Sustainable Cocoa Farming Strategies in Overcoming the Impact of Climate Change Through SEM PLS 2

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Abstract*: Most cocoa plantations have undergone changes and sustained damage due to climate change. The objectives of the present study were to identify sustainable cocoa farming strategies in the effort to overcome climate change effects in regencies; and to analyze sustainable business strategies in overcoming the effects of climate change; This study was conducted from June to August 2018 in Luwu and North Luwu Regencies, South Sulawesi Province. Data collection was carried out through interviews with 282 farmers and interviews conducted on five key informants. Descriptive statistical analysis was conducted in the form of a frequency distribution table using Excel program and SPSS version 24. Model implementation strategies in overcoming climate change effects were designed based on the SEM PLS 2. The results revealed that the effort to overcome climate change effects in the development of the cocoa agribusiness and the farmers' social relationships were high, while preservation of environmental conditions was in the low category. Conclusion : Sustainable cocoa farming strategies in the effort to overcome climate change effects consisted of adaptation climate accompaniment extension strategies, increasing government support strategies, and farmer character improvement strategies in overcoming climate change effects.

***Keywords* : climate change, cocoa, farmer**

I. INTRODUCTION

Climate change influences the sustainability of human, animal, and plant life. According to the results of studies by climate change experts in the IPCC (Intergovernmental Panel on Climate Change), the threat of climate change and its effects on the agricultural sector have been observed worldwide in the last 50 years.

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The most prominent climate change effect on plantation crops, especially oil palm, rubber, and cocoa, is the decline in production due to changes in precipitation patterns and extreme climate incidences. Droughts have an effect on the productivity and quality of oil palm, rubber, cocoa, sugarcane, and coffee crops (1). Demonstrated that cocoa as a plantation crop was also affected by the climate which had an impact on the crop's biophysical environment and the farmer's socio-economy (2). This was supported by Boer[5] who stated that cocoa plants are non irrigated crops whose source of water is rain. Precipitation is an element of climate, which is the average conditions of the weather in a vast area and a long time, and has an effect on cocoa production; others elements are wind, temperature, humidity, and pressure.

The issue here occurred in the cocoa plantation areas in Luwu and North Luwu Regencies, South Sulawesi, which most have undergone changes and sustained damage which have decreased production and affected the farmers' income. Threats of harvest failure due to floods or drought will continue to increase due to the increased vulnerability which is the effect of climate factors. Area's vulnerability is a function of exposure due to environmental degradation, sensitivity, and the adaptation capacity level of the said area (3) (4). Therefore, efforts to build the area's adaptation capacity are very important to be conducted by the Government, the private sector, and the community. Efforts to build farmers' adaptation capacity are made so they are able to adopt technology by applying a more progressive cocoa plantation development strategy. This will create an adaptation to advanced technology available to the farmers and farmers would be able to quickly adopt new technology. Adaptation strategies to overcome climate change effects have quite often been conducted by farmers and the effects had a positive influence on the production of food crops (5). This indicated that the strategies implemented by the food crop farmers could be continued and could be applied to cocoa plants in accordance with the plant's needs and specific location. The farmers' adaptation strongly depends on the farmers' capacity in adopting information and technology. Adaptation capacity cannot be separated from changes in the farmers' internal and external behavior in overcoming changes in the agribusiness environment due to climate change. In relation to the explanation above, the objectives of the present study were to identify sustainable cocoa farming strategies in the effort to overcome the effects of climate change in the two regencies; and to analyze sustainable business strategies in the effort to overcome climate change effects.

II. MATERIALS AND METHODS

Site description study

The study was conducted between June and August 2018 in Luwu and North Luwu Regencies, South Sulawesi Province. The determination of the study location was conducted using stratified sampling in the two regencies, four sub-districts, and eight villages. Each regency consisted of two sub-districts and four villages. The population studied was cocoa farmers who fulfilled the criteria of allocating more of their time in managing their cocoa plantation and being the decision maker in their agribusiness, numbering 960 farmers. The number of samples in this study was determined using the Slovin equation; the 282 farmers were distributed in these areas: (1) Bupon Sub-district: Kamburi Village, P. Tujuh; (2) Kamanre Sub-district: South S. Paremang Village, S. Paremang; (3) Sabbang Sub-district: Batu Alang Village, Bakka; and (4) Baebunta Sub-district: Mario Village, Tarobok.

Data Analysis

Primary data were collected from the study's respondents through structured interviews using questionnaires and in-depth interviews with five related informants including an extension agent, a private partnership coordinator (Mars Sustainability Indonesia), a climate authority (BMKG), a community elder, and an official in the Agricultural Agency and other institutions. The data collected were tabulated and analyzed using descriptive statistics in the form of frequency distribution tables to identify sustainable cocoa farming strategies in the two regencies using the Excel program and the Mann Whitney difference test using the Statistical Product and Service Solution (SPSS) version 24 program. The sustainable cocoa agribusiness operational model implementation strategies in overcoming climate change effects were designed using the input, process, output, and outcome approach based on the SEM PLS 2 analysis results, and qualitative data was used to provide an explanation for the quantitative data.

III. RESULTS AND DISCUSSION

Farming sustainability, Agribusiness Development and Environmental condition assurance

Analysis of the results of the respondent farmer distribution in Table 1 revealed what was very significantly different was the development of agribusiness, whereas the environmental condition assurance and farmers' social relationships were relatively the same in the two regencies. Farming sustainability in the development of agribusiness and dynamic farmers' social relationships were in the high category and environmental condition assurance was in the low category.

The development of agribusiness in the analysis results of the respondent farmer distribution (Table 1) was within the high category with an average of 10.3 percent. The farming sustainability indicator in agribusiness development was measured by observing the increase and decrease in the average production/harvest every harvest season which occurs twice a year. The next indicator was the increase or decrease in the profit, the selling price at the farmer level, the number of workers used, and the increase in area size owned by the farmers in the last two years during the study.

Farming sustainability from the agribusiness development aspect in Luwu Regency had a very low percentage, 38.28 percent, with the highest number of respondents, 39.36 percent, giving answers in the low category. This was because many of the farmer respondents in Luwu Regency have changed land use. According to Mr. AK as the agriculture extension agent, "*Land-use change has been opted by the majority of the cocoa farmers in this area when there are problems with their agribusiness because there is more than one superior commodity available*". The conditions of the soil which still carried much potential for a variety of commodities to choose aside from cocoa such as the expansion of food crop land which is the Government's focus through the opening of new paddy fields, corn subsidy from the Government, the large number of patchouli oil processing plants, the replanting of cocoa plants with seasonal side crops such as patchouli, papaya, cloves, and pepper have made the farmers have less concern about surviving on cocoa plants alone.

Table 1. The distribution of cocoa farmers based on cocoa agribusiness sustainability in Luwu and North Luwu Regencies.

Cocoa agribusiness Sustainability	Category	Regency: Luwu n= 128%	Regency: North Luwu n=154%	Total 282 %	Mann Whitney Difference test
Agribusiness Development Average =10.3	Very low (5-7.50)	38.28	0.65	17.73	0.00**
	Low (7.51-10)	35.16	42.86	39.36	
	High (10.1-12.50)	18.75	43.51	32.27	
	Very high (12.51-15)	7.81	12.99	10.64	
Environmental condition assurance Average=8.87	Very low (5-7)	25.00	27.27	26.24	0.902
	Low (7,1-9)	25.00	24.03	24.47	
	High (9.1-11)	39.84	46.75	43.62	
	Very high (11.1-13)	10.16	1.95	5.67	
Farmers' social relationships Average=11.61	Very low (6-8.75)	21.09	7.14	13.48	0.656
	Low (8.76-11.50)	18.75	40.91	30.85	
	High (11.51-14.25)	42.19	41.56	41.84	
	Very high (14.26-17)	17.97	10.39	13.83	

* significantly different at 0.05 , ** very significantly different at 0.01

According to the results of the study conducted by (5) there are seven attributes in the economic dimension of land-use change that could potentially affect the farming sustainability level, namely the economic effectiveness, the stability of harvest prices, the source of agribusiness capital, the product selling location, the diversification of income sources, the harvest marketing system, and the contribution of agroforestry to the farmer's total income. In addition, it gives a significant profit that is fair to the actors in the present and the future through increases in productivity, profit, and business scale.

The analysis results of productivity growth in North Luwu Regency, which was one of the benchmarks, in Table 1 were categorized as high = 43.51 percent. In this area, the development of agribusinesses received much support from the farmers' external factors to guarantee success in developing a sustainable cocoa sector. This effort was accompanied by efforts to encourage the development of sustainable livelihood options for the farmers by improving the entrepreneurship capacity in this area. The private sector encouraged middlemen to collaborate and cocoa doctors to play a more active role. The involvement of corporate accompaniment is providing innovations that could improve the farmers' capacity (especially in the context of productivity and profit growth, better land management, labor availability, the size of land owned by farmers, and farmer organization or cooperation funding) which helps the effort to create a sustainable cocoa sector. Moreover, the export market situation is demanding commodities that are produced with strong considerations for social and environmental protection elements (6)(7).

Seen from the environmental conservation aspect, the analysis results of the respondent farmers distribution (Table 1) had an average of = 8.87 which was in the high category. The two regencies were relatively similar and were both in the high category with 43.62 percent of the respondents. Meanwhile, the farming sustainability indicator in the assurance of environmental conditions consisted of the increase or decrease in water sources available to the farmers' cocoa plantations, the disease and pest attack rate, and flooding and drought threats during the extreme climate incidences La Nina and El Nino. The indicators in this study were still within normal standards with a high percentage in the two regencies; therefore, the environmental conditions could still be renewed with the farmer adaptation approach in facing the effects of climate change as an environmental factor for cocoa agribusiness management.

The GAP and GMP program could be executed by applying a more progressive cocoa plantation development program. Based on the assessment values, Herman[12] classified the indices of sustainability into four dimensions: the ecological dimension, the economic dimension, the socio-cultural dimension, and the technological dimension. In addition, Reijntjes[13] stated that the agriculture sustainability approach was minimum input (Low Input Sustainable Agriculture/LISA). This agricultural system contained a moral persuasion to make policies in 3 aspects: (1) having environmental awareness; (2) having economic value; and (3) having a social/community character which means it is in harmony with the local social norms and culture. Cocoa plantations in Luwu and North Luwu Regencies which had the type C climate should use the agroforestry concept with trees to provide shade for protecting the plants from drying. Cocoa plants were most suited for A and B-type climates; therefore, in the type-C climate which has a longer dry season, trees to provide shade must be managed on cocoa plantations[14].

Table 1 presents the analysis results of the percentage of respondent farmer distribution in a dynamic farmers' social relationships with an average of = 11.61 which was categorized as high and was relatively similar between the two regencies with the number of respondents' answers being 41.84 percent. Sustainability in farmers' dynamic social relationships had indicators consisting of trust in extension agents, water agents, climate agents, corporations, customary laws, and tolerance between citizens. This relationship demonstrated that the cocoa farmers in the two regencies had adaptation abilities through a combination of the dualism between socio-cultural and eco-modernist understandings. Humans experience the symptoms and effects of natural changes; therefore, humans need to manage and control nature (8). The human race's cultural resilience is in the form of a collective or community ability to overcome pressure and disturbances due to changes in the environment. Ability to access business capital to adopt technology transfer innovations, institutional ability, partnerships, and social capital (9). There needs to be developed *understandings of resilience*, climate security which is defined as the individual and community's ability to overcome and adapt to social, political, economic, and ecological challenges in the effort to overcome the effects of climate change and climatic incidences. There needs to be an extension process which understands the integration between natural and social sciences, which is also known as local or traditional ecological knowledge. Extension agents need to have a transdisciplinary understanding of resilience with a scientific approach which combines between cultivation, managerial, and socio-cultural techniques and support from the private sector and government in the biocultural perspective.

Cocoa farmers' Adaptation Capacity Strategies for Business Sustainability

The SEM PLS analysis results in Figure 1 demonstrated that the structural model equation was $Y2 = 0.630Y1$. R^2 was 0.397, demonstrating that 39.7 percent of agribusiness sustainability was influenced by the factors studied in this research, while 60.3 percent was influenced by factors other than those covered by this study. Based on the R^2 value, the model produced was categorized as moderate. In this study, the resulting loading factor demonstrated there were two indicators that reflect agribusiness sustainability: the agribusiness development indicator and farmers' dynamic social relationship indicator. Meanwhile, the assurance of environmental conditions indicator had to be excluded from the model because its value was 0.7, below the loading factor.

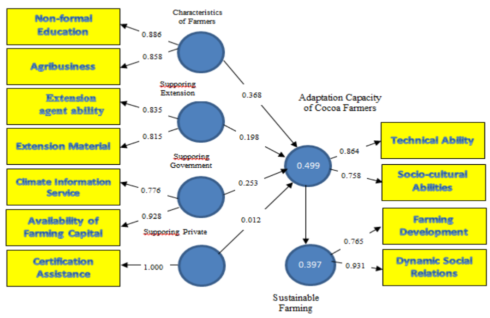

Figure 1. Assessment model (outer model) of Cocoa farmers' Adaptation Capacity Strategies for Business Sustainability.

Strategies to improve human resources in managing an agribusiness that is adaptive to climate change effects is an external (environmental) factor for plants which is difficult to predict requires individual farmer adaptation efforts as a reference for the regional adaptation in accordance to the local climate conditions.

Law number 16 Year 2006 pertaining to SP3K mandates extension as an effort to improve human resources capacity. Law number 19 Year 2013 pertaining to farmer protection and empowerment is aimed to improve the role of farmers and farmer groups by building collaborations between farmers and other parties that are related to agribusiness. Law number 18 Year 2018 pertained to farmer empowerment through farmer corporations.

Strategies are designed based on available input, and then an extension process is conducted, producing the expected outcome which is strong farmer capacity and in the end, the effect of the outcome is a sustainable agribusiness, an increased farmer income and farmers' group self-reliance, environmental sustainability, and farmer regeneration.

The climate adaptation extension and accompaniment strategy

Extension agents need to be provided with information about the climate in the study location through climate workshops, regular meetings, climate field-schools, and information dissemination through various media. These activities could become research materials for extension agent which would be passed on to farmers to be applicable information.

Extension climate change adaptation is a combination of technical innovation, institutional managerial innovation, and socio-cultural innovation. BMKG authorities and the P3A institution are expected to collaborate with government, private, and NGO extension agents in conducting their responsibilities in the field. The provision and utilization of information by farmers are influenced by a number of factors: the extension agents' ability to search for and disseminate information and to obtain feedback from the farmers, obstacles and the timeliness in disseminating the information, the information utilization process, and the suitability of technology to the farmers' needs. These could be fulfilled if the extension agent's capacity for utilizing climate information is improved. On the other hand, according to the Head of the Agricultural Human Resources Development Agency, the extension agents' ability to understand climate changes and forecasts published by the Agency for Meteorology, Climatology, and Geophysics (Badan Metereologi, Klimatologi dan Geofisika (BMKG)) is still limited. Therefore, there need to be efforts to prepare professional extension agent human resources who can face the changes and challenges in climate change in the context of disseminating information as an agent of change (1).

Adaptation to the climate in the agricultural sector includes the development of climate-resilient production technology, plant varieties (drought resistant), sustainable use of water, breeding technology, public awareness-building, and guaranteeing the flow of information related to the climate in planning and policy-making. Formal institutions also play a major role in the implementation and in the search for various forms of adaptation or intervention which could be in the form of knowledge (training/skill development), information, and support (technology, input, funding).

The Strategy to Improve Government Support

In relation to climate information service, according to the amendment to the UNFCCC framework which is stated in Law number 17 Year 2004 and the Government of Indonesia's Law number 31 Year 2009 pertaining to Meteorology, Climatology, and Geophysics, the Government is obligated to conduct mitigation and adaptation actions to climate change. Based on Law number 12 Year 1992 and Government Regulation number 6 Year 1995, plant-disturbing organism handling activities are the responsibility of the Government and the community and is conducted in the form of an Integrated Pest Control system. The execution of the laws and the government regulation strongly requires authorities and cocoa farmers to have knowledge of the characteristics and signs of attacks so that it would be easy to identify the pests and diseases in cocoa plantations. Farmers should be able to make simple weekly observations so that they could decide on the best actions to take in managing their agribusiness.

Innovation to the Climate Adaptation Cocoa Cultivation Calendar Information System which functions as a tool in increasing the production of cocoa plants.

The calendar functions as a tool for identifying the impacts and anticipating directions and climate change adaptation and mitigation in the agricultural sector which are the agricultural sector's strategy in facing climate change. The climate factor as a requirement for cocoa plant growth is very important to be adjusted to the cocoa plant's natural environment. The cocoa plant's natural environment is tropical forests which depend on the climate factor. Climate factors such as the precipitation rate, temperature, and sunlight exposure also have a strong effect on these plants in addition to the physical and chemical factors of the soil which are related to root infiltration and its ability to absorb nutrients. Therefore, it is very important to provide information on the relation between climate factors and cocoa plants growth requirements and regional conditions which would affect cocoa plants, necessitating the farmers' adaptation in overcoming the effects on the plant as listed in the following Table. These adaptations are the strategies conducted by the farmers in minimizing vulnerability as an effect of climate change cocoa plants in Luwu and North Luwu Regencies, South Sulawesi.

Table 2. Climatic elements and their effect on cocoa farmers' adaptation in Luwu and North Luwu Regencies

Climate Factor	Growth Requirements	Luwu and North Luwu Regencies	Effect on cocoa plants	Farmer adaptation
Geographical position	10°N-10° S	5°N-10° S	Optimum and less than optimum growth	- Adaptif Clone/graft /superior variety
Altitude	<800m AMSL	80-800m AMSL	Optimum and less than optimum growth	- Adaptif Clone/graft /superior variety
Climate type	A and B	C	Long dry season	- Shade trees
Precipitation rate	1.100-3.000 mm per year	1250-3000 mm per year	- Black-pod rot	- Pruning - Water availability - Arrangement of shade trees

Temperature	15°-21° C to 30°-32° C	18 ° -21 ° C to 30°-32° C	- Flush formation - Flowering - Leaf damage - Leaf shedding - Dry flowers - Seed weight - Bud death	- Water availability - Sunlight availability - Pruning
Humidity	Day 70-80% and night 100%	Day 70-80% and night 100%	- Black-pod rot	- Pest and disease control - Pod-sleeving
Sunlight	Immature Plants 25-35% and Mature Plants 65-75%	Immature Plants 25-35% and Mature Plants 65-75%	- Leaf shedding - Dry flowers - Seed weight - Bud death	- Fertilizing - Pest and disease control
Wind	< 4/s or 15 km/hour	< 4/s or 15 km/hour	- Leaf shedding - Flower shedding - Black-pod rot	- Fertilizing - Pest and disease control
Soil texture and structure	50% sand, 10-20% dust, and 30-40% clay	50% sand, 10-20% dust, and 30-40% clay	- Soil fertility	- Fertilizing
Soil	Fulfillment of physical and chemical characteristics and organic matter	Fulfillment of physical and chemical characteristics and organic matter	- Soil fertility	- Fertilizing
Soil pH	1.0 - 7.5	4.0 - 8.5	The depletion of soil organic materials	- Applying lime twice a year

Table 2 can be seen that cocoa plants are classified as a C3 plant which can conduct photosynthesis at low temperatures. Maximum photosynthesis occurs when the light exposure on the canopy is 20 percent of the full lighting. Cocoa plants can grow on various types of soil as long as the physical and chemical requirements of the soil which play a role in cocoa growth and production are fulfilled. Soil acidity (pH), organic material content, nutrients, adsorption capacity, and base saturation are the chemical characteristics that need to be considered, whereas the physical factors are effective depth, groundwater level, drainage, structure, and soil consistency. In addition, land slope is also a physical characteristic which affects cocoa growth.

Factors that could be optimized by the farmers are environmental factors such as climate factors which could support the physiological factors in optimizing the growth of cocoa plants. The climate element as a growth requirement for cocoa plants is a reference for a number of partnership corporations in Luwu and North Luwu Regencies which base their agribusiness management on the cocoa cultivation calendar. The farmers' treatments in developing their agribusiness are based on climate information. Climate change has taken the center stage after a number of efforts have been conducted. One of these is pest control; it should not center on the agent of cause as the main focus but should control the underlying factor, the environmental factor.

Farmer adaptation efforts are needed in facing changes in the dry season by regulating water sources which are of the utmost importance for both immature and aged cocoa plants. Government institutions, especially the P3A, need to assist the cocoa farmers by encouraging the private sector stakeholders' participation in the cocoa agribusiness.

Water management. Water management is required during times of abundance and drought and strongly determines the success in cocoa cultivation. Cocoa cultivation needs a small amount of water distributed evenly throughout the year, especially during the flowering process and the replanting of cocoa plants. Therefore, a water-saving irrigation model needs to be developed through a sprinkler system and drip irrigation. The Government could also construct reservoirs and a vertigation system near cocoa plantation areas to store water during the rainy season, even though the majority of the farmers have water available on their cocoa plantations through a simple system. Water is required not only during the dry season but also during pest and disease control through spraying. The management of water resources is conducted through the development of water resources, the construction of an irrigation network, the construction of reservoirs and channel dams, and the institutional development of Water-Using Farmer Association (P3A).

The water resource governance is planned by the Government through the development and management of water resource conservation, the utilization of water for various needs, controlling the destructive power of water, community empowerment, and management of the water resource data and information system which is aimed to realize a more sustainable water resource utilization. The existing policies in fulfilling the raw water needs sustainably consist of: a) irrigation network functional improvements and rehabilitation; b) optimization of operational activities and the maintenance of irrigation infrastructure; c) improvement of the function of irrigation networks that have been constructed but are not yet functioning well, especially those serving cocoa farmers; d) rehabilitation of irrigation areas which have sustained damage and improving irrigation efficiency by repairing irrigation channels, e) the development of a water-saving irrigation system.

Land conversion. Land conversion, especially for sloped land contours, is conducted by creating beds which cut across the slope plane. Various land resource management technologies are available such as the integrated dry-climate agricultural system technology, soil, water, and fertilizer management technology to support the plant growth productivity, suboptimal land management technology through the application of an integrated soil nutrient and soil conservation system, technology to utilize soil biological agents for the fertility restoration of degraded soil, greenhouse gas mitigation technology through an integrated plant management, swampland utilization optimization technology, various organic, inorganic, biological, and soil-reforming fertilizer formulae, and various tools/kits such as cane and oil palm nutrient test kits, pH measuring equipment, digital organic fertilizer test kits, swampland soil test kits, and pesticide residue analyzing equipment.

Conservation, rehabilitation, and reclamation of agricultural land are needed and are aimed to fix the effects of soil damage which do not directly affect agricultural production. However, without any soil and water conservation efforts, the high agricultural land productivity and the agribusiness will not be sustainable. Agriculture conservation is the right choice in the recovery and conservation of the environment and efforts to prevent damage and to restore erosion-damaged soil. Policies that are related to conservation, rehabilitation, and reclamation are directed toward the application of soil and water conservation principles. Conservation requires intensive advocation to the community to explain that rescuing land resources and the environment is not the Government's responsibility but is the collective responsibility of all the generations of Indonesians.

Production increase. The increased production in a number of plantation commodities is due to attractive prices, price certainty, and market certainty which motivate the farmers to take good care of their plants. In addition, the production increase is affected by the increase in plantation size, the use of superior variety seeds, Government intervention through rehabilitation activities, area expansion, farmer empowerment, High Production Block assessments, parent garden maintenance, superior seed/seedling facilitation, post-harvest handling, Climate Field School (CFS), Integrated Pest Control Field School (IPCFS), and Plant-Disturbing Organism Control (PDOC).

Policies pertaining to the agriculture facilities and infrastructure were directed by the implementation of Law number 19 Year 2013 pertaining to Farmer empowerment. Seedling Production and Breeding are an agriculture production facility which has a weak seed production and distribution system. The main agricultural production facility that has been provided and will continue to be provided by the Government to support agribusiness is providing seed and fertilizer. Fertilizers and organic fertilizers are mostly provided by State-Owned Enterprises and organic fertilizer is provided by the Government, the private sector, and the community. In addition, the development of organic fertilizer processing plants by farmer groups is also encouraged, not only for self-consumption but also for selling to other groups. In the management and utilization of seed and fertilizer subsidy, there need to be Government policies that can guarantee the fulfillment of 6 principles (proper type, amount, quality, place, time, and price) in the allocation and distribution of seed and fertilizer according to the needs of each region.

In relation to the agribusiness funding system, there are a number of funding sources to support agriculture that are available in the present day including conventional and sharia banking, non bank, State-owned enterprise and private investments, Agribusiness Micro Finance Institutions (LKM-A), customary community institutions, and facilitation through the state and regional budgets. The Government has specifically provided services and conveniences for the farmers to access agricultural credit funding sources.

Farmer Characteristic Improvement Strategy in Overcoming Climate Change Effects

Some issues in the agricultural sector resources mentioned above are due to the human resources factor in addition to the effect of natural resources. The development of natural resources is mostly determined by and affected by human resources. Therefore, the Government and the related stakeholder's main concern should be the human resources.

Farmer regeneration. The future challenge is how to change the younger generation's perception of agriculture, to make them aware that there is a lot of agricultural potentials that awaits to be utilized in an optimum way. One of the efforts that could be made to pique the younger generations' interest in the agricultural sector is by developing more advanced and modern agriculture based on innovation and technology which can produce products with high economic value which are demanded by the market. Building agriculture in the industrial context which is rife with innovations and technology that are applied from upstream to downstream will create a greater chance for producing various agricultural products with high economic value. For this, a number of important points need to be addressed in rural areas: (1) constructing and repairing agricultural infrastructure in rural areas, (2) building a better younger generation human resource capacity, and (3) encouraging policies and regulations in the field of agriculture which is to be followed by improvements in the curriculum and revitalization of learning facilities and infrastructure, including the right teachers, in relation to a guaranteed opportunity for employment that is suitable to the younger generation's skills and expertise.

Encouraging the younger generation's interest in production at on-farm and off-farm levels includes better access for young people, especially those who have finished high school or university, to opening businesses in agriculture. In addition, to improve farmer skills, a Center for Agricultural Training and Self-Reliant Rural Area (Pusat Pelatihan Pertanian and Perdesaan Swadaya (P4S)) as a farmer-owned institution which has a direct active role in agricultural development through the development or agricultural human resources in the form of training, extension, and education. This training institution is owned and managed independently by farmers, both individually and collectively. Moreover, a Community-Rooted Independent Institution (Lembaga Mandiri yang Mengakar di Masyarakat (LM3)) has been developed. This is a moral and social education activity in society and it has strengths and potentials to be developed as a driving force for rural development. LM3 was developed in religious institutions such as Islamic boarding schools, seminaries, parishes, ashrams, and viharas.

Agriculture human resource quality. Having minimal education is one of the characteristics of farmers living in rural areas and this is a serious issue and it could be overcome through non-formal education. Non-formal education is an education for adults through training, courses, field schools, demonstration training (demo plots) as media for learning directly and visiting farmers or agribusinesses which could motivate the farmers. Nonformal education is an extension effort and will run effectively if agriculture extension accompaniment is prepared in their competence, intensity, materials, and method.

Farmer institutional approach and extension have become part of an important strategy in agriculture development. The development of both formal and informal agricultural institutions has not yet had an important role in rural life. This is because the role of the education and training institution, Subdistrict Agricultural Extension Training Center (BP3K), is not yet well coordinated. The function and presence of extension institutions tend to be ignored. Change in the SP3K Law pertaining to extension number 16 Year 2006 into Law number 23 Year 2004 made the extension system even more powerless. The role of extension agents as agents of change in farmer behavior in the knowledge, attitude, and skill aspect has decreased. Its role was shunted aside by the Government, and certification for expert extension agents was only a concept with no concrete proof. Agricultural extension agents should have their roles activated as with teachers who actively teach in schools, even though they handle different subjects and objects. Extension agents should have demo plots together with expert researchers in the Agricultural Research and Development Agency. Agricultural extension agents should imitate the private sector facilitator's accompaniment pattern in terms of competence, performance, facilities, and incentive.

IV. CONCLUSION

Sustainable business strategies in overcoming the impact of climate change in developing the cocoa agribusiness and farmers' social relationships are classified as high, whereas the environment assurance is in the low category, and the aspect that is significantly different between the two regencies was the business development aspect. This means that the farmers still have low environmental awareness; therefore, there needs to be an effort to build an understanding and provide information about the effects of environmental change influenced by climate change which will affect the sustainability of the cocoa agribusiness. Sustainable cocoa farming strategies in overcoming climate change effects consist of climate adaptation extension accompaniment strategies, Government support improvement strategies, and farmer characteristic improvement strategies.

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AUTHORS PROFILE

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