

PAPER • OPEN ACCESS

## Institutional strengthening of farmer group to support sustainable agriculture and food security in Pesawaran regency

To cite this article: Indah Listiana *et al* 2021 *J. Phys.: Conf. Ser.* **1796** 012028

View the [article online](#) for updates and enhancements.



**IOP | ebooks™**

Bringing together innovative digital publishing with leading authors from the global scientific community.

Start exploring the collection—download the first chapter of every title for free.

# Institutional strengthening of farmer group to support sustainable agriculture and food security in Pesawaran regency

Indah Listiana<sup>1</sup>, Abdul Mutolib<sup>1</sup>, Rinaldi Bursan<sup>2</sup>, Helvi Yanfika<sup>1</sup>,  
Raden Ajeng Diana Widyastuti<sup>3</sup>, Ali Rahmat<sup>4</sup>,

<sup>1</sup>Study Program of Agricultural Extension, Faculty of Agriculture, University of Lampung, Indonesia

<sup>2</sup>Faculty of Economics and Business, University of Lampung, Indonesia

<sup>3</sup>Study Program of Agrotechnology, Faculty of Agriculture, University of Lampung, Indonesia

<sup>4</sup>Department of Soil Sciences, Faculty of Agriculture, University of Lampung, Indonesia

\*Corresponding author: indahlistiana@yahoo.com

**Abstract.** Sustainable agriculture and food security can be realized through the institutional strengthening of farmer groups, namely independent business and collective solidarity in facing land degradation problems, environmental quality degradation, and food security problems. This study aimed to analyze the role of farmer group institutions in supporting sustainable agriculture and food security of farmers. The method used in this study was a survey research method. The research approach used was a quantitative approach that is supported by qualitative data. Data used in this study were primary data from interviews using questionnaires to research respondents and in-depth interviews. Furthermore, the data were analyzed by the tabulation technique and analyzed by correlation analysis using the *SPSS* application. The results showed that there is no significant relationship between the roles of farmer groups in preserving the environment. However, farmer groups as learning units have a significant relation to farmers' ability to preserve the environment. The relationship between farmer group institutions (means for learning, cooperation arena, and production units) and household food security level has a very significant relation both as a whole and as a group function. The institutional strengthening of farmer groups indirectly affected the improvement of environmental quality and had a direct effect on rice farmers' food security in Pesawaran Regency.

**Keywords:** environmental quality, food security, farmer group institutions

## 1. Introduction

According to Statistics Indonesia or BPS, the amount of population that lives below the poverty line are much dominant in a rural area compared to the urban area [1-3]. One of the leading causes of poverty in rural areas is food problems because the shortage of foods makes it hard to fulfill household consumption needs [4]. Food and Agriculture Organization (FAO) reported that food index averaged 96.1 points in August 2020, up 1.8 points (2.0 percent) from July 2020 [5, 6]. Farmer group is one of the agricultural institutions that have a role in developing rural business units with the local and also supporting the effort



to fulfill the food needs [7, 8]. Farmer group is a collective of farmers in an area that is informally tied by everyday needs [9, 10].

Farmer groups formed by farmers and the existence of a farmer group cannot be separated from the agricultural extension [11, 12]. The relationship between extension and farmers are built upon trust to ensure good cooperation [13]. Cooperation built with trust, norm, and networks become the social asset key in interaction [3]. The farmer needs the information from the extension [14]. Agricultural development involving farmers cannot be separated from global scale development. All of the development must be moving toward Sustainable Development Goals (SDG) to create an environmentally friendly development [15, 16]. One of the crucial aspects of SDGs will help to cope with poverty and starvation while ensuring life continuity [17]. According to the Global Hunger Index (GHI), in 2019, Indonesia placed 70 out of 117 countries with the highest hunger rate [18]. From the environmental aspect, in Indonesia, agriculture is one of the sectors that contribute to greenhouse gasses [19,20]. Agricultural development with considering environmental aspects in mind must be the end goal of now and future development [21,22].

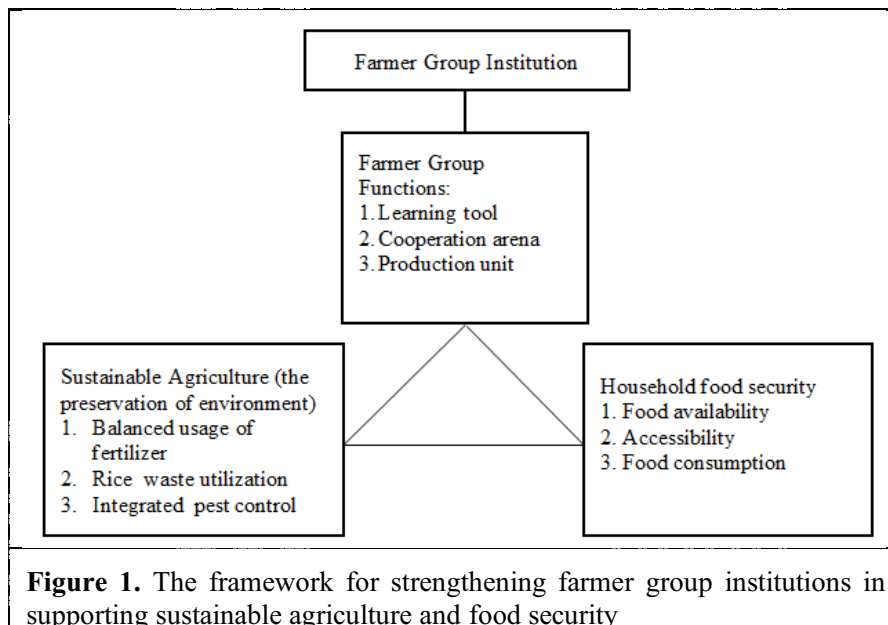
Preliminary research manages to identify that many farmers live in hand with poverty and powerlessness [23]. Farmer became the last choice when there are no other options [24]. Economically, working on the farm provide little economic sufficiency, but on the other hand, it provides another way for a family to survive. In some cases, institutional farmer groups became an important aspect to increase household food security [25,26]. However, research on the relationship between farmer groups and agricultural sustainability is still limited [27-29]. This research is focused on the relationship between institutional strengthening of farmer groups and agricultural sustainability from the aspects of farmer attitudes, cultivation, production and post-harvest. The hypothesis of this research is that farmer group affects sustainable agricultural development and farmers' food security. This research expected can be used as a reference in the future to help realize sustainable agricultural development and farmers' food security. The purpose of the research is to identify the role of institutional farmer group in supporting sustainable agriculture and locals' food security in Pesawaran regency.

## 2. Research Methods

The research was conducted in Padang Cermin Village and Kota Jawa Village, which are located in the administrative area of Padang Cermin subdistrict and Way Khilau subdistrict, Pesawaran Regency. The location was purposely selected because it is a central agricultural region where many of the inhabitants work as lowland rice farmers. Primary data collection was conducted from April to July 2020. The population or the subjects in this study were farmers that actively involved in farmer groups in the two subdistricts. Respondents were determined using a simple random sampling method, and from it, 96 respondents were obtained, scattered in the two districts.

There are two different sets of data used in this study, which are primary and secondary. Primary data obtained through interviews. Secondary data obtained from books, reports, and other sources. This research was conducted using a survey research method. Hypothesis testing research is a study that explains the causal relationship between variables through hypothesis testing [30]. The research approach used is a quantitative approach supported by qualitative data. The data were collected using questionnaires. The data include the institutional role of farmer groups (learning media, cooperation, and production units), sustainable agriculture (balanced fertilizer usage and utilization of rice waste), household food security (availability, accessibility, and food consumption).

The data processing and analysis techniques used in this study were divided into three stages. After the data is collected, it is then written down into the logbook and respondent codebook before being processed using SPSS. The rank spearman used to determine whether there is an influence between two variables, which are the institutional role of farmers group variable, sustainable agriculture, and the status of household food security of farmers variable.



### 3. Results and Discussion

#### 3.1. Farmers characteristic

The individual characteristics of the respondents varied. The average age of farmers in the productive age range is around 49 years. Productive age is the age that is open to various kinds of innovations and changes. The education level is dominated by junior high school graduates, although there are respondents who received high school and higher education levels. The average respondents' income is Rp. 4,000,000.00. Some respondents can be categorized into prosperous range according to the determination of the poverty line by BPS. The cultivation area controlled by the respondents ranged from 0.25 ha to 2 ha. The characteristics of the research respondents are shown in Table 1.

**Table 1.** The distribution of individual characteristic of respondent

No	Farmer characteristics	Range	Average	Classification
1.	Age	30 – 65 years	49 years	Productive Age
2.	Education level	Elementary to College	9 years	Junior High School
3.	Time spent as farmer	7 – 41 years	20 years	Adequate
4.	Number of dependents	2 – 7 peoples	4 peoples	Adequate
5.	Farmer income	Rp. 200.000- Rp. 5.400.000	2.160.000 /mnth	Adequate
6.	Farm area	0,25 ha – 2 ha	0,58 ha	Small

#### 3.2. The role of farmer group institution

Farmer groups are formed from farmers, by and for farmers based on the need to learn, cooperate, and as a forum for farming business development. A farmer group is a group of farmers/ranchers/planters formed on shared interests, common environmental conditions (social, economic, resource), and familiarity to improve and develop members' businesses. As the party closest to farmers, extension workers have direct access to

provide input and guidance [31]. The roles of farmer groups as a means for learning, cooperation arena and a production unit are shown in Table 2.

**Table 2.** The roles of farmer groups as a means for learning, cooperation arena and a production unit

Variables/Indicators	Classification	Farmers (in %)
<b>Farmer Groups roles</b>		
Means for learn	Non - existing	0
	Very Low	16,3
	Low	14,7
	Medium	37,1
	High	31,9
Average Scores	Medium	70,4*
Cooperation Arena	Non - existing	14,2
	Very Low	16,2
	Low	24,4
	Medium	37,4
	High	7,8
Average Scores		64,3*
Production Unit	Non - existing	17,4
	Very Low	28,1
	Low	16,5
	Medium	23,0
	High	14,9
Average Scores	Medium	61,5*

Explanation \* Index Score Classification: Non - existing = 0-20; Very low= 21-40; Low= 41-60; Medium= 61-80; High= 81-100

### 3.2.1. Role of farmer groups as learning class

The principal role of a farmer group's institutional function is as a learning class. It provides a means for learning for farmers at the farmer group meeting. In it, farmers interact with each other, communicate, exchange information, and their experiences in managing their farm. The exchange of information is essential because it provides knowledge to the farmers who lack it. More than half of farmers (69%) agree that farmer groups can help solve problems related to farming. The farmer group functions as a forum for exchanging information regarding the balanced usage of fertilizers, processing straw into compost, processing rice husks into planting media and integrated pest control, and various kinds of production technologies both on-farm and off-farm to increase productivity and quality of agricultural products [32].

In addition to the role mentioned above, farmer groups' existence makes it easier for extension workers to introduce various new agricultural innovations that can optimize cultivation. The role of farmer groups as a learning class is in the medium category, meaning that not all farmers think that farmer groups are essential. More than 30% of respondents consider the function of farmer groups only as vessels to request government assistance. Therefore, it is necessary to optimize farmer groups' function to increase production and farmer welfare, so that they can change the view on farmer groups as a mere vessel.

### 3.2.2. Role of farmer groups as cooperation arena

The role of farmer groups as a cooperation arena, in this case, farmer groups, is to strengthen cooperation among farmers in groups and between groups and with other parties. The role and function of farmer groups

as a cooperation arena cannot operate on their own. It is because they need to be supported by extension agents and other parties. The institutional role of farmer groups as a cooperation arena is still relatively low. That farmers are not satisfied with the ability of extension workers in developing the organizations[33]. Also, many of the farmers consider the extension efforts' to develop farmer groups below. Farmers are required to have a high motivation to build networks or collaborations through farmer groups. Every member must help each other in order to increase the ability of the farmer group class. Also, extension workers and other related parties must assist farmers to build networks/partnerships with other parties.

### 3.2.3. Role of farmer groups as production unit

In this case, farmer group as a production unit, a farming business that was carried out by each member, is seen as a business unit that can be developed to achieve economic scale in terms of quantity, quality, and continuity. Like farmer groups' role as a cooperation arena, the institutional role of farmer groups as a production unit is dominated by the deficient and medium categories. Because the current farmer groups serve only as learning classes, a vessel to get assistance (subsidized fertilizers) and other agricultural programs from the government. The farmer groups were shown to be unable to fulfill their actual roles that have been determined by the Ministry of Agriculture. Some farmers view farmer groups only as learning classes and hangout places and their function as production units. Farmer groups still not been able to produce an original local product and the relationship with other groups to advertise their Products.

### 3.3. Farmer Groups, Sustainable Agriculture and Household Food Security

**Table 3.** Farmer groups, sustainable agriculture and household food security

Variables/Indicators	Classification	Farmers (in %)
<b>Sustainable Agriculture</b>		
Environment Preservation	Non – existing	15,5
	Very Low	24,2
	Low	38,6
	Medium	14,8
	High	6,9
Average Score	Low	59,2*
<b>Household Food Security</b>		
Food Security Status	In Danger	7,29
	Vulnerable	9,37
	Inadequate	34,37
	Steady	48,90
Modus	Steady	48,90

Explanation \* Index Score Classification: Non - existing = 0-20; Very low= 21-40; Low= 41-60; Medium= 61-80; High= 81-100

#### 3.3.1. Farmer groups and sustainable agriculture

The results of the study show that the role of farmer groups in developing sustainable agriculture/preserve the environment is still in the low category. The farmer's ability to apply a balanced fertilizer, utilizing rice waste, and controlling the environment still needs to be improved as an effort to support sustainable agricultural development and environmental preservation. While farmers have received training on the usage of balanced fertilizers, there are still many farmers who use fertilizer excessively, thinking that higher fertilizer will result in higher yield. In utilizing rice stalk (straw) waste as compost, only 25 percent of

farmers have applied it. Currently, the harvested straw is thrown away or burned; this kind of practice provides no economic and ecological benefits for the farmers and the environment.

In an integrated pest control aspect, only a few farmers apply it. Mostly they use chemical pesticides and herbicides that are easily obtained in markets/agricultural shops because they are considered more accessible and practical. Other reasons are because the usage of chemical pesticides and herbicides show faster results than the use of natural pesticides and herbicides. In general, the ability of farmers to conserve the environment in supporting sustainable agriculture is still low. There is a need for more substantial efforts from various parties to develop farmer groups as institutions that can support sustainable agriculture at the site level.

### 3.3.2. Household food security

Following Law No. 7/1996, food security is a condition in which the food needs in households are fulfilled. The availability of sufficient food in quantity and quality, safe, equitable, and affordable. Food security aims to realize the availability of food for all households, sufficient quantity, quality and proper nutrition, safe for consumption, equitable, and affordable for every individual [34]. World Bank defines food security as the access of all people to sufficient food to ensure an active and healthy life [35,36].

The distribution of household food security status is divided into four levels: secure, lack, insecure, and vulnerable. The results showed that 48.90% of farmer households have a secure food security level, and 34.37% of farmer households lack category. Meanwhile, 9.37% and 7.29% of farmer households are categorized as insecure and vulnerable level, respectively. Farmers households in insecure and vulnerable levels have a similar tendency that food consumption is highly dependent on rice consumption and cannot independently secure their rice supply. It is different from food secure households that able to provide their rice independently because all of their rice supply comes from their production.

The provision of non-rice food (side dishes) to all farmer households is still dependent. The consumption of side dishes is very dependent on the food supply from outside. Dependent side dishes supply availability will harm household food security in the future. It is hoped that the farmers can improve their ability to provide food, both rice, and non-rice. In general, farmer households in the secured category are still below 50%, which shows that more efforts are necessary to create food security. A good example is cooperating between parties through farmer groups because almost all farmers in its area are members. It is hoped that the farmer group institutional reach can cover all levels of farmers.

### 3.4. The Relationship between Farmer Group Institutions and Environmental Preservation and Household Food Security Levels

In the discussion, the relationship between the existence of farmer group institutions with environmental preservation, as well as the relationship between farmer group institutions and the level of household food security will be reviewed. The relationship between farmer group institutions (means for learning, cooperation arena, and production units) with environmental conservation and household food security was analyzed using the Rank Spearman correlation test. The relationship between the research variables can be seen in Table 4.

**Table 4.** The correlation coefficient between farmer group institutions, the environment preservation and food security

	Environment Preservation	Food Security
Farmer Group Role	0,098	0,202**
Means for Learns	0,120*	0,138**
Cooperation Arena	0,090	0,193**
Production Unit	0,059	0,240**



From Rank Spearman, the relation between farmer group institutions (means for learn, cooperation arena and production unit) with environmental preservation by farmer group members in applying balanced fertilizer, utilization of rice stem waste and rice husks, application of IPM technology for rice plants value of 0.098 was obtained. The calculated  $r_s$  value shows no significant relationship between the general role of farmer group in preserving the environment and farmer groups as a cooperation arena and production unit. The role of farmer groups as learning units is significantly related to farmers' ability to preserve the environment. It shows that farmer groups have been utilized by their members to exchange information about environmental preservation. The more farmers exchange information, the better the farmers' ability to preserve the environment.

The function of farmer groups as production units has no relation to environmental preservation. It means that if farmers fully utilize farmer groups as production units to increase their production and income, the ability to conserve the environment will get lower. The farmers are more likely to pursue economic benefits without taking environmental sustainability into account. Farmers using chemical fertilizers, excessive use of chemical pesticides, and herbicides to effectively increase production and not recycling waste from rice stalks and husks as compost. The important factor affecting the support of farmer groups in sustainable agricultural development is participation [37][38]. It is necessary to involve the active participation of farmer group members in the development of sustainable agriculture and food security.

Based on the results, the relation between farmer group institutions (means for learning, cooperation arena, and production units) and the level of household food security shows a very significant relation both as a whole and as a group function. Suppose the group members more actively taking advantage of the functions of farmer groups, the better the level of household food security. Farmer groups became a medium for farmers to exchange knowledge, experience, and information to solve agricultural problems. One of the problems faced today is climate change and its impact on agriculture [39]. Climate change causes crop failure and decreases of food availability [40]. The exchange of information increases farmers' skill in managing their farms and, in turn, increasing farmers' income. Besides, through farmer groups, farmers get subsidized fertilizers, receive agricultural production tools, assistance, and guidance from extension workers, and other things that farmers need to increase farm productivity and income.

#### 4. Conclusion

The role of farmer groups as a means for learning is from medium to high category. The institutional role of farmer groups as a cooperation arena is relatively low. Most of the farmers are not satisfied with the impact and benefits of farmer groups in the aspect of cooperation. The shallow and medium categories dominate the institutional role of farmer groups as a production unit. Mostly, farmer groups still function only as study classes and as a vessel to get government assistance. The role of farmer groups in developing sustainable agriculture/preserving the environment is still in the low category. Most of the farmers consider chemical pesticides and herbicides to be more comfortable and faster than using natural pesticides and herbicides. Only 48.90% of farmer households are in the food secure category. Most farmers do not have independent sources of food (rice and non-rice), so they have to buy from other parties and regions.

There is no significant relationship between the roles of farmer groups in preserving the environment. However, farmer groups as learning units have a significant relation to farmers' ability to preserve the environment. The relationship between farmer group institutions (means for learning, cooperation arena, and production units) and household food security level has a very significant relation both as a whole and as a group function. If the group members more actively take advantage of farmer groups' functions, the better the level of household food security. In general, the institutional strengthening of farmer groups directly affects environmental quality improvement and has direct and indirect impacts on the food security of rice farmers in the Pesawaran Regency.



## References

- [1] Badan Pusat Statistik B 2017 *Persentase Penduduk Miskin Indonesia* (Jakarta: Badan Pusat Statistik)
- [2] McCulloch N A, Timmer P and Weisbrod J 2011 *Pathways Out of Poverty During an Economic Crisis: An Empirical Assessment of Rural Indonesia* (Washington, D.C.)
- [3] Bhandari H and Yasunobu K 2009 What is social capital? A comprehensive review of the concept *Asian J. Soc. Sci.* **37** 480–510
- [4] Juliantono F and Munandar A 2010 Fenomena Kemiskinan Nelayan: Perspektif teori Strukturasi *J. Polit.* **12** 1857-1866.
- [5] Dahuri R 2010 *Paradigma Baru Pembangunan Indonesia Berbasis Kelautan". Orasi ilmiah pengukuhan guru besar tetap bidang pengelolaan sumber daya pesisir dan lautan.* (Bogor: Fakultas Perikanan dan Ilmu kelautan Institut Pertanian Bogor.)
- [6] FAO 2020 World Food Situation *FAO* 1
- [7] Khapayi M and Celliers P R 2016 Factors limiting and preventing emerging farmers to progress to commercial agricultural farming in the King William's Town area of the Eastern Cape Province, South Africa *South African J. Agric. Ext.* **44** 25–41
- [8] Yanfika H, Listiana I, Mutolib A and Rahmat A 2019 Linkages between Extension Institutions and Stakeholders in the Development of Sustainable Fisheries in Lampung Province *J. Phys. Conf. Ser.* **1155** 1–6
- [9] Šūmane S, Kunda I, Knickel K, Strauss A, Tisenkopfs T, Rios I des I, Rivera M, Chebach T and Ashkenazy A 2018 Local and farmers' knowledge matters! How integrating informal and formal knowledge enhances sustainable and resilient agriculture *J. Rural Stud.* **59** 232–41
- [10] Hellin J, Lundy M and Meijer M 2009 Farmer organization, collective action and market access in Meso-America *Food Policy* **34** 16–22
- [11] Ramdwar M N A, Ganpat W G and Bridgemohan P 2013 Exploring the Barriers and Opportunities to the Development of Farmers' Groups in Selected Caribbean Countries *Int. J. Rural Manag.* **9** 135–49
- [12] Gramzow A, Batt P J, Afari-Sefa V, Petrick M and Roothaert R 2018 Linking smallholder vegetable producers to markets - A comparison of a vegetable producer group and a contract-farming arrangement in the Lushoto District of Tanzania *J. Rural Stud.* **63** 168–79
- [13] Lutz J, Smetschka B and Grima N 2017 Farmer cooperation as a means for creating local food systems- Potentials and challenges *Sustain.* **9** 925
- [14] Mittal S and Mehar M 2016 Socio-economic Factors Affecting Adoption of Modern Information and Communication Technology by Farmers in India: Analysis Using Multivariate Probit Model *J. Agric. Educ. Ext.* **22** 1–14
- [15] Buralli R J, Canelas T, de Carvalho L M, Duim E, Itagyba R F, Fonseca M, Oliver S L and Clemente N S 2018 Moving towards the Sustainable Development Goals: The UNLEASH Innovation Lab experience *Ambient. e Soc.* **2** 1–20
- [16] Moyer J D and Hedden S 2020 Are we on the right path to achieve the sustainable development goals? *World Dev.* **127** 104749
- [17] Kumar S, Kumar N and Vivekadhish S 2016 Millennium development goals (MDGS) to sustainable development goals (SDGS): Addressing unfinished agenda and strengthening sustainable development and partnership *Indian J. Community Med.* **41** 1–4
- [18] Index G H 2019 2019 Global Hunger Index by Severity <https://www.globalhungerindex.org/results.html> 1
- [19] Malahayati M 2018 The role of the forest-related sector to the Indonesian Economy: SAM Multiplier Analysis 1985-2008 *Open Agric.* **3** 171–179
- [20] van Noordwijk M, Agus F, Dewi S and Purnomo H 2014 Reducing emissions from land use in

- Indonesia: Motivation, policy instruments and expected funding streams *Mitig. Adapt. Strateg. Glob. Chang.* **19** 677–692
- [21] Yu J and Wu J 2018 The sustainability of agricultural development in China: The agriculture-environment nexus *Sustain.* **10** 1776
- [22] Siebrecht N 2020 Sustainable agriculture and its implementation gap - Overcoming obstacles to implementation *Sustain.* **12** 3853;
- [23] Ogundipe A A, Oduntan E A, Adebayo O and Olagunju K O 2017 Agricultural Productivity, Poverty Reduction and Inclusive Growth in Africa: Linkages and Pathways *SSRN Electron. J.*
- [24] Wolfert S, Ge L, Verdouw C and Bogaardt M J 2017 Big Data in Smart Farming – A review *Agric. Syst.* **153** 69–80
- [25] Kuwornu J K M, Suleyman D M and Amegashie D P K 2013 ANALYSIS OF FOOD SECURITY STATUS OF FARMING HOUSEHOLDS IN THE FOREST BELT OF THE CENTRAL REGION OF GHANA *Russ. J. Agric. Socio-Economic Sci.* **1** 26–42
- [26] Nkomoki W, Bavorová M and Banout J 2019 Factors associated with household food security in Zambia *Sustain.* **11** 2715
- [27] Kassam A, Friedrich T, Shaxson F, Bartz H, Mello I, Kienzle J and Pretty J 2014 The spread of Conservation Agriculture: policy and institutional support for adoption and uptake *F. Actions Sci. Reports* **7** 0–12
- [28] Rahmat A, Khoiru Zaki M, Effendi I, Mutolib A, Yanfika H and Listiana I 2019 Effect of global climate change on air temperature and precipitation in six cities in Gifu Prefecture, Japan *Journal of Physics: Conference Series* pp 1–9
- [29] Yanfika H, Rangga K K, Viantimala B, Listiana I, Mutolib A and Rahmat A 2020 Evaluation of the Success of Programs and Strategy for Sustainable Coastal Community Development in Tanggamus Regency *Journal of Physics: Conference Series* vol 1467 (Institute of Physics Publishing)
- [30] Effendi S and Singarimbun M 1981 *Metode penelitian survai* (Jakarta: LP3ES)
- [31] Listiana I, Efendi I, Mutolib A and Rahmat A 2019 The behavior of Extension Agents in Utilizing Information and Technology to Improve the Performance of Extension Agents in Lampung Province *J. Phys. Conf. Ser.* **1155** 1–10
- [32] Isnaeni I 2019 Proses Penumbuhan Kelompok Tani Sebagai Wadah Kerjasama Ekonomi *Kementerian. Pertan.* **1**
- [33] Listiana I, Hudoyo A, Prayitno R T, Mutolib A, Yanfika H and Rahmat A 2020 Adoption Level of Environmentally Friendly Paddy Cultivated Innovation in Pringsewu District, Lampung Province, Indonesia *Journal of Physics: Conference Series* vol 1467 (Institute of Physics Publishing)
- [34] Murniati K and Mutolib A The impact of climate change on the household food security of upland rice farmers in Sidomulyo, Lampung Province, Indonesia
- [35] El Bilali H, Callenius C, Strassner C and Probst L 2019 Food and nutrition security and sustainability transitions in food systems *Food Energy Secur.* **8** e00154
- [36] Burchi F and De Muro P 2016 From food availability to nutritional capabilities: Advancing food security analysis *Food Policy* **60** 10–9
- [37] Puspitaningsih O S, Utami B W and Wijianto D A 2016 Partisipasi Kelompok Tani dalam Mendukung Program-Program Pertanian Berkelanjutan di Kecamatan Puring, Kabupaten Kebumen (Studi Komparasi Kelompok Tani Kelas Lanjut dan Pemula) *Caraka Tani – J. Sustain. Agric.* **31** 79–85
- [38] Nuryanti S, Dewa D and Swastika K S 2011 Peran Kelompok Tani Dalam Penerapan Teknologi Pertanian *Forum Penelitian Agro Ekon.* **19** 115–28
- [39] Lawrence D and Vandecar K 2015 Effects of tropical deforestation on climate and agriculture *Nat. Clim. Chang.* **5** 27–36

- [40] Altieri M A and Nicholls C I 2017 The adaptation and mitigation potential of traditional agriculture in a changing climate *Clim. Change* **140** 33–45