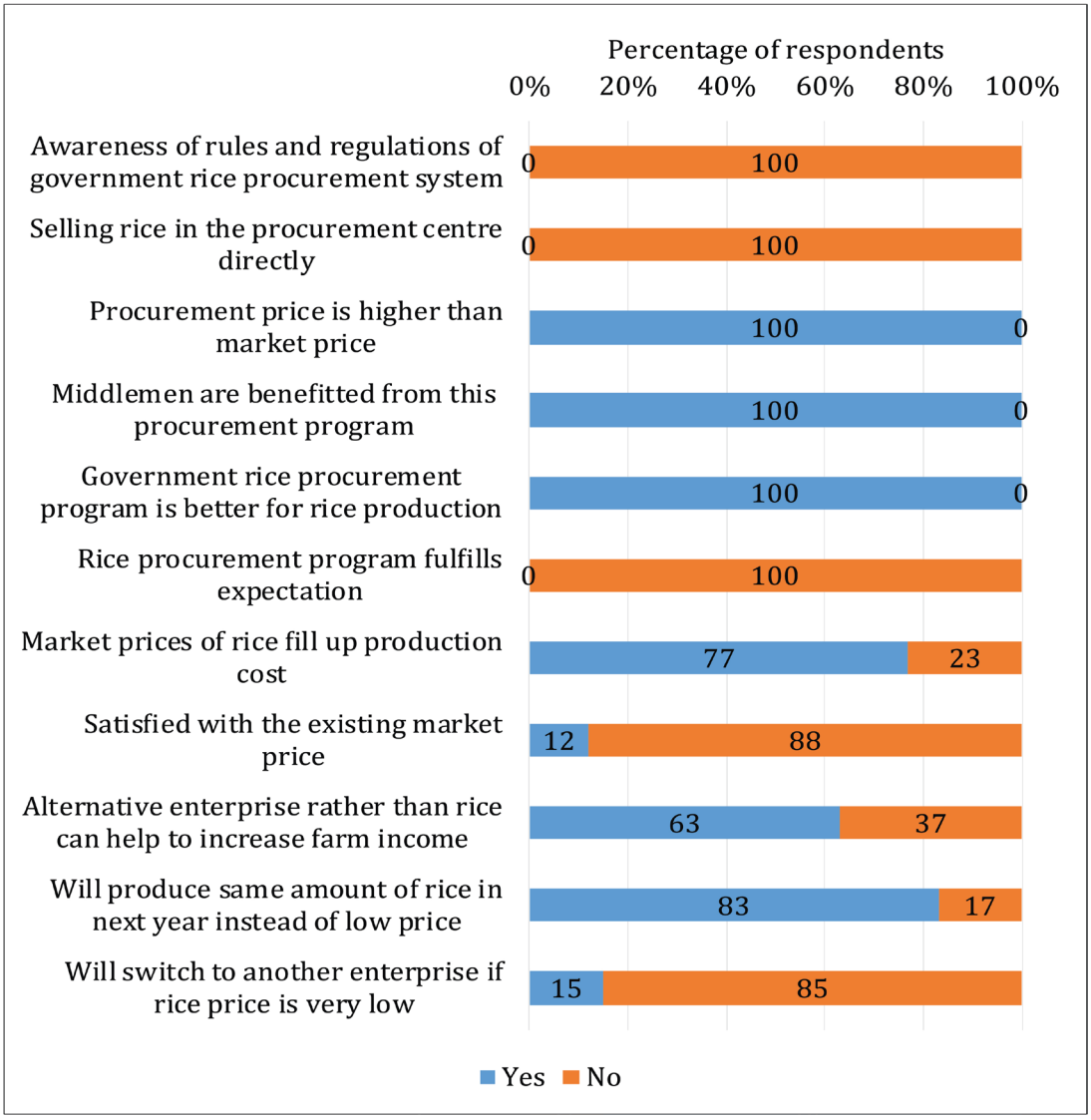


Figure 3. Farmer' perceptions of rice procurement program and existing market price.

first two groups are the goods providers and support receivers. Since most of the farmers do not participate directly in the rice procurement system, it is vital to know their general degree of perception about that system. Figure 3 reveals the survey responses from farmers about their perception of government procurement programs and existing market price.

Results revealed that none were aware of the rules and regulations of the procurement program. Moreover, no farmers sold their rice to the procurement centre directly. It was found that they sold rice to the middleman like bepari, paikar, faria or near the village market at a lower price. However, farmers perceived that the procurement price is higher than the actual market price. The farmers believed that the government procurement program was better for them, but the middlemen still benefited since farmers could not sell their rice directly to the procurement centre. So, the government procurement program could not fulfil the expectation of the farmers. Most of them believed that changing enterprise could increase their farm income. Still, farmers would not switch to another enterprise from rice instead of lower market price. They would produce the same amount of rice next year because of their home consumption. Similar findings were reported by the study of Rosenberg et al. (2014) on farmers' perception of local food procurement in Mississippi.

4. Conclusion

The public procurement program intends to support farmers, but various factors reduce its impact on prices received by farmers and their income. This study was conducted to assess the supply response to rice production and assessing financial risk and farmer's perception of the government procurement programs in Bangladesh. The results revealed that present production was significantly affected by the last two years of production. Rainfall and exchange rate also had significant effects on rice production. Farmers' actual return from the rice was lower than the expected return, which indicates the presence of financial risk in rice production. This risk is more in Aman rice compared to Boro rice production. The middlemen gained the actual advantage of the procurement program because they purchase rice from the farmers and sell it to the government procurement centre. As a result, farmers were getting a lower price than the procurement price. Furthermore, farmers did not know the rules and regulations of the procurement program. The procurement program could be useful if market prices and procurement prices are positively associated. The government can support farmers by purchasing rice directly from them. Effective intervention should be ensured to improve the rural rice market so that the financial risk of rice production can be reduced. Moreover, the farmers should be informed with proper and accurate rules and regulations of the procurement program.

Conflict of interest

The authors hereby declare that there is no conflict of interest.

References

Ahmed, R. (2004). Rice economy of Bangladesh: progress and prospects. Economic and Political Weekly, 39 (36), 4043-4052.

Alam, M. J., Akter, S., & Begum, I. A. (2015). Effectiveness of Rice Procurement Program and the Determinants of the Farm Level Stocks of Rice in Bangladesh, in International Conference of Agricultural Economists, Milan, 2015. Retrieved from https://ideas.repec.org/p/ags/iaae15/210942.html

Alam, M. J., Akter, S., Begum, I. A., & Haque, M. M. (2020). Determinants of the farm-level stocks of rice and effectiveness of rice procurement program in Bangladesh. Journal of the Asia Pacific Economy. DOI:10.1080/13547860.2020.1722559

Ali, S. A. M. M. (2010). Strengthening the Government's Instructional Capacity for Improving Food Security. Final Consultancy Report to ADB and the Ministry of Food and Disaster Management. Ministry of Food and Disaster Management, Dhaka, Bangladesh.

Amin, M. A. (2020). Government procurement of rice through app delayed, limited. Dhaka Tribune. Retrieved from https://www.dhakatribune.com/bangladesh/government-affairs/2020/04/29/government-procurement-of-rice-through-app-de-

ISSN-Internet 2197-411x OLCL 862804632

layed-limited

Ammani, A. A. (2013). Impact of market-determined exchange rates on rice production and import in Nigeria. International Journal of Food and Agricultural Economics (IJFAEC), 1(2), 85-98.

Ampadu-Ameyaw, R., & Awunyo-Vitor, D. (2014). Effect of price and non-price incentives on production and marketable surplus of food crops supply in Ghana. Asian Journal of Agricultural Extension, Economics & Sociology, 3(6), 666-679.

Askari, A. & Cummings, J. T. (1976). Agricultural Supply Responses: A Survey of the Econometric Evidence, Paralgar Publishers, New York.

Auriol, E., Straub, S., & Flochel, T. (2016). Public procurement and rent-seeking: the case of Paraguay. World Development, 77, 395-407.

Ayinde, O. E., Bessler, D. A. & Oni, F. E. (2017). Analysis of Supply Response and Price Risk on Rice Production in Nigeria. Journal of Management and Accounting Studies, 2(04), 12-17. DOI:10.17306/J.JARD.2017.00279

Barry, P. J. (Eds.). (1984). Risk management in agriculture, Ames IA: Iowa State University Press.

BBS (2018). Statistical Year Book of Bangladesh, Bangladesh Bureau of Statistics, Ministry of Planning, Government of People's Republic of Bangladesh, Dhaka.

BER (2018). Bangladesh Economic Review 2018. Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.

Chanda, S. C., Ali, M. A., Haque, M. E., Abdullah, M. R., & Sarwar, A. G. (2019). Cost of production and cost benefit analysis of different rice in Sirajganj district. Asian Journal of Crop, Soil Science and Plant Nutrition, 1(01), 07-14.

Dick, W. J., & Wang, W. (2010). Government interventions in agricultural insurance. Agriculture and Agricultural Science Procedia, 1, 4-12. DOI:10.1016/j.aaspro.2010.09.002

Edison, E. (2015). The Analysis of Supply Responsiveness of Jambi's Rice Farming, Journal of Agriculture and Sustainability, 7(1), 27–38.

Gemech, F., Mohan, S., Reeves, A., & Struthers, J. (2011). Market-based price-risk management: Welfare gains for coffee producers from efficient allocation of resources. Oxford Development Studies, 39(01), 49-68. DOI:10.1080/13600818.2010.550399

Gujarati, D. N., Porter, D. C., & Gunasekar, S. (2003). Basic Econometrics, 4th edition, McGraw-Hill, New York.

Gulati, A. & Kelley, T. (1999). Trade Liberalization and Indian Agriculture, Oxford University Press.

Hamilton, J. D. (1994). Time Series Analysis, Princeton University Press, Princeton, New Jersey.

Islam, Z., Begum, R., Sharmin, S., & Khan, M. A. (2017). Profitability and Productivity of Rice Production in Selected Coastal Area of Satkhira District in Bangladesh. International Journal of Business, Management and Social Research, 03(01), 148–153.

Karlsson, S. (2013). Forecasting with Bayesian vector autoregression. In Handbook of economic forecasting, Elsevier, New York, 2, 791-897. DOI:10.1016/B978-0-444-62731-5.00015-4

Khan, A., Huda, F. A., Alam, A. (2010). Farm Household Technical Efficiency: A Study on Rice Producers in Selected Areas of Jamalpur District in Bangladesh. European Journal of Social Sciences, 14(2), 262-271.

Khan, S. U., Faisal, M. A., Haq, Z. U., Fahad, S., Ali, G., Khan, A. A., & Khan, I. (2018). Supply response of rice using time series data: Lessons from Khyber Pakhtunkhwa Province, Pakistan. Journal of the Saudi Society of Agricultural Sciences, 18(4), 458–461. DOI:10.1016/j.jssas.2018.03.001

Krishna, R. (1962). A Note on the Elasticity of the Marketable Surplus of a Subsistence Crop. Indian Journal of Agricultural Economics, 17, 79-84.

Kuwornu, J. K. M., Izideen, M. P. M., & Osei-Asare, Y. B. (2011). Supply Response of Rice in Ghana: A Co-integration Analysis, Journal of Economics and

Sustainable Development, 2(6), 1-14.

Lucky, R. Y., Kabir, J., Rabbani, G., Siddique, A. B., & Hossain, E. (2018). An Agronomic and Profitability Study on Rice Production: A Case of Jalgaon Village of Comilla District, Bangladesh. International Journal of Agricultural Economics, 3(1), 14-22. DOI:10.11648/j.ijae.20180301.13

Mohan, S. (2007). Market-based Price-risk Management for Coffee Producers. Development Policy Review, 25(3), 333-354. DOI:10.1111/j.1467-7679.2007.00373.x

Mondal, M. H. (2010). Crop agriculture of Bangladesh: Challenges and opportunities. Bangladesh Journal of Agricultural Research, 35(2), 235-245. DOI:10.3329/bjar.v35i2.5886

Nziguheba, G., Palm, C. A., Berhe, T., Denning, G., Dicko, A., Diouf, O., ... & Kaya, B. (2010). The African green revolution: Results from the millennium villages project. In Advances in agronomy, Academic Press, 109, 75-115. DOI:10.1016/B978-0-12-385040-9.00003-7

Parvez, S. (2020). Govt to buy 50pc more paddy to feed the poor. The Daily Star. Retrieved from https://www.thedailystar.net/business/news/govt-buy-50pc-more-paddy-feed-the-poor-1890667

Pasaribu, S. M. (2010). Developing rice farm insurance in Indonesia. Agriculture and Agricultural Science Procedia, 1, 33-41. DOI:10.1016/j.aaspro.2010.09.005

Paul, B. K., & Rasid, H. (1993). Flood damage to rice crop in Bangladesh. Geographical Review, 83(2), 150-159. DOI:10.2307/215253

Raha, S. K., Moniruzzaman, M., Alam, M. M., & Awal, M. A. (2013). Structure, conduct and performance of the rice market and the impact of technological changes in milling. NFPCSP-FAO Project, Institute of Agribusiness and Development Studies, Bangladesh Agricultural University, Mymensingh. Retrieved from http://fpmu.gov.bd/agridrupal/sites/default/files/ToR%204%20Final%20report-2.pdf

Rahji, M. A., & Adewumi, M. O. (2008). Market Supply Response and Demand for Local Rice in Nigeria: Implications for Self-Sufficiency Policy. Journal of Central European Agriculture, 9(3), 567–573.

Rahman, M. (2019). Factors Affecting Price Fluctuation of Rice and Exploring the Rice Market in Barishal from the Consumer and Wholesaler Point of Views. Retrieved from https://halshs.archives-ouvertes.fr/halshs-02275376/document

Rahman, N. M. F., Hossain, M. I., Aziz, M. A., Baten, M. A., & Kabir, M. S. (2013). Prospects of Boro rice production in Bangladesh. Advances in Environmental Biology. 7(14), 4542-4549.

Rasha, R. K., Liza, H. A., Manjira, S., Kazal, M. M. H. & Rayhan, S. J. (2018). Financial profitability and resource use efficiency of boro rice production in some selected areas of Mymensingh in Bangladesh. Research in Agriculture Livestock and Fisheries, 5(3), 293-300. DOI:10.3329/ralf.v5i3.39575

Rezvi, M. R. (2018). The Factors of Declining Agricultural Growth in Bangladesh and Its Impact on Food Security. South Asian Journal of Social Studies and Economics, 1(4), 1-9. DOI:10.9734/sajsse/2018/v1i425810

Rokonuzzaman, M., Rahman, M. A., Yeasmin, M., & Islam, M. A. (2018). Relationship between precipitation and rice production in Rangpur district. Progressive Agriculture, 29(1), 10-21. DOI:10.3329/pa.v29i1.37476

Rosenberg, N., Truong, N. L., Russell, T., Abdul-Haqq, D., Gipson, J. A., Hickson, D. A. (2014). Farmers' Perceptions of Local Food Procurement, Mississippi, 2013. Prev Chronic Dis 2014, 11, 140004. DOI: http://dx.doi.org/10.5888/pcd11.140004

Roy, A. C., Rahman, M. A., & Khan, M. A. (2020). Yield gap, profitability and inefficiency of Aman rice in coastal areas of Bangladesh. Progressive Agriculture, 30(4), 395-404. https://doi.org/10.3329/pa.v30i4.46900.

Roy, P., Himu, A. A, & Shabuj, M. (2019). Rice Procurement by Govt: Lists of farmers raise questions. The Daily Star. Retrieved from https://www.thedailystar.net/frontpage/bangladesh-government-list-of-farmers-for-rice-procurement-raise-question-1751836

ISSN-Internet 2197-411x OLCL 862804632

Shahabuddin, Q. & Islam, K. M. N. (1999). Domestic Rice Procurement Programme in Bangladesh-An Evaluation. Food Management and Research Support Project, Ministry of Food, Government of the People's Republic of Bangladesh. Retrieved from http://fpmu.gov.bd/agridrupal/content/domestic-rice-procurement-program-bangladesh-%E2%80%93-evaluation-fmrsp

Shemu, S. A., Sabur, S., Alam, M. J., & Kausar, A. K. M. G. (2013). Public Intervention and Its Effectiveness: The Case of Government Boro Paddy Procurement Program in Mymensingh District. Bangladesh Journal of Crop Science, 25, 21–30.

Talukder, D., & Chile, L. (2014). Characteristics of rice cultivation and rural rice market in Bangladesh: Evidence from a survey. Agricultural Economics Review, 15(2), 68–84.

Tanko, M., & Alidu, A. F. (2016). Supply response of domestic rice and price risk in northern ghana. American International Journal of Social Science, 5(4), 107-115.

Wolf, C. A. (2012). Dairy farmer use of price risk management tools. Journal of dairy science, 95(7), 4176-4183. DOI:10.3168/jds.2011-5219

Yixian, L. I. U., Roberts, M. C., & Sioshansi, R. (2018). A vector autoregression weather model for electricity supply and demand modelling. Journal of Modern Power Systems and Clean Energy, 6(4), 763-776. DOI:10.1007/s40565-017-0365-1

Zahid, S. H. (2020). Paddy procurement: Intention and outcome. The Financial Express. Retrieved from https://thefinancialexpress.com.bd/views/paddy-procurement-intention-and-outcome-1584029999

Future of Food: Journal on Food, Agriculture and Society
8 (3) October 2020

Food traceability system awareness and agricultural operation: A Study of tea farms in Fujian, China

MEIYING CHEN[1], WENGUANG ZHANG[2], YI ZHENG[1] AND JI LU[3*]

[1]FUJIAN Agriculture and Forestry University, China
[2]Beijing Normal University, China
[3]Dalhousie University, Canada

* Corresponding author: ji.lu@dal.ca

Data of the article

First received : 27 March 2020 | Last revision received : 20 July 2020
Accepted : 12 October 2020 | Published online : 18 October 2020
DOI:10.17170/kobra-202010131941

Keywords

Food traceability; food safety; Chinese farm; pesticide control

China is establishing a Food Traceability System (FTS), but the policy implementation is behind most developed countries. The lack of FTS awareness may be a factor contributing to farming practices that are not consistent with FTS policies. Furthermore, the structure of an agri-food supply chain is a factor influencing farms' compliance with FTS. The present study focuses on pesticide residue control and traceability issues in one of the largest tea production areas in China. It aims to examine the effect of FTS awareness and related policies on tea farms' operations as well as the influences of supply chain structure on the effects of policy awareness.

In this study the data were collected from Fujian province, which is a traditional, major tea-growing region in China with 18% of national production. Farms were recruited through a Stratified Sampling procedure that included 428 participating farms from the four largest tea-producing counties in Fujian. The participating farms answered questions regarding their awareness of FTS and related policies as well as the supply chain structure. The participants also reported their agricultural record-keeping practices related to pesticide residue control, including pesticide use, pesticide residue test, and sales record.

The results reveal that farm owners' or operators' FTS awareness has a positive effect on pesticide use and sales record-keeping practice, and the supply chain structure importantly moderates the effects of policy awareness on operations related to pesticide residue control. Compared to independent growers, tea farms within an integrated supply chain were more likely to take pesticide residue tests or keep sales records. The results suggest that increasing FTS awareness among tea growers would be crucial to establish a safe and traceable system. Furthermore, governments need to take the supply chain structure into account.

1. Introduction

Tea is one of the most consumed drinks worldwide. As China is the largest tea producing country (Chang, 2015), a safe and traceable tea production system in China would significantly contribute to the health and wellbeing of the global population. In recent years, there are frequent reports of excessive and inappropriate pesticide use on tea crops in China and the world market (Liu and Guo, 2019; Wang et al., 2017; Wei et al., 2012). As pesticides may remain on or in food after applied to crops, food safety incidents may occur through the consumption of treated crops (Lam et al., 2013). Therefore, it is crucial to establish a Food Traceability System (FTS) to improve tea safety and quality. A Food Traceability System consists of

regulatory, technical, logistic, and business systems to reduce and control food safety risks with the ability to follow food ingredients and products across the processes of farming, processing, and distribution (Olsen and Borit, 2018). To establish an effective FTS, governments must implement policies to ensure that all players along the agri-food supply chain comply with the related regulations (Aung and Chang, 2014; Regattieri et al., 2007). As farms widely use pesticides for agricultural pest management (Carvalho, 2006; Cooper and Dobson, 2007), an FTS must regulate agricultural operations to control the pesticide residue level and minimise the impact.

China is actively establishing regulatory frameworks for an FTS (Jia and Jukes, 2013; Lam et al., 2013), but the progress of policy implementation is still behind most developed countries. The lack of FTS awareness among farmers may be one crucial factor contributing to farming practices that are not consistent with FTS policies (Charlebois et al., 2014; Tang et al., 2015; Wu et al., 2018). Furthermore, the structure of an agri-food supply chain in which a farm operates is another critical factor influencing the degree of compliance to FTS (Roth et al., 2008). Chinese farms are operating in diversified structures of agri-food supply chain. Being part of a consolidated supply chain, some tea farms supply products to large business organisations through formal contractual agreements (Zhang, 2012). Other tea farms, often smallholder farms, sell products to consumers through direct channels, such as farmers' markets. Since a consolidated food supply chain may offer farms with technical, financial, and other competitive advantages (Aung and Chang, 2014), the FTS policymaking process needs to take the diversified structures of the China tea supply chain into account. The present study focuses on the pesticide residue control and traceability issues in one of the largest tea production areas in China, Fujian province, and aims to examine the effect of FTS awareness and related policies on tea farm operations as well as the influences of supply chain structure on the effects of policy awareness.

1.1 Pesticide residue control and traceability

The use of agrochemicals contributes significantly to feed the growing world population. However, driven by health and environmental concerns, many countries have been tightening the regulations on pesticide use and lowering the maximum permitted concentration of pesticide residue in food (Carvalho, 2006). In order to reduce the health risks, it is vital to regulate the use of agrochemicals in farming practices, select appropriate types of pesticides, control the amounts of application, and allow sufficient intervals between pesticide applications and harvest. Beyond pesticide application control, the principles of traceability further require a transparent information collection and sharing system along the agri-food supply chain (Hobbs, 2004). As an essential part of this system, farms need to collect and store accurate information regarding pest management operations (Aung and Chang, 2014). This information would help improve food safety and quality and facilitate traceback operations in food safety incidents (Golan et al., 2004; Opara, 2003).

This study focuses on tea farms' information collection and keeping practices that are critical to controlling the hazards of pesticide residue, namely, pesticide application record-keeping, residue level testing, and sales record-keeping. (1) Pesticide application records include the time of applications, the formulation and manufacturer/supplier of the pesticide, as well as applied amount and concentration. This information is necessary for an FTS to track and control the potential hazards brought by pesticides (Aung and Chang, 2014; Peets et al., 2009). (2) Before the tea product enters the market, it is important to test the pesticide residue and compare the results to the legal maximum allowed level. The tests help not only to ensure chemical residue levels are tolerable and safe for consumption but also to provide useful data for optimal pesticide and FTS policies (Skevas et al., 2013). (3) Sales records document the time of the transaction, buyers' information, and the amount and specific product sold. Such transactional information is a critical resource to control potential hazards in a timely and appropriate manner.

1.2 Awareness of FTS and pesticide management policies

The Chinese government enacted the Agri-food Quality and Safety Law, specifically dedicated to food quality and safety control in 2006, which first mentioned the concept of a food traceability system. Since then, China has been progressively building and revising the regulation, inspection, and enforcement

system aiming at a national wide FTS (Jia and Jukes, 2013). The Food Safety Law of China was first enacted in 2009 and was revised in 2015, in which a detailed FTS policy implementation structure was specified. The current Food Safety Law of China is a result of a progressive process of revision and improvement. This policymaking and implementation process has distinctive characteristics of experimentalism governance (Heilmann, 2008). That is, policies usually start from pilot projects or policy experiments at the municipal or provincial level and are eventually adopted by the upper-level legislation or regulatory bodies (Zhu and Zhao, 2018). This process takes the advantages of evidence-based policymaking, but policy awareness can sometimes not keep up with the speed of policy revision. Facing such a rapidly changing regulatory environment, food producers, distributors, retailers, and even local governments often experience some difficulties and uncertainty while keeping their standards of business/administrative conduct up-to-date. The lack of awareness may seriously influence farms' operations related to controlling the pesticide residue level.

Empirical evidence from both developed and developing countries has shown that the awareness and attitudes toward the financial, environmental and social benefits of the program may influence farms' participation in programs and compliances to policies (Atari et al., 2009; Liao et al., 2011; Mattevi and Jones, 2016; Winter and May, 2001). FTS contributes to public health and provides logistic, technological, and marketing support to farms (Monteiro and Caswell, 2009; Parreño-Marchante et al., 2014; Saltini and Akkerman, 2012). The awareness of FTS may be able to leverage farms to adopt certain agricultural operation practices consistent with the principles of a safe and traceable agri-food system (Liao et al., 2011; Mattevi and Jones, 2016). Therefore, this study hypothesises that:

H1: Tea producers' awareness of FTS and its related policies is positively associated with the likelihood of information collection and keeping practices related to pesticide use.

1.3 Supply chain structure

The tea industry in China adopts diversified structures of the supply chain to organise the physical products and information flow moving from farm to end-consumer, and tea farms differ in the degree to which they integrate into a consolidated supply chain (Guo et al., 2007). On the one hand, many Chinese tea farms, usually smallholders, operate in a relatively independent manner; they sell most of their products directly to end-consumers through less industrialised distribution channels, such as farmers' markets and tea gardens. On the other hand, supply chain integration influences the tea industry's operations and brings benefits and competitive advantages to many tea farms within the chain. From a vertical chain integration perspective, some farms are an integral part of Tea Industry Bases, usually located in large-scale tea production areas. Often with the financial and policy support from local and regional governments, a typical industry base consolidates the operations of farms, manufacturers, and distributors by providing agricultural material supply, production and processing technology, product quality and safety control, innovation incubator, personnel training, as well as marketing and information services. From a horizontal integration perspective, some tea farms form strategic partnerships (e.g., through family ties) or cooperatives to gain competitive advantages; they usually negotiate and supply most of their products to large-scale manufacturers or distributors through long-term contractual arrangements (Ito et al., 2012).

Even with the awareness of FTS and its related regulation/policy, agricultural businesses are not necessarily willing or able to operate in accordance with FTS, which often needs to overcome cost and technique barriers. The integrated supply chain usually has a contractual structure to specify the rights and obligations of farms, which may include operational guidelines or requirements for food safety and traceability (Gale and Hu, 2011). As such, this study hypothesises that supply chain integration has a direct effect on the farming operation:

H2: Tea producers within an integrated supply chain are more likely to collect and keep information related to pesticide use than independent tea farms.

An integrated supply chain may offer farms with financial or informational support, including understanding the policy and principles of traceability, learning and adopting new technology, as well as purchasing equipment and information technology

ISSN-Internet 2197-411x OLCL 862804632

systems. The agricultural industry bases and cooperatives have long been recognised as one of the most influential organisations that positively contribute to food safety-sensitive operations. The membership of a relatively integrated or consolidated supply chain, be it vertical (Banterle and Stranieri, 2008) or horizontal integration (Fischer and Qaim, 2012; Francesconi and Heerink, 2010; Verhofstadt and Maertens, 2014), within an agri-food supply chain is generally associated with greater willingness and better supporting resources to adopt improved agricultural practices or programs aiming at a higher standard of food quality and safety. This study aims to test the hypothesis that being part of an integrated supply chain moderates the effect of FTS policy awareness.

H3: The effect of FTS and policy awareness on information collection and keeping practices related to pesticide use is stronger for farms within an integrated supply chain than for that of independent farms.

1.4 Tea farms in Fujian

The present study collected data from Fujian province, a traditional and prominent tea-growing region in China with 18% of national production in volume contributing over 90 billion RMB (14 billion USD) in GDP. The Fujian tea industry hires over 3 million employees working for 16,000 tea-producing/trading business entities. Among them, are 1,500 grower cooperatives, and many more independent growers. Some farms are integrated into one of the 26 registered tea industry bases or have contractual selling arrangement with the 62 government-recognised leading ("dragon head") tea-producing/trading enterprises. Alternatively, a large number of growers operate outside of such integrated value chain structures and mainly sell products directly to end-consumers. In 2012, the Fujian provincial government enacted a regulatory document (Fujian People's Congress, 2012) devoted to a strategic development plan for the tea industry, which is the first of its kind in China. In 2015, the provincial "agri-food quality and safety action plan" further stipulated critical measures to control the pesticide residue of tea products, including the development and implementation of a tea-traceability information platform, pesticide use monitoring system, and market entry permission-based tests and record-keeping mechanism (Fujian Provincial Government, 2015). Facing diversified types of tea farms, governments heavily emphasise the function of consolidated value chain structure captained by tea industry bases and leading enterprises on building FTS. It is of practical importance to gather information regarding farms' policy awareness and examine the direct and indirect influence of value chain structure on tea growers' pesticide use control practice.

2. Materials and Methods

2.1 Data collection

Sampling: This survey study recruited tea-producing farms in Fujian province. The Tea Division of Fujian Provincial Agricultural Department provided a registration list of tea-producing farms in the four largest tea-producing counties (Anxi, Duding, Wuyishan, and Fuan) within the province. Based on the registered addresses, the study selected the sample through a stratified sampling procedure. From each of the four counties, the study identified two to four of the largest tea-producing towns. The number of towns selected is proportional to the production share in volume within the province. For each of the 12 selected towns, the study randomly selected 40 farms from the registration list. Researchers first contacted the farms and then had a face-to-face interview with the owner of each consenting farm. Four hundred and eighty farm owners agreed to participate in this study. Among them, 428 farm owners completed the interviews with valid answers to the questionnaire.

Measurements: Researchers and trained research assistants conducted the interviews. For each farm, the participant was the owner of the farm, head of the family, or someone primarily responsible for the tea farm's operation. As most of the participants were expected to have a high school education or less, this study took a face-to-face interview based on a questionnaire. To further simplify the interview, the questionnaire mainly consisted of yes or no (Y/N) questions. Layperson language was adopted in interviews as much as possible, and researchers and research assistants provided an explanation when participants were not clear with the questions.

The questionnaire included questions regarding tea-producing farms' FTS related operations, partic-

ipants' awareness of FTS related policies, and the distribution channel as an indicator of the membership of a consolidated value chain structure. Participants also reported some questions regarding the characteristics of their farms. The interview also included three Y/N questions regarding FTS related operations in the year of this investigation. The questions asked, "Have you done (or have you been doing) the following for your tea farm in the past 12 months?" For operations during tea growing, whether they keep records (paper or digital) of pesticide use in their tea farm; for operations after harvest, whether test pesticide residue before selling the product; for operations after sales, whether records of sales are kept (product sold, date, buyer, quantity etc.).

There were pesticide controlling and monitoring policies built into the Fujian province FTS framework (Fujian Provincial Government, 2015). (1) Register the purchase of agricultural supplies: to buy pesticides or other agricultural supplies from designated agricultural materials suppliers, farms must obtain an agricultural supply purchase card, which links to the farm's business identity. By showing this card when purchasing restricted pesticide, the transaction information, including buyer and supplier's identity, product types and trade name, and the quantity is registered in a record system. (2) Pesticide Residue Testing (PRT) mechanism in the local tea market. It is required that tea products to be sold in Fujian province shall be tested for pesticide residue and compared to the maximum allowed level set by the policy. The participants indicated whether they were aware of the following policies (in two separate Y/N questions): The Agricultural Material Purchase Registration policy and the Maximum Pesticide Residue Levels allowed for tea products sold in the market. Participants also reported whether they knew the Food Traceability System (Y/N). The questions read: "Have you ever heard of xxx (xxx represents the name of each policy mentioned above or Food Traceability System)?"

For the supply chain structure, the interviewer asked participants, "Have you sold your tea products to industrial organisations such as tea industrial bases/centres or "big" companies last year? (Y/N). If the answer to this question was "No," this study assumes farms sold all products directly to individual consumers and were independent growers. In contrast, those who answered "Yes" were counted as growers within an integrated value chain. The interview also included some questions regarding owners' demographic and tea farm characteristics (See Table 1 for details of the sample).

2.2 Statistical model

This study examined three types of farms' FTS related operations, namely record-keeping of pesticide use, pesticide residue test, and sales record-keeping. In a multivariate probit model, the three types of operation were specified as outcomes. These were explained by the awareness of FTS and FTS-related policies, the distribution channel, as well as the two-way interactions between distribution channel and awareness. The model also controlled farms' and participants' characteristics. As compared to three independent conventional binary probit models, the multivariate probit model can simultaneously capture the factors that influence three outcome variables in one single model and allows for the correlations between the equations (Greene, 2008; Hausman et al., 1978; Chib et al., 1998). The model was specified as follows:

$$y^*_{1i} = x_i\beta_1 + \varepsilon_{1i}$$
$$y^*_{2i} = x_i\beta_2 + \varepsilon_{2i} \qquad (1)$$
$$y^*_{3i} = x_i\beta_3 + \varepsilon_{3i}$$
$$y_{hi} = 1 \text{ if } y^*_{hi} > 0 \text{ and } y_{hi} = 0 \text{ if } y^*_{hi} \leq 0 \ (h=1,2,3)$$

Through probit link functions, y*hi represents the probability of the binary outcomes of pesticides records-keeping (y1), pesticide residue test (y2), and sales record-keeping (y3). The x and β vectors are predictors and their coefficients. To capture the correlation between three outcome variables, the model specified that the error terms follow a multivariate normal distribution ∅(0,∑) with a zero mean and a variance-covariance matrix ∑ as indicated in function (2) (Maddala, 1983). Where, ρhk, are the correlation between each pair of outcomes. The model was estimated using the maximum likelihood method.

$$\begin{bmatrix} 1 & \rho_{12} & \rho_{13} \\ \rho_{12} & 1 & \rho_{23} \\ \rho_{13} & \rho_{23} & 1 \end{bmatrix} \quad (2)$$

ISSN-Internet 2197-411x OLCL 862804632

Table 1: Descriptive Statistics of Key Questions

Interview Questions	Percentage (n=482)
FTS-related Operations	
Keep Pesticides Use Record	57%
Test Pesticide Residue	75%
Keep Sales Record	69%
Supply Chain Structure (Distribution channel)	
Farms within an integrated supply chain (Sold product to industrial organizations)	52%
Awareness of FTS and related Policies	
FTS Awareness	43%
Agricultural Material Purchase Registration	49%
Maximum Pesticide Residue Levels	39%
Owner's Demographic and Farm Characteristics	
Age > 44	39%
Tea Producing Experience > 17 years	42%
Education > high school	27%
Farm Scale in > 1 ha	15%
Percent of household income from Tea> 70%	44%

3. Results and discussion

Table 2 presents the estimated coefficients. After accounting for all the predictors and control variables, the pesticide use record-keeping and sales record are positively correlated ($\rho = 0.20$, $p = 0.03$). In contrast, no other correlation between outcome variables was found significant. Participants older than 44 were less likely to keep pesticide use and test pesticide residue (ps < 0.02). An education level higher than high school contributed to a decreased probability of pesticide use record-keeping ($p = 0.02$). Farms larger than 1 hectare were more likely to keep records of pesticide use and test the pesticide residue after harvest (ps = 0.01). If tea sales contributed to more than 70% of a farm's total income, the farm was more likely to take pesticide residue tests (p=0.01). The following sections will discuss the key predictors and their influences on the three outcome variables.

3.1 Pesticide use record-keeping

In support of H1, FTS and policy awareness influenced whether or not a farm kept pesticide use records. Specifically, the awareness of FTS had a significant positive influence on the likelihood of keeping pesticide use records ($z=3.60$, $p<0.01$), and participants who were aware of the policy of Maximum Pesticide Residue Levels were more likely to keep recording pesticide use (marginal significant, $z=1.70$, $p=0.09$). H2, which expects a direct effect of the supply chain on pesticide use record-keeping, was not supported. As indicated by the farmer's adopted distribution channel (direct selling to consumers vs selling to organisations), the supply chain structure (independent vs integrated) was not a significant predictor of the odds of farmers' pesticide use record-keeping.

In terms of H3, the moderating effect of supply chain structure was found significant (p=0.05), as indicated by the interaction of distribution channel by the awareness of the Agricultural Material Purchase Registration policy (registration policy hereafter). Specifically, for farmers within an integrated supply chain, those with registration policy awareness were more

likely to keep pesticide use records than those not aware of the policy (see Table 3). Whereas, the effect of the registration policy awareness was not as salient for independent farms.

3.2 Pesticide residue tests

As for the results regarding the pesticide residue tests (PRTs), the awareness of policies had significant positive influences on the odds of taking pesticide residue tests after harvest (supporting H1). Specifically, the effects of awareness of both registration policy ($z=2.22$, $p=0.03$) and the Maximum Pesticide Residue Levels (MRLs) policy ($z=4.25$, $p<0.01$) were significant. In terms of H2, farms who were an integral part of a supply chain had a positive influence ($z=3.54$, $p<0.01$) on the odds of taking pesticide residue tests (PRTs).

Significant interactions between supply chain structure and policy awareness indicated that the supply chain structure moderated the effects of policy awareness on PRTs. However, the direction of moderating effects was opposite to the H3. In terms of the effect of registration policy awareness among the independent growers (see Table 3), those who were aware of the registration policy were more likely to take PRTs than those who were not aware of it. For farms within an integrated supply chain, the awareness of the registration policy was surprisingly associated with a decreased odds of taking PRTs. A similar pattern was found for MRL policy awareness. Independent growers who were aware of the MRL policy were more likely to test the pesticide residue than those who did not have the awareness. Among farms within an integrated supply chain, the awareness of MRL policy had a negative impact on the likelihood of taking PRTs.

3.3 Sales record-keeping

In terms of the results regarding the record-keeping

Table 2: The Estimated Coefficients of the Multivariate Probit Model

Outcomes: Farming Operations	**Before harvest: Y_1**			**After harvest: Y_2**			**Before Sales: Y_3**		
	Pesticide Use Record			**Pesticide Residue Test**			**Sales Record**		
Coefficients:	β	z	p	β	z	p	β	z	p
Intercept	-0.40	-1.74	0.08	-0.20	-0.88	0.38	0.20	0.89	0.37
Supply Chain Structure (SCS)	0.17	0.65	0.51	0.93	3.54	<0.01	0.51	1.98	0.05
FTS awareness (FTS)	1.00	3.60	<0.01	0.25	0.89	0.37	0.90	3.03	<0.01
MRLs Policy awareness (MRL)	0.38	1.70	0.09	1.15	4.25	<0.01	0.37	1.65	0.10
Registration Policy awareness (REG)	0.13	0.57	0.57	0.51	2.22	0.03	-0.46	-2.11	0.04
FTS X MRL	-0.44	-1.49	0.14	-0.62	-1.88	0.06	-0.26	-0.80	0.42
FTS X REG	-0.47	-1.66	0.10	-0.08	-0.27	0.78	-0.76	-2.49	0.01
FTS X SCS	0.03	0.10	0.92	0.35	1.15	0.25	0.03	0.10	0.92
MRL X SCS	0.24	0.85	0.39	-0.99	-3.09	<0.01	0.30	0.95	0.34
REG. X SCS	0.54	1.93	0.05	-1.10	-3.77	<0.01	0.47	1.56	0.12
Age	-0.56	-3.68	<0.01	-0.39	-2.40	0.02	0.05	0.30	0.76
Tea Farming Experience	0.25	1.76	0.08	0.04	0.25	0.80	-0.08	-0.54	0.59
Education	-0.36	-2.27	0.02	0.10	0.57	0.57	-0.27	-1.63	0.10
Farm Size	0.50	2.53	0.01	0.65	2.51	0.01	0.32	1.49	0.14
Tea Sales Income	0.04	0.28	0.78	0.39	2.56	0.01	-0.16	-1.05	0.29
Correlations between Outcomes:	ρ	z	p						
Between Y_1 and Y_2: ρ_{12}	0.11	1.24	0.22						
Between Y_1 and Y_3: ρ_{13}	0.20	2.23	0.03						

ISSN-Internet 2197-411x OLCL 862804632

Table 3: Observed percentages (%) of participating farms who reported "yes" for FTS related farming and selling practices

Policy Awareness	Registration Policy		MRLs Policy		FTS Awareness	
	No	Yes	No	Yes	No	Yes
Number of Participating farms in each group (n)						
Independent Growers	78	127	142	63	134	71
Integrated Supply Chain	140	83	120	103	109	114
Observed percentages of FTS practices (%) within each group						
Pesticide Use Record						
Independent Growers	44.9%	44.1%	43.0%	47.6%	35.1%	62.0%
Integrated Supply Chain	63.6%	78.3%	64.2%	74.8%	56.0%	81.6%
Pesticide Residue Test						
Independent Growers	56.4%	77.2%	60.6%	88.9%	67.2%	73.2%
Integrated Supply Chain	85.7%	68.7%	82.5%	75.7%	71.6%	86.8%
Sales record-Keeping						
Independent Growers	66.7%	42.5%	49.3%	57.1%	47.8%	59.2%
Integrated Supply Chain	88.6%	80.7%	80.0%	92.2%	81.7%	89.5%

of sales information (product sold, date, buyer, quantity, etc.), FTS awareness was a significant predictor ($z=3.03$, $p<0.01$). Consistent with the expectation of H1, participants with FTS awareness were more likely to keep the sales record than those who did not know about FTS. The awareness of registration policy, however, was a significant negative predictor of the likelihood of sales record-keeping ($z=-2.11$, $p=0.04$); farms with policy awareness were less likely to keep the record than those without awareness. In support of H2, the supply chain structure was a significant predictor of the likelihood of taking sales records ($p=0.05$). Specifically, the farms within an integrated supply chain were more likely to keep records of sales than independent tea growers. No interaction between policy awareness and supply chain structure was found to be significant.

3.4 Discussion and implications

This study investigated Fujian tea farms' agricultural operation practices that related to pesticide residue control. The results reveal that farm owners' or operators' FTS awareness has a positive effect on pesticide use as well as in sales record-keeping practice. This finding is consistent to the literature (Liao et al., 2011; Mattevi and Jones, 2016) showing that, with the knowledge of logistic, marketing, and social benefits that an FTS may bring to the farm, growers may have a stronger willingness to operate following the principles of a traceable system for food safety and quality. Given that only 43% of tea farms in our sample were aware of FTS, this result highlights the importance of FTS awareness in establishing a safe and high-quality food system.

For specific policies related to pesticide residue control, the results indicate that the awareness of these policies is an essential factor influencing farms' operation. The awareness of policy for maximum pesticide residue level was positively associated with all three practices measured in this study, and such awareness was particularly salient in predicting a farm's likelihood of conducting pesticide residue tests after harvest. As only 39% of participants reported they were aware of this policy, it indicates that an awareness program would greatly improve the farms' operations for an effective food traceability system.

The awareness of the Agricultural Material Purchase Registration policy, however, had mixed effects on farms' operations. The registration policy awareness demonstrated a positive effect on farms' likelihood of taking pesticide residue tests, but such awareness had

a negative effect on sales record-keeping. The registration policy regulates the supply of pesticide, and suppliers are required to check the identity of pesticide buyers, control the supplied pesticide type and volume, and record the transactions. This policy effectively encourages agricultural material suppliers to provide farmers with more information regarding pesticide residue hazards and how to reduce or control the risks. As such, it is no surprise to observe that tea farms were more likely to test the residue if they knew this policy. The study also found a negative effect of registration policy on sales record-keeping. One possible explanation is that the registration policy highlights the hazard of pesticide use as well as the potential legal and financial consequences of food safety incidents. To avoid taking responsibility in case a food safety incident happens, tea growers may choose not to keep the sales record.

The results also reveal the supply chain integration as an important factor influencing pesticide control practices. Compared to independent growers, tea farms in an integrated supply chain were generally more likely to take pesticide residue tests or to keep sales records. The reality of China's agriculture sector is that most farmers are smallholders with low education levels (Qiao et al., 2016). As food traceability is a relatively a new concept in agricultural communities, time is needed to communicate with farmers the benefits of a food traceability system, and more so to leverage meaningful changes in their operations. An integrated supply chain is usually led by larger organisations, such as agricultural cooperatives, processors, distributors, or retailers, which generally have better policy awareness, technical support, and financial resources. Within a consolidated business structure, these advantages of larger and more formal organisations may have a direct effect on the operations of smallholder farms through the contractual agreements, which may specifically require tea growers to test the pesticide residue and keep sales records.

The results also reveal that the supply chain structure importantly moderates the effects of policy awareness on operations related to pesticide residue control. Previous literature argues that an integrated supply chain would provide the necessary support to help growers operate by the principles of an FTS (Gale and Hu, 2011; Ito et al., 2012). The results regarding the record-keeping practice are consistent with these findings. With an awareness of the registration policy, farms within an integrated supply chain were more likely to keep tracking pesticide use. Conversely, this effect of policy awareness was not observed for independent growers. However, in terms of pesticide residue tests, the direction of the supply chain structure's moderating effect is the opposite of the hypothesis. For independent tea growers, the awareness of registration policy and maximum residue level was associated with an increased likelihood of taking pesticide residue tests. Among the farms within an integrated supply chain, those who were aware of the registration or MRL policies were less likely to test the pesticide residue than those who did not know the policies. An explanation to these unexpected results may be that knowing the policy, some farms within a consolidated business operation may assume testing pesticide residue is the responsibility of the channel captain. This responsibility shift may be the cause for the low rates of testing. In contrast, independent growers have no other organisations to rely on and must test the residue on their own, if they will.

The food traceability program was initiated in China in 2006. However, this study finds that many tea growers in Fujian province are still not operating as per the policy requirements of an effective food traceability system. The results of the study suggest that to increase FTS awareness among tea growers would be crucial to establish a safe and traceable system. However, policymakers need to take a closer look at some of the negative effects of policy awareness identified in this study. The results reveal potential challenges for policy implementation. A mere increase in policy awareness would not necessarily improve primary agricultural operation.

Furthermore, governments need to take the supply chain structure into account. An integrated supply chain would influence how farms operate, and this study finds that the influences may not always be positive. Opposite to the widely accepted notion that a consolidated supply chain would improve the food quality and safety, this study observed that among farms with policy awareness, independent tea growers are more likely than farms within an integrated supply chain to test pesticide residue after harvest. The pattern of the results points that when designing the reg-

ISSN-Internet 2197-411x OLCL 862804632

ulatory system for food safety, the government needs to take a holistic view of all the links in a food supply chain instead of examining the players along the supply chain separately.

3.5 Study limitations

The results need to be interpreted with the study's limitations. The study sample was from one province of China. As different areas of China differ in the implementation of food safety and traceability regulations, further investigation comparing various areas of China may discover valuable insights for effective policy. This research reveals the relationships between policy awareness, supply chain structure, and agricultural operations, but the study took very simplified dichotomous measurements on these key concepts. Future studies would benefit from measurements with more extensive details, multiple items, and a more accurate description of the reality. This was a cross-sectional study depicting the current situation of the food traceability system in China. While China is actively developing the system, it is of theoretical and practical interests to conduct longitudinal research to study the long-term effects of policy changes. Finally, the study only investigated the operations of tea growers. While the results demonstrated the complicated influences of supply chain structure, it calls for future studies to include the interactions between tea farms and larger organisations in the supply chain.

4. Conclusion

This paper presents an empirical study investigating agricultural operations related to the food traceability system in China. There were less than half of the tea growers in our study that reported they were aware of FTS and related policies. The results indicate that to grow the awareness of FTS and policies may positively contribute to food safety and quality. The results also emphasise the importance of supply chain structure, implying that the policy implementation must be considered in the context of local and regional markets.

Conflict of interest

The authors declare no conflict of interest. In addition, the funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

References

Atari, D. O. A., Yiridoe, E. K., Smale, S. & Duinker, P. N. (2009). What motivates farmers to participate in the Nova Scotia environmental farm plan program? Evidence and environmental policy implications. Journal of Environmental Management, 90(2), 1269-1279. https://doi.org/10.1016/j.jenvman.2008.07.006

Aung, M. M., & Chang, Y. S. (2014). Traceability in a food supply chain: Safety and quality perspectives. Food control, 39, 172-184. https://doi.org/10.1016/j.foodcont.2013.11.007

Banterle, A., & Stranieri, S. (2008). The consequences of voluntary traceability system for supply chain relationships. An application of transaction cost economics. Food Policy, 33(6), 560-569. https://doi.org/10.1016/j.foodpol.2008.06.002

Carvalho, F. P. (2006). Agriculture, pesticides, food security and food safety. Environmental science & policy, 9(7-8), 685-692. https://doi.org/10.1016/j.envsci.2006.08.002

Chang, K. (2015). World tea production and trade: Current and future development. Food and Agriculture Organization of The United Nations, Rome.

Charlebois, S., Sterling, B., Haratifar, S., & Naing, S. K. (2014). Comparison of global food traceability regulations and requirements. Comprehensive reviews in food science and food safety, 13(5), 1104-1123. https://doi.org/10.1111/1541-4337.12101

Cooper, J., & Dobson, H. (2007). The benefits of pesticides to mankind and the environment. Crop Protection, 26(9), 1337-1348. https://doi.org/10.1016/j.cropro.2007.03.022

Fischer, E., & Qaim, M. (2012). Linking smallholders to markets: determinants and impacts of farmer collective action in Kenya. World Development, 40(6), 1255-1268. https://doi.org/10.1016/j.worlddev.2011.11.018

Francesconi, G. N., & Heerink, N. (2010). Ethiopian agricultural cooperatives in an era of global commod-

ity exchange: does organisational form matter?. Journal of African Economies, 20(1), 153-177. https://doi.org/10.1093/jae/ejq036

Fujian People's Congress. (2012). Regulations of promoting the development of tea industry in Fujian province, Fujian People's Congress. Fujian, China: 2012. http://www.fjrd.gov.cn/ct/63-88053

Fujian Provincial Government. (2015). The implementation opinions about accelerateing transformation of agricultural development of people's government of Fujian province. Fujian, China: Minzheng 2015 (No. 51).

Gale, H. F., & Hu, D. (2011). Food safety pressures push integration in China's agricultural sector. American Journal of Agricultural Economics, 94(2), 483-488. https://doi.org/10.1093/ajae/aar069

Golan, E., Krissoff, B., & Kuchler, F. (2004). Food traceability: One ingredient in a safe and efficient food supply. Amber Waves, 2(2), 14-21.

Guo, H., Jolly, R. W., & Zhu, J. (2007). Contract farming in China: perspectives of farm households and agribusiness firms. Comparative Economic Studies, 49(2), 285-312. https://doi.org/10.1057/palgrave.ces.8100202

Heilmann, S. (2008). From local experiments to national policy: the origins of China's distinctive policy process. The China Journal, (59), 1-30. https://doi.org/10.1086/tcj.59.20066378

Hobbs, J. E. (2004). Information asymmetry and the role of traceability systems. Agribusiness, 20(4), 397-415. https://doi.org/10.1002/agr.20020

Ito, J., Bao, Z., & Su, Q. (2012). Distributional effects of agricultural cooperatives in China: Exclusion of smallholders and potential gains on participation. Food policy, 37(6), 700-709. https://doi.org/10.1016/j.foodpol.2012.07.009

Jia, C., & Jukes, D. (2013). The national food safety control system of China–a systematic review. Food Control, 32(1), 236-245. https://doi.org/10.1016/j.foodcont.2012.11.042

Lam, H. M., Remais, J., Fung, M. C., Xu, L., & Sun, S. S. M. (2013). Food supply and food safety issues in China. The Lancet, 381(9882), 2044-2053. https://doi.org/10.1016/S0140-6736(13)60776-X

Liao, P. A., Chang, H. H., & Chang, C. Y. (2011). Why is the food traceability system unsuccessful in Taiwan? Empirical evidence from a national survey of fruit and vegetable farmers. Food Policy, 36(5), 686-693. https://doi.org/10.1016/j.foodpol.2011.06.010

Liu, P., & Guo, Y. (2019). Current situation of pesticide residues and their impact on exports in China. In IOP Conference Series: Earth and Environmental Science, 227(5), 052027.

Mattevi, M., & Jones, J. A. (2016). Traceability in the food supply chain: Awareness and attitudes of UK Small and Medium-sized Enterprises. Food Control, 64, 120-127. https://doi.org/10.1016/j.foodcont.2015.12.014

Monteiro, D. M. S., & Caswell, J. A. (2009). Traceability adoption at the farm level: An empirical analysis of the Portuguese pear industry. Food Policy, 34(1), 94-101. https://doi.org/10.1016/j.foodpol.2008.07.003

Olsen, P., & Borit, M. (2018). The components of a food traceability system. Trends in Food Science & Technology, 77, 143-149. https://doi.org/10.1016/j.tifs.2018.05.004

Opara, L. U. (2003). Traceability in agriculture and food supply chain: a review of basic concepts, technological implications, and future prospects. Journal of Food Agriculture and Environment, 1, 101-106.

Parreño-Marchante, A., Alvarez-Melcon, A., Trebar, M., & Filippin, P. (2014). Advanced traceability system in aquaculture supply chain. Journal of food engineering, 122, 99-109. https://doi.org/10.1016/j.jfoodeng.2013.09.007

Peets, S., Gasparin, C. P., Blackburn, D. W. K., & Godwin, R. J. (2009). RFID tags for identifying and verifying agrochemicals in food traceability systems. Precision Agriculture, 10(5), 382-394. https://doi.org/10.1007/s11119-009-9106-4

Qiao, Y., Halberg, N., Vaheesan, S., & Scott, S. (2016).

ISSN-Internet 2197-411x OLCL 862804632

Assessing the social and economic benefits of organic and fair trade tea production for small-scale farmers in Asia: a comparative case study of China and Sri Lanka. Renewable Agriculture and Food Systems, 31(3), 246-257. doi:10.1017/S1742170515000162

Regattieri, A., Gamberi, M., & Manzini, R. (2007). Traceability of food products: General framework and experimental evidence. Journal of food engineering, 81(2), 347-356. https://doi.org/10.1016/j.jfoodeng.2006.10.032

Roth, A. V., Tsay, A. A., Pullman, M. E., & Gray, J. V. (2008). Unraveling the food supply chain: strategic insights from China and the 2007 recalls. Journal of Supply Chain Management, 44(1), 22-39. https://doi.org/10.1111/j.1745-493X.2008.00043.x

Saltini, R., & Akkerman, R. (2012). Testing improvements in the chocolate traceability system: Impact on product recalls and production efficiency. Food Control, 23(1), 221-226. https://doi.org/10.1016/j.foodcont.2011.07.015

Skevas, T., Lansink, A. O., & Stefanou, S. E. (2013). Designing the emerging EU pesticide policy: A literature review. NJAS-Wageningen Journal of Life Sciences, 64, 95-103. https://doi.org/10.1016/j.njas.2012.09.001

Tang, Q., Li, J., Sun, M., Lv, J., Gai, R., Mei, L., & Xu, L. (2015). Food traceability systems in China: The current status of and future perspectives on food supply chain databases, legal support, and technological research and support for food safety regulation. Bioscience trends, 9(1), 7-15. https://doi.org/10.5582/bst.2015.01004

Verhofstadt, E., & Maertens, M. (2014). Can agricultural cooperatives reduce poverty? Heterogeneous impact of cooperative membership on farmers' welfare in Rwanda. Applied Economic Perspectives and Policy, 37(1), 86-106. https://doi.org/10.1093/aepp/ppu021

Wang, J., Tao, J., Yang, C., Chu, M., & Lam, H. (2017). A general framework incorporating knowledge, risk perception and practices to eliminate pesticide residues in food: A structural equation modelling analysis based on survey data of 986 Chinese farmers. Food control, 80, 143-150. https://doi.org/10.1016/j.foodcont.2017.05.003

Wei, G., Huang, J., & Yang, J. (2012). The impacts of food safety standards on China's tea exports. China Economic Review, 23(2), 253-264. https://doi.org/10.1016/j.chieco.2011.11.002

Winter, S. X. C., & May, P. J. (2001). Motivation for compliance with environmental regulations. Journal of Policy Analysis and Management, 20(4), 675-698. https://doi.org/10.1002/pam.1023

Wu, Y. N., Liu, P., & Chen, J. S. (2018). Food safety risk assessment in China: Past, present and future. Food Control, 90, 212-221. https://doi.org/10.1016/j.foodcont.2018.02.049

Zhang, Q. F. (2012). The political economy of contract farming in China's agrarian transition. Journal of Agrarian Change, 12(4), 460-483. https://doi.org/10.1111/j.1471-0366.2012.00352.x

Zhu, X., & Zhao, H. (2018). Experimentalist governance with interactive central–local relations: Making new pension policies in China. Policy Studies Journal. https://doi.org/10.1111/psj.12254

Future of Food: Journal on Food, Agriculture and Society
8 (3) October 2020

Evaluation of antioxidant activity and the phenolic composition of Syrian Arbutus andrachne L.

Diana Hmaidosh[1*], Mahmoud Ali[2], Rim Salame[3]

[1]PhD, Ecological Sciences, Faculty of Agriculture, Tishreen University, Latakia, Syria.
[2] Professor, Department of Forestry and Ecology, Faculty of Agriculture, Tishreen University, Latakia, Syria.
[3] Assistant Professor, Department of Pharmacognosy, Faculty of Pharmacy, Tishreen University, Latakia, Syria.

* Corresponding author: dianah1983@gmail.com

Data of the article

First received : 30 March 2020 | Last revision received : 20 June 2020
Accepted : 07 October 2020 | Published online : 18 October 2020
DOI:10.17170/kobra-202010131942

Keywords

Arbutus andrachne L., phenolic content, antioxidant activity, FRAP.

Arbutus andrachne L. (Grecian Strawberry tree) is widespread in the Mediterranean and the Black Sea Regions. This study aimed at determining total phenolic content and antioxidant activity of Arbutus andrachne parts (flowers, leaves, bark and fruit) collected from different parts of the Latakia Province (Syria). Our work is the first to conduct this experiment on the selected plants in Syria.

The fresh samples were extracted using ethanol 50% as an extraction solution, then the total contents of the phenolic compounds were determined spectrophotometrically using the Folin-Ciocalteu reagent. The results showed higher phenolic contents in flowers (38.32 mg/g) than any other parts. Antioxidant activity was determined by FRAP (ferric reducing antioxidant power) method, and the results were in accordance with those obtained with the Folin-Ciocalteu method, which the general trend of the antioxidant activity FRAP in the botanical parts was similar to the total phenolic contents, which flowers have an antioxidant activity value (19.35 µMFe2±/g) that exceeds the other parts.ANOVA analysis showed significant differences in the contents of phenolic compounds between the four parts of Arbutus andrachne L. ($p<0.05$). Therefore, a positive correlation was found between total phenolic contents and antioxidant activity for Arbutus andrachne L. ($R2=0.952$).

1. Introduction

Medicinal plants are the richest biological resources of traditional medicine systems, nutritional supplements, herbal medicines and pharmaceuticals (Handa et al., 2008). The World Health Organization has confirmed that traditional medicine still has a primary role in health care, especially primary health care, as it is estimated that 60% of the world's population and 80% of the population in developing countries depend on traditional medicine (Gairola et al., 2010).

Phenolic compounds are the most effective antioxidants in food as they have many health effects (Cox et al., 2005). The antioxidant activity of plant products is mainly attributed to phenolic compounds (Chua et al., 2008). Hence, the importance of a diet rich in fruits with high contents of natural antioxidants is due to its therapeutic value (Sokol-Letowska et al., 2007), and their ability to neutralize free radicals (Stratil et al., 2007).

Free radicals are continuously generated as a result of normal metabolic processes in the body and are

sometimes produced by immune system reactions to bacterial and viral infections (Stratil et al., 2007). Due to the growing concerns about the potentially toxic effects of synthetic antioxidants, consumers have turned to consume natural antioxidants coming from food and diet. Thus, several studies have focused on new antioxidants to be chosen in typical foods (Mohd Azman et al., 2016).

The Eastern strawberry tree, Arbutus andrachne L., is a medicinal evergreen, small tree naturally distributed in the Mediterranean region and Southwestern Asia (Davis, 1982). Arbutus andrachne L. also called Greek Strawberry-tree, and Qayqab in Arabic is one of the Syrian medicinal species (Aljabari et al., 2014). This evergreen tree belongs to the Ericaceae family. Several plant species belonging to the Ericaceae family have been identified due to their medicinal properties within the list of species that are included in the composition of herbal medicines (Guendouze-Bouchefa et al., 2015).

Traditionally, Arbutus andrachne L. leaves are used as an antiseptic, anti-diarrheal, treatment for urinary infections and astringency, and its depurative properties and against some cancer types (Sakar et al., 1991). The fruit also has diuretic and laxative effects (Fonseca et al., 2015). The fruit has been customarily eaten in Spain and other Mediterranean countries, and they are known for their richness in numerous nutrients, especially calcium, phosphorus and potassium (Aljabari et al., 2014). Phenolic compounds are commonly found in the fruits, leaves and roots of the Arbutus andrachne L. like phenols, catechins, quercetin, rutin and myricetin. Subsequently, leaves and flowers recorded antimicrobial and antioxidant activities (Ergun et al., 2014). However, scientific literature confirming the effects of Arbutus andrachne L. fruit is minimal, and only a few studies from Middle Eastern countries have been published about the Arbutus andrachne L. components and their biological effects (Sakar et al., 1991; Serce et al., 2010; Tawaha et al., 2007).

The present study was directed towards the identification of antioxidant ability of ethanolic extracts from the Arbutus andrachne L. accessions sampled from the province of Latakia in Syria.

2. Material and Methods

2.1. Plant material

Plant materials of Arbutus andrachne L. (leaves and flowers) were collected in Spring of 2016 (100 g of each part), the bark was collected in the Fall of the same year (100 g), and fully ripe fruit with a healthy external appearance was collected in the winter of the same year (200 g) from different sites (10 sites graduated above sea level from 600 m to 900 m) of Latakia Province in Syria.

A total of 30 samples were collected from the studied sites (3 samples from each site to form a compound sample). Samples were packed in plastic bags and carried to the laboratories in a cold system within a day (stored at - 20 °C until analysis).

2.2. Extract preparation

1 g of each part (leaves, flowers, and bark) were taken from Arbutus andrachne L. and were appropriately sliced to facilitate the extraction process. The fruits of the Arbutus andrachne were juiced according to the method by Mezadri et al. (2008), where the fruits were pressed with a homemade machine and then filtered through filter paper. The juice was refrigerated at -20°C until the analysis was performed. The juice was directly used when determining the total content of phenolic compounds after its extraction so that the concentration of phenolic compounds was within detectable limits for a standard gallic acid series. At the same time, the other plant parts were extracted using ethanol 50% (because of its extraction ability and inexpensiveness) at a temperature of 70°C for 30 min from the start of boiling, with a 600 rpm.

2.3. Determination of total phenolic content

The phenolic contents of the extracts were determined using the Foline-Ciocalteu reagent according to the method previously reported by Slinkard and Singleton (1977) using gallic acid as a standard. The results are expressed as follows: the number of milligrams of gallic acid equivalent to phenolic compounds present in 1g of fresh plant extract (mg GAE/g). All experiments were carried out in triplicates, and the results were expressed as mean ± standard deviation.

2.4. Determination of antioxidant capacity FRAP assay

Ferric reducing antioxidant power (FRAP) assay was used to measure the concentration of total antioxidant. An intense blue colour appears when the TPTZ-Fe3+ complex reduces to the TPTZ-Fe2+form (2,4,6-tripyridyl-s-triazine) in the presence of antioxidants. The reduction occurs rapidly with all reductants with half-reaction reduction potentials above that of Fe3+/Fe2+ (Pellegrini et al., 2003).

FRAP assay were done with FRAP reagent (i.e. 1 mM2,4,6-tripyridyl-2-triazine [TPTZ]) and 20 mM ferric chloride in 0.25 M sodium acetate, pH 3.6. 100 ml of extract were added to 1ml of FRAP reagent and mixed thoroughly. After standing at ambient temperature (20 °C) for 4 min, absorbance at 593 nm was measured against a water blank. Calibration was against a standard curve (100–600 mM ferrous ion) produced with freshly prepared ammonium ferrous sulphate. All experiments were carried out in triplicates, and the results were expressed as mean ± standard deviation.

3. Statistical analysis

ANOVA contrast analysis was performed to compare the significant differences between the averages of phenolic and antioxidant values using Least Significant Difference (LSD) at the level 5% using the statistical analysis program SPSS (Version 16.0). Graphs were created using Microsoft Excel. The average of the three values (n=3) for each sample was calculated. Results were presented as means ± standard deviations.

4. Results and Discussion

4.1. Total phenols and antioxidant activity for Arbutus andrachne L.

Fresh plant material was chosen instead of dry plant material to maintain the sensitivity of the phenolic compounds. Dry plant material is at risk during the drying process and can result in a loss of the compounds but can provide results that are more accurate in terms of concentration levels (Bruneton, 1999). While reference studies used dried plant material, this is the first to use fresh plant material to determine the phenolic content of an Arbutus andrachne L.
The concentration of phenolic compounds is graded first from the flowers that recorded the highest content (38.32 mg/g), followed by the leaves (37.25 mg/g), then the bark (36.93 mg/g) and finally the fruit (3.62 mg/g) (Table 1). Our results were consistent with the results of Serce et al. (2010), who reported that the content of Arbutus andrachne fruits of phenolic compounds was 2.4 mg/g in fresh weight (fw). While Saral et al. (2017) reported that the phenolic content of Arbutus andrachne fruits was 7.29 mg/g of fw.

On the other hand, other studies that used dry plant materials indicated that the highest phenolic content of Arbutus unedo L. was in leaves (119.97 mg/g dw) (Saral et al., 2017), (197.16 mg/g dw) (Orak et al., 2011), (179 mg/g dw) (Guendouze-Bouchefa et al., 2015) and (207.84 mg/g dw) (Moualek et al., 2016). Besides, a study by Saral et al. (2017) stated that the concentration of phenolic compounds in Arbutus andrachne flowers was 43.27 mg/g of dw. Regarding phenols in bark, a study by Abidi et al. (2016) found that bark of Arbutus andrachne is rich in phenols (416.15 mg/g dw).

Table 1. The phenolic compounds and antioxidant activity for Arbutus andrachne L. using the FRAP method (n=3).

	Phenolic content **mg GAE/g**	**The antioxidant activity** **µMFe^{2+}/g**
Flowers	38.32±0.04 [a]	19.35±0.06 [a]
Leaves	37.25±0.04 [b]	16.81±0.04 [b]
Bark	36.93±0.01 [c]	14.33±0.06 [c]
Fruit	3.62±0.05 [d]	1.02±0.02 [d]
LSD	0.07	0.57
Similar letters indicate that there is no significant difference, while different letters indicate a significant difference.		

ISSN-Internet 2197-411x OLCL 862804632

The difference in the results of the mentioned studies with the current study can be attributed to the solubility of phenolic compounds governed by the physical statues of the used material (using dry compared to fresh materials), solvent type, the studied plant type, the studied plant part, in addition to the differences in geographical locations, and the extraction protocol (Saral et al., 2017). As noted by Panico et al. (2009), the role of environmental conditions such as heat, light intensity and soil composition in the accumulation of phenolic compounds found in strawberry fruits helps explain the difference in these results.

The antioxidant activity was calculated using the FRAP method for the ethanolic extracts prepared from the parts (flowers, leaves, bark and fruit) of the Arbutus andrachne L. From the results in Table (1) flowers have an antioxidant activity (19.35 µMFe2±/g) that exceeds the antioxidant activity of the leaves (16.81 µMFe2 ±/g), bark (14.33 µMFe2±/g) and fruit (1.02 µMFe2±/g). A significant difference was observed using ANOVA analysis in the total phenolic content of plant parts (flowers, leaves, bark and fruit) ($p<0.05$). Also, there was a significant difference in the antioxidant activity by the FRAP method for the plant parts of the Arbutus andrachne L.

Table (2) shows some reference studies that dealt with the antioxidant activity of some plant species belonging to the Ericaceae family, which differ by some values from the current study for several reasons, including the solvent used, the studied plant parts, and the difference of the plant species. Other studies indicated that flowers of Arbutus andrachne L. were superior in their antioxidant effectiveness compared to leaves (Okmen, 2015), and Arbutus unedo L. flowers outperformed their phenolic content and their antioxidant efficacy over fruits (Isbilir et al., 2012). This result is confirmed by the study of (Saral et al. 2017), which showed the superiority of A. andrachne L. flowers with their phenolic content and their antioxidant effectiveness (FRAP) over fruits.

4.2. The relationship between total phenolic content and FRAP antioxidant efficacy

The relationship between the contents of the plant parts of Arbutus andrachne L. of phenolic compounds and the antioxidant activity of the FRAP method is represented by a graph (Fig 1), based on the previous

Table 2. Reference studies on the antioxidant efficacy of some Ericaceae species plant extracts using FRAP method.

Reference	Plant	solvent used	antioxidant activity (FRAP)
Pavlovic et al., 2009	Arbutus unedo L. (Leaves)	Ethanol 70%	5.11 µMFe$^{2\pm}$/g
	Erica arborea L. (Leaves)		3.55 µMFe$^{2\pm}$/g
	Erica carnea L. (Leaves)		3.49 µMFe$^{2\pm}$/g
Saral et al., 2017	Arbutus andrachne L. (Fruit)	Methanol	3.41 µMFe$^{2\pm}$/g
	Arbutus andrachne L. (Flowers)		104.81 µMFe$^{2\pm}$/g
Ruiz-Rodriguez et al., 2011	Arbutus unedo L. (Fruit)	Ethanol	9.86 µMFe$^{2\pm}$/g
Serce et al., 2010	Arbutus andrachne L. (Fruit)	Aqueous	22.4 µMFe$^{2\pm}$/g

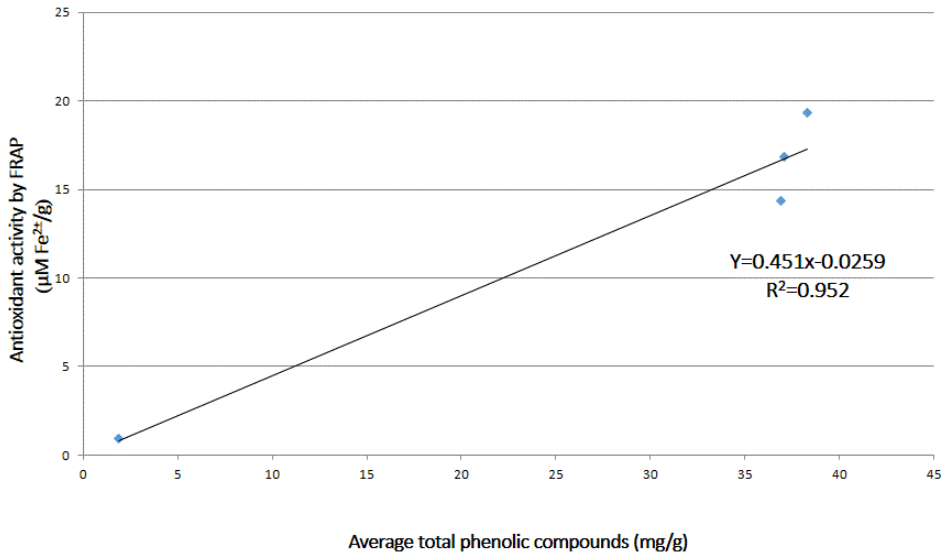


Figure 1. Increased antioxidant activity of plant parts for Arbutus andrachne L. FRAP method with increasing concentrations of phenolic compounds.

results presented in Table (1). A strong correlation is observed between the concentration of phenolic compounds and the antioxidant activity as shown in Figure (1), so it can be said that the more phenolic compounds in the plant part, the higher its antioxidant activity.

It is known that phenolic compounds differ from each other with their antioxidant effectiveness, and many studies have found a strong positive correlation between the total content of phenolic compounds and the antioxidant effectiveness (Bilto et al., 2015). This correlation is consistent with the current study, as the correlation between the total contents of phenolic compounds and the antioxidant effectiveness of the studied plant was strong, as the R2 coefficient reached a value equal to 0.952 by the FRAP method for Arbutus andrachne L. (Figure 1)

Finally, many studies have indicated that the physiological function of natural foods can be attributed to the antioxidant capacity of the phenolic compounds present in it (Hamzaa et al., 2012).

5. Conclusion

This study confirms that the flowers of A. andrachne L. contain high amounts of phenolic compounds (38.32±0.04 mg GAE/g), followed by leaves (37.25±0.04 mg GAE/g) and bark (36.93±0.01 mg GAE/g). The general trend of the antioxidant activity (FRAP) in the botanical parts was similar to the total phenolic contents, which flowers have an antioxidant activity value (19.35±0.04 µMFe2±/g) that exceeds the rest of the parts.

A positive correlation was found between total phenolic contents and antioxidant activity for Arbutus andrachne L. (R2=0.952).

Conflict of interest

The authors hereby declare that there is no conflict of interest.

References

Abidi, E., Habib, J., Mahjoub, T., Belhadj, F., Garrab, M., & Elkak, A. (2016). Chemical composition, antioxidant and antibacterial activities of extracts obtained from the roots bark of Arbutus andrachne L. a Lebanese tree. International Journal of Phytomedicine, 8(1), 104-112.

Aljabari, Z., Alzeer, J., & Arafeh, R. (2014). Catechin detection in callus and in vitro cultures of the Eastern

ISSN-Internet 2197-411x OLCL 862804632

strawberry tree, Arbutus andrachne L., an endangered medicinal tree in Palestine. Global Journal of Research on Medicinal Plants & Indigenous Medicine, 3(5), 196-205.

Bilto, Y. Y., Alabdallat, N. G., & Salim, M. (2015). Antioxidant properties of twelve selected medicinal plants commonly used in Jordan. British Journal of Pharmaceutical Research, 6(2), 121-130. doi: 10.9734/BJPR/2015/16136.

Brunton, J. (1999). Pharmacognosy: Phytochemistry, Medicinal plants. Intercept Limited.

Chua, M. T., Tung, Y. T., & Chang, S. T. (2008). Antioxidant activities of ethanolic extracts from the twigs of cinnamomumosmo phloeum. Bioresource Technology. 1918-19225. doi.org/10.1016/j.biortech.2007.03.020.

Cox, S. D., Jayasinghe, K. C., & Markham, J. L. (2005). Antioxidant activity in Australian native sarsaparilla (Smilax glyciphylla). Journal of ethnopharmacology, 101(1-3), 162-168. doi.org/10.1016/j.jep.2005.04.005.

Ergun, N., Okmen, G., Yolcu, H., Cantekin, Z., Ergun, Y., Isık, D., & Sengul, P. (2014). The enzymatic and non-enzymatic antioxidant activities of Arbutus andrachne L. leaf and flower and its antibacterial activities against mastitis pathogens. Eur J Exp Bio, 4(1), 227-232.

Fonseca, D. F., Salvador, Â. C., Santos, S. A., Vilela, C., Freire, C. S., Silvestre, A. J., & Rocha, S. M. (2015). Bioactive Phytochemicals from Wild Arbutus unedo L. Berries from Different Locations in Portugal: Quantification of Lipophilic Components. International journal of molecular sciences, 16(6), 14194-14209. doi: 10.3390/ijms160614194.

Gairola, S., Shariff, N.M., Batt, A., & Kala, C.P. (2010). Influence of climate change on production of secondary chemicals in high altitude medicinal plants: Issues needs immediate attention. J. Med Plants Res., 4(18), 1825-1829.doi: 10.5897/JMPR10.354.

Guendouze-Bouchefa, N., Madani, K., Chibane, M., Boulekbache-Makhlouf, L., Hauchard, D., Kiendrebeogo, M., ... & Duez, P. (2015). Phenolic compounds, antioxidant and antibacterial activities of three Ericaceae from Algeria. Industrial crops and products, 70, 459 - 466. doi.org/10.1016/j.indcrop.2015.03.053.

Hamzaa, R. G., El Shahat, A. N., & Mekawey, H. M. S. (2012). The antioxidant role of mulberry (Morus alba L.) fruits in ameliorating the oxidative stress induced in γ-irradiated male rats. Biochem Anal Biochem, 1(122), 2161-1009. doi: 10.4172/2161-1009.1000122.

Handa, S., Longo, G., Khanuja, S., & Rakesh, D. (2008). Extraction Technologies For Medicinal and Aromatic Plants. International Center For Science and High Technology-Trieste, 266p.

Isbilir, S.S., Orak, H.H., Yagar, H., Ekinci, N. (2012). Determination of antioxidant activities of strawberry tree (Arbutus unedo L.) flowers and fruits at different ripening stages. Acta Sci Pol, 11, 223-237.

Kong, K. W., Mat-Junit, S., Aminudin, N., Ismail, A., & Abdul-Aziz, A. (2012). Antioxidant activities and polyphenolics from the shoots of Barringtonia racemosa (L.) Spreng in a polar to apolar medium system. Food Chemistry, 134(1), 324-332. doi.org/10.1016/j.foodchem.2012.02.150.

Mezadri, T., Villaño, D., Fernández-Pachón, M. S., García-Parrilla, M. C., & Troncoso, A. M. (2008). Antioxidant compounds and antioxidant activity in acerola (Malpighia emarginata DC.) fruits and derivatives. Journal of Food Composition and analysis, 21(4),282-290. doi.org/10.1016/j.jfca.2008.02.002.

Mohd Azman, N. A., Gallego, M. G., Segovia, F., Abdullah, S., Shaarani, S. M., & Almajano Pablos, M. P. (2016). Study of the properties of bearberry leaf extract as a natural antioxidant in model foods. Antioxidants, 5(2), 11p. doi:10.3390/antiox5020011.

Moualek, I., Aiche, G. I., Guechaoui, N. M., Lahcene, S., & Houali, K. (2016). Antioxidant and anti-inflammatory activities of Arbutus unedo aqueous extract. Asian Pacific Journal of Tropical Biomedicine, 6(11), 937-944. doi.org/10.1016/j.apjtb.2016.09.002.

Okmen, A.S. (2015). Antioxidant and antibacterial activities of different plants extracts against Staphylococcus aureus isolated from soccer player's shoes and

knowledge and applications about foot hygiene of the soccer players. Afr J Tradit Complement Altern Med 12,143-149.

Orak, H. H., Yagar, H., Isbilir, S. S., Demirci, A. Ş., Gümüş, T., & Ekinci, N. (2011). Evaluation of antioxidant and antimicrobial potential of strawberry tree (Arbutus unedo L.) leaf. Food Science and Biotechnology, 20(5), 1249-1256.

Panico, A. M., Garufi, F., Nitto, S., Di Mauro, R., Longhitano, R. C., Magrì, G., ... & De Guidi, G. (2009). Antioxidant activity and phenolic content of strawberry genotypes from Fragaria x ananassa. Pharmaceutical Biology, 47(3), 203-208, doi. org/10.1080/13880200802462337.

Pavlovic, R. D., Lakusic, B., Doslov-Kokorus, Z., & Kovacevic, N. (2009). Arbutin content and antioxidant activity of some Ericaceae species. Pharmazie, 64, 656–659. doi.org/10.1691/ph.2009.9551.

Pellegrini, N., Serafini, M., Colombi, B., Del, D., Salvatore S., Bianchi, M., & Brighenti, F. (2003). Total antioxidant capacity of plant foods, beverages and oils consumed in Italy assessed by three different in vitro assays. J Nutr, 133: 2812–2819p.doi.org/10.1093/jn/133.9.2812.

Puertas-Mejía, M. A., Rincón-Valencia, S., & Mejía-Giraldo, J. C. (2015). Screening of UVA/UVB absorption and in vitro antioxidant capacity of Bejaria aestuans, Cavendishia pubescens and Cavendishia bracteata leaf extracts. Res. J. Med. Plant, 9, 435-441. doi: 10.3923/rjmp.2015.

Ruiz-Rodríguez, B. M., Morales, P., Fernández-Ruiz, V., Sánchez-Mata, M. C., Camara, M., Díez-Marqués, C., ... & Tardío, J. (2011). Valorization of wild strawberry-tree fruits (Arbutus unedo L.) through nutritional assessment and natural production data. Food Research International, 44(5), 1244-1253. doi. org/10.1016/j.foodres.2010.11.015.

Saral, Ö., Bak, F. E., & Ölmez, Z. (2017). Determining total phenolic content and antioxidant activity in fruits and flowers of naturally grown Arbutus andrachne L. in Artvin. Artvin Coruh UEniversitesi Orman Fakueltesi Dergisi, 18(1), 51-54. doi:10.17474/artvinofd.271042.

Sakar, M. K. Berkman, M. Z. Calis, I., & Ruedi, P. (1991). Constituents of Arbutus andrachne. Fitoterapia. 62, 176-177.

Serçe, S., Özgen, M., Torun, A. A., & Ercişli, S. (2010). Chemical composition, antioxidant activities and total phenolic content of Arbutus andrachne L. (Fam. Ericaceae) (the Greek strawberry tree) fruits from Turkey. Journal of Food Composition and Analysis, 23(6), 619-623. doi.org/10.1016/j.jfca.2009.12.007.

Stratil, P., Klejdus, B., & Kubáň, V. (2007). Determination of phenolic compounds and their antioxidant activity in fruits and cereals. Talanta, 71(4), 1741-1751. doi.org/10.1016/j.talanta.2006.08.012.

Sokół-Łętowska, A., Oszmiański, J., & Wojdyło, A. (2007). Antioxidant activity of the phenolic compounds of hawthorn, pine and skullcap. Food chemistry, 103(3), 853-859. doi.org/10.1016/j.foodchem.2006.09.036.

Tawaha, K., Alali, F. Q., Gharaibeh, M., Mohammad, M., & El-Elimat, T. (2007). Antioxidant activity and total phenolic content of selected Jordanian plant species. Food chemistry, 104(4), 1372-1378. doi. org/10.1016/j.foodchem.2007.01.064.

Yeum, K. J., Russell, R. M., Niki, E., & Aldini, G. (2010). Antioxidant activity and oxidative stress: An overview. Biomarkers for Antioxidant Defense and Oxidative Damage: Principles and Practical Applications, 3-19p. doi.org/10.1002/9780813814438.ch1.

ISSN-Internet 2197-411x OLCL 862804632

The European Commission has today launched a public consultation on its future Action Plan on Organic Farming.

https://ec.europa.eu/info/index_en

This sector will play an important role in achieving the European Green Deal ambition, and reaching the objectives set out in the Farm to Fork and Biodiversity Strategies. It is a priority for the Commission to ensure that the organic farming sector has the right tools in place as well as a well-functioning and consensual legal framework which is key to achieving the objective of 25% of agricultural land dedicated to organic farming. While the new organic regulation provides a solid basis, secondary legislation still to be adopted needs to be equally resilient. At the request of Member States, the European Parliament, third countries, and other stakeholders, the Commission has therefore proposed today as well to postpone the entry into force of the new organic legislation by one year, from 1 January 2021 to 1 January 2022.

Agriculture and rural development Commissioner Janusz **Wojciechowski** said: "The Farm to Fork and Biodiversity strategies set ambitious targets for the agricultural sector to ensure it is Green Deal-ready. Organic farming will be a key ally in the transition that we are leading towards a more sustainable food system and a better protection of our biodiversity. The Commission will support the organic sector towards the achievement of the 25% target of agricultural land under organic farming by 2030 with the appropriate policy and legal framework. "

The future Organic Farming Action Plan, due for adoption early in 2021, will be an important instrument to accompany the future growth of the sector. The Commission's Farm to Fork and Biodiversity Strategies include the target of reaching 25% of agricultural land under organic farming by 2030. To help reach this target, the European Commission is putting in place and making use of key tools:

- **An Action Plan for Organic Farming**, which will be instrumental in helping boost the sector, both at demand and supply level. It will be organised around three key angles: stimulating demand for organic products while maintaining consumer trust; encouraging the increase of the organic farming area in the EU; and, enhancing the role of organic production in the fight against climate change and biodiversity loss, including in sustainable resource management. The public consultation launched today aims at gathering feedback on the draft plan from citizens, national authorities and relevant stakeholders. The questionnaire will be online for a period of 12 weeks, until 27 November
- **The new organic legislation,** which will reflect the changing nature of this rapidly growing sector. The new rules are designed to guarantee fair competition for farmers while preventing fraud and maintaining consumer trust. To ensure a smooth transition between the current and future legislation and to allow the industry and Member States to be fully ready to implement the new rules, the Commission has proposed to postpone by one year its entry into force. The postponement was originally requested by Member States, the European Parliament, third countries, and other stakeholders due to the complexity and importance of the secondary legislation under preparation. As a result of the coronavirus crisis, work on the secondary legislation has slowed down. The postponement will allow sufficient time for the necessary extensive consultations and legislative scrutiny.
- **The EU agri-food promotion policy**, which supports the European agricultural sector by promoting its quality features on the internal market and in third countries. For the year 2021, the Commission plans to allocate a specific budget of €40 million to organic farming under the promotion policy. This budget will co-finance promotion actions and information campaigns on the EU organic sector, raising awareness about its qualities and aiming at stimulating demand.

For further Information: **https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1548**

Have your say……

Photo credit: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

European Green Deal

About this initiative

Summary: Under the European Green Deal, the EU has set an ambitious target for 2030:

- at least 25% of EU agricultural land to be farmed organically
- a significant increase in organic aquaculture (fish farming).

This action plan will help consumers, farmers, business operators, national governments and local authorities to reach this target. It will:

- drive investment and innovation in sustainable farming
- respond to increased consumer interest in organic food
- boost demand for organic food.

Topic: Agriculture and rural development
Type of act: Communication

The Commission would like to hear your views.
This roadmap is open for feedback for 7 weeks. Feedback will be taken into account for further development and fine tuning of the initiative. The Commission will summarise the input received in a synopsis report explaining how the input will be taken on board and, if applicable, why certain suggestions can't be taken up.

If you are interested to get into the discussion more deeply please visit:
https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12555-Organic-farming-action-plan-for-the-development-of-EU-org

ISSN-Internet 2197-411x OLCL 862804632

BioFach 2021.

https://www.biofach.de/en

BIOFACH2021
into organic

im Verbund mit

VIVANESS2021
into natural beauty

BioFach is taking place from 17th to 19th of February 2021 at Messe Nuremberg

Organic is more than a label or certificate; it is about the product's quality and even the producer's and consumers' self-discipline and responsibility.
BioFach, the largest exhibition for organic food organizations and companies, will be organized this year with the collaboration of Vivaness, the trade fair for natural and organic personal care.
Every year, this exhibition brings together over 3 200 exhibitors and 51 000 international visitors.
It provides an excellent opportunity for both exhibitors and visitors to network, does brand positioning and market testing, and gain invaluable information on the latest trends, sustainability, and innovations.

This year, BioFach will take place from 17th to 19th of February 2021 at Messe Nuremberg.

For more information:
https://www.biofach.de/en

ISSN-Internet 2197-411x OLCL 862804632

TP Organics: Green Deal Call being published

https://ec.europa.eu/info/index_en

The European Commission published the Green Deal call as part of the **Horizon 2020 Work Programme 2018-2020.** Research and innovation projects are to be funded in 8 thematic areas. Area 6 is about the Farm to Fork strategy, Area 7 about the Biodiversity Strategy for 2030.

Area 6 proposals will test, pilot and demonstrate innovative systemic solutions (innovation actions) to one of the following 6 subtopics, corresponding to urgent and pressing food systems' challenges:

- Achieving climate neutral farms by reducing GHG emissions and by increasing farm-based carbon
- sequestration and storage
- Achieving climate neutral food businesses by mitigating climate change, reducing energy use and increasing energy efficiency in processing, distribution, conservation and preparation of food
- Reducing the dependence on hazardous pesticides; reducing the losses of nutrients from fertilisers, towards zero pollution of water, soil and air and ultimately fertiliser use
- Reducing the dependence on the use of antimicrobials in animal production and in aquaculture
- Reducing food losses and waste at every stage of the food chain, while also avoiding unsustainable
- packaging
- Shifting to sustainable healthy diets, accessible to all EU citizens, including the most deprived and vulnerable groups

In addition, proposals for projects in 2 horizontal areas with a longer-term perspective are invited:

- **Strengthening our knowledge in support of the European Green Deal**
- **Empowering citizens for the transition towards a climate neutral, sustainable Europe**

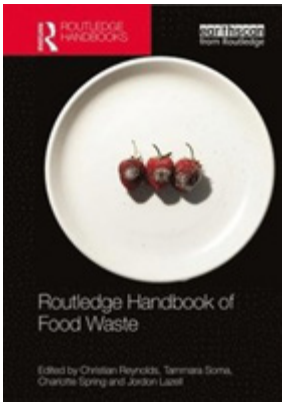
Deadline for submissions is **January 26, 2021.**

You can find more information:

https://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-cc-activities_en.pdf

ISSN-Internet 2197-411x OLCL 862804632

Future of Food: Journal on Food, Agriculture and Society, 8 (3)



Routledge Handbook of Food Waste

A review by Yasmeen Ismael

Authors: Christian Reynolds, Tammara Soma, Charlotte Spring, Jordon Lazell
Publisher: Routledge
Published year: 2020
Language: English
ISBN: 978-0-429-87070-5
Length: 524 pages

Food waste, or food loss, is one of the major global problems that is facing the recent efforts towards a more sustainable world. Recent research considers food waste not only a financial problem but also an ethical and environmental one. Food waste can be a result of any part of the food chain: farmers, retailers, food industries, caterers and consumers. Routledge Handbook of Food Waste is a comprehensive handbook that presents state of the art research on food waste from different perspectives such as agriculture, economics, food science, industrial ecology, environmental policy, consumer behaviour, geography, theology, and sociology.

Understanding the drivers behind the current food waste issue is a key factor to search for solutions to this global problem. In the first part, the book goes through the history of food waste and explores shocking statistics of the amount of food waste globally. Besides, it explains the different factors that have led the world to the contemporary food waste issue such as politics, economy, consumption habits and food systems. The book sheds light on how the value of food has changed throughout the historical timeline. It suggests that most of the food waste we witness nowadays results from deliberate actions, and doubts the efficiency of the capitalist economies that invest in the different parts of the food chain and eventually end up throwing away food.

Food waste, and loss, can be detected all along the supply chain parts, from farm to fork. In its second part, the book is discussing the causes, solutions and future developments regarding this global issue. In the first chapter, Lisa K. Johnson discusses how agricultural loss is often missing when discussing the concept of food waste. Moreover, the author explains the different definitions between food "waste" and "loss." The World Resources Institute defines food "waste" as the waste that results during the storage, processing, and distribution stages of the supply chain, whereas food "loss" results from agricultural processes or technical problems during packaging or marketing. In the second section, Martin Gooch and Abdel Samie Felfel discuss the food wase and loss (FLW) during the processing and distribution. The authors highlight strategies and techniques to reduce FLW, such as the PDCA (Plan →Do →Check →Act) and 'TIM WOOD'. The PDCA is a methodology that has been applied for 40 years and provides an effective approach to testing small changes and solving problems. It is useful for measuring improvements across the company.

Although food waste is a real global problem, many countries and regions follow their own strategies to reduce or prevent this issue. The third part of the book provides a review of different regional approaches to solving this problem. This part is divided into six chapters studying food loss and waste alongside policies and legislations in the different regions such as the United States, Asia, Saudi Arabia, New Zealand and Brazil. Each chapter deals with research reviews in a different region.

Throughout the world, different methodologies to study and investigate food waste and loss have been presented. The chapters of the fourth part present the different methodologies of investigating food waste through both qualitative and quantitative methods. An example of those methodologies is "Quantifying Food Waste" presented by Sally Geisler. This method pays special attention to audits, surveys, and new technologies. It allows the researchers to answer questions such as "what" and "how much" is related to food waste and loss. Another example is the application of social innovation and indigenous methodology to challenge the issue of food waste. This method allows the stake-

holders to develop a shared understanding of the problem and work together to innovate solutions through data collection and analysis.

As the previous parts of this book explore the complex reasons and interpretations of food waste and loss, maybe one of the most critical questions of this book is discussing the solutions to solve or prevent food waste. The fifth part of this book demonstrates the most important solutions that have been suggested for the different parts of the supply chain. Some authors emphasise the vital role of human eating behaviour in finding solutions, others highlight the potential role of technology, while others explore the role of policies. One of the suggested solutions is to redistribute the surplus food, which is edible and safe for human consumption, from food industry actors to other organisations. Another solution is to use unavoidable food waste in the food chain as animal feed. Moreover, the average percentage of food waste generated by consumers' behaviour is from 40% to over 50%. Therefore, one of the most effective methods to avoid food waste is to investigate the factors that increase food waste at consumer level such as the impact of food labelling and packaging, as well as the eating environment that surrounds food. Studying the impact of each factor will help to find effective solutions that lead to food waste reduction.

This book is a captivating book full of literature on food waste, intriguing stories of regional methodologies and creative innovations of finding solutions. One review would not be enough to cover all the exciting aspects of this book. The book explores the multidisciplinary nature of food waste research. The reader would not feel bored, as each part presents a different aspect of this problem and new concepts.

About the author:

Yasmeen Ismael is an experit with an outstanding record in training & academic teaching. She is working in the field of teaching intl' management courses (Marketing, Purchasing, Communication, Entrepreneurship, English language for Business). She obtained a Master II in Law, Commerce and Management specialised in International Management and Purchasing from the University of Le Havre, France. She has studied and worked internationally in countries like France, USA, UK, UAE, KSA, Malaysia and the Middle East.

ISSN-Internet 2197-411x OLCL 862804632

CALL FOR PAPERS

Vol. 9, Number 1 2021

THE FUTURE OF FOOD JOURNAL
JOURNAL ON FOOD, AGRICULTURE & SOCIETY

Special Issue on Sustainable Agriculture & Food Systems

Current environmental challenges, global warming, climate change and the loss of biodiversity and natural resources are in one way or another linked to human behaviour. Unsustainable production methods and individual consumption could explain most of these challenges. These global issues are encouraging people to adopt better pro-environmental practices. Sustainable agriculture and sustainable food systems are helping meet society's current food needs, as well as textile and energy needs, without compromising the needs of future generations. However, there is still a worldwide debate about the relationship between agriculture and nature conservation. For example, how much arable land should be used for commodities linked to textile (such as cotton) or energy production (e.g. maize)? Still, sustainable agriculture is key to fostering food safety and sovereignty. Therefore, researchers and practitioners are required to strive and integrate the concepts, benefits and consequences of more sustainable agriculture and food systems in their work-related efforts.

Future of Food Journal is currently running a special issue entitled "Sustainable Agriculture & Food Systems". This special issue aims to highlight original research articles, researcher's opinions, news and book reviews on the related topic.

The topics include but are not limited to:

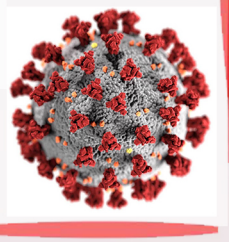
- Sustainable agricultural practices in different countries
- Economic, social and political context of value chains
- Food production and transformation e.g. urban agriculture
- Food consumption and Food education programs
- Farming and natural resources (e.g. biodiversity, climatic relevant emissions, water)
- Emerging trends and new technologies in sustainable agriculture and food systems

FOFJ is a free-of-charge, peer-reviewed and open-access online journal for international scholars and researchers supported by the University of Kassel and the Federation of German Scientists (VDW).

For further details on the submission process, please see the instructions for authors at the journal website:

http://www.thefutureoffoodjournal.com/index.php/FOFJ/information/authors

Special Call for Papers



THE FUTURE OF FOOD JOURNAL
JOURNAL ON FOOD, AGRICULTURE & SOCIETY

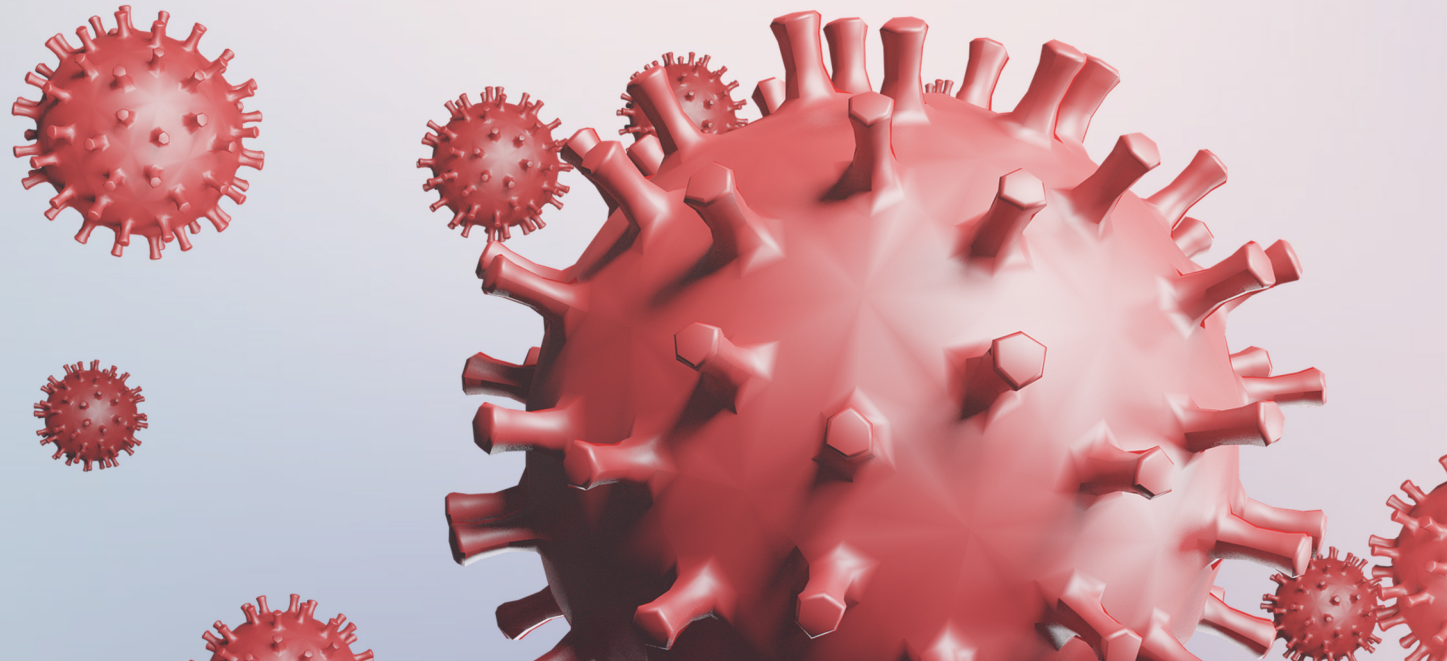
The multidimensional impacts of COVID 19 on the food systems

COVID 19 has been having multidimensional impacts on the food system, influencing food production, food trade, transport, and consumption. It also impacted water, energy, and labour supply, all directly linked to the food system. Nevertheless, the academic literature so far has been focusing on the measures adopted by governments during the pandemic, focusing on short term measures and solutions.
What is missing is a discussion on how COVID 19 is impacting the different dimensions of the food system both in the short term as well as in the long term.

This Special Issue call aims at developing such discussion, inviting scholars from different disciplines to engage in such an academic debate able to unpack and unfold the nuances behind impacts, responses, and implications. This would allow practitioners, policy makers, and scientists is to gain a better understanding of the problem at hand for the food system, on potential measures and solutions that could be adopted, and on their implications.

Furthermore, the special issue is also interested in understanding the how the pandemic is impacting the society and the people, including food producers and the most marginalised segments of societies, reflecting on how are peoples experiencing COVID-19 and what will be its long-term impact politically, economically, socially, and culturally? It encourages papers from a wide range of disciplines and methodological approaches.

Submission Guidelines - Deadline: December 31, 2020



Call for Reviewers

THE FUTURE OF FOOD JOURNAL
JOURNAL ON FOOD, AGRICULTURE & SOCIETY

Future of Food Journal is opining now a Call for Reviewers. Join us in our effort to reduce the manuscript processing lead time!

As the peer-review process is a fundamental criterion in scientific publication, the number of qualified reviewers is declining when the number of submissions is increasing. We are looking to expand our team of expert peer reviewers in the fields of:

1- Sustainable Agriculture
2- Sustainable Food system
3- Food Production & Technology
4- Nutrition and Diets
5- Environmental and Climate Sciences
6- Consumers Behaviour

And we would be delighted for you to join our team.

What to expect being a reviewer at FOFJ:

1- A great scientific experience
2- An acknowledgement in one of our published issues after the completion of 5 reviews
3- The opportunity to join the Editorial Board when a call for members is open
4- 100 € after the completion of 5 reviews

Your duties would be to:

1- Review the assigned paper within max. 3 weeks
2- Review the manuscript once it has been accepted and revised within max. 1 week

Looking forward to receiving your application.

Please follow the link below for the new online registration process:

https://www.thefutureoffoodjournal.com/index.php/FOFJ/user/callReviewer

Thank you Reviewers

THE FUTURE OF FOOD JOURNAL
JOURNAL ON FOOD, AGRICULTURE & SOCIETY

FOFJ appreciates the efforts and experience of all its highly qualified reviewers who contribute to the science and quality of research. Therefore, FOFJ thanks all the reviewers who dedicate time, knowledge, and effort to improve the quality of submitted manuscripts.
In this issue, FOFJ would like to extend a sincere Thanks to our reviewers **Prof. Dr. Nasser Haboub, Dr. agr. Wahyudi David, Dr. Diana Hamaidosh and Dr. Eny Palupi** for their contribution in reviewing articles for Vol 8 Nr 1,2 and 3. As FOFJ launches a new Call of Reviewers, we hope to continue working with experienced academics to provide the best for our readers and authors.

Dr. Diana Hmaidosh is a researcher with a strong knowledge of medicinal and aromatic plants and bio accumulators. She gained extensive experience in medical drug laboratory during her work in the laboratories of the Faculty of Pharmacy in both Tishreen university and Andalus Private Medical University, Syria.

She is an academic teacher and supervisor and has supervised several undergraduates, graduate and postgraduate students in the Faculty of Agriculture and Pharmacy at Tishreen University, Syria.
Currently, she works in the Department of Biodiversity- Cedar & Fir reserve, Ministry of Agriculture, Syria. Before that, she worked as a member of the National Environmental Observatory Project in the Ministry of Local Administration and Environment, where she obtained ten years of rich practical experience in GIS.

Dr. Hmaidosh obtained her Ph.D. degree from Tishreen University. During her studies, she conducted chemical experiments at the laboratories of the Agricultural faculty of Basra University, Iraq.
Her work and results were presented in many national and international scientific conferences. Before her Ph.D. studies, she obtained a BA and MA in Ecological science from Tishreen University, Syria.
Throughout her academic years, Dr. Hmaidosh has published several scientific papers.

Dr.Eny Palupi is a researcher in food and nutrition sciences. She has been actively working on the indigenous forgotten source as future sustainable food to cover global food and nutrition security. She also investigates its utility for supporting the optimal growth of fetuses, infants, and children. Some of the identified forgotten sources include edible insects, forgotten legumes, fermented foods, aquatic sources, forgotten mushrooms, plants, and some agricultural by-products. She also works in meta-data to get a robust conclusion in the food and nutrition area.

She is an academic staff in the Department of Community Nutrition, Faculty of Human Ecology, IPB University, Indonesia. She delivers various courses on undergraduate and graduate programs in the area of food safety and security, food analysis, nutrition evaluation, sensory evaluation, foodstuff and its post-harvest characteristics, food processing, and product development.
Dr. Palupi studied at the Faculty of Agricultural Technology, Bogor Agricultural University, Indonesia, where she gained a BSc in Food Technology. In 2011, Eny completed an MSc program of International Food Business and Consumer Studies at the Faculty of Organic Agricultural Sciences, Kassel University, Germany. She obtained her PhD in 2015 from the Department of Organic Food Quality and Food Culture at Kassel University, Germany. Her PhD focused on potential ways to reduce malnutrition among Indonesian children using locally available foods.

Thank you Reviewers

THE FUTURE OF FOOD JOURNAL
JOURNAL ON FOOD, AGRICULTURE & SOCIETY

Nasser HABOUB is a university professor and researcher in the fields of agricultural machinery, waste management, industrial and municipal wastewater technology. He is interested in all environmental issues and his mechanical engineering studies were a stepping stone to various areas in which he later worked. He did his doctorate at the Humboldt University in Berlin in the field of agricultural machinery and then completed a six-month course at the University of Kassel about Methods of university didactics and scientific research.

In addition to Prof. Haboub's long academic experience, more than a quarter of a century, he was also active in the field of economics bringing theory and practice together. His work was also related to sustainability where participated in the development of a machine for shredding agricultural waste at one of the German universities, which was the entry into waste management. He gained the trust of scientists and business people in Germany and this was the gateway to his participation in the planning and construction of several industrial wastewater treatment plants outside of Germany. He gained the experience of managing engineering studies in the field of wastewater engineering through his work in the largest engineering office in Syria for several years. He worked as a visiting professor at the Weihenstephan-Triesdorf University in Bavaria.

During Prof. Haboub's career, he worked as a link between Germany and the Mediterranean countries in the academic and economic field by participating in the organization of the activities of the German-Syrian Environment Week for energy and sustainable environmental systems.

Prof. Haboub is currently working as a consultant at "the Arab Center for the Studies of Arid zones and Dry land – ACSAD.

Dr. agr. Wahyudi David is a Assistant Professor of Food Science and Tech. Universitas Bakrie, Indonesia.

For more than 12 years, he was involved in organic research, particularly in the processing and sensory evaluation. He serves as associate editor of Journal Organic Agriculture (section food processing) (https://www.springer.com/journal/13165/editors) as well as Managing Editor of Asia Pacific Journal of Sustainable Agriculture Food and Energy. In 2013, together with other University colleagues in Southeast Asia, he initiated the Sustainable Agriculture Food and Energy (SAFE) Network that consists of 10 countries and 34 Universities in the Asia Pacific regions.

He publishes more than 50 scientific papers. Most of the publication is on organic food, dietary pattern, food culture, and sensory evaluation (both in English and in Indonesian). He awarded a research grant from several funding institutions.
He is a member of the Indonesian Association of Food Technologist (IAFT) and an active member of the International Society of Organic Agriculture Research (ISOFAR) as well as a member of the Indonesia Society for Functional Food and Nutraceutical (ISFFN).

He was involved as a technical committee for Indonesia Standard Body (BSN) for sensory evaluation standards and a scientific advisor for Indonesia Organic Alliance (IOA). Since 2019, He appointed by the IFOAM Asia as Organic innovation, Research, and Development Committee board.
He obtained a Doctoral degree in 2011 as Doktors der Agrarwisshenschaften (Dr.agr), specifically in the field of Organic Food Quality and Food Culture and his Master's degree from Universitaet Kassel.