# KEYNOTE SPEECH

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# Food Security and Climate Change in Developing Economies: Evidences and Policy Responses

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## 1. Introduction

The challenge of food security is to assure that all people have access to enough food to lead productive lives. Food production, however, is vulnerable to climate change. The general consensus is that changes in temperature and precipitation will directly result in changes in land and water regimes that will subsequently affect agricultural productivity. It also indirectly impacts on human development, economic growth, and trade flows. The impact of climate change on food security is therefore a vital challenge and a particularly critical one for vulnerable regions such as tropical developing countries. This paper elucidates some evidences of the impacts of climate change on food production, and hence food security and policy responses to minimise its impacts.

## 2. Food Security Issues in Developing Economies

The food security agenda in the twenty-first century faces a totally new set of challenges. Domestically, the competition for resources (land, labour and capital) continues to intensify as urbanisation and industrialisation grow rapidly. Lack of innovations and technology in food production merely depletes food sector's ability to compete. Limited investment in food and agriculture have made this sector lagged on all fronts; productivity, efficiency and development. The effect of climate change is showing, aggravated further by unsustainable practices such as overuse of chemical fertilisers, and poor water management. The international market also poses the bigger challenge to developing countries' food security in particular "extreme volatility". The trajectory of the global food system is no longer in the main determined by the resolution of demand and supply fundamentals. External shocks are emerging from a complexity of sources and are having a profound influence in causing vulnerability in food systems. The detrimental impact of volatility is further magnified by structural problems such as: poor infrastructure, poor supply response, inefficient market, and susceptibility to climactic disturbances.

The conventional fundamental framework is still applicable as demand is chasing over stressed supply due to serious resource constraints. The awakening of the populous Indian and Chinese economies has put pressures on food supply of the world. The volatility of the crude oil prices, for instance, as well as its increasing trend has increased the demand for biofuel feedstock which leads to lesser resources for food production and competition for land. Lurking actively is the climatic changes which are affecting the four dimensions of food security include: food availability, stability of food supplies, access to food, and food utilisation.

## 3. Evidences of Climate Change Impacts

Climate change poses challenges for all sectors of the economy, but particularly those sectors dependent on natural resources such as agriculture. Despite technological advances in biotechnology, climate is still a key factor in determining agricultural productivity and hence food security and agricultural economy. The impacts of climate change on food security may be felt primarily through changes in crop yields, water availability, pests and diseases, animal health and other biophysical factors. Such biophysical changes propagate through a number of components of the socio-economic system and ultimately, impact the livelihoods of people in a variety of ways.

Despite general uncertainties, studies have consistently shown that overall agricultural production in the mid- and high latitudes is likely to benefit in the near term (approximately to mid-century), while production systems in the low-latitudes are likely to decline. This finding has implications for world food security and farm incomes, since most developing countries are located in lower-latitude regions. Falling farm incomes

will increase poverty and reduce the ability of households to invest for a better future. At the national level, climate change will cut revenues and raise spending needs, worsening public finance.

There is a general agreement that the long-term effects on agriculture are negative. If climate change effects are not abated, agricultural production in the mid- and high-latitudes is likely to decline in the long term (approximately by the end of 21$^{st}$ century). They are due primarily to detrimental effects of heat and water stress on crop growth as temperatures rise.

## 4. Policy Responses

Developing economies, being mostly food deficit countries, a policy framework that deals with the effect of climate change on food production, consumption and trade is crucial. This framework is needed to provide practical tools to develop effective and efficient policies to deal with climate change challenges. Some possible areas in the framework include adaptation strategies to build resilience into production systems; mitigation strategies, both command-and-control and market-based instruments, to reduce or offset greenhouse gas emissions; research and development strategies to enhance the agricultural sector capacity to respond to climate change, awareness and communication strategies to inform decision making by agricultural producers, and effective risk management system and social safety nets.

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# Economic Impact of Climate Change on Rice Production

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## 1. Introduction

There are serious concerns about the impact of climate change and its variability on agricultural production throughout the world. First, food security issues are considered significant in the list of human activities, and ecosystem services are under threat of dangerous anthropogenic interference on earth's climate. Second, each country is naturally concerned with potential damages and benefits that may arise over the coming decades from climate change impact on its area as well as globally, since these will affect domestic and international policies, trading patterns, resource use, regional planning and eventually the people's welfare. Since global demand for food increasing steadily, particularly in Asian markets, any permanent reductions in output of key agricultural commodities resulting from climate change is likely to drive average food prices higher as consumers compete for limited supplies. Thus, attention to climate change issue is urgent, as it poses a significant threat to food supplies and security.

## 2. Effect of Climate Change on Potential Production of Rice

After wheat, rice is the most important crop in the world, and the dominant staple food crop in Asia with more than 90% of the rice produced and consumed. However, due to rapidly expanding population, increasing in rice production is required. The impact of climate change on rice production may add to an already complex problem. The major climatic variables that effect the rice production are temperature, rainfall, solar radiation, and atmospheric $CO_2$. Hence, any changes in these variables may have a significant impact on rice productivity. Since rice is a highly water demanded plant, unpredicted climatic changes like extreme weather are expected to influence its water use required.

Previous studies have shown that increased air temperature adversely affect rice yield and its grain quality. High temperature increases the transpiration rate, reduces the photosynthesis, and shortens the growth duration of rice plant. However, more solar radiation has beneficial effect on rice grain yield. It controls photosynthesis and biological process of plant. Furthermore, increased atmospheric Carbon Dioxide ($CO_2$) concentration increases growth and development of rice plant and consequently rice yield. However, the rice yield is more strongly influenced by temperature than by $CO_2$. The elevated $CO_2$ may positively increase the number of panicles; however filled grain per panicle may sharply decline with increasing temperature. Among these factors, temperature therefore has a major influence on rice growth and yield.

## 3. Economic Impact of Climate Change

There is a general agreement that potential changes in climate may reduce productivity and output in agricultural industries. Since climate continuously changes and affects the agriculture in various ways, good measurement of its impacts on sustainable agriculture is required.

Since global demand for food is steadily increasing, especially in Asian markets, any long term reductions in production of key agricultural commodities, arising from climate change, is probable to drive average food prices higher as consumers compete for limited supplies. In fact, crops that decline in supply will rise in price. Higher prices reduce consumption level and adversely affect on consumer welfare. It may increase the fears over food security and more hunger people due to rising population.

The government as the policy maker has to play most influential role to support farmers and farm level production by defining the appropriate subsidies and incentives programs. Thus, rice policies and investments need to be more strategic.

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# Innovation to address the Potential Impacts of Climate Change on Agriculture in Indonesia: Research Needs[+]

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## 1. Introduction

Agricultural industry has been identified as one of vulnerable sectors to the impacts of climate change. The impacts raise awareness many countries around the world specifically to address the potential adverse impacts of climate change that may threaten food security (Schmidhuber and Tubiello 2007). A global study conducted by Cline (2007) estimated that the economic loss due to global warming (worse scenarios) on agriculture sector in 2080 would be equivalent to about 6.33 billion USD (without $CO_2$ fertilization) and 1.967 billion USD (with $CO_2$ fertilization). Interestingly, the potential impacts are distributed unevenly across the globe with potential adverse impacts felt by developing countries located near the equator. Inline with the Cline's report, study on the impacts of climate change on ASEAN countries reported that in a few last decades, ASEAN countries have been exposed to increasing trends of extreme climate hazards which has been considered due to global warming and climate change (ADB 2009).

Indonesia as one of ASEAN countries located near equator is considered vulnerable to climate change. This is expected as agricultural production is highly influenced by climate variability. In the context of climate variability, climate extreme events in Indonesia are frequently associated with the ENSO (*El Nino and Southern Oscillation*) events. For example, the El Nino events are often associated with drought condition that eventually may decrease crop production in many parts of Indonesian regions such as Jawa Barat, Lampung dan Sumatra Selatan dan Sulawesi Selatan (Boer et al. 2009). As the frequency of ENSO events are expected to increase in the future due to global warming (Timmermann et al. 1999), it is anticipated that the frequency of climate extreme events may also increase in the future. In short, global climate change may decrease crop production in Indonesia due to increasing frequency of climate extremes. This climate exposure may exacerbate the decrease in crop production due to exposure from agricultural land conversion. A study conducted by Boer et al. (2009) suggested that paddy production in Java was estimated to decrease by 5 million tonnage in 2025 and 10 million tonnage in 2050 due to agricultural land conversion (with an assumption of 30 thousand hectare per year) and global climate change. Other works that evaluated the impacts of climate change in Indonesia can be seen in the country report published by Ministry of Environment that summarize current states of the climate change impacts and vulnerability in Indonesia (MoE 2007).

The vulnerability of agricultural Industry in Indonesia may happen because of many drawbacks in various aspects, namely: Research, Policies and Integrated Programs on Climate Change Adaptation & Climate Change Mitigation, Infrastructure & Spatial Plan, Poverty, Institutions, Climate Information Services, and Technologies (Boer et al. 2011). As a consequence, adaptation programs to alleviate the potential negative impacts of climate change should be planned and implemented. Early Action is important as late action to address the potential adverse impacts of climate change will lead to more severe impact and the adaptation will be very costly and may be impossible to be handled (ADB 2009). Understanding, the implementation of climate change adaptation will incur costs so that plausible adaptation should be selected. Perdinan and Winkler (2013) proposed a guidance to conduct adaptation assessment. The assessment integrates the "top-down" and the "bottom-up" approach that combines the application of modeling approaches and local knowledge (i.e., stakeholders' experience).

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This paper attempts to identify potential innovations to address the impacts of climate change on agriculture that also can be potential adaptation options. The innovations are proposed based on our understanding on current states of knowledge on the climate change impacts, vulnerability and adaptation. We specifically emphasize research needs so that an innovation can be discovered and implemented in Indonesia. Generally, the subjects of innovation for climate change adaptation are in the field of climate information, information technology, and agricultural technology (Figure 1).

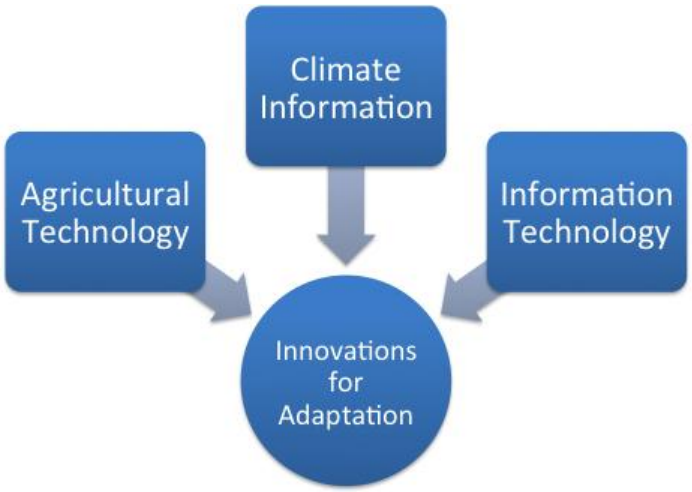


Fig. 1: Subjects of innovation needed for climate change adaptation

## 2. Proposed Innovations: Research Needs

Climate change adaptation is designed to minimize the adverse impacts of climate change and to maximize its benefits. By this definition, we identify innovations that are required to support the implementation of climate change adaptation or can be chosen as an adaptation option. The innovations are derived based on current knowledge on critical issues of climate change assessments, the needs for the development and application of climate models, the advancement in the application of information technology, and the employment of agro-meteorology models for agricultural technology application. Details for each innovation are described.

### 2.1. Climate Information

Research needs for climate information is proposed concerning the availability and accessibility of climate data/information. The concern on data availability rises because climate stations are often limited or a specific climate variable (e.g., solar radiation) may not be available. Currently, there are some alternatives that can be employed to estimate values of a climate variable such as daily radiation. The methods are categorized into two broad terms: 'traditional approaches' and 'modern approaches' (Perdinan, Winkler, and Andresen 2013). The traditional approaches that are frequently applied to estimate values for a point or location include empirical equation, mechanistic models, and stochastic generation. The modern approaches are those that are employed gridded datasets such as satellite observations, regional climate models (RCMs) and reanalysis data. In developed, world such as the United States, the gridded datasets are readily available. For example, NASA POWER Database (satellite) (NASA 2011), North American Regional Climate Change Adaptation Project (RCMs) (Mearns et al. 2012), and North American Regional Reanalysis (reanalysis) (Mesinger et al. 2006). The main benefit of grid datasets is 'continuous' surface that means values are available for all grids covering a region. Considering this understanding, research needs for climate information associated with data availability in Indonesia should be addressed to answer below questions:

- How to develop the estimated values for a climate variable for a particular region in Indonesia?
- How to quantify and consider biases introduced by estimated values for specific climate variable?

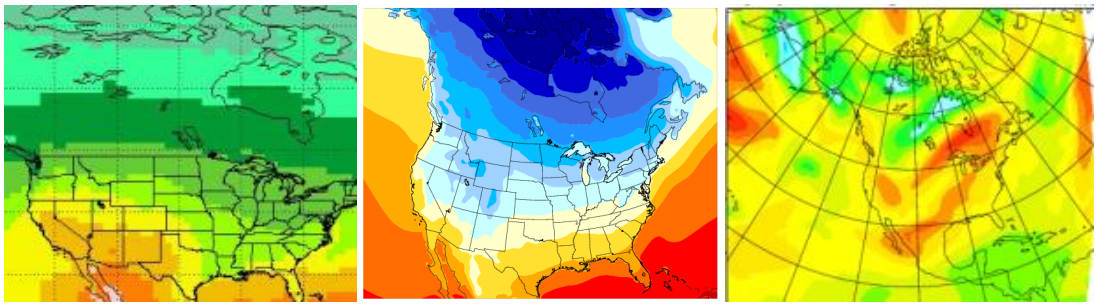

Fig. 2: Example format of grids of NASA-POWER, RCMs (NARCCAP) and Reanalysis (NARR). Image source: NASA POWER: http://earth-www.larc.nasa.gov/, NARCCAP: http://www.narccap.ucar.edu/ and NARR: http://www.ncl.ucar.edu/

The next issue associated with climate information is the accessibility of climate data/observations that are ready to use. It is recommended to conduct quality check following homogenization procedure to control data quality. Adjustments should be made to correct for data errors. In addition, climate impact, vulnerability and adaptation assessments are also need climate projections. Such projections are usually constructed from outputs of global climate models or regional climate models. Downscaling techniques may also be applied to project future climates. We propose the utilization of web-based system to ease the access of climate data/information. The supply of climate information should also be tailored with user needs. An example of this web-based information of climate projections is pileus project (Winkler et al. 2012). A website, www.pileus.msu.edu, is designed to allow users to obtain climate projections for a specific location. User inputs have also been considered when selecting climate variables that are published in the website.

## 2.2. Climate Forecast Application

The advancement in computer power contributes significantly to weather forecast. As computer power increases, forecast skill increases (Shuman, F. G.(1989) and Kalnay, et al. (1998)). This better skill is because higher computer power is required to solve the complex equations that are formulated for the weather forecast. Global teleconnection can now also be studied as computer power becomes higher and affordable. Studies have found that global forcing factors influence regional climate variations (Lee and Robertson 2011). Considering this advancement, below ideas are proposed to take advantage of current knowledge on global teleconnection and computer power for agricultural production.

- Development of methods to predict the onset dates of the rainy season based on global forcing factors (e.g., MJO, IOD, SST, SOI). The prediction of rainy onset is important as rainfall is a critical factor that determines farming activity in Indonesia.
- Evaluation of the skill of forecast for Indonesia.
- Development of dynamic cropping calendar based on the global forcing factors so that climate extreme events associated with climate dissaster such as flood and drought can be anticipated.

## 2.3. Precision Agriculture

Precision agriculture is proposed to take an advantage of information and technology applications in providing customized services to farmers. In this approach, a crop manager plays a vital role to manage a farm. High computer technology, soil measurement, and geographic information system are employed to support daily farming activities. This innovative procedure is purposed to increase efficiency of the use production inputs as well as use climate information effectively to support farming activity (Figure 3). The issue is this system can be very expensive; on the other hand, farmers in Indonesia commonly own a relatively small land area, unlike in developed countries where precision agriculture is introduced. Regardless of this condition, position of crop manager is still needed. Considering the land ownership in Indonesia, a crop manager can be a role taken by a local government officer. The crop manager should understand how to use climate information to support farming activities and disseminate the information to farmers in a region that is his/her responsibility.

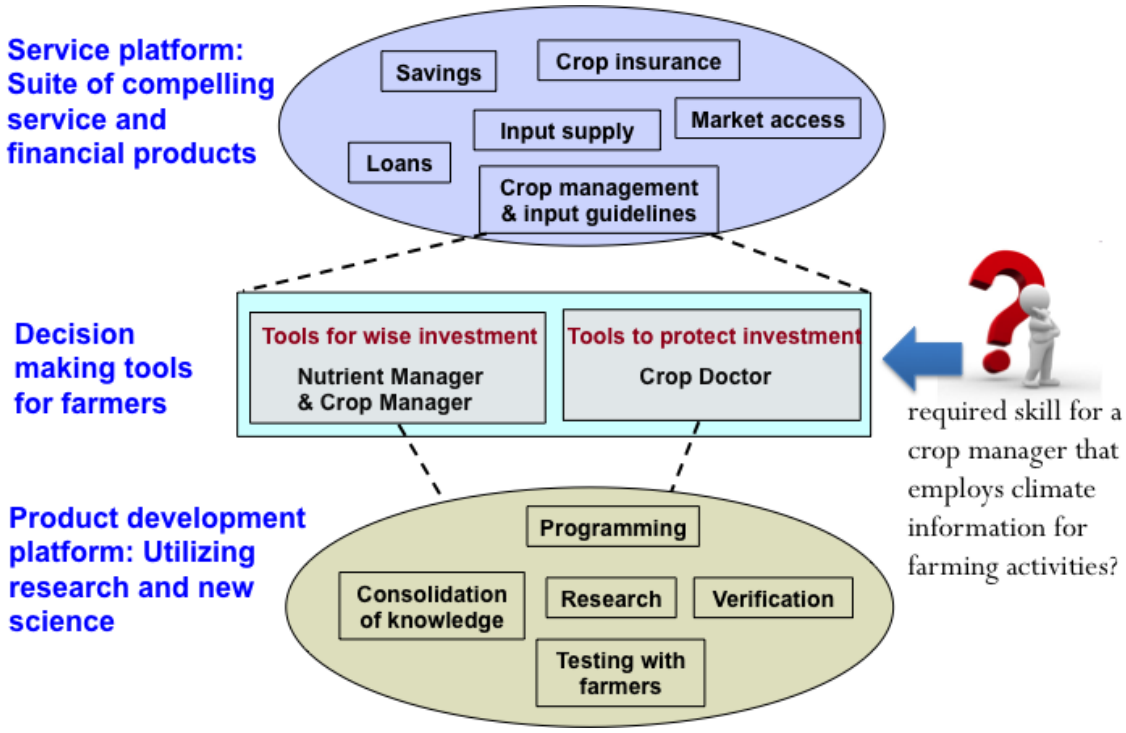


Fig. 3: Diagram steps in precision agriculture. Source: Boer and Zaini (2012)

## 2.4. Crop Cultivar Adaptive to Climate Change

Understanding the impacts of climate change on crop production, crop cultivars that are resilience to drought or flood are explored and developed. This action is considered as a plausible adaptation option as increasing crop productivity in the recent decades is significantly influenced by the advancement in agricultural technology particularly the invention of crop cultivars (Egli 2008). As summarized by Boer (2013), crop cultivars that are resilience to drought, flood and salinity have been invented. Now, the question is to explore potential areas to plant the new cultivars in Indonesia.

For this purpose, an integration of agrometeorology (i.e., crop) models and geographic information system (GIS) to explore areas those are suitable for a 'new' crop cultivar. The agrometeology models require inputs of soil, daily climate data and cropping practices (Jones et al. 2003) that offer an advantage to identify the dynamic impacts of climate fluctuations on crop growth and development. The GIS offers a capability to map outputs of the crop models simulated for a number of farmland within a region so that potential areas for a certain crop cultivar under specific farming practices can be evaluated. An example of the combination of crop models and GIS is presented in Figure 4. An important aspect that should be considered when using crop models for crop simulation are the consideration on uncertainty introduced by crop models. This uncertainty is the main focus of the *Agricultural Model Intercomparison and Improvement Project* (AgMIP) that attempt to compare different crop models employed to simulate a particular crop such as wheat (Rosenzweig et al. 2013).

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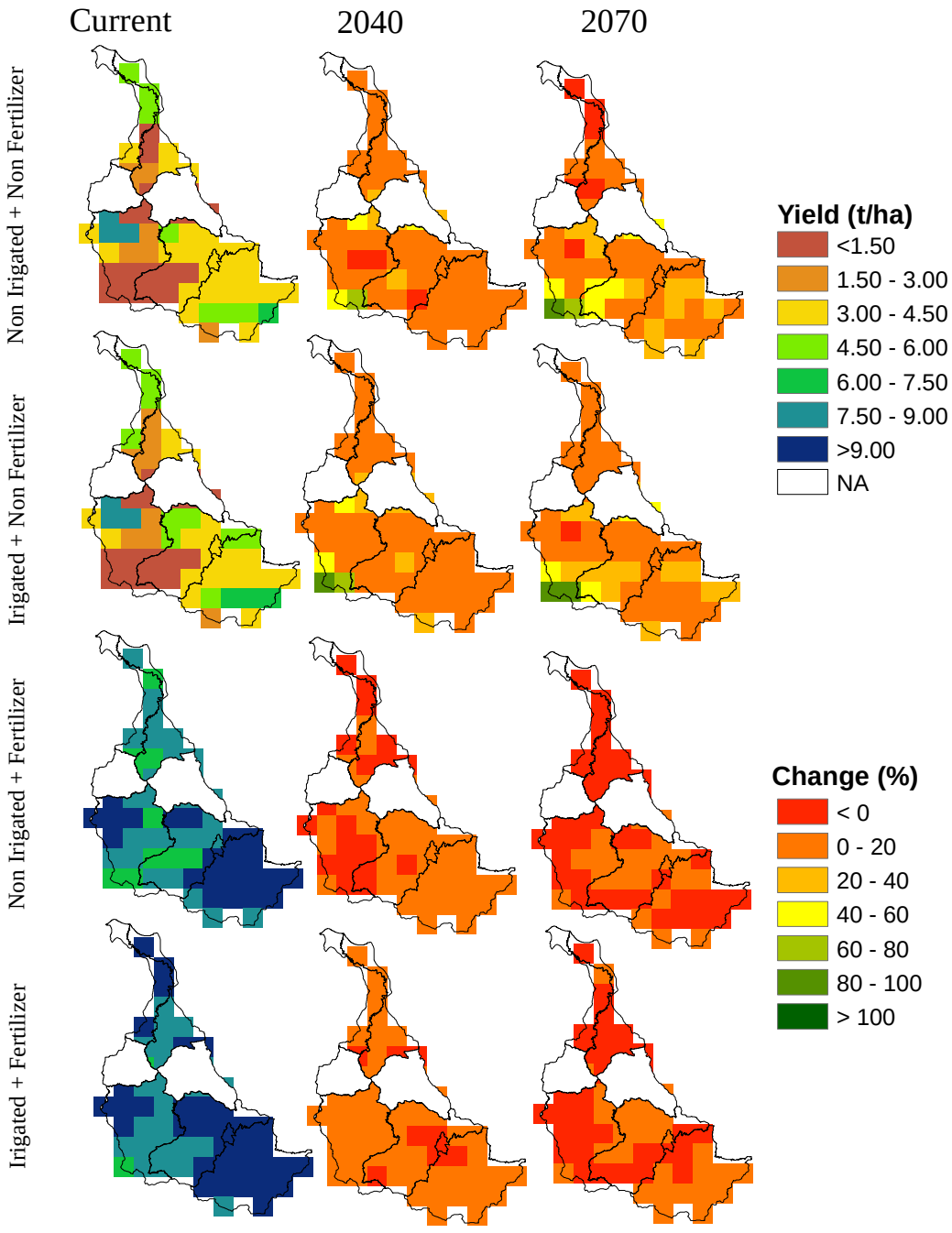


Fig. 4: An example of the application of a crop model and GIS to map vulnerable areas to climate change. The case is for citarum watershed. Source: prepared by Perdinan and Febriyanti (2013)

## 2.5 . Climate Index Insurance

Climate index insurance is proposed considering the failure of the implementation of crop insurance in Indonesia as discussed by Boer (2012). Philosophy of the insurance is payment will be made on the basis of unexpected climate condition regardless of crop loss/failure. This approach will simplify the complexity of crop insurance that requires 'field' checking to evaluate crop losses due to climate extremes. Boer (2012) explains that an index derived based on climatic condition such as rainfall amount during growing season that can cause crop failure (i.e., a climate threshold) is used to determine whether farmers can claim the

payment. For example, the amount of rainfall about 75 mm during growing season is used as a threshold for a location, which means farmers can claim the payment when the amount of rainfall during the season is less than 75 mm, regardless of crop failure or losses. Initially, the climate index insurance has been developed in developing countries, i.e., Africa, India, and the Phillipines as summarized by Boer (2012). The major challenge in the insurance system is to determine the climate threshold (i.e., index) for a location as climatic condition is location specific (i.e., development of climate index). Detail policy on payment and claim of the insurance system for Indonesia is also still being investigated. Further research is still needed including how to include the climate index into farming management in Indonesia as an adaptation option.

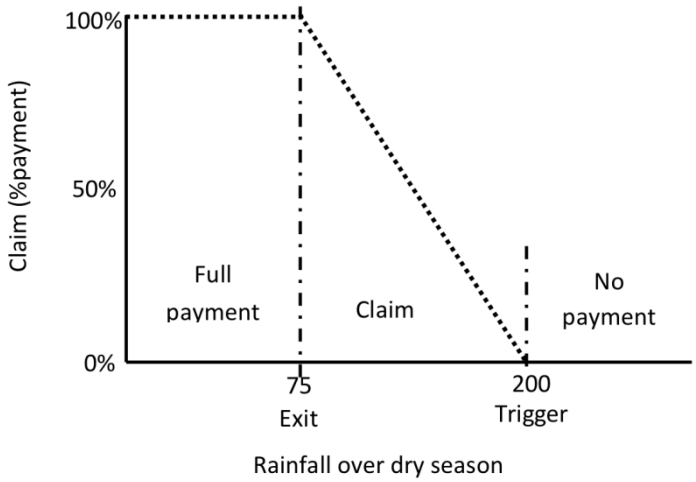


Fig. 5: Illustration of rainfall index and percentage of payment of insurance claim (Source: translated from Boer, 2012)

### 2.6. Management of Pest Infestations

Future warming condition is expected to influence the frequency of pest infestations. Many works have alarmed about the potential increase in pest infestations under climate change (e.g., Diffenbaugh et al. 2008; Luck et al. 2011). Changing climate pattern over the globe may also cause an invasion of pest and disease to a new region. Therefore, it is recommended to develop climate-pest/disease models to estimate pest infestations under the 'new' climate regime. Taking an advantage of climate index insurance, a development of climate index insurance for pest infestations is also recommended.

## 3. Summary

Climate change is already occurring and expected to continue in the future. Consequently, adaptation programs to anticipate the potential impacts of climate change should be planed and implemented. This paper elaborates potential 'innovations' in the field of climate information, information technology, and agricultural technology to support farming activities that also can be seen as plausible adaptation options.

We believe to materialize the proposed innovations coordination and collaboration among stakeholders in agricultural sector is critical in order to maintain food security. Therefore, the important questions are 1) how can we work together in synergy?, 2) how to bring together high potential leaders from business, government and civil society to jointly develop the required capabilities for leading profound innovation and organizational transformation in the context of climate change?. International collaboration to strengthen the implementation of adaptation options is also recommended (Perdinan 2010) considering different adaptive capacity from country to country around the world. We do hope this paper can provide valuable information as an attempt to response to those questions.

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# SUPPORTING PAPERS

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# Pro-Poor Technology in Small Scale Farming For Adaptation to Weather Anomalies

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**Abstract.** The objective of study was to assess the role of local biodiversity resources and pro-poor technology input on the ability of local community (community resilience) to face the impact of weather or climate anomalies. Local resources of floral feed have a significance sense to farmer community resilience faced climate anomalies impact, particularly in some certain local farmer in the dry land of northern and eastern small island of Bali, Indonesia. Forage availability was influenced by on water shortage. Climate anomaly impact to perceive rainfall shifting, even to the dry season period began. In Bali, peak of dry climate crisis in 2004 led to feed even to food scarcity. Those above problems should be anticipated by enthusiasm of local farmer communities. Due to this obscurity, studies had been summarized on the potential of floral forage resources. This study examines in attempt to identify local forage sources utilized as feed and silage during the transition and along the dry season. Results of the current assessment concluded that silage fermentation was acceptable for the forage preservation in effort to maintain feed availability as livestock favor. Main study was verifying the role of fermentative and hydrolyzing microbes, particularly *Lactobacillus plantarum*. The output of the representation work could become a reference in addressing for adaptation response through the application of functional microbial technology involvement in the small local cattle management activities, in particular for silage handling to keep the feed quality and its continuity of the supply.

**Keywords:** local-resources, anomalies-impact, silage, microbial-technology

## 1. Background

Case study was executed in the dry land exotic island of Bali. The programs focused on farming resilience to weather anomalies for adaptation. Related work was designated to small scale livestock throughout microbial fungsional applications. Climate change is a real issue, and some certain action is needed to be established. Weather anomalies influenced farm planning and its utilities. At the same time, technology utilities appear to have beneficial from their various efforts to understand their potential vulnerabilities and to evaluate long term planning options. Despite of the uncertainty, small scale farming is reasonable and has prudent steps taking the ordinary technology to better understand and manage the farm within cope the risk required to support rural livelihood. In the contrary, strengthening of feed intake often missed by farmer particularly to the small scale cattle activities. In the other hand, the presence of small cattle by farmers in Indonesia which are relatively large; empowered of its potential and might become a national oblige to contribute for self-sufficing of meat provision (Pusat Penelitian dan Pengembangan Petemakan, 2010).

Forage sources can be obtained from the forest and the gardens, or cultivated within agroforestry farming. Agricultural waste used as feed source being consumable directly to livestock, subsequent to ensilage process. At the ensilage technology, there were recognized through biological (silage) and chemical processing (ammonium hydrolysis). The biological process normally used anaerobic microbes as inoculant. Silage can maximize the uptake of feed and gain the weight more rapidly. Forage portion preparation using as the main ingredient, then fitted with supplements, additives such as probiotics and pro-vitamin, will ensure adequate nutrition for livestock (Rook *et al*, 2004).

Forage availability derived from natural habitats and as well as cultivated ones, must be influenced by climatic conditions. In the rainy season forage availability is often abundant, while in the dry season becomes less. In the normal climatic conditions, the rhythmic of supply and demand might tend to be balanced in nature. Climate change due to weather anomalies was affecting floral growth performance

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producing forages. Strategies were needed to improve adaptability of each component to their respective life communities. Part of basic concept of integrated farming system would keep resulting for vegetation mixtures that combine grasses, legumes, trees, palms, shrubs and edible weeds, vegetable, fruits etc., and will contribute to increase photosynthesis, improve nutrient recycling, recover soil biota and fertility, and enhance biodiversity (Bellefontaine *et al*., 2002). Unavailability of feed stock in the sufficient quantities as due to land restriction in some certain places must be solved together to obtain the solution (Risdiono *et al*., 2009; Murgueitioa *et al*., 2011; Janzen, 2011; Ukanwoko and Igwe, 2012).

Reveal the above mention so the study was focused to inventory on local floral resources used for feed in the dry land area. Microbial technology in feed process disseminated to the farmer which is aimed to optimize the feed quality and stock continuity along the dry season. In the other hand, the aims of the activities is also to provide information on the scope of mainstreaming effort in the adaptation concept in relation to climate change due to anomalies weather impacts affect the small-scale cattle farming activities in the rural neighborhood.

## 2. Method

Field rapid assessment was determined before work implementation. Local forage inventory was completed into descriptive assessment. Pure microbial culture was prepared in the laboratory and turn to applicable field inoculant, it is called starter, and straightly introduced to local farmer. Laboratory inoculant (starter) then augmented in the field to have some confident yield of some microbial cells' function (for feed, composting, urine fermentation) by using some local resources such as carbon source (local palm sugar), mineral (coconut water), nutrient (vegetable extract), or even snail (*Pomacae canaliculata* Lamarck) egg as protein source, molasses, etc., to become field inoculant (FI) preparation that can be reproducible by farmer.

Hundred kilograms of fresh forage (60 percent moisture content due to dried in ambient room condition after harvest; preferably chopped in one cm square) added with some of mixed material (consist of 5 kg rice brand, 400 ml FI, 200 ml molasses, and 1400 ml water). Filled the mixed-chopped-forage into full and compact volume inside sealed air-tight bag, and wrap to keep anaerobic condition, afterward that ensiled feed has turn into nutritive value after three days incubation. The silage can be storage for long stock to few months. Uncertainly forage moisture, in about 40 percent, could make excessive heating inside the bag because of mold growth, and as due to that spoilage silage has to be disposed. In the same way, there was other usage of dry forage (agriculture waste such as straw of grasses and legumes families are dried into twenty percent moisture). A hundred kilograms of dry chopped forage mixed with 4 kg organic compound (urea as non-protein nitrogen sources) and make it in a closely package. After incubation, that amonification forage should be kept at open drying to evaporate odors before feed (Schroeder, 2013).

To evaluate result of fermented and hydrolyzed forage, then the proximate analysis through the samples include the percentage of water content, pH, ash content, dry matter, crude fiber, crude fat, neutral detergent fiber (NDF: lignocelluloses material), acid detergent fiber (ADF: hemicelluloses material), extract materials without nitrogen, protein content, crude protein, total acid, calcium (Ca) and phosphorus (P) were observed in the laboratories work.

## 3. Result and Discussion

Certain types of agricultural land uses and traditional practices might support important numbers of native plant, and also contribute to conservation value. Dry land revegetation incorporates to native trees and shrubs are instrumental for the productive rehabilitation of small rural cattle production and for biodiversity conservation in agricultural landscapes. Diversity of local species used for feed resources had already familiar to farmers and only technology input was needed. Silage had become proven technology and easy to understand because the microbial process had unstated next to local people as imitate to make their traditional fermented food. Survey finding summarized the species diversity of local forage source that can be used directly or even through fermented process. Some species had known as dry tolerant forage stock (Table-1). Inoculant is able to realize some feed nutrient through fermentation process to make up some silage sources.

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Table 1. List of potential local feed

**Tabel-1a. LOCAL FORAGE SOURCES**

| No. | Vernacular name | Scientific name |
|---|---|---|
| 1 | Lamtoro | *Leucaena leucocephala* (Lamk.) de Wit |
| 2 | Gamal | *Glirisidia sepium* (Jacq.) Kunth ex Walp. |
| 3 | Turi | *Sesbania grandiflora* (L.) Poiret |
| 4 | Kaliandra | *Calliandra calothyrsus* Meisn. |
| 5 | Bunut | *Ficus glauca* Miq. |
| 6 | Jati belanda | *Gmelina arborea* Roxb. |
| 7 | Nangka | *Artcarphus heterophyllus* Lamk. |
| 8 | Mahoni | *Swietenia macrophylla* King |
| 9 | Sengon | *Paraserianthes falcataria* (L.) I.C. Nielsen |
| 10 | Angsana | *Pterocarpus indicus* Willd. |
| 11 | Johar | *Cassia siamea* L. |
| 12 | Ketela karet | *Manihot glaziovii* Muell. |
| 13 | Kabesak/ Pilang | *Acacia leucophloea* (Roxb.) Willd. |
| 14 | Tambaring/kiu/ asam jawa | *Tamarindus indica* L. |
| 15 | Kom/bidara | *Zizyphus timoriensis* DC |
| 16 | Kedondong hutan | *Lannea grandis* Engl. |
| 17 | Gewang | *Corypha gebanga* Blume |
| 18 | Kelapa sawit | *Elaeis guineensis* Jacq. |
| 19 | Kakao | *Theobroma cacao* L. |
| 20 | Kapuk | *Ceiba pentandra* (L.) Gaertn. |
| 21 | Waru | *Hibiscus tiliaceus* L. |
| 22 | Dadap | *Erythrina variegate* L. |

**Tabel-1b. AGRICULTURE WASTE AND OTHER SOURCES**

| No | Vernacular name | Scientific name |
|---|---|---|
| 1 | Padi | *Oryza sativa* L. |
| 2 | Jagung | *Zea mays* L. |
| 3 | Kacang tanah | *Arachis hypogaea* L. |
| 4 | Kedelai | *Glycine max* (L.) Merr. |
| 5 | Rumput gajah/Rumput raja | *Pennisetum purpureum* Shcumach. 1827 |
| 6 | Kalanjana | *Panicum sarmentosum* Roxb. |
| 7 | Sentrosema | *Centrocema pubescens* Benth. |
| 8 | Kacang rambat | *Clitoria ternatea* L. |
| 9 | Kacang asu | *Calopogonium muconoides* Desv. |
| 10 | Setaria | *Setaria sphacelata* (Schumach.) M.B. Moss var. sericea (Stapf) W.D. Clayton |
| 11 | Tebu | *Saccharum officanarum* L. |
| 12 | Ketela rambat | *Ipomea batatas* Lam |
| 13 | Pisang | *Musa* spp. |
| 14 | Manja | *Themeda gigantea* (Cav.) Hack. |
| 15 | Ki rinyuh | *Chromolaena odorata* (L.) King & H.E. Robins |

Tabel-2. Analysis of feed nutrients

| No. NUTRIENTS (%) | FERMENTED BY *Lactobacillus*: | | | | AMMONI-FICATION OF RICE STRAW | DRIED RICE STRAW |
|---|---|---|---|---|---|---|
| | CORN STALK | CORN LEAF | CORN COB | RICE STRAW | | |
| 1. Dry matter | 38,99 | 51,61 | 77,75 | 50,85 | 52,19 | 77,07 |
| 2. Ash | 2,38 | 4,10 | 2,35 | 10.51 | 10,69 | 17,86 |
| 3. Crude protein | 3,31 | 4,75 | 7,18 | 4,18 | 5,50 | 6,59 |
| 4. Fibre | 15,37 | 18,27 | 34,24 | 20,33 | 24,77 | 36,19 |
| 5. Crude fat | 4,26 | 0,65 | 2,02 | 0,69 | 3,11 | 5,55 |
| 6. Nitrogen free extract | 13,67 | 23,84 | 31,96 | 15,14 | 8,12 | 10,88 |
| 7. Neutral detergent fiber (NDF) | 32,96 | 41,25 | 82,24 | 38,56 | 42,91 | 59,62 |
| 8. Acid detergent fiber (ADF) | 29,99 | 23,65 | 40,03 | 27,38 | 32,08 | 50,19 |
| 9. Calsium (Ca)* | 25,81 | 52,87 | 1,32 | 200,61 | 180,02 | 240,86 |
| 10. Total phosphorus | 0,35 | 0,23 | 0,09 | 0,20 | 0,18 | 0,17 |
| 11. Total acid | 1,08 | 1,13 | 1,03 | 1,12 | 1,08 | 1,11 |
| 12. Protein | 10,94 | 8,06 | 3,62 | 0,98 | 1,17 | 0,21 |
| 13. Moisture content | 46,75 | 46,94 | 23,08 | 50,70 | 37,35 | 11,00 |
| 14. Acidity (pH) | 7,56 | 7,69 | 7,23 | 7,65 | 7,36 | 7,58 |

*mg/kg

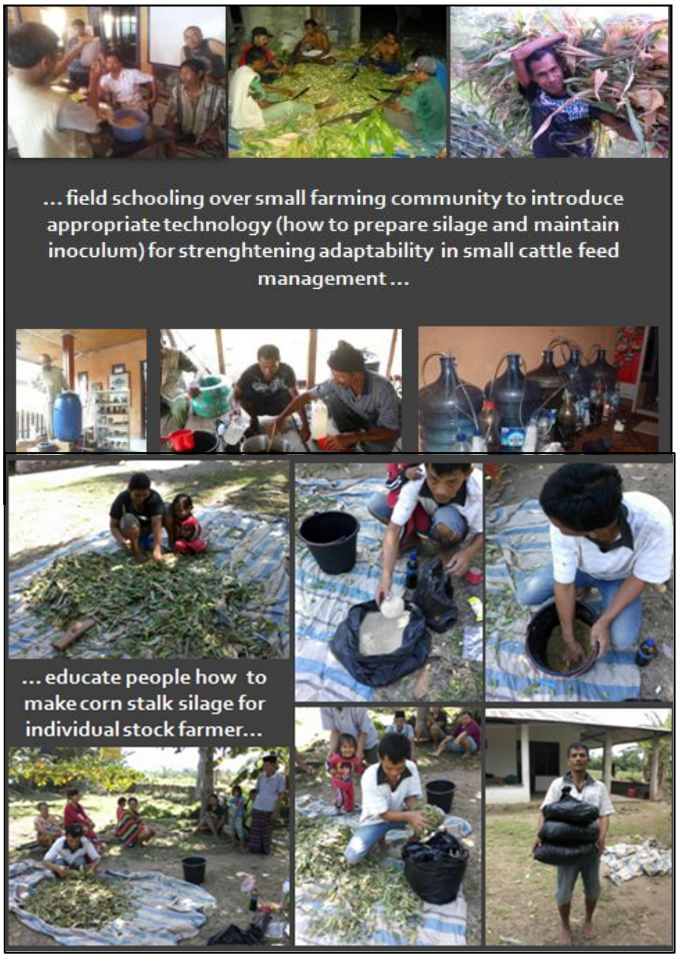


Fig. 1: Dessimination activities in the field

Environmental failure which is associated to agricultural activities are forest destruction, grasslands expansion, land degradation and, increasing of degraded lands, as well as desertification, and all of that ought to become problem. The effect is to reduce biodiversity impacts. In the other hand, land crisis occurs within increasing human population, agricultural commercialization, agricultural technology inputs, and increasing consumption need. Tropical silvopastoral systems provide benefits in terms of ecosystem services, climate change, sustainable productivity, and landscape-level restoration. Current potential of small agriculture system are beginning to recognize in the productive, ecological, and social advantages of smaller-scale, less-intensive, sustainable, and their potential to provide future food as well as feed security (Herrero *et al*., 2010). In the other way within relation to small cattle management in the study, integrated farming systems might offer an option to increase land productivity based on simple technology and incorporating input agronomic and ecological aspects.

Feed requirements necessary to offset local government support, among others, to expand the garden green fodder, seed supply, as well as striving for the establishment of feed processing units. Feed supply center can be arranged through the manufacture of feed mill centers, or manufacturing feed barn. Intake of silage making technology with a functional role for microbes utilizes agricultural waste into feed. Rice straw is available in abundance in every area of arable farm to be used as feed source.Results of the current assessment concluded that silage fermentation was acceptable for the forage preservation in effort to maintain feed availability as livestock favor. Main study was verifying the role of fermentative and hydrolyzing microbes, particularly *Lactobacillus plantarum*(Table 2).

## 4. Conclusion

The output of the representation work could become a reference in addressing for adaptation response through the application of functional microbial technology involvement in the small local cattle management activities, in particular for silage handling to keep the feed quality and its continuity of the supply. Microbial technology transfer is a critical step in good handling practice for feed quality improvement and more likely applied via small farmers' activities in the dry land areas.Concept of improvement within functional microbe and its utilization for adaptation through local resources become practicable relating to management of small scale livestock.Supply of feed through integrated farming activities was able to keep small cycle carbon energy (cellulose) and which was even in maintain decreasing emissions.

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# Analysis of Farming Systems in the Arid Climate Region as Impacts of Adaptation to Climate Change in East Nusa Tenggara (NTT)

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**Abstract.** Performers farming in arid climate areas of East Nusa Tenggara familiar with short rainy season. However, the climate anomaly has caused many extreme events such as adverse agricultural drought, flood, pest attacks and uncertainty season. The research aims to analyze the changes in farmer's behavior as adaptation to climate change in dry areas. The experiment was conducted in the province East Nusa Tenggara as representative of arid climate regions in Indonesia.To compare that effect, selected two sample sites namely rainfed and irrigation on climate type $D_3$ and $D_4$ (climate type Oldeman) in two regency Kupang and South of Timor Tengah. Respondents were selected randomly in the sample sites. Primary data was collected through a questionnaire survey with tools against 30 respondents. Observed variables encompassed farming activities, cropping pattern, seed requirements, farming cost, kind of commodities, pest attack and coping strategies of family upon normal and extreme years. Data were statistically analyzed with a nonparametric test of hypothesis using the comparative testKruskall Wallisand Chi Square test,crosstabulationof the normal/extreme year. The results showed that the significant impact be found on the level of pest attack, seed application, fertilizer application, varieties of paddy. The conclusion, dryland farmers in both irrigated and rainfed adapt by improving cultivation by replacing varieties and manure applications. however the cost is not significantly different on different conditions. Different is the level of pest attack is higher during extreme rainfall years.

**Keywords:** Climate change, farming system, pest attack.

## 1. Background

Climate change is a change in climate parameters such as temperature, humidity, rainfall within a period of 50-100 years, triggered by an increase in greenhouse gas emissions. Greenhouse gas emissions continue to rise has consequences for global warming. Where greenhouse gases ($CO_2$, $CH_4$ and $N_2O$) are inhibiting the reflection of infrared radiation to the earth so that the earth's atmosphere is getting hotter. According to [1] increase in global temperature due to a doubling of $CO_2$ concentration has led to an increase in global temperatures between 1.0 to 3.5 ° C which will take place between now and 2100. Temperature increase is also followed by an increase in the average presitipasi 10-15% due to a warmer atmosphere bind more water vapor.

Region of East Nusa Tenggara mostly located (30,4%) on the island of Timor. Rice harvested area in 2010 from all districts of the island of Timor contributed nearly 20% of the whole province of NTT [2]. Cropping pattern during normal years is one rice and one-time planting crops, but the calendar is very dependent on water availability. Uncertainty of rainfall has disrupted the planting calendar farmers depend on rain water. Although the Local Government through budget funds have built up a network of technical irrigation to anticipate fluctuations in the availability of water but not fully correct the problem.

Climate anomalies in the arid region NTT affected by El Nino events and La Nina is affecting the growth center of the cloud and sea surface temperature. BMKG Kupang Lasiana station stated that the type of monthly rainfall in the region is a type of rain NTT Monson in which only happened one rainy season typically peaks from December to January Month. Differences in the dry season to the rainy season is very clear where the rainy season occurs during south-west monsoon system is dominant across the region.

Issues underlying this paper is that the farmers in the area during the dry climate has experienced difficulties in crop farming. Low rainfall, poverty and powerlessness has increased the vulnerability of farmers to climate change impacts. Meanwhile, commodity crops are also sensitive to climate change thus

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might add to the burden of farmers. Therefore, this paper will discuss how farmers do farming as an effort to adapt to climate change along with the changes of the supporting aspects.

## 2. Literature Review

The rainy season in Indonesia is influenced by several factors such as El Nino / La Nina, sea surface temperature, dipole modes, and monsoon easterlies / westerlies [3;4]. Climate anomalies in the arid region NTT affected by El Niño events and La Nina is affecting the growth center of the cloud and sea surface temperature. Meteorological and geophysics agency Lasiana Kupang stated that the type of monthly rainfall in the region is a type of rain NTT Monson which only happened one rainy season normally peaks from December to January Month. Differences in the dry season to the rainy season is very clear where the rainy season occurs during south-west monsoon system is dominant across the region [5].

Research [6] in Indonesia, stated that the extension agrometeorology role in improving the understanding of farmers in aspects of management and manipulation of water in their fields. Through field school climate in a particular period, farmers in Indramayu and Gunung Kidul trained to observe rainfall and temperature then make records relating to pests and productivity. Lessons learned from it is used to adjust farm management (sowing, transplanting, water, pest fighting, using fertilizers etc.).

Increased frequency natural disasters such as floods, tsunami, hurricane, etc during the recent year might be attributed to the climate change assosiated to increased accumulation of greenhouse gases (GHGs) in the atmosphere. The global surface temperature increased by $0.6^{o}$C since the late 19th century with a current average warming rate of $0.17^{o}$C per decade [7]. According to the data [8] in Indonesia, agriculture produce methane gas averaged 6.9% since 2005 is higher than the average world production. In addition, the use of fertilizers based on average kilograms per hectare of arable land, Indonesia is much higher than the world average.Besides as the emitter, the agricultural sector also play a role as an absorber of greenhouse gases such as sinks, C sequestration, and maintaining watershed hydrology [9].

Several studies have revealed [10; 11] that Carbon sequestration from the atmosphere can be applied through measures such as rotation cultivation, intercropping, cover cropping, companion cropping, ratoon cropping, and appropriate cropping practices.In addition, adaptation strategies to anticipate the impacts of climate change AARD has generated technological innovations such as improved varieties low emission, land and water management, and zero waste technology [12].

## 3. Method

Location of the study was in the province of NTT in 2011. The choice of location is based on the consideration that the majority of the island of Timor in NTT Province including dry and extremely dry category ($D_3$ and $D_4$) based classification according Oldeman climate. With the category of vulnerable regions to climate change, especially the parameters of rainfall, temperature and humidity.

Sampling locations are intentionally determined Kupang and South Timor Tengah (TTS) with consideration of the area is a food crop production centers to the mainland island of Timor. There are irrigated and rainfed rice in every type of climate. Therefore, in determining the location of the sample must be representative of the population (overall condition). Climate type $D_3$ irrigated rice in East Kupang District represented by Noelbaki village, rainfed lowland villages represented by Tuakole and Oesao. While climate type $D_4$ in TTS district represented by Batu Putih village Oebobo for irrigated and South Amanuban represented by Bena Village for rainfed rice. The selection of respondents with stratified random sampling method is selected respondents stratified by climate type next based on the type of irrigation. The number of respondents as a whole is 30 people.

Data types can be classified on nominal data or categorical and numerical data. Furthermore, the data were analyzed according to the rules of non-parametric statistics using SPSS software. Analysis of the farming system is approached from some variables e.g cropping pattern, application of fertilizer, variety, farming costs (seed, fertilizer, pesticides) and farm scale. Making conclusion is based on the hypothesis testing is appropriate. Hypothesis testing in accordance with the research data is comparative test for more than 2 pairs of data groups namely normal year, extreme drought year and extreme precipitation yearsusing

the Kruskall-Wallis and Chi-Square test (α=5%). For deepening the discussion, several variables such as the use of seed, fertilizer application and intensity of pests attack was analyzed descriptively and cross tabulation.

# 4. Result and Discussion

Farmers in dry climates with very poor conditions suffered because of climate uncertainty. It is related with the availability of water as a critical factor in farming. Upon dry climate, sufficient water is available only for once planting paddy so that farmers must rescue the farm so as not to suffer greater losses. Altough wetland irrigation have water storage reservoir, yet during dry year available water is not sufficient to watering the paddy field. It is only sufficient to watering maize crop or other legume. Distinction of agro-climatic zone showed duration the period rainy season or dry season (Table 1).

Table 1. Description of study sites

| **Agro-ecosystems** | **Agro-climatic Zone** | | | | | |
|---|---|---|---|---|---|---|
| | Zone $D_3$ | | | Zone $D_4$ | | |
| | Village | Sub-District | Regency | Village | Sub-District | Regency |
| Irrigation | Noelbaki | Noelbaki | Kupang | Oebobo | Batuputih | South Timor Tengah |
| Raifed | Oesao | Center Kupang | Kupang | Tuakole | Batuputih | TTS |
| | Babau | East Kupang | Kupang | Bena | South Amanuban | TTS |

Source : Primary data (2011)

There are some actions that do farmers as effort to adapt against the climate change. For example the changes in cropping pattern, the use of seed, fertilizer use so that alter the overall farming costs.Table 2 showed that cropping pattern upon the normal year are once paddy and twice paddy with number of farmer rateably. During extreme precipitation most farmers change their cropping pattern to be twice of paddy. Otherwise, farmers reluctant to take the risk during extreme drought. Nevertheless, the alteration is not significant statistically if compare between normal year and extreme year. Except comparing between extreme precipitation and extreme drought.

Table 2. Cropping pattern of farmer in Kupang and East Timor Tengah, NTT Province, Indonesia

| Cropping pattern | Year | | |
|---|---|---|---|
| | Normal | Extreme precipitation | Extreme drought |
| Paddy | 16 | 7 | 23 |
| Paddy – Paddy | 14 | 23 | 7 |
| Total | 30 | 30 | 30 |

Source : Primary data (2011)

What did farmers actions in term of seed application as adaptation to climate change on their environment? Table 3 indicates that there is difference of treatment during extreme drought year. In arid region, the farmer have been guessed that delayed rainy season related with severe drought and high risk of failure. So that, farmer did not invest high quality seed. To averted worse losses, farmer working off-farm.

Accordance to the fact during extreme precipitation that there are enhancement seed cost and seed quantity. Some superior yield variety are rather suitable to extreme precipitaion for example Situ Bagendit and Cigeulis. The main problem was pest attack and fall down cause of wind and high rain intensity. To obtain the optimum produce, farmer followed advices pesticide and fertilizer.

Table 3. Seed aplication for normal, extreme precipitation and extreme drought in Kupang and East Timor Tengah, NTT Province, Indonesia

| Seed Application | Year | | |
|---|---|---|---|
| | Normal | Extreme precipitation | Extreme drought |
| Label | 27 | 26 | 24 |
| Non label | 3 | 4 | 6 |
| Total | 30 | 30 | 30 |

Source : Primary data (2011)

In terms of fertilizer application, the fact on Table 4 indicated that there were some means of fertilizer application, namely just added manure, added chemical fertilizer, both of them and no addition. During extreme precipitation, majority farmer increase dosage and kind of fertilizer. Because it expected able to guard the crop from pest attack and erotion of nutrient. Farmer choosed the option consider chance of water availability during longer period.Manner of fertilizer application, statistically differ between normal and extreme year.

Table 4. Fertilizer application for normal, extreme precipitation and extreme droughtin Kupang and East Timor Tengah, NTT Province, Indonesia

| Fertilizer application | Year | | |
|---|---|---|---|
| | Normal | Extreme precipitation | Extreme drought |
| (+) Manure | 0 | 1 | 0 |
| (+) CF * | 14 | 18 | 16 |
| (+) Manure & (+) CF | 6 | 4 | 4 |
| No additional | 10 | 7 | 10 |
| Total | 30 | 30 | 30 |

*CF = Chemical fertilizer
Source : Primary data (2011)

Table 5 shows that of the seven parameters tested just one parameter different significantly that is level of pest infestation. Higher levels of pest attack occurred in extreme wet. Whereas farmers increase cropping intensity in that year. Meaning that if farmers want to benefit from the excess rain water, farmers have to raise capital to seed quality and high levels of pesticides as pest deterrent. While the other parameters were not significantly different. Parameter seed costs, fertilizer costs, pesticide costs do not distinct even when the extreme dry or wet. Farmers in dryland farming did not increase spending because of the lack of capital to do it.Irrigation in dry land areas does not give large changes in extreme due to water debit in the reservoir is insufficient to irrigate the paddy fields so that farmers keep land fallow.Similar conditions occur in extreme wet years in which excess water debit caused flooding in paddy fields so that farmers no opportunities to increase/ decrease the scale farming.

Table 5. Test Statistics for some parameters using Kruskal Wallis test based on grouping variables extreme years [a,b]

| | Seed cost | Urea cost | TSP cost | Chemical Pesticide cost | Level pest infestaton | Type of irrigation | Farm scale |
|---|---|---|---|---|---|---|---|
| Chi-Square | 1.340 | 1.205 | 1.329 | 2.946 | 48.138 | .110 | .072 |
| Df | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Asymp. Sig. | .512 | .547 | .515 | .229 | .000 | .947 | .965 |

a. Kruskal Wallis Test
b. Grouping Variable: Extreme years

## 5. Conclusion

During extreme precipitation, farmers increase cropping intensity and improve cultivation patterns with changing varieties and method of fertilizer. However, higher levels of pest attack occured on extreme precipitation and thus require greater pesticide costs of. Thus, the system of rice farming in extreme precipitation requires a higher cost in order to obtain optimal results. The condition also occurs in irrigated land because the debit of water irrigation has not been sufficient to regulate water during extreme years. to avoid greater costs, farmers in dry lands recommended to make efforts to implement adaptation using the mixed crop varieties and quality and balanced fertilization during years of extreme wet and extreme dry.

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# Rice Supply on Climate Anomaly Condition in Central Java Province

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**Abstract.** The happening of climate anomaly, El Nino and La Nina, have been much stronger and making a huge impact on various sectors in the last decade. In the agricultural sector, El Nino and La Nina cause the greater dry and wet conditions than the normal condition, so that the food production system in Indonesia is hampered obviously. This study aims to analyze the impact of El Nino and La Nina concerning to rice supply in Central Java Province. The study was analyzed with descriptive analysis method by making use of secondary data from years 1990-2010. In this study, the supply function was analyzed by regression analysis of ARMA (Autoregressive Moving Average) to estimate the alteration of rice supply in the climate anomaly circumstances. The occurrence of El Nino and La Nina is indicated by south oscillation index, then it is included in the regression analysis as dummy variable. The regression analysis shows that El Nino has no significant important on rice supply in Central Java. On the other hand, La Nina has a positive impact on rice supply. Rice supply function indicates that the rice supply in Central Java increases at the occurrence of La Nina. Therefore, rice supply is much greater at La Nina condition than the normal and El Nino conditions. The increasing of rice supply in Central Java during La Nina condition becomes one of the alternative way for area optimization when climate anomaly occurs. It is certainly good thing for the government, because the climate anomaly is not always make a bad impact. A good management about rice cultivation in the occurrence of climate anomaly, supports the increase of rice supplies so that the welfare of farmers will be improved.

**Keywords:** El Nino, La Nina, supply, ARMA

## 1. Background

Indonesia is known as an agricultural country which relies on agriculture as source of livelihood as well as the support of development. The agricultural sector is a strategic sector and has an important role in the national economy and for community survival, particularly in its contribution to Gross Domestic Product, employment providers and the provision of food in the country. Being aware of this role, make most of the people still maintain agricultural activities. However, over the years the production of agricultural products is still far from expectations. This is due to several factors. Internal factors that affect the low quality of human resources peasant society, hence, most farmers still use the conventional way while the recent technology is highly demanding modernization. Moreover, external factors that affect them is the conversion of agricultural land into industrial land and the climatic factors as well,which is being a concern to the experts because it raises a lot of disasters.

Climate anomaly subsequently influenced the Indonesian agricultural production, especially rice. One form of climate anomalies that have been occuring at this time are the El Nino and La Nina, which are becoming more frequent and longer in duration. El Nino events are usually followed by a decline in rainfall, while the La Nina lead to increased rainfall. Both of these events can be considered as disasters caused by climate anomalies and disadvantageous. At El Nino events, the availability of water for agricultural crop production is reduced, which decreases or even no harvest because of drought. While the La Nina events, the availability of water to be excessive and cause flooding so that the plant can also crop failure. Climate anomalies are more frequent with more extremely weather conditions and the longer duration, it rises a significant impact on agricultural production in many countries. (IPCC, 2008). Since rain is one of the important components in the agricultural world , it is very important to have the information about rainfall, especially for determining the plan for cropping patterns and post- harvest and other activities related directly or indirectly .

Central Java Province as one of the national food buffer has fluctuative rice production levels from time to time. The availibility of land area is fixed, and even tends to decrease because it is switching to non-

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agricultural functions. The average of riceharvested areain Central Java is1.6 million ha / year during the years 1990-2010. Agriculture potention in Central Java province scattered throughout the district. This area also among provinces with the title of national food buffer. The main results of agriculture in Central Java province is the rice and horticultural crops. (Triyanto, 2006) .

From the description, it appears that El Nino and La Nina were also taking a role in affecting the agricultural sector in the province of Central Java. El Nino and La Nina as a form of climate anomalies will affect agricultural production. Because water is an absolute necessity for plant growth, then the condition of water shortage at El Nino orexcessive water at La Nina during the course will affect plant growth. Plant growth which is not optimal of course will affect the rice offers downhill and of course this will have contributed to the price received by farmers. Because the prices received by farmers decreased, it can be said that the welfare of farmers measured from farmers exchange rate also decreased because their income is reduced. Therefore, in this study, it willbe estimated the influence of El Nino and La Nina on the supply function and the exchange rate function of rice farmers.

## 2. Literature Review

The phenomenon of drought and flood is a natural disaster that occurred almost every year in parts of Indonesia. These disasters are usually large and give highly detrimental impact on agriculture. One scientist who has been researching the impact is Irawan (2006) which states at the national level, food production opportunities rice and pulses were lost due to El Nino on average by 3.06 percent, or about 1.79 million tons for each El Nino event. Decline in food production was greatest in maize by 11.9 percent and lower in cassava plants only decreased by 1.28 percent, and rice by 2.43 percent. Soybean that was sensitive to water shortages, experienced substantial decline in production about 5.10 percent. The opposite occurred in La Nina events. At the national level, the climate anomalies stimulatedthe increase production of food grains and pulses at 1.084 percent for every La Nina occurrence. The highest increase happened in production of corn, whichwas equal to 3.92 percent. This suggests that corn plants are sensitive to climatic anomaly, either El Nino or La Nina, compared to other crops. Increased production is not very high because of La Nina occurs in plants

Further research conducted by Utami (2008) on the impact of El Nino and La Nina on the supply and the welfare of rice farmers and corn on the island of Java. The results showed that during the period 1987-2006, El Nino events have resulted a decrease rice yield by 4.15 percent, while La Nina increased rice yield by 1.45 percent. With the analysis of supply function, note that the El Nino does not significantly influence rice deals, but La Nina significantly influence rice deals. This means that rice production at the farm level is affected by the occurrence of climate anomalies.

## 3. Method

This study usesthe basicresearchdescriptiveanalysis, itis a methodforexaminingthe status ofhuman groups, an object, a set of conditions, a systemof thoughtora class ofeventsin the present. Data collection wasperformedby the method ofrecording thesecondary datacontainedinthe Central Statistics Agency, Department of AgricultureCentralJava province, andBOMAustralia from1990 to 2010. Forricesupply functionvariablesareregressedusingquarterlydata since it is in accordance with riceproduction dataas the dependent variablewhich is onlyavailablepergrowing season (four months), so the dataof independent variablesthatare availablein themonthly datawere averagedperfour months.

To estimate the influence of the El Nino and La Nina on rice supply function was analyzed using the method of ARMA (Autoregressive Moving Average). The main reason for the use of ARMA models is the movement of economic variables in the supply function were obtained from the time series data that are difficult to explain by economic theories (Widarjono, 2007). In the ARMA model, there is no specific assumptions about the historical data of the time series, but uses an iterative method to determine the best model. Supply function is estimated as follows:

$$\log Qt = \log b_0 + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + b_8 AR(3) + b_9 MA(5) + b_{10} D_1 + b_{11} D_2 + e$$

Description:
logQt : log rice supply (tons)
$b_0$ : constants
$b_1$-$b_{11}$ : coefficient
log$X_1$ : log of dry grain harvest prices (USD / I)
log$X_2$ : log of corn prices (USD / I)
log$X_3$ : log of soybean prices (USD / I)
log$X_4$ : log of cassava prices (Rp / I)
log$X_5$ : log of urea fertilizer prices (USD / kg)
log$X_6$ : log of TSP fertilizer prices (USD / kg)
log$X_7$ : log of average wage laborer (USD / day / person)
$D_1$ : dummy variable El Nino events
1 = occurred El Nino
0 = not occur El Nino
$D_2$ : dummy variable La Nina events
1 = occured La Nina
0 = not occur La Nina
AR (3) : autoregressive 3
MA(5) : moving average
e : factor disorders

## 4. Result and Discussion

El Nino and La Nina are climate anomalies associated with rainfall,cover a wide area which are Australia, Southeast Asia, western United States to western South America. Some research has been conducted to determine the impact of El Nino and La Nina particularly in the field of agriculture. El Nino and La Nina as climatic anomalies events certainly have a negative impact, especially in Indonesia, its geographical position vulnerable to the impacts of climate anomalies.

The occurrence of El Nino and La Nina will affect rice production in Indonesia, especially in Central Java province as provincial national food buffer. Fluctuations in rice production in normal conditions, El Nino and La Nina are shown in Figure 1 below.

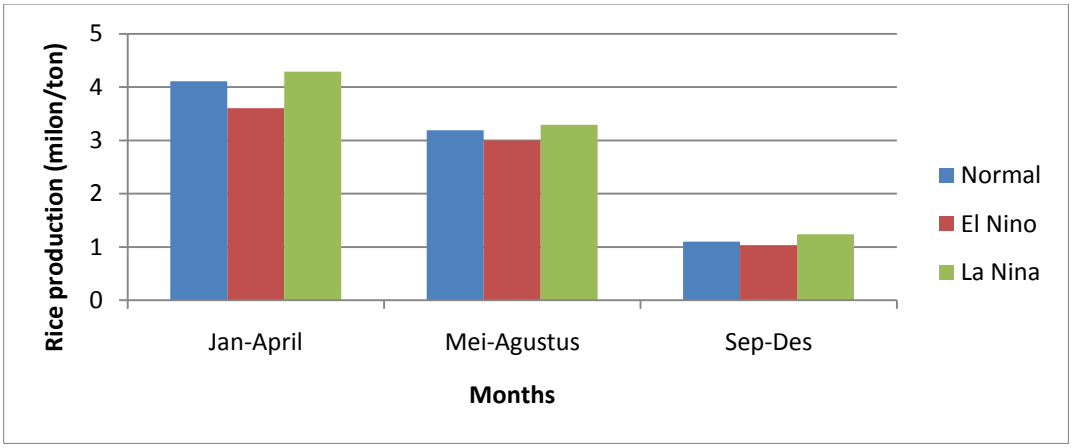


Fig.1 : Rice Production in Normal, El Nino, and La Nina Condition

Figure 1 shows the quarterly fluctuations in rice production in normal conditions, El Nino and La Nina in Central Java province in 1990-2010. From Figure 1 it is seen that the highest rice production was always obtained at the condition of La Nina and the lowest rice production was obtained on El Nino conditions. Production on normal conditions is always located between El Nino conditions and La Nina. The result holds for all months from January to December which is then divided into quarterly system.

Supply model is used to determine the price and quantity sold in the market. This model accommodates the possibility of factors that can change the balance, which will then be displayed in the form of a shift of the offer .

In line with the theory of supply, rice production will also offer experienced response as there are several variables that affect it. Moreover, because rice is one of the agricultural products. One of the main characteristics of agricultural products is a time lag between planting and harvest. In most agricultural commodities, the price of output cannot be ascertained when the commodity was planted. Farmers should take production decisions based on an estimate of product prices according the experiences of the past . It refers to the interval between the two periods, when to plant and harvest. Farmer response occurs after an interval as the impact of changes in input prices, output and government policies.

Seeing the privilege of rice as one of the agricultural products and as a political product, of course, it is important to know the bid response when there are several variables that affect it, especially when there is a variable climate anomalies in it. To determine the effect of these factors it is necessary to test using a regression model. Table 1 shows the regression results of the rice supply function with ARMA method.

Table 1. Result Of Rice Supply Regression

| Variable | Coefficient | Value of Significant t |
|---|---|---|
| C | 26,28665 | 0,0000*** |
| Log of dry grain harvest prices ($t-_1$) | 0,56050 | 0,1952ns |
| Log of corn prices($t-_1$) | -1,41032 | 0,0075*** |
| Log of soybean prices($t-_1$) | -1,57400 | 0,0001*** |
| Log of cassava prices($t-_1$) | -2,17600 | 0,0000*** |
| Log of urea prices($t-_1$) | -1,16953 | 0,0000*** |
| Log of TSP prices($t-_1$) | -0,99232 | 0,0016*** |
| Log of average wage laborer($t-_1$) | -1,98027 | 0,0000*** |
| Dummy of El Nino | -0,09130 | 0,2631ns |
| Dummy of La Nina | 0,17374 | 0,0928* |
| AR(3) | 0,78460 | 0,0000*** |
| MA(5) | 0,95330 | 0,0000*** |
| *Adjusted* $R^2$ | 0,68274 | |
| Value of significant F | 0,00000 | |

Source : Secondary Data Analysis, Central Statistic Agency 1991-2011
Description
*** : significant at $\alpha = 1\%$
* : significant at $\alpha = 10\%$
ns : not significant

In the coefficient of determination test, adjusted $R^2$ value was seen at 0.6813. This means that 68.13% of rice offers explained by variable rates of dry grain harvest, corn prices, soybean prices, the price of cassava, urea fertilizer prices, fertilizer prices TSP, the average wages of agricultural laborers, dummy El Nino and La Nina, and AR (3) MA (5), while 31.87% is explained by other variables outside the model. F test results indicate that $H_0$ is rejected ($p < 0,05$). This means that the variables altogether with dry grain harvest prices, corn prices, soybean prices, cassava prices, urea fertilizer prices, TSP fertilizer prices, and average wages laborer respectively in period t - 1, dummy of El Nino, dummy of La Nina, AR (3), MA (5) significantly influence rice deals.

## 5. Conclusion

Rice production will decline in the event of ElNino and the opposite will occur in the event of LaNina. Then, the factors that influence rice deal sare corn prices, soybean prices, cassava prices, Urea fertilizer

prices, TSP fertilizer prices, average wages laborer, and dummy LaNina. Tocope withth eclimate anomalies such as El Nino and La Nina is necessary cooperation of various fields. In this case, the Meteorology and Geophysics Agency in each state can publish the value of Southern Oscillation Index. Then the Department or Ministry of Agriculture can contribute to disseminate the marker of El Nino and La Nina to farmers.

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# Potency and Intitutional Performance on Integration System of Beef Cattle and Oil Palm (SISKA) for Increasing the Beff Cattle Population

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**Abstract.** Beef cattle breeding activities, especially Brahman Cross species, on fortified SISKA system showed a positive response for increasing the population, but its socio-economic and institutional aspects has not yet been studied comprehensively. The objective of this research was (1) to describe the socio-economic conditions, and (2) to analyze the potency and performance of institutions on SISKA development. The research was conducted by survey method, and simple random sampling, namely 30 samples taken from 350 farmer population member of oil palm planter. Data was collected on July-August 2013. It was processed and analyzed by tabulation and descriptive analysis. The results showed that (1) socio-economic condition of farmers at the region of SISKA development were potential for developing the SISKA program, (2) institutional performance of cooperative institutions (namely Koperasi Permata) was stated on high catagory and (3) institutional performance of farmer groups was stated on medium category, (4) farmers have positive perceptions to SISKA program.

**Keywords:** institutional performance, SISKA, cooperative, farmer groups, perceptions

## 1. Background

Government's efforts to address the needs of the national meat, was through Program of Self-Sufficiency Beef (PSDS) which was began at 2005, 2010 until to 2014. At the same time Crop Livestock Integration Systems (SITT=Sistem Integrasi Tanaman Ternak) has been started at various area of Indonesia. It was one of the forming of implementation the concept of Integration System Beef Cattle and Oil Palm (SISKA=Sistem Integrasi Sapi dan Kelapa Sawit). The main concept is based on placement beef cattle in oil palm cultivation, without reducing the activity and productivity of oil palm cultivation, but it was expected to increase the productivity of both oil palm and beef cattle.

Beef cattle breeding activities of the nation's foremost Brahman Cross species that apply on fortified SISKA system (in PT Andira Agro at Banyuasin district) showed a positive response, especially on increasing the population, but the institutional and socio-economic aspects is still need to be studied more comprehensively. Study of the institutional aspects was aimed to develope an institutional system based agribusiness centers of production of beef cattle and collect a good data base. Therefore, it is important to conduct the studies on the potency and performance of institutional Integration System of Beef Cattle and Oil Palm (SISKA). The objective of this research are (1) to describe the socio-economic condition of the community and (2) to analyze the potency and performance of institutions for supporting the SISKA program.

## 2. Literature Review

There are some basic concepts should be considered to answer the problem related the objective of research, namely socio-economic conditions of society, the concept of institution and institutional performance. Institution is a set of norms and behavior has been going on for a long time, endure from time to time to meet the collective needs and are used to achieve a common need [1]. The term of "institution", it was consisted of "institutional aspects" and "organizational aspects" . The institutional aspects was focused on the behavior with core basis on values, norms, and rules behind it, while the organizational aspects was intended on the roles and structure[2] . Institutional was different with organization. Institutional is "the rules of the game", while the organization is "their interpreneurs are the player ".This opinion is reinforced by statement that "institutions determine social organization"[4].

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Farmer groups is a sum of farmers /ranchers/growers are formed on the basis of shared interests, equality under the condition of (social, economic, resource ) and familiarity to improve and develop members [5] ). Institutional farmers (farmer groups) has a function as a place of learning, a vehicle of cooperation, provider of tools and supporting unit production, unit production, processing and marketing units and supporting servises services [6]. The performance of an institutional system is the result of a complex process in a system of interaction. Institutional performance is determined by the pattern of interactions, that in the sistem was contained the action situation variable and the actors variable [7]. Institutional analysis is "help to identify the constarins within organizations that can undermine policy implementation.The contrains may exist at the level of internal proceses , relationship concerns among organizatiom ( eg between ministries ) or be a product that the way the system is organized (reporting hierarchies ) or operates the financial year is not folowed in practis and accaunt are not closed". Institutional analysis was studied the formal institutional as well as power of soft instrumentation on many levels, such regulations and power structure at various level[8].

Institution that related to Integration System of Beef Cattle and Oil Palm is the institution of farmer groups and cooperative. Institutional performance could be measured from two aspects, namely organization management and administrative management. Organisation Management of cooperative consisted of the establishment of the structure, the presence of members at the meeting, and the duty participation of tasks. While aspects of administrative management consisted of the meeting intensity, the existence of the principal books, supporting book, work plans, and facilities owned. Similarly, for the farmer groups performance, aspects of organizational management are working distribution, members task agreement, and the idea contribution for solving the problems . By knowing the potency and performance of institutions in the Integration Systems of Beef Cattle and Oil Palm, as well as faced the problems, it is expected to formulate a strategy to empowering the farmers through SISKA program for improving the national beef cattle population.

# 3. Method

The research was conducted at the around area of PT Andira Agro, at *Kumbang Padang Permata* village of Banyuasin I District, Banyuasin Regency, that all of farmer of palm oil population was had partnership with PT Andira Agro. The research was based on survey method, and simple random sampling. There are 30 farmer was taken as responden for representing of 350 oil palm farmers. Primary and secondary data was collected in July-August 2013. The data was processed and analyzed by tabulation and descriptive analysis for meeting the appropriate research objective. The measurement of institutional performance variable was done by assigning scores to the indicator variable, then analyzed descriptively.

# 4. Result and Discussion

## 4.1. Socio-Economic Conditions Community on SISKA Development Area

The village of *Kumbang Padang Permata*, Banyuasin I District, Banyuasin Regency, was located at 30 m above sea level, 60 km from the capital city of South Sumatra (Palembang). It could be reached within 1.5-2 hours by speedboat, or 2 hours through land road by car. The villages was covering an area of 1485 hectares, consisted of peat land which was suitable for oil palm plantations. The majority (88.78 %) of land was used for agriculture, and 8.23 % for the settlement, and the remaind area was for buildings, roads, cemeteries, and village economic activities. The population was amount of 1,221 people, consisting of 644 men and 577 women, with 350 families. The majority of the population is Muslim (99.4 %). Supporting infrastructure development in this region were educational facilities consisted of one Elementary School, one Junior High School and one Senior High School. Places of worship was consisted of 4 mosques, 5 praying house, and 1 church. There was health facilities with one midwife, and the economic supporting service facilities consisted of 23 retail shoping house. Transportation sevices was taken care by sea transportation consisted of armpit (*ketek*), boat and *motor rivers*, while rural transportation was taken care by bicycles, motorcycles, cars, and traditional transportation such as *gerobak* or modified special car for local and intern transportation in plantation area.

## 4.2 . Potency and Institutional Performance at SISKA Area

Potential and development of SISKA research area could be seen by performance of the of oil palm plantations PT Agro Andira, performance of Cooperatives Institution and perperomance of farmer groups.

### 4.2.1. Performance of PT Agro Andira

PT Agro Andira was an oil palm plantation company, located in *Dusun* Teluk Naning, Karang Anyar Village, Muara Padang District of Banyuasin Regency, South Sumatra. The company was initiated to construct at 1995 with a land area of 21,750 m² and building area of 345 m². The core plantation area of PT Agro Andira was 5033.85 hectares, while the area of plantation society (namely *plasma*) was about 4,000 ha. In addition business of oil palm cultivation, the company of PT Andira Agro was also developing the beef cattle husbandry business.

### 4.2.2. The Partnership of PT Andira Agro with The Farmer's Plasma

Implementation of the partnerships was aimed to solve the limitations of capital, lack of technology, marketing guarantee, increase the farmers' income, and also had benefited others in partnership. The greatest souerce of motivation for farmers to participate in the partnership was assured marketing, provided seeds, fertilizers, pesticides, coaching or companion, and the types of high productivity plants. Knowledge of farmers was also determine how to accept innovation partnership that will be implemented, of course, it was espected the benefit from the partnership. According to Purnaningsih (2006), the knowledge of the partnership consisted of the type of plants, cultivation techniques, the parties and characteristics of partner, partnership rules or procedures, and sanctions implementation.

The partnership between PT Andira Agro with farmers are partnering of Nucleus-Plasma. Plasma plantation that joint to the partnership PT Andira Agro consisted of five villages with four *transmigration* villages namely *Kumbang Padang* village, *Sido Makmur* village, *Tirta Makmur* village and *Panca Mulya* village, and one local resident village namely Karang Anyar village. The main requisite for farmers is an honest, reliable, able to work in the team, providing land, and are willing to sign the partnership agreement. While PT Agro Andira as core provides the means of production (seeds, fertilizers, pesticides), capital, technology and marketing of products ensures crops. The early farmers clearing land was on 2001. The capital lent to farmers was issued on 2002 by PT Andira Agro, and on 2007 was issued bythe Bank, the amount of Rp 52,000,000.00, respectively, per farmer for clearing land area of 2 hectares.

The farmer groups *plasma* of PT Andira Agro was grouped by plantation based plots. There are 13 farmer groups with the members about 26-30 people per group. Farmer groups regularly hold meeting at least once a month, to provide input and solve problems. They implemented the custom habit that the plantation was managed by the groups management, where the nature of mutual helping was running well. The partnership of farmer groups with PT Agro Andira was also running well. The production of TBS (original palm oil fruit) of farmers groups plantation was as much as 2-3 tons per month per heactares, with an average price of USD 1300.00, including transportation costs as much as USD 45.00 per kg. Income earned by farmers yield per plantation plot was about Rp 2,000,000.00 - Rp 3.500.000.00.

## 4.3. Individual Characteristics of *Plasma* Farmer Oil Palm Plantation

Majority of respondents farmers were migrants from Java Island. Respondents aged was 31-69 years with an average of 44.8 years. Most ( 66.7 % ) of them had a formal elementary school, 73.7 % experienced on palm farming more than 11 years, and all respondents (100 %) had the plantation land of 2 ha, but they never had experienced beef cattle husbandry business. Most of the oil palm production (70 %) at low katagori (30 -36 tonnes/year), and most of the revenue (60 %) was in moderate category (Rp 38.75 million to Rp 44,192,983). The results show that allocation of working time for farming businesss of oil palm is low, namely 41.04 person-days per year (for family working time alocation ) and 54.00 person-days per year ( for the outside family working time alocation). It means that there are a lot of free time that could be used for other activities. It is a high potential for development of SISKA program, where the remain working time of farmers could be used for beef cattle husbandry business.

## 4.4. Institutional Performance

Institutional performance related to SISKA program consisted of Cooperative performance and Farmer groups performance. PT. Andira Agro have 5 Village Unit Cooperative (KUD), namely the KUD Permata (established in 2000 ) with 350 members, KUD Sumber Makmur Jaya, Jaya KUD Kumbang Jaya (initiated on 1998) with 375 members, KUD Subur Mulia and KUD Restu Ilahi. This intitution (KUD) was acting as the link between farmers and company. The KUD of PT Andira Agro is also quite active and positive influence to farmers and companies. The KUD itself was also over shadowed some farmer groups.

### 4.4.1. Cooperative Performance

The performance aspect was included organizational management, and quality management. The results showed that there are high- performance criteria organizations, both from the aspects of organization and management. Aspects of the organization was consisted of the establishment the structure, the presence of members at meetings, and tasks distribution. From the aspect of the organization, it was showed that most (76.6 %) of respondents said the formation of the structure has been done and speciafied, the presence of members exceeds qourum, and the existing tasks distribution was done systematicaly and well-executed. The management aspects was consisted of the meeting implementation, the principal books, supporting book, work plans, and cooperation with other groups. Achievement scores of each indicator both aspects was stated in Table 1.

Table 1. Permata Cooperative Institutional Performance

| Variabel/Indicators | Frequency of resp.answer | | | Average score | Criteria |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | | |
| **Organization management** | | | | **8,30** | High |
| 1.Formation of structure | 0 | 7 | 23 | 2,77 | High |
| 2.Member presence | 0 | 14 | 16 | 2,53 | High |
| 3.Task distribution | 0 | 0 | 30 | 3,00 | High |
| **Administrative** | | | | **13,93** | High |
| 1. Meeting | 0 | 28 | 2 | 2,07 | High |
| 2. Basic book/manual | 0 | 0 | 30 | 3,0 | High |
| 3. Supporting book/manual | 0 | 0 | 30 | 3,0 | High |
| 4. Work/Action plan | 0 | 4 | 26 | 2,87 | High |
| 5. Own tool/means | 0 | 0 | 30 | 3,0 | High |
| **Total performance organization** | | | | **22,23** | High |

*Description score: * 1,00 – 1.66 = low, 1,67– 2,33 = medium, 2,34 – 3,00 = high*

### 4.4.2 . Potential and Performance Famer Groups Institutional

There were 13 farmer groups from *Kumbang Padang Permata* village in partnership with PT Andira Agro. All of the groups was formed by the farmer community, high levels of partisipation (active), and willingness to be a member of the group. These conditions indicate the existence of a high potential to develop the farmer groups as a unit of production and learning among members of the groups.

Farmer groups institutional performance was measured from the aspects of organizational management and administration. The result showed that there are high criteria for management aspects of the organization. It was means that there were exiting distribution task regularly among farmer in the group, good deal of task, adequate sharing idea contribution. Aspects of administrative management was stated on medium criteria, which was shown by the monthly meeting, the lack of basic books, lack of owned facilities own, and sistematically the work plan running. Those description was detailed in Table 2.

Table 2. Farmer Groups Institutional Performance

| Variabel/Indicators | Frequency of resp.answer | | | Average score | Criteria |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | | |
| **Organization Management** | | | | **8,17** | High |
| 1.Task/working distribution | 0 | 0 | 30 | 3,00 | High |
| 2.Commitment/deal of task-working | 0 | 9 | 21 | 2,70 | High |
| 3.Idea contribution | 0 | 15 | 15 | 2,47 | High |
| **Administrative** | | | | **10,17** | High |
| 1. Meeting | 0 | 30 | 0 | 2,00 | Medium |
| 2. Basic book/manual | 28 | 2 | 0 | 1.07 | Low |
| 3. Supporting book/manual | 0 | 1 | 29 | 2,97 | High |
| 4. Work/Action plan | 0 | 4 | 26 | 2,87 | High |
| 5. Own tool/means | 28 | 0 | 2 | 1,13 | Low |
| **Total farmer groups performance** | | | | **18,34** | Medium |

*Description score: * 1,00 – 1.66 = low, 1,67– 2,33 = medium, 2,34 – 3,00 = high*

**4.4.3.Farmers Perception on SISKA Program**

Potential SISKA program development could also be viewed from the perception of farmers on SISKA program, which was measured from few indicators, namely the favorability of Siska program existence, aplicability, and motivation to implement Siska. The results showed that the farmers perception of Siska program was categorized on high criteria. This is demonstrated by the majority of respondents stated that the existence SISKA Program was favorable, the technology can be applied, and can increase the revenue because of utilization the palm oil waste. This result was supported by Bangun (2010) which showed that SISKA could increase the farmers' income[10]. The other research concluded that SISKA was feasible and potential to be developed both from of economic and non-economic aspect [11].

# 5. Conclusion

1. Socio-economic conditions of farmers was potential for SISKA program development.
2. Cooperative Institutional Performance (*Permata* cooperatives) was stated on high criteria.
3. Farmer group institutional performance was stated on medium category.
4. Farmers' perceptions of SISKA program was stated on positive values.

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# Dynamic Supply Response of Rice in Jambi Province

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**Abstract.** Alternative specifications of model of supply response of Jambi rice crop and their economic implications are considered in terms of the existences and nature of production lags, and the choice between expected price and gross returns as the preferred explanatory of producer's response to changing economic condition. The analysis indicates that there are lags which are due primarily to the difficulties and cost of rapid adjustment rather than to the time required to revise expectations. The statistical results were similar for the alternative specification of gross margins and prices as the economic decision available. However, the price elasticities derived using the gross margins specification were about a third of those using the prices specification. The gross margin specification yielded additional information in the form of yield and input cost elasticities.

**Keywords:** DynamicSupply response, Production response, Rice, Jambi Province

## 1. Background

Agriculture is the largest sector in the Indonesian economy in terms of contribution to GDP, foreign exchange earning and employment creation. The sector had been neglected until 1986's because growth was thought to be synonymous with industrialization. This view was justified by the belief that industry is the dynamic sector, while agriculture is static and unresponsive to incentives. This belief led to the taxing of agriculture by turning domestic terms of trade against agriculture. The consideration that agriculture is unresponsive implied that resources generated in agriculture could be transferred to other sectors of the economy without significantly affecting agricultural growth (Pearson et al, 1991).

In the context of modernizing traditional agriculture Moseand Kuvyenhoven (2007) argued that lack of knowledge with respect to the contribution of agriculture to growth has bred many a doctrine and political dogmas. One of such doctrines was that farmers are not responsive to economic incentives. An important dimension of the question in this context was could agricultural production in low income communities be substantially increased by an efficient allocation of the factors of production at their disposal? How much additional agricultural production can be achieved by improving allocative efficiency of farming? (Guyomard et al, 1996)

The role of incentives which has become to be taken for granted for the success of any agricultural development program today was not always like so. A number of empirical studies in the 1960s (Behrman 1989, and Yotopoulos1972, Choi, and Helmerger 1993, Mose and Kuvyenhoven, 2007, Keeney, danHertel. 2008) addressed the question of farmers' response to economic incentives and efficient allocation of resources through the analysis of both time series and cross sectional data from a number of developing countries.

Agriculture sector in Jambi Province during the last three decades or so has witnessed a number of developments both in the factor and product markets and experienced many policy shifts resulting in substantial changes in the structure of market incentives faced by farmers. However, quite a few of these changes have been crop specific/crop oriented, as there have been wide variations in quantum of changes in the incentives (Edison, 2011).

The performance of rice crop has important bearing not only for the growth and development of agriculture but also the capacity utilization and growth of the industrial sector which depends for the supply of its raw material on agriculture. From the foregoing it is apparent that there are many forward linkages of rice crop with the industry and other sectors of the economy, which generate employment and value addition in the economy (Yu et al. 2010).

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The objective of this study was to increase our understanding of the specification and estimation of agricultural supply response as well as to provide instruments for agricultural policy analysis. The structure of the paper is as follows: Section 2 discusses theoretical model and dynamic supply analysis, Section 3 discusses methodology, Section 4 discusses results and discussion, Section 5 conclusions.

## 2. Theoretical model and dynamic supply analysis.

An agriculture supply function describes how the quantity of the product offered for sale varies as its price varies to relative to other product prices (Cochrane, 1995). Cochrane distinguishes between supply response functions. The supply function describes the quantity which would be supplied at different prices with all other things constant, while the supply response relationship describes what will happen to the quantity supplied when all other things are not held constant (Askari and Cummings, 1977). Nerlove (1958) provided much of the theoretical frame work in the supply response studies.

Let the supply equation be

$Qt = a_o + a_1 P_t + a_2 Z_t$ …….……..... (1)

Qt = Actual quantity produced

Pt = Actual price of rice produced.

Zt = Supply Shifters

$Qt = a_o + a_1 P^*_t + a_2 Z^*_t$…… (2)

Where Qt = Quantity produced in time t

P* = Expected price

$Z^*_t$ = Supply shifters expected

The expected price is not observable and is explained as expected „normal" price, i.e., the level about which the future price is expected to fluctuate. This can be expected as:

Actual $P-P_{t-1}$

$P^* - P^*_{t-1} = \beta (P_{t-1} - P^*_{t-1})$, $0 \leq \beta \leq 1$……..... (3)

We assume the expected price is actual price. P = P*

We can get the following equation by getting the value of P* from equation (2) and substituting in into equation (1) and rearranging it,

$Qt = b_o + b_1 P_{t-1} + b_2 Q_{t-1} + b_3 Z_{t-1} + b_4 Z_{t-1}$……. ……..….…..... (4)

The equation (3) can be estimated economically.

To estimate elasticities the formula used was ∂Q/P. P/Q the first term for short and long run will be: Short run ∂Qt/Pt-1 and Long run: b1/1-b2

## 3. Methodology

This section discusses the nature, sources, and limitations of the data and specification issues. The empirical analysis of this study will be conducted with a sample of annual data that cover Jambi'srice crop for the time period 1986 to 2012. In addition to the economic factors as manifested by the prices of a given commodity/crop a number of other factors like the availability of water and other inputs, development of infrastructure, institutional support, economics of competing crops, etc impact on farmers allocation of resources to a given crop.

In the estimated models crop area has been used as a dependent variable. The crop area has been preferred over the production as farm production is also influenced by weather conditions, which are beyond the control of farmers. Yield is subject to more random variation than acreage due to factors outside the farmers' control such as the weather. Based on our extensive review of literature, discussions with experts and knowledgeable farmers we have identified the following factors impacting on farmer's allocation of crop area. Acreage = f (real price of output at time t-1, yield of output at time t-1, area planted to output at time t-1) Prices of a commodity received by the farmers in the recent past in lieu of the expected price at harvest time which is not known at the planting time, yield of the given crop obtained in last year as it inter alia shapes economic incentives for the commodity, yield of competing crops as a proxy for the opportunity cost and farmers' know how and experience about the cultivation of the crop.

### 3.1 Mathematical form of the Model

The following models were chosen among the various mathematical forms on the basis of economic, statistical and econometric criteria as dynamic supply response (Colin and Townsend, 2011).

**A. Production Response**

$QR_t = f (PR_{t-1}, QR_{t-1}, D_t, e_t )$ …….…….…….. (5)

**B. Acreage Response**

$AR_t = f (PR_{t-1}, AR_{t-1}, D_t, e_t)$ ……..……..……..…….. (6)

Where:

QRt is the total rice production (ton) in year t.

AR t is the total acreage under rice (ha) in year t

$PR_{t-1}$ is the wholesale price of Rice (Rp/kg) in year Lagged t-1

$QR_{t-1}$ is the total rice production (ton) in year lagged t-1

$AR_{t-1}$ is the total acreage under Rice (ha.) in year Laggedt-1

Dt is the dummy variable for new order era1986 - 1997 = 0 and for 1998 – 2011 = 1

et is the random disturbance term.

## 4. Results and discussion

The time series for the present study was from 1986 to 2012 and secondary data will be collected for the analyses (Source Economic Survey of Jambi Various). The results were obtained by using SPSS and presented in Table 1, and 2.

**(A) Production Response**

Ln QRt = Ln 6,82 + 0.208 Ln PR t-1+ 0,514 LnQR t-1 – 0.294 Ln Dt

Table 1. Structural co-efficient, their significance and value of $R^2$ for rice production response in Jambi (1986-2012)

| Variable | Co-efficient | Standard Error | t-Ratio | Significance |
|---|---|---|---|---|
| Constant | 6.820 | 0.867 | | |
| PRt-1 | 0.208 | 0.077 | 2.701 | ** |
| QRt-1 | 0.514 | 0.123 | 4.179 | *** |
| Dt | - 0.294 | 0.103 | 2.854 | ** |
| R2 | 0.9326 | | | |
| R2 (Adjusted) | 0.9237 | | | |

*** = Significant at 1 percent level of Significance.

** = Significant at 5 percent level of Significance

The examination of the co-efficient of determination for production response equation indicated that 92% variation in the production of rice in Jambi was explained by the explanatory variable included in the model. The Coefficient of lagged price of rice had a positive sign with a value of 0.208. The coefficient is significant at 5% confidence level which indicated that with one unit increase in the price of the rice in the last year, the production increased by 0.208 units. The sign and magnitude of co-efficient was according to expectations. The co-efficient of this variable had a positive sign with a value of 0.514 and was significant at 0.1 confidence level, which showed that lagged production of rice had a significant influence on the production of the rice. The size and sign of co-efficient was according to the expectations based on theory. The dummy variable represented the new order era before in 1998. The co-efficient was negative, as was expected with a value of 0.294 and a significant at 5 percent confidence level. The negative influence of new order era on production might be due to non-availability of inputs at crucial stages in the production.

**(B) Acreage Response**

Ln ARt = Ln 9.203 + 0.0897 Ln PR t-1 + 0.126 Ln AR t-1 – 0.102 LnD t

Table 2. Structural co-efficient, their significance and value of $R^2$ for acreage response in Jambi

| Variable | Co-efficient | Standard Error | t-Ratio | Significance |
|---|---|---|---|---|
| **Constant** | 9.203 | 1.043 | | |
| PRt-1 | 0.0897 | 0.0389 | 2.306 | ** |
| ARt-1 | 0.126 | 0.128 | 0.984 | |
| Dt | - 0.102 | 0.0473 | 2.156 | ** |
| R2 | 0.9604 | | | |
| R2 (Adjusted) | 0.9564 | | | |

*** = Significant at 1 percent level of Significance.
** = Significant at 5 percent level of Significance

The examination of the co-efficient of determination was 0.9564, which indicated that 96% percent variation in the acreage under rice in Jambi was being explained by the independent variable included in the model. The Coefficient of lagged price of rice had a positive sign with a value of 0.0897. The coefficient is significant at 5% confidence level which indicated that lagged price of rice had significant influence on acreage under rice. The lagged acreage under Rice had a positive sign, according to expectations, with a value of 0.126 and was non-significant. This indicated that scope of horizontal expansion in Jambi was limited. The dummy variable represented the new order era in 1998, the co-efficient was negative, as was expected with a value of 0.102 and a significant at 5 percent confidence level. This indicated that war had a negative impact on the acreage under rice, which might be due to destruction of irrigation and other infrastructure and non-availability of inputs and other services.

**(C) Elasticities**

The estimated short-run and long run elasticities for production and acreage response under rice are summarized in Table.3.

Table 3. Own Price Elasticities for Production and Acreage under Rice in Jambi

| | Production Response | Acreage Response |
|---|---|---|
| Short Run | 0.104 | 0.084 |
| Long Run | 0.428 | 0.103 |

The own price elasticity for production shows that with the increase in the price of Rice by 1 percent during the period of analysis, the quantity of rice production increased by 0.104 percent in the short run and 0.43 percent in the long run. In case of acreage response, with the increase in the price of rice by 1 percent during the period of analysis, the acreage under rice increased by 0.084 percent in the short run and 0.103 percent in the long run.

# 5. Conclusions

The “best” model was a long linear form, many variables were not including in the model due to non-availability of data, and important variables are included. The results of the analysis indicate that rice cropis response to changes in the prices of rice in the case of production and acreage under rice response. The dummy variable for the new order era period had a negative impact both on production and acreage under rice in the years 1986-2012. The co-efficient of lagged acreage was non significant, which indicated that horizontal expansion in area is limited in Jambi, any increase in production will come through vertical expansion in future. This is a policy implication for government policy makers and researchers. With regards to elasticities. The own price elasticity of rice is 0.104 and 0.428 for short-run and long run production response and were acceptable on economic and statistical criteria.

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# Anticipation and Adaptation of Climate Change for Food Crops in Indonesia

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**Abstract.** Since a number of decades ago in Indonesia and elsewehere there has been a climate change, namely the occurrence of prolonged rain or the occurrence of prolonged drought. As a result, agricultural cultivation became distracted, especially food crops that can result in disruption of crop production to meet the needs of the people of Indonesia. The questions here are what the levels of impacts of climate change in Indonesia and what measures as to anticipate and adapt the climate change for food crops. This paper is thereafter intended to explain the anticipation and adaptation to climate change as an effort to keep the implementation of the cultivation of food crops to the production is secure and can meet the food needs of the people of Indonesia. A number of measures are recommended in order to anticipate and adapt to climate change to continue to support the implementation process of the cultivation of food crops by farmers in the field. The measures include the familiarity to climate change, drought-resistant selection of commodities, superior variety selection, implementation made earlier planting, appropriate harvest time, proper processing and marketing, the use of organic fertilizers, proper maintenance, planting backward, and control of pests and diseases that are environmentally friendly.

**Keywords:** anticipation and adaptation, climate change, food crops.

## 1. Background

Indonesia is one of the important world's countries which will be affected by natural phonemenon called climate change. Climate change is one of the natural phenomenon in which extreme changes in climate elements. These changes occur due to natural processes but also by human activity on earth. In addition to increasing global temperatures, climate change is causing the climate anomalies such as El-Nino and La-Nina), Indian Ocean Dipole, an increase or decrease in extreme temperatures, shifting climate, rainfall, and rising sea levels.

Currently, climate change is no longer a debate about its existence. Climate change is already a problem with inter-agency, inter-state, and in fact has become a global problem. so many aspects of life affected by climate change, including the agricultural sector. Change and climate anomalies believed to affect agricultural productivity and progression, including agri-food sector. The changes in climate have caused a considerable yield degradation of agricultural farming (Susandi, Tamamadin and Nurlela, 2013). That is why, many people who believe that agriculture is a sector that is in a position not to have certainty. Many reports by experts have reported negative impacts of climate change namely impact on soil erosion rates (Nearing, Pruski and O'Neal, 2004).

According to Pedzoldt and Seaman (2013), climate change affect a number of climate elements namely temperature, moisture in the air, increase in CO2 levels, all of which will affect the development of plant pests and diseases. Garret et al. (2006) stated that the effect of climate change on disease through its influence on the level of the genome, cellular, physiological processes of plants and pathogens. Further questios to ask are what the levels of impacts climate change in Indonesia and what measures to anticipate and adapt to the climate change for food crops. This paper is intended to explain the impacts of climate change and the anticipation and adaptation to climate change for food crops.

## 2. Impact of Climate Change on Agriculture

Climate change is one of a very serious threat to the agricultural sector and the potential to bring new issues to the sustainability of food production and agricultural production systems in general. The main cause

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of climate change is human activity (anthropogenic) associated with increasing greenhouse gas emissions such as $CO_2$, methane, CO, NO and CFCs (Chlorofluorocarbons). Global climate change will affect at least three climate elements and components nature is very closely related to agriculture, namely: (a) air temperature rise also have an impact on other climate elements, especially moisture and atmospheric dynamics,(b) changes in precipitation patterns and the increasing intensity of climate events extreme as El-Nino and La-Nina, and (c) increase in surface water mountains due to melting sea ice in the Arctic (Las, 2007). Boer and Subbiah (2005) reported that between 1844 and 2009 there has been 47 and 38 times the events of El-Nino and La-Nina respectively which cause drought and flood. The level of risk of climate change by region in Indonesia can be seen in Table 1.

Table 1. Level of risk of climate change by region in Indonesia

| Risk | Sumatra | Java-Bali | Kalimantan | Sulawesi | Nusa Tenggara | Maluku | Papua |
|---|---|---|---|---|---|---|---|
| Lowering water availability | M, H, VH | H, VH | L, M | H, VH | H, VH | L, M | L |
| Flood | H, VH | H, VH | L, M, H | L, M, H | L | L | L, M |
| Drought | H, VH | M, H, VH | L | L, M | L, M, VH | L | L |
| Inundation of sea water | M, H | M, H, VH | M, H, VH | M, H | M, H | M, H | M, H |
| Spread of dengue | L, M, H | L, M, H | L, M | L, M | L, M | L, M | L, M, H |
| Spread of malaria | L, M | L, M, H | L, M | L, M, H | L, M, H, VH | M, H | M, T, VH |
| spread of diarrhea | L, M, H | L, M, H | L, M, H | L, M, H | L, M, H | L, M, H | L, M, H, VH |
| Decrease of paddy yield | H, VH | H, VH | - | - | H, VH | - | - |
| Forest fire | VH, H, M | H, M | - | - | - | - | - |

Legend: L = Low, M= moderate, H = high, VH = very high
Source: Ministry of Environment (2010)

## 3. Anticipation Strategy for Climate Change and Anomalies

As can be seen in the previous table it is clear that the levels of risk of climate change by region vary from low to very high levels of risks of climate change including in the field of food crops agriculture. Environmental management strategies cropping can be done through a variety of planning efforts, adjustments, good agricultural practices, resource management and application of agricultural technologies to address climate change impacts and anomalies. The following are the strategies in anticipation and adaptation to climate change to continue to support the implementation process of the cultivation of food crops by farmers in Indonesia (after Agus, 2011 and Saragih, 2011).

## 4. Improve the Understanding the Climate Change of Farmers

Understanding of farming communities to climate change, its impact needs to be improved. Ministry of agriculture to the relevant agencies in the county or city. This understanding is important because climate change disturbing behavior threatens farmers can harvest they would get. Agricultural extension workers and farmers can address climate change by comparing the climate before the common signs that climate change is currently occurring (eg an increase in air temperature, rainfall pattern is erratic and others).

If farmers and agricultural extension workers have felt the signs of climate change, they are motivated to change the implementation of the cultivation of food crops to become a more agricultural cultivation that is able to anticipate and adapt to climate change so that the cultivation of food crops can be done well.

## 5. The selection of drought-resistant commodities

As is widely understood that climate change leads to prolonged drought or prolonged rainy season. Both of these conditions lead to disruption of the cultivated crop farmers, thus threatening their crops. to overcome

the problem of agricultural extension workers in the field can encourage or guide the farmers in order to anticipate and adapt to climate change. Attempts to do is to plant food crops that are resistant to drought or flood in their farming land.

### 5.1. Selection of high yielding varieties

Researchers have been trying to find different varieties of crops that are resistant to pests and diseases, drought and floods. A number of varieties have been found that are superior and resilient to climate change. Therefore, agricultural extension workers and farmers in the field should pay attention to varieties that will be planted according to the conditions and anticipated climate change. If the area is expected to occur in extreme dry then prompted farmers to plant the crop varieties that are resistant to drought according to the description of varieties suitable for it.

### 5.2. Implementation of early planting or posponing

If the climate changes as signs of impending drought will soon come. Furthermore, the farmers are advised to prepare their farm land for planting crops such as corn somewhat drought resistant, peanuts, green beans, taro, cassava, sorghum and others. All of the plants can be planted immediately in farm land owned by farmers.

The initial step is to do early tillage, or immediately after harvesting the previous crop of corn planted directly next to the newly harvested rice bolt, so that cultivation can be done the same time as weeding the corn that has been grown. With so planting time can be earlier than before, so it's time to rain or water availability can be utilized for the growth of food crops that are managed by farmers in the field, in case of prolonged drought and sudden nature of the dry season, hence the efforts is rewind time tillage and planting the crops.

### 5.3. Crop diversification

To anticipate and adapt to climate change is happening and get a good production for the well-being of farmers and their families, it can be done diversification of food crops in farmers' fields. Plants can be directly planted without tillage done first, by way of direct planting these plants such as corn, peanuts, green beans or other crops. diversification of crops is done in order to obtain a high economic value and reduce crop failures. The trick is to grow plants that have high economic value together with plants that have low economic value, such as a combination of corn with sweet potatoes, soybeans with taro.

### 5.4. Other actions in the context of anticipation and adaptation

There are also a number of other actions in the context of anticipation and adaptation in agriculture to climate change. Such measures include timely harvesting, processing and marketing right, the use of organic fertilizers, proper maintenance and control of pests and diseases that are environmentally friendly (Saragih, 2011).

## 6. Conclusion

Climate change is a necessity that has happened in some places. This natural phenomenon affecting many aspects of life and human activity. Although as a contributing cause of climate change, the agricultural sector is a victim and most vulnerable to climate change itself. Impact of climate change on food security occurs coherently, ranging from a negative impact on resources (land and water), agricultural infrastructure (irrigation), to the production system through decreased productivity, extensive planting and harvesting. On the other hand, farmers have limited resources and capabilities to be able to adapt to climate change.

A number of measures are recommended in order to anticipate and adapt to climate change to continue to support the implementation process of the cultivation of food crops by farmers in the field. The measures include the familiarity to climate change, drought-resistant selection of commodities, superior variety selection, implementation made earlier planting, appropriate harvest time, proper processing and marketing, the use of organic fertilizers, proper maintenance, planting backward, and control of pests and diseases that are environmentally friendly.

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# Impact of Climate Change on World Soybean (*Glycine Max*.) Production: a Nutrition and Food Security Perspective in Indonesia

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**Abstract.** Indonesian imports of soybean represents a share of 2 percent of the total soybean traded in the world. Due to deficit in domestic soybean production , over 80 percent of it must be imported to meet the high demand of soybean based food and oil. Changing climatic conditions of increasing atmospheric temperature, accumulating level of carbondioxide, and varying rainfalls will alter soybean yields in the major producing regions. According to projection, USA, Brazil and Argentina will still lead in production of soybean up to 2020. Various study have demonstrated yield decrease up to 40 percent in the major producing areas under different climate change scenarios. Since Indonesia imports over half of the total soybean needed to meet its yearly consumption, it is very vulnerable to world price volatility and poses threat to food security. Lack of recognizing future threats and responding through effective interventions can lead to food insecurity and increase in malnutrition problems in the country.

**Keywords:** Soybean, climate change, nutrition, food security.

## 1. Background

Soybean is one of the food commodities that has profound significance to the livelyhood of Indonesian people. It provides an affordable and rich source of plant protein that is accessible to the majority of the population. Over half of the household in Indonesia consumed tempeh and tofu which are produced from soybean [1]. The imports of soybean to indonesia was about 1.2 million metric tonne in 2011 [2]. It was reported that in 2012 and 2013, soybean import will be over 80 percent to meet the domestic demand [3]. In addition to consumption, producers of major foods from soybean especially tempeh and tofu benefit through marketing of the food. Soybean therefore is important in maintaining welfare and food security in Indonesia. The changing world climatic conditions, will affect soybean production that may result in adverse effect to consumers and other users of soybeans. Loss of productivity due to extreme climatic conditions will cause soybean supply to decline, a limited supply and high demand will force price to escalate. High price will reduce soybean accessibility for processors and limit consumption by end users. The aim of this paper are to review impact of climate change on yield of soybean in the largest exporting soybean nation and provide a discussion on the possible implications it will have on food and nutrition security in Indonesia.

## 2. Literature Review

### 2.1 World production and consumption of soybean

Soybean is traded in world for its oil, as food, soymeal for supplement in animal feeds and biofuel production. The major producing countries of soybean in the world are USA, Brazil and Argentina that supplied almost 90 percent of the total soybean in the world market [4,5]. Production trends for the 3 countries are displayed in Figure 1, showing soybean yields over the years up to 2012.

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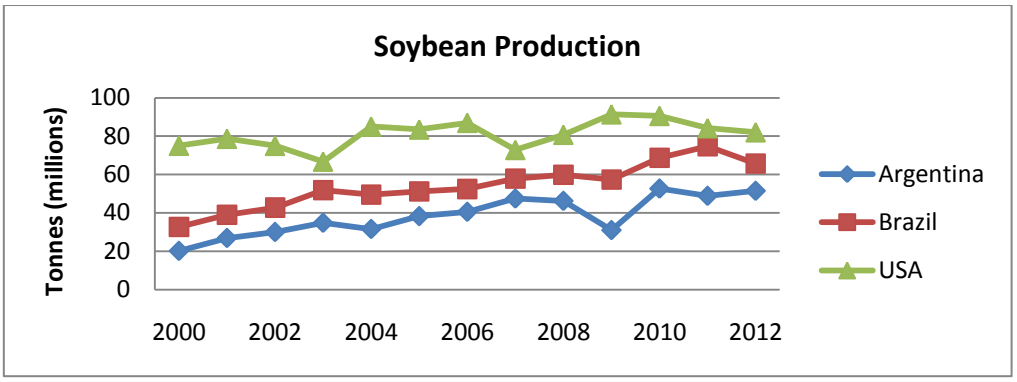


Fig. 1: Soybean production trends in 3 major producing countries. *Source:* Faostat, 2013.

The 2011 yield of soybean in USA was 8 percent less than in 2010 due lower planting and yield loss by weather changes . Competition of land by other crops such as maize also account for the decrease in harvest yield [6]. Indonesian imports of soybean is amongst the top 10 in the world, and occupies about 2 percent of the total soybean import [2]. China still remains the largest importer of soybeans on world market. It was forcasted that from 2010-2020 U.S soybean production will remain near flat due to limited hectares available for cultivation, while Brazil and Argentina are expected to increase soybean exports to satisfy world demand [4].

## 2.2 Soybean supply and utilization in Indonesia

The soybean supply in Indonesia is derived from both domesic production and imports. Over half of the total soybean demand in indonesia is met from imports. In 2011/2012 the country's domestic production was less by 30,000 MT compared to the 2010/2011 production at 650 000 MT. The import of soybean in period of 2011/2012 was 1.922MMT which marked an increase of 1.26 percent than the previous period. Amost 88 percent of soybean supply in indonesia are used for making tempeh and tofu [7]. The major imports of soybean in indonesia is from USA about 90 percent while remainding fraction come from Argentina, Malaysia and other producing countries [8].The estimated per capita consumption annually for tempeh and tofu is 8.5 and 7.8 kg/cap/year respectively [1]. The soybean consumption increased from 8.13 in 1998 to 8.94kg/cap/year in 2004 while local production of soybean had been declining since 2009 from 97,000 tonnes to 85,000 tonnes in 2012 [5].

## 2.3 Climate change effect on soybean production

Among other factors the main contributor of climate change is due to anthropogenic emission of green house gases (GHG) especially carbondioxide, methane and nitrous oxide. The agriculture sector is vulnerable to changes in temperature, precipitation and carbon dioxide concentration in the atmosphere [9]. Higher temperatures affect plant health, increase prevalence of pests and reduce water available in plants through rapid rate of evapotranspiration. Varying rainfall patterns decrease water availability and have negative consequences for both rainfed and irrigated farming systems while increased level of carbondioxide may improve crop yield in some regions [10] The growth and productivity of crops can be either positively or negatively affected by climate change. In elevated $CO_2$ concentration free aircarbon experimented study (FACE) showed 15-25% increase in yield of $C_3$ crops (wheat, rice, soybean) and 5-10% in C4 crops (maize, sorghum, sugarcane). High level of $CO_2$ also increase the water use efficience of the C3 and C4 plants. While other studies demonstrated that increase level of $CO_2$ showed less favorable crop response [11]. Crop modeling study under increasing atmospheric temperature of 1-3$^oC$ were demonstrated to have less beneficial changes on crop production in temperate regions and negative yield impact of crops in tropical regions under increase atmospheric level and varrying rainfalls [12].

A non linear projection of soybean under temperature range from 29-30$^oC$ showed yield increase with rising temperature, however temperaure over 30$^oC$ reduce soybean yield [13]. Changes in temperature during summer period was shown to affect soybean production and variation in rainfall pattern during planting and phase of development also affect soybean yield in Southern Brazil [14]. Water stress during early reproduction and seed filling stage was found to accelerate senescence leading to early maturity and low

yield of soybean up to 10-23 percent [15]. Climate change was predicted to affect yield in the 3 major exporting countries of soybean. The impact is presented in the Table 1, below under different climate change scenarios [16].

Table 1. Impact of climate change on soybean yield (%) under different scenarios

| Location of study site | Impact (change in yield in %) | Climate change scenario |
|---|---|---|
| Argentina | -3 to -8 | GISS, GFDL, UKMO with $CO_2$ |
| Brazil | -61 to -6 | GISS, GFDL, UKMO with $CO_2$ |
| USA | -40 to +15 | GISS, GFDL, UKMO with $CO_2$ |

Source. Adams et al, 1998

The data in Table 1, showed decline in yield for soybean in Argentina and Brazil while for USA the change in yield will vary across the region. This data presented important implications for importing countries because according to forcast, Brazil, USA and Argentina will still lead in exporting of soybean up to 2020.

## 3. Discussion

Under changing climate condition and competition of land by other crops, soybean production in the major growing and exporting countries like USA, and Brazil had and will experienced decline in harvested yield. Since agricultural commodities prices are greatly influenced by the large producers, sudden price hikes can have severe repercussion on importing countries. The decline in soybean production in exporting countries and the weakening of the Rupiahs against U.S Dollar have seen the price of soybean soar.

In addition indonesian policy on self sufficiency and imposing of tarrif on imported soybeans has badly affected the tofu and tempeh industry in the nation. Local price upsurge of soybean products can have significant impact on tofu and tempeh accessibility and utilization. A study conducted on global price volatility of soybean had shown to have poverty consequences in Indonesia. Increase of world price of soybean by 20, 40 and 60 percent directly caused the domestic price of soybean to rise by 11.5, 22.1 and 30.1 percent respectively. These increase in prices corresspond with increase in poverty index by 0.132, 0.204 and 0.296 as well [17]. Increase poverty is linked to food insecurity and exacerbate malnutrition problems. Poor household spend more than half of their total expenditure on food and with food price increase, can have signicant drawbacks on their nutrition and welfare [18]. For instance another study of rice price crisis in 1990 in Indonesia caused increase in maternal wasting because some mothers in poverty marginalized household deliberately reduced their energy intake in order to feed their children [19].

Tempeh and tofu production occupy a thriving market in indonesia pertaining to the high demand and local preference of the food that is part of the traditional society. Soybean based food provide an affordable source of protein that majority of population in Indonesia can have access to meet their dietary requirement of protein. The average consumption of legume food is approximately 9g/cap/day compared to fish which is 13g/cap/day making legumes the second most available consumed protein source. Decrease in soybean supply can lower the daily intake of protein and other micronutrients essential for promoting health and protection against diseases. Producers of tempeh and tofu will suffer loss of income as price hike force consumers to limit their soybean based food intakes. Deficiency in soybean will also affect other food production activities that utilize soybean meal for animal and fish feeds and soybean oil for food products.

If soybean on world supply falls then there will be deficit in demand since the current local production of soybean is insufficient. If only domestic production of soybean is increased to meet over half of the total demand than it can relieved dependency on imports. Currently lack of incentives and competition of soybean from imports impede local production. The government to set floor price for local production can boost and motivate farmers to increase hectare of cultivation. In order to increase local supply of soybean will mean expansion of current land area available to increase yield. Land expansion must fall in line with climate mitigation strategies of reducing clearing of new forest. Crop rotation on current land used for growing rice and maize can alleviate need for further land expansion.

The government response to high price by waivering of import tarriff barrier was shown to have little effect on improving poverty by only 0.059 percent or decrease in number of people living in poverty by only 12,3275. Intervention to remove tariff from imported soybeans during external price shock can be beneficial if only the world price increase is below 10 percent. [17].

# 4. Conclusion

Agriculture production is vulnerable to effect of climate change that will impact food security, leading to increase number of hunger people and malnutrition as a result of collapse food system. Food production will become a challenge for the world to achieve under adverse changing environmental conditions, increasing population pressure and degrading land and natural resources. Indonesian dependancy on soybean imports posses a threat to food security with volatility in world soybean price.

Building resilience to future effect of climate change on major food commodities like soybean is an essential step forward towards adaptation. Government investment into boosting local production by encouraging local farmers through incentives, introduction of improved technology can stimulate interest into increase farming of soybeans. Increase domestic production can relieve dependency on imports and reduce risk to food insecurity during world price upsurge.

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# Rice Production Enhancement through Spatial Utilization "Land for Plant Life" in Industrial Crop Forest (ICF) Zone for Avoiding of Peat Fire

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**Abstract.** Approximately 588,841 hectares of the 645,249 hectares of degraded peat land in Ogan Komering Ilir (OKI), South Sumatra Province are being rehabilitated through ICF. Under government regulations that the layout of the plantation land use intended by 70 percent for staple crops with of *Acacia crasicarpa* species, and 5 percent is allocated to the plant life that aim for cultivating by people around ICF as a source of income. Land to plant life can be used for food crops, horticulture, and plants that have woody tree. Around the plantation, is still there, the local people who do farming activities by burning peat (the local term is "Sonor System"). Farmers Rice conducting Sonor System not fully willing to work the land because prohibited to burn the peat. Former transmigran farmers who live around of ICF has begun starting clearance through the cultivation of land life or Tillage System. Research conducted in Simpang Tiga Sakti Village, Tulung Selapan Sub district and in Simpang Heran Air Sugihan Sub district in OKI Regency, using Disproportionate Stratified Random Sampling Method. Results of research showed that farming Sonor System only produced rice was 0.47 tons and revenues was 1,507.00 million rupiah per hectare, while farmers Tillage System got rice yield by 3.30 tons and revenues was 6,060.50 million rupiah per hectare. Excess production that was produced by farmers using Tillage System without burning peat reached by 7.0 times compared with the farmers of Sonor System.

**Keywords:** Plant Life, Land Cultivation, Rice Production

## 1. Background

Indonesia's forest area until the year 2009 was 88.17 million hectares. Deforestation that occurred in the 2000-2009 Period covering 15.16 million hectares (Sumargo *et.al.,* 2011). Until the Year 2008, in Indonesia there were 84.70 million hectares of degraded land, that there was 69.86 percent in forest zone. Shrinking forests in Indonesia could not be separated from land and forest fires events resulting from El Nino phenomenon of 1997. Rehabilitation of degraded land in Indonesia of which is done through the development of plantation forests or industrial crop forest (ICF). Its target reach until 9.2 million hectares or 16 percent of production forest area. Minister of Forestry Decree No. 70/Kpts-II/1995, Minister of Forestry Decree No. 246/Kpts-II/1996 and Minister of Forestry Regulation No. P.21/Menhut-II/2006 have set layout of ICF space. Space of ICF allocated by 70 percent for staple crop, 5 percent for area of the plant life, 10 percent for area of local species plant, 10 percent for conservation area, and 5 percent for infrastructure (General Directorate of Forestry Production Development of The Forestry Ministry Republic of Indonesia, 2010).

In Ogan Komering Ilir Regency of South Sumatra, in its production forest area, there were 645,249 hectares degraded peat land. Amounting to 90.73 percent or 585,405 hectares of it allocated for ICF. Realization of planting acacia as staple crop until year 2012 reached approximately 250,000 hectares. Area for plant life allocated was 32,777.87 hectares or 6.0 percent. Activities in the area of plant life effort to create jobs for the people live around ICF through agribusiness activities in agriculture and forestry. Other plants are cultivated in this area were food crops, forest trees or woody species and types of fruits. ICF activities not only for the company's interests in the timber business, but also simultaneously increase economic activities based on agriculture and social welfare (Armaizal, 2012).

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ICF company has implemented a variety of plant life activities such as paddy rice and corn, and other crops such as citrus. ICF companies do guidance for communities to undertake land clearing without burning (Armaizal , 2012). Habits of local people who live around or in area of ICF were used to plant rice with clearing land by burning, which known as "Sonor System". "Sonor" means the traditional rice planting in peat swamps in the long dry season, with no attempt to control the fire. Planting is done by way of sowing rice seeds, left without maintenance such as fertilizing, pest control and weeding grass until harvest (Suyanto and Khususiyah, 2004). Ashes resulted by burning of peat as a medium as plant nutrients (Abidin, 2011). In the other hand, former transmigran farmers have been done plant rice without burning. Their land preparation were done chemically by using herbicides (Asmani *et al*., 2011).

Based on the above description, the purpose of the study was to assess the potential for development of food crops in the area of plant life through rice cultivation by way of land clearing without burning to change the traditional way "Sonor System".

## 2. Method

Research method used in this study was Case Study, and the sampling was done by using a Disproportionate Stratified Random Sampling Method. Strata in this study consisted of local farmers who did rice cultivation by land fire or Sonor System (1$^{st}$ Stratum), and farmers who did rice cultivation by land management or Tillage System (2$^{nd}$ Stratum). Total of samples of each stratum was 30 people. The study was conducted at Simpang Tiga Sakti Village Tulung Selapan Sub district for 1$^{st}$ Stratum, and for 2$^{nd}$ Stratum performed at Simpang Heran Air Sugihan Sub district, which all the location are in the OKI Regency South Sumatra Province. Primary data collected through interviews using a questionnaire, carried out in June 2013. To find out the losses peat fires was obtained from one of the employees of the company as an example of the in-depth study. Secondary data drew from variety of sources such as the District Head Office in Simpang Tiga Sakti, Cooperatives of Bina Andalas in Simpang Heran, and Main Office PT.SBA Wood Industries in Palembang. Data was processed in tabulation and presented using quantitatively description.

## 3. Result and Discussion

32,777.87 hectares of plant life in the areal of ICF is a potential to be developed as rice fields, swampy or tidal rice fields. This area if used for planting rice one time per year potentially can support rice supplies. In addition, there are many spaces, around 5 thousand hectares, are delimiter between embankment blocks which can be used to plant rice or other food crops. The total of these two areas are 5 percent of the 758,732 hectares of rice fields in South Sumatra Province (Central Bureau of Statistics of South Sumatra Province, 2012). If both types of these areas were utilized, the potential rice can be obtained around 100 thousand tons per year.

Table 1. Cost and Revenue Analysis of Rice Farm between Sonor System in Simpang Tiga Sakti Village and Tillage System Simpang Heran Village Ogan Komering Ilir Regency South Sumatra Province, in June 2013

| No. | Parameter | Unit | Sonor System | Tillage System |
|---|---|---|---|---|
| 1. | Land zise | $ha^{-y}$ | 2.20 | 1.60 |
| 2. | Production | $kg^{-ha-y}$ | 470.00 | 3,300.00 |
| 3. | Cost production | $Rp^{-ha-y}$ | 373,000.00 | 3,400,000.00 |
| 4. | Selling price of rice | $Rp^{-kg}$ | 4,000.00 | 3,800.00 |
| 5. | Revenue | $Rp^{-ha-y}$ | 1,880,000.00 | 12.540,000.00 |
| 6. | Net revenue | $Rp^{-ha-y}$ | 1,507,000.00 | 6,060,500.00 |
| 7. | Net revenue total | $Rp^{-y}$ | 3,315,000.00 | 9,696,800.00 |
| 7. | R/C | | 5.04 | 1.93 |

The results of research in Table 1 has indicated that rice grown on degraded peat land by way of opening the land without burning, farm produced production of rice 7 tomes more than the way of the Sonor

System. The land area under cultivation using Tillage System by farmers of the former transmigran was capable only 1.60 hectares. Farmer who did the activities of Sonor System, open land for rice reached 2.20 hectares. After rice seed spreading, Sonor farmers were not doing plant maintenance activities such as fertilizing, pest control, and weeding. Its cost production was lower than Tillage System. Costs incurred only for the purchase of seed rice, whereas labor is derived from his own family. Sonor System income was lower around four times than the Tillage System. Its cost production only 10.97 percent compared to Tillage System. Comparison of revenue and costs of production (R/C) in Sonor System was 5.04 whereas Tillage System was 1.93.

Base on the description of the results of these studies that managing peat land by using inputs such as fertilizers and herbicides can increase rice production compared to the way of fires. Tillage Systems in addition to increase production and income as well as reduce the release of green house gas emission. The amount of emissions from the burning degraded peat land based on research results Asmani *et.al.* (2011) reached 49.90 tons of carbon dioxide per hectare per year. Preventing sonor can reduce green house gas emission. Firing peat causes reducing soil quality, biodiversity and hydrological cycle (Muhendar, 2012). The losses of socioeconomic activities of Sonor System can cause laziness nature for farmers because they want to achieve something easily and not productive. The productivity of rice was low. Farmers who continue to implement Sonor System has a reason that did it very simple, low input, low labor and low cost.

ICF companies are very interested in the prevention of peat fires. Peatland fires resulted in the destruction of investment in plant acacia and depletion of peat as media acacia. The company of ICF for fire prevention caused by sonor activity spent of money around 500 thousand per hectare. If one hectare of land has been planted with young acacia burning causes an average loss of about 5 million rupiah per hectare Anticipating the peat fire–, the company invites the public about HTI joined the group Concerned Citizens Fire (Armaizal, 2012).

## 4. Conclusion

From the results of the study concluded that:

1. The area of plant life on the plantation and embankment spatial divider block potentially planted for the development of rice field as big as 5 percent of total rice land of South Sumatra to support food stock.
2. Managing peat land with cultivating of rice with tillage potentially to increase production of rice 7 times and net revenue 4 times compared with sonor by burning of peat.
3. People who seek sonor cultivation system still continues to strive to do such activities because of the relatively low cost of production that do not require a lot of inputs and labor employment.
4. The company of ICF very concerned to prevent peatland fires because it would destroy investment in plant and eliminate peat as a medium crop.

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# Diversification of Staple Food As a Solutions to Overcome Food Insecurity of Household due to Global Climate Change

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**Abstract.** The research was conducted in the village of Karang Menjangan Eastern Semendawai sub-district East Ogan Komering Ulu Regency using survey methods. The results showed that the average of household rice consumption of paddy farmers by 118 kg per capita per year, lower than the national rate of rice consumption in 2010 (139 kg per capita per year). Paddy farmers in East Ogan Komering Ilir was already diversifying staple food. While the climate change, Paddy farmers adapt their staple food diversification as a solution to overcome food insecurity.

**Keywords:** Climate Change, Diversification of Staple Food, Food Insecurity

## 1. Background

Diversification of food consumption essentially expand the people's choice in consumption activities desired to the taste and avoid boredom to get the food and nutrition in order to healthy and active live. However, consumption of staple food diversification program which is expected during the non-rice food to consume more has not been achieved. More people choose to eat fast food or easy to get, easy to cook, and with affordable prices, such as instant noodles that was currently consumed by people as a substitute for rice.

Agriculture is a vital segment for the development of Indonesia, has a dependency on the climate and weather conditions. Climate change is a real threat and a challenge to the agricultural sector in maintaining the sustainability of food production. A shift of the season, will affect the planning of agricultural activities, so the planting schedule will be disrupted resulting in declining production and even crop failure , which will further threaten food security.

About ten years later, farmers feel the change in weather patterns. Among other things, excessive rainfall in a given year and next year is very less rainfall. There is no clear boundary between wet and dry seasons. This weather pattern changes greatly impact on rice farming , because it depends on the weather . Changes in rainfall patterns and climatic extremes result in planted area in some regions / areas experiencing drought. The total areas experiencing drought increased from 0.3 to 1.3 % to 3.1 to 7.8 %. (Ministry of Agriculture RI ; National Action Plan on Climate Change Adaptation Indonesia, 2012 ).

According to the Intergovernmental Panel on Climate Change ( IPCC ), released in April 2007, said that Indonesia will experience a decrease in rainfall in the south , whereas in the northern region will experience an increase in precipitation. It means that declining rainfall region is potentially destructive agricultural cropping systems, especially plants that do not have the potential for resistance to drought.

In that regard, it is interesting to do research on staple food consumption and diversification on rice farmers in Eastern Ulu Ogan Histories as well as to see the effect of climate change and try to analyze it in a frame correlation overcome food insecurity households . Based on the description above , then pulled the problems , as well as research purposes, which is interesting to study, as follows: 1. How does staple food consumption in paddy farmers in Eastern Ulu Ogan Histories? 2. How does staple food diversification on rice farmers in Eastern Ulu Ogan Histories? 3. Is diversification of rice farmers in Eastern Ulu Ogan Histories as a solution to overcome food insecurity due to global climate change?

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## 2. Assessing Library

Diversification to be one important factor in overcoming the problems caused by nutritional imbalances nutritional remember that less diversified food consumption resulted in the emergence of good nutrition problems of malnutrition and over nutrition ( Budiningsih, 2009).

Bidarti Tampubolon in 2012, diversification of food is a food that the election process is not dependent on one type of food but rather a variety of foods ranging from aspects of production , processing , distribution aspects , to aspects of food consumption at the household level. The concept of diversification is not a new thing in terms of the agricultural development policy in Indonesia, therefore, the concept has been formulated and interpreted by many experts in the context of its purpose.

Diversification of food consumption essentially expand the people's choice in consumption activities fit the desired taste and avoid boredom to get the food and nutrition in order to live a healthy and active . However, consumption of staple food diversification program which is expected during the non-rice food to consume more has not been achieved . More people choose to eat fast food or easy to get, easy to cook , and with affordable prices , such as instant noodles that is currently widely consumed by people as a substitute for rice.

Food insecurity , according to Ariningsih ening, et al. 2008, occurred when a household, community or region having insufficient food to meet the physiological needs for growth and health of the individual members . There are three important things that affect the level of food insecurity, namely: ( a) the ability to provide food to individuals / home , ( b ) the ability of the individual / household to get food , and ( c ) the distribution and exchange of available food and resources; owned by individuals / households. The third thing , the food shortages are acute or chronic and can appear simultaneously are relatively permanent. Looking at the case of seasonal food insecurity and temporary, factors that affect the possibility of only one or two factors only and are not permanent.

Indirect effects of climate change on world food production decline, for example, through an increase in area and production of bio -fuels ( the conversion of food land ), which resulted in an increase in food prices due to the area allocated to food has decreased. Variability in productivity is strongly influenced by climatic conditions, because the variability of results will lead to variability in supply (supply), the international trade is often used as a tool to overcome the variability of this offer.

## 3. Method

The research was conducted in the village of Karang Menjangan Semendawai District East East Ulu Ogan Histories. The data was collected in February 2013 until June 2013. This study uses survey. The sampling method used was simple random sampling ( simple random sampling ). The sample size is 10 per cent of the population of Rice Farmers Household. The data collected in this study of primary data and secondary data. Tabulation of the data processing is done then analyzed and described. Statistical analysis tools used in this study is a multiple linear regression analysis, using computerized techniques.

## 4. Results and Discussion

Diversification of staple foods have a relationship with food consumption of rice and rice substitutes. Generally the type of food instead of rice consumed by the villagers of Karang Menjangan extremely diverse, due to several things. The types of food such as rice substitute instant noodles, bread, corn, cassava, and so forth. However, in the study area Histories Ulu Ogan East , the food instead of rice consumed is the most dominant of instant noodles. While many other types of rice replacement will be consumed by the population in accordance with consumer tastes and the availability of food instead of rice, such as bread, potatoes and sago are food instead of rice that is easily obtainable by the residents.

While corn and food ketersediaanya oyek is limited and not every week the residents get the replacement food. According to the respondents who met at the time of the study, the average of respondents stated that they consume oyek if the existing food supply or food during the encounter.

The results showed that 33.3 % Rice Farmer Households consume instant noodles instead of rice. In addition to instant noodles, bread is a food replacement for both samples, which is used by rice farmers, this

is because bread is a food that is easy to obtain at low prices. Average household consumption of rice paddy farmers was of 118 kg per capita per year. Results of calculation of average rice consumption is decreased by 17.27 percent when compared to the national rate of rice consumption in 2010 (139 kg per capita per year). Low consumption of rice was due to population Histories Ulu Ogan East began to try to reduce the consumption of rice with non-rice staple food consumed.

The results showed that rice farmers in the Eastern District of Ulu Ogan Histories already diversifying staple food , it is evident from the existence of some carbohydrate food besides rice consumed by rice farmers. In line with the findings of this study, the results of research Yunita, et al ( 2010) showed that rice Farmer Households in Ogan Ilir and Ogan Ilir Histories diversify staple food rice as one of their household coping mechanisms in addressing food insecurity in the lean season.

Farmers in the village of East Semendawai Menjangan District Histories Ulu Ogan East in the face of climate change refers to the process of adaptation. Adaptation is done more in the form of staple food diversification, they try to adapt to the response to the effects arising from the uncertain climate conditions or who are expected to take place in order to survive and if possible can take advantage of the opportunity to thrive. Climate change ever occurs in the range of 2010 to 2011. In 2010, there was a transition season with high rainfall levels and difficult to predict. This condition is different from the condition in 2012.

Transition conditions like this, will have a strong influence in terms of rice production. In 2010, the condition of the rice planting season is uncertain due to high rainfall and difficult to predict, so the rice production deficit . Based on the data that the average difference amounted to 138.2 kg of rice consumption between consumption in seasons with high rainfall, in 2010 and at the time of climatic conditions with normal rainfall in 2013.

Based on the data, that in the year 2010, when the climate is not normal, the consumption of other staple food of 17.17 kg . While at the time when the normal climate, in 2013, consumption of other staple food diversification of 12.45 Kg. Thus, if observed with rice there are interesting things, that the level of rice consumption decreases when the climate is not normal, but there was an increase in staple food other than rice. While at normal climate rice consumption levels rise, whereas the level of consumption of staple foods other than rice is reduced.

Reality is interesting, that the diversification of staple food, indirectly become their adaptation strategy to climate change, while keeping as well as a solution to food insecurity rate them, when the production of rice farmers suffered decline due to climate change. Adaptations made rice farmers do in the post- harvest process, by making savings on food patterns and diversified rice staple food, in addition to rice.

Further testing with a paired two-sample test, the t test - Paired Samples t test were used to compare whether there are differences in the average of two sample pairs which in this case is the level of consumption in the diversification of staple food rice farmers in the district of East Ulu Ogan Histories when the climate is not normal, in 2010 and at the time of normal climate, in 2013. 16:00 SPSS processing results obtained significance value of 0.0001 with □ = 1.699 then the decision rule reject Ho ( significance ≤ □ ) . This means that there are differences in the diversification of staple food consumption in the district of East OKU before and after conditions of climate change. Then the value of the average ( mean ) obtained by -1.1732 meaning a declining trend in rice consumption and increase consumption of non- staple food rice after the conditions of climate change in the Eastern District of Ulu Ogan Histories.

## 5 . conclusion

Based on the results of research and discussion can be summed up some of the following:

1. Average household consumption of rice paddy farmers by 118 kg per capita per year, meaning that the average consumption of rice in a rice farming family amounted to 471.5 kg per family per year. Results of calculation of average rice consumption when compared with the national rate of rice consumption in 2010 amounted to 139 kg per capita per year, then the tabulation was lower by 24 kg per capita per year or by 17.27 %. Low consumption of rice was due to the population of East Ulu Ogan Histories try to reduce the level of boredom on rice consumption, so the residents do non-rice staple food consumption.

2. Rice farmers in the Eastern District of Ulu Ogan Histories already diversifying staple food, it is evident from the presence of some carbohydrate food besides rice consumed by rice farmers. Food consumption of carbohydrates consumed by rice farmers as much as 130.45 kg/capita/year with rice being the highest food consumed by rice farmers.
3. At a time of climate change, rice farmers adapt their staple food diversification as a solution to overcome food shortages. At the time of abnormal climate, the level of rice consumption decreased, but there was an increase in staple food other than rice. While at normal climate ascending level of rice consumption, instead of staple food consumption, other than rice increased. This means, the adaptations made rice farmers in post-harvest processing is done, by making savings on food patterns and diversified rice staple food, in addition to rice.

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# Are There Any Relationship Between Rice Barn Development and Welfare of Farmers in South Sumatra Indonesia?

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**Abstract.** Rice barn is one of the well-known economic institutions built by the government with a good cause as well as a mean for coping mechanism with community food insecurity. The research was conducted in the province of South Sumatra.during April to September 2009 on the locations selected purposively. The sampling method for barn members was a disproportionate stratified random sampling. Outputs of this study are expected to be useful in providing input on the interested parties in an effort to develop and empower rice barns in the Province as well as giving an impact on improving people's welfare. The results revealed that the presence of barns was significantly correlated with an increase in farmers'income, moderately correlated with increased production and welfare, and weakly correlated with the prevalence of malnutrition, the number of poor households, and prevalence of hunger. This shows tha the construction of barns in South Sumatra has given positive impact on improving the welfare of the insitution members. In order to support the improvement of institutional management, it is necessary to also improve the quality of the management through formal as well as non-formal education and training for the party barns suggested, such as (1) create patterns of education in accordance with the conditions of the barns, (2) make a plan of systematic and continuous work program, (3) prepare the regeneration for board and manager. In addition, it requires efforts to increase the participation of members by (1) involving members in any activity barns and (2) implementing the decisions of themembers meeting/agreement.

**Keywords:** Rice barns, relationship, welfare, farmers

## 1. Background

Good management of food stocks at the household, communities, regional and national is one of keys for acheiving food security and minimizing food insecurity. The importance of food reserves at community level was addressed by the government through Regulation No. 30/2008, which is about the food reserves village government. It emphasized the need to faster tradition developed individually in doing food reserves. Food stocks at household level is closely related to access to food. Access to food include physical dimensions and economy, associated with physical access factor control of food production at household level. Meanwhile, the purchasing power of food is a reflection of the ability to access of food (Maxwell and Frankenberger, 1992; Braun *et al* . , 1992; Haddad , 1997 in [15]). Meanwhile, Sen, 1981; Maxwell and Frankenberger , 1992 in [15] identified that constraints of access to food is related to the weak entitlement (factor ownership) in the household or individuals that cause disability did "control" of the food. Degree entitlement is linearly related to the level of stability or an individual household access to food, because of the degree of entitlement is determined by what they owned in , which is manufactured, sold, and the inherited or given. [14] showed that about 56-100 percent of households conduct food reserves. Opportunities occur in household food reserves correlated with low livestock asset ownership, low land size, and low rice proportion of low agricultural incomes.

The success of food security efforts must be supported by many factors, such as institutional, partnership, and wisdom. Meanwhile in agricultural development , institutional is one factor that needs to be examined to determine which one require gaining institutional priorities related to improving farming system. Institutional existence (in the sense of the organization) is the main topic in agricultural economics because its function is quite decisive, especially the smooth flow of input and output. Also greatly affect the institutional offer, in addition to distribution, which in turn affects the price. Officially, institutional divided into two, namely government agencies and non-government institutions. Government agencies or institutions that all facilities and infrastructure provided by the government, while the government is not classified as

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institutional or infrastructure held by farmers, businessmen, or any other agency or non-governmental organizations [6], [13].

Institutional empowerment of agriculture is a strategic step that get attention from many parties, especially the government. Institutions is one of the factors supporting the farms in reaching food security. According to [13] an institution is characterized by its structure, clear objectives, participants, and has technology and resources. The village-level institutions related to rice farming is a group of farmers, women farmers, and farmer groups, Koperasi Unit Desa (KUD), barns, Badan Penyuluhan pertanian ( BPP ), agriculture services, and others.

Rice barn is one of the popular economic institutions built by the government with a good reason as one means of coping as well as for the realization of food security mechanisme society. Institutional barns society is still at modest levels and socially-oriented, have the potential to be developed and revitalized trough empowerment process in a systematic, integrated, intact and continuous by involving all relevant elements in rural area. To determine the relationship construction of barns to the welfare of farmers is most need for assessment. In accordance with above problems, this study aims at: (1) Analyzing the performance of barns in South Sumatra, (2) Analyzing the relationship performance of barns to the welfare of farmers in South Sumatra Province.

## 2. Research Framework

This approach is designed to get a description, picture, or the conclusion of an assessment within a limited period. Diagrammatic analysis model research are presented in Figure 1. Rice Barn System Performance supported by three aspects: (1) aspects of management, (2) Aspects of Tehnic, and (3) Aspects of Behavior. Goes on three aspects must be supported by institutional factors between officials and members barns. Each of these aspects is observed to have different characteristics. If the characteristics of each institution is known, it can be easily analyzed impact barns in South Sumatra Province can be analyzed further for policy makers will be able to construct a measure empowerment. Institutional empowerment of farmers is expected to strengthen the position of farmers in the market and ultimately lead to improving the welfare of farmers.

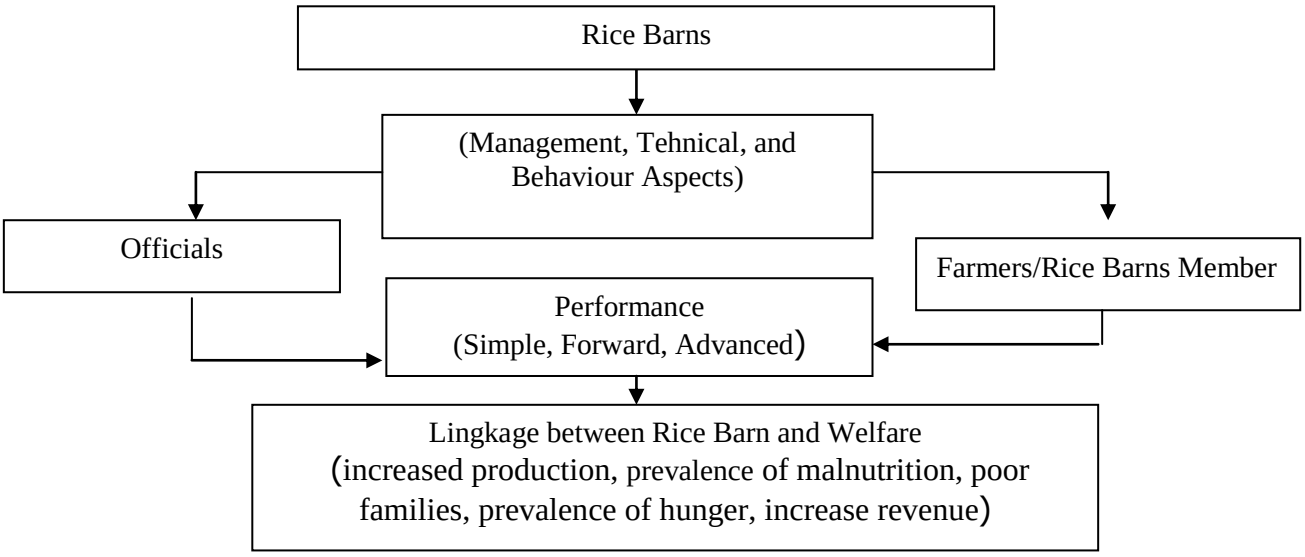


Fig. 1: Research Framework

The hypothesis proposed to analyze the effects of rice barns on the level of welfare of farmers is rica barn that has gone well and active real have correlated positively with an increase in the welfare of farmer family.

## 3. Research Method

The research was conducted in the province of South Sumatra during April to September 2009. The method used in this research was a survey of barns South Sumatra Province. The sampling method used in

this study was disproportioned stratified random sampling, with consideration of the number of members barns unbalanced sample, with 22 active rice barn and 8 inactive rice barn in every district at South Sumatera. Discussion is limited to only look at the qualitative aspects of the Food Barn management, technic, and behavior using a scoring method. The method used in this research was a survey of barns South Sumatra Province. Overall in this study using two approaches, namely quantitative and qualitative approaches. The quantitative approach is a primary approach, while the qualitative approach as an approach to support analysis, especially in explaining. Assessment score to rice barn performance were divided into three categories: simple, forward, and advanced. The score will be displayed in the form of average and classified in the class interval using Likert Skala. To answer the hypothesis that the formula used Contingency Correlation coefficient test (C) in which to measure the closeness of the simplest relationship between two groups of variables using the formula as follow:

Ho= There are no relationship between rice barns performance and welfare of farmer of rice barns member
Ha= There are relationship between rice barns performance and welfare of farmer of rice barns member

$$C = \sqrt{\frac{X^2}{N + X^2}}$$

Where :

$$X^2 = \sum_{I=1}^{P}\sum_{J=1}^{C}\frac{(Oij - Eij)^2}{Eij}, db = (p-1)(c-1)$$

If $x^2 hit \geq x^2\alpha(db) \rightarrow$ Reject Ho

## 4. Result and Discussion

The analysis showed that the rice barn in South Sumatra classified Forward Type Rice Barn. There are several things that need to be considered and to be an important indicator of the type of advanced barns. [3], [4], [5] state the following as follows: (1) The organization consists of a core board coupled with 1-2 fields, (2) food Lumbung has had experience in managing the business, but not professional, (3) the business activities carried out by the principles of economy but still limited, (4) Control of the administration, board meetings and members meetings have been conducted, (5) food Lumbung has a written rule, but not 100 % run, (6) has an annual work program, (7) has a complete infrastructure except packing equipment and quality control system. In terms of types businesses that developed, as previously described, examples barns have had various types of businesses such as lending that are social, savings and loans, marketing delay selling, service inputs, and processing services/milling. Further terms of business scale to capacity 3 month average forward barns have a capacity of 5-200 tons. Partnership with various stakeholders has also forged a partnership in the provision of agricultural inputs. Furthermore , if viewed by category, then as many as 10 barns simple category ( 45.45 % ) and 12 barns in the category of forward sample ( 54.55 % ) as show in Figure 2.

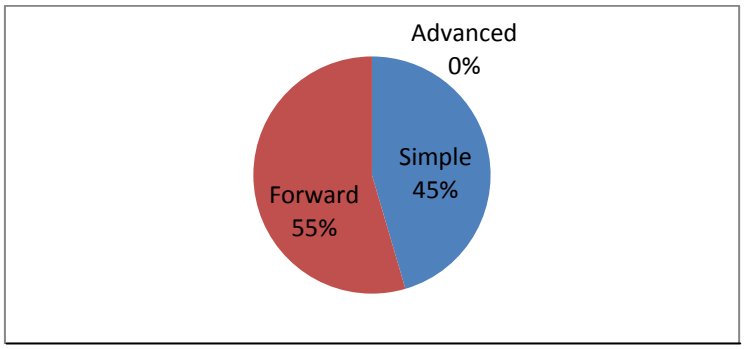


Fig. 2: Rice Barn categories

Existing barns in South Sumatra continue to monitor the presence and function to run in accordance with its objectives. Improving farmers' welfare is the ultimate goal of empowerment barns. The results showed that there is a relationship with the more advanced barns with some welfare criteria are observed, namely: (1) Increased production, (2) Malnutrition prevalence, (3) The number of poor households, (4) Prevalence of Hunger, and (5) increase income.

Table 1. Contingency Correlation Result between Rice Barns Performance and Welfare of Farmers

| No. | Indicator | Chi-Square Value | Contingency Corellation Coeficient (C) |
|---|---|---|---|
| 1. | Prevalence of Hunger | 0,018 | 2,82 |
| 2. | Prevalence of Malnutrition | 1,302 | 24,49 |
| 3. | Prevalence of Poor Families | 0,206 | 9,48 |
| 4. | Increased Production | 4,168 | 39,87 |
| 5. | Increased Revenue | 12,32* | 59,83 |
| 6. | Improved Welfare | 5,06 | 43,24 |
| | Chi-Square Tabel Value (0,05;4) | 9,48 | |

Note: Significant at 0,05 level

Relationship correlation of test results between the performance of the barns (Simple, Forward, Advanced) with increased welfare (Improved Production, Malnutrition prevalence, number of poor households, prevalence of hunger and Increased Revenue) appeared to affect the performance of the welfare barns members, for more details can be seen in Table 1.

Chi-square test results show that the better category of barns, the better revenue growth in the real level of 0.05 percent. Value of the correlation between categories barn with an increase in revenue is 59.83 %. This suggests that the existence of a new barn correlated with an increase in revenue with a correlation coefficient of 59.83 %. The analysis also showed that the presence of high barns correlated with increased production and prosperity. Thing that attracts attention is that high enough barns correlated with an increase in production but is strongly correlated to the increase in total income of farm families. The analysis using contingency correlation coefficient C indicates that the correlation categories barns to increase production only 39.97 %.

On the production side, there are a lot of things that caused agricultural production. Barn has not been instrumental in efforts to increase production, the role of the barn is still limited to the provision of advice but haven't touch production technical aspects of production yet, including the adoption of the latest production technology. In terms of income generation, it appears that the high correlation between the better category barn with an increase in revenue. The same statetament also stated by **[10] [11].**

In connection with the explanation of the previous production, **[1]**stated it is known that the role of the barn as much on aspects of the provision of the means of production , and non- technical. Type of business conducted by the barns are lending that are social, savings and loans, marketing delay selling, service inputs, and processing services / milling. In terms of the diversity of the business, must be recognized that the type of business that have not developed that touches many aspects of the production techniques.

Furthermore, Table 1 shows the presence of low barns correlated with the prevalence of hunger, malnutrition, and poor families on the real level of 0.05. Correlation results showed that the barns are generally correlated significantly lower with an increase well-being of its members are respectively 2.82%, 9.48 %, and 24.29 %. Whether in fact the correlation barn on the prevalence of hunger, malnutrition, and poor families because many factors that must be improved to address these issues such as the programs related to public health. Finally, the analysis shows that rice barns correlated with lower levels of well-being.

The low correlation is related to the number of problems that must be addressed, if we want to improve the welfare of members. Barns, is only one factor or agency that can improving the welfare of members. Many other factors that also need to be addressed in order to improve the well-being, such as improved farming technical, business scale, commercial farming systems development, and others. Figure 3 showed the relation between Rice barn performance and some welfare criteria are observed in detailly.

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Institutional barns today's society in general still at modest levels and socially oriented. Therefore need to be reconstructed village barn roles and functions as well as strengthen ability. Barns are expected not only helps endurance community food on a limited scale, but in the long run can be increased again to institute economic mainstay for farmers in countryside. Empowerment is done in a systematic, complete, integrated and sustainable by involving all relevant elements. This effort expected to be able to contribute significantly to the the realization of food security, economic and social institutions. The agency is able to drive the rural economy [8]. In order to support the improvement of institutional management, [2], [11] state it is necessary to also improve the quality of the management of education and training through formal and non-formal, for the party barns suggested: (1) Look for patterns of education in accordance with the conditions barns, (2) Make a plan of work program systematic and continuous, (3) Perform the regeneration board / manager. Also necessary efforts to increase the participation of members by way of: (1) Involve members in any activity barns and (2) Realizing the decisions of the meeting of members/agreement.

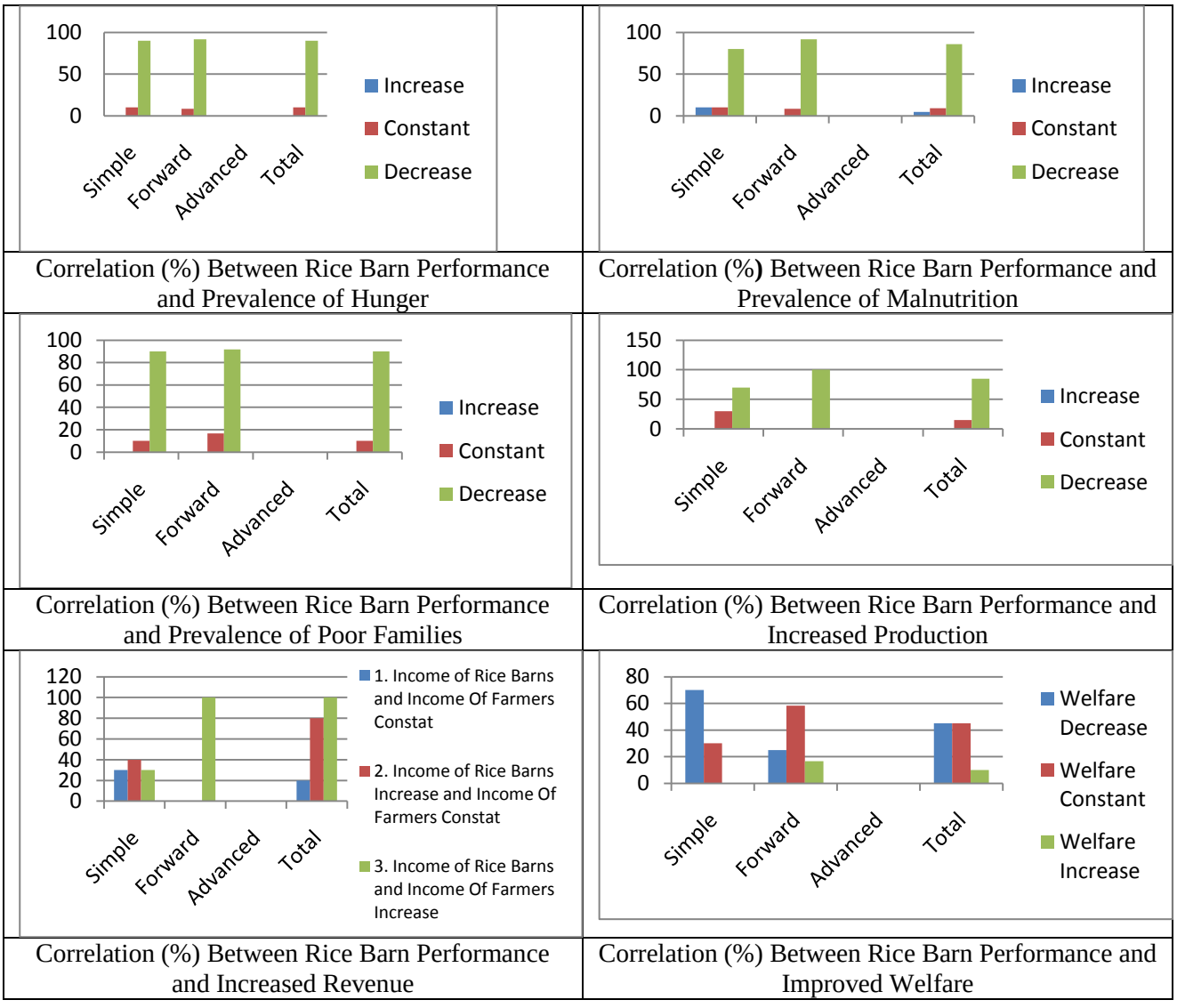


Fig. 3: The Correlation (%) between Rice Barn Performance and Some Welfare Criteria are Observed in Detailly

## 5. Conclusion

As many as 45.45 % barns simple category and 55.55 % barns in the category of forward sample. Existence barns correlated with an increase in income, high enough correlated with increased production and welfare, and low correlated with the prevalence of malnutrition, the number of poor households, prevalence of hunger. This shows the development of rife barns in South Sumatra have good impact on improving the welfare of members of barns.

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# Diversification of Food Consumption in South Sumatera: an Analysis Based-on Desirable Dietary Pattern

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**Abstract.** Food diversity is an effort to increase the consumption to a more variety of food consumed based on balanced nutrition principles. Food diversification aims to improve food security supported by local resources, institutions and local culture. However, until now Indonesia is still facing problems in food diversity shown by the score of desirable dietary pattern that still very low. This paper aims to analyze the diversification of food consumption in South Sumatra in 2012. Actual conditions of food consumption by food commodity groups compared with the ideal conditions of food consumption based on desirable dietary pattern. Using Susenas 2012, found that scores of desirable dietary pattern in South Sumatera is still far from ideal conditions. Cereals consumption is still quite high, above the ideal consumption, otherwise consumption of animal products, vegetables and fruits and pulses are still very low. However, compared to conditions in 2009 food diversification in South Sumatera has improved.

**Keywords**: food consumption diversity, desirable dietary pattern

## 1. Introduction

Food is a basic need of every human being which must be met in order to establish active life in accordance with health standards. Law 18 of 2012 on Food said that the food needs is a fundamental right guaranteed to every citizen by the Constitution in order to get quality of human resources. Thus the food needs to be an obligation for the state to provide adequate and quality food for its population.

Indonesian population continues to increase so that demand for food is also increasing. The country has a challenge in achieving food self-sufficiency that is how to meet domestic food ruquirement by its own domestic food production. This means that domestic food production must be increased to meet the food needs of the continuously increasing of Indonesian population. Another issue that also important is the implementation of food diversification, so that we do not only rely on the food consumption of certain food commodities but we develop other food commodities as a substitute.

In the PP. 68 of 2002 on Food Security stated that the food diversification is an effort to increase the consumption to a more variety of food consumed based on balanced nutrition principles. Food diversification aims to improve food security supported by local resources, institutions and local culture. Diversification of food consumption as one dimension of food diversification is not only limited to the main food commoities but also other types of food commodities in order to improve the nutritional quality, as an effort to improve the quality of human resources.

However, until now Indonesia is still facing problems in food consumption diversity shown by the score of desirable dietary pattern that still very low, 77.5 in 2010 (Kementan, 2012). One problem is the high reliance on rice consumption. In 2011, rice consumption in Indonesia is still very high, reaching 103 kg/ capita/year while specifically South Sumatra reached 100 kg/capita/year (Pusdatin Kementan, 2012). This condition is exacerbated by the people lack of knowledge and awareness about the importance of diversification of food and nutrition (Suryana, 2007).

This paper aims to analyze the diversification of food consumption in South Sumatera in 2012. Actual conditions of food consumption by food commodity groups compared with the ideal conditions of food consumption based on desirable dietary pattern. Benefit that can be obtained is identification of the dietary pattern for evaluation and planning of food diversification in South Sumatera. Furthermore, by obtaining

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desirable dietary pattern score, we will know the achievement of food diversification program in South Sumatera province.

## 2. Literatur Review

FAO (1989) mentioned that the ideal food composition based on the nutritional value of food that contain of total energy 2100 kcal/capita/ day with 40 percent certainty derived from cereals, pulses 6 percent, 5 percent of vegetables and fruits, 5 percent of roots and tubers, 20 percent of animal products, 10 percent of the added fats and oils, 3 percent of nuts and oilseeds, 8 percent of sugar and 3 percent of other (beverages etc.) consumptions. These conclusions are then called Desirable Dietary Pattern (Pola Pangan Harapan - PPH). PPH score explains the extent of variability of food consumption, where food diversification achieved ideal conditions if PPH value reaches 100.

In the Indonesian context, in 2004 through the National Workshop on Food and Nutrition VIII has been agreed that the minimum nutritional requirement (Angka Kecukupan Gizi - AKG) based on consumption is 2,000 kcal/capita/day (LIPI, 2004). Nationally also have developed the National Desirable Dietary Pattern refers to the AKG with respect to consumption patterns and nutritional needs of the population of Indonesia (Hardinsyah et al., 2001). The composition of Desirable Dietary Pattern in Indonesia is 50 percet of cereals, roots and tubers 6 percent, 12 percent of food products, added fats and oils 10 percent, 3 percent of nuts and oilseeds, pulses 5 percent, 5 percent sugar, 6 percent vegetables and fruits and 3 percent other consumption (DKP, 2006).

## 3. Reseach Methods

The data used in this paper is the results of Panel National Socioeconomic Survey (Survei Sosial Ekonomi Nasional - Susenas) 2009 and First Quarter Susenas 2012, taken from the official publication of BPS Provinsi Sumatera Selatan (2010 and 2013). First Quarter Susenas 2012 is household survey that collect household consumption data of more than 200 food commodities. This survey was conducted in March 2012 with a sample of 2,390 households in South Sumatra (BPS Provinsi Sumatera Selatan, 2013). While the Panel Susenas 2009 also held in March of 2009 but with a smaller number of samples as many as 1,824 households (BPS Provinsi Sumatera Selatan, 2010).

Table 1. National Desirable Dietary Pattern

| No. | Food Groups | National Desirable Dietary Pattern | | | | |
|---|---|---|---|---|---|---|
| | | Gram/day | Energy (kcal/day) | %AKE | Weight | PPH Score |
| 1. | Cereals | 275 | 1000 | 50 | 0,5 | 25,0 |
| 2. | Roots and Tubers | 90 | 120 | 6 | 0,5 | 2,5 |
| 3. | Animal Products | 140 | 240 | 12 | 2,0 | 24,0 |
| 4. | Added Fats and Oils | 25 | 200 | 10 | 0,5 | 5,0 |
| 5. | Nuts and Oilseeds | 10 | 60 | 3 | 0,5 | 1,0 |
| 6. | Pulses | 35 | 100 | 5 | 2,0 | 10,0 |
| 7. | Sugar | 30 | 100 | 5 | 0,5 | 2,5 |
| 8. | Vegetables and Fruits | 230 | 120 | 6 | 5,0 | 30,0 |
| 9. | Other | 15 | 60 | 3 | 0,0 | 0,0 |
| Total | | | 2000 | 100 | | 100,0 |

Source: DKP, 2006

The method used here is desirable dietary pattern performed by comparing actual consumption pattern with the ideal consumption pattern and then calculates PPH score. Briefly calculation steps are described as follows:

a. Calculate the energy content (in kilocalory) of each commodity consumed based on quantity of commodity consumed in Susenas

b. Classify each commodity into 9 groups of food commodities in desirable dietary pattern sheet and calculate the total actual energy consumption of each food group
c. Calculate the energy contribution of each food group based Minimum Energy Requirement (Angka Kecukupan Energi - AKE) as follows

$$\%\ AKE_i = \left(\frac{Total\ Energy\ Content\ of\ Food\ Group\ i}{2000}\right) x\ 100$$

d. Furthermore, multiply the energy contribution by the weight of each food group to obtain the score of each food group. But each food group has a maximum score, so if the the score exceeds the maximum score, we used the maximum score (Table 1.)
e. Add up the scores of all food groups to get the PPH score

## 4. Results and Discussion

The level of energy and protein consumption is an important indicator to determine the fulfillment of nutritional needs. In 2012, the average energy consumption of South Sumatera 1925.99 kcal/capita/day, while the average protein consumption, 52.84 grams/capita/day. The average energy consumption is lower than the minimum energy requirement (Angka Kecukupan Energi – AKE) based on WNPG 2004 that is 2000 kcal/capita/day, while protein consumption is still higher than the corresponding Minimum Protein Intake (Angka Kecukupan Protein – AKP) based on WNPG 2004 that is 52 grams/ capita/day. However, AKE and AKP tend to decrease in the last 3 years (Table 2.).

Table 2. Average Energy and Protein Consumption of South Sumatera, 2009-2012

| Type of Nutrition | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|
| Energy (kcal/capita/day) | 1,991.76 | 1,989.11 | 1,950.08 | 1,925.99 |
| Protein (gram/capita/day) | 53.62 | 54.67 | 54.30 | 52.84 |

Source: BPS Provinsi Sumatera Selatan, 2013

The above results lead us to the importance of encouraging an increase in the quality of food consumption through increased access and affordability of food, especially for low-income people. As shown in Table 2 above, there is an indication of declining quality of consumption as shown by the declining trend in the average consumption of energy and protein in the last 3 years. Related to this is the importance of maintaining adequate food availability, equity on food distribution and the stability of food prices.

Food consumption diversity can be determined by using the actual dietary pattern and compare it with desirable dietary pattern and calculate the PPH score. It can be concluded that the actual dietary pattern of South Sumatra is still far from ideal conditions in which in 2012 the PPH score was 77.8. However, compared to 2009, PPH score increased from 74.7 in 2009 (Table 3.). The ideal condition is achieved when the PPH score has reached 100.

Regarding the desirable dietary pattern of South Sumatra Province in 2012 and 2009, we know that four food groups still have a proportion of consumption that is far from ideal score. Consumption of cereals has a higher proportion of consumption compared to ideal score. In 2012, AKE score of cereals consumption reached 28.7 while the maximum score for cereals consumption only by 25. Thus, consumption of cereals be continually reduced to achieve the ideal proportion of food consumption. Compared to 2009, the consumption of cereals has decreased with decreasing gap between AKE score with a maximum score of food consumption according DDP.

Reducing the reliance on cereals consumption especially rice become our next task, because the consumption of cereals is still very high. Improvements and innovations are required to develop alternative foods and need a vigorous campaign to change the paradigm of the public about food consumption patterns. Reducing rice consumption is a significant challenge because based on the results of Susenas, we found a relatively small changes in rice consumption from year to year (BPS Provinsi Sumatera Selatan, 2013). The dominance of rice in food consumption also led to rice becoming a political commodity so that the government's food policies are often biased in rice (Ariani, 2004).

The other three food groups namely animal products, vegetables and fruits, and pulses have proportion of consumption is still far below the ideal proportion of food consumption. In 2012, the consumption of animal products has AKE score of 16.5 while ideal maximum score is 24. AKE scores for fruits and vegetables is 22.2, still below the maximum score 30. Similarly, the energy consumption for pulses has AKE score of 4.0 also still far below the maximum score for this group, 10.0. Compared with 2009, there was improvement of consumption of animal products as well as vegetables and fruits shown by the decreasing gap between AKE score and the maximum score.

Table 3. Desirable Dietary Pattern of South Sumatera Province 2009 and 2012

| No | Food Groups | 2009 | | | | | | 2012 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Energy (kcal/ capita/ day) | % AKE | AKE Score | Max Score | Diff. AKE Score and Max Score | PPH Score | Energy (kcal/ capita/ day) | % AKE | AKE Score | Max Score | Diff. AKE Score and Max Score | PPH Score |
| 1 | Cereals | 1189.78 | 59.5 | 29.7 | 25.0 | 4.7 | 25.0 | 1147.12 | 57.4 | 28.7 | 25.0 | 3.7 | 25.0 |
| 2 | Roots and Tubers | 128.41 | 6.4 | 3.2 | 2.5 | 0.7 | 2.5 | 87.83 | 4.4 | 2.2 | 2.5 | -0.3 | 2.2 |
| 3 | Animal Products | 147.73 | 7.4 | 14.8 | 24.0 | -9.2 | 14.8 | 165.30 | 8.3 | 16.5 | 24.0 | -7.5 | 16.5 |
| 4 | Added Fats and Oils | 215.10 | 10.8 | 5.4 | 5.0 | 0.4 | 5.0 | 241.25 | 12.1 | 6.0 | 5.0 | 1.0 | 5.0 |
| 5 | Nuts and Oilseeds | 23.57 | 1.2 | 0.6 | 1.0 | -0.4 | 0.6 | 12.82 | 0.6 | 0.3 | 1.0 | -0.7 | 0.3 |
| 6 | Pulses | 40.03 | 2.0 | 4.0 | 10.0 | -6.0 | 4.0 | 40.30 | 2.0 | 4.0 | 10.0 | -6.0 | 4.0 |
| 7 | Sugar | 128.45 | 6.4 | 3.2 | 2.5 | 0.7 | 2.5 | 105.84 | 5.3 | 2.6 | 2.5 | 0.1 | 2.5 |
| 8 | Vegetables and Fruits | 81.19 | 4.1 | 20.3 | 30.0 | -9.7 | 20.3 | 88.80 | 4.4 | 22.2 | 30.0 | -7.8 | 22.2 |
| 9 | Other | 37.49 | 1.9 | 0.0 | 0.0 | 0.0 | 0.0 | 36.72 | 1.8 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Total | 1991.76 | 99.6 | 81.2 | 100 | | 74.7 | 1925.99 | 96.3 | 82.6 | 100 | | 77.8 |

Source: Calculated from Susenas 2009 and 2012

Paralell with the efforts to reduce consumption of cereals, it also needs some efforts to increase consumption of other food that is still very low, especially in the three food groups namely animal products, vegetables and fruits, and pulses. Therefore, it is necessary to improve our people knowledge about the importance of balanced nutritional content on food consumption even from an early age and starting from school. Particularly animal products, low consumption of this food group are also due to the high price of food such as beef. As a maritime nation, the consumption of animal products can actually be directed to increase the consumption of fish, but ironically fish consumption tended to decline in Indonesia including in South Sumatera.

Finally, food diversification program indeed not only food problems alone, but includes political, economic, health, education, social and even cultural. The change on food consumption pattern is the interaction of various factors, so that food diversification program interventions should be a joint motion of all components related. Slow progress in food diversification program which has been carried out for this may be due to all components of the nation did not work cooperatively for support programs.

## 5. Conclusions

Based on the results and discussion above, we conclude the following things related to diversification of food consumption in South Sumatra:

a. The quality of food consumption tends to decrease so that we need some efforts to improve the quality of food consumption in particular by increasing the affordability of food for the poor
b. The level of food consumption diversity in South Sumatra is still low although increases in the last three years
c. Four food groups has a larger deviation to the ideal score: cereals that have a high consumption and the other three food groups; animal products, vegetables and fruits, and pulses that have low consumption
d. Improving food consumption diversity in Sumatera Selatan, means reducing cereals consumption and the same time increasing consumption of animal products vegetables and fruits, and pulses. These efforts should be an integrated work of entire community in South Sumatera.

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# Food Insecurity and Global Food System: Political Decision?

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**Abstract.** Food insecurity may exist at the national, regional, and local levels, where the food is not available, accessible, and properly utilized. This paper describes the basic cause of hunger and food insecurity of most parts of the world is national and global political choice. The weak government's policies contribute to unequal distribution of food within nations, regions, and communities. In addition, developed countries via their multinational corporations perform their business in developing countries as a form of neocolonialism, which have pushed developing countries deeper into poverty. A country can make political decisions to ensure all of the citizens are not hungry by the changing economy, agriculture, and national policy paradigms which pro poor.

**Keywords:** food insecurity, global food system, food policy

## 1. Background

In global food situation, there is a gap between developed and developing countries. Developed and developing countries differ in concerning their nutritional status consumption. While developing countries are still struggling in fulfilling their calorie intake, developed countries have already concerned about high protein food supply. Poor people in developing countries expend more than 50 percent of their income for food and about 70 percent of it is for staple food. Otherwise, food expenditure is only about 15 to 30 percent of total expenditure in developed countries. Surprisingly, cereals consumption per capita in developed countries is more than 500 kg per annum, whereas in developing countries consume no more than 200 kg (150 kg in Southeast Asia). Approximately 90 percent of cereal consumption in developed countries is allocated for livestock feeds (Buckle *et al*., 1985).

For food security to exist at the national, regional, and local levels, food must be available, accessible, and properly utilized. However, food availability does not ensure food accessibility. The weak government's policies in developing countries contribute to unequal distribution of food within nations, regions, and communities. Furthermore, poor democracies do not spend much on people's health and education sectors. Thus, it leads to lack of information and knowledge about food and nutrition resulting undernourished condition and worsen by cultural aspect. In addition, developed countries via their multinational corporations perform their business in developing countries as a form of neocolonialism. Those factors have pushed developing countries deeper into poverty.

## 2. Literature Review

### 2.1. Food Insecurity

Food insecurity is the condition existing when people lack sustainable physical or economic access to enough safe, nutritious, and socially acceptable food for a healthy and productive life. Food insecurity may be chronic, seasonal, or temporary, and it may occur at the household, regional, or national level. The root causes of food insecurity include: poverty, war and civil conflict, corruption, national policies that do not promote equal access to food for all, environmental degradation, barriers to trade, insufficient agricultural development, population growth, low levels of education, social and gender inequality, poor health status, cultural insensitivity, and natural disasters. Globally, certain groups of people are more vulnerable to food insecurity than others. Vulnerable groups include: victims of conflict (e.g., refugees and

internally displaced people); migrant workers; marginal populations (e.g., school dropouts,

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unemployed people, homeless people, and orphans); dependent populations (e.g., elderly people, children under five, and disabled and ill people); women of reproductive age; ethnic minorities; and low literacy households.

A household is considered food secure when its occupants do not live in hunger or fear of starvation. Hunger is the body's signal that it needs food. Once we have eaten enough food to satisfy our bodies' needs, hunger goes away until our stomachs are empty again. People who do not get enough food often experience hunger, and hunger can lead to malnutrition over the long term. But someone can become malnourished for reasons that have nothing to do with hunger. Even people who have plenty to eat may be malnourished if they don't eat food that provides the right nutrients, vitamins, and minerals. Hunger is also an effect of poverty and poverty is largely a political issue. Access to food and other resources is not a matter of availability, but rather of ability to pay. Poverty is the shortage of common things such as food, clothing, shelter and safe drinking water, all of which determine our quality of life. It may also include the lack of access to opportunities such as education and employment. The effects of poverty may also create a "poverty cycle" operating across multiple levels, individual, local, national and global.

## 2.2. Millenium Development Goals

The Millennium Development Goals (MDGs) are eight goals to be achieved by 2015 that respond to the world's main development challenges. The first goal is related to the topic of this paper which is to eradicate extreme poverty and hunger. MDGs will never be achieved unless there are strong efforts from all world population since there are many constraints hampering. They should be considered as challenges instead of problems. These challenges can be divided into two basic categories: challenges related to the availability of food and challenges related to access to food.

### 2.2.1. Challenges related to the availability of food

a. Water shortage

Water shortages are identified as a potential food security challenge. Water is a key determinant of crop yields. Many countries are already facing significant water scarcity issues. Thus, rapid growth in water demand, coupled with escalating costs of development of new water sources, could be a serious threat to future growth in food production, especially if it requires meeting household and industrial water demand through water savings from irrigated agriculture.

b. Climate

Another challenge is likely to be the climate. Food security and climate change are inextricably linked. The most immediate effects of climate change on food production will involve changes in temperature, precipitation, length of the growing season, and changes in $C0^2$ concentration.

### 2.2.2. Challenges related to access to food

a. Purchasing power

When people do not have incomes, they cannot buy enough food. Undernourished people in many of Asia’s low-income countries have been attributed to insufficient purchasing power among the poorer segments of the population. Many poor countries do not grow enough food to be self-sufficient and given their poverty, they are unable to import food to make up for the deficit.

b. Children living in rural areas are nearly twice as likely to be underweight as children in urban areas

There are strong, direct relationships between agricultural productivity, hunger, and poverty. Three-quarters of the world's poor live in rural areas and make their living from agriculture. Hunger and child malnutrition are greater in these areas than in urban areas. Moreover, the higher the proportion of the rural population that obtains its income solely from subsistence farming (without the benefit of pro-poor technologies and access to markets), the higher the incidence of malnutrition. Therefore, improvements in agricultural productivity aimed at small-scale farmers will benefit the rural poor first.

c. Political instability and war are close to food insecurity

Food security and political stability are often linked, although the relationship is complicated and not necessarily direct or causal. However, evidence suggests that food security can be upset by a lack of

political or social stability. Similarly, the lack of food security resulting from a sudden jolt (i.e. International embargo, poor climate) can lead to political instability. "Food riots", when they occur, are often instigated by urban residents; poorer rural residents rarely have a political voice.

d. The Role of International Market

Today, more than 95 countries in the world import more food than they produce. However, importing countries must earn enough foreign exchange (by selling non-food commodities, for instance) to be able to buy this food. Many Southeast and East Asian countries have witnessed wild fluctuations in their currency values, which have in turn affected their ability to purchase food on the international market. Another problem related to international markets is the issue of economic sanctions. Economic sanctions can weaken importing countries' faith in international markets as a food provider of last resort. This may, in turn, spur countries to pursue food "self-sufficiency" policies that are inefficient and counterproductive.

## 3. Discussion

When we talk about the food system, the things that spring to mind are these three sectors of the food system. They are 1) inputs, including the seeds, machines, water, fertilizers and chemical substances, loans, research, and other matters that can be used in food production; 2) agriculture production, including everything done by the farmers or breeders; and 3) postharvest activities, including keeping food in the storage, food processing, food distribution, restaurant, and mass foods. When it is the global food system, it means that all of the sectors explained above are globally done or done in more than one part of the world. It includes any part of the world, the "north world" and also the "south world". These two terms, north and south world, is used to explain the two main groups of countries in the world, where the northern world is for the well-developed and rich countries which mostly in the northern part of the world (such as US and European countries) and the south world is for the under-developed or developing countries (such as countries in Africa and Asia).

In my opinion, the rich countries (north world) have been trying to make south world's to imitate their food system and to serve the food for them. Ironically, many countries even do not try to solve their own food problems but they still imitate the rich's food system anyway. This imitation is very good not only to increase the wealth status of the rich but also their politic influences.

The third sector of the food system may be the closest one to us, as an example is the supermarket. Every supermarket/hyper mart gives a deep impression to its customers by displaying many kinds of food. They sell the same product with different brand/label. Thereby, they give the effect of so many food options. Whereas, when the consumers realize it, the options are only a few. The companies completely realize that they will not get much profit if they sell the product directly after harvested or if the product only processed by simple processing, such as the wheat is processed into wheat flour. The long and complex processing is their mainstay. In other words, the more peculiar and more interesting the product in the way it is processed and packaged, the more the profit the companies will get.

Related to food packaging, private labeling, and branded foods, I argue that by issuing their food global system, the northern world, through their food companies happily remove the south world's goods and as the result they export to south world the food labeled under their companies name, and sometimes with frills "additional nutrition" on food package which gives the effect of producing "different" food via advertisement. It is not a difficult thing, it only needs some adjustments, and then they change the eating habits of the south's world that is used to eat national/traditional food into other food as though south world's ordinary food is lack of nutrient and out of fashion. As an example is the global trade of cereal as the breakfast. In fact, it is a big lost if we compare the cost of producing this kind of food to the cost of producing traditional/local food. For me, food global trade sometimes makes the inhabitants need a particular kind of food (with the "western image"), not only stealing their money or decreasing their cultural value level of traditional food but also sometimes the "new food" contains poison, as the example is "babies food affair" (melamine imported milk).

Liberalization of food trade means that the south's world's farmers will collapse soon. When transnational companies enter the developing countries, the farmers will suffer a financial loss. Why? Because the transnational companies rarely use raw materials of local products. Bread, as an example, is

processed by using 100 percent imported wheat. They even do not want to mix the wheat with the local rice because they do not want to change their processing machines. By using machines in processing the food, they do not create a new vocation for the local people. On the other hand, they abolish many vocations because of the collapse of local companies.

## 4. Conclusion

As Paul J. Smith (1998) has noted: "Food distribution systems are largely shaped by political and economic forces that prevent the food from getting where it is most needed", the basic cause of hunger and malnourishment is not the lack of food in the world, but the fact that the food is not getting to the people who need it the most. Hunger and food insecurity in most parts of the world are not determined by resource scarcity and technology, but by nationally and globally political choice. The government has absolute authority over its own food system regardless global food system and or the authority disagree with the food standardization. A country can make political decisions to ensure all of the citizens are not hungry by the changing economy, agriculture, and national policy paradigms which pro poor. No matter that such country will be a big barrier to global food distribution, as long as its people eat the food in accordance to their preference but still consider their health, and they proud consuming local products as an effort to help their farmers wealthy.

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# Rice Consumption Analysis for Different Income Groups in Palembang, Indonesia

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**Abstract.** As a staple food, rice is the most basic consumption needs of the population of Indonesia. Rice commodities viewed as a strategic commodity because it involves various aspects of national life, where the availability, distribution and price levels are very influential on the national stability. The purpose of this study were 1) to analyze the factors that influence the consumption of rice by population with different income groups at Palembang, South Sumatra Province, 2) to analyze the consumption of rice by households in Palembang , South Sumatra Province. The research was conducted in the city of Palembang, which consists of three sub-district; Pakjo, Sako, and Pulokerto. The data collected consists of primary and secondary data. Sampling method applied was simple random sampling. The results showed that the factors prices, the price of substitutes, income, family size, age, gender, and occupation are factors those significantly affect on the rice consumption. No statistically significant effect of the levels of education on the rice consumption. The result also showed that the consumption in high-income households lower than medium and low incomes.

**Keywords:** Rice, Household, Income, Consumption

## 1. Introduction

Rice is the staple food in Indonesia. With a population of 230 million and the population growth rate of 1.4% per year, the supply of rice at this time has reached its lowest level in over a period of 30 years which is accompanied by a rise in rice prices in the last 10 years. This means that Indonesia, just like other Asian countries, facing problems in securing the supply of rice to peoples (Tsubaki, 2010). To achieve sustainable food consumption required physical and economic accessibility to food. Accessibility is reflected in the number and type of food consumed by households. Thus, food consumption data in real terms can demonstrate the ability of households to access food and describe the level of household food security. Implicitly, the development level of food consumption also reflects the level of income or purchasing power of food. In addition, consumption patterns are often used as an indicator to measure the level of social welfare. In case of low-income population generally most of the income used are to meet food needs, while the higher income the lower percentage of their income to meet the food needs [7].

Palembang is a rice deficit area, due to its dominant population are livelihood rather than as a rice farmer, so the city of Palembang is the biggest rice consumers in South Sumatera Province. As the capital of South Sumatra Province Palembang is an area that has a high population heterogeneity that can be distinguished based on ethnic origin or based on income levels that can be seen from their jobs. The purpose of this study are:

1. To analyze the factors that influenced the consumption of staple rice in Palembang.
2. To analyze food staple rice consumption per capita in Palembang households which has different income groups in the city of Palembang in South Sumatra Province.

## 2. Methodology

Samples was taken by using a simple random sampling to represent the three categories of areas, i.e. areas which are high income population, areas with moderate income population and areas with low-income population. There were 20 samples taken for each group, so the number of samples were 60. The first research goal addressed by using statistical analytical tools. Estimator model calculations methode formulated by using a simple least squares *(OLS = Ordinary Least Square Method).* Independent variables

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were analyzed as a descriptive *(explanatory variables)*, the diversity of domestic rice consumption is income (Inc), the number of members in the household (JAK), sex composition (Jk), age composition (U), the price of rice (Hb ), the price of substitute goods (Hs), and level of education (PDK). Mathematically so that the estimator equations can be formulated as follows:

$$CBR = \alpha . Inc.^{\beta 1.} JAK^{\beta 2.} Hb^{\beta 3.} Hs^{\beta 4.} U^{\beta 5D1.} Jk^{\beta 6D2.} Pdkn^{\beta 7D3.} E^{\mu}$$

Where:
CBR = household consumption of rice in Palembang (kg / kk / yr)
Pd = Revenue (Rp / kk / Year)
JAK = Number of household members (org)
Hb = The price of rice (USD / kg)
Hs = The price substitution items (Rp / wrap)
D1 = dummy variable for age composition of household members
0= if <50% of household members aged unproductive
1= if ≥ 50% of household members aged productive
D2 = dummy variable for gender composition of the dominant in the household
0= if male ≥ female
1= if female <male
D3 = dummy variable for education level of head of household
0 = if head of household education <Junior
1= if head of household education ≥ junior
α = intersept
®1–β 7 = parameter estimators
μ = error

Then, the second purpose is answered by quantitative descriptive analysis using tabulation and mathematical calculations of the average rice consumption of resident households (kg / kk / year) and then calculated the average consumption in kg /capita/year.

# 3. Results and Discussion

## 3.1. Analysis factors which affect on rice consumption

Based on Table 1, $R^2$ value obtained is equal to 0.65594 indicate that the variation of rice consumption rate in the city of Palembang 65.59% can be explained by the variables of family income, family size, the price of rice, prices of noodle as substitute in food, gender, and head of household education level. While the remaining 34.41% is a variable that is not included in the equation. Based on Table 1, F-count value is 16.84046, the value is significant at α = 1% level. Based on F-test results, it can be said that all of the variables, namely the family income, family size, the price of rice, noodles price, gender, and education level of family heads significantly influence on the level of rice consumption collectively for Palembang cases.

For more details, the following description of the factors that influence the level of rice consumption in the population in different income group in Palembang as follows: Income variables significantly affect the level of consumption of rice at α = 5%. Alleged parameter values obtained indicate that the variable rate revenue of -0.31621, which means that every 1 percent increases in revenues then the level of domestic rice consumption Palembang City residents will be reduced by 0.31621%, while the other variables being constan (*ceteris paribus*).

Number of family members significantly affect the level of rice consumption at α = 5%, with a value of 0.50015 alleged parameters, meaning that each additional family member of 1% then the consumption of rice will increase by 0.50015%, while the effect of other variables considered be fixed (*cateris paribus*).

Table 1. Results Parameter Alleged Some Variables Affecting Rice Consumption Rate of Household Population Palembang

| Explanatory variables | Alleged parameter values (Bi) | t-count | Prob-t | Remark |
|---|---|---|---|---|
| Intercept | 7.25330 | 2.56392 | 0.01322 | |
| Revenue | -0.31621 | -4.97834 | 0.00001 | A |
| Number of family members | 0.50015 | 3.85716 | 0.00031 | A |
| The price of rice | 0.36238 | 0.49035 | 0.62591 | - |
| The Price of noodles (subtitution goods) | -1.27188 | -1.44082 | 0.15552 | C |
| Sex composition | 0.02009 | 0.59740 | 0.55278 | - |
| Education head of household | -0.08171 | -1.48026 | 0.14473 | C |
| $R^2$ | 0.65594 | Description: | | |
| F-count | 16.84046 | A = significant at the level α= 0.05 | | |
| DW | 1.67565 | B = significant at the levelα = 0.10 | | |
| | | C = significant at the levelα= 0.20 | | |
| | | D = significant at the levelα= 0:30 | | |

The effect of rice price variable, the analysis shows that the price of rice did not significantly affect the level of rice consumption in the city of Palembang, this means that although the price of rice rose, people will still buy it, because rice is the staple food that can not be replaced by other foodstuffs.

Substitute rice obtained in this study is the predominantly by noodles. Based on the results of regression analysis, the price of a substitute significantly have negative effect on the level of consumption of rice by houshold in Palembang, where alleged parameter value is equal to -1.27188, which means that if the price of noodles increased by 1%, the total rice consumption would fall by 1.27188% , ceteris paribus. Regression analysisalso showed that the gender composition variables did not significantly affect the consumption of rice.

Education level of the family patriarch in the samples varied start from primary school up to graduate level education as a high level. Based on the results of regression analysis showed that the alleged parameter values for the variables of education level is -1.48026, which was tested by the t test showed significant affect on the rice consumption in the level α= 20%. This means there are differences in the level of rice consumption among higher than junior high school level of education and lower junior high school level of education of family patriarch, where rice consumption by the family patriarch who educated junior high school or higher 1.48026% smaller than the rice consumption by families which level of education of family patriarch is lower than junior high school.

## 3.2. Analysis of Rice Consumption Based on per capita income level of residents

Palembang city residents tend to consume rice as a staple food. As a staple food, rice is not the only option for food primarily on the population of different income groups. Average of Rice Consumption for The High Income, Moderate Income and Low Income in the city of Palembang can be seen as the Figure 1.

Figure 1, shows that the largest rice consumption in the city of Palembang is in the population with low income levels, where the amount of rice consumed was 93.50 kg/capita/year, followed by moderate income level, where the amount of rice consumption was 60.30 kg/capita/year, while the lowest rice consumption is a population with high income levels, where the amount of rice consumption of 45.95 kg/capita/year. Based on this it could explained that increasing in the income of a society, will decreasing the amount of rice consumption, due to the income increased, then purchasing power for different types of food will increase.

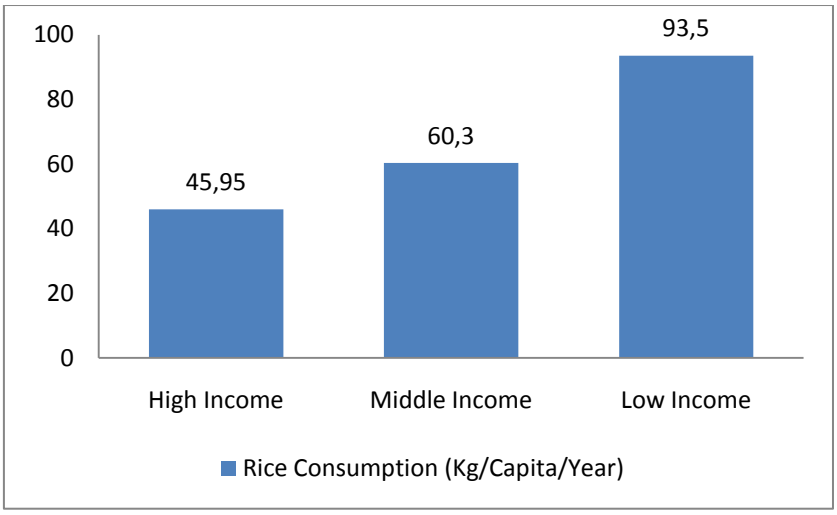


Fig. 1: Average Rice Consumption Per Capita Per Year Population Level at different income

# 4. Conclusion

## 4.1. Conclusion

Based on the results of research that has been done, it can be concluded as follows:

1. Factors that significantly affect the consumption of rice in of Palembang are the level/amount of income of resident income, family size, the price of substitution primarily instant noodles, and educational level of family patriarchy.
2. The highest consumption of rice is population of Household with low income levels, while the lowest consumption of rice is a population with high income levels.

## 4.2. Recommendation

1. As Palembang City is the largest rice consumer, then the distribution of the surplus to deficit areas should be conducted in accordance and without constraints.
2. Need to do more research on pricing policy of rice, inventory levels and distribution of rice in the rice deficit areas.

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# Communication Analysis of Edamame *(Glycin max (L) Meriil)* Supply Chain Management: Case of Farmer Group in West Bandung Region, West Java, Indonesia

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**Abstract.** This paper aims at assessing the perception of farmers on issues related to communication in their role as one of the actor in the supply chain management of a product named edamame. Communication is becoming the central issue in the chain as it is determining the bargaining position as well as the allocation of profit margin among the actors in edamame business. The information used here is mainly coming from the focus group discussion between the researcher and the group of a farmer group in West Bandung Region. It is being arranged special for this study where a genuin and deeper answer are expected to come out objectively on communication issues surrounding their business as supplier of the edamame product. The communications issues are raised using a list of questions ranging from input until output processing where in each stage the groups was asked on their perception about the issues. The result shows that communication has been played its role in the network management of small supply chain managment case of edamame farmer. It is founf that farmers and the core company have performed exchange of strategic information. Some improvement are still need to be done because they essentially determine the business relationship between the core company and farmers group in the future.

**Keywords:** Edamame, communication, information, supply chain management

## 1. Background

Indonesia is tropical country well known for its fertile land for agriculture products either for domestic market or for export. Among the products is soybeans, a product wellknown for Indonesian tempe and tofu making. In general Indonesia is deficit in terms of demand for and supply of soybeans. According to the latest data, total production of soybean nationally is 100,000 tons a year, While the demand 150.000 – 160.000 ton edamame so there is gap to fill from import to meet the domestic demand so the gap is around 50,000 to 60,000 tons, so the gap must fulfilled from import[1]. However in the mid of the deficit, some businessmen doing business on soybeans to cater specific segment of the market namely frozen green soybeans, using Japanese style processing named edamame, either for domestic customers or exported mainly in East Asian countries.

Similar to other commodities business activities, the edamame is also having its own supply chain and management where usually a business entity act as the core and some farmer or group of farmer are the suppliers according to the specifity required by the core. This kind of chain has happened in many agriculture products and even in husbandry activities for example sheep and cow raising business. Among the characteristics of such relationship are usually the weaker position of farmers as supplier because all the farming from input-process-and output is usually guided and even dictated by the core. This potentially reduce the gain and margin of the farmer because of weak negotiation and bargain. However it is not necessarily so when there is equal position between the two main actors so win-win situation may exists in which collaboration on equal right and obligations exist[2]. It is interesting to observe and explore to what extent and what has been developed in terms of communication between farmer and core company in the case study of edamame business. From this exploration some problems that may exist between them could be bridged to find the optimal solution that accommodating both parties' interests.

Communication is perhaps among the reason and improving the communication skill of the farmer will able to improve their bargaining power at least for price maker and involving them in the planning-implementation- evaluation of the co-operation or partnership. This paper tries to explore the communication

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problems that may exists in the relationship among those two main actors in the supply chain management at various stages of production process using the case of edamame farmers group in West Bandung Region, West Java, Indonesia. Analysis will be given to answer what kind of challenges do the supply chain in the current structure on communication? And what kind of communication strategy should be taken into account in the SCM of edamame case?

## 2. Literature Review

### 2.1 Supply Chains Management

Supply chain as the modern knowledge in logistics science has been developed and been implemented at various sector as part of the economy. A generic definition of supply chain may be refered to a system of suppliers, manufacturers, distributors, retailers, and customers where materials flow downstream from suppliers to customers, and information flows in both directions as suggested by Houlihan[3]. A further detail and elaboration of supply chain may be found in the literature for example in Drucker[4]. The Supply Chain Management on the other hand is the management on in each segment and between supply chain stages so that all supply chain activities could be optimized to gain maximum profit[5].

As a network system, the relationship among the actors of the chain from suppliers, plants, retailer, distributors as well as sub contractor guarantee the needs to communication. This is important aspects that to some extent neglected in some practices of supply chain management especially in the agriculture sector. In terms of form communications components, it consists of format and contents and the other is macro context of co-ordination and synchronization[6]. Tsai[2] further stressed the strategic supplier partnerships and customer relationships as the main components in the supply chain management. Information flow and sharing among those actors are as Lalonde[7] mentioned will be among the pillars of sound supply chain management. In other words the success of any partnership need to be acompanied by an appropriate communication scheme mainly in the case of complicated structure of supply chain.

### 2.2 Communication Perspective of SCM

From the organization point of view, the importance of communication has been among the center of communication experts'[8]. With the progress of economic structure driven by globalization like nowadyas, organization usually responses with either forming a corporate or co-operate (alliances). Communication will be critical to maintian the sustainability of the organization mainly in adapting the global change. Similar to the above statement Hines[9] indicates that in the case of commodity products, thugh it is common to have adversarial relation between buyer and supplier, it is considered beneficial if suppliers are adopted as partner. This will enable a better supply chain performance due to many benefits may exist due to sharing in information, risk and other benefit from mutual coordination.

Better communication will let everything in the business will arrive with the right quantities (at the right place) at the right moment at minimal cost, that will also benefit the farmer as a partner. In general sense communication may refer to exchange of ideas or information among communicants[10][11]. Research on communications aspects of SCM have been discussed mainly in the context of information management within the context of network organization[12][13].Communication role in SCM has been viewed by some researcher as a managerial issue. The role of communication in the field of supply chain management has been emphasized as a managerial issue [14]. However the development of ICT has also brought about the communication strategic role in managing a better SCM[13].

Among the question raised in dealing with communication in the context of SCM then would be what kind of information to exchange (type and content) and which media to use. Information management will therfore part of the SCM management in which according to Carroll better information will serve a better communication and so provide better input for decision making[15].

## 3. Materials and Method

Edamame is ala Japanese-processed of green soybeans. The process starts with the sorting and grouping just after harvested soybeans into those with three or at least two seeds. The selected soybeans then are boiled and quickly frozen under certain treatment in the factory of the core company. So edamame is

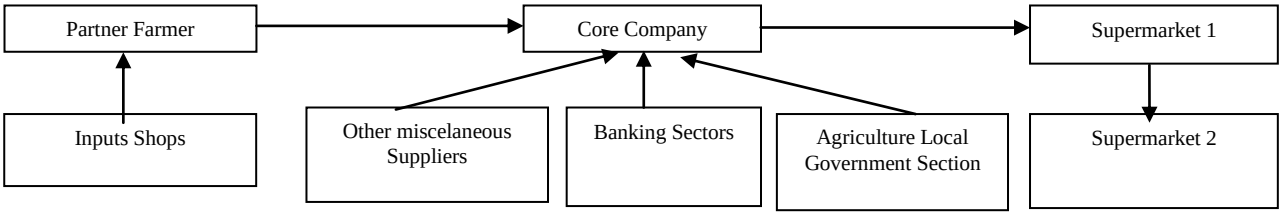
categorized as frozen food. Edamame is marketed by a company as a nucleus and some farmer groups as the soybeans supplier. The supply chain is quite simple where farmers grow the soybeans, and send the harvested raw soybeans to the company. The company processes the soybeans into edamame and market it to supermarket in Bandung City and whole seller in Jakarta and West Java, Central and East Java up to Bali Island and some potential export markets are still on assessment.

This paper utilize the result of surveying the farmers by choosing a group of farmer which supply the company. The farmer is located in West Bandung Region, West Java Province. The group of farmer is consisted of 25 members. A list of question has been asked and an indepth interview in a group discussion was conducted in March 2013, with the 5 representatives of the group to tap their perception on issues related to the their position in the supply chain and communication during their interaction with the company they supplied.

## 4. Result and Discussion

Supply chain structure is determined by the number of actors involved. As part of agriculture network system, the supply chain of edamame is not so complicated as compared to other sector, e.g construction or manufacturing sector. The following Figure 1 shows the supply chain of edamame product in the case of West Bandung. From the figure it shows that the there are limited actors and therefore short linkages for edamame product.

The communicators in the supply chain management of edamame consists of primary members that are core company, partner farmer and supermarket (outlets), and the secondary members are inputs shop, miscelaneous suppliers, banking sector, and local government official (agriculture section). From the figure the core company has become the central in which all the member of the system is directing their orientation. There is no communication might happened among other actors. It may happened only under the facilitation of core company.




Source: Adapted from Amelia, 2013 [16]

Fig. 1: The Supply Chain system of edamame product in West Bandung

The brief supply chain as shown in Figure 1 supposed no complication and therefore the management must be easier to conduct. However this does not mean there will be no problem at all as communication may potentially raise some conflicts because of inefficient format and or contents due to information assymetric[17]. This is due to the fact that the supply chain in edamame if we look at its subsystem that connect farmer and the company, it is totally not interconnected to other sub-system. Farmers have no access to other actor in the supply chain of edamame except to input provider.

The first communication between the farmer group and the core company is the agreement on rights and obligations for each parties as shown in the following Table 1. This has been trough many intensive discussion since the initiation of the project. The core company which has the intitative to produce edamame have done many discussion and negotiation to ensure the farmers group that they will join the project of edamame. The closing of this communciation process is the fixation of the right and obligation of both sides concerning the project. The detail can be shown in Table 1 that shows the process from input processing until harvesting.

Table 1. Right and obligation of Farmer and Core Company

| Farmer | | Core Company | |
|---|---|---|---|
| Right | Obligation | Right | Obligation |
| Guidance from the Company | Cultivating land and labor provision | Guaranteed supply of of soybeans | High Qality seed provision |
| Market guarantee and price | Produce edamame according to the standart of core company | Guaranteed standart of soybeans quality | Production Buying |
| To get seed from the company | To plant and harvest on schedule | | Plant growing Guidance |
| | | | On time payment to farmer |

Source: Adapted from Amelia 2013[16]

Table 2 shows the comparison of characteristics of communication and flow of information that part of the supply chain management before and after the partnership with core company. From the table below it is shown that the orientation of farmers in terms of communication i.e information source, orientation and contents are almost all towards the core company. Farmers feel that this has reduced their cost and effort to find information regarding their edamame cultivation. However they still search information mainly on information exchange about any prospect of edamame price. In general their pereived benefit of being the member of SCM is the cost efficiency in finding information related to their edamame business.

Table 2. Characteristic of SCM of Edamame product at Cibodas, West Bandung Regency

| No | Element | Before | After |
|---|---|---|---|
| 1 | Information source | Extension or fellow farmers | Mentor from company |
| 2 | Amount of information sharing and monitoring | Limited to needs of current transaction | As required for planning and monitoring processes |
| 3 | Communication change | Less dynamic depends on farmer orientation | Dynamic, routine change depend of taste and market orientation |
| 4 | Information on farming | Freedom in terms of timing and no standart | Based on agreement with core company |
| 5 | To eliminite miscommunication | Solved individually | Need facilitator in knowledge transfer |
| 6 | Risk Allocation | Own risk | Shared with the company |
| 7 | Bargaining | Full authority | Dependence on core company |

Source: Interview, 2013

There are at least three issues that farmers need more communication and find the effective way to solve. First is concerning the planting and harveting schedule. Some information are felt one way and assymetric and mostly dictated by the core company without specific and clear argument. Farmers feel that all farmer member should be in one forum with the core company to set agreed schedule. Second issue is edamame payment, msot of the farmers complaint the late payment by the core company because of late payment from the supermarket (agent 1 or 2 in the Figure 1). Farmers demand that the core company should bail out and that until now a process of negotiation through communication is on going. Third issue is dealing with the edamame quality. Many farmers are not in accordance with their promise as listed in the right and obligation so as a consequence the core company demand the farmers to sort themselves to fulfill the requirement of the core company. It seems that farmer in this case tend to be less reactive as they are passively seeks any information to improve their edamame quality. It is also interesting to observe that their information seeking behavior which information needs arise and the way that need is satisfied[10]. Farmers tend to concern more to issues directly affect their economic interest those are in scheduling and payment. It was proved with their active information seeking either from the core company or other sources mainly other fellow farmer from outside the group[11][10].

Table 3. Farmers Problems and the way to communicate in the SCM of Edamame

| Issues | Media Source | Information/ Message | Factors affecting communication | Networking | Strategy | Importance | Info seeks activities (active/passive) |
|---|---|---|---|---|---|---|---|
| Planting & Harvesting Schedule | Direct | Seed handling, planting and harvesting Schedule | Assymetric information | Partnership | Direct meeting between farmers and core companye | Very Important | Active |
| Payment *edamame* | Direct | Late Payment | Late payment by agent (supermarket) | Partnership | Negotiate on time payment by Core Company. Comparative information from fellow farmer outside the group | Very Important | Active |
| Quality | Direct | *Edamame Criteria* | Farmer disobey the guide | Partnership | Farmer sort edamame themselves | Important | Passive |

Source: Interview, 2013

Though there is only simple relationship between the core company and farmer group, problems that need to be overcome are mainly in the case of assymetric information between core company and farmer mainly in the scheduling and order delivery. This has happened for some time without proper treatment and threathen the bond of partnership between core company and some members of farmer group. Some farmers have already seeked some other potential buyers unless there is improvement. With that tendency, sustainability within the SCM of  is an issue that must be taken into account[11]

## 5. Conclusion

Business relationship must be managed properly and communication is playing its role as has been shown in the edamame case. The case of edamame has shown the importance of keeping fair enough and symmetric communication is neded if parties would take benefit from the economic collaboration[13]. The perceived benefits of supply chain management systems in the edamame case is lower cost of farmers to find information dealing with edamame planting.  factors were found to hinder the implementation of supply chain management systems in the in edamaame case is some information mainly on payment certainty. However, trust between the core company and farmers in general was found to be eroded.

At whatever scale of business, communication determine the sucess of relationship among the actors involved that is why Sharma[17] noted the importance of communication in business and repeats it 3 times when stressing this word by communicate, communicate, communicate some more. Communication aspect in SCM in Indonesian would be an area that still need further research mainly in the era of openness and accountability demand in any collaboration relationship including in business.

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# Factors Influence Farmers' Decision to Convert Rainfed Lowland in South Sumatera, Indonesia

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**Abstract.** Wetland is one of the production factors which non-replaceable for rice cropping. Wetland conversion problems become an important policy issue since the late 80s. Wetland conversion not only have a negative impact on rice production which is the staple food of Indonesia's population (98%), but also to the socio-economic and environment. This study discusses the conversion of rainfed lowland in Ogan Komering Ilir Regency. Determining the location of study undertaken purposively; the regency has the widest rainfed lowland in South Sumatra Province, an area of 44.47%. This study applied binary logistic regression model to determine the factors that influence farmers' decisions in converting rainfed land. The findings indicate that grain prices at the farmer's level, number of family members, and dummy of soil fertility are significant variables influencing farmers' decision in converting rainfed lowland. Government needs to provide incentives for farmers in order not to convert rainfed lowland. Development of irrigation facilities is also considered important to increase cropping intensity of rainfed rice.

**Keywords:** farmers' decision, land conversion, rainfed lowland

## 1. Background

Wetland conversion to other uses is one of the important issues in the current agricultural development. This is due to wetland conversions have a significant negative impact, not only on rice production, but also to the socio-economic and environment. Based on land data of the last three decades, the average of wetland conversion in Java at 8 346.65 hectares per year and outside of Java 2 269.75 hectares per year, so that the area of land converted annually on average to reach an area 10 616.4 hectares per year (Purbiyanti, 2013). Although not as massive as Java, wetland conversion outside Java also seemed inevitable. The allocation of land will lead to the use of land resulting in higher rents (Barlowe, 1978). This condition is alarming, considering the rapid economic growth outside Java and the current rate of population growth outside Java are still reaching 1.36 % in the last decade (BPS, 2000-2010); both of these causes of land competition. Table 1 illustrates the rate of population and rainfed lowland growth in Ogan Komering Ilir Regency in the last five-years.

Table 1. The Rate of Population and Rainfed Lowland Growth in Ogan Komering Ilir Regency, 2006-2011

| No. | Description | Rate of Growth per Year (%) | | | | |
|---|---|---|---|---|---|---|
| | | 2006-2007 | 2007-2008 | 2008-2009 | 2009-2010 | 2010-2011 |
| 1. | Population | 1.95 | 1.64 | 1.60 | 2.79 | 2.06 |
| 2. | Rainfed lowland | 0.00 | 18.45 | -18.60 | 0.00 | -7.11 |

Sources: BPS Sumsel (2005-2011)

South Sumatra is one of the national food storage outside Java was not separated from this condition. Moreover, South Sumatra has four dominant land typologies (BPS Sumsel, 2011), namely: lowland (38.24%), rainfed land (13.18%), technical irrigated land (5.82%), and tidal lands (29.95%). Statistics show that from 2008 to 2011 there has been a widespread decline in the rainfed land of 24.39% (BPS Sumsel, 2009-2011). The decreasing rainfed lowland outside Java, especially in Sumatra and Kalimantan, may be caused by the conversion or the conversion of agricultural land into plantations crops (Wahyunto, 2009).

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Attempt new printing areas are not necessarily able to replace the converted land. As one of the key factors in agricultural production systems, the availability of land is still a major challenge in the development of agriculture to this day because it is limited. Therefore, land conversion is a serious threat in efforts to achieve food security which leads to self-sufficiency. To that end, this study is important to analyze the factors that influence farmers' decisions to convert rainfed lowland in South Sumatra.

# 2. Literature Review

## 2.1. Land Conversion

Land conversion is defined as *net* land conversion. It means land area in the year *t* is the area of land previous year plus new paddy fields minus land conversion. Wetlands have important significance in determining national food security. Of several previous studies that wetlands conversion occurs as a result of high competition for land use and non-wetlands. Factors that affect wetland conversion are: economic factors (economic growth, industrialization and urbanization result, the purchasing power of farmers, and prices), social (such as population growth, land ownership, and so on), and ecology (such as: climate change, land degradation). Wetlands converted his usual allocated for residential use, the construction of public facilities, tourism, and so on (Purbiyanti, 2013).

Ilham *et al.* (2006) refers to several previous studies related reasons farmers convert wetlands in various areas, among others researches: Rusastra *et al.* (1997) in South Kalimantan, Syafa'at *et al.* (1995) in Java, and Jamal (2001) in Karawang, West Java. The results showed that the main reason farmers converted wetlands in South Kalimantan were the need for a high price, as well as a less efficient scale. Similarly, farmers in Java converted wetlands were due to the needs, the land was in an industrial area, and the price of land. Meanwhile, land sales price received by farmers in the process of conversion of land in Karawang, West Java, is significantly influenced by the status of the land, the number of workers absorbed in the land, distance from the tertiary canal, distance from the road, and the distance from the industrial area or residential.

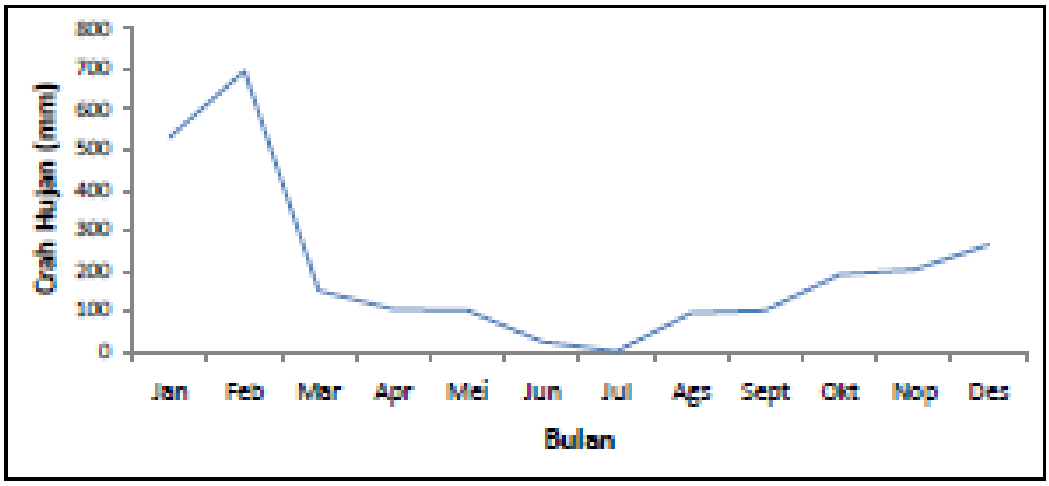
Characteristics of wetland conversions are: 1) *Permanent*, meaning that the food problem will still be felt in the long term despite the conversion of land is not the case anymore ; 2) *Cumulative*, where the reduction of the area of wetland is permanent causing food problems caused by the conversion of wetland for a certain period will be the cumulative and 3) *Progressive*, meaning that once wetland conversion occurs at a location of the area of land converted in these locations will be greater due to wetland conversion occurring at locations along the vicinity. According Irawan (2005), there are 4 factors that cause wetlands conversion impact on the food problem cannot be immediately recovered: a) wetlands that were converted will not be able to go back to the rice fields (permanent); b) new wetland takes a long time about 5-10 years; c) resource can be used as wetlands become more limited; and d) Increased productivity of rice farming is also difficult due to stagnation of technological innovation.

## 2.2. Rainfed Lowland

Rainfed lowland is a source of irrigation rice fields depend entirely on rainfall in the local area. So, on the land can be accommodated (cistern) rain water, surface made flat and flat land, surrounded by galengan and water for irrigation is possible in the land for the time required. In general, the rainfed lowland planted to rice only once a year during the rainy season, while in the dry season, most of them experienced fallow until the next planting season. Rainfed lowland is one of the potential for agro food supply. For sustainable production in this area is needed sorting typology of land to choose technologies that can be applied. Segregation of land based on altitude, rainfall, evapotranspiration, types and soil properties, as well as site-specific cropping. Sorting suitable varieties are also necessary to support the success of farming. (Sastrosoedardjo and Tohari , 2001).

Rainfed lowland is a provider of both food after rice irrigated land. Climate type of rainfed lowland according to the Oldeman’s classification, including the type D and E with an average wet month is 3 months

(Figure 1). Problems of agriculture in rainfed land, include: uncertainties intensity and distribution of rainfall, low soil fertility, weeds, pests and diseases, the narrow land ownership, low quality of agricultural products. The strategies that must be done is: accurate climate forecast, soil fertility enhancement, increased cropping intensity, and utilization of ground water or rainwater run-off through reservoir technology "*embung*"[2].




Source: The average number of daily rainfall in Jakenan (Central Java) in 2008, 2009, 2010

Fig. 1: Rainfall Patterns Rainfed Lowland.

## 3. Method

Types of data collected in this study are primary and secondary data; time-series and cross-section types. The primary data of the survey obtained from interviews with 30 farmers using questionnaires as the approach. In the other hands, materials of secondary data obtained from the institutions associated with this study, both the central and local levels.

To answer the objective related factors that lead farmers took the decision to convert or not to convert his farm was answered by using binary logistic regression analysis. Mathematically it can be formulated as follows:

$$\left(\frac{\text{Pi}}{1-\text{Pi}}\right) = \alpha_1 + \beta_1 Log\,HG + \beta_2 LogHK + \beta_3 LogPT + \beta_4 LogLL + \beta_9 LogJK + \beta_5 LogLP + \beta_6 LogD1 + \mu_1$$

Where in:

| | | |
|---|---|---|
| $P_1$ | = | Opportunity people to convert land |
| $1\text{-}P_1$ | = | Opportunity people not to convert land |
| HG | = | Price of grain at the farmer level (Rp/kg) |
| HK | = | Latex price (Rp/kg) |
| PT | = | Total income of farmers (Rp) |
| LL | = | Area of land (ha) |
| JK | = | Number of family members (people) |
| LP | = | Long taking education (year) |
| D1 | = | Dummy of soil fertility (acid = 1, no acidic = 0) |

The authors would like to thank all those who have assisted in this study for their input and suggestions, the informants, both primary and secondary.

[2] www.litbang.deptan.go.id

# 4. Result and Discussion

The statistic of Omnibus test results known that sig = 0.001 which is less than 0.05, which means the decision: reject $H_0$. It can be concluded that the value of 19.052 $G^2$ with *p-value* 0.001 (model), which means with a confidence level of 95%, there is at least 1 independent variables that affect the dependent variable, so it can be concluded that the model can be used for further analysis. The results of the Hosmer and Lemeshow test output value sig = 0.245 is greater than 0.05 which means thank $H_0$, so the conclusion: with a 95% level of confidence, to believe that the logistic regression model used has enough/able to explain the data / fit. Partial test results indicate that the significant variables at the level of up to 30% are price of grain at the farmer's level (16.2%), number of family members (23.4%), and dummy of soil fertility (7%). Explanation of each variable is as follows.

## 4.1. Grain price at the Farmer's Level

Grain prices at the farmer's level significant influence on the level of 16.2% with a positive sign. Results of this study do not support the hypothesis that an increase in the price of grain at the farmer's level can be one of the incentives for farmers to keep trying to rice farming. These findings coincide with research of Purbiyanti (2013) which concluded that the combination of alternative policies and policy import prices suggests that prices of existing policies will not be effective if at the same time the government depends on the import policy, because that actually increases the availability of rice is imported policy there. Instead, the policy will be effective if the price of rice import policy eliminated in the long run.

Grain prices of at the farmer's level with a selling price of wet grain; more commonly known as dry harvest grain (GKP). The average price of grain at the farm level in September 2013 was Rp3 500.00/kg. The average production obtained is 2.669 tons. Rainfed rice farming in this area is done only one time in a year. This is because farmers plant rice in the rainy season only, so that the average rice farm receipts earned in a year is Rp7 828 000.00. After deducting production costs about Rp1 299 182.00, the average rice farming income earned during the year is Rp6 528 887.17 818.00 or about Rp17 000 a day. By using the World Bank poverty standard that is if the income of the poor day-to-day under 2 USD or approximately Rp20 000.00, assuming 1 USD = Rp10 000.00; the farmers of rice in this area are still under the poverty line.

## 4.2. Number of Family Members

The average number of family members is 3 sample farmers. Increasing the number of members will give consequence to increased family expenditure. In addition, increasing the number of family members also allow the fragmentation of land, so the land is getting smaller and harder to achieve efficiency in rice farming. Vast rainfed areas the average farmer who owned the sample is an area of 0.72 hectares, equivalent to "*1 bahu*". The majorities of the farmers' livelihood are as farmers and farm workers, although there is trade and builder. Sense of kinship and mutual assistance in this area are still good, so that several stages of rice farming done to work together, alternately helping other farmers.

## 4.3. *Dummy* of Soil Fertility

Dummy variable of soil fertility affect significantly the level of 7%. The independent variables effect significantly in the opposite direction to the dependent variable. This indicates the increase in soil fertility will reduce the farmer's decision to convert his farm. A little number of day droughts resulting in paddy soil salinity increased. Less fertile land also led farmers provide fertilizer beyond measure. In addition, land is not flooded causing massive weed growth, thus requiring herbicides to eradicate. Dummy here means soil fertility soil fertility ever flooded and are not affected by flooding. Rainfed lowland which are located close to the river frequently flooded, which makes the soil acidic. Farmers in this area rarely use manure, they are more trusting of chemical fertilizers to address the less fertile land, though menur is very beneficial to improve soil physical and chemical properties. Besides the addition of manure, farmers also have to use drought-tolerant seed varieties. Farmers in this area have also been utilizing ground water with a simple pump system to irrigate their wetlands, while continuing to hope irrigation development be realized.

## 5. Conclusion

Government continues to run the efforts to reduce the rate of conversion of rainfed lowland; due to the importance of rainfed lowland also in the production of rice. The findings showed that the increase in the price of grain at the farm level is not enough to make the farmers not converting his farm. Government must optimize the efforts that have been made to improve the welfare of farmers, such as subsidizing agricultural inputs, working capital assistance, and mentoring, not to mention the construction of irrigation facilities. Development of irrigation facilities is also considered important to increase cropping intensity of rainfed rice. In addition, the government should also provide special incentives for farmers who still retain the rainfed lowland for rice farming.

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# The Farmer Choices in Utilizing Organic Fertilizers: Tidal Swamp Rice Farmers Case

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**Abstract.** Rice farming in the tidal wet land requires its own cultivation techniques, because soil and environmental conditions are not similar to irrigated land. Cultivation problem can causing crop and canal so damage the land and environment. The rapid changing of climate could cause the loss of production. One of way to minimize the loss was by introducing use of organic fertilizer to improve the soil fertility. This article tries to elaborate the probability of farmers to use the organic fertilizer under some factors influence in a case swamp tidal land at Banyuasin District, South Sumatera. The probability of rice farmers to use or not use organic fertilizers is affected by some aspects could be valued by binary choice model or Logit Model. The results show that the land size, experience, a ratio of fertilizer price to the price of rice were effect on the odds partially farmers use organic fertilizers. Also, education and market access influence the opportunities of farmers using organic fertilizer even not sensitive.

**Keywords:** farmer choice, organic fertilizers, rice, tidal swamp

## 1. Introduction

Intensive use of inorganic fertilizers has led to the decline in soil organic matter. This situation lowers the productivity of land. To improve land productivity in a sustainable manner required breakthroughs that lead to farm efficiency by utilizing local resource. Las *et. al.* (1999) stated that in increasing rice production needs to be done preservation of the production environment, including maintaining soil organic matter content by using organic fertilizer in cultivation. The wetland lower soil fertility which is related to its own characteristics. Cultivation problem can causing crop and canal so damage the land and environment. The rapid changing of climate could cause the loss of production. Ones of way to minimize the loss was by introducing use of organic fertilizer to improve the soil fertility.

Current level of use of organic fertilizer in Indonesia is still low. The low levels of organic matter in Indonesia is the need for organic fertilizer in large quantities. There are many farmers who do not understand the technology of organic agriculture itself. These are caused by some factors (Indraningsih et. al., 2005) namely age, experience, land size, ratio of own capital to total operational capital, market access, family number and ratio of input price. This article tries to elaborate the probability of farmers to use the organic fertilizer under some factors influence in a case swamp tidal land at Banyuasin District, South Sumatera Province.

## 2. Methodology

The research was conducted in districts Banyuasin, they are Air Saleh, Makarti Jaya, Muara Telang, Tanjung Lago, and Banyuasin I. This location was determined purposively which is production center of tidal swamp rice in South Sumatra. The data was collected from rice farmer in June 2013 to September 2013. Techniques used in Disproportionate Stratified Random Sampling (Darwan, 2000; Firdaus *et. al.*, 2008), where the population is divided into homogeneous group of rice farmers who already use organic fertilizer and rice farmers who use in organic fertilizers. Totally, there are 95 samples consist of 6 fully organic, 44 semi-organic and 45 inorganic rice farmers.

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The probability of rice farmers to use or not use organic fertilizers is affected by some aspects. It could be valued under binary choice model known as Logit Model (Gujarati, 1991) the empirical decision model in this research was:

$$K = Ln\left(\frac{P_i}{\_\_\_\_\_}\right) = \alpha - \beta_1 U + \beta_2 LL + \beta_3 Ex + \beta_4 Ed + \beta_5 JAK + \beta_6 AP + 1 - P_i\beta_7 RM - \beta_8 RH + e \quad (1)$$

where:

K = farmer decision use or not to use organic fertilizer, where 1 isdecision to use organic fertilizer and 0 is decision not use it.
U = age (year)
LL = land size (ha)
Ex = experience (year)
Ed = education (year)
JAK = Family (man)
AP = market access
RM = Capital ratio
RH = Input price ratio
e = Galat

Likelihood test was used to assess the fit of model to describe the data better. While, the influence of each independent variables to the dependent variable was tested by (t-test) at significance level of 5%.

# 3. Results and Discussion

## 3.1.The Use of Organic Fertilizer Level

Type of fertilizer used rice farmers vary. Farmers to use Solid organic fertilizer and liquid organic fertilizer (POC) and complementary liquid fertilizer (PPC). PPC usage is greater than the use of POC. The use of fertilizers to farmers is dominated by semi - organic fertilizer coop / petro , urea , SP - 36 and PPC. The use of urea fertilizer and petro fertilizers is higher than other types of fertilizers are respectively 72 percent and 19 percent. Using farmers dominated by the use of inorganic fertilizer is urea and SP - 36. Percentage of urea reached 79 percent and the SP - 36 to 21 percent of the total fertilizer used in rice farmers Banyuasin district.

Table 1. The average use of production inputs on Organic, Semi-Organic and Inorganic in Banyuasin.

| Input | Unit | Usage | | |
|---|---|---|---|---|
| | | Organic | Semi-Organic | Inorganic |
| **Fertilizer** | | | | |
| 1. Urea | kg/ha | 0 | 323,30 | 188,22 |
| 2. SP-36 | kg/ha | 0 | 40,11 | 50,56 |
| 3. POP | kg/ha | 0 | 0 | 0 |
| 4. POC | kg/ha | 6,75 | 0 | 0 |
| 5. PPC | Bottle /ha | 7,08 | 1,39 | 0 |
| 6. Coop /Petro | kg/ha | 0 | 83,18 | 0 |
| **Microorganisms** | liter/ha | 63,75 | 0 | 0 |
| **Pesticide** | | | | |
| 1. PO | Liter/ha | 85 | 0 | 0 |
| 2. Insecticide | Liter/ha | 0 | 0 | 0 |
| 3. Herbicide | Liter/ha | 0 | 1.39 | 31,44 |
| **Seed** | kg/ha | 70,83 | 34,09 | 51,44 |
| **Labor** | man /ha | 25 | 10,63 | 12,75 |
| | JOK/ha/MT | 198,33 | 85 | 102 |

Notes : POP : Organic Fertilizer Solid , POC : Liquid Organic Fertilizer , PPC : Supplementary Liquid Fertilizer , MOL: Local Microorganisms , PO : Organic Pesticides , SEAT : The Working Hours

## 3.2. The Probability of Farmer to Use Organic Fertilizer

The influence of these variables with the opportunities of farmers using organic fertilizers assessed by testing the equation logit, who was twice the value of Nagelkerke $R^2$ statistic is equal to 0459, thus it can be concluded that the ability of independent variables to explain the model is at 45.9 percent or statistical values of log-likelihood 91 365.

Table 2. Logit model coefficients opportunities rice farmers use organic fertilizers in the district Banyuasin

| No | Variable | B | S.E. | Wald | Sig. | Exp (β) |
|---|---|---|---|---|---|---|
| 1 | Age (year) | -0,005 | 0,036 | 0,021 | 0,886 | 0,995 |
| 2 | Land Size (hectare) | -1,284 | 0,456 | 7,943 | **0,005**[a] | 0,277 |
| 3 | Experience (year) | 0,065 | 0,033 | 3,823 | ***0,051***[b] | 1,067 |
| 4 | Education (year) | 0,181 | 0,113 | 2,541 | ***0,111***[c] | 1,198 |
| 5 | Family Number (man) | 0,196 | 0,255 | 0,589 | 0,443 | 1,216 |
| 6 | Market Access | 0,936 | 0,716 | 1,710 | ***0,191***[c] | 2,550 |
| 7 | Capital Ratio | 0,004 | 0,012 | 0,110 | 0,740 | 1,004 |
| 8 | Input Price Ratio | -0,065 | 0,021 | 9,949 | ***0,002***[a] | 0,937 |
| | Constant | 11,216 | 2,300 | 0,279 | 0,597 | 0,296 |

Notes: a : very obvious at the level of 1 % , significant at the level of 5 % , and significant at 15 % level

Value - the value of such statistics are presented in Table 3 shows the logistic regression coefficient (Logit), Wald, and significance tests for each variable according to the original allegation (a priori). The effect of each of these variables on the chances of farmers using organic fertilizers are described below.

Experience significant effect on the level of 1 percent. Age coefficient indicates that when other variables are assumed constant (ceteris paribus) more opportunities young inexperienced farmers use organic fertilizers 0.07 times higher than the farmers have not experienced or otherwise inexperienced farmers use organic fertilizers 0.07 times lower rate of use of organic fertilizers compared to more experienced farmers.

Extensive wetland will reduce the chances of getting farmers to use organic fertilizer by 1.28 times higher than farmers with an area of wetland is relatively narrow. The average land area of 1.64 acres of paddy farmers, where farmer organic fertilizer user average area of only 1.4 hectares lower. For farmers producing organic fertilizer independently with the materials available in the surrounding rice fields such as straw, and manure and decomposing organisms then it takes more manpower that need workers in larger numbers. The average family size rice farmers 4. Shortage of labor in the family farmers met through labor outside the family with a certain wage level. With the high level of labor costs is IDR.65.000 –IDR.70.000 per day.

Opportunities of organic fertilizer use by farmers become larger with the decrease in fertilizer prices. Increase the odds of 0.07 times higher than when fertilizer prices experienced price declines. Instead farmers use organic fertilizers chance is even greater for rice price high. Pure rice farmers using organic fertilizer is relatively small 6.32 percent , the biggest part of rice farmers using organic and inorganic fertilizers together as much as 46.32 percent , and farmers use inorganic fertilizers such as urea and pure SP -36 47.37 percent. Effective use of organic and inorganic fertilizers simultaneously deliver higher production compared to the use of organic fertilizer or inorganic fertilizer alone.

Improve educational opportunities for farmers to use organic fertilizers 0.18 times higher with the higher education rice farmers. Average rice farmer education studying for 8 years or equivalent secondary school. Pure organic farmers fertilizer users have higher education for 10 years or the equivalent of high school. Organic fertilizer application requires specific knowledge of fertilizer production process, the process of mixing different types of organic fertilizers and so on. Farmers require additional education or training.

Market access has a positive effect on increasing the chances of farmers using organic fertilizer. It means that the availability of ready-made organic fertilizer or material - material for organic fertilizer such as microorganisms on the market or stall - stall or stall - stall of agricultural inputs that are close to production centers encourage increased use of organic fertilizers by rice farmers. Market access will increase probability of farmers use organic fertilizers by 0.93 times higher when a more open market access.

## 4. Conclusion

Usage of input production specially in fertilizers were vary. The most use of organic fertilizers was Solid Organic Fertilizer (SOF), Liquid Organic Fertilizer ( LOF ) and Complementary Liquid Fertilizer ( CLF). The SOF usage is greater than the use of LOF. But, the use of Urea, Petro, SP-36 and CLF fertilizers is less.

The land size, experience, a ratio of fertilizer price to the price of rice were effect on the odds partially farmers use organic fertilizers. Also, education and market access influence the opportunities of farmers using organic fertilizer even not sensitive. It is quite different when compared with the variables that affect the chances of farmers using organic fertilizer in the district OKUT, then the variable price ratio and the number of family members had no significant effect on the chances of farmers using organic fertilizer in Banyuasin district.

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# Efficiency Technical and Economic Analysis of Tall Variety Farming at Different Tidal Land Typologies in South Sumatra Province

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**Abstract.** This research aimed to analyzethe technical and economic efficiency of tall variety farming at different tidal land typologies in Banyuasin and Ogan Komering Ilir. It was conducted by using proportionate stratified random sampling, the number of samples was 240 households of farmers. The technical efficiency used in this research wasproduction function model Cobb-Douglas type, while ratio of value of marginal product with input price was applied for economies efficiency. The results showedthatthetechnical efficiencyandprice, the use of laborand pesticides intype A area was already efficient yet the use of labors was no longer efficient and it had to be decreased. In type B area, the use of arable land and NPK fertilizer were already efficient but the labors and pesticides had not been efficient yet so they had to be improved. In type C area, the use of labors had not been efficient yet while the use of Urea fertilizer, pesticides, and the width of arable land had not been efficient yet so they had to be decreased. In type D area, the use of labors was already efficient while the use of Urea fertilizer, pesticides, and arable land had not been efficient yet so they had to be decreased.

**Keywords:** tall variety farming, tidal land, technical efficiency, economic efficiency

## 1. Introduction

Indonesia is known as a Nyiur wavingcountry, because many coconut trees are scattered throughout the archipelago, not just in coastal areas, but also in the rural area. Coconut plantation covers 3.9 million hectares, in which 3.7 million hectares is small holder. Many do not realize that coconut groves have high economical value (Raharjo, 2005). Coconut commodity in Indonesia has a very strategic role in terms of both social and cultural, foreign exchange income, source of farmers' income and employment potential and not to mention a major source of domestic oil meal (Kamaluddin, 2008).

When the national economy was contracted by 13.68 per cent, the agriculture sector has continued to grow by 6.7 percent. If the national employment fell by 2.13 percent or 6,429,530 people, the agricultural sector would be able to increase the employment capacity of 432 350 people (Sudaryanto, et al., 2002 ; BPS, 2008 ; Hariawan , 2010). This situation shows that in crisis times, the agricultural sector has high articulate capacity and is resilient in facing economics and monetary shocks. Farming system that has been developed and has long been known in Indonesia is a system of irrigated agriculture on ecosystems /lowland and upland ecosystems. While the swamp ecosystem consists of tidal wetlands and swampy marsh postscript their area is very spacious and some have been reclaimed since 20-30 years ago, has not been touched much in earnest. In addition to support the transmigration program for population expansion outside Java, the wetlands are intended to be able to expand productive agricultural land in the marsh area (Sianturi, 2010).

At the empirical level, there is still a critical issue for farmers as the main perpetrators of farm (agribusiness farming subsystem) that is the low value-added, so that the level of their income is small. This is due to the inability of capital resourcesaccess, arable land is narrow, low bargaining power, the nature and a large number of perishable products (perishable and bulky) and non-farm structure was dispersal, asymmetries, and tends to be distorted, causing transmission problems (pass through problems). While the vicious cycle of modern socio-economic phenomena occurred in capital state, technological mastery, and physical productivity is relatively high, but the income received by the farmers was small. In such conditions, farmers face a paradox of productivity, where productivity has increased but the real income

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received by farmers is small (Saragih, 2001). How was the technical and economic efficiency of tall variety in small holder plantation in the various typologies tidal land South Sumatera?

## 2. Methodology

This zoning study was purposive sampling, because it is one of the largest oil producing regions and the people managing the largest coconut plantation in South Sumatra province. The research method used was a survey (Saptawan, 2000; Sriati, 2004) and data obtained from samples sourced to represent the population (Mantra, 1998 in Yamin, 2003). Locations sampled Banyuasin regency, Sungsang district of the Sungai Semut village, and Makarti Jaya of the Pendowo Harjo village (type A), Muara Telang district of the Sumber Jaya and Marga Rahayu village (type B ), OKI regency, Air Sugihan district of the Mukti Jaya and Srijaya Baru village (type C ), then of the Kerta Mukti and Banyu Biru village (type D). Considering that the majority of the villagers are subsistence farmers of tall variety in a tidal land that is always wet type both large and small at high tide. Withdrawal sample farmers was conducted using stratified random balanced (proportionate stratified random sampling) (Bungin, 2010) with the sample to be studied samples totaling 240 farmers (10 per cent of the total population in the coconut farmers).

Analysis tool used was the Cobb Douglas production function model (Debertin, 1996), whereas the results of the regression testing of the production unction included statistical test (t-test,f-test, the coefficient of determination) and the classical assumption test (multicollinearity test, heteroscedasticity test, autocorrelation test). The efficiency of price(allocative efficiency) in coconut farming in a comparison of the value of the marginal product (NPM) and input prices (Px) (Soekartawie, 2003). The test of the efficiency of priceused $NPM_{Xi}/H_{Xi}$ with hypothesis formulation as follows :

$$NPM_{xi} = PM_{xi}.H_y = \beta_i.\frac{Y}{xi}.H_y = H_{xi}$$

Ho was $NPM_{Xi}/H_{Xi} = 1$
Hi was $NPM_{Xi}/H_{Xi} \neq 1$
When NPMXi/HXi=1, then Ho was accepted which means that the coconut farming reached the priceefficiency.
When NPMXi/HXi≠1, then Hi was accepted which means that there were two possibilities in coconut farming namely it had not reach the the efficiency of priceyet if $NPM_{Xi}/H_{Xi}>1$, or did not achieve the efficiency of priceif $NPM_{Xi}/H_{Xi}<1$.

## 3. Results and Discussion

In addition to the efficiency of the price, the analysis of technical and economical efficiency factors in the coconut production in any various types of tidal lands was also applied. The analysis showed that in type A tidal land, technically the use of production factors labor and medicine is no longer efficient pesticides (Ep<0) or is in the region of production III (irrational). On this area if labor and pesticides continue to be added, then it will reduce production so that profits will decline even negative as demonstrated in the following table.

Table 1. Results of analysis of technical efficiency and economic factors in the production of tall variety in tidal land type A

| No | Production factor | Elasticity production | Criteria |
|---|---|---|---|
| 1 | Labour | -1,452 | Inefficient |
| 2 | Urea fertilizer | 0,873 | Efficient |
| 3 | Pesticides | -4,699 | Inefficient |

The use of factors of production labor did not reach economic efficiency because it did not achieve the price and technical efficiency also its use was no longer efficient. Likewise with pesticides also did not achieve economic efficiency because efficiency has been achieved despite the price, but technically

inefficient use. Meanwhile, the use of Ureafertilizer is technically efficient(0 <Ep <1) or is in the region of production II(rational) because in this region reached the optimum level of utilization of production factors. Thus, the use of Urea fertilizer production factors achieved maximum economic efficiency or profits due to technical and price efficiency criteria turns its use already efficient.

Meanwhile, the results of the analysis of technical and economic efficiency of the factors of production tall variety in a tidal land of type B showed that technically arable land use of factors of production, labor and pesticides on tidal land were inefficient in type B (Ep<0) or is in the region of production III(irrational).At this third production area where factors of production are constantly added, then it will reduce production generated so that profits will decline even negative as shown in the following table.

Table 2. Results of analysis of technical efficiency and economic factors in the production of tall variety in tidal land type B

| No | Production factor | Elasticity production | Criteria |
|---|---|---|---|
| 1 | Arable Land | -1,124 | Inefficient |
| 2 | Labor | -0,431 | Inefficient |
| 3 | NPK fertilizer | 0,263 | Efficient |
| 4 | Pesticides | -0,362 | Inefficient |

The use of NPK fertilizer production factors are technically efficient(0 <Ep <1) or is in the region of production II(rational) because in this region reached the optimum level of utilization of production factors. Meanwhile, the use of coconut production factor in these type B land did not achieve economic efficiency, especially labor and arable land, due to technical and price efficiency turns its use is inefficient. Its use of pesticides also did not achieve economic efficiency because efficiency has been achieved despite the price, but technically inefficient in use. NPK fertilizer use efficiency has not reached because; although technically economical use is efficient but has not reached the price of efficiency.

So is the use of tall variety production facto in tidal land type C, the analysis shows that it is technically arable land use of production factors and inefficient Urea fertilizer (Ep<0) or is in the region of production III(irrational). On this area when the use of Urea fertilizer and arable land continue to be added, then it will reduce production generated so that profits will decline even negative. Urea fertilizer use did not achieve economic efficiency because efficiency has been achieved despite the price but its use is no technically efficient as shown in Table 3.

Table 3. Results analysis of technical and economic efficiency factor in the production of tall variety in tidal land type C

| No | Production factor | Elasticity production | Criteria |
|---|---|---|---|
| 1 | Arable Land | -0,414 | Inefficient |
| 2 | Labor | 0,103 | Efficient |
| 3 | Urea fertilizer | -0,548 | Inefficient |
| 4 | Pesticides | 0,190 | Efficient |

Meanwhile, the use of production factors ofarable landdid not achieve the efficiency economic because its use is technically inefficient and did not achieve the efficiency of the price. Use of production factors labor and pesticides are technically efficient (0 < Ep < 1) or is in the region of production II (rational) because in this region reached the optimum level of utilization of production factors. Thus, the use of production factors labor and pesticides achieve economic efficiency or maximum profit for technical and the efficiency of price turned out to use is efficient.

In soil type D, the results of the analysis indicate the use of factors of production is technically inefficient urea (Ep< 0) or is in the region of production III (irrational). At this third production area where

the use of Urea fertilizer continues to be added, then it will reduce production generated so that profits will decreased even be negative,the following Table 4.

Table 4. Results of analysis of technical efficiency and economic factors in the production of tall variety in the tidal land type D

| No | Production factor | Elasticity production | Criteria |
|---|---|---|---|
| 1 | Arable Land | 0,171 | Efficient |
| 2 | Labor | 0,146 | Efficient |
| 3 | Urea fertilizer | -1,322 | Inefficient |
| 4 | Pesticides | 0,863 | Efficient |

Thus, the use of Urea did not achieve the economic efficiency due to technical and the efficiency of price used apparently is no longer efficient. Technically, the use of production factors arable land, labor, pestisides and are efficient ($0 < Ep < 1$) and the production is in the region II (rational) which in this area is reached optimum level of utilization of production factors. The use of factors of production of arable land,labor dan pestisides achieve maximum economic efficiency or profits due to technical and the efficiency of priceturned out to use is efficient. The use of factors of production labor has not reached economic efficiency because although technically efficient but its use has not yet reached the price efficiency.

Addition or reduction of production factors will realize the achievement of economic efficiency in the implementation of the coconut farming. Achievement of technical efficiency does not guarantee the achievement of a high earnings in coconut farming in when not coupled with the achievement of economic efficiency. However, the achievement of technical efficiency in carrying out the important note in the coconut farming because of technical efficiency shows the ability of farmers to achieve maximum production level.

Therefore emphasis outreach activities aimed at farmers with technical efficiency score below average. When viewed from the criteria of economic efficiency apparently not all of the factors of production used in the coconut farming activities in achieving economically efficient, because the value of the MPP is still far greater than the price of factors of production /output prices, meaning that the use of factors of production can still be increased up to achieve economic efficiency.

# 4. Conclusion

## 4.1. Conclusion

In tidal area of type A and B only used efficient fertilizer production factors, in type C land and labor used pestisides efficiently, while in type D land used arable land, labor and pestisides efficiently.

## 4.2. Recommendation

1. Extension activities should be enhanced, so that the ability of farmers to manage farming activities especially for coconut crop can be better.
2. Also needs to befacilitated so that farmers can easily acquire the means of production and at economic prices, in order to reach a combined use of the means of production with a minimum price (least cost combination)

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# Labor Allocation and Leisure Time of Oil Palm Farmers on Indonesia's Wet and Dry Lands

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**Abstract.** The activities of oil palm agribusiness in Indonesia gives a pretty good odds. With conditions that favor land, where palm trees can grow well in the two typologies of land, the wet lands and dry land. The study was conducted in two districts in South Sumatra, with the characteristics of Musi Rawas regency Banyuasin dry land and wet land characteristics. Research objectives are 1) to analyze the allocation of family labor in smallholder palm oil farming activities, and 2) Calculate the potential of work and leisure time activities of smallholders in oil palm farming, other farming and non-farming in dry land and wet in South Sumatra. The results showed that the allocation of family labor farmers in wet lands greater than on dry land. On wet lands and dry land use outside labor (wage) is more widely used. Then from the calculation of free time suggests that there is still a lot of free time left. This shows that there is still a lot of good farmers in the dry lands and wet lands utilizing other activities both productive activities and other activities, especially the children who give the biggest free time.

**Keywords:** oil palm, labor allocation, leisure time

## 1. Introduction

The opportunities to develop oil palm agribusiness are opened enough for Indonesia, especially in South Sumatra province which has total area of oil palm large enough. Crops acreage and production of oil palm which is cultivated in South Sumatra have continued to increase every year. The growth and production of oil palm are influenced by many external factors as well as factors of the oil palm plant itself. In addition to the land held, the availability of labor and a very supportive climate for reaches the maximum oil palm production.

Further, oil palm plantations have promising potential, where the South Sumatra province have supported land, where palm trees can grow well in dry land and wet land. Oil palm development can provide benefits in increasing the income of farmers and communities. Oil palm farmers could have income of about 2 million to 6 million rupiahs per month per 2 hectares per family. In addition to the production of industrial raw materials that create added value in the country (South Sumatera Plantation Office, 2010).

The efforts to improve the management and performance of oil palm plantations continue to be done, considering the production and the price of fresh fruit bunches (TBS) and palm oil are still fluctuating. Internal potential of the farmers used as a foundation in improving farm productivity and farmers' income. Potential in question is a productive farmers labor, allocation and utilization of spare time can be improved both in and outside the farming of oil palm, so the farmers are not entirely dependent life from the oil palm, but also not overlook the potential of oil palm that has been earned (Lifianthi and Husin, 2012).

This opportunity allows for optimized, considering the allocation of labor to oil palm farming that has been produced not require the allocation of labor intensively, required only at certain times only, at the time of fertilization, weeding and harvesting. In connection with the allocation of labor needed for oil palm plantations are so few that there are a lot of free time owned by farmers. This free time can be used by farmers to work various jobs outside oil palm farming, thus farmers have the ability to increase household income (Zahri, 2005).

Various types of work done to meet the needs of farmers influence the allocation of household labor families both within and outside the farming. According to Hakim (2004), the number of farmers or people who devote time to work on more than one type of work due to the results of the main employment in the

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agricultural sector has not been sufficient throughout the household expenses, especially for the poor who do not master the resource than labor .

Allocation of labor households are believed to affect the total income of farmers' households. According to Zahri (2004) allocation of labor and income characterize the economic capabilities of households. Allocation of family labor, beside reflects how much the ability of farmers utilizing free time, also reflect an independent attitude and entrepreneurial farmers. If the farmers think working out of farming with wage or income level greater than the outpouring of their work on the farming will decrease and eventually they will use labor from the family. This condition will affect the amount of production costs incurred households to finance their farming.

Furthermore, according to Risza (2004), stated that the success of an oil palm plantation business is determined by the ability of farmers to manage or implement human resource management / labor, in which labor will determine the level of productivity of the farming.

Based on the above, the purposes of this research were to : 1) analyze the allocation of smallholder family labor in oil palm farming activities, and 2) Calculate the potential of work and leisure time activities of smallholders in oil palm farming, other farming and non- farming in dry and wet land in South Sumatra.

## 2. Literature Review

### 2.1. Concept of Labor Allocation

Human labor consists of men, women and children. Labor in family farming typically consist of farmers, their families and the outside labor that waged by the family who are involved in farming (Sokartawi, 2002). Furthermore, Daniel (2004) revealed that the increase in family labor will increase revenue. Allocation of labor is the division of labor time available to farmers and their families in the productive and non-productive activities. Farmer and family labor than was devoted to the business (activities) are also used to find the additional household income in the business.

According to Nakajima (1986) the households have working time outside the primary business, this suggests that the presence of a high household income (derived from farming and non-farming) will lead to better utilize their work time to relax (have fun). Low-income households, their work time more widely used for a variety of activities for the production than for the relaxed (recreation). Concept of Free Time

Unit of measure commonly used to regulate labor by Hernanto (1996) are:

a. Number of hours and days of work total. The size of the preparatory work to count all the outpouring of planting to harvest. Can use the inventory business hours (1 working day = 7 hours) too and used as the total working days (HK total). If the business consists of several branches then calculated by summing each branch are cultivated.
b. Equal number of men (Men equivalent) number of hours devoted to the whole process of production is measured by the size of the working man. This means having to use a conversion based on wages, for men in grades 1 HK men, women 0.7 HK men, cattle 2 HK, and children 0.5 HK guy.

### 2.2.Concept Leisure Time

Leisure time is often also called free time. Leisure time is a time filled with activities in which we are not in productive work time. There are many alternatives in the selection of this activity during leisure time, such as exercise, social services, and arts and cultural activities in the election tailored to the character or personality (Spillace, 2003).

Leisure time will be maximized and effective if we can spend the time to plan it as a productive time. The free time will be wasted if it used without planning. Therefore, it takes a tactic or strategy in the utilization of spare time so the time can be maximized and effective in its used (Royan, 2003).

Therefore, the efforts to utilizing spare time owned by farmers is an alternative that should be developed. Use of leisure time into work time is meant increasing the use of family labor. Use of family labor to the main business and additional business is referred as the allocation of family labor (Zahri, 2003).

According Suratiyah (2011), leisure time itself derived from the potential labor in the family minus a productive time for farming activities and outside of farming. Where the potential for employment in a year of adult men were 300 HOK, adult women were 226 HOK, and children were 144 HOK.

# 3. The Methodology and Model

## 3.1. Place and Time

The research was conducted in the area of South Sumatra, which is the region has largest production of palm oil in South Sumatra and has distinct characteristics that land in Musi Rawas regency which has the characteristics of dry land and Banyuasin district which has the characteristics of wet lands.

## 3.2. Types and Source of Data

Data collected were primary and secondary data. Primary data were collected by direct observation in the field and interviews with respondents using a questionnaire instrument. Types of primary data in the form of data required land area, production, product prices, the number of labor family and outside the family, next is the data flow for the families working time farming activities of oil and other productive activities. While the secondary data obtained from the agencies involved in this study, among others, South Sumatera Plantation Office, Central Bureau of Statistics. Secondary data were also obtained through the literature and other data sources that support this research.

The sampling method used was stratified random sampling method of the population. Total samples collected were 60 oil palm smallholders, with each region is taken as many as 30 oil palm smallholders, with samples of the following criteria:

1. Palm plantation area is 2 ha.
2. Productive life of oil palm plantations.
3. Have a side business, which is non-palm farming and off-farm activities.

Data collected activity data of oil palm business in 2009 and 2010.

## 3.3. Data Processing Method

For the purpose of research is required to answer all operational model mathematically that will be described in detail. After doing the tabulation of data, and then do the processing. To answer the first objective that is to analyze the allocation of farm family labor on oil palm farming activities, leisure and its utilization of business activities of non-oil palm farming in the drylands and wetlands in South Sumatra. Calculation of labor allocation of farmers' families from oil palm farming, non-oil palm farming and out of farming carried out using mathematical calculations (Suratiyah, 2011):

Total of work hours = JO x HK x JK ……..……..…..... (1)

$$\text{Working days} = \frac{JKtotal}{JKS} \text{ ……..} \quad (2)$$

Furthermore, to calculate working days available, then:

$$\text{Working days}_{available} = HOK_{us} + HOK_{nuw} + HOK_{lu} \text{ ….....……..…..... (3)}$$

Calculation of utilization of free time:

$$\text{Leisure time} = \text{Labor Potential} - \text{Working days}_{available} \text{ …..……..…..... (4)}$$

where:

HOK = Day of the work (work days)
JO = Number of (people)
HK = Weekday (day)
JK = Hours (hours)
JKS = Standard hours (hours), for 7 hours of farming, farming beyond 8 hours (Department of Manpower and Transmigration, 2007)
HOKus = Day of People Working on oil palm cultivation (Weekdays)
HOKnus = Day of the non-farm work in the oil palm (Weekdays)
HOKlu = Day of the off-farm work (Business Day)

# 4. Result and Discussion

## 4.1. Analysis of Plasma Farmer Labor Allocation on Dry Land and Wet Land

Based on the results of a study of a sample of farmers in dry land for oil palm farming staple show any differences with farmers example palm oil activities in wet lands. The average area of land owned by farmers each site is 2 acres.

The activities carried out are fertilizing, pest and disease control and peruningan. This activity is carried out to provide the best results for the production of oil palm FFB, where the age of oil palm plantations in two typologies of land still in the productive age of plant, plant age is between 7-15 years. In oil palm farming activities involve the entire workforce in the family which includes the labor of men, women and children. While the only non-family male and female labor. The average allocation of labor in the family at the location of dryland and wetlands can be seen in Table 1.

Table 1. Average Allocation of Labor in the Family Farmers Plasma In Oil Palm Farming Activities on Dry Land and Wet land

| No | Activity | In Family | | | Total (HOK/Th) |
|---|---|---|---|---|---|
| | | Adult Men | Adult Woman | Children | |
| 1. | **Dry Land** | | | | |
| | a. Fertilization | 6.80 | 2.52 | 0.16 | 9.48 |
| | a. Control of Pest and Plant Diseases | 5.58 | 1.08 | 0.05 | 6.71 |
| | c. *Peruningan* | 5.09 | 0.10 | 0.09 | 5.28 |
| | Total | 17.47 | 3.70 | 0.30 | 21.47 |
| 2. | **Wet Land** | | | | |
| | a. Fertilization | 7.51 | 4.87 | 1.12 | 13.50 |
| | b. Control of Pest and Plant Diseases | 4.60 | 1.96 | 1.17 | 7.73 |
| | c. *Peruningan* | 7.35 | 0.00 | 0.80 | 8.15 |
| | Total | 19.46 | 6.83 | 3.09 | 29.38 |
| | **Total** | **37.06** | **9.73** | **3.39** | **50.18** |

In Table 1 the total person-days per year in wetlands greater than dry soil, respectively 21.47 person-days per year for dry land and 29.38 person-days per year for wetlands. For fertilization activity is an activity that most people do in the wetlands, this is due to the condition of wetlands fertilization activity is often done because of waterlogged conditions resulted in the leaching of fertilizer. While dry land conditions were less frequent. More men labor poured it in all the activities of oil palm farming for dry lands HOK only 17.47 per year while at HOK wetlands 19.46 per year. Land typology condition that causes the difference in terms of treatment of oil palm plantations.

Based on Table 2 it can be seen that the farmers in the allocation of labor outside the family farmers for harvesting both on dry land and in wetlands all the harvesting is done by the labor of men and women outside the family (wage). The average use of labor outside the family was 52.19 person-days per year on dry land and 46.06 person-days per year in wetlands for men and 9.14 women per year HOK and HOK 15.60 per year. The reason why the use of non-family labor in harvesting due to be completed more quickly and TBS will not be damaged before transfer to the processing factory. Harvesting is done once every two weeks that all workers harvesting much use outside labor (wage). So still a lot of productive time that could be used for other farming activities and outside farming.

Table 2. Average Allocation of Labor Affairs Family Farmers Plasma In Palm Farming Activities on Dry Land and Wet land

| No | Activity | Out Family | | | Total (HOK/Th) |
|---|---|---|---|---|---|
| | | Adult Men | Adult Woman | Children | |
| 1 | **Dry Land** | | | | |
| | Fertilization | 1.91 | 0.00 | 0.00 | 1.91 |
| | Spraying | 1.24 | 0.00 | 0.00 | 1.24 |
| | *Peruningan* | 1.96 | 0.10 | 0.00 | 2.06 |
| | Harvesting | 52.19 | 9.14 | 0.00 | 61.33 |
| | Total | 57.30 | 9.24 | 0.00 | 66.54 |
| 2 | **Wet Land** | | | | |
| | Fertilization | 0.00 | 2.86 | 0.00 | 2.86 |
| | Control of Pest and Plant Diseases | 0.00 | 2.58 | 0.00 | 2.58 |
| | *Peruningan* | 2.52 | 0.00 | 0.00 | 2.52 |
| | Harvesting | 46.06 | 15.60 | 0.00 | 61.66 |
| | Total | 48.58 | 21.04 | 0.00 | 69.62 |
| | **Total** | **105.88** | **30.28** | **0.00** | **136.16** |

## 4.2. Potential Work and Leisure Time Plasma Oil Palm Growers

Utilization of manpower allocations on activities outside farming and farming of the potential workforce by allocating work that has been done still have the free time that actual productive can still be used. Table 3 describes the potential of working families and leisure time that is still utilized in productive activities in two typologies of land.

Seen from Table 3 that each activity is performed in two typologies dominant land doing besides oil palm farming, on dry land is rubber farming, while in wetland activities that can be done is rubber and rice breeding farm. For non-farming activities in dryland and wetland variety activities from farm laborers, shop business, motorcycle taxi drivers, merchants, officer and so on .

For dry land average weekday potential contained in the 832.72 family of farmers at HOK . Of the three productive activities is derived as much free time farmers 360.60 HOK which means that as many 360,60 person-days many farmers are still not utilizing other activities both productive activities and other activities, especially the children who give the biggest free time . By the presence of the supposed free time on dry land farmers tend to use to maintain the oil palm plantation . But in reality farmers at this location is not much use of their spare time to maintain the oil palm plantation . This proves that indeed the condition of their oil palm plantations are not properly maintained, where their palm oil plantations many weeds that grow around the palm trees. More farmers to work in rubber farming activities. Meanwhile in the wetlands there are four productive activities that they can do apparently free time available for 430.78 HOK proves that there is still a lot to do activities . Similarly, in dry land for oil palm plantation activities in just a bit . More farmers working in non- farm activities ( such as being an employee and traders ) . Should there spare time is filled with activities , where farmers seriously thinking of doing the activity is still plenty of alternatives in the choice of activities during leisure time is still available, not only alone but in non farm activities, such as social services, arts and culture.

Leisure time is not utilized to the maximum is equal to one year unemployed people, which means there is one person in the family who are unemployed (not doing productive activities). Supposed to be good farmers in dry land and in wetlands can use their spare time with productive activities to increase revenue. From Table 3 in the time spent on activities smallholder palm oil farming less than the other business activities, in two typologies of the land.

This is supported by research conducted by Zahri (2004), revealed that farmers with basic farming palm allocate manpower to manage the oil palm plantation is very little and can be categorized as the underemployment rate of plantation workers in this field is the use of labor for harvesting, sale proceeds and

maintenance of oil palm plantations so that family farmers have a lot of spare time and efforts are needed to increase the use of family labor to productive activities, such as use their spare time to work on a variety of activities outside the core business as oil palm farmers. Thus farmers have the ability to increase their household income.

Table 3. Working Potential and Leisure Time at Several Activities on Dry Land and Wet Land

| No | Activity | Allocation of Working Time (HOK/Th) | | | Total (HOK/Th) |
|---|---|---|---|---|---|
| | | Adult Men | Adult Woman | Children | |
| 1. | **Dry Land** | | | | |
| | a. Palm Cultivation | 17.60 | 2.90 | 0.30 | 21.47 |
| | b. Rubber Farm | 166,57 | 134,12 | 7.37 | 308.06 |
| | c. Non-Farm | 92.54 | 50.72 | 0.00 | 143.26 |
| | **Total** | **276,71** | **187.74** | **7.67** | **472.79** |
| | **Work Potential** | **300.00** | **226.00** | **306,72*** | **832,72** |
| | **Free Time** | **23.29** | **38.26** | **299.05** | **360.60** |
| 2. | **Wet Land** | | | | |
| | a. Palm Cultivation | 19.46 | 6.83 | 3.09 | 29.38 |
| | b. Rubber Breeding Farm | 64.51 | 32.73 | 33.69 | 130.93 |
| | c. Rice Farming | 9.31 | 5.49 | 8.80 | 23.60 |
| | d. Non-Farm | 141.41 | 85.27 | 0.00 | 226.67 |
| | **Total** | **234.69** | **130.32** | **45.58** | **410.58** |
| | **Work Potential** | **300.00** | **226.00** | **315.36*** | **841.36** |
| | **Free Time** | **65.31** | **95.68** | **269.79** | **430.78** |

Note:
Potential weekday adult men (husband): 300 HOK / year
Potential of adult women working days (Wife): 226 HOK / year
Potential weekday children: 144 HOK / year
* Potential business day x the average number of children.

## 5. Conclusion

Based on the description above it can be concluded that the allocation of family labor farmers in wetlands greater than on dry land. More fertilization activities conducted in wetlands. On wetlands and dry land use outside labor (wage) is more widely used. The activities are mostly done harvesting, where harvesting TBS must be completed quickly in order not to be damaged harvested and quickly transported to the processing factory. Time calculation results show that there are still many remaining free time. This shows that there is still a lot of good farmers in the dry lands and wetlands utilizing other activities both productive activities and other activities, especially the children who give the biggest free time. Indeed, the existing conditions revealed that farmers who have a farm staple palm allocate manpower to manage the oil palm is still very little. Though if farmers can take advantage of free time to work on a variety of productive activities will be able to contribute to their income.

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# The Economic Behavior of Rubber Farm Household in term of Achieving of Their Family Food Security in Musi Banyuasin Regency, South Sumatra Province, Indonesia

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**Abstract.** A study aims to analyze the determinant factors of rubber farm household economic behavior through some productive activities to fulfill their family needs and to achive their family food security in Musi Banyuasin Regency, South Sumatera. This research used cross section data, analyzed by descriptive and econometric analysis. The estimation of econometric model (the simultaneous equation) used two stage least squares (2SLS) method. The result of this study , most respondents have some income sources (rubber farm, non-rubber farm and off farm activities), where the rubber farm income is the main source. The average rubber production is relatively lower (1.87 tons/ha/year) than the national average production (2.50 tons/ha/year), but higher than province average production (1.40 tons/ha/year). The rubber farm household income is around Rp38.223.million (US $3,940.50) per year (rubber area is around 2.9 hectares/ farm household). This income give the highest contribution (62%) to total farm household, is equal to their working time allocation (63%). Mostly, the family income (Rp61.45 million) are higher than the family expenditure for consumption (Rp41.91 million), so that the farm households can fulfill their primary needs, especially for food consumption (38.54%), non food consumption (37.49%) and the rest income for saving. Estimation result of simultaneous equation has been proved that the economic behavior of rubber farm households (in working time allocation, production and consumption) are interact each other. These relationships indicated also by high response (elastics) among variables of economic activities. The behavior of farm household working time allocation are affected by rubber farm area, non rubber-farm area, rubber farm income and non farm income. The behavior of farm household production is influenced by the working time allocation of family labor on rubber and non-rubber farm, rubber production cost. The behavior of farm household consumption (for food) is affected by total income and the number of farm household member, whereas the behavior of farm household consumption (for non food) is affected by total income and the production cost for rubber and non-rubber farm.

**Keywords:** economic behavior, household, rubber farm, food security

## 1. Introduction

The agricultural sector in developing countries (including Indonesia), will always regard three characteristics, namely (1) agricultural production technology, (2) the farm household as a single economic unit, and (3) agricultural products as commodities [6]. Farm household is an important aspect to be studied considering the majority of agricultural products in Indonesia contributed by their activities. In reality, there are many complex problems in farm household, their behavior can be divided into three main groups, namely as producer, labour supply and as a consumer. The rubber farm household income can be from multiple sources, depending on the season and occasion. In 2011, Musi Banyuasin Regency is the third largest rubber area in South Sumatera Province (13,80%) and the number of farmers involved are about 82,000 households, however the rubber productivity is the lowest in this province (0.95 tons/hectare) (Plantation Agency, 2012). Perwitasari (2012) found that rubber farm income contribution in this area is the hghest (65.81%), the rest income proportion from non rubber farm and non farm income. The research result in the same province but different area (Prabumulih) showed that the rubber farm income also has the highest and big proportion (95,31%) by allocating more than 75 pecents of family working time (Anggraini, 2010; Husin and Wulansari, 2011). However, generally the rubber farm household in South Sumatera have several kinds of productive activities to support their family income, that is non-rubber farm (such as paddy, fish, horticultural) and non-farm (driver, trader, farm worker) activities. They are not only to fulfill their primary needs, but also their secondary needs and investment.

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Several studies had been done related to this topic, whether conducted by the researcher herself or by other researchers. Activities of farm households are one unit as producer and as a consumer, especially when they will interact with the labor market [2 and 6]. Study about the farm household economic behavior had been done for several commodities in Indonesia such as for oil palm [3], for food crops [8 and 5], and for rubber farm [1]. Most of these studies concluded that the family labor supply, production and consumption were interact each other (non recursive), but another study found that those activities were separable (*recursive)* [8]. Therefore, this study is to analyze how the family members allocate their working time to several kinds of productive activities, how much each productive activity contribute to their family income, and how their income can fulfill their family's needs (for food, non food consumption and investment), and what factors that influence the farm household behavior.

## 2. Methodology

This study used the cross section data of 2012, represented by 80 rubber farm households (5.15%) as respondents, from two villages in Musi Banyuasin, South Sumatera. This study used descriptive (by mathematical tabulation) and econometric analysis (simultaneous equation). The identification process proved that this model is over identified so that Two Stage Least Squares (2SLS) method can be applied [4]. Data processing performed by SAS computer program. The analysis of economic behavior is derived from the concept of consumer's utility maximizing, as follow:

$$\text{Max } U = u(X_a, X_m, X_l) \quad \ldots\ldots(1)$$

$$\text{Subject to: } P_m X_m + P_a X_a + W X_l = S \quad \ldots\ldots(2)$$

Then the Lagrange function can be:

$$L = u(X_a, X_m, X_l) - \lambda (P_m X_m + P_a X_a + W X_l - S) \quad \ldots\ldots(3)$$

First Derivative of L-function can be found the first order condition (FOC):

$$L_a = \partial U / \partial X_a - \lambda P_a = 0 \text{ atau } U_a = \lambda P_a \quad \ldots\ldots(4)$$

$$L_m = \partial U / \partial X_m - \lambda P_m = 0 \text{ atau } U_m = \lambda P_m \quad \ldots\ldots(5)$$

$$L_l = \partial U / \partial X_l - \lambda W = 0 \text{ atau } U_l = \lambda P_l \quad \ldots\ldots(6)$$

$$L_\lambda = -(P_m X_m + P_a X_a + W X_l - S) = 0 \quad \ldots\ldots(7)$$

$$\text{or } P_m X_m + P_a X_a + W X_l = S \quad \ldots\ldots(8)$$

Next, by using the equation system, will be found the consumer demand's for good and service

$$X_i = f(P_a, P_m, W, S), \text{ untuk } i = a, m, l. \quad \ldots\ldots(9)$$

In case of rubber farm household, the income determined by family productive activities, and it will influence their full income (S), then change their consumer behavior through demand or the consumption ($X_a, X_m, X_l$). The consumer behavior will be influenced by production behavior through their income. By doing several times of model re specification, we estimate the rubber farm household's economic behavior model by using the system equation (consists of 12 structural and 8 identity equations). These equations are the allocation of the family working time (husband and wife in those productive activities), production and income (from rubber farm, non-rubber farm and non farm), consumption (food and non food) and saving.

## 3. Results and Discussion

The farm households in this regency have 1 to 6 hectares of farm area, the average for rubber farm is around 2.9 ha and for non-rubber farm is 1.45 ha, where the rubber farm is a primary activity. The farmers (78%) are in productive age, the most in 40 to 56 years olds. The most formal education are secondary school level for wives and high school for husbands. There are 4 family members on average. Around 63 percents of family member working time (husband and wife) allocated for rubber farming, and the rest working allocated equally for non-rubber farming (paddy or fish cultivation) and for off farm activities. The rubber productivity in this area (1.87 tons/ha) is higher than the average rubber productivity in South

Sumatera (1.46 tons/ha). The total family income are Rp 61.45 millions per year, the highest contribution (62.21%) from rubber income (Rp38.22 millions per year) or Rp 3.19 millions per month.

The rubber farm househod allocate the family income for their need almost equally, that is food consumption (33.89%), non food consumption (33.81%) and for investment or saving (32.30%). This finding is supported by *the Engel's Law*, where the part of income used for food spending tends to decline when income increases. In other words, the higher income households will spend a smaller part of their income for food consumption [7].

The household working time behavior is affected by rubber farm area, non-rubber farm area, rubber farm income and off farm income. The rubber and non rubber production are influenced by the number of family working time and rubber production cost. The farm household consumption behaviors are affected by total income and the number of family member. This result indicates that the farm household economic behavior will influence each other through their endogenous variables (*non-recursive behavior*). Therefore every decision in their productive activities has to consider other activities, in term of making income to fulfill their family's need and increase their welfare. The Estimation of economic behavior model of rubber farm household in this area is presented in Appendix A.

## 4. Conclusion

Based on the study, there are some sources of family income (rubber farm, non rubber farm and off farm). The highest portion of working time for rubber farm, therefore it gives the highest contribution to total income (around 62%). Mostly, the family income are higher than their expenditure, so they can fulfill their family needs or expenditure (for food, non food consumptions) and investment in almost equal share. Estimation of simultaneous equation has proved that the behavior of family labor supply (working time on productive activities), production and consumption/expenditure are interact each other, so that one decision will influence the others. The rubber farm household in this area have made accurate decision, where they do not rely merely on rubber farm income due to the unpredicted rubber price and low bargaining position in determining the product price. In order to develop their rubber farm as a competitive commodity, any government intervention (policy) should consider the rubber farm household as a complex economic behavior like the result of this study.

## 5. Acknowledgements

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## APPENDIX A

A 1. Equation Estimation of Working Time on Rubber Farm

| | Variable | Coefficients | t-test | Probability | Elastisity | |
|---|---|---|---|---|---|---|
| Men | Intercept | 1,565 | 7,107 | 0,0001 | - | F-test = 5,170 |
| | Man Labor for Non Rubber | -0.610 | -2,232 | 0,0286 | 0.193 | $R^2$= 0,22 |
| | Man Labor for Off-Farm | -0,500 | -2,186 | 0,0320 | -0.097 | |
| | Total Income | -0,000003 | -0,542 | 0,5896 | 0.089 | |
| | Rubber Farm Area | 112,497 | 1,381 | 0,1715 | 0.237 | |
| Women | Intercept | 1.249,932 | 9,847 | 0,0001 | - | F-test = 8,786 |
| | Woman Labor for Non Rubber | -0,274 | -1,333 | 0,187 | -0,08 | $R^2$ = 0.372 |
| | Woman Labor for Off-farm | -0,6 | -4,462 | 0,0001 | -0,14 | |
| | Total Income | -0,000006 | -1,397 | 0,167 | -0,20 | |
| | Rubber Farm Area | 156,3510 | 2,605 | 0,0111 | 0,38 | |
| | The number of Small Children | -88,975 | -1,324 | 0,186 | -0,00 | |

A 2. Equation Estimation of Working Time on Non Rubber Farm

| | Variable | Coefficients | t-test | Probability | Elastisity | |
|---|---|---|---|---|---|---|
| Men | Intercept | 286,185 | 1,371 | 0,175 | - | F-test =24,044 |
| | Man Labor for Rubber | 0,063 | 0,485 | 0,629 | 0,198 | $R^2$ = 0,619 |
| | Man Labor for Non Rubber | -0,311 | -2,967 | 0,004 | -0,191 | |
| | Non Rubber Income | -0,00001 | -3,273 | 0,002 | -0,278 | |
| | Rubber Farm Area | -22,540 | -1,383 | 0,171 | -0,151 | |
| | Non Rubber Farm Area | 205,385 | 5,052 | 0,0001 | 0,763 | |
| Women | Intercept | 1.211,06 | 1,817 | 0,073 | - | F-test = 2,020 |
| | Woman Labor for Rubber | -0,739 | -1,348 | 0,182 | -2,466 | $R^2$ = 0.142 |
| | Woman Labor for Off-farm | -0,438 | -1,965 | 0,053 | -0,615 | |
| | Non Rubber Income | -0,00002 | -1,996 | 0,050 | -0,630 | |
| | Rubber Farm Area | 33,045 | 0,602 | 0,549 | 0,269 | |
| | Non Rubber Farm Area | 232,289 | 2,423 | 0,018 | 1,053 | |
| | The number of small children | -42,161 | -0,358 | 0,721 | -0,015 | |

A 3. Equation Estimation of Working Time on Off- Farm

| | Variable | Coefficients | t-test | Probability | Elastisity | |
|---|---|---|---|---|---|---|
| Men | Intercept | 701,473 | 1,709 | 0,096 | - | F-test = 7,005 |
| | Man Labor for Rubber | -0,095 | -0,341 | 0,734 | -0,49 | $R^2$ = 0.27 |
| | Man Labor for non rubber | -0,65 | -2,693 | 0,009 | -1,06 | |
| | Off Farm Income | 0,00001 | 2,119 | 0,037 | 0,26 | |
| | Farm Area | -31,26 | -0,820 | 0,415 | -0,34 | |
| Women | Intercept | 1.959,78 | 2,354 | 0,021 | | F-test= 11,32 |
| | Woman Labor for Rubber | -1,40 | -2,054 | 0,044 | -7.261 | $R^2$ = 0. 43 |
| | Woman labor for non rubber | -0,60 | -1,386 | 0,17 | -1.452 | |
| | Off farm Income | 0,000015 | 1,418 | 0,16 | 8.792 | |
| | Rubber Farm Area | 109,09 | 1,685 | 0,10 | 0.384 | |
| | The number of small children | -15,02 | -0,100 | 0,92 | 0.442 | |

A 4. Equation Estimation of Production of Rubber and Non Rubber Farm

| Type of Farm | Variable | Coefficients | t-test | Probability | Elastisity | |
|---|---|---|---|---|---|---|
| Rubber | Intercept | 558,125 | 1,806 | 0,28 | - | F-test =329,92 |
| | Family Labor for Rubber | -0,257 | -1,148 | 0,25 | -0,12 | R2 = 0.95 |
| | Cost for Rubber | 0,00001 | 1,284 | 0,20 | 0,046 | |
| | Rubber Farm Area | 1.858 | 18,605 | 0,00 | 0,99 | |
| | Family labor for non rubber | -0,23 | -0,837 | 0,40 | -0,03 | |
| | Non rubber income | 0,035 | 0,496 | 0,62 | 0,01 | |
| Non Rubber | Intercept | 93,12 | 0,63 | 0,53 | - | F-test =316,08 |
| | Family labor for non rubber | -0,14 | -0,80 | 0,43 | -0,07 | $R^2$ = 0,94 |
| | Cost for non Rubber | 0,00003 | 1,50 | 0,14 | 0,06 | |
| | Non Rubber Farm Area | 1059,50 | 15,99 | 0,00 | 1,02 | |
| | Rubber production | -0,020 | -1,19 | 0,24 | -0,06 | |

A 5. Equation Estimation of Productivity of Rubber Farm

| | Variable | Coefficients | t-test | Probability | Elastisity | |
|---|---|---|---|---|---|---|
| | Intercept | 1.857,23 | 23,438 | 0,0001 | - | F-test =26,059 |
| | Rubber Production | 0,42 | 8,649 | 0,0001 | 1,23 | $R^2$ = 0.58 |
| | Rubber Farm Area | -803,010 | -8,384 | 0,0001 | -1,25 | |
| | Family Labor for Rubber | 0,03 | 0,938 | 0,3511 | 0,05 | |
| | Family Labor for Rubber | -0,06 | -2,023 | 0,0467 | -0,02 | |

A 6. Equation Estimation of Expendiutre for Consumption and Saving

| | Variable | Coefficients | t-test | Probability | Elastisity | |
|---|---|---|---|---|---|---|
| for Food | Intercept | 7575748 | 2,700 | 0,01 | - | F-test =15,904 |
| | Family Income | 0,09 | 2,915 | 0,03 | 0,25 | $R^2$ = 0,46 |
| | Non food consumption | 0,10 | 1,040 | 0,30 | 0,10 | |
| | Family Labor for Rubber | 238,57 | 0,228 | 0,82 | 0,03 | |
| | Number of family member | 1153181 | 3,335 | 0,00 | 0,25 | |
| for Non Food | Intercept | 397186 | 0,109 | 0,91 | - | F-test = 51,29 |
| | Family Income | 0,7699 | 6,772 | 0,00 | 2,07 | $R^2$ = 0,81 |
| | Food Consumption | -0,6082 | -1,505 | 0,14 | -0,06 | |
| | Family Member | -503963 | -0,894 | 0,37 | -0,11 | |
| | Cost for Rubber | 0,1134 | 2,249 | 0,03 | 0,11 | |
| | Cost for Non Rubber | 0,4703 | 2,655 | 0,01 | 0,01 | |
| | Family Saving | -0,8378 | -4,504 | 0,00 | -0,26 | |
| Saving | Intercept | 6257799 | 1,231 | 0,22 | - | F-test = 31,52 |
| | Family Income | 0,51 | 6,821 | 0,00 | 2,09 | $R^2$ = 0,68 |
| | Food Consumption | -0,78 | -1,537 | 0,13 | -1,18 | |
| | Family Member | -974369 | -1,143 | 0,26 | -0,32 | |
| | Rubber area | 786550 | 0,927 | 0,36 | 0,17 | |
| | Non Rubber Area | -1801990 | -2,650 | 0,01 | -0,21 | |

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# The Comparative Analysis of Production and Consumption Behavior of Rice Farmer Households Based on Land Typology and Capital Resources

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**Abstract.** The purpose of this research was to analyze differences in rice production and consumption behavior of rice farmers households with different capital sources on irrigated land and rainfed areas in South Sumatra province. A total of 80 respondents selected randomly. Data collected and processed with descriptive statistics and described in tabulation. The results showed that the average of irrigated rice production is higher than the rainfed rice production. The average production of rice farmers with its own capital is higher than farmers with loans and shared equity capital. The consumption of rice farmers household in irrigated rice with their own capital is lower than households with loans and shared equity capital. Similarly, when compared with the average consumption of rice farmers household with their own capital in rainfed land. Rice farmers household's food expenditure in rainfed land is higher than farmers household in irrigated land.

**Keywords:** irrigated land, rainfed land, rice production, rice consumption behavior

## 1. Background

Agriculture is a important segment for the development of Indonesia, has a dependency on the climate and weather conditions. Climate change is a real threat and a challenge of the agricultural sector in maintaining the sustainability of food production. A shift of the season, will affect the planning of agricultural activities, so the planting schedule will be disrupted which was resulting production declined and even crop failure, which will further threaten food security.

One of the main problem of our nation in the future is how to ensure the availability of adequate food for all people. By 2015 the population will reach 255 million people, with a consumption rate 135 kg/capita/year we need rice 38.49 million tons/year. To produce that much rice we need the harvested area 13.38 million hectares. Though the available harvest area only 12.65 million hectares, 0.73 million hectares that deficit (Central Food Security Council, 2013).

Based on the results of Soepardi's research (1996); Mulyana (1998); Purnamawati and Purnomo (2007), that as food, rice production is the most basical consumer goods of Indonesian people. Further, stated by Mulyana (2008) that, as the majority of the staple food of Indonesian people, rice commodity was instrumental until nowdays, therefore, generally has not significantly replaced by alternative commodities, such as cassava, sweet potato, and corn sourced of production of the farmers itself, or from imports, such as wheat that processed into instant noodles. Rice is the staple food for the people of Indonesia that provides high energy and nutrients. Role of rice, in addition as a staple food source is also a source of income for farmers and the needs of everyday life for millions of people.

Problems encountered in farming by Syukuriwantoro (2009) is limited farmers' access to capital and high interest rates on farming. Most of farmers do not have enough capital. Accessibility of farmers to the capital resources are still very limited, especially for rice farmers who control a narrow area which is the largest communities of rural communities.

South Sumatra, as one of the National Food Barn Province, has a range of typologies of agricultural land area of 5,524,725 hectares, or about 70 percent of the total land area, including rainfed land, tidal land, swampy lowlands, and lands with technical irrigation. In relation with the ownership status of arable land, in South Sumatra generally, there are variations in the status of ownership of arable land. Some farmers who

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have land worked on their own rice fields (owner and tiller). In addition there are farmers who work in the land owned by someone else, and the relationship between the owner of the tillers could be profit-sharing and leasing to provide a sum of money or in kind (eg, grain) in each growing season.

Rice-producing areas in South Sumatra include the Ogan Komering Ilir and Musi Rawas. Ogan Komering Ilir regency represent typologies of rainfed areas, while the Musi Rawas represent typologies of irrigated land. The purposes of this research were: (1) analyze the differences in the rice production in irrigated and rainfed areas in South Sumatra Province, and (2) analyze the consumption behavior of rice farmers household in the typology of irrigated land and rainfed areas of South Sumatra.

## 2 . Literature Reviews

Farmers households is a mixture of activities, namely as a company because it has a production activity, and as a consumer because there are consumed (Yamin, 2003). Furthermore BPS (2005) stated that the household is a person or group of people who stay in a building and usually live together under one roof, eat in one kitchen in the relation of economic, social and cultural. In economic theory of the household is assumed to act rationally in allocating resources and consume goods and services. Therefore be regarded as household economic unit that has the goal to fulfillment by utilizing a number of resources availability. Kusnadi's study results (2005), in a household objectives is to maximize utility by utilizing a number of resources.

Broadly speaking household needs can be grouped into two major categories, namely food and non-food needs. This means that, at a certain income level households will allocate income to meet both these needs. Naturally, quantity of food needed for someone will reach saturation point while the non-food needs including food quality is not constrained in the same way. Thus the amount of income proxied by total expenditure spent on food of a household can be used as a guideline level of prosperity of the household or in other words, the higher share of food expenditure, means the less prosperous households concerned. Conversely, the smaller share of the household food expenditure is increasingly prosperous (Purwantini and Ariani, 2008), or households with a high share of food expenditure by households belonging to the low level of well-being compared with the proportion of households with low food expenditure (BPS, 1996; BPS, 2009; Rachman and Supriyati, 2004).

Consumption and expenditure patterns generally differ between agroecosystems, between income groups, ethnic or inter-ethnic and inter-temporal (Arifin and Simatupang, 1988; Suryana et al, 1988 and Rahman and Wahida, 1998). People's food consumption behavior based on the eating habits that grow and thrive in a family environment through a process of socialization. Eating habits can be influenced by the ecological environment (characteristic of crops, livestock and fish are available and can be local cultivated), cultural environment and economic systems. In the central areas of rice production is assumed to land use and the use of the technology involved, as a result there are differences that will affect the level and type of rice consumption.

## 3. Method

The research method used was a survey of Rice Farmers Household in the village of Suko Mulyo and Nawang Sari Tugumulyo sub-district Musi Rawas regency and village of Lubuk Makmur and Muara Bunai I Lempuing Jaya sub-district Ogan Komering Ilir regency. The village conducted by consider that the village can represent land owned by farmers and tillers population, as well as the diversity of sources of capital owned by farmers (own capital, loan capital, and the shared capital). Sample as 80 households collected by simple random sampling. Primary data through interviews with the help of questionnaires, while secondary data obtained from the literature such as reports from various departments, relevant agencies as well as the results of previous studies of a variety of educational and research institutions. Data processing was conducted by descriptive statistics and described in the tabulation.

# 4. Results and Discussion

## 4.1. Characteristics of Farmers

The results showed that the average age of farmers is still relatively productive age. Farmers in the irrigated land with its own capital, loan capital, and capital shared around 41-47 years old. Similarly, farmers in rainfed land, the average age of farmers is 44,5 years. At this age a person will work optimally in farming because he can contribute a more effective workforce. Judging from the formal education of farmers, both in irrigated and rainfed land, the level of education has not been so good. The average farmer only formal education for six to eight years. However, when seen from the experience of trying to farm, the average farmer had been long enough rice farming activities, which ranged from 11 to 22 years in irrigated land, and for 20 years in the rainfed. Considerable farming experience is expected to have a positive impact, more farmers get lesson of farming so the motivation to improve production and quality can be built and produce better. Number of members of peasant households in both types of land and capital resources owned by no difference, which ranges from three to four people.

## 4.2 . Rice Production

There is a vast cultivated difference between rice farmers on the typology of irrigated land and rainfed land. Similarly, farmers with their own capital, loan capital, and the shared capital. The average area of land cultivated for irrigated farmers with their own capital were greater than farmers with loans and shared equity capital. Similarly, the average area of cultivated land farmers capital owner in irrigated were greater than the farmers in the rainfed (Table 1).

Table 1. Average Land Area (Hectares) Rice Farming based on Typology and Resources capital

| No | Land Typology | Capital Resources | | |
|---|---|---|---|---|
| | | Own Capital | Loan Capital | Shared Capital |
| 1 | Irrigated | 0,93 | 0,62 | 0,5 |
| 2 | Rainfed | 0,84 | | |

Table 2 explain that the ratio between rice production per hectare of irrigated and rainfed rice fields showed that the average production of irrigated land is higher than rainfed land. This is caused by the irrigated rice get a good watering and regular than the rainfed rice. Besides rice seeds used in the average irrigated seed that is recommended, ie Ciherang or IR 64. Use of improved seed is dominated by farmers on irrigated typology makes the quantity and quality of rice produced better than in the typology of rainfed land. In addition, the typology of irrigated land, most farmers have been using fertilizer as recommended, instead of rice farmers in the rainfed typology did not use fertilizer as recommended yet.

Table 2 . Rice Production (MPD) based on Typology of Land and Capital Resources

| No | Land Typology | Capital Resources | | |
|---|---|---|---|---|
| | | Own Capital | Loan Capital | Shared Capital |
| 1 | Irrigated | 6,102 | 5,494 | 1,144 |
| 2 | Rainfed | 4.737 | - | - |

## 4.3. Household Food Consumption Behavior Farmers

Food consumption behavior of rice farmers households in this study reflected on the many rice consumed, percentage of rice stored and sold, and the amount of expenditure on food and non-food, Table 3 shows that there is a difference between the amount of rice consumed by rice farmers households in irrigated and tides. Similarly, among rice farmers households that have their own capital, loans and shared equity capital. Rice farmers household in irrigated land with their own capital consumed the rice lower than rice farmers household with loans and shared equity capital. However, when compared to the average consumption of rice farmers households own capital on the typology of irrigated with rainfed, the average

rice farmers household consumption of rice farmers with their own capital in the rainfed higher, as many as 120 kg per capita.

Table 3. Average Rice Consumed based on Typology of Land and Capital Resources

| No | Land Typology | Capital Resources | | |
|---|---|---|---|---|
| | | Own Capital | Loan Capital | Shared Capital |
| 1 | Irrigated | 392 kg/RTP or 98 kg/capita | 335,71 kg/RTP or 111,9 kg/capita | 360 kg/RTP or 90 kg/capita |
| 2 | Rainfed | 480 kg/RTP or 120 kg/capita | - | - |

The results also showed that the farmers in the area who observed the second typology, there is the phenomenon that a percentage of the amount of rice sold is greater than the stored rice. The average rice sold by the rice farmer households in irrigated land ranged from 71 percent to 83 percent, while rice farmers households in the rainfed land average of 75 percent.

Table 4. Average Farmers Household Food Expenditure based on Typology of Land and Capital Resources (Rp/Month)

| No | Land Typology | Capital Resources | | |
|---|---|---|---|---|
| | | Own Capital | Loan Capital | Shared Capital |
| 1 | Irrigated | 849,455 | 723,625 | 770.000 |
| 2 | Rainfed | 947,733 | - | - |

Consumption behavior seen of farmers household expenditure on food needs showed that farmers household food expenditure in rainfed land is higher than farmers household food expenditure in irrigated land. Similarly, when viewed from the source of capital ownership. This is consistent with research showing that rice farmers household consumption in the rainfed land has the highest number.

## 5. Conclusion

1. Average irrigated rice production is higher than the rainfed rice production. The average production of rice farmers with its own capital is higher than farmers with loans and shared equity capital.
2. Rice farmers household in irrigated rice with their own capital consumed rice lower than rice farmers households with loans and shared equity capital. Similarly, when compared with the average rice consumption of rice farmers household with their own capital in rainfed land.
3. The average rice sold by the rice farmer households in irrigated land ranged from 71 percent to 83 percent, while households in the rainfed land average of 75 percent.
4. Farmers household food expenditure in rainfed land is higher than farmers household food expenditure in irrigated land.

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# Coastal Sand Soils and Their Assessment for Upland Rice Cultivation in Terengganu, Malaysia

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**Abstract.** The research aimed to study coastal sand soils and to analyze their assessment for upland rice cultivation in Terengganu, Malaysia. Research sampling was conducted based on the soil series of the research area, i.e. Baging, Rhu Tapai, Rudua and Jambu. The works were divided into two steps, field survey activities and laboratory work. The research results showed that the BRIS soil series are occurring side by side which relate the coexistence of beach terraces running parallel in different elevation to the seashore lines and the main BRIS soil series are Baging, Rhu Tapai, Rudua and Jambu. Soil fertility status of soil series are classified as very low to low, except Base Saturation because the soils are strongly influenced by sea movement. The soil suitability was **S3-twrne** for Baging and Rhu Tapai**,S3-twrnx** for Rudua, and **S3-twrn** for Jambu with the soil productivity of around < 1, 1-2 and 2-3 tons dried paddy per ha per year respectively. The needed efforts to improve soil capability from actual to potential soil suitability for upland rice cultivation are i.e. cover the soils with mulch, make sprinkle irrigation, make dam for water holding and retention, give and maintain organic matters in the soils and do not burn biomass, fertilize soils with NPK and organic fertilizers, do wash elements of Na and H and break down sallow spodic horizons, make terraces and mix mineral subsoils to BRIS soil to improve CEC.

**Keywords:** Coastal sand soils, physical assessment, upland rice, Terengganu

## 1. Background

Sand soils or BRIS (*Beach Ridges Interspersed with Swales*) soils in Peninsular Malaysia are mostly found near the coastal area in Terengganu with area of 67,582.61 ha, in Pahang around 36,017.17 ha, and in Kelantan about 17,806.20 ha. The soils are originated from sediment and located in places as diverse as along the coastal area and inland dominated by sand fraction. The coarse sand is from the sea that accumulated from the erosion of layers of steep cliffs by the sea during the monsoon seasons [1]. The soils are regarded as marginal soils. There is little progress made on the rehabilitation and revitalization of the BRIS soils without knowing their capability and suitability. MARDI has promoted to cultivate tobacco, upland rice and potatoes as well as Roselle. Allworksare successfullymanaged with very high investment and intensive capitals only for specific areas and its technology is difficult and still questionable to transfer to other BRIS soils.

## 2. Literature Review

Due to increase in population density and/or economic necessity, some people in Terengganucultivate upland rice on the BRIS soils, in addition to cultivating lowland rice in small valleys. Therefore, there is a necessity to determine the soil suitability based on a scientific analysis in order to ensure the long-term sustainability of the rice production on BRIS soils.

The main problems developed in the BRIS soils till today are follows, i.e. capability and suitability of the soils is not really known, changes in soil character is difficult to be estimated and managed as well as their limiting factors of soil suitabilityin detail is also unknown. Thus, we do not know which area is suitable for any particular crop until presently, these questions are still unanswerable, and thus the land remains with low production [2]. Therefore, this study aims to evaluate the soil fertility status of the dry coastal sand soils and

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to identify the main limiting factors for upland rice; increase farmer understanding of soil characteristics and fertility of their fields for better upland rice; and facilitate farmer adoption of soil amelioration practices and soil environmental protection.

Soil suitability for upland rice production prepared for the Terengganu area is basically focused on the relationship of rice yield with various parameters as follows; to find out relationship between rice yield and elevation, to investigate relationship between rice yield and soil aspect, to analyze the relationship between rice yield and slope, and to determine relationship between rice yield and use of fertilizer. The final output is a soil suitability of favorablesoils for good yield of rice in Terengganu.

## 3. Method

This study was conducted in Merang and its surrounding, Terengganu, Malaysia. The selected research location is based on drainage classes and spodic horizon depth, i.e. soil series of Baging, Rhu Tapai, Rudua and Jambu. The four soil series of terraces running parallel to the coastal lines were intensively observed. Pointing the sampling location was helped by the topography map of Peninsular Malaysia with map scale of 1:50,000. The soil profiles were intensively described [3] and classified according to soil taxonomy [4]. Composite soil samples were taken after completing soil profile descriptions and then analyzed in the laboratory. Soil color was determined using Munsell Soil Color Chart while bulk density was determined according to Sparks [5]. Particle-size analysis was analyzed by using hydrometer method. Weathering indices was determined according to silt/clay ratio, chemical analysis (organic carbon, soil pH, total nitrogen, CEC and exchangeable cations) were determined according to Sparks [5].

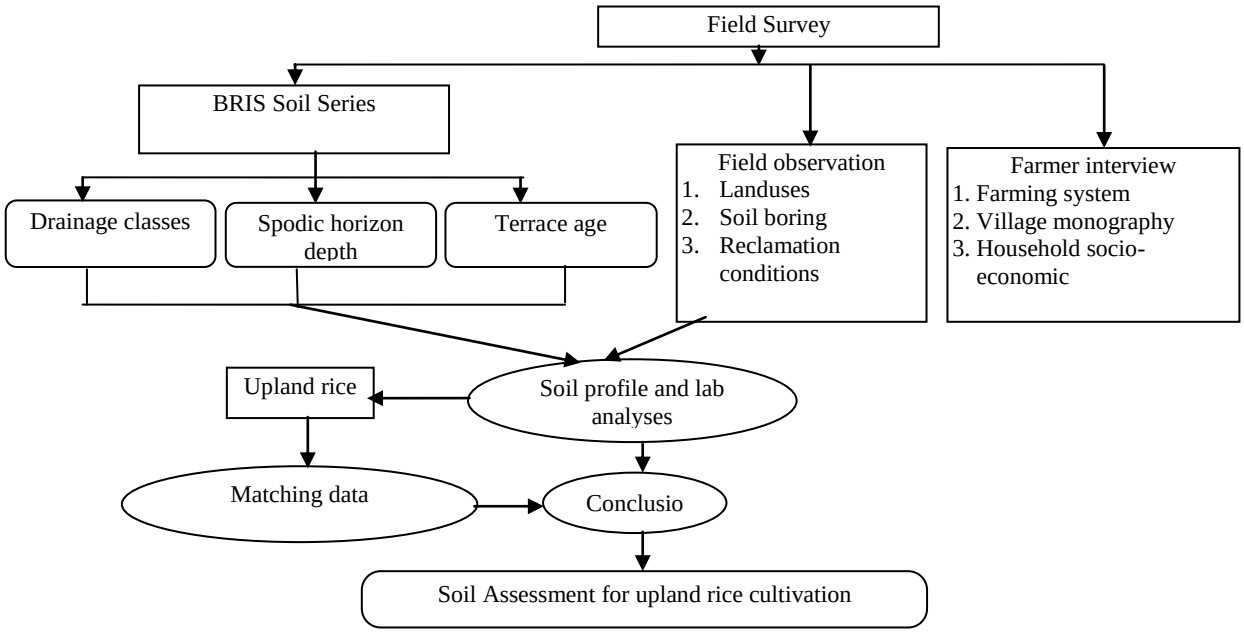


Fig. 1: Flowchart of field activities and data analysis

## 4. Result and Discussion

### 4.1. Climate, Geomorphology and Geology of Merang

The Merang is located about 30 km to the north of Kuala Terengganu and in the District of Setiu in the central section of Terengganu state and mostly dominated by the long coastline. Research location (Kampung Merang) is sited geographically at **Longitude:** 102° 53' 06" E and **Latitude:**5° 31' 44" N. Merang in the northern part is bordered with South China Sea, in the southern with the Batu Rakit, in the eastern with the South China Sea, while in the western part with the Permaisuri city and Ulu Chalok.

Merang is characterized by uniformly high temperature and the annual rainfall is above 2,500 mm. The moisture regime of the well drained areas is either udic or perudic. The slight variation in climate may have

some influence on the genesis of the soils. The temperature in the soil can be as high as 45 °C during the afternoon of a hot day. The research area is continually affected by the forces of the monsoon. Due to the high rainfall and temperature coupled with the sandy nature of the parent materials, the process of leaching and eluviations in the soils are assumed to be very active.

The natural vegetation in the study area and its surrounding is short shrub, grass (*Zoysia matrala*) and casuarina species (*Casuarina equisetifolia*). These low nutrients demanding plant species could have provided organic materials, but the humus is very acid and cannot produce soil humus especially in the topsoil, because this acidic humus is not able to support high biological activities in the BRIS soils.

The deposits of ridges (or terraces) consist of unconsolidated deposits of sand and gravel with some clay and silt. These deposits are young Alluvium (Sub recent Alluvium) and belong to Holocene age (< 10,000 years). The young Alluvium is characterized by unweathered or slightly weathered clasts and soils developed from these deposits have depths of < 2 m.

Based on terrace locations and absence/inabsence of spodic horizon depths, thus the terraces found nearest to the coastal line is classified as the youngest age ($R_1$), while the middle terraces belong to the intermediate age ($R_2$); however the ridge farthest away from the coastal line is classified as the oldest age ($R_3$). The $R_1$ ridge is the youngest among the three and is located nearest and running parallel to the shoreline [1]. During the field survey, soil series in the depression were not intensively studied because the common features of the landscapes were very dynamic and commonly they are not utilized for agriculture purposes, except for tourism and recreation. Catena of BRIS soils from East to West of Merang is given in Figure 2.

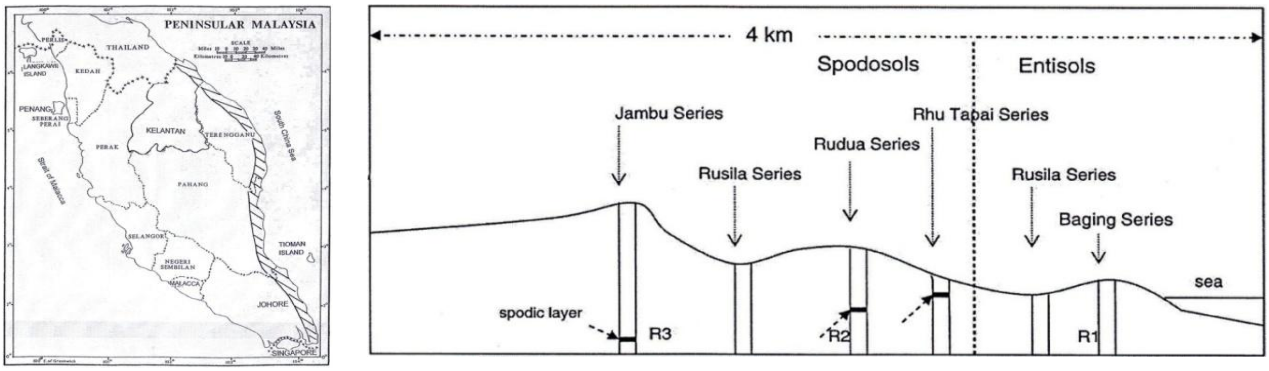


Fig. 2: Catena of BRIS soils from East to West (R1, R2 and R3 represents the young, older and oldest terraces respectively, modified from Roslan*et al*[6]

## 4.2. BRIS Soil Series

Based on drainage classes and absence/inabsence of spodic horizon depths, BRIS soils can be divided into four soil series, i.e. Baging, Rhu Tapai, Rudua and Jambu.

**Baging Series.** Baging is located nearest and running parallel to the shoreline on the first terraces (R1) and belongs to the youngest among the three other soil series. The topography of the area was almost flat which probably due to agricultural activities with elevation around 50-120 cm above sea level. Baging series do not show horizon differentiation and are classified as Entisols *(Sandy, siliceous, isohyperthermic, Typic Quartzipsamments)*. Baging series are somewhat excessive drained **meaning that water**is removed from the soil rapidly. Internal free water occurrence commonly is very rare or very deep. The soils are commonly coarse-textured and have high saturated hydraulic conductivity. The water table was < 130 cm depth (during the dry months). Spodic horizons are not found till depth of > 130 cm.

**Rhu Tapai Series.** Rhu Tapai Series are commonly located on the second terraces ($R_2$) in the distance away (> 500 m) from the first terraces and classified as Spodosols *(Sandy, siliceous, isohyperthermic, Arenic Alorthods)*. Rhu Tapai series are moderately well drained. It **means thatw**ater is removed from the soil somewhat slowly during some periods of the year. Internal free water occurrence is moderately deep and transitory through permanent. The soils are wet for only a short time within the rooting depth during the growing season, but long enough that most mesophytic crops are affected. They commonly have a moderately low or lower saturated hydraulic conductivity in a layer within the upper 1 m and periodically receive high rainfall. Spodic horizon occurs at < 50 cm depth.

***Rudua Series.***Rudua series are somewhat e**xcessively drained.** Water is removed very rapidly. The occurrence of internal free water commonly is very rare or very deep (> 50 cm). Free of mottling was related to wetness. The soils are commonly coarse-textured and have very high hydraulic conductivity. Processes of eluviations, illuviation and podzolization are commonly caused by the excessive drainage conditions. Therefore spodic horizon is translocated down to a lower depth compared to that of Rhu Tapai series; in the Rudua series spodic horizon occurs at 50-100 cm depth. The Rudua series are more leached comparing to Rhu Tapai. Both soils are classified as Spodosols *(Sandy, siliceous, isohyperthermic, Arenic Alorthods).*

***Jambu Series.*** Jambu Series are sited on the oldest among the terraces (R3) and located farthest away from the coastline. Spodic horizon in the soil was found at depths of > 120 cm. The strongly bleached elluvial horizon is very thick. The Jambu series are classified also as Spodosols *(Sandy, siliceous, isohyperthermic, Arenic Alorthods)*. The terraces containing Jambu Series could have been leveled flat (to a lower elevation) as a result of sand mining or agricultural activities (land leveling). Sometimes it was done in good faith, trying to make this ridge conform to the surrounding landscape for practical agricultural production. As such the spodic horizon in this area was observed to be less than 120 cm below the surface and thus no longer considered as Jambu Series as defined by the Malaysian System of Soil Classification. Jambu Series were commonly found in an undisturbed location.

## 4.3. Evaluation of Soil Fertility Status

All soil parameters are classified as very low to low, except Base Saturation because the soils are strongly influenced by sea movement. The soil reaction is closely related to some soil chemical properties, such as solubility H, organic matter content, the content of the bases, saturation-Al and so others. Soils with high hydrogen ion solubility and high organic acids, low bases content and high Al saturation generally reacted as an acidic to a very acidic soil. Instead, the soils have properties opposite to those above generally reacted neutral. The average value of pH $H_2O$ and pH KCl are 4.3-5.1 and 4.0-4.6 respectively which indicated that the soil is generally classified as very acid to acid. The value of pH and CEC data was connected each other. This is also an indication that the oxidation of Fe and Al-free on these lands is rather high (Table 1).

In the BRIS soils, coarse sand and fine sand ratios may play an important role for present indices of parent material homogeneity. It seems that all soil profiles are developed from homogenous parent materials. The profile shows a relatively homogeneous content in all horizons. The indices of homogeneity that are the fine to coarse sand ratios throughout the profile may show the unique numbers-that the soils were formed from the same parent material. The ratio of silt to clay gives indices to weathering and soil development. This is based on the fact that the more weathered the soils are, the lower the silt contents. If the silt clay ratio is less than 0.15, the soils are classified as highly weathered. All BRIS soils give the figure of above 0.15 (1.91-12.45) that means the soils are relatively young.

## 4.4. Soil Assessment for Upland Rice Cultivation

The most important upland rice growing environment is climate, physical conditions and soil fertility. According to Djaenudin *et al* [7], soil suitability for upland rice is classified into S1 class (highly suitable), S2 (suitable), S3 (marginally suitable), and N (not suitable). The limiting factors for the development of upland rice in Merang are explained as follows:

1. Soil temperature (t) that includes inhibiting factors, i.e. average temperature,
2. Water availability (w) that includes inhibiting factors, i.e. monthly rainfall and soil humidity,
3. Rooting medium (r) that includes inhibiting factors, namely soil drainage class, soil texture, coarsematerials and rooting depth. Rooting depth is an indicator for effectively shallow depth of soils, especially in areas with high sand content and fast drainage,
4. Holding capacity of soil nutrients (n), which include inhibiting factor, i.e. Cation Exchange Capacity (CEC), Base Saturation (BS), soil pH, and organic C,
5. Poisoning (x), which include inhibiting factor, namely salinity and sulfidicmaterials (spodic horizons),
6. Erosion and abrasion hazard (e) that includes inhibiting factors, i.e. slope and erosion and abrasion hazard.

The marginally suitable means it needs more input to make the soils become suitable for the growth and development of upland rice. To soil class of N (not suitable), then the constraints are permanent and very difficult to be reclaimed or require a very high cost. Based on the character of both physical and chemical properties, the research location does not have soils that belong to not suitable N (Table 2).

Almost all areas are classified as marginally suitable for upland rice due to some biophysical and chemical soil properties and climate constraints. However, from the facts on the ground and regional development issues that upland rice is likely to be developed. Table 3 summarized some efforts to improve the soil capability for upland rice. Table 3 states clearly that upland rice can be improved to suitable (S2) for the soils if organic material, lime and fertilizer P are given. Soil suitabilityfor upland rice is found on flat land until the slope (0-10%). For a more sloping land (> 10%) it is needed a simple conservation efforts, such as individual terrace to anticipate soil erosion.

Table 1. Laboratory analyses of BRIS topsoils (0-16 cm) and its Assessments [a]/

| Laboratory analyses and its unit | | Baging (no spodic) | Rhu Tapai [b]/ (< 45 cm) | Rudua [b]/ (> 50 cm) | Jambu [b]/ (> 98 cm) |
|---|---|---|---|---|---|
| Bulk density | $kg/dm^3$ | 1.38 | 1.30 | 1.27 | 1.43 |
| Pore | % | 48 | 47 | 42 | 53 |
| pH $H_2O$ (1:1) | - | 4.7 (acid) | 5.1 (acid) | 4.3(very acid) | 5.0 (acid) |
| pH KCl (1:1) | - | 4.3 (very acid) | 4.6 (acid) | 4.0 (very acid) | 4.0 (very acid) |
| C-organic | % | 0.09 (very low) | 0.78 (very low) | 0.82 (very low) | 0.83 (very low) |
| N-Total | % | 0.01 (very low) | 0.36 (middle) | 0.09 (very low) | 0.42 (middle) |
| P-Bray I | ppm | 0.91 (very low) | 10.40 (low) | 12.78 (low) | 2.40 (very low) |
| Na-dd [c]/ | me/100g | 0.01 (very low) | 0.03 (very low) | 0.02 (very low) | 0.07 (very low) |
| K | me/100g | 0.01 (very low) | 0.02 (very low) | 0.02 (very low) | 0.05 (very low) |
| Ca | me/100g | 0.05 (very low) | 1.32 (very low) | 0.03 (very low) | 2.86 (low) |
| Mg | me/100g | 0.11 (very low) | 0.45 (low) | 0.02 (very low) | 0.65 (low) |
| CEC [d]/ | me/100g | 0.96 (very low) | 2.12 (very low) | 1.81 (very low) | 4.52 (very low) |
| BS[e]/ | % | 68 (very high) | 86 (very high) | 75 (very high) | 74 (very high) |
| $Fe_2O_3$ | % | 0.55 | 0.21 | 1.62 | 0.62 |
| Texture class | | Sand | Sand | Sand | Sand |
| Soil fractions | | | | | |
| Sand | % | 98.21 | 96.50 | 95.56 | 98.64 |
| Silt | % | 1.54 | 2.30 | 4.11 | 1.04 |
| Clay | % | 0.25 | 1.20 | 0.33 | 0.32 |
| Silt/clay ratio | | 6.16 | 1.91 | 12.45 | 3.25 |
| WR[f]/ | | | | | |
| 0.33 | bar | 5.22 | 5.41 | 6.50 | 4.50 |
| 1.0 | bar | 3.83 | 3.92 | 4.10 | 3.13 |
| 15 | bar | 2.67 | 2.74 | 3.03 | 2.03 |

Explanation : [b]/ with Spodic Horizon, [c]/ dd: Exchangeable, [d]/ Cation Exchange Capacity, [e]/ Base Saturation, and [f]/ Water Retention

Source : [a]/ Data from Laboratory Analyses (2013), Roslan *et al*[6] (2010) and Nafis [8]

Table 2. Limiting factors of soil suitability classes for upland rice in the research site

| Soil Series | Sub class*/ | Limiting Factors | Yields (ton paddy/ha/year) |
|---|---|---|---|
| Baging &Rhu Tapai | S3-twrne | Soil temperature, water availability (humidity), rooting medium (soil drainage, soil texture), holding capacity of soil nutrients (CEC, pH, and organic C), erosion and abrasion hazard | < 1 |
| Rudua | S3-twrnx | Soil temperature, water availability (humidity), rooting medium (soil drainage, soil texture), holding capacity of soil nutrients (CEC, pH, and organic C) and poisoning (salinity and spodic horizons) | 1-2 |
| Jambu | S3-twrn | Soil temperature, water availability (humidity), rooting medium (soil drainage, soil texture), holding capacity of soil nutrients (CEC, pH, and organic C) | 2-3 |

Explanation: */ t: Soil temperature (It is difficult to be managed), w: Water availability (It needs drainage system and ameliorant), r: Rooting medium, n: Holding capacity of soil nutrients (very low soil fertility), x: Poisoning (high salt content and spodic horizon which limits upland rice growth), e: Erosion and abrasion hazard

Source: Results of field observation and laboratory analyses (2013)

Table 3. Efforts to increase soil capability for upland rice

| Soil suitability | | Efforts to increase soil capability for upland rice from actual to potential soil suitability |
|---|---|---|
| Potential | Actual | |
| S2 | S3-twrne | Cover the soils with mulch, make sprinkle irrigation, make dam for water holding and retention, give and maintain organic matters in the soils and do not burn biomass, fertilize soils with NPK and organic fertilizers, mix mineral subsoils to BRIS soil to improve CEC and Make terraces |
| S2 | S3-twrnx | Cover the soils with mulch, make sprinkle irrigation, make dam for water holding and retention, give and maintain organic matters in the soils and do not burn biomass, fertilize soils with NPK and organic fertilizers, mix mineral subsoils to BRIS soil to improve CEC, do wash elements of Na and H and break down sallow spodic horizons (spodic depth of less 30 cm) |
| S2 | S3-twrn | Cover the soils with mulch, make sprinkle irrigation, make dam for water holding and retention, give and maintain organic matters in the soils and do not burn biomass, fertilize soils with NPK and organic fertilizers and mix mineral subsoils to BRIS soil to improve CEC |

# 5. Conclusion

Based on the results and discussion, the result of this study revealed as following that:

1. The BRIS soil series are occurring side by side which relate the coexistence of beach terraces running parallel in different elevation to the seashore lines and the main BRIS soil series are Baging, Rhu Tapai, Rudua and Jambu
2. Soil fertility status of soil series are classified as very low to low, except Base Saturation because the soils are strongly influenced by sea movement
3. The soil suitability was **S3-twrne** for Baging and Rhu Tapai**,S3-twrnx** for Rudua, and **S3-twrn** for Jambu with the soil productivity of around **< 1, 1-2** and **2-3** tons dried paddy per ha per year respectively
4. The needed efforts to improve soil capability from actual to potential soil suitability for upland rice cultivation are i.e. cover the soils with mulch, make sprinkle irrigation, make dam for water holding and retention, give and maintain organic matters in the soils and do not burn biomass, fertilize soils with NPK and organic fertilizers, do wash elements of Na and H and break down sallow spodic horizons, make terraces and mix mineral subsoils to BRIS soil to improve CEC.

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# The System of Biological-environment Adaptive Control as Alternative Technology to Address Climate Change

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**Abstract.** Climate change can affect the critical development of resources, and therefore it results in significant impact on food security, including the horticultural industries. Alternative technology has to be developed in order to avoid difficulty that might occur in the future. Communication of climate change information is important to scientific development to address the climate change; one of those is the concept of biological-environment adaptive control system. The concept is a software system that provides control facilities which reference or set point (optimal environment) can be adjusted according to the desired condition of plant produce. The desired condition of plant produce can be based on the quantity, quality, or the preferences of consumers, or the combination between those factors. The biological-environment adaptive control system consists of two optimization solutions, namely the optimal environment to be used as a reference in controlling and optimal control parameters in order to get the performance of desired controlling system. The biological-environment adaptive control system is more flexible due to more choices of control modes and plant produce criteria, as well as for data acquisition.

**Keywords:** biological-environment, adaptive control system

## 1. Introduction

Climate change could be new challenges as well as opportunities for horticultural industries. Horticultural industries successfully adapt to climate change, both pre-emptive and reactive adaptation strategies, or other options that need to be developed. Indonesia's horticultural industries are dealing with increased threats from imported plant produce, and the needs of effective and efficient technology. Horticultural industries will need to develop adaptive strategies to manage adverse environmental conditions as well as developing and implementing improved production practices to increase efficiency and productivity.

Biological environment includes all biological factors in living ecosystem that associate with climate factors. Climate change has been hot issue due to its effects on food security. It is due to climate change has been claimed to affect the crop production in broad regions of the world. The increase of human population is rapidly in developing countries, includes Indonesia; therefore climate change adaptation is important especially for developing countries since those countries are predicted to bear the brunt of the effects of climate change. The capacity and potential for plants to adapt the climate change is uneven across different plants. There had been some research on plant adaptations to climate change, included quality of plant produce after climate change, as well as the mechanism on how plant adapt to environmental stress [1][2][3][4].

Environment plays a role for the growth and development of plants; therefore the characteristics of a particular plant will not appear as expected when it is not supported by the provision of appropriate environmental conditions [5]. If the favorable environment of the plants can be established, some advantages might be obtained during the circumstances such as high yield of production, saving energy with environmental friendly system. Adaptive control system can be one of alternative technology to produce qualified plant produce with higher added value. However, preparations to control optimum environmental conditions need to be determined in advance for the optimum environmental conditions in producing desired parts of plants. The implications for improving the quality of the plant produce, especially local vegetables and fruits might have impact on increasing the competitiveness with imported plant produces.

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Modification of the environment in plant house in order to produce qualified crops had been carried out by previous researchers [6][7][8]. For examples: the optimization of the lighting system by using a genetic algorithm in a plant house [9], controlling the moisture for optimum plant growth for *Chrysanthemum* in plant house [10], identifying system and analyzing the application of the identification system for controlling environment in plant house [11]. Furthermore, computer-based technology was developed to create the optimal condition for optimal plant growth [12][13]. A computer-based algorithm was also developed to control flowering plants [14], as well as automatic fertigation system for speaking plant approach in greenhouse [15].

There has been quite a lot of computer-based controls of the plants environment parameters in Indonesia. The software developed is still limited to the use of certain control mode and not yet available to the plant environment identification facilities. Biological-environmental identification is based on the understanding the model that describes the relationship between environmental factors with plant to be harvested. Understanding the response of plants in such a situation is termed asbiological-environment.

It is still very difficult to develop a sensor that can be used to evaluate the performance of plants directly (real time). Nevertheless, it is constantly evolving and there have been attempts to identify the biological-environment control system, namely through the control system based on plant responses (speaking plant approach). Environmental-control systems are still rare in the form of biological software that combines with the facility of control mode selection, especially in Indonesia. It is still necessary to develop a system that is flexible, which provides a mechanism for the selection and identification of control mode and plant in an integrated environment.

Biological-environment adaptive control system in the plant house was developed without the requirement of output sensor for the plant produce. In other words, real time control detection towards output (plant produce) is not required anymore. Due to the detection of plant produce properties is not required in the operation of real time control, the output data can be both destructively and non-destructively collected. It is possible to choose the plant produce properties as the target, and this flexibility makes biological-environment adaptive control is more applicable. This paper describes the perspective of biological-environment adaptive system in plant house as alternative technology to address the climate changes.

## 2. Biological-environment Adaptive Control System

Biological-environment adaptive control system is a software system that provides control facilities which reference or set point (optimal environment) can be adjusted to the desired condition of plant produce. The desired condition of plant produce can be based on the quantity, quality, or taste. This control system provides a facility that controls the variable mode selection to the set point, in other words, the error of the response is small and stable to control systems in all areas of operation. There are two optimization solutions, namely the optimal environment to be used as a reference and optimal control parameters to obtain the desired performance.

Adaptive control is control parameters that can be adjusted to the real condition. Optimal control is a control that combines optimization based on theory for determining the performance of the control system, so it can respond as efficient as possible to the variables that change over time.

There are two terms in biological-environment adaptive control system, namely the optimization environment that will serve as a reference, and optimization control parameters that control the response to get the performance associated with minimum error. The control design in adaptive control system includes four stages, namely measuring, comparing, counting, and correcting. Three stages of controlling system are grouped as controller which compares the reference with variable process, calculates how many corrections that needs to be done, and issues a correction signal in accordance with the results of the calculation.

Algorithm is to calculate the magnitude of the correction that is done by the mode control, such as fuzzy and PID (Proportional-Integral-Differential). Input of mode control is error and error change, while the output is signal correction or manipulation of variables that can be changed, therefore the magnitude of the variable control or process is equal to the reference. Each mode control has parameter in order to maintain

the similarity of variable process to reference. These parameters should be optimized to avoid instability of the control system by reference change or disturbance.

Biological-environment adaptive control system based on the identification of the optimal set point and the estimation of optimal control parameter consists of sub-system of optimal control parameter's determination and sub-system of real-time control. The results of those sub-systems can be applied on the real time controlling of biological environment in the plants house.

There are two terms of biological-environment. Firstly, it is the relationship between environmental factors as inputs and plant produce as output. Secondly, the sensors for detecting the inputs and outputs are placed near the plant canopy in order to detect the surrounding conditions of plants related to photosynthesis, respiration and transpiration. The optimal environmental condition for plant growth has to be established prior to controlling by using a mathematical equation (model).

## 3. Structure and Component of Biological-Environment Adaptive Control System

Biological-environment adaptive control system includes some operators. Those are identification, optimization, control (fuzzy and PID), image processing, as well as mass-transfer model [16]. Artificial neural network (ANN) structure consists of layers i.e. input, hidden and output layers. The nodes within layers are connected by weights, and they receive inputs and process them to obtain an output. The connections of nodes between layers determine the information flow between nodes, either one direction or bidirectional. Through a set of learning process, the weights are modified in such a way by using a particular algorithm, such as back propagation. The back propagation algorithm is used in layered feed-forward ANNs. It means that the nodes are organized in layers, and send their signals forward, and the errors are propagated backwards. The inputs are received by nodes in the input layers, and the output is node in the output layers. There may be one or more hidden layers between input and output layers.

Back propagation method is successfully proved by the process of multi-layer neural network training. Information about the error is also controlled through the system, and it is used to justify the relationship between the layers, so that the network performance will increase. Back propagation algorithm is a commonly used to train the ANN. The network weight is modified by minimizing the sum of squared errors which is calculated against all the output nodes. Back propagation algorithm is a form of differential gradient which is aimed to reduce the error. The training begins with random weights, and the goal is to adjust them so that the error will be minimal.

Genetic algorithm (GA) is one of frequent optimization techniques used, for example in controlling micro climate in greenhouse [17]. Genetic algorithm uses a natural analog phenomenon such as biological evolution, in which the best individuals in a population will experience mutations. The population consists of individual who each is possible to solve a problem. Each individual, which in this case is similar chromosomes, has fitness value corresponding to the feasibility of the solution of the problem. Some individuals in the population are with better fitness value opportunity for reproduction. Cross over or mutation might occur during the process. At the end of process, the best individual would appear and therefore it would be selected.

Genetic algorithms use direct analogy of natural properties. This algorithm uses a population of individual which in each represents a possible solution to a given problem. Each individual has a value of fitness function in accordance with the completion of the feasibility problem. Highly fit individual has the opportunity to recombine with the individuals in the population. This process produces new individuals as offspring that has parent nature. Individuals that have low fitness value could not be selected for reproduction so that the species will become extinct.

In addition to cross-over between individuals, the natural evolution of the well known mutations, i.e. changes in individuals who are not influenced by other individuals. The best fitness value would produce the next generation of individuals. On the other hand, low fitness value of individual would be discarded in order to produce the similar next generation. This process is repeated until the desired generation or a high value of the fitness function for solving problems is obtained.

The characteristic of GA is different from other optimization techniques. The differences are found in the operating system which GA runs based on the coding set in the parameter, the selecting system is in a population, information of objective function as technique for evaluating the individual who has the best solution, not the derivative of a function. In addition, AG uses probabilistic transition rules, not deterministic rules.

The variables used in the genetic algorithm are as follows: 1) the fitness function, which is owned by each individual for analyzing the individual's level of compliance with the criteria to be achieved. Fitness is maximized with the application of genetic algorithms, 2) population is the number of individuals, who are involved in every generation, 3) Opportunity (probability) in recombination occurs in a generation, 4) opportunity mutations occur in every transfer bits, and 5) number of generations to be established would determine the number of the application of genetic algorithms.

Logical fuzzy and PID techniques have been widely applied in the control system. The steps of the application are as follows: 1) calculation of the error and error difference, 2) fuzzification, 3) determination of the control rules (decision matrix) and calculation of the maximum value, and 4) de-fuzzification. Proportional integral differential control and its parameters follow Ziegler and Nichols method.

## 4. Determination of Optimal Set Point and Controlling

Optimal set point in this system is the environmental conditions which are based on the maximum of plant products harvested. The optimal set points in biological-environment adaptive control system are the optimal environmental conditions for the desired plant produce to be harvested. It could be in quality, quantity, or the preferences of consumers, or the combination between those factors. The environmental conditions are not always suitable for normal plant growth, but they might inhibit the growth of particular part of plant which is intended to increase the quality of the particular part of the plant produce. For examples, water stressed treatment can increase the crispness of vegetables, wherein in such water stressed treatment, the environment is controlled for inhibiting the growth of plant.

The environment conditions can also affect the taste of the pineapple, the smell of tobacco, and others. Plant also has the adaptability to changing environmental conditions, so the optimal environmental conditions may vary, depending on the objectives of manipulated treatment itself. In order to obtain the specific criteria of the plant produce, it is necessary to provide facilities for the determination of the set point to anticipate the requirements. The determination of the facility is equipped with a sub-optimal plant model systems and image sensors. The biological-environment adaptive control system uses two operators for identification and optimization. The operators are the artificial neural network and genetic algorithms.

Environmental parameters are associated with minimum error and stable control performance. The determination of the optimal parameters control facility is integrated with the simulation system. The optimal control parameters are determined through simulations by using ANN operator or heat transfer models. The relationship between the internal and external environment of the plant house (biological environment) is explained by the model environment. Then, the optimal control parameters are determined by using genetic algorithm operator and equipped with the control menu options.

## 5. Conclusions

Biological-environment adaptive control system in plant house can be used as alternative technology to address the climate change. This technology is capable of supporting horticultural commodities with certain specifications. The concept is a software system that provides control facilities which reference or set point (optimal environment) can be adjusted according to the desired condition of plant produce. The desired condition of plant produce can be based on the quantity, quality, or the preferences of consumers, or the combination between those factors. It consists of two optimization solutions, namely the optimal environment to be used as a reference in controlling and optimal control parameters in order to get the performance of desired controlling system.

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# The Application of Eco-Microbe for Water Quality Bioremediation, Pilot Test at FRIM Kepong, Malaysia

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**Abstract.** Water flowing slowly in ponds enhances the eutrofication activities. Nonetheless, eutrofication processes can be slowed down by using appropriate bioremediation techniques. The objective of this study was to improve the water quality using bioremediation method. The bioremediation treatment on a greenish colour pond was established at the Forest Research Institute Malaysia (FRIM). Treatment using eco-microbe has improved the water quality for the aquatic life in this pond. Results showed that the water quality was improved from Class III before treatment to Class II of the Malaysian Water Quality Index, 10 weeks after treatment. The pH values remain more or less constant throughout the trial but other parameters differ accordingly. Toward the end of the experiment, dissolve oxygen was high but suspended solid was low. Chemical oxygen demand (COD), Biochemical oxygen demand (BOD) and Ammoniacal nitrogen value were decreased. The algae which conceal the green colour of chlorophyll as a photosynthetic pigment, was reduced accordingly. Hence, visually the water clarity has improved to become less greenish.

**Keywords:** Pond, water quality, euthrofication, aquatic life

## 1. Background

Water quality bioremediation is the application of biological treatment using microbes to clean contaminants in the water. Application of microbial formulation can be done to improve water quality by reducing nutrient levels in the water, thus reduce the risk of eutrofication and algal blooms.

In the case of my study, the need for more environmentally and economically sustainable approach for sustainable development water quality remediation had encouraged Smart Solution Biotechnology Sdn Bhd (SSB) to come up with a biotech product. The eco-microbe product (Pro –biotic formula) which is registered as CF-Bio and CF-Enviro which is suitable for water quality remediation and safe for the environment.

CF-Bio and CF-Enviro is a mixed culture of selected beneficial microorganisms from our natural environment. It was developed locally through R & D by Circle Field Sdn Bhd (Malaysia) in collaboration with Melaka Biotechnology Corporation. It is cultured under controlled processes and environment with the quality constantly tested by accredited laboratories to ensure the consistency in quality and safety.

Untill now, water quality monitoring at FRIM is not yet well established. Water body here has esthetic value aside from the function as retention ponds for storm water. On the other hand, study on water quality is very important as pollution that contaminates the water and increase of nutrients level in water will kill the beneficial organisms. These effects will reduce the water quality and esthetical values of the ponds.

The objectives of the study are (1) To determine effectiveness of eco-microbe products in improving water quality of the pond and (2) To create a safer and healthier environment for aquatic lives as well as cleaner recreational site for public.

## 2. Literature Review

Pro-biotic formula for the bioremediation can be formulated by scientists and make it commercially available. For example, a standardize total endospore count of 5 billion CFU/gm, can multiply in a bucket to 150 billion CFU/gm in 18 hours (bioremediate.com). Two lbs. of this microbial formulation, will inoculate a 1 acre pond to many thousand times more than the bacterial biota normally found in a water column

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(Macrothink.org). Overall, bioremediation using pro-biotic formula will reduce nutrient levels, thus reduce the risk of eutrofication and algal blooms in the water bodies.

## 3. Method

Eco-microbein the form of CF-Bio Mudball (solidform), CF-Enviro (liquid form) was applied at 350 pieces and 210 liter respectively, to the pond containing 500,000 liters of water (Figure 1). ffectiveness of the method was monitored through water analyses. Sampling was done at 5 weeks intervals, once before and 3 times after application of the treatments. One composite sample was taken from the water inlet and outlet area at each measurement.

The water samples were collected in bottle containers and sent to the laboratory for analyses. Analyses of the water samples include Dissolve Oxygen (DO), COD, BOD, Suspended Solids (SS), pH and Ammoniacal Nitrogen ($NH_3N$). Data gathered was compared to the Malaysian Water Quality standard (DOE) to ascertain the water quality index. Figure 1 shows the Location of the studied pond.

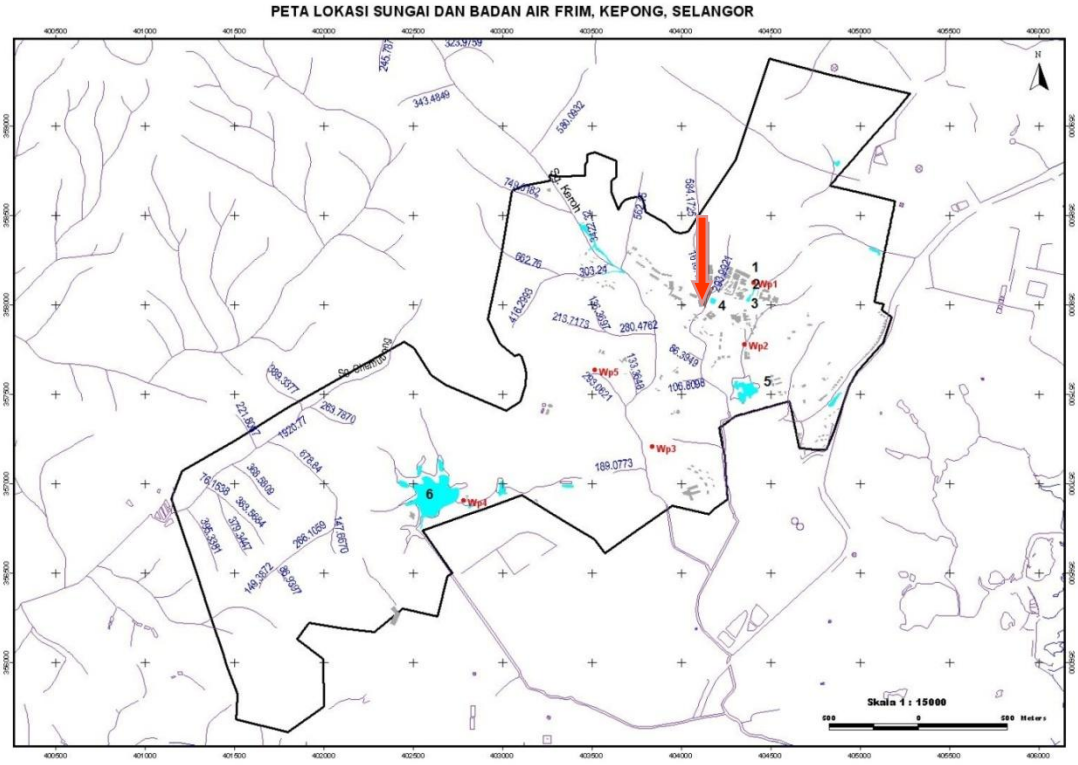


Fig. 1: Location of the studied pond was numbered as 4

Monitoring was done using portable water quality meter. This equipment gave value number once it was inserted into the water body. Samples also taken for analysis of COD and BOD in the laboratory.

Fig. 2: Visual of water condition before and during treatment

## 4. Result and Discussion

Figure 2 shows the colour of water in the pond before and during treatment. The water clarity was less green (Figure 3) compared to the initial condition before treatment.

Fig. 3: Visual of water condition 15 weeks after treatment

Results showed that there was marked difference of water quality class after treatment. The water quality class was upgraded from class III before treatment to class II begin from 10 weeks after treatment. The pH value was average throughout the trial but other parametersdiffer accordingly. Dissolve oxygen was high but suspended solid was low. COD and BOD increased 5 weeks after treatment but the value decreased afterwards. Ammoniacal nitrogen values were decreasingly low after treatment. Table 1 shows the result of water quality assessment before and after treatment.

Table 1. Water Quality Index (WQI) of the pond before and after treatment

| Treatment | pH | DO % | SS mg/l | COD mg/l | BOD mg/l | NH3-N mg/l | WQI mg/l | CLASS |
|---|---|---|---|---|---|---|---|---|
| Before treatment | 6.3 | 105 | 12 | 62 | 5 | 1.9 | 73.4 | III |
| 5 weeks after treatment | 6.6 | 109 | 10 | 118 | 24 | 0.1 | 69.2 | III |
| 10 weeks after treatment | 6.0 | 128 | 29 | 66 | 3 | <0.1 | 81.7 | II |
| 15 weeks after treatment | 6.2 | 60.3 | 22 | 33 | 2 | 0.2 | 78.1 | II |

Physically, the water clarity was improved to become less greenish. The green colour of algae derived from the dominance of chlorophyll as an accessories photosynthetic pigments in the water.

## 5. Conclusion

Water quality of the treated pond at FRIM is good and suitable for aquatic life. Treatment using pro-biotic formula **(**eco-microbe**)** has further improved the water quality for the aquatic life. It is recommended to be applied to water bodies in order to improve the water quality and colour clarity besides improving the biodiversity in the water. However subsequent observations need to be carried out to monitor the water quality in a longer time. This will help to determine the treatment longevity.

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# Quality Assessment of Delayed-Drying Rice

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**Abstract.** The analysis of physical, chemical and sensory characteristics of delayed-drying rice which was known as *batik* rice was carried out. The rice variety of *Ciherang* was selected due to the most planted variety in South Sumatera swamp areas. The delayed-drying rough rice was dried until reaching the water content of approximately 14% (w/w). The physical characteristics included grain dimension and colour intensity, chemical characteristics were proximate analysis, thiamin and amino acid content, and antioxidant activity. Sensory evaluation was carried out by paired comparison test. The results showed that the length, width and thickness of rough and milled *batik* rice slightly increased compared to the non delayed-drying rice (ordinary rice). The rough *batik* rice had *L** 54.03%, *a** 7.97, and *b** 27.07; whereas the *L**, *a**, and *b** of milled *batik* rice were 69.90%; 2.43; and 11.27, respectively. The texture of cooked *batik* rice (29 gf) was harder compared to the texture of cooked ordinary cooked (20.67gf). The protein and amino acids contents decreased in milled *batik* rice. The antioxidant activity of milled *batik* and ordinary rice at IC50 were 6.44 g/100mL, and 6.82 g/100 mL, respectively. The result of paired comparison test showed that there was no significant difference between the aroma, colour and texture of cooked *batik* rice and cooked ordinary rice.

**Keywords**: physical, chemical, sensory, delayed-drying, *batik* rice

## 1. Introduction

Wetland is defined as land that is constantly covered by water and without a drainage system. Wetlands in Indonesia are around 33,393,570 hectares, and approximately 60% of these wetlands are tidal swamp and the rest is lowland swamp [1]. Paddy is one of the most adapted plants that can grow well in both tidal and lowland swamp. The water requirement for paddy growth is from the swamp areas. Paddy is usually harvested towards the end of the dry season, however, the frequent changes of climate resulted in the harvest time might shift to the rainy season. This situation resulted in piles of rice grains waiting for artificial drying with a paddy dryer. Stacking wet rough rice grains results in patches on the surface of rice endosperm that looks like *batik* pattern, and therefore it is named as *batik* rice. *Batik* rice is considered as low-quality rice.

There has been no scientific research done on the phenomenon that occurs in *batik* rice, especially the yellow patches that appear on the surface of rice endosperm after milling. It is possible that the formation of yellow patches on milled *batik* rice involving chemical process due to large amount of nutritious components in aleurone layer, and germ. Aleurone layer contained 13.2% to 17.3% of protein, 17% to 22.9% of crude lipid, and 9.2% to 11.5% of total ash, while the crude protein and lipid content in rice germ were 17.7% to 23. 9%, and 19.3 to 23.8%, respectively [2].

The aleurone layer of rice contained various components such as essential amino acids, anthocyanin, and γ-oryzanol [3][4][5]. One of essential amino acids in rice was *lysine* [4]. The rice aleurone could function as supplements and cosmetics due to its functional properties such as antioxidant. The chemical process might occur in *batik* rice which could be indicated by the yellow patches on milled *batik* rice. The speculated occurrence of the chemical reactions on the surface of milled *batik* rice was studied by analyzing the antioxidant activity on *batik* rice. Anthocyanin can function as antioxidant [6][7][8].

With the onset of chemical reactions inside the wet rough rice grain in which the water content is between 25% and 30%, it was possible that the chemical reaction might have impacts on the physical and sensory changes, as well as the possibility of functional properties in *batik* rice. The physical, chemical, functional and sensory characteristics of *batik* rice were studied in this research. The results could be used as a rationale for the development of *batik* rice into functional products.

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# 2. Materials and Methods

## 2.1. Materials

The materials used in the experiments were *batik* rice (*Ciherang* variety). The chemical agents used in proximate analysis were in analytical grade. The equipments were analytical balance (Ohaus), texture analyzer (LFRA 1500, Brookfield, USA), chromameter (Minolta), HPLC, oven (Memmert), spectrophotometer (Jenway 6305), muffle furnace (1400 Barnstead Thermolyne).

## 2.2. Methods

The research included two phases, namely: 1) sampling of *batik* rice, 2) analysis of physical, chemical, sensory and functional characteristics of *batik* rice. All analysis on *batik* rice would be also carried out in milled ordinary rice. It was intended to compare the changes that occur in *batik* rice with ordinary rice.

The physical properties of the samples were analyzed for the grain dimension and color intensity. Chemical properties were analyzed for the levels of protein, thiamin, essential amino acids, and antioxidant activity. Analysis of crude protein and antioxidant activity [9] were conducted in the laboratory of Chemistry of Agricultural Product, Faculty of Agriculture, Sriwijaya University. Amino acid analysis was carried out by using High Performance Liquid Chromatography (HPLC) at the Integrated Laboratory of Bogor Agriculture Institution in Bogor, and thiamin analysis by using HPLC at the laboratory of Saraswanti Indo Genetech, Bogor. The grain dimension was measured by using calipers.

The texture analysis was carried out on cooked rice which was cooked in a rice cooker at the ratio between rice and water of 1:3. The specification of texture analyzer's probe was TA 39 with 2mm of diameter, 20mm of length, flat end made of *stainless steel*. The colour intensity was measured by chromameter for the attributes of *L* (lightness), *C* (chroma), *h* (hue), *a**(redness), *b** (yellowness). The sensory evaluation of paired comparison test was selected for cooked milled *batik* rice. Cooked milled ordinary rice was used as standard in the paired comparison test.

# 3. Results and Discussion

## 3.1 Physical Properties of Batik Rice

The physical properties of *batik* rice grain were observed for the rice grain dimensions (length, width, and thickness), colour intensity and texture analysis. The average of water content on rice grain was around 12% (w/w).

Rice grains are not completely spherical or cylindrical. The longest side of a rice grain was considered as length of the rice grain. The greatest side of a rice grain's center was considered as width, while the shortest side of a rice grain's center was assumed as thickness. The results of rice grain dimension are presented in Figure 1.

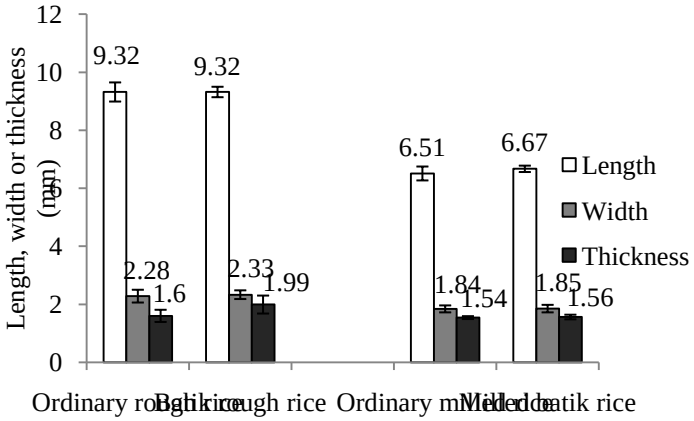


Fig. 1: Rice grain dimension

Figure 1 shows that the length, width and thickness of *batik* rice grain (both rough and milled rice) tend to be larger than ordinary rice. *Ciherang* rice variety was classified as long rice grain due to the ratio of length and width was more than 3. The ratio between length and width of both rough *batik* and ordinary rice were 4.09 and 4.00, respectively, while the ratio between length and width of milled *batik* and ordinary rice were 3.54 and 3.61, respectively.

Color analysis was carried out by using the CIELAB system, and *LCH* color scale. CIELAB color space set in cube form (shape of a cube). *L* * axis starting from the top down (top to bottom) with *a** maximum value of 100 indicating perfect reflecting diffuser is indicated as a white, and a value of zero indicates the color black. Axes *a** and *b** have no numerical limits. Positive *a** indicates red, and negative *a** is green. Positive value of *b** is yellow and negative *b** is blue. In this study, the color of ordinary rice grain sample was considered as standard. The results of color intensity for milled *batik* and ordinary rice grains are presented in Table 1.

Table 1. Colour intensity of milled *batik* and ordinary rice grains

| No. | Colour components | Milled ordinary rice | Milled *batik* rice |
|---|---|---|---|
| 1. | *L* (*Lightness*, %) | 69.90 ± 1.87 | 72.23 ± 2.85 |
| 2. | *C* (*Chroma*, %) | 12.00 ± 0.20 | 11.57 ± 0.67 |
| 3. | *h* (*Hue*, $^{o}$) | 77.83 ± 0.49 | 79.27 ± 1.63 |
| 4. | *a** | 2.43 ± 0.15 | 2.23 ± 0.35 |
| 5. | *b** | 11.27 ± 0.67 | 11.77 ± 0.25 |

Lipase is the primary enzyme that resulted in hydrolysis of triglycerides into glycerol and fatty acids. Lipase significantly increased free fatty acids in brown rice due to lipid hydrolysis [10], wherein the lipase activity is affected by moisture, temperature, pH, time and water activity [11][12]. The activity of lipase enzyme increased at the temperature of 40$^{o}$C, then its activity would decrease after reaching the temperature of 60$^{o}$C [13]. The humidity in the stack of wet rough rice grains was high and its temperature might reach 40°C, and this condition could support the occurrence of such lipase activity.

Texture analysis showed that the texture of cooked *batik* rice (29 gf) was higher than that of cooked ordinary rice (20.67gf). It might be due to aleurone on the surface of milled *batik* rice disrupting water penetration into the rice endosperm during cooking, so it resulted in harder texture in cooked milled *batik* rice. Higher degree of milling resulted in easier water absorption into the rice endosperm when cooking rice [14]. Higher milling degree means more aleurones were brushed off during milling that could be indicated by whiter milled rice. In addition, it might result in softer texture in cooked rice [14].

## 3.2. Chemical Characteristics of *Batik* Rice

Chemical properties were analyzed on amylose, protein, amino acid, and thiamin content, as well as antioxidant activity. Protein contents of milled *batik* and ordinary rice were 6.64% and 6.94%, respectively. The protein content in milled *batik* rice was lower than milled ordinary rice, which might be due to some proteins, especially the water-soluble proteins dissolved and leached out in water during the delay-drying process of *batik* rice grain. Amino acids contents in milled *batik* and ordinary rice are presented in Table 2.

The results of thiamin content analysis showed that thiamin was not detected in both milled *batik* and ordinary rice. The antioxidant activity was calculated as IC50, which means the amount of material required to inhibit DPPH radical formation (1,1-Diphenyl-2-picryl-hydrazyl) (DPPH) by 50%. Analysis of antioxidant activity in milled *batik* rice at IC50 was 6.44 g/100 mL, and in milled ordinary rice was 6.82 g/100 mL. The difference in antioxidant activity between milled *batik* and ordinary rice was only 0.38 %. It can be explained that only small amount of aleurone attached on the surface of milled *batik* rice during the delayed-drying rough rice grains. The slight amount of aleurone on the surface of milled *batik* rice was indicated by darker colour on *batik* rice. It could be speculated that only small amount of antioxidant compounds could migrate into rice endosperm during the delayed-drying process, therefore there was only slight increase of the antioxidant activity in milled *batik* rice. Compounds that can function as antioxidant in rice aleurone are tocopherol, tocotrienol and oryzanol [15][16][17][18]. Those compounds can inhibit the oxidation of fatty acids in the aleurones.

Table 2. Amino acid content in rice

| No. | Amino acids | Percentage(%) in | |
|---|---|---|---|
| | | Milled *Batik* Rice | Milled Ordinary Rice |
| 1 | Aspartic acid | 0.54 | 0.51 |
| 2 | Glutamic acid | 1.18 | 1.08 |
| 3 | Serine | 0.3 | 0.28 |
| 4 | Histidine | 0.11 | 0.10 |
| 5 | Glycine | 1.52 | 1.40 |
| 6 | Threonine | 0.16 | 0.15 |
| 7 | Arginine | 0.41 | 0.39 |
| 8 | Alanine | 0.34 | 0.31 |
| 9 | Tyrosine | 0.12 | 0.11 |
| 10 | Methionine | 0.18 | 0.17 |
| 11 | Valine | 0.34 | 0.32 |
| 12 | Phenylalanine | 0.37 | 0.34 |
| 13 | Isoleucine | 0.25 | 0.23 |
| 14 | Leucine | 0.47 | 0.43 |
| 15 | Lysine | 0.19 | 0.16 |

### 3.3. Sensory Analysis

Sensory analysis was performed by using paired comparison test on 25 panelists. Of the 25 panelists who provide assessment, there were 16 panelists who expressed the differences in aroma of cooked milled batik and ordinary rice. There were 15 and 14 panelists who stated that there were differences in colour and texture of cooked milled *batik* and ordinary rice, respectively. There must be at least 18 panelists from 25 panelists who give the statement of "different" in order to state that there are differences between two samples. The results showed that cooked milled *batik* and ordinary rice did not significantly differ for the attributes of aroma, color and texture.

## 4. Conclusions

The delayed-drying rice (*batik* rice) had greater size compared to non delayed-drying rice (ordinary rice). The yellow patches on the surface of milled *batik* rice showed very low functional properties as indicated by antioxidant activity at IC50 of 6.82 g/100 mL, while antioxidant activity of milled ordinary rice at IC50 was 6.44 g/100mL. The rough *batik* rice had *L** 54.03%, *a** 7.97, and *b** 27.07; whereas the *L**, *a**, and *b** of milled *batik* rice were 69.90%; 2.43; and 11.27, respectively. The texture of cooked milled *batik* rice was harder (29 gf) compared to cooked milled ordinary rice (20.67gf). The protein and amino acids contents decreased in milled *batik* rice. The delayed drying rough rice had no significant effect on the aroma, color, and texture of cooked milled *batik* rice based on the paired comparison test.

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# The Point of Zero Charge of Coal Fly Ash due to Chicken Manures Addition and Incubation Time

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**Abstract.** Fly ash as a coal combustion residue of thermal power plants has been regarded as a problematic solid waste all over the world. Due to the environmental problems created by large-scale fly ash generation, efforts are being made to recycle these materials. Generally, fly ash is a ferro-alumino-silicate mineral containing considerable quantities of Ca, K, and Na. They may, however, contain considerable quantities of minerals (aluminosilicate minerals like Mullite), which dissolve under strongly acidic conditions to provide liming function. Because of their chemical characteristics, fly ash have the potential to ameliorate soil chemical properties, such as the point of zero charge (PZC). Mixing fly ash with organic manure may enhanced the quality of the amelioran to improve the soils chemical properties. In the present study, the possibility to improving the status PZC in fly ash (FA) and chicken manure (CM) mixtures was investigated. Fly ash was mixed with organic matter in the form of cow chicken manure at 0:4, 1:3, 2:2, 3:1 and 4:0 ratios and incubated for 60 days. The FA+CM mixture with incubation time tended to decrease of the PZC status compared with the FA or CM alone. Among the different compositions of FA+CM mixtures, the 2:2 mixture at 45 days incubation time appeared to exhibit the lowest of the PZC compared with the other treatments. This composition could be use as an amelioran to improve the soils chemical properties in terms of soil fertility and lowering PZC, and it is necessary for further research.

**Keywords**: chicken manure, coal fly ash, point of zero charge (PZC)

## 1. Background

Coal fly ash is a combustion by-product that is produced during the combustion of coal at thermal power stations during the generation of electricity. Fly ash is the residue from coal combustion that enters the flue gas stream and collected from gas stack using specialized devices. It is composed predominantly of fine particles, and is either collected in emission control devices, such as electrostatic precipitators or mechanical filters, or released from the stack (Carlson and Adriano, 1993). The fly ash generation is expected to grow further as coal would continue to remain as major source of energy. It is estimated that approximately 600 million tons of fly ash is produced globally every year out of which only 20 to 25% is utilised in the construction industry largely as a replacement of cement for concrete production, fill material for embankments and as grout (Shafiq *et al.*, 2007). The disposal of such a huge amount of fly ash is one of the major problems of developing countries and is usually disposed in basins or landfills near the power plants. Due to the environmental problems created by large-scale fly ash generation, efforts are being made to recycle these materials (Kishor *et al*., 2010).

Fly ash is a heterogeneous mixture of amorphous and crystalline phases and is generally contain considerable quantities of minerals, eg up to 40 % aluminosilicate minerals like Mullite (El-Mogazi *et al*., 1988; Yunusa, 2006). Chemically, fly ash contains oxides, hydroxides, carbonates, silicates, and sulfates of calcium, iron, aluminum, and other metals in trace amount i.e. almost all the nutrients present in the soil with exception to nitrogen (Carlson and Adriano, 1993; Kishor *et al*., 2010). Composition of some oxides contained in coal fly ash is as follows: $SiO_2$ 54,59 %; $Al_2O_3$ 31,69 %; MgO 4,38 %; CaO 4,27 % dan $Fe_2O_3$ 3,19 % (Jumaeri *et al.*, 2007). All the fly ash products contain very fine particles of which more than 80% fell within the fine sand – silt category (<0.02 mm), suggesting they easily react with the soil (Yunusa *et al*., 2006). Because of its physico-chemical characteristics (as explained above), fly ash has a vast potential for use as a soil amelioran that may improve soils physical, chemical and biological properties.

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US-EPA has determined that coal ash is not a hazardous waste (non-hazardous). The chemical constituents of coal ash are commonly found in many everyday products and natural materials. They are present in soil, rock and other parts of the earth's crust. The ranges of major elements in coal fly ash and soils have been evaluated .The comparison shows that the constituents in coal fly ash fall within the typical ranges of those in soils (American Coal Ash Association Educational Foundation, 2009). Various research results indicate that coal fly ash is relatively safe to use as ameliorant on agricultural land and is known to increase crop production (Mitra *et al*., 2003; Aggarwal *et al*., 2009; Kishor *et al*., 2010; Pandey and Singh, 2010).

Numerous studies revealed that the lower coal fly ash incorporation in soil modifies the physico-chemical, biological and nutritional quality of the soil. However, the higher dosage of coal fly ash incorporation results in heavy metal pollution and hinders the microbial activity (Pandey and Singh, 2010). The use of fly ash as an ameliorant can be enhanced by blending it with organic matter such as chicken manure. The latter contains significant amounts of N and P. Consequently, fly ash may serve as a composting ingredient, along with organik manures (Sajwan *et al*., 2006). The benefits may include better nutrient balance, reduction in toxins or contaminants, improved moisture content, improved economic value, improved soil conditioning effects, etc (Hanani *et al*., 2010).

Several studies focused mainly on the general characteristics of ashes that are essential for the soil treatments and their benefits to the growth and yield of crops. Therefore, the objectives of this study were to evaluate the effect of coal fly ash and chicken manure mixtures on the changes of the the point of zero charge (PZC) of the mixtures. Soil surface charge is often characterized by net positive charge, therefore, cations are easily leached and soil fertility conditions deteriorate. Theoretically, cation loss can be prevented by developing negative surface charge and thus creating additional cation exchange capacity (CEC) (Uehara and Gillman 1981; Marcono-Martinez and McBride, 1989). This can be obtained either by raising soil pH or lowering the PZC. PZC is a point, where the net charge of variable charge components is zero due to the equal $H^+$ and $OH^-$ adsorption on them (Sakurai *et al*., 1988). Soil amendments that may affect these soil properties include the application of the material with low PZC such as lime, phosphate, silicate and organic matter. Through this study are expected to be obtained by the composition of the mixture of coal fly ash and chicken manure that has a low PZC and will hopefully be used as ameliorant to improve soil chemical properties and crop production, particularly soils with high PZC such as Ultisol.

## 2. Methods

This research was conducted in the Laboratory of Chemistry and Soil Fertility, Soil Department, Faculty of Agriculture, Sriwijaya University in November 2012 through March 2013. Coal fly ash obtained from Bukit Asam power plant, Tanjung Enim, South Sumatra. Chicken manure obtained from chicken farms in the area Inderalaya, Ogan Ilir, South Sumatra. Fly ash was mixed with organic matter in the form of chicken manure at 0:4, 1:3, 2:2, 3: 1 and 4:0 ratios and incubated for 60 days. Each treatments arranged in completely randomized design (CRD) with 3 replications. The mixture of coal fly ash and chicken manure in every pot is equivalent to 1 kg on the basis of absolute dry weight.

Analysis of the chemical characteristics of the mix include: pH $H_2O$ and pH KCl (1:1), C-organic (Walkley-Black), cation exchange capacity (CEC) (1 N $NH_4OAc$ pH 7) and available P (Bray I). pH measurement is done by using a pH meter, P and CEC with a spectrophotometer (Sulaiman *et al*., 2005). Value of the point of zero charge (PZC) for each treatment carried out by salt titration methods (Sakurai *et al*., 1988). Determination of P sorption is done with reference to the Fox and Kamprath (1970).

## 3. Results and discussion

### 3.1. The characteristics of coal fly ash and chicken manure

Results of laboratory analysis of samples of coal fly ash and chicken manure are presented in Table 1. The fly ash used in this study is alkaline (pH 8.75), with the content of bases such as Na, Ca, Mg and K were relatively high. Cation exchange capacity (CEC) (9.53 $cmol_{(+)}kg^{-1}$) and the solubility of Al in the coal fly ash is relatively low, as well as levels of C- organic and N-total. Coal fly ash has been reported to have very low CEC (Bilski *et al*. 1995). The burning processes of coal at high temperatures resulting in organic C and

nitrogen levels in ash produced has collapsed (Bhattacharya and Chattopadhyay, 2004). Meanwhile, available P levels in coal fly ash is relatively low, and most of the P is in the form of bonds with Al, Fe and P-organic, as well as the P sorption capacity of 626.61 µg $g^{-1}$. P content in coal fly ash is generally low and therefore the efforts are needed to increase the P availability in their utilization for crop production (Kumar *et al*., 1998; Bhattacharya and Chattopadhyay, 2002). In addition, the used of coal fly ash is dominated by silt and clay-sized particles (71.20%), suggesting that they easily react with the chicken manures.

Table 1. The results of a preliminary analysis of coal fly ash and chicken manure

| Type of Analysis | Unit | Analysis Results | |
|---|---|---|---|
| | | Coal Fly Ash | Chicken Manure |
| pH $H_2O$ (1:1) | - | 8,75 | 8,14 |
| pH KCl (1:1) | - | 8,70 | 7,54 |
| Organic C | % | 0,11 | 9,22 |
| Total N | % | 0,04 | 1,12 |
| Available P | µg $g^{-1}$ | 10,35 | 109,05 |
| Exch.K | $Cmol_{(+)}kg^{-1}$ | 0,06 | 31,95 |
| Exch.Na | $Cmol_{(+)}kg^{-1}$ | 2,72 | 21,75 |
| Exch.Ca | $Cmol_{(+)}kg^{-1}$ | 4,80 | 0,28 |
| Exch.Mg | $Cmol_{(+)}kg^{-1}$ | 21,00 | 1,80 |
| CEC | $Cmol_{(+)}kg^{-1}$ | 9,53 | 39,15 |
| Exch.Al | $Cmol_{(+)}kg^{-1}$ | nd* | nd |
| Exch.Fe | µg $g^{-1}$ | 10,73 | 18,82 |
| P Sorption | µg $g^{-1}$ | 626,61 | 657,82 |
| Al-P | µg $g^{-1}$ | 1,13 | 19,13 |
| Fe-P | µg $g^{-1}$ | 16,5 | 37,95 |
| Organic-P | µg $g^{-1}$ | 19,34 | 31,20 |
| Fraction: | | | |
| Sand | % | 28,80 | |
| Silt | % | 56,13 | |
| Clay | % | 15,07 | |

*) nd. - not detected

Furthermore, chicken manure used in this study also had a relatively alkaline pH (pH 8.14), levels of P-available and high bases, solubility of Al, Fe and C/N ratio is low. Cation exchange capacity (CEC) of chicken manure used is relatively high (31.95 $cmol_{(+)}kg^{-1}$). Meanwhile, the P sorption capacity of chicken manure used is relatively high (657.82 µg $g^{-1}$). Despite this, P availability is high and most of P are in the form of a bond as Al-P, Fe-P and organic-P. Mixing of coal fly ash and chicken manure with relatively different characteristics is expected to be able to improve its quality as ameliorant to improve soil quality and crop production.

## 3.2. Some Chemical Charactheristics of Coal Fly Ash and Chicken Manure Mixture

Changes in pH, organic C, cation exchange capacity (CEC), and avilable P in different combinations of fly ash-chicken manure mixture are presented in the Table 2. The mixed of fly ash-chicken manure had a lower pH, which may be due to the accumulation of organic acids from microbial metabolism during decomposition processes (Sajwan *et al*., 2006).

The pH values for all treatments tend to decreased with incubation time, and the decrease in pH was greater with higher rates of chicken manure. pH decreased up to 45 days of incubation is relatively larger than the decrease in pH at 60 days of incubation. The results suggest that chicken manures and fly ash play a significant role in decomposition processing, which tend to increase up to 45 days of incubation. In 45 and 60 days of incubation, solution pH for the composition of fly ash-chicken manure 2:2 was the lowest (7.77 – 7.69) compared to other treatments. In this pH range, the solubility of trace elements would be low, as adsorption and precipitation reactions would decrease their solubilities (Sajwan *et al*. 2006).

Furthermore, P-available, C-organic and cation exchange capacity value tends to increase due to the addition of chicken manure on coal fly ash. P-available, C-organic and mixed cation exchange capacity tends

to increase with increasing ratio of chicken manure added up to the composition of the 1:3 mixture. Microorganisms activity were reported to increased with the addition of organic matter and caused the increases of plant nutrients availability (Bhattacharya and Chattopadhyay, 2002; Sajwan et al., 2006).

Table 2. Some chemical characteristics of the coal fly ash and chicken manure mixture at each incubation time

| Treatments | 15 DI | | | | | 30 DI | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pH (1:1) | | C-org | CEC | P-avail | pH (1:1) | | C-org | CEC | P-avail |
| | $H_2O$ | KCl | (%) | ($Cmol_+ kg^{-1}$) | (µg $g^{-1}$) | $H_2O$ | KCl | (%) | ($Cmol_+ kg^{-1}$) | (µg $g^{-1}$) |
| Alone | 9,02 | 8,91 | 0,11 | 12,75 | 6,00 | 8,98 | 8,85 | 0,14 | 13,05 | 14,45 |
| CM Alone | 8,25 | 8,07 | 9,22 | 35,25 | 98,40 | 8,07 | 7,76 | 8,50 | 38,75 | 124,05 |
| FA:CM (3 : 1) | 8,34 | 8,07 | 2,62 | 18,00 | 44,40 | 8,22 | 7,97 | 2,77 | 19,15 | 49,65 |
| FA:CM (2 : 2) | 8,28 | 8,13 | 4,25 | 23,50 | 77,70 | 8,09 | 7,83 | 4,47 | 23,50 | 83,70 |
| FA:CM (1 : 3) | 8,34 | 8,09 | 6,91 | 28,73 | 88,65 | 8,11 | 7,76 | 6,91 | 32,20 | 97,80 |
| | 45 DI | | | | | 60 DI | | | | |
| Alone | 8,81 | 8,70 | 0,14 | 14,70 | 14,25 | 8,82 | 8,80 | 0,12 | 15,23 | 17,40 |
| CM Alone | 7,96 | 7,62 | 9,93 | 45,68 | 133,95 | 7,87 | 7,63 | 9,93 | 39,15 | 134,10 |
| FA:CM (1 : 3) | 7,93 | 7,70 | 2,98 | 19,28 | 51,55 | 7,84 | 7,64 | 2,69 | 17,40 | 68,55 |
| FA:CM (2 : 2) | 7,77 | 7,45 | 4,82 | 26,10 | 94,80 | 7,69 | 7,42 | 4,75 | 21,75 | 88,35 |
| FA:CM (3 : 1) | 7,81 | 7,48 | 7,80 | 39,15 | 118,35 | 7,73 | 7,45 | 7,62 | 30,45 | 105,45 |

DI =Days of Incubation

In addition, levels of available P, organic C and CEC on chicken manure is relatively high (Table 1), thus contributing to the increased availability of P, C-organic content and CEC value of the mixture. Composting of coal fly ash and organic manure has been an effective way to improve the nutritional status of the mixture, via increases in cation exchange capacity (CEC) and by provision of some essential nutrients (Carlson and Adriano, 1993; Bhattacharya and Chattopadhyay, 2002; Sajwan *et al*., 2006).

### 3.3. pH and Point of Zero Charge (PZC) of Coal Fly Ash and Chicken Manure Mixture

One of the obstacles in the soil with heavy weathering intensity has a high value of PZC and at low pH tend to have a positive charged. Therefore, cations are easily leached and soil fertility conditions deteriorate. Theoretically, cation loss can be prevented by developing negative surface charge and thus creating additional cation exchange capacity (CEC) (Uehara and Gillman 1981). This can be obtained either by raising soil pH, increasing the electrolyte concentration in the soil solution or lowering the PZC. PZC is a point, where the net charge of variable charge components is zero due to the equal $H^+$ and $OH^-$ adsorption on them. If the pH of a soil is above its PZC the soil surface will have a net negative charge and predominantly exhibit an ability to exchange cations (CEC— exchange of one positive ion by another), while the soil will mainly retain anions (electrostatically) if its pH is below its PZC (AEC—exchange of one negative ion for another) (Sakurai *et al*., 1988). Soil amendments that may affect these soil properties include lime, phosphate, silicate and organic matter application. Fly ash is considered to be a rich source of Si, thereby potentially for lowering the value of PZC. Organic matters have a low PZC value, so it can function to lower the PZC and increasing negative charge (Uehara and Gillman, 1981). In addition, the ionization of functional groups of organic compounds can produce a number of negative charge on the surface of colloidal so PZC value will decrease (Stevenson, 1982).

Changes in pH and point of zero charge (PZC) value in different combinations of fly ash-chicken manure mixture are presented in the Table 3. Results of analysis of variance showed that the mixture of coal fly ash and chicken manure with 2:2 composition at 45 and 60 days of incubation have a lowest PZC and pH values and significantly different composition than the other mixed. Meanwhile, at the 15 and 30 days incubation, between each of the all composition does not show any significant differences. Cyclic changes in soil pH with time possibly a result of the changes in soil microbial activity (respiration, decomposition of organic matter and mineralization of C and N) controlling the release of $H^+$ (Bloom *et al.*, 2005). This also suggests that the incubation period for 45 days has reduced the value of PZC. It also seems that chicken manure has a role in lowering the PZC of the mixtures. Organic acids result from weathering of organic material, can reduce the value of the PZC. PZC is expected to decline due to the sorption of organic anions

by oxide-hidrus Al and Fe (Ali and Sufardi, 1999). This indicates that manure can reduce the status of PZC, increasing the amount of negative charge and CEC after 45 days of incubation. Overall these studies showed that mixture of fly ash and chicken manure (2:2) as a soil amendment could provide benefits in terms of soil fertility and lowering PZC.

Table 3. pH and point of zero charge (PZC) value of the coal fly ash-chicken manure mixture at each incubation time (Days of Incubation)

| Treatments | PZC | | | | pH $H_2O$ (1:1) | | | |
|---|---|---|---|---|---|---|---|---|
| | 15 DI | 30 DI | 45 DI | 60 DI | 15 DI | 30 DI | 45 DI | 60 DI |
| FA Alone | 8,70 B | 8,73 B | 8,68 C | 8,50 C | 9,02 B | 8,98 B | 8,81 C | 8,82 C |
| CM Alone | 7,47 A | 7,04 A | 6,71 B | 6,89 B | 8,25 A | 8,07 A | 7,96 B | 7,87 B |
| FA:CM (1 : 3) | 7,90 A | 6,77 A | 6,66 B | 6,74 B | 8,34 A | 8,22 A | 7,93 B | 7,84 B |
| FA:CM (2 : 2) | 7,33 A | 6,67 A | 5,84 A | 5,76 A | 8,28 A | 8,09 A | 7,77 A | 7,69 A |
| FA:CM (3 : 1) | 7,40 A | 6,79 A | 6,58 B | 6,55 B | 8,34 A | 8,11 A | 7,81 AB | 7,73 A |
| Sig. | ** | ** | ** | ** | ** | ** | ** | ** |
| LSD(0,01) | 0,70 | 0,53 | 0,33 | 0,41 | 0,11 | 0,15 | 0,15 | 0,05 |

Means followed by a same letter are not significantly different at the 1% level by LSD

## 4. Conclusion

The coal fly ash and chicken manure mixture with incubation time tended to decrease of the PZC status compared with the coal fly ash and chicken manure alone. Among the different combinations of coal fly ash and chicken manure mixtures, the 2:2 mixture at 45 days incubation time appeared to exhibit the lowest of the PZC compared with the other treatments. This composition could be use as an amelioran to improve the soils chemical properties in terms of soil fertility and lowering PZC, and it is necessary for further research.

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# The Decrease of Pempek Lenjer Quality During Storage at Room Temperature

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**Abstract.** The research objective was to study the effects of temperature and formulation on shelf life of pempek lenjer at room temperature. Treatments in this study were four levels of pempek formulation ($X_1$), five levels of temperature ($X_2$)and nine levels of shelf life ($X_3$). Data was analyzed by using multivariant regression through computer program of SPSS ver 17. The results showed that higher tapioca flour addition results in higher values of texture, pH and color whereas total volatile nitrogen (TVN) and total microbes (TPC) were lower. Higher temperature at center point of pempek results in higher values of texture, pH, color and total microbia but TVN value was relatively constant. Longer storage time results in lower values of texture (elasticity), pH and color whereas TVN and total microbes were higher. The maximum shelf life of pempek was 30 hours.

**Keywords:** quality, shelf life, pempek

## 1. Background

Pempek is one of South Sumatra traditional food made from milled fish flesh, tapioca flour or sago palm flour, water, table salt and spices as flavour enhancement. Pempek can be developed into larger industrial scale. The main problems for current pempek industry were diverse quality and short shelf life because the pempek producers, especially for small scale industry, were frequently changed the pempek formulation and the optimum cooking duration and temperature were not yet developed which results in decreasing of quality especially in term of nutrients and deterioration due to excessive heat treatment that gave impact on relatively short shelf life of pempek. Provision of food industry product should be accompanied by assurance of food safety and quality.

Pempek processing stages were consisted of fish flesh milling, ingredients mixing, pempek forming and cooking (Karneta, 2010). Cooking stage (boiling) is one of important stage because heat and mass diffusions were occurred at this stage as well as physicochemical reactions such as protein denaturation and starch gelatinization. Temperature increase of boiled product is affected by the heat transfer rate from boiling water into product through convection process and heat transfer within product was occurred through conduction process (Huang and Liu, 2009). Conduction heat transfer on heated product was located at the slowest heating point (cold point), i.e at center of product (Jaczynski and Park, 2002; Opaku, 2006). Heat diffusivity characteristic was affected by product chemical composition, product structure and temperature (SilalahidanTambunan, 2005; Sun, 2006). The research objective was to study the effect of temperature and pempek formulation on pempek shelf life at room temperature.

## 2. Method

Materials used in this research were tapioca flour, snake head fish (*Ophicephallusstriatus*Blkr), table salt (NaCl) and ice water. Snake head fish was bought from Cinde Market of Palembang with average weight of 400 to 500 grams per fish. Treatments in this research were as follows:

$X_1$: Fish and flour formulation having ratios of :
$X_{1.1}$ = 1 : 0,5 ; $X_{1.2}$ = 1 : 1,0 ; $X_{1.3}$ = 1 : 1,5 and $X_{1.4}$ = 1 : 2,0.
$X_2$ :Temperature treatments on center point of pempek :

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$X_{2.1}$ = 75$^0$C ; $X_{2.2}$ = 80$^0$ C ; $T_{2.3}$ = 85$^0$ C ; $T_{2.4}$ = 90$^0$ C and $T_{2.5}$ = 95$^0$C.
$X_3$ = Storage time (hours) :
$X_{3.1}$ = 0 hour (control); $X_{3.2}$ = 6 hours ; $X_{3.3}$ = 12 hours ; $X_{3.4}$ =18 hours ; $X_{3.5}$ = 24 hours; $X_{3.6}$ = 30 hours; $X_{3.7}$ = 36 hours ; $X_{3.8}$ = 42 hours and $X_{3.9}$ = 48 hours.

Procedure:

a. Pempek dough processing was based on their formulations by addition of water and 2.5% table salt. Water addition was conducted according to the following formulation :75% dough weight – (fish water content x fish weight) – (flour water content x flour weight).
b. Weighing of 350 grams pempek dough followed by pempek molding in cylindrical form which was then boiled within water bath at temperature of 100 $^0$C. Temperature measurement on pempek was conducted by using thermocouple line of K-type (chromel + and allumel -) installed on sample container during boiling. The use of thermocouple line was to guarantee that sample temperature measurement was at pempek center point. Samples that had achieved center point temperature of 75 $^0$C, 80 $^0$C, 85 $^0$C, 90 $^0$C and 95 $^0$C were raised and leaked through.
c. The cooked pempek based on its center point temperature was then leaked through and stored at room temperature. The pempek deterioration was observed every 6 hours through textural change (elasticity) by using *texture analyzer*, color change by using Munsell system, pH (AOAC), Total Volatile Nitrogen (TVN) by using AOAC method and Total Microbes (TotalPlate Count. TPC).

# 3. Result and Discussion

## 3.1. Colour

The research results showed that fish formulation produced pempek with lower lightness value (achromatic color or color brightness), whereas chroma (color intensity) and hue (chromatic color) values were higher. The longer the storage time, the lower was the lightness value but chroma and hue values wer higher. Measurement results of pempek lightness (color brightness) were in the range of 53.3 to 75.5 and their values were decreased after 48 hours storage in the range of 46.4 to 61.0. Lightness or achromatic color within the rangeof 0 to 25 was black, within the rangeof 25 to 70 was dark grey, within the rangeof 70 to 80 was light grey and within the rangeof 80 to 100 was white (Soekarto, 1990). The effect of formulation, temperature and shelf life on the change of pempek color was described by the following model :

$$Y = 86{,}382 + 3{,}981X_1 – 0.379X_2 – 0{,}228X_3 \quad (R^2 = 0{,}952) \quad (1)$$

Pempek storage subsequently decreased its color brightness or lightness. According to Haryadi (1995), flour gel during storage gradually became blur and turbid which was followed by deposition*(retrogradation*). According to Kang (2007), the color brightness of fish gel (kamaboko) was also determined by fish freshness.

Measurement results of pempek chromatic color (hue) were in the range of 53.0to64.8 and their values were increased after 48 hours storage in the range of 69.0to77.2. The effect of formulation, temperature and shelf life on the change of pempek chromatic color (hue) was described by the following model :

$$Y = 44{,}667 – 2{,}506\ X_1 + 0{,}230X_2 + 0{,}290\ (R^2 = 0{,}968) \quad (2)$$

The chromatic color (hue) represents true color such as red, violet andyellow. Hue is usedto differentiate colors and to determine redness, greenness etc. as well as related to light wavelength. Hue has value in the range of 0 to 360 degree with spectrum as follows : 0 degree (red), 60 degree (yellow), 120 degree (green), 180 degree (blue), 240 degree (purple) and 360 degree (reddish purple)(Soekarto, 1990).

Measurement results of pempek color intensity (chroma) were in the range of 4.0to6.8 and their values were increased after 48 hours storage in the range of 4.8 to 8.3. The effect of formulation, temperature and shelf life on the change of pempek color intensity (chroma) was described by the following model :

$$Y = 1{,}754 – 0{,}700\ X_1 + 0{,}60\ X_2 + 0{,}27\ X_3 \quad (R^2 = 0{,}972) \quad (3)$$

Chroma or color intensity is color level based on its sharpness which has function to define the color of an object that tend to be pure or dirty (gray). The color intensity or chroma represents intensity of chromatic color that have values in the range of 0 (colorless) to 10 (colorfull).

### 3.2. Texture (elasticity)

The research results showed that fish formulation produced pempek with lower value of texture (elasticity). High temperature had effect on higher value of texture (elasticity). Initial measurement of pempek texture gave average value in the range of 317.2 to 811.6. The values of pempek texture were decreased after 48 hours storage in the range of 216.2 to 586.2. The effect of formulation, temperature and shelf life on the change of pempek texture (elasticity) was described by the following model :

$$Y = - 17{,}417 + 109{,}892\ X_1 + 3{,}710\ X_2 - 4{,}301\ X_3\ (R^2 = 0{,}977) \quad (4)$$

Texture is an important characteristics in evaluation of pempek quality. Higher addition of tapioca flour would increased starch gelatinization capacity due to availability of water and heat which results in elastic texture of pempek. Tapioca flour has function as binder agent that capable to improve texture, but excessive addition of tapioca flour will results in elastic texture. Protein content has significant effect on pempek texture. Protein content within fish flesh that has effect on texture is actomiosin. Prevention of actomiosin denaturation is one of the most important factor to take into account. One method to prevent actomiosin denaturation is by using highly fresh fish as raw material (Wang, 2011) and maintaining constant low temperature during handling (Astawan*et al*., 1996). Starch has two fractions which consisted of amylose and amylopectin. Amylose has effect on gel hardness, whereas amylopectin has effect on gel elasticity.

### 3.3. Total Volatile Nitrogen (mg/100g)

The research results showed that fish formulation produced pempek with higher value of total volatilenitrogen. High temperature had effect on lower value of total volatilenitrogen. Measurement results of total volatilenitrogen of pempek were in the range of 6.11 to 8.52. The values of total volatilenitrogen of pempek were increased after 48 hours storage in the range of 12.89 to 19.76. The effect of formulation, temperature and shelf life on the change of total volatilenitrogen of pempek was described by the following model :

$$Y = 3{,}501 + 0{,}70X_1 - 1{,}030\ X_2 + 0{,}409\ X_3\ (R^2 = 0{,}992) \quad (5)$$

Total volatile nitrogen is one of parameter to determine quality deterioration of fish and fish derived products. TVN measurement on pempek was conducted to determine the rottenness indication of protein containing in food product. The increase of TVN concentration on pempek during storage was due to protein degradation and its derivatives by proteolytic bacteria activity that decompose protein into simpler protein coumpounds which consisted of highly volatile bases such as ammonium, trimethylamine, histamine, indole, $H_2S$ andskatol as well as breakdown of TMAO (Trimethyl Amine Oxide) into TMA (TrimethylAmine). The acceptable maximum concentration of TVN for food products was 20 mg/100 gram (Castro *et al.*, 2012) and about 30-35mg/100gramin case of fish flesh (Huss.1988 *in*Kaba, 2006 ., Amegovu*et al.*, 2012). Pempekthat had been stored for 24 hours was still consumable because it hasTVN maximum concentration of 18 mg/100 gram material, whereas 36 hours storage was in the range of 20 to 24 mg/100 gram material and 48 hours storage was in the range of 25 to 29 mg/100 gram material. Therefore, it can be concluded that pempek stored for 48 hours was started to deteriorate and no longer consumable.

### 3.4. pH

The research results showed that fish formulation produced pempek with lower value of pH and high temperature results in higher value of pH. The pH measurement results for pempek were in the range of 6.68 to 6.93.The pH values of pempekwere decreased after 48 hours storage in the range of 5.62 to 6.32. Therefore, pempek is classified as low acid food. The effect of formulation, temperature and shelf life on the change of pH of pempekwas described by the following model :

$$Y = 6{,}908 + 0{,}002\ X_1 + 0{,}000944\ X_2 - 0{,}016\ X_3\ (R^2 = 0{,}892) \quad (6)$$

The pH of pempekwas depend on pH of fish flesh material, i.e lower fish quality results in lower pH.pH value for fresh fish is 6.9 and for unfresh fish is in the range of 6.4 to 6.9 due to decrease of glycogen concentration. According to Wang (2011), fish gel formation of product is not occurred if pH value is less than 6. The decrease of pH value during storage was due to decomposition of protein and carbohydrate into simpler compundsas a results of microbe and enzyme activities. This was in accordance to the increasing numbers of total microbes at the end of storage period.

### 3.5. Total Microbe (TPC)

The highest value of total microbes at initial shelf life was found in treatment combination of formulation 1 and $95^0$ C with magnitude $9.1x10^4$ colonies/gram, whereas the lowest total microbes was found in treatment combination of formulation 4 and $75^0$ C with magnitude $1.0x10^4$ colonies/gram. Results of total microbes analysis at 24 hours storage from several treatment combinations had indicated some deterioration, especially at pempek formulation containing higher fish flesh content with exception of formulation 4 that had relatively good quality due to TPC content with magnitude of 7.2 x $10^5$colonies/gram. All treatments at 30, 42 and 48 hours storage time had TPC values of $10^6$colonies/gram, $10^7$colonies/gram and $10^8$to $10^9$coloniesi/gram, respectively.The effect of formulation, temperature and shelf life on the change of TPC of pempek during storage was described by the following model :

$$Y = 1{,}528 - 0{,}096\ X_1 + 0{,}035\ X_2 + 0{,}092\ X_3 \quad (R^2 = 0{,}989) \qquad (7)$$

The numbers of aerobic microorganism on food material can be determined from its TPC concentration in which the numbers of bacteria, fungi and yeast were increased during storage. Microbes growth during storage was due to availability of organic components especially protein, carbohydrate and water within pempek. Microbes growth within food will produce several metabolites or byproduct which are associated with deterioration characteristics. Based on the standard from Dirjen POM No.03726/B/SK/VII/1989, the maximum limit for microbes or TPC within food, fish and fish products was $10^6$colonies/gram (Dirjen POM, 1989). The maximum limit of microbes number for products made of fresh fish was $10^6$colonies/gram and it is still organoleptically acceptable up to $10^8$colonies/gram although mucous had already been developed on products (Kaba, 2006.,Amegovu*et al*, 2012).

## 4. Conclusion

1. Higher addition of tapioca flour produced higher values of texture (elasticity), pH and color of pempek, but produced lower values of total volatile nitrogen (TVN) and total microbes (TPC). Higher temperature at pempek center point produced higher values of texture, pH, color and total microbes, but produced relatively the same value of total volatile nitrogen (TVN). Longer storage time produced lower values of texture (elasticity), pH and color of pempek, but produced higher values of total volatile nitrogen (TVN) and total microbes (TPC).
2. Deterioration mechanism of pempek lenjer during storage was initiated by the change of textural characteristics, mucous formation on surface of pempek, color change, decrease of pH as well as microbes availability, especially fungi and khamir.
3. The shelf life of pempek can be predicted by model that relating formulation and temperature, total volatile nitrogen, total microbes, pH, color and texture. Maximum shelf life of pempek was 30 hours.

## 5. Recommendation

1. Further research is needed to prolong the shelf life of pempek with packaging.
2. Pempek quality standard is required in order to maintain consistent quality.

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# Effect of Foaming Agents On *Pandan* Leaf Powder Characteristics Processed by Foam Mat Drying Method

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**Abstract.** The objective of this study was to determine the effects of foaming agents addition using foam mat drying method on *pandan* leaf powder characteristic. Two factors were investigate, namely kinds od foaming agens (egg white albumin and carboxy methylcellulose) and their concentration (3 and 7% (w/w) and 0.25 and 0.75% (w/w) for albumin and carboxy methylcellulose, respectively). Three paramaters were observed in this research, including moisture content, wettability and dispersibility. The result showed that concentration of foaming agents showed significant effects on moisture content, wettability and dispersibility of *pandan* leaf powder. In other words, the increase in foaming agent concentration resulted in powder with lower moisture content and wettability, and higher dispersibility.

**Keywords:** *Pandan* leaf powder, foam mat drying, foaming agents.

## 1. Background

The use of food additives in food processing raised consumer's concern in latest decade. Food additives commonly used in food processing are for example coloring and flavoring agents. *Pandan* (*Pandanus amaryllifolius*) leaf is tropical plant widely used as flavoring and coloring agents in Southeast Asia countries such as Indonesia, Malaysia and Thailand. *Pandan* leaf is known for natural green color source from its chlorophyll content. This natural green color has potential to be used as food colorant for snack, bread, beverage and cosmetics industry [1][2]. In addition, *pandan* leaf is also used as flavoring agents for food, beverages and perfumery. The major flavor compound in *pandan* leaf is 2-acetyl-1-pyrroline which produced popcorn-like aroma [3]. However, bioactive compound content may change during food processing.

Food additive can be applied in powder form. Powdered product has advantages in handling and storage. It is also applicable for preparing several products like snack, beverages, pastry and paste [4]. Drying is one of processing method to produce food powder. Several factors affected drying process including time and temperature of drying. Drying using high temperature could be done in shorter time but lead to change in characteristics of dried product, while lower temperature require longer drying time [5]. Foam mat drying is method often used to produce powder with acceptable characteristics. This method does not require high temperature and needs only shorter time for drying. Foam mat drying is conducted with convertion of liquid or semi-liquid food into stable foam using foaming agents before drying [6][4]. This research aim was to study characteristics *pandan* leaf powder using different type and concentration of foaming agents.

## 2. Literature Review

### 2.1. Pandan (Pandanus amaryllifolius) Leaf

*Pandan* (*Pandanus amaryllifolius*) belonged to pandanaceae family which produced specific flavor. This plant is widely planted in Southeast Asia country such as Indonesia, Malaysia and Thailand and used as spices, coloring and flavoring agents [8][9]. In Indonesia, there were three species of *pandan*, namely *Pandanus amaryllifolius*, *Pandanus latilifolius* and *Pandanus odoratisimus* [7]. The leaf contained chlorophyll as green source color [2][1]. *Pandan* leaf was also known for popcorn-like flavor which was produced by 2-acethyl-1-pyrroline compound [8][10]. Therefore, *pandan* leaf could be applied as coloring and flavoring agents. It was widely used in food and cosmetic processing.

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Nowadays, there is increasing health knowledge and awareness of consumers not to use synthetic coloring and flavoring agents as food additive in food processing [11]. Referring to bioactive compound contained in *pandan* leaf, it has potential to be developed as natural coloring and flavoring source. Previous study showed that coloring and flavoring compound contained in *pandan* leaf. Extraction and heating processes is applied in order to obtain coloring and flavoring compound from *pandan* leaf [8][9][2]. There is possibility to produce powder from *pandan* leaf to increase its storage stability and handling.

### 2.2. Foam mat drying

Drying is defined as water removal using thermal energy to extent certain limit of water activity which inhibit microbes metabolisms and growth, but it could lead to changes in both desireable and undesireable characteristics [12][13]. Conventional drying such as solar drying could cause damage in sensory and nutritional values of dried product [14]. Foam mat drying is dehydration process which convert liquid or semi-liquid product into a stable foam. It has some advantages such as suitable for heat-sensitive agents, using low heat, and require short time [15]. Producing instant carrot powder using a combination of vacuum and foam mat drying requires a lower temperature and short time compare with vacuum drying [16]. It also maintain phytochemical characteristics of the dried agent. Drying *Aloe vera* skin using this method showed total phenolic content of 34.29% [17], whereas drying spirulina produces powdered with beta-carotene content of 140 mg/100 g of agent [18].

Foam-mat drying conducted through pretreatment and agents preparation, conversion liquid concentrate into stable foam, agent drying and grinding into powder. Conversion process of liquid concentrate into a stable foam is important in this method. Factors influencing foam formation are, total soluble solids, time and temperature during foaming as well as type and concentration of foaming agents. Total soluble solids affected density and stability of the foam formed, whereas types and different concentrations of foaming agent produced different final dried products. Concentration of foaming agent used in the manufacture of powder was influenced by characteristics and type of foaming agent used [6].

## 3. Materials and Method

### 3.1. Experiments and agents preparation

*Pandan* leaf were obtained from traditional local market in Palembang South Sumatera. All supporting materials were locally available. Samples was prepared by reducing pandan leaf size by cutting into same size. *Pandan* leaf was then crushed using blender with addition water with water ratio of 3:1. A 10% maltodextrin was added to crushed *pandan* leaf. After that, foaming agents were added according to treatments. Two factors were investigated, namely foaming agents (egg white albumin and carboxy methylcellulose) and their concentration (3 and 7 percent for egg white albumin and 0.25 and 0.75% for carboxy methylcellulose (CMC) with two replications measurement. All samples was dried in tray oven with temperature of $50^{o}$ C ± $2^{o}$ C for 3 hours ± 5 minutes. The dried samples were then mashed and filtered (40 mesh). The following parameters were observed, including moisture content, wettability and dispersibility.

### 3.2. Samples Analysis

#### 3.2.1. Moisture content

Moisture content analysis use gravimetry method based on AOAC [19]. A 2 g sample was weighted into a crucible that already weighted previously. The sample was then transferred to oven at 105 $^{o}$C until constant weight was . Samples were then moved to desicator for 15 minutes for cooling and then weighted. The difference in values between wet and dried sample was calculated, then divided by wet samples weight, and calculated as moisture content percentage.

### 3.2.2. Wettability

Wettability was described as time to disperse in the water and measured in second at room temperature. Wettability was determined with the method described by Park *et al.* [20]. A 0.4 g sample was weighted and filled to 40 ml aquadest in graduate cylinder.

### 3.2.3. Dispersibility

The dispersibility was measured according to Kulkarni *et al.* (1991)[21] with slight modification. The amounts of 1 gram of sample was dispersed in distilled water in 25 ml graduate cylinder at pH 7. The distilled water was then added until 10 ml. The mixture was stirred vigorously and allowed to settle for three hours. The volume of settle particles was subtracted from 10 and multiplied by 100, and the result was reported as dispersibility percentage.

## 4. Result and Discussion

### 4.1. Moisture Content

Result of moisture content of this research is shown on Figure 1. The moisture content was affected by type and concentration of foaming agents used during foaming. Foaming stability was influenced by some factor such as type and concentration of foaming agents used, as well as time and temperature during foaming [6].

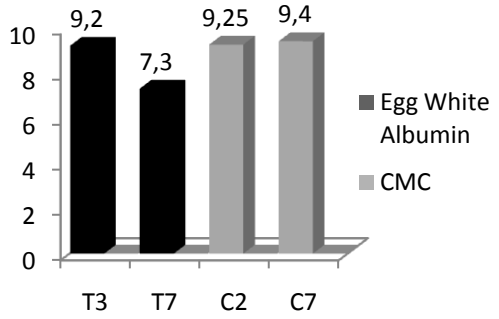


Fig. 1: Moisture content of pandan leaf powder

Result showed that increasing foaming agents concentration influenced moisture content values. Increasing concentration of egg white foaming agents will decrease the moisture content, while increasing CMC concentration will increase the moisture content. Egg white is foaming agents widely used and perform a good foam stability [22], while CMC showed increasing viscosity of mixture in concentration higher than 0.5%. This affected foam formation [23]. Increasing concentration of foaming agents will increase foam formation during foaming process, decrease drying time and increase water evaporation during drying. It was becaused water from agents could be easily removed trough foam from the surface of agents. Water removal from foaming agent drying was faster and easier than drying same agents without foaming, and resulted in lower moisture content of agents. This results were supported by previous research in drying of tomato juice that showed the same phenomena which was increasing concentration of foaming agent being decrease in moisture content [24]. *Pandan* leaf powder showed a good characteristic at 10% moisture content [7], while powder product generally contained 4% or less [25].

### 4.2. Wettability

It was shown that wettability time of pandan leaf powder was between 8.2 and 14.0 seconds (Figure 2). The type and concentration of foaming influenced the wettability time for *pandan* leaf powder. Wettability was a characteristic that was influenced by rehydration of dried product [13].

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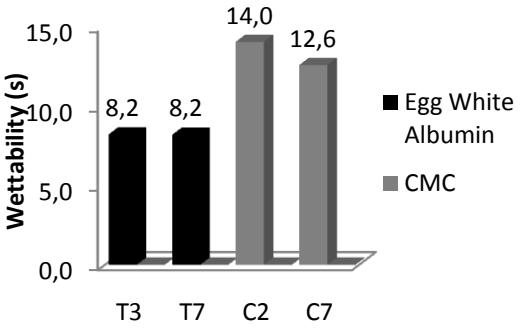


Fig. 2: Wettability of pandan leaf powder

Increasing foaming agents concentration influenced wettability time. Both type of foaming agents showed decreasing wettability time because of increasing concentration of foaming agents. Wettability of dried product was affected by its dispersing ability in water. Factors affecting dispersing ability were porosity and chemical composition of product [26]. Porosity of the powder contributed on rehydration. The two foaming agents used in this investigation was widely used as emulsifier. Increasing foaming agents concentration will produce porous powder after drying process. It has relationship with increasing foam formation during foaming that increased concentration of foaming agents. This led to increase in foam formation. Dried powder resulted from foam mat drying had porous structure which enabled water absorption during rehydration. This product showed good characteristic for rehydration and produced good solubiliy when dissolved in water [23][24].

## 4.3. Dispersibility

Dispersibility of *pandan* leaf powder was showed on Figure 3. The higher concentration of foaming agent increased dispersibility of powder. Dispersibility is a characteristic of instant powder or flour product that showed powder ability to dissolve in the solvent. It was influenced by some factors such as particle size and water reabsorption [13][27].

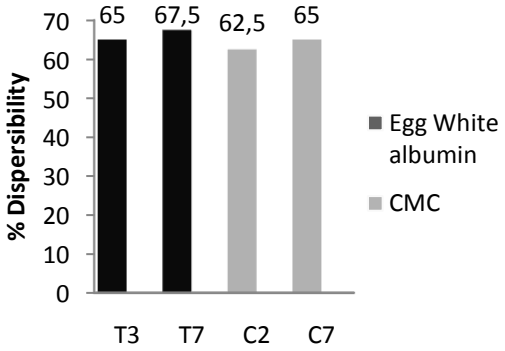


Fig. 3: Dispersibility of *pandan* leaf powder

Water rehydration ability of powder led particle to swell. This was caused by water absorption in the powder matrix. Higher ability in reabsorption caused higher water absorption in the powder matrix and consequently increased its dispersibility [24]. Porous particle contributed in water reabsorption and increased dispersibility. Particle size also influenced dispersibility. Particle with larger size absorbed water easily and decreased dispersibility. It was reported that mango powder with 50 mesh particle size have higher dispersibility compared to mango powder with 80 mesh particle size [27]. Dispersibility of powder increased with increasing sinkability and was reduced by agglomerate formation during dispersion [28].

# 5. Conclusion

It was conlcluded that type and concentration of foaming agents affected moisture content, wettability and dispersibility of *pandan* powder leaf significantly. Result showed that egg white albumin concentration of 7% contained moisture content of 7.3%, wettability of 8.2 s and dispersibility of 67.5%, whereas concentration of 0.75% of CMC showed moisture content of 9.4%, wettability of 11.2 s and dispersibility of 65%. Egg white albumin addition resulted in therefore better *pandan* leaf powder characteristics.

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# The Effects of Climate Change on Plant Diseases and Possible Means for Their Mitigation

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**Abstract.** This paper aimed at explaining the possible effects of climate change on the interaction among environment, plant and pathogen, and proposing possible means for mitigating the effects on plant disease. Based on literature review, it is clear that climate change has direct effects on pathogens, on plant-pathogen interactions, and has indirect effects on microbial interactions. Prolonged periods of environmental conditions (temperature, presipitation and relative humidity) that close to the optimal for the development of the pathogen lead to more severe epidemics. Climate change may directly affect several aspects of the biological of the host plants, including their phenology, sugar and starch contents, nitrogen and phenolic contents, root and shoot biomass, number of size leaves, changes in stomatal densities and conductance and root exudation. Any change of these areas may affect infection and colonization by pathogens. Short-term and long-term changes in the abiotic conditions under which plants are grown may influence not only the growth and the productivity of plants but also the populations of microorganisms living on plant surfaces. Mitigating means for climate 's effects can be among the followings: a comprehensive studies on the impact of climate change on the development of plant pests and diseases are needed as to determine appropriate measures which can be adopted by government and farmers. Better understanding by farmers is required as to adjust cultural practices in their farming systems to the climate changes that take place in their localities. Indigenous knowledge which is the bases for arranging the proper planting time in places like Java can be retrieved as traditionally successful pest management. Bio-intensive IPM which optimize the existing bioresources can be applied seriously which require cooperation among goverment, universities, research centers and all components of civil society

**Keywords:** climate change, effects, plant pathogens, plant diseases, mitigation.

## 1. Background

Changes in environmental conditions are intimately associated with differences in the levels of crop yield loss caused by a disease because it significantly affects the environment plants, pathogens and their antagonism. The changes were closely related to global warming (for example an increase in temperature, changes in the quantity and pattern of rainfall, increased CO2, ozone levels, drought, etc). That all may affect the incidence and severity of plant diseases and affect the co-evolution of plants and pathogens (Garrett *et al*., 2006). Environmental conditions such as temperature and relative humidity affect development of diseases cause by Phytophthora spp (Duniway, 1983). This paper tries to explain the possible effects of climate change on the interaction among environment, plant and pathogen, and proposing possible means for mitigating the effects on plant disease.

## 2. Climate Change's Direct Effects on Pathogens

Environmental factors can directly affect several aspects of the biology of a pathogen. More severe epidemics are the result of optimal condition of prolonged periods of environmental conditions. As temperatures increase, many pathogens will spread into new geographic areas, where they will come into contact with new potential hosts. Pathogen survival in the absence of a host can also be influenced by temperature and relative humidity.

The strongest consequences of global warming are believed to take place in tropical countries like Indonesia because tropical species have narrow temperature growth range and are therefore, relatively vurnerable to changes in temperature. According to Ghini *et al*. (2011), many tropical species are living very close to their optimal temperature conditions. According to Caffara *et al.* (2012) epidemics involving

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polycyclic pathogens are strongly affected by the number of generations of the pathogen within a particular time period. Temperature and moisture govern the rate of reproduction of a number of pathogens. The longer growing seasons which will result from global warming will extend the length of time available for pathogen reproduction and dissemination. Climate change may affect the sexual reproduction of the pathogens thereby increasing the evolutionary potential of invidual populations.

From the concept of disease triangle it is clear that climate change which acts as the physical environmental factor affect strongly a disease development process. The effect of climate factor on pathogen can be towards the life cycle of the pathogen, virulence (ability to infect), infection and pathogen reproduction. According to Garret et al. (2006) and Wiyono (2007) climate change affect a disease development through its effect on genom level, celluler, plant physiological process and pathogen.

## 3. Climate Change's Direct Effects on Plant-Pathogen Interactions

Climate change may directly influence a number of aspects of the biology of host plants, their phenology, the contents of sugar and starch, the contents of ntrogen and phenolic, biomass and composition of wax on leaves, changes in stomatal densities and conductance and root exudation. Any change in any of the areas may affect the infection and colonization by pathogens.

In contrast, several diseases are less severe when the availability of moisture is limited. Drought can reduce root growth, that reduces the chance which roots will come into contact with propagules of soil-borne pathoghens, decreasing the insidence of infection. Factors that influence plant growth, such as elevated levels of CO2, increased temeperature or drought, may lead to changes in the physiology of host species which will deeply alter the colonization of host tissues by biotrophic pathogens. The stress of physical environment may induce the activation of general defence pathways in plants, that increase resistance, buat also increase vurnerablity of the plants to certain pathogens (Wiyono, 1997; 2007).

## 4. Climate Change's Indirect Effects on Microbial Interactions

Garret *et al*. (2006) reported that increased levels of CO2 in the atmosphere are expected to have major consequences on carbon cycling and the functioning of a number of ecosystems. The increase of CO2 and temperature levels and nitrogen deposition are important factors influencing soil microbial ecosystem. Therefore, these microbial communities are likely to be affected by climate change.

Changes in abiotic conditions under which plants are grown may affect not only the growth and productivity of these plants but also the populations of microorganisms living on plant surfaces. Changes in the populations of microbia in the phyllosphere may, in turn, influence plant growth and the ability of the plants to withstand aggressive attack by pathogens.

## 5. Possible Means of Mitigating The Effects of Climate Change

Disease development in a crop plantation is the cumulative effect of a number of factors which affect the host and pathogen. A bit of change in microclimatic conditions will affect the outcome of the plant-pathogen interaction. The relationship of plant-pathogen can also be influenced by microbial populations or control agents. Different climate change will have an effect that differ in different plant-pathogen systems.

A comprehensive studies on the impact of climate change on the development of plant and pests and diseases are needed as to determine appropriate measures which can be adopted by government and farmers. Better understanding by farmers is required as to adjust cultural practices in their farming systems to the climate changes that take place in their localities. Indigenous knowledge which is the bases for arranging the proper planting time in places like Java can be retrieved as traditionally successful pest management. Bio-intensive IPM which optimize the existing bioresources can be applied seriously which require cooperation among goverment, universities, research centers and all components of civil society (Wiyono, 2007).

## 6. Conclusions

Climate change has direct effects on pathogens, on plant and on plant-pathogen interactions, and has indirect effects on microbial interactions. Prolonged periods of environmental conditions (temperature, presipitation and relative humidity) that close to the optimal for the development of the pathogen lead to more severe epidemics. Climate change may directly affect several aspects of the biological of the host plants, including their phenology, sugar and starch contents, nitrogen and phenolic contents, root and shoot biomass, number of size leaves, changes in stomatal densities and conductance and root exudation. Any change of these areas may affect infection and colonization by pathogens. Short-term and long-term changes in the abiotic conditions under which plants are grown may influence not only the growth and the productivity of plants but also the populations of microorganisms living on plant surfaces. Mitigating means for climate ‘s effects can be among the followings: a comprehensive studies on the impact of climate change on the development of plant and pests and diseases are needed as to determine appropriate measures which can be adopted by government and farmers. Better understanding by farmers is required as to adjust cultural practices in their farming systrems to the climate changes that take place in their localities. Indigenous knowledge which is the bases for arranging the proper planting time in places like Java can be retrieved as traditionally successful pest management. Bio-intensive IPM which optimize the existing bioresources can be applied seriously which require cooperation among goverment, universities, research centers and all components of civil society.

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# Monensin Clearance Trait and Its Effect on Methanogenesis in The Rumen

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**Abstract.** Monensin were use to mitigate methanogenesis in the rumen. Nevertheless, its clearance trait and residual effect were unclear. This present study was aim to obtain information on monensin clearance trait and its effect on methanogenesis in the rumen. Three ruminally canulated japanese black cow were fed Italian ryegrass straw and concentrate with monensin (30ppm) but without any other antimicrobials. Rumen fluid samples were collected via cannula before morning feed for monensin concentration, methanogen density, and fermentation profiles. These samples were collected on days 0, 1, 3, 5, 7, 10, 14 and 21 after monensin supplementation was ceased.. For *in vitro* incubation, rumen fluid samples were collected at 3h after morning feeding on days 0, 7, 14 and 21. Methane, Hydrogene and Short Chain Fatty Acid were determined. Clearence trait of monensin were related to the profile of methane and hydrogene produced post-ceased supplementation of monensin. Short chain fatty acid also increased rapidly post-ceased monensin supplementation.

**Keywords:** monensin, methanogenesis, rumen, gren house gasses

## 1. Background

Methane, along with other green house gasses (GHG) were address to contribute on global warming which later lead to climate change. Steinfield (2006) reported that over 18% of GHG were atributed to cattle, buffalo, camel, sheep, goat, pig and poultry. Cattle, buffalo, camel, sheep and goat were grouped into ruminant based on similarity of their digestive system. Methane released from digestive system of ruminant was most-drawing public concern. It was illustrated that from one cattle fed daily with 50 kg of grass could release methane 350 L/day and $C0_2$ 150 L/day. Annually methane releases from herd of cattle (500 head) could over 63 million litres. A representative volume to caused global warming. Kobayashi (2010) reported there were methods applied on methane reducing experiment; using hydrogen sink, halogenated compounds and methane-inhibiting chemicals, vaccines, bacteriocins, fats and fatty acids and also using plants extract and ionophore antibiotics such as monensin.

Monensin is a feed additive which alters rumen microbial ecosystem in ruminants. Many studies were carried out to explain biological effects of monensin in the rumen (Schelling, 1984). Kone et al., (1989) also reported that monensin decrease acetate production by 35% in continuous culture while acetate and hydrogen is main precursor of methanogenesis in the rumen, therefore methanogenesis in rumen will be altered afterward. Nevertheless, information on post monensin clearance trait and its effect on rumen methanogenesis were few. This study were done to obtain information on clearance trait and residual effect of monensin to methanogenesis in the rumen.

## 2. Method

**Animal:** Three cow ruminally cannulated crossbreed cows (Japanese Black Cattle x Holstein) 14 months old with average body weight 363 $\pm$ 11 kg were used in this experiments. These animals were fed 21 days before sampling and offered Italian ryegrass straw and concentrate with monensin (30ppm) but without any other antimicrobials. The amount of the straw and concentrate are 1.6kg/day and 6.4kg/day, respectively. The diet was equally divided and offered twice a day at 10:00 and 17:00. Water and mineral block were

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available *adlibitum*. When sampling is started, the animals were offered same diet but without monensin in the concentrate.

**Sampling:**Rumen fluid samples were collected via cannula before morning feed for monensin concentration, methanogen density, and fermentation profiles. These samples were collected on days 0, 1, 3, 5, 7, 10, 14 and 21 after monensin supplementation was ceased. The rumen fluid collected were stored at -25°C until analysis. For *in vitro* incubation, rumen fluid samples were collected at 3h after morning feeding on days 0, 7, 14 and 21. The rumen fluid collected was brought to the laboratory at 39°C and used for *in vitro* incubation.

***In vitro* incubation**: McDougall buffer (Tilley and Terry, 1966) were used for dilution of the rumen fluid. The buffer was pre-warmed at 39°C and pre-gassed with $N_2$. The rumen fluid was strained through 4-layer of surgical gauze with bubbling $N_2$. The strained rumen fluid was diluted with the buffer at the ratio of 1:1. The diluted rumen fluid was then dispensed into the Hungate tube with flushing of $N_2$. The tube was sealed with a butyl-rubber septum and a screw cap. The rumen fluid incubated for 4 hours at 39°C with vigorous shaking at 180 rpm. In the end of incubation, pressure of headspace gas was measured. Composition of headspace gas was analyzed with gas chromatography (Shimadzu GC-8A).

**Monensin concentration**: Monensin concentration was determined with liquid chromatography-tandem mass spectrometry (UPLC-MS/MS).

**Short-chain fatty acid analysis**: Composition and concentration of shortchain fatty acid (SCFA) were analyzed with High Performance Liquid Chromatography (HPLC.)

## 3. Result and Discussion

Profile of gas production in *in vitro* incubation is shown in Table 1. Methane production in day 0 was the lowest compare to the other day but at day 7 its production increased rapidly and decrease again from day 14. In contrast to methane production, $H_2$ production was the highest at day 0 and decreased rapidly. Data of methane and $H_2$ gas at day 0 and 7 were related to the process of methanogenesis in the rumen. In the rumen, methanogens primarily use hydrogen and carbon dioxide, and formate as substrates (Kumar et al., 2009). High methane production in day 7 was related of decreasing $H_2$ production in same day. Wolin and Miller (1988) reported that $H_2$ never accumulated and was utilized by methanogens in ruminants to form methane. This observation was also confirmed with theoretical aspect of methanogenesis in the rumen which involved $H_2$ (Bryant, 1979).

Table 1. Profile of incubation gas production (mL) post-ceased monensin supplementation

| Sampling Time | $CH_4$ | | $H_2$ | |
|---|---|---|---|---|
| Day 0 | 0.17 | ±0.16 | 0.0148 | ±0.0132 |
| Day 7 | 0.75 | ±0.45 | 0.0053 | ±0.0028 |
| Day 14 | 0.41 | ±0.17 | 0.0046 | ±0.0012 |
| Day 21 | 0.45 | ±0.16 | 0.0048 | ±0.0010 |

Values are average ± standard deviation (n = 3)

Proportion of SCFAs, Total SCFAs and monensin concentration are shown in Table 2. Proportion of major SCFAs were similar during experimental period. The concentration of SCFAs was the lowest at day 0 and gradually increased along the period. The concentration was more than 2-times higher between day 0 and 21. Monensin concentration in rumen fluid post-ceased supplementation were decreased along the sampling time, it was lasted only 24 hour (day 1), while on day 3, 5, 7, 10, 14 and 21 monensin concentration were under detectable level. These results are consistent with findings by Rogers et al. (1997) who reported monensin disappeared from rumen within 24 hour. Van Nevel and Demeyer(1992) reported that monensin has been shown to depress methane production by mixed rumen microflora *in vitro*, therefore when monensin decline from rumen on day 1, methane production is increased in this study. The clearance trait of monensin was consistent with the profiles of $H_2$ and methane production in *in vitro* incubation.

Table 2. Proportion and concentration of short chain fatty acids (SCFAs) and monensin

| Sampling Time | Proportion (%) | | | | | | Total SCFAs (mmol/L) | | Monensin (µmol/L) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Acetate | | Propionate | | n Butyrate | | | | | |
| Day 0 | 71.7 | ±3.0 | 15.6 | ±2.9 | 11.7 | ±3.3 | 38.2 | ±4.8 | 0.40 | ±0.08 |
| Day 1 | 67.4 | ±2.8 | 21.3 | ±2.2 | 11.4 | ±1.0 | 68.3 | ±13.2 | 0.16 | ±0.16 |
| Day 3 | 68.3 | ±3.7 | 17.1 | ±2.7 | 14.6 | ±3.0 | 52.7 | ±23.3 | nd | |
| Day 5 | 68.1 | ±3.4 | 18.1 | ±2.7 | 13.8 | ±1.0 | 67.6 | ±15.6 | nd | |
| Day 7 | 68.2 | ±2.6 | 17.2 | ±2.3 | 14.6 | ±0.3 | 73.5 | ±12.2 | nd | |
| Day 10 | 71.1 | ±4.0 | 16.7 | ±1.5 | 12.2 | ±2.7 | 63.5 | ±29.3 | nd | |
| Day 14 | 67.7 | ±1.1 | 20.8 | ±0.5 | 11.6 | ±1.1 | 66.7 | ±28.5 | nd | |
| Day 21 | 67.0 | ±3.1 | 20.0 | ±1.7 | 13.1 | ±1.7 | 84.9 | ±17.0 | nd | |

d = not detected

## 4. Conclusion

Residual effect of monensin only last for 48 hour and this result in increasing of short chain fatty acid significantly. Presumably, the absence of monensin re-established certain activities bacteria.

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# Climate Change Impacts on The Walang Rice Pest (*Leptocorisa Oratorius* F.*)* in Tidal Rice Field on Ci 200

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**Abstract.** Climate change has been the topic of conversation now the impact has been felt by farmers in tidal rice fields especially Muara Telang. Entry of salt water into the rice planting season, not the season, and there was an explosion of pests *Leptocorisa oratorius* F. for rice cultivation. As a result farmers overcome confusion pest problems so that using less precise measures and unwise use of insecticides which excessive impact on natural enemies and the death of an explosion *Leptocorisa oratorius* F. should be pest control *Leptocorisa oratorius* F. by way of prevention, natural enemies and biological agents. use of insecticides as a last resort if the pest *Leptocorisa oratorius* F. exceed the economic threshold. By knowing the effects of climate change then we are more sensitive and respect nature as well as reducing the use of insecticides which excessive habits and wiser.

**Keywords:** climate change, tidal rice fields and walang rice pest *(Leptocorisa oratorius* F.)

## 1. Background

Climate change (Climate Change) is a very important thing to be a theme in any discussion at this time, due to the leaking of the ozone layer ($O_3$) so that the energy-energy that can go into the surface of the earth it is suspected of increasing greenhouse gas (GHG) consists of ($CO_2$) from land clearing and forest fires, fumes, methane ($CH_4$) from livestock manure such as cow and buffalo, as well as of rice, NOx and SOx comes from burning coal as a material that emit sulfur Power Generation of nitric oxide ($N_2O$), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfuric hexafluoride ($SF_6$).

Total greenhouse gas emissions in 2000 around 42 Gt CO2e by increased concentrations of 2.7 Gt CO2e / year. CO2 is the largest contributor to GHG emissions at 77%, amounting NH4, N2O by 8% and 1% F-gases such as PFCs and SF6. The results showed that there has been an increase in the earth's surface temperature by 0.7° C. In 1900 during the last 30 years occurred rapidly increasing global temperatures by 0.2° C per decade [1].

Signs of climate change can be seen in the physical and biological mechanisms. As an example of the displacement range of the species as far as 6 km towards the poles each decade during the last 30-40 years. Another indicator is the change in seasonal events such as flowering and its spawn faster pest 2-3 days at each decade in temperate regions [2].

While the non - energy sector, the largest emissions generated from land clearing. The agricultural sector contributed 14 % and the lowest of the waste by 3 % further stated GHG content currently around 430 ppm CO2e (CO2 equivalent) before the industrial revolution GHG content of 280 ppm . This concentration causing global temperatures rise more than 0.5° C. using the Business As Usual scenario (BAU) GHG content can be more than triple by the end of this century.

Largest source of GHG emissions is gas $CH_4$ (85.6 %) , $N_2O$ (13.4 %) , and the rest is CO and NOx . Donations biggest methane global warming has caused widespread and serious impacts to the biophysical environment (such as melting polar ice caps , rising sea levels , expanding deserts , increased rainfall and flooding , climate change , extinction of some flora and fauna , migratory fauna and pest , and so on . while the impact on the socio-economic activities include : (a) interfere with the function of coastal areas and

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coastal cities, (b) reduction in the productivity of agricultural land, (c) the disruption of residential areas, (d) reduction in the productivity of agricultural land, (e) increased risk of cancer and disease, and so on [3] .

The greenhouse effect was first discovered by Joseph Fourier in 1824, is a process by which heat the atmosphere of a planet. The greenhouse effect is caused by rising concentrations of carbon dioxide and other gases in the atmosphere. The increase in the concentration of $CO_2$ gas is caused by the increase in fuel burning oil, coal and other organic materials which exceed the ability of plants and sea to absorption. In addition to $CO_2$ gas that can cause the greenhouse effect are sulfur dioxide emissions, nitrogen oxide and nitrogen dioxide mono and some other organic compounds such as methane and chlorofluorocarbons. These gases play an important role in enhancing the greenhouse effect [4].

The purpose of this paper is to provide an overview of the impact of climate change has been a topic of conversation that only result in walang rice pest, and it is hoped that we may better appreciate the nature and habits of farmers using insecticides reduce excessive.

## 2. Impact of Climate Change

### 2.1. Impact of climate change on Indonesia

If not addressed , then the temperature rise due to global warming by 2100 will lead to the melting of polar ice caps and warming oceans , resulting in increased volume and increase the surface oceans around 9-100 cm , causing flooding in coastal areas, can even submerge the islands. Among the 17,500 islands in Indonesia , around 4000 the island will sink [3]. In Indonesia alone , the signs of climate change due to global warming has long been seen. For example , several times we had a long dry season . Years 1982-1983 , 1987 and 1991 , drought caused extensive forest fires. Nearly 3.6 million acres of forest in East Kalimantan depleted by fire in 1983.

In the dry season of 1991 also led to 40,000 hectares of rice fields had dried up and the national grain production plummeted from 46.451 million tons to 44.127 million tons in 1990. In 2006, due to global warming seen in the late rainy season should have been dropped in October 2006. But until December 2006 also dropped rain delay was not also accompanied by a short period of rain, but high intensity. Consequently floods hit Jakarta and surrounding areas. Sea level rise in addition to a change in ocean currents also cause damage to coastal mangrove ecosystem, which currently only condition is very worrying. Extensive mangrove forests in Indonesia has declined from 5,209,543 ha (1982) decreased to 3.2357 million ha (1987) and decreases again to 2,496,185 ha (1993).

Within a period of 10 years ( 1982-1993 ) , there has been a decline in mangrove forests ± 50 % of the total area of the original . If the existence of mangrove untenable , then the abrasion will often occur in the absence of a wave barrier , the pollution of the river to the sea will rise in the absence of the filter , so that the sea water will enter rice fields farmers in the growing season or rainy season in tidal rice fields on in 2011 in the disctric Jaya Makarti so farmers already had failed planting and replanting because plant roots are unable to grow due to salty water in the state. Local weather anomalies will be common in the future several times within hail tornado occurred in Jakarta some time ago only a small portion of the local weather which affected the regional impact of climate change is happening now.

Global warming is suspected to cause the melting of polar ice caps resulting in rising sea level. As a country with a long coastline and islands are much smaller, increase in sea level will cause the loss flow coastal areas and small islands in Indonesia.

### 2.2. Sources of Greenhouse Gas Emissions in Agriculture Sector

GHG emissions from the agricultural sector increased by 10% between 1990-2000, mostly from agriculture According to the World Resources Institute [5], the agricultural sector contributes about 14% of the world's total GHG emissions from the agricultural sector energy emissions from various sources as follows :

1. Fertilizer is the largest source of emissions (38%) for the agricultural sector. Soil release NO2 on nitrification and denitrification processes. Good use of fertilizers organic and inorganic increase levels of NO2 are released land.
2. Livestock is the second largest contributor to emissions of 31% of agricultural emissions. Methane produced from ruminant digestive waste (enteric fermentation) mainly cattle, goats, buffalo, and sheep .
3. Rice cultivation release about 11% of emissions. Cause flooding in rice fields can not be decomposed organic matter in the presence of oxygen resulting inorganic decomposition produces methane. The amount of emissions from rice cultivation depends on the management of water and the amount of fertilizer used.
4. The use of manure, including manufacturing and storage process caused 7% of agricultural sector emissions. Methane emitted during manure stored under conditions sufficient oxygen which causes the decomposition of inorganic, otherwise faeces and urine nitrogen in livestock trigger nitrification and denitrification that produces $N_2O$.
5. Savanna burning and agricultural residues, forest clearing with Paddy Field burning is a source of GHG emissions in the form of methane gas in Indonesia.

### 2.3. Impact of climate change on tidal rice field

Impact of climate change on rice cultivation tidal pest explosion that occurred this was because walang rice pest at age 30 after rice planting areas in the land of drought and C due to no rain for about 30 days this is what causes the eggs walang rice pest experiencing rapid hatching and plus the number of people who burn the straw on the eve of planting to 2 times (CI 200) that can indirectly coming to walang rice pest because of the smoke smell burnt rice straw. This needs to be further study of the impact of straw burning , then its a lot easier farmers panic or less know walang rice pest attacks rice plants at the time when they do not know if walang rice pest attack when cooking rice milk, their young if there is confusion in the plant pest rice.

Spraying that exceed the recommended dose and do the mixing of various insecticide active ingredients, which can cause death walang rice pest natural enemies such as spiders , beetles and grasshoppers karabit so walang rice pest become more and become resistant / immune so walang rice pest population explosion for 10-15 perumpun rice can cause a vacuum in the panicles of rice plants in 1 sack results achieved GKP farmers reach 70-75 kg due to being attacked by walang rice pest only reach 25 kg by half of its normal results .

By pests so walang rice pest that farmers suffered tremendous losses were so great, because the first crop harvest (CI 100) is used for planting to 2 times lets it but the results are not right in this case to overcome the above problems required the support of all parties so that no particular food scarcity and farmers find help in the form of loans and others so that farmers are able to grow rice in the next rendengan season.

## 3. Walang rice pest

### 3.1. Biology and Impacts attack on Rice field

Walang rice pest eggs on the upper leaf surface of rice and other herbaceous grasses as a group in one to two lines. Eggs are black, hexagon -shaped and flat. One group consists of 1-21 eggs grains, eggs long period average of 5.2 days, nymphs are smaller than adults and are not winged. Long period average nymph 17.1 days. In general nymph light green and yellowish -brown on the abdomen and wings brown when mature. However walang rice pest color is more determined by the food nymph period. Walang rice pest ventral abdomen yellowish brown if kept in rice, but the green vaginal discharge when reared on grass.

Adult insect is brown and slender shape, measuring about 14-17 mm long and 3-4 mm wide with long legs and antenna. Comparison between male and female is 1:1. After a new imago of this insect can marry after 4-6 days, with pre- nesting period and 8.1 walang rice pest life cycles between 32-43 days. Long laying periods average 57 days (between 6-108 days), while insects can live for an average of 80 days (between 16-134 days) [6].

Walang rice pest (*Leptocorisa oratorius* F) is a major pest of ladybugs group (Hemiptera) that destroy rice crops both in irrigated and tidal rice cultivation and invade almost every planting season. This pest damage by sucking the mature grain in phase so that the grains into empty milk. Heavy attack can reduce the results to not be harvested. This pest also has the ability to spread is quite high, so it is able to cross the other rice crops that mature milk mualai phase, the result will be global attack. The jam walang rice pest has the ability to produce eggs more than 100 eggs per female [7]. Walang rice pest life cycle of 35-56 days and were able to lay 200-300 eggs per stem. Nesting capability that can cause an increase in the pest population quickly walang rice pest in paddy crop so this will increase attacks [8].

### 3.2. Walang rice pest control techniques

Measures used to control pests walang rice pest that is often done by farmers using insecticides they buy in the market stalls and farm to mixing/mixing of various active ingredients this is because they want instant these pests die . But is not that dead pest but walang rice pest natural enemies are dead so walang rice pest pest explosion so large that attack rice farmers reached 14 tails in a clump on things walang rice pest economic threshold in integrated pest management concept is in an area of 1 there is a 15 meter tail walang rice pest. It is becoming a big problem and makes concern for farmers in the district of Muara Telang particular and the resulting reduction in rice production.

Measures used to control walang rice pest using insecticides is the final step when another control is not able to handle it is not cutting edge solutions.

a. Use of traps.
   The use of materials from the snail stinging trap then strung on wire and soaked with insecticide are made active organo-phosphate and installed at a distance of 5-10 in field so walang rice pest that came to visit and sucking the material and die because walang rice pest more attracted to the smell -these smells than eating rice.
b. Use of natural enemies.
   Natural enemies are actually quite a lot walang rice pest in rice fields but because farmers often spraying dead natural enemies of predator species predator species of spiders, beetles and grasshoppers karabit.
c. Use of mothballs.
   According Asikin and Thamrin walang rice pest control using mothballs are effective in controlling pests walang rice pest. Application control tactic was made during the vegetative phase when rice bunting or until the grains of rice begin to harden that is by hanging mothballs that have been incorporated into the wrapping of rags. Control tactics using the mothballs are rejected or repel pests coming walang rice pest because of the smell emitted by the substance contained in the lime mounting distances ranging from 5 m in the rice plant. In this way the intensity of the damage can be reduced by walang rice pest ranged between 5-10%.
d. Use biological control
   Using entomopathogenic fungi is based on research results Efendy et al [8], use of entomopathogenic fungus origin swamp land of South Sumatera and *Metharizium* and *Beauveria* species by infecting befallen walang rice pest, befallen befallen infected decrease tends to show the movement and eating infected befallen walang rice pest tends to stay away from the dead because Beuveria mushrooms and white indicates dry. Walang rice pest control using walang rice pest / backfire. By capturing walang rice pest then do mixed or extracts from walang rice pest because toxins inside walang rice pest and odor caused can reduce walang rice pest populations. Need to examine more about the impact and results.

## 4. Conclusion

Impacts of climate change that has been the issue can finally be felt community of Muara Telang particular, and the use of insecticide improperly can cause walang rice pest. Walang rice pest control can be

done in various ways, but the use of insecticides is the last step not the first step. Within the impact of climate change is expected to the public more aware of and respect for nature and other creatures that exist on the surface of the earth.

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# Estimates on Carbon Stored of Standing Trees as a Climate Change Mitigation Efforts

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**Abstract.** Mitigation of climate change can be observed through the range of values of carbon stocks in vegetation. A study has been carried out and standing trees in the Punti Kayu Park, Palembang used as the subject of observation of the value of carbon stocks in a vegetation forest tourist. Observations conducted during December 2012 to January 2013. Carbon stocks strored is assumed to be 50% of total biomass of standing trees. Allometric approach is uses to calculate the value of biomass. Sampling plots measuring 20mx20m as mean as 16 plots is used to observe the standing trees with diameter more than 5cm (diameter at breast height/dbh). Carbon stocks stored in standing trees in the study site was 2104.35tons/ha and the total potential carbon stored in an area of 40 ha is 131.522 tons. This value decrease compared to the value stored carbon stocks from the previous year observations. Lower rainfall decrease the value of biomass. Diameter affects the biomass and carbon stocks in standing trees. Town forest convertion affects the ability of trees to store carbon.

**Keywords:** mitigation, standing trees, carbon stock

## 1. Background

One of the causes of global climate change is the increasing levels of CO2. The amount of CO2 increases with decreasing forest cover and low effort to reduce greenhouse gas emissions (Arief 2001:78). If this is allowed, then the estimated concentrations of greenhouse gases, especially CO2 will reach twice the current concentration at 100 years to come. Global temperatures will rise $1^{o}$-4, 5°C and sea level rise of up to 60 cm. Rising sea levels will narrow land area and submerge several small islands, as well as the impact on climate change (Boer 2004: 86). Research IPCC (2001: 13) suggests that since the 90's temperatures will rise $1.4^{o}$-5, $8^{o}$C in the late 20th century.

Hadad (2010: 6-7) describes mitigation measures can be done by adding, strengthen or expand the earth system that serves as an absorbent and natural carbon sink, so that CO2 emissions and greenhouse gases are released in the air can be captured , absorbed and stored back in the trees. Photosynthesis is an important in the process carbon cycle and maintain CO2 in the atmosphere, also a role in the cycle of oxygen at the same time (Gratimah 2009: 2). Plants obtain CO2 from the air through photosynthesis, which is then converted into carbohydrates (Hairiah et al. 2011: 1). CO2 absorbed by plants through photosynthesis and store it in plant tissue (Sutaryo 2009: 3).

Punti Kayu an area of 40 ha of forest tourist who made urban forest in the city of Palembang in accordance with local regulations No.6/2007. Diversity of vegetation in Punti Kayu expected to increase carbon stocks, stabilizing, reducing the amount of CO2 and other pollutants that can contribute to global warming. Based on these statements conducted this study to estimate the carbon stocks stored in tree stands in Punti Kayu in Palembang related to climate change mitigation.

## 2. Methods

The experiment was conducted during December 2012 to January 2013 are located in forest nature Punti Kayu in Palembang. Determination of the location of the plot carried out by the method of random sampling

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and based on the observed number of tree stands (MacDicken 1997 in Manuri 2011: 12). Plot measuring 400 m2 (Kusmana 1997) as many as 16 plots.

Biomass of all trees found in the sample plots done in a non-destructive, note the type and diameter> 5cm at breast height measured from ground level. Then most of the branch cut along the specified ± 20 cm and density, diameter branches, and wet weight (Pratama, 2013). Followed by drying in an oven with a temperature of 80o C for 48 hours. Each day samples weighing up to obtain constant weight (Hairiah & Rahayu 2007: 21). Heavy tree using allometric equations to convert into biomass value. Biomass estimation was calculated using Hairiah & Rahayu (2007: 35).

branch volume : $$\textbf{Volume } (cm^3) = \pi \times R^2 \times T$$

Specify gravity ($g/cm^{-3}$) :

$$\textbf{BJ } (g/cm^{-3}) = \frac{\text{dry weight (g)}}{\text{Volume } (cm^3)}$$

Allometric equation to convert biomass using methods Ketterings *et al*. 2001 in Hairiah & Rahayu (2007: 35).

$$W = 0{,}11 \times \rho \times D^{2+c}$$

Estimate the biomass of pine diameter was calculated using the equation in 1995 in Waterloo allomatrik Hairiah & Rahayu (2007: 30).

Dry weight /Biomass (kg/tree) :

$$\text{Dry weight} = 0.0417\ D^{2.6576}$$

Large tree biomass per area:

$$\frac{\text{Total biomass (kg)}}{\text{Wide plot } (m^2)}$$

Carbon stock is calculated using the approach of biomass is 50% carbon stored (Sutaryo 2009: 2; Brown 1997).

$$\text{Carbon stocks (C)} = 0{,}5 \times W$$

## 3. Results and discussion

Highest biomass of 547.6 tonnes / ha was found in plot 14, the lowest biomass of 50.8 t / ha was found in plot 12. Biomass affected stem diameter. Highest biomass values also caused the average tree diameter 46.84 cm, while for the lowest biomass had an average diameter of only about 21.15 cm. Asril (2009: 40) describes the diameter of the growth-related increase in tree biomass and the amount of carbon stored in it.

Table 1. Number of trees, average tree diameter and Standing Biomass in Each Plot at Punti Kayu Palembang

| Plots | Number of tree | Diameter averange (cm) | Biomass (Ton/ha) |
|---|---|---|---|
| 1 | 15 | 31,35 | 183,1 |
| 2 | 11 | 31,41 | 127,2 |
| 3 | 13 | 46,49 | 387,6 |
| 4 | 6 | 40,39 | 57,4 |
| 5 | 12 | 46,60 | 344,7 |
| 6 | 29 | 36,71 | 494,9 |
| 7 | 11 | 37,57 | 217,3 |
| 8 | 19 | 37,41 | 343,6 |
| 9 | 25 | 27,52 | 258,6 |
| 10 | 16 | 39,33 | 324,5 |
| 11 | 9 | 31,63 | 156 |
| 12 | 18 | 21,15 | 50,8 |
| 13 | 14 | 40,62 | 459,1 |
| 14 | 12 | 46,84 | 547,6 |
| 15 | 6 | 38,32 | 93,5 |
| 16 | 13 | 35,75 | 189,5 |

Value of biomass on plots 5 and 8 tend to be similar because the diameter of the trunk at 5 plots tend to be smaller than the plot 8, although the number of trees in plot 5 more. This causes the biomass plot 5 (344.7 tonnes/ha) higher than plot 8 (343.6 tonnes/ha). According Asril (2009:40), the amount of biomass does not depend on the number of trees but influenced the size of the diameter of the tree. The larger the diameter of the tree, the greater the tree biomass. Total carbon content of tree stands on each plot is obtained based on the assumption that 50% of biomass is carbon stored (Sutaryo 2009:2). Biomass was calculated by measuring the diameter of the tree trunk 1.3 m above ground level.

Highest carbon stocks at 273.8 tonC / ha was found in plot 14 and the lowest was 25.4 tonC / ha was found in plot 12. Value of the second largest carbon reserves (247.5 tonC / ha) was found in plot 6. Dominance of certain species populations in each plot affects the value of the observed carbon stocks. *Acacia mangium* Willd dominate the plot 14, plot 12 *Swietenia mahogany* dominate, whereas *Pinus Jungh. & De Vr* dominate the plot 6. Suin (2003 in Asril, 2009: 35) explains the dominance of a species demonstrate the ability of species to adapt to its environment and competitiveness against other types

Results also showed that the total carbon stock of tree stands all plots in the study area of 2104.35 tons / ha, the potential of the carbon stored in the area is 5260.88 tons (Windusari *et al*, 2013). Carbon potential value decreased compared with observational data in some previous years. Total carbon stock and carbon potential in the area Punti Kayu year 2009 (Hidayah, 2010) is 195.76 tons / ha and 7595.49 tons / ha, then decreased whereas in 2010 (Anfibi, 2011) note that the total carbon stocks and potential carbon in the area is 666.92 tonnes / ha and 6609.31 tons / ha. Dynamics of carbon stocks stored in the observation area associated with the process of growing, evolving, or a reduction in the total area of green in the city of Palembang. Value of carbon reserves in line with the ongoing process of revegetation.

Satoo & Madgwick (1982 in Onrizal, 2004: 8) states climatic factors (rainfall and temperature) affect the rate of increase in tree biomass, in addition to the climate differences also lead to differences in the rate of production of organic matter. Onrizal Soerianegara in 1965 (2004: 69) has reviewed between rainfall and biomass of forest stands in Indonesian couple whose results include reduced stem biomass of 292.6 tonnes / ha to 170.158 tonnes / ha following the annual rainfall of 3,874 mm fell to 1,625 mm in the lowland forest, East Kalimantan.

Table 2. Carbon stocks in each plots

| Plots | Carbon store (tonC/ha) |
|---|---|
| 1 | 91,55 |
| 2 | 63,6 |
| 3 | 193,8 |
| 4 | 28,75 |
| 5 | 172,4 |
| 6 | 247,5 |
| 7 | 108,7 |
| 8 | 171,8 |
| 9 | 129,3 |
| 10 | 162,25 |
| 11 | 78 |
| 12 | 25,4 |
| 13 | 229,5 |
| 14 | 273,8 |
| 15 | 46,75 |
| 16 | 94,75 |
| **Total** | **2104,35 TonC/ha** |
| **averange** | **131,522 tonC/ha** |

The results that have been obtained in the study show areas Punti Kayu role as a carbon sink and mitigate against climate change. Biomass of tree stands 264.71 tons / ha were obtained during the investigation allegedly associated with a decrease in rainfall is only 257 mm per month or 3,084 mm per year.

Town forest conversion affects the ability of trees to store carbon is assumed to be in the form of tree biomass. The impact of climate change through changes in precipitation / temperature which can affect tree biomass, and loss of carbon storage areas make free carbon in the atmosphere to form greenhouse gases and affect the Earth's climate. City parks is important to be protected.

## 4. Conclusion

Estimates of carbon stocks stored in tree stands in the area of Palembang Punti Kayu 2104.35 tonnes / ha with a total of 5260.88 tons of carbon potential indicates the role of forests as carbon sinks and travel can be used as mitigation against climate change in the South Sumatra especially Palembang city.

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# Minimal Cooking Time Determination of *Pepes* Nile Tilapia Processed By Microwave Oven

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**Abstract.** The objective of this research was to determine the minimal cooking time of *pepes* nile tilapia (*Oreochromis niloticus*) processed by microwave oven. The treatment was the cooking time of raw *pepes* using microwave oven which consists of three levels (3, 4 and 6 minutes) with three replications. The observed parameter was the well done state of *pepes* which was determined by microbial total plate count (TPC), internal temperature and visual observation of *pepes*. The result of experiment show that all of the sample total plate count at three cooking time treatment levels were less than the maximum limit of microbial total plate count regulated by SNI. The internal temperatures of *pepes* at three treatment levels were above the minimum limit regulated by FSIS-USDA. Visual observations indicated that *pepes* has been cooked during 4 minutes was rare state while *pepes* processed for 5 and 6 minutes were well done state. It was concluded that minimal cooking time of *pepes* by microwave oven was five minutes.

**Keywords:** Nile tilapia, microwave oven, *pepes*.

## 1. Background

Nile tilapia (*Oreochromis niloticus*) is a cultivable fish that its availability is not affected by the season. Nile tilapia can be processed into various products and dishes such as fish *pepes*, which is an traditional fish product from Indonesia. Fish *pepes* is prepared by steaming it for 30 minutes [1]. However, steaming could reduce the nutritional content of fish [2][3][4].

Beside steaming, microwave technology could be used to cook fish. The term 'microwaves' is used for wavelengths between 1 m and 0.1 cm or for bands of frequencies between 300 MHz and 300 GHz [5]. There are plenty of related research studying about the effects of microwave cooking on the nutrient content of fish [6][7][8].

The research investigated the effects of microwave processing on *pepes* product. Cooking *pepes* with microwave oven was expected to reduce heating time and consequently minimize the nutritional content loss. The objective of this research was to determine the minimal cooking time of *pepes* nile tilapia (*Oreochromis niloticus*) by using microwave oven. Preliminary research indicated that nile tilapia fish can be cooked with microwave oven for five minutes.

## 2. Literature Review

### 2.1. Nile Tilapia *Pepes*

Nile tilapia (*Oreochromis niloticus*) is a nutritious animal food. Nutrient composition of fresh nile tilapia per 100 g edible portion is 77.81 % of moisture, 1.04 % of ash, 3.73 % of fat and 19.04 % of protein content, respectively [9]. Mineral content of dried nile tilapia in 7.5 % of moisture content is 0.23 % of phosphorus , 0.20 % of calcium , 0.32 % of potassium , 0.23 % of magnesium , 0.12 % of iron and 0.80 % of sodium, respectively [10]. Nile tilapia can be processed into various products such as nile tilapia fillet, baby nile tilapia chips, shredded nile tilapia, smoked nile tilapia, sweet and sour nile tilapia, nile tilapia with bali seasoning [11] and *pepes* nile tilapia [1].

*Pepes* is an Indonesian traditional fish product made of fish and spices, wrapped with banana leaves and then cooked by steaming for 30 minutes. Fishes from seawater or freshwater could be used as raw materials for *pepes*[1]. Main spices which commonly used are shallot, garlic, red chilli, candlenut, ginger, turmeric,

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lemon grass and salt, and alternatively *tempoyak* to produce *pepes tempoyak*. *Tempoyak* is a fermented durian product [12].

### 2.2. Food Cooking by Microwave Oven

The heating of foods by microwave energy is accomplished both by the absortion of microwave energy by dipolar water molecules and ionic components of the food. Thus, both the water content and the dissolved ion content (often salt) are dominating factors in the microwave heating of foods. When the dipolar water molecule is subjected to a microwave field, with the field rapidly changing its direction, the dipole tries to align itself with the field direction. There is a time lag, as some response time is required for the water molecule to overcome the inertia and the intermolecular forces in the water. The electric field thus provides energy for the water molecule to rotate into alignment. The energy is then lost to the random thermal motion of the water and results in a temperature rise. When ionized compounds are subjected to a microwave field, they randomly collide with nonionized groups in an electric field. The kinetic energy of these ions is transmitted into heat during the collisions [13].

Temperature distribution in cooking using microwaves may not be uniform. Consequently, food could not be cooked uniformly [14]. The measurement of food temperature at several parts was important in order to confirm that the food temperature has reached recommended temperature sufficient to kill pathogenic microbes. In other words, cooked fish should reach 145 °F [15]. Measurements of fish temperature can be carried out in several parts based on consideration of the difference in thickness. When the shape of food is irregular, the thinner and the narrower parts tend to be hot more rapidly in microwave cooking [16].

## 3. Materials and Method

### 3.1. Experiments and materials preparation

Fresh nile tilapia (*Oreochromis niloticus*) (250g ± 20% in weight), tamarind, shallot, garlic, red chilli, salt, sugar, ginger, candlenut, turmeric, galangal, lemon grass and banana leaves were purchased from local traditional market in Palembang, South Sumatera. The materials were brought to WSTPHP (Workshop Teknologi Pengolahan Hasil Perikanan) of The Fishery Faculty of University of PGRI Palembang in Palembang South Sumatra. Fresh fish were eviscerated, descaled and then washed with tap water. Raw *pepes* was prepared according to a modified method of Diana et al. (2010) [1] with a slight modification, namely unit conversion of material from piece to weight (weighted), and the use of tamarind juice and refined sugar to improve flavor of *pepes*. The following equipments were used in this research, including commercial microwave oven (Sharp model R-2491N(W), 2450 MHz, 800 W), pot steamer, thermometer insertion (digital thermometer Krisbow KW06-308, temperature range -40°C to 250°C) and other equipments for microbial analysis. The research was conducted from January 2013 to March 2013.

One factor was investigated in this research, namely cooking time of *pepes* with microwave oven and consisted of three following levels: 4 ($A_1$), 5 ($A_2$) and 6 minutes ($A_3$) with three replications. In addition, *pepes* was heated in microwave oven for additional 3 minutes before removed. The observed parameters were total plate count (TPC), internal temperature and visual observation. TPC analysis was conducted at LPPMHP (Laboratorium Pembinaan dan Pengujian Mutu Hasil Perikanan) Palembang in Palembang South Sumatra, whereas internal temperature measurement and visual observation were conducted at WSTPHP (Workshop Teknologi Pengolahan Hasil Perikanan) of The Fishery Faculty of University of PGRI Palembang in South Sumatra.

### 3.2. Samples Analysis

#### 3.2.1. Microbial content (TPC)

The microbial load of *pepes* was determined with total plate count (TPC) (SNI 01-2332.3-2006 [17]). The maximum limit of microbial content should not exceed $5x10^5$ CFU/g (SNI 7388:2009 [18]). TPC analysis principle was the growth of microorganisms after incubating on agar media at 35 °C for 48 hours. The growing microorganisms will form colonies that could be directly calculated and expressed in log CFU/g.

### 3.2.2. Internal temperature

*Pepes* internal temperature was measured using a thermometer insertion at four points, namely in abdomen (belly), near the head (anterior), in the middle of the body (middle) and near the tail. Average internal temperature were expressed in Celcius degrees (°C). A safe minimum internal temperature for fish is 145°F or 63 °C [15].

### 3.2.3. Visual observation

Visual observation of well done state of *pepes* was conducted by using Suwandi (1990) method [2] with a slight modification, namely additional characteristics of fish, including fat color and texture of spices.

## 4. Result and Discussion

### 4.1. Microbial content (TPC)

In general, microbial content of *pepes* measured as total plate count (TPC) showed that the populations were under standard maximum limits, namely $5x10^5$ CFU/g or 5.70 log CFU/g. Increasing cooking time led to a decrease in the number of microbial colonies. The average value of TPC was 4.89 log CFU/g (for $A_1$ treatment: cooking for 4 minutes), 4.77 log CFU/g (for $A_2$ treatment: cooking for 5 minutes) and 4.75 log CFU/g (for $A_3$ treatment: cooking for 6 minutes) (Figure 1).

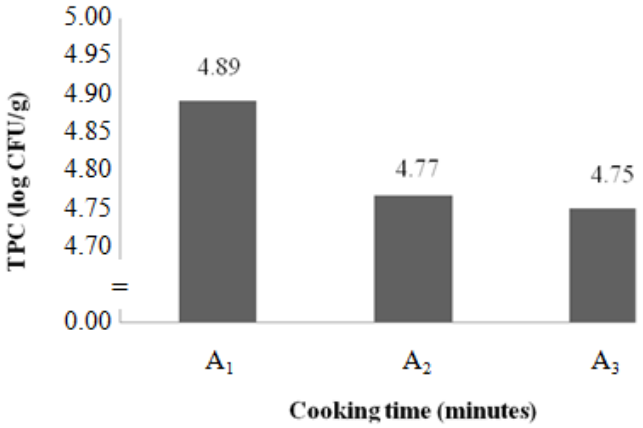


Fig. 1: The average values of total plate count (TPC) of *pepes* heated with microwave oven

The results were in accordance with those of Hollywood, Varabioff and Mitchell (1991) [19] who studied the effect of microwave cooking and conventional oven on temperature profiles and microbial flora of beef. Mesophilic microbial colony counts contained in beef studies showed a decrease with increasing time after the cooking and standing. The conclusion of that study was food cooking by microwave need adequate procedure and standing time after the food was cooked in order to achieve the balance of temperature and exposure to microbes. The destruction of microorganisms during microwave heating was mainly caused by the heat generated by microwaves [20]. Heat caused denaturation of proteins that destroy the activity of the enzyme which controls the metabolism of microorganisms [21].

TPC data of *pepes* were then used to determine D value with reference to Winarno (1994) [22]. Linear equation obtained from the relationships of heating time of microwave oven and the number of survived microbes in *pepes* was shown on Figure 2. D value was then calculated from the resulting equation of y = -0.070 x + 5.156 and gave 14.28 minutes. The following conditions of microwave oven were applied: power 800 W and frequency 2450 MHz. In other words, killing of 90% of the microbial population in *pepes* could be accomplished in 14.28 minutes. Jeng *et al.* (1987) showed that the sporicidal mechanism of microwave was caused by thermal effects [23]. That study showed that D value on sterilization of dried spores of *Bacillus subtilis* subsp. *niger* are 88, 14 and 7 minutes at 117, 130 and 137 °C, respectively.

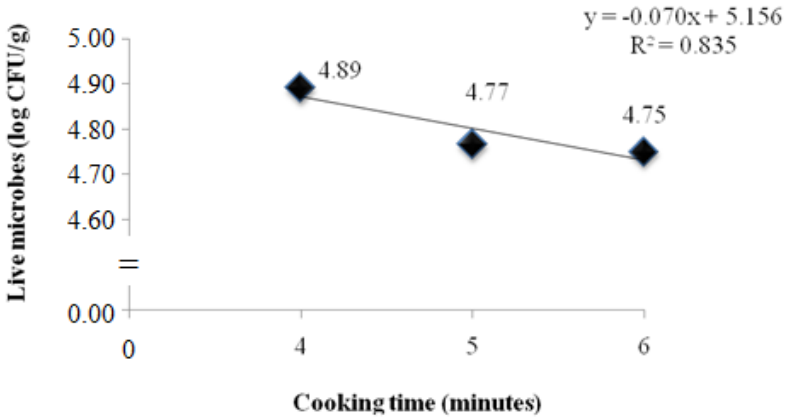


Fig. 2: Effects of microwave oven heating time on the number of microbes in *pepes*

## 4.2. Internal temperature

The measurements of *pepes* internal temperature showed that all treatments exceeded the minimum standard of internal temperature of 63 °C. The average internal temperature *pepes* are 73.8 °C of $A_1$ treatment (cooking for 4 minutes), 76.1 °C of $A_2$ (cooking for 5 minutes) and 81.7 ° C of $A_3$ (cooking for 6 minutes) (Figure 3). Increasing cooking time caused increase in *pepes* internal temperature. Similar result has been reported for cooked meat by microwave oven [19].

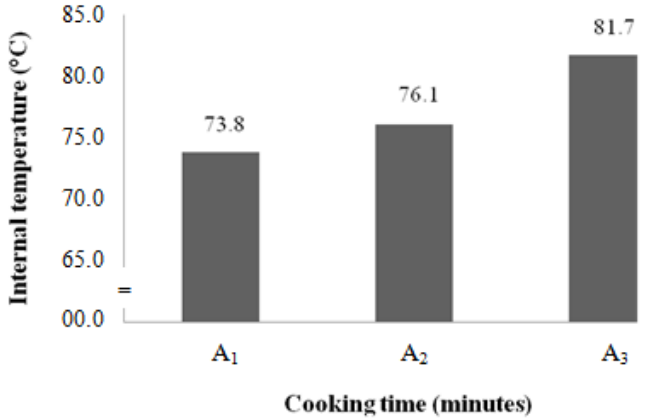


Fig. 3: Internal temperature of *pepes* processed by microwave oven

Cooking could increase *pepes* internal temperature due to heat transfer from heat source. There are three modes of heat transfer, which contribute to the overall heat transfer process in differing proportions namely conduction, convection and radiation. Conduction is the transfer of heat by molecular motion in solid bodies. Convection is the transfer of heat by fluid flow, created by density differences and buoyancy effects, in fluid products. Radiation is the transfer of electromagnetic energy between two bodies at different temperatures [24].

## 4.3. Visual Observation

Visually, *pepes* from $A_1$ treatment (cooking time of 4 minutes) produced rare state of *pepes*. This was shown by clear, reddish flesh, a transparent fat in the abdominal area and in the abdominal cavity, moist and chewy texture of flesh, flesh was attached to bone and moist texture of spices. Both $A_2$ (cooking for 5 minutes) and $A_3$ treatments (cooking for 6 minutes) produced a well done state of *pepes* and shown by typical brownish white-coloured flesh, white fat in the abdominal area and in the abdominal cavity, moist and tender texture of flesh and spices, and flesh was easily removed from bone.

Fish heating converts the translucent, jelly-like cellular mass into an opaque, friable, slightly firm and springy form. Synaeresis or shrinkage occurs and fluid is release, the proteins in which may coagulate to

form curd separately from the main solid mass. As noted above, the connective tissue holding the cells together is easily degraded and blocks of cells or the cells themselves become readily separated from one another. Thus, unlikely many meats, cooked fish easily falls apart and becomes palatable on mild heating [25].

## 5. Conclusion

It was concluded that minimal cooking time of *pepes* by microwave oven was five minutes. The resulting *pepes* meets microbiology criteria (shown with TPC), internal temperature and physical characteristics (in term of visual observation).

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# Toxicity Characteristics of *Bacillus Thuringiensis* Strain MSP-02 Agricultural Insect Pests

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**Abstract.** Insects play important roles in reduction of crop production. They need to be control. One technique to control them is the used of entomopathogenic bacteria.*Bacillus thuringiensis* is a gram-positive bacterium, rod-shaped, aerobic and spore-forming.The protein crystals will be produced by *B. thuringiensis* during sporulation.This protein is toxic to insect pests. The objectives of research were to investigate the characters of *B. thuringiensis* isolated from swamp land in South Sumatera including their toxicity against armyworm *Spodoptera litura* (Lepidoptera:Noctuidae). The result of preliminary bioassay showed that one isolate was very toxic to larvae of *S. litura*. It was named MSP-02 strain. This strain was further investigated of its protein and cell formation by Scanning Electrone Microscope (SEM), its molecular weight of protein and bioactivity towards *Popilliae japonica* larvae and *S. litura* larvae. After collecting crystal protein by LB mass production, bioassay test against insect pests was conducted. The result showed that strain MSP-02 was very toxic to armyworm *S.litura* (100%). However when conducting bioassay to *P. japonica*, its toxicity was not higher as those in armyworm(67.7%). Crystal protein was measured its molecular weight by SDS-PAGE electrophoresis. It was assumed that the molecular weight of protein was about 135 kDa indicated that this strain belonged to Cry1 protein group. This strain was then chosen as a candidate to produce mass production of bioinsectide.

**Keywords:** *Bacillus thuringiensis*, *Spodoptera litura*, toxicity

## 1. Introduction

Plant pest and disease problems become an important constraint on agriculture, both food and industrial crops. How to control pests and diseases must be environmentally friendly, effective, simple and economically cheap. Control with chemical pesticides will kill pests rapidly. The negative effects of using pesticides are environmental pollution and killing of non-target. For those reasons, it is necessary to perform an alternative control by using of biological control especially entomopathogen. *Bacillus thuringiensis* is a microorganism with the ability to kill insect. In the other side, *B. thuringiensis* have potency to induce crop resistant to diseases and to increase plant growth. Comprehensive research to pest control using B. thuringiensis has promising prospects because the source of *B. thuringiensis* can be found in various habitats, especially in the tropics. Pujiastuti (2003) reported the results of *B. thuringiensis* isolation in South Sumatera found various isolates in various habitats. *B. thuringiensis*isolate is very effective to control important pest such as *Spodoptera litura*(Pujiastuti *et al,* 1999*)*. Source of *B. thuringiensis* in environment is abundance such as soil, leaf surfaces, and other habitats. In the environment with good conditions and adequate nutrition, bacterial spores can survive and continue the vegetative growth. This bacterium can be found in various plants, including vegetables, cotton, tobacco, and forest plants (Ferre, 2006).

The characteristics of *B. thuringiensis* could be determined by morphological, molecular and their insecticidal aspects. Morphological character of *B. thuringiensis* was shown by the size the form and the color of colony, while molecular character was shown by cell and protein size detected by Scanning Electrone Microscope (SEM). Insecticidal activity of *B. thuringiensis* was shown by mortality of species of insect caused by digesting of protein (Soberón *et al.,* 2009). This paper reported *B. thuringiensis* strain isolated from swamp soil in South Sumatera, strains of *B. thuringiensis*, the characteristics of *B. thuringiensis* strains and their toxicity against important insect pests, i.e. armyworm *Spodoptera litura* (Lepidoptera: Noctuidae) and leaf-eater *Popillia japonica* (Coleoptera: Scarabidae).

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# 2. Methodology

## 2.1. Isolation of *B. thuringiensis*

Five g of soil samples is diluted well in 15 ml $dH_20$ in test tube. Shaked well until perfectly diluted. One ml of upper part of dilution is taken in eppendorf tube, added by 1 µl Triton X-100, and heated in water bath 85ºC 15 minutes. With a sterile spatula, the solution was streaked on the medium NaCl Glycine Kim and Goepfert (NGKG) on petridish. Petridish was incubated at 30ºC, for 24-72 hours. Colonies of B. thuringiensis will grow in white color. After 24-72 hours incubation, proteinaceous parasporal inclusion bodies will presence. Identification of *B. thuringiensis* refers to Thiery and Frachon (1997), by microscopic observation of bacterial cells tests, gram staining.

## 2.2. Production of crystal protein, SDS-PAGE and SEM

Propagation of B. thuringiensis using Luria Bertani medium (LB), 5 g yeast extract, 10 g Tryptone and 10 g NaCl in 1000 ml volume, pH 7.2 and sterilized by autoclave for 20 minutes, the temperature of 121°C 1 atm. One colony of B. thuringiensis than for oblique (performed in laminar air flow) is taken to be multiplied by 50 ml of LB media and shaken for 2 days with a speed of 150 rpm. Harvesting is done by rotation protein (centrifuge) at 2000 rpm for 15 minutes and will be done 2 times. Results of sediment were taken and diluted with 1 ml $dH_2O$ shaken until homogeneous and stored in Eppendorf tubes and ready for testing.Crystal proteins isolated from B. thuringiensis strains are analyzed by sodium dodecyl polyacrilamide gel electrophoresis (SDS-PAGE).

## 2.3. Insect test preparation

Groups of eggs of armyworm *S. litura* were obtained from the field and subsequently maintained in the laboratory. Larvae reared in a plastic container maintenance (d = 15 cm and h = 9 cm). Food used were the leaves of water spinach (*Ipomoea reptana*) grown without pesticide treatment for mass rearing for *S. litura*. Temperature and relative humidity were maintained. Maintenance of container was done by cleaning of residual dirt and food remains to ensure the availability of food and cleanliness. At the bottom of the box was placed maintenance of sterile soil that had been sterilized as a place of *S. litura* to become pupae. If the larvae has reached pre-pupa phase characterized by no activity, meaning caterpillar will enter the pupa stage. Larvae of *S. litura* reared to be a phase of insect pupae, and imago. Insect samples used were second generation (F2). P. japonica was kindly provided by Dr. Asano (Lab of Applied Molecular Entomology, Hokkaido University, Japan).

## 2.4. Bioassay of insects

Protein was diluted in sterilized water, smeared on the surface of spinach leaf and given to larva 3$^{rd}$ instar of *S. litura*. While treatment to *P. japonica* was done by mixing protein with living medium (soil), and 5 individues of 1$^{st}$ instar larvae were prepared on thi medium. Mortality of larvae was observed during 7 days after treatment.

# 3. Results and Discussion

## 3.1. Isolation of *B. thuringiensis* strains

Sample of soil was prepared from swamp land. Results of isolation found 15 strains of 27 soil samples were positive of B. thuringiensis. To investigate their toxicity against insect pests, it was conducted screening test with $10^6$ spores/ml in each strain. The result showed that strain MSP-02 showed very toxic to S. *litura* (unpublished data). Therefore it was chosen as an object to find out other characteristic.

## 3.2. Scanning Electron Microscope result

Cell and protein of *B. thuringiensis* strains were shown in Fig. 1. Cell form was very clear, while the crystal protein was slight and round. It was assumed that this protein caused mortality to insect pest.

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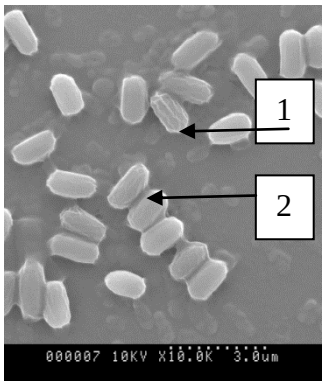


Notes: 1: cell, 2: protein
Fig. 1: Profil cell and protein of *Bacillus thuringiensis* MSP-02 strain

### 3.3. Molecular weight of *B. thuringiensis* crystal protein

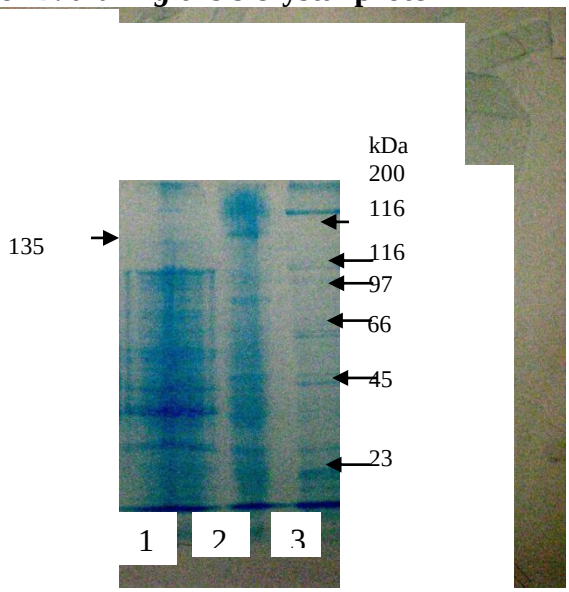


Fig. 2: Profile of crystal protein of *B. thuringiensis* MSP-02 strain (lane 1), SMR-03 strain (lane 2) and Protein Size Marker (lane 3)

Molecular weight of *B. thuringiensis* MSP-02 strain tend to show 135 kDa of molecular weight. As it was a preliminary result, it was assumed that this strain content of Cry I protein as reported by Hoftey & Whitley (1989). The group of Cry I protein was reported toxic to Lepidopteran larvae. The other groups (fo example Cry III) was toxic only to Coleopteran larvae (Cannon, 1995). To prove this statement, it was conducted bioassay of protein of *B. thuringiensis* MSP-02 strain against *S. litura* and *P. japonica*.

### 3.4. Bioassay of insect pests

Bioassay was done by : Protein was diluted in sterilized water, smeared on the surface of spinach leaf and given to larva 3rd instar of *S. litura*. Treatment to *P. japonica* was done by mixing protein with living medium of this insects (soil). The result showed that *P. japonica* was died two of three individues. It was preliminary bioassay, since the number of *P. japonica* was limited (Fig. 3.). It was not a good result, because - compared with other strain (i.e. SMR-03)- only 66,7% were died. There was specificity toxicity of *B. thuringiensis* especially because of content of crystal protein and insect target. As stated by Hoftey &Whitley (1989), to be toxic, protein must be digested as protoxin in available mid gut condition. Lepidopteran larvae possessed alkaline condition (pH 9). This condition supported alteration from protein to be protoxin.


Fig. 3: Mortality of *Popillia japonica* by *B. thuringiensis* MSP-02 strain (No.2), SMR-03 strain (1), PIK-01 strain (No. 3) and PDIK strain (No 4)

## 4. Conclusion

B. thuringiensis MSP-02 strain was highly toxic to S.litura but lower toxic to P. japonica. Molecular characteristics showed that protein content was high and molecular weight was about 135 kDa. This strain was expected to be a candidate of material base for mass production of bio-insecticide.

## 5. Acknowledgement

We would like to thank Directorate General of Higher Education, Ministry of Education and Culture, Republic of Indonesia for financial support through International Collaborative Research and International Publication program, year 2012.

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# Improvement of Rice Growth and Productivity Through Balance Application of Inorganic Fertilizer and Biofertilizer in Inceptisol Soil of Lowland Swamp Area

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**Abstract.** The objective of this study was to get a proper balance dose between biofertilizer and inorganic fertilizer in order to increase the growth and yield of rice in Inceptisol soil of lowland swamp origin. Biofertilizer was made by enriching rice straw compost with $N_2$ interceptor bacteria, phosphate solvent bacteria and growth stimulator bacteria isolated from swamp lowland in South Sumatra. This study was conducted from November 2012 to March 2013 at the Greenhouse. The design used was completely randomized design (CRD) factorial, with two treatment factors consisting of inorganic fertilizer (0, 25, 50, 75 and 100% recommended dosage) and biofertilizer (0, 100, 200, 300, 400 and 500 kg.ha$^{-1}$). The results showed that the best treatment in term of plant height at 8 weeks after planting (WAP), the maximum number of tillers, number of productive tillers, number of grains per panicle and weight of milled dry rice was obtained in combination of 75% inorganic fertilizer and 300 - 400 kg.ha$^{-1}$ biofertilizer.

**Keywords:** biofertilizer, inorganic fertilizer, lowland rice

## 1. Introduction

The intensive utilization of paddy field land in the long run will decrease soil productivity and environmental quality. The use of high input of agrochemical substances presicely will decrease soil nutrients and produce the negative impact for environment in form of increasing agrochemical substances residue within soil and crop. On the other hand, decrease of relatively fertile paddy field area due to land conversion into non-agricultural usage produces threat in maintaining food sufficiency effort (Wiharjaka and Abdurachman, 2007).

Lowland swamp is one of suboptimal land that capable to be used as substitute for some functional conversion of paddy field area. Lowland swamp is flat topography area found along the right and left sides of main river which is usually flooded during certain period, especially during wet period, and relatively unaffected by sea water tidal fluctuation (Najiyati *et al*., 2005). Lowland swamp in South Sumatra is relatively extensive comprising of about 368,685 hectares an it is unique ecosystem due to differences of water flooding as well as availability of flooding and dry periods. Availability of continous flooding and dry periods create different utilization of lowland swamp such as for crops cultivation which in turn will affect soil microbe diversity. The knowledge of community and biotechnology potential related to soil microbe in lowland swamp area is currently not widely investigated. However, population and type of bacteria and fungi available on lowland swamp are higher than that found in secondary forest. Cultivation of perennial crop such lowland swamp rice may increase population and type of bacteria and fungi due to intensive land management such as soil tillage before planting and manure application which may stimulate soil microorganisms activity (Gofar *et al*., 2007).

Gofar *et al*. (2009), had found endophytic bacteria from healthy rice crop grown in lowland swamp ecosystem and these bacteria can be used as growth stimulator as well as nitrogen interceptor for low fertility soil condition so that it may optimize the early growth of rice crop and reduce inorganic N fertilizer dependency which in turn capable to increase productivity of lowland swamp and tidal lowland. This endophytic bacteria isolate as growth stimulator had been developed as economical biofertilizer. According

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to Isroi (2008), biofertilizer is inoculant which contain organism active substance that has function to catch specific nutrients or to facilitate nutrients availability within soil for crop.

Marlina et al. (2013), had already found the isolates of *Azotobacter* sp. and *Azospirillum* sp. which is isolated from crop's rhizosphere grown in lowland swamp area. These isolates had been proved capable to catch $N_2$, to stimulate rice crop growth and to increase NPK nutrients absorption so that they can be developed as biofertilizer for rice crop cultivation at lowland swamp area. Tthe study by Gofar and Marsi (2013) showed milled dry rice yield of 17.20 g from dry land of ultisol soil by applying biofertilizer dose of 10 ton.ha$^{-1}$ and 75% of inorganic fertlizer.

It can be shown from the previous discussion the importance of balance fertilizing between biofertilizer and inorganic fertilizer for rice crop at lowland swamp which can affect nutrients absorption, growth and yield of a crop. Therefore, combination of biofertilizer and inorganic fertlizer (Urea, SP-36 and KCl) is very important input in order to improve land productivity at lowland swap.

The objective of this research was to determine the balance dose between biofertilizer and inorganic fertlizer which capable to increase the growth and production of rice crop in inceptisol soil at lowland swamp area.

## 2. Materials and Methods

This research was conducted as the greenhouse experiment by using Completely Randomized Design (CRD) Factorial which consisted of 2 treatment factors. The first factor was inorganic fertlizer dose with five levels consisting 0 %, 25 %, 50 % , 75 % and 100 % of recommended dose. The second factor was biofertlizer dose with 6 levels consisting 0, 100, 200, 300, 400 and 500 kg.ha$^{-1}$. The recommended doses of NPK fertilizer for rice crop of Ciherang variety were 250 kg.ha$^{-1}$ urea, 150 kg. ha$^{-1}$ SP-36 and 100 kg.ha$^{-1}$ KCl.

Compost was made from chopped rice straw having size of ± 5 cm and manure from cow dunk which is mixed with ratio of 10:1 and is composted for 4 weeks period, followed by sieving with screen having 2 mm in diameter. This compost was then sterilized by using autoclave at temperature of 121$^0$C and 1 atm pressure for 15 minutes period.

Biofertilizer was made by mixing 100 kg sterile compost with bacteria biomass which is extracted from 100 ml isolate of *Azotobacter*, 100 ml isolate of *Azospirillum*, 100 ml isolate of endophytic bacteria and 100 ml isolate of phosphate solvent bacteria respectively having density of $10^{-9}$ spk.mL$^{-1}$. Bacteria biomass was obtained by centrifuging the liquid propagation of these bacteria at velocity of 15000 rpm for 5 minutes.

Plant media preparation was started by soil sampling at depth of 0-20 cm, followed by air drying and sieving of soil. Soil having weight of 10 kg was put into pot. Biofertilizer and fertilizers of N, P and K were applied one day before seed planting. The N fertilizer was given two times, i.e. half dose was given on 1 day before planting and the rest was given when plant was 1 month old after planting. Five rice seeds were planted on each pot with depth of 2 cm. After one week, 2 plants that showed uniform growth were choosen to be reared.

Crop maintenance was consisted of : 1) Watering was conducted one time per day. 2) Crop selection was conducted one week after planting, 3) Cultivating was conducted manually by pull out the existing weeds, 4) Pest and disease control was conducted manually. Harvesting was done after more than 75% of rice grain was mature at each tiller which was shown by yellow flag leaves. The harvested crop was rice grains.

The observed parameters were chemical soil properties before experiment, crop height in 8 weeks after planting, number of maximum tillers, number of productive tillers, analysis of soil N and P, NPK content of crop tissue at primordial phase, biofertilizer analysis, grain numbers per tiller and weight of milled dry rice. Data was statistically processed by analysis of variance for Completely Randomized Design (CRD) Factorial. If the variance analysis results showed significant difference, then it is followed up by Least Significance Difference (LDS) test at 5% level.

# 3. Results and Discussions

## 3.1. Soil Characteristics Before Treatment

The soil used as growth media in this research in general having low soil fertility level with pH $H_2O$ of soil is classified as acid having low values of C-organic content, N-total and available P. This is conform with notion from Subagyo (2006) which showed that soil pH of lowland swamp area was in the range of 4.0 to 5.5 and had low value of macro nutrients content. In addition, soil in this research should be added with inorganic fertilizers or biofertilizer which contain bacteria of *Azospirillum* sp., *Azotobacter* sp., endophytic bacteria and phosphate solvent bacteria in order to increase N, P and K nutrients so that better growth and production of rice crop can be achieved.

## 3.2. Vegetative Growth of Rice Crop

Table 1. The main effect of inorganic fertilizers on plant height at 8 weeks after planting, maximum number of tillers (tillers), number of productive tillers (panicles) and NPK uptake

| Inorganic fertilizer (% of recommended dose) | Plant height at 8 weeks after planting (cm) | Maximum number of tillers (tillers) | Number of productive tillers (panicles) | N uptake (g $tan^{-1}$) | P uptake (g $tan^{-1}$) | K uptake (g $tan^{-1}$) |
|---|---|---|---|---|---|---|
| 0 | 95.42 a | 35.67 a | 22.22 a | 1.048 a | 0.192 a | 2.271 a |
| 25 | 100.42 b | 38.89 ab | 23.78 a | 1.346 b | 0.213 a | 2.513 ab |
| 50 | 103.42 b | 43.1 bc | 27.00 b | 1.698 c | 0.211 a | 2.623 ab |
| 75 | 107.25 c | 45.00 c | 31.67 c | 1.903 c | 0.265 a | 2.795 b |
| 100 | 107.67 c | 44.67 c | 27.00 b | 1.829 c | 0.253 a | 2.542 ab |
| LSD 0.05 | 3.45 | 5.29 | 3.03 | 0.285 | 0.083 | 0.452 |

Note: Numbers followed by different letters in a column were significantly different ($P < 0.05$) using LSD test

Application of 300 kg.$ha^{-1}$ biofertilizer had increased maximum number of tillers and number of productive tillers and was significantly different than that of applications of 0, 100 and 200 kg.$ha^{-1}$ such as shown in Table 3. The increase of maximum number of tillers and number of productive tillers on 300 kg.$ha^{-1}$ biofertilizer treatment was due to capability of this compound to create better soil condition for crop growth and provision of crop nutrients in form of nitrogen (1.08 g.$kg^{-1}$), phsophorus (87.30 mg.$kg^{-1}$) and potassium (111.83 $cmol_{(+)}.kg^{-1}$). Biofertilizer application will stimulate microbe growth and add macro and micro nutrients which in turn will increase soil fertility. According to Faluddin (2009), the use of biofertilizer was proper strategy to refertilize the soil. Biofertilizer which is put into soil will help the availability of certain nutrients for crops. Biofertilizer may contains bacteria that are important to stimulate crop growth so that crop yield is still high and sustainable. According to Permentan (2009), biofertilizer is biological active product which consisted of microbia that can improve the fertilizing efficiency, fertility and soil health. Moreover, Vessey (2003) stated that biofertilizer facilitates nutrient availability, organic matter decomposition and better environment of N rhizosphere which in turn may support the growth and yield increase of crop.

Table 2. The main effect of biofertilizer on plant height at 8 weeks after planting, maximum number of tillers (tillers), number of productive tillers (panicles) and NPK uptake.

| Biofertilizers (kg.$ha^{-1}$) | Plant height at 8 weeks after planting (cm) | Maximum number of tillers (tillers) | Numbers of productive tillers (panicles) | N uptake (g.$tan^{-1}$) | P uptake (g.$tan^{-1}$) | K uptake (g.$tan^{-1}$) |
|---|---|---|---|---|---|---|
| 0 | 102.10 | 35.07 a | 23.20 a | 1.189 a | 0.149 q | 1.899 a |
| 100 | 101.33 | 38.27 ab | 25.33 ab | 1.427 ab | 0.194 ab | 2.225 ab |
| 200 | 103.47 | 42.20 bc | 25.80 ab | 1.544 bc | 0.211 ab | 2.388 ab |
| 300 | 105.30 | 47.07 c | 29.20 c | 1.834 c | 0.311 c | 3.294 d |
| 400 | 102.70 | 44.27 c | 27.93 bc | 1.754 c | 0.257 bc | 2.947 cd |
| 500 | 102.10 | 41.93 bc | 26.33 bc | 1.640 bc | 0.240 bc | 2.539 bc |
| BNT 0.05 | ns | 5.80 | 3.32 | 0.312 | 0.091 | 0.495 |

Note: Numbers followed by different letters in a column were significantly different ($P < 0.05$) using LSD test

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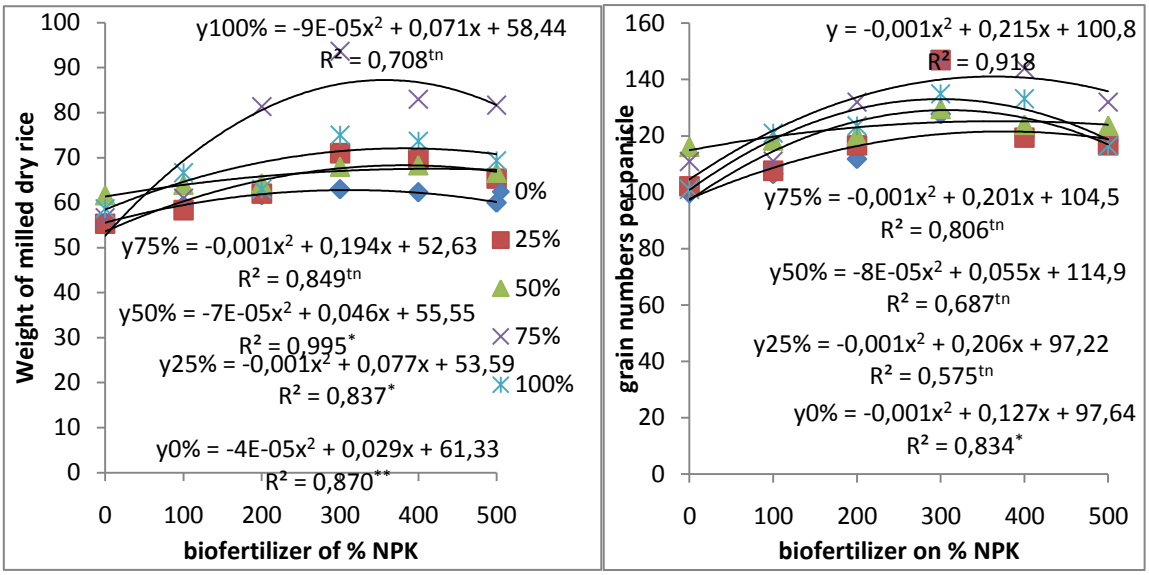


Fig. 1: Rice Crop Yield

Moreover, there was positive relationship between NPK nutrients uptake and production level (grain numbers per panicle and weight of milled dry rice) for each biofertilizer. The higher the NPK nutrients uptake, the higher was the rice crop production. Value of $R^2$ showed that rice crop had higher correlation between NPK nutrient uptake and crop production.

Biofertilizer used in this study contained bacteria of *Azospirillum* sp., *Azotobacter* sp., endophytic bacteria and phosphate solvent bacteria which had specific roles. This was supported by studies of Saxena and Tilak (1998), Yasari and Patwardhan (2007), Shaukat *et al*. (2006) and Karthikeyan and Sakthivel (2011) which showed that bacteria of *Azospirillum* and *Azotobacter* could increase crop biomass, crop productivity, contributing N nutrient through $N_2$ fixation at crop rhizosphere environment as well as contributing phytohormone in direct manner. Moreover, studies from Yasari and Patwardhan (2007), Mehry *et al*. (2008) and Arzanesh *et al*. (2009) showed that application of *Azospirillum* was very effective in stimulating crop growth.

Results of study from Hindersah and Simarmata (2004) showed that *Azotobacter* bacteria had capability in producing phytohormone of auxin and cytochinine as well as supporting the soil function as growth media. Furthermore, Gofar (2007) showed that some endophytic bacteria from plant tissue may stimulate the growth of chilly crop, although others may suppress the growth of chilly crop.

Study from Simanungkalit (2001) showed that application of biofertilizer and inorganic fertilizer was integrated approach in improving the growth and production of crop.

## 4. Conclusion

Application of biofertilizer at 300 - 400 $kg.ha^{-1}$ dose combined by inorganic fertilizer at 75 % of crop requirement dose was the best combination in increasing NPK nutrients uptake for rice crop and weight of milled dry rice.

## 5. Acknowledgement

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# Water Management of Swampland as Adaptation Toward The Climate Change in South Sumatra

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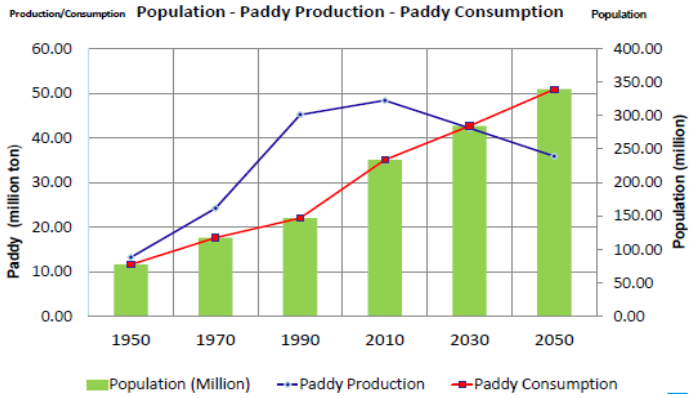
**Abstract.** Increasing of population spurs the increase for foods and shelters requirement. Agricultural extensification on non-tidal lowlands or swampland, especially in South Sumatra, should be done in order to fulfill yearly increase for foods requirement. However, swampland frequently had been changed into non-agricultural usages such as for settlement and office areas. Moreover, the decrease of land and water resources quality had occurred due to climatic change such as *El Nino* (drieness) and*EL Nina* (flood). The hotter temperature and uncertain seasonal change results in planting and harvesting failures, diseases outbreak and agricultural land degradation. Swampland can be utilized by using optimum water management method. This paper has an objective to give overview in term of strategic alternative and opportunity of water management technology and irrigation system as an adaptation toward climate change in South Sumatra. The method used in this paper was literatures review and secondary data from several studies related to non-tidal lowland or swampland. The conclusion from this paper were as follows :1). Water management strategy in swampland can be conducted by using several technological alternatives and irrigation system taken into account swampland characteristics and soil properties as well as topography in this area; 2). Water management was conducted by controlling water table depth that can be determined from hydrological, climatological and water requirement aspects. By considering these perspectives, water management on swampland can adapt to the climatic change.

**Keywords:** swampland, water management, irrigation system, climate change

## 1. Introduction

The current increase of Indonesia population requires additional requirement of foods and settlements. Self sufficiency of rice that had been achieved in Indonesia will no longer prevail because the rate of population increase was faster than the rate of food supply. Rice productivity, population numbers and rice consumption predicted from years 1950 to 2050 can be seen in the following figure.




Source :Suryadi, F.X. 2013

Fig. 1: Capacity building in Lowland development, food production and food security

The decrease of land and water resources quality had occurred due to climate change such as *El Nino* (drieness) and*EL Nina* (flood). The hotter temperature and uncertain seasonal change results in planting and harvesting failures, diseases outbreak and agricultural land degradation.

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Food crisis had also occurred due to function shifting of agricultural land into settlement area and non-agricultural area. The National Food Security Council had reported that agricultural land conversion in 2009 had magnitude of 110 thousand hectares per year that was used for other activities (Sutjahjo,2011). Pressure for function shifting of irrigation paddy field had increased every yearthat was used for non-agricultural activities (Sutanto, 2010). According to Irawan and Friyatno (2005), the rate of land function shifting in outside Java (132 thousand hectares per year) was higher than that of Java island(56 thousand hectares per year). In order to balance this land function shifting, the government had conducted agricultural intensification in Java and Bali islands. On the other hand, government hadconducted agricultural extensification in Sumatra, Kalimantan, Sulawesi and Papua islands due to availability of extensive swampland in these areas.The area of swampland in Indonesia was about 33,393,570 hectares consisting of 20,096,800 hectares (60.2%) tidal lowland and 13,296,770 hectares (39.8%) non-tidal lowland (swampland). Total area that had been developed by government was 1.8 million hectares consisting of 1,452,569 hectares tidal lowland and 347,431 hectares non-tidal lowland (swampland)(Dit.Rawa dan Pantai, Departemen PU, 2009 *in* Susanto, 2010).Total area of swampland in South Sumatra that had been reclaimed up to 2010 was 373,000 hectares (BSWVII, 2010).

Lowland area, especially swampland, has high potential to be used as strategic choice for development of agricultural production area to cope with climate change and food security (Alihamsyah, 2002). Swampland can be developed as productive agricultural area by using proper management and by considering land characteristics as well as appropriate application of technology (Ismail *et al*., 1993). Activity and operation at swampland are highly depended on water management system. Lack of water or excessive of water will create disaster. Crops that experience water deficit will result in decrease of product quality and quantity. Excessive water will create the decrease of harvesting yield and diseases outbreak. Extreme condition of excessive water will results in soil leaching, erosion and flood.

There are many constraints for water management on swamplandso that the previous water management was not optimum. The important point for successful agricultural effort on lowland swamp is water management technology and irrigation system in this area. Therefore, properwater management technology and irrigation system on swamplandare very important.

Based on the above description, this paper has an objective to give overview in term of strategic alternative and opportunity of water management technology and irrigation system as an adaptation toward climate change in South Sumatra. The method used in this paper was litratures review and secondary data from several studies related to swampland.

## 2. Results and Discussion

### 2.1. Water management condition inswampland

Lowland area is the land that is always wet or water logged for all year long or several months in a year or has shallow water table, or even flooded (Daryono, 2009). Lowland area can be differentiated into two categories, i.e. tidal lowland and non-tidal lowland (swampland). Tidal lowland is the land in which its flooding condition is affected by sea water tidal movement, whereas lowland swamp is the land found in the right and left sides of main rivers and their branches, having flat topography, water flooded during wet season and dry or constantly flooded during dry season (Susanto,2010). Based on land surface variation, altitude and flooding period, swampland can be classified into three types : bund swampland, middle swampland and deep swampland (Ditjen Pengairan, DPU, 1996). Bund and middle swamplandshave higher potential to be developed as rice crops and paddy field areas, whereas deep swampland can be utilized as fresh water fishes or water fowl husbandry such as ducks (Direktorat Rawa, 1991).swamplandis the land that has water regime affected by topography and rainfall which occurred either locally or from surrounding areas and has relatively low topography, but it has high potential in term of land and water resources for agricultural, fishery and husbandry production. Nearly 91 percent of cultivated swamplandwas for rice production with one time planting pattern and the rest of 9 percent had two times planting. The province that had the most extensive area with one time planting pattern of rice was South Sumatra which covered about 146,279 ha (Alihamsayah , 2004).

The current problems related to utilization of swamplandfor agricultural sector are as follows :1). Uncontrolled water management or water gates, 2). Low level of soil fertility, 3). Biological problems related

to pests, diseases and weeds, 4). Socioeconomic problems such as manpower or labor, capital deficiency, educational level, farmers empowerment, institutions, soil status, farm labors, lack of coordination as well as structures and infrastructures (Direktorat Rawa, 1991).

Problems related to swamplandin South Sumatra were low production due to improper water management system in addition to biophysical factors and low fertility of soil. These problems were initiated during swamp reclamation process by digging out huge channels such as primary, secondary and tertiary channels(Subagyo, 2006). Water gates on tertiary channels were in improper function which results in uneven water availability. Water flow can not be controlled so that land was flooded during rainfall for long period and produced farm enterprise failure.

Rice is the main commodity cultivated on swamplandin South Sumatra. Rice variety having relatively high yield was IR42 especially in Lematang with average yield of 4 to 5 ton/ha. Second crops having good adaptation such as corn, soybean and greenpeal were cultivated on shallow swamp. Tubers crops and chilly were also cultivated on swamplandin South Sumatra.

## 2.2. Potential of Technology and Irrigation System on Swampland

Operational activities on swamplandwere highly depended on water management system. Water flooding during wet season and dryness condition during dry season results in oxidation and reduction processes within soil which produce low soil pH and low nutrients availability for crops.Swamplandhaving shallow water flooding can be managed as rain-fed paddy field or combination of paddy field and bund (*surjan* system). This technology had been developed by Balai Penelitian Pertanian Lahan Rawa (Balitra). Results study by Waluyo*et al.* (2002) showed that application of surjan system on swampland produced more efficient utilization of land because land can be cultivated all year long. Moreover, crops rotation will produce more fertile soil, increase land productivity and it is hoped capable to increase farmers income.

The other alternative technologies for water management on swamplandwere consisted of :a). Water channel system equipped with partition gate (*stop log)*on the left and right sides of tertiary channel; b). Channel system with partition gate *(stop log)*on the left side of tertiary channel and flap gate on the right side of tertiary channel. These technologies showed that stop log can maintain water level elevation in tertiary channel during dry season; water circulation can be developed through flap gate installation which facilitate land leaching process; land drainage function can be achieved as well as primary and secondary channels can be used as transportation lanes without deepening process on both channels during wet season or dry season. Therefore, water management system equipped with water gates having proper types and numbers is capable to provide supply function and create flow circulation which results in optimum perfomance for water management network (Budi, 2007).

Technology for swamplandmanagement can be put into effect through amelioration, balance fertilizing as well as soil and water treatments(Adnyana *et al.*,2005). Water management technology is directed toward maximum utilization of water resources to fulfill crop water requirement as well as to regulate the balance between water inflow and outflow. Proper arrangement of water channel is very important to control water flow. Water management on land can be done by using surjan system, kemalir system and caren system. Water inflow and outlow processes can be easily controlled by using these systems. Technology of water balance is the one that capable to regulate water inflow and water outflow. One of important conclusion from hydrologic cycle is that water quantity in certain area is determined by water balance of land .Water balance technology for land is capable to determine agroclimatic condition, especially the dynamics of soil water content on swamplandwhich subsequently can be used to design the general planting pattern. Water balance needs input and output data in forms of rainfall, evapotranspiration and soil water content (Salwati *et al,* 2007).

The choice of water management network type is depended on swamplandcharacteristics as well as rainfall and land topography. Some swamplands used *handil* system as traditional water management system having very simple design in form of channel that protrude into river estuary (Muhammad, 2001:100). Handil generally has 2-3 m width, 0.5-1 m depth and entrance length from river estuary of 2-3 km. Anjir system, which is also called as canal system, is water system having big channel that connects two main rivers. This channel has function to irrigate and distribute the inflow water from river in case of high tidal period as well as to collect drainage water during low tide period through handils which are developed along

anjirs. Therefore, river water can be utilized for crops in more extensive and unimpeded ways.Anjir provision made areas in the right and left sides of channel can be irrigated by handils development (tertiary channels) which are perpendicular to canal. Garpu system is water management system designed with channels which are developed from river edge protrude into inland in forms of navigation channels and primary channels followed by secondary channels which may consisted of two branches channel so that water network resemble garpu or fork (Noor,2001 : 103).

### 2.3. Water management strategy on lowland swamp

Alternative for water management strategies on swamplandswere as follows :

1. The choice of system and technology for water management on swampland should be in accordance to tipology and water flow within this area because swamplandconditions are different from one area to the others, especially for swamplands in South Sumatra that have different characteristics. Physical and chemical conditions of soil, rainfall, crop types and topography affect the discharge magnitude for irrigation water supply.
2. The land function shifting can be minimized by analyzing land change for several years obtained from landsat image which was interpreted in form of land cover map and development of Regional Space Order Plan for South Sumatra Province so that land can be used according to its allotment. Therefore, swamplandcan adapt toward the change of climate and weather.
3. Water management should take into account the calculation of design flood discharge in order to determine water table level on swamplandso that water table level can be controlled in proper manner. swamplandcondition is affected by climate and weather. Therefore, water balance calculation should be done in term of rainfall, evapotranspiration and water availability. This was conducted through analysis of hydrology, climatology and water requirement.Planting pattern regulation is required in order to facilitate water management so that crop water requirement is in accordance to availability of water supply. Planting pattern give the description of periods and crop types to be planted during one year period. Water management pattern was conducted through two activities as follows. Water at wet season (rice planting period) is used for leaching process in order to improve quality of water and soil. Water gate structures were provided at secondary channel to minimize water losses from paddy field areas as well as development of land surface levelling. Soil water during dry season (secondary crops planting period) should be maintained by operating water gate structures on tertiary channels in order to control water table level.

## 3. Conclusion

### 3.1. Conclusion

1. Water management strategy on swamplandcan be conducted by using several alternatives of technology and irrigation system by taking into account land tipology, swamplandcharacteristics, soil condition, water flow regimes and swamplandtopography so that it can be converted from marginal condition into optimal condition.
2. Water management was done by controlling water table level. Water table level can be determined from hydrological, climatological abd water requirement aspects. Therefore, water management at swamplandcan adapt toward climate change.

### 3.2. Recommendation

Water management technology on the swampland should betake into account condition of land tipology and water regime in order to control water table level. Proper water management is the key point for successful development on swampland.

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# Tactics of Equitable Livelihood for Food Producers Towards Hedonistic Society's Life

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**Abstract.** When agribusiness implemented based on good planning, organization, direction, coordination and control, food producer tactics with environmental orientation can be efficient and effective to achieve hedonistic society's life. The best tactic is implementating fair and equally distributed or equitable livelihood through corporate social responsibility (CSR) and land ownership. Such implementation starts fron the planning point in line with the application of science and technology as well as"iman"and taqwa" to the God Almighty who will normalize the climate and secure food production that will then direct the producers towards hedonistic life. The research aim at analyzing the income of farmers with average land ownership of 2 hectares uitilized for multicrops of rubber, chilli, and catfish; or paddy, chilli and catfish. The research objective is to analyze the income producers have 2.0 hectares of cultivated land between crop diversification of rubber, chili and catfish or rice, chili and catfish. The results show that for that size of land, combination of rubber plantation (1.5 hectares) chili plants (0.5 hectares) and catfish (0.2 hectares), yielded maximum profit for producers. Rubber farmers could increase income from Rp 2.30 million to Rp 14.89 million per month by processing chili into sauces. With basic living standard of Rp 5.41 million per month per family (4 persons), the producer acieved a hedonistic society's life.

**Keywords:** equitable livelihood, management functions, iman, food, hedonistic society

## 1. Introduction

Human life in the world have clearly defined rules as a command of God Almighty that anyone has equal right in any activity in the world. Then God the Creator will give ridho and add more favor to human beings who behave fairly and respect the equal right ofeach other for their whole life until the day afterlife. Fair and equally distributed activities for anything that characterizes human beings as the innovator of science and technology (Fuglie,2004; Sjarkowi, 2004), iman and taqwa are guaranteed by God the Most Justice that allow them to enter heaven. Human beings have the systems of step by step automatic application through five management functions, including agribusiness system. Several opinions by experts including Ministry of Trade (1977) and Mustapadidjaja (1993) mentioned that a system is the operation process of elements influencing each other, interrelated and inseparable in achieving its objectives. If one element is missing, the goal will not be achieved.

Agribusiness system has elements of inputs, production and outputs. Output elements are widely intended for activities of marketing functions . From the aspect of the activities, it starts with plan, organize, direct, coordinate and control (supervise) (Sjarkoi and Sufri, 2004; Sjarkowi, 2010) until they reach purposes of equal implementation of Corporate Social Responsibility (CSR), land ownership and marketing of products that have not been effective. Almighty God can normalize the climate and securing food. The task of coordination must be integrated to achieve synchronization and activitiy goals If the system is still running slow and not fully coordinated with other related elements, the efforts to reach the producers' goals and their synchronization may fail. Slow running elements mean it they do not work properly because the sub-elements are not set up by complete tactics and can not affect each other. Consequently both productivity and quality are relatively low, and the products do not proceed to the processing level in order to obtain more added value and to pursue feasible producers life towards hedonistic stage.. Sufri, Sjarkowi and Sriati (2007) mentioned that hedonistic life refers to a decent human life that is their life become more prosperous and having iman/faith and taqwa to the afterlife.

Human needs for such decent life can be obtained from production in general and from food production in particular by utlizing inputs. Input element includes materials and tools in realion to the use of

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infrastructure and facilities. Agribusiness infrastructure and facilities are owned and used by the producers personally or from the company in the form of CSR which is effectively granted by the company to the producers. Meanwhile, the producers usually already own land of certain size for farming. Rural communities that previously did not have agricultural land, may have new land through redistribution program from large landlords owning land larger than 5 hectares. The problem is whether CSR is effectively carried out by the company and whether all of the villagers have land for cultivaion. Therefore it requires several stages of action research, starting from a particular location as a case. The research objective is to analyze the producers income from 2 hectares of cultivated land with diversification system between rubber plant, chili and cat fish, or paddy, chili and cat fish.

## 2. Research Method

### 2.1. Fair and Equally Distribution Tactics

Fair and equally distribution tactics which are implemented in Corporate Social Responsibility program for producers with two hectares of land can be done by the use of scienceand technology with iman/faith and taqwa, and then surely God Almighty would normalize the climate and securing the food.

1. Capital Grant
   All farmers are recorded to determine their capital capabilities. The sources of capital come from rich farmers and from companies in the form of Corporate Social Responsibility (CSR). Companies develop and provide capital carefully fairly and equally distributed to all communities. It means that the implementation is done according to the science and technology in the faith and taqwa to pursue successful agribusiness producers. .
2. Distribution of land to citizens who do not own land.
   People who have more than five hectares of land are asked to sell them to people who do not have land, unti every citizen has a 2 hectares minimum. Payments are made in installments each month according to the production of the land, applying science and technology in iman/faith and taqwa.
3. Chilli cauce processing should be promoted and supervised by the Department of Trade, Food and Drug Research Agency, and the Department of Health. Question: When will the three agencies that want to work together to apply science and technology in the iman/faith and taqwa towards hidonistix as the blessing of Almighty God ?

### 2.2. Place and Time

All villages throughout Indonesia starting with certain locations in South Sumatera that applied diversification of agribusiness with 2 hectares of land. The villages were South Talang Ubi of Penukal Abab and Lematang Ilir Regency, Lubuk Pauh of Musi Rawas Regency, Talang Buluh of Banyuasin Regency and Tegal Rejo of East OKU Regency (Sufri,2012-2013). The research fund was obtained as a grant and guidance from the Extension Office for Agriculture, Fisheries and Forestry.

### 2.3. Research Methods

This research used a case study method. Case studies have shown the characteristic of four agribusiness orinciples. On 2.1 hectares of land was planted with rubber trees of 1.5 hectares, chilli plant of 0,5 hectares and catfish of 0.1 hectares. The fresh chilli products unsold were then processed into chili sauce. Rubber plants or paddy yielded nearly equal amount of income.

### 2.4. Data Analysis Method

The type of data includes amount and value of production inputs, volume and value of outputs, the value of garage and warehouse infrastructures, while the facilities were motorcycle and tools used in the agribusiness. The data was calculated with revenue formula, depreciation formula of infrastructure and facilities, and a portion of each activity (in percentage). Nominal value was converted to present value (real) with the formula of factor compounding = $(1 + i)^t$ and the discount factor $(1 + i)^{-t}$ , where *i* is the rate of inflation or bank interest rate prevailing in 2012. Table of feseable living standard refered to Permen Nakertran No.17/2005 but the price of goods were collected from village nominal value (Sufri, 2003;

Sjarkowi and Sufri, 2004; Depnakertran RI, 2005; Sjarkowi, 2010; Centre Institute of Statistics South Sumatra Province, 2012).

# 3. Results and Discussion

The five management functions (planning, organizing, directing, coordinating and controlling) are automatically applied to humans in any activity, eventhough not priory realized because it had not compiled in the past (Alvarez and Arias, 2003).

Human activity is a living environment. When people talk about environment it means such environment (Sjarkowi, 2004) which consists of 1) social environment (organization, science and technology in the iman/faith and taqwa, regulatory, and economic), 2) natural environment (taking advantage of natural resources : the sun, water, air, soil, flora and fauna) and, 3) man-made environment (taking advantage of constructed resources : the production by the workforce etc.). So the social environment of agribusiness works with 5 management functions that simultaneously with the natural and man-made environment, and resulting the products in the form tools, seeds/seedlings, fertilizers, pesticides, herbicides, vehicles, garages, and warehouses.

## 3.1. Income and Hedonistic Life Analysis

The age rubber trees in the garden were reaching 12 years old, and from rubber plantations of 1.5 hectares it realized rubber slabs of 6,520 kgs per year, at the price of Rp10,100,- per kg, Then the revenue was Rp 65,852,000,- per year, or equal to Rp 5,487,660,- per month. The net income was Rp 4,650,000 per month. In the case of paddy, then on 1.5 hectares planted twice a year, the production were 16.2 tons of harvest dry grain equivalent of 8.9 tons of millled-rice. At the rice price of Rp 8,120 , - per kg , then the revenue would be Rp 72.27 million per year, and at the production cost of Rp 14.12 million, then the net income was Rp 58.15 million per year or Rp 4.85 million per month.

Chili plants of 0.5 hectares produced fresh chilies as many as 3.39 tons per year,with the average price of fresh chilies Rp 18,000 per kg, then the revenue equals to Rp62,920,611 or Rp18,511,506.62 per tonne of 3.0 tonnes of fresh chilies or Rp16,338,487.75 per year, or Rp1,361,540.65 per month. Chili production in the second season were 2 tons of fresh fruits and then they can be processed into several bottles of chili sauce with a profit of Rp 45.18 milliaon per year. Meanwhile, production of catfish gives revenue of Rp3.03 million per year.

Table 1. Production and Income from Several Agribusiness Units

| Amount of production | Income (Rp million/Year) | Income (Rp million/Month) |
|---|---|---|
| 6,5 Tons of fresh rubber (1.5 hectares, age 12 years)* | 65.85 | 5.48 |
| 3,0 Tons of fresh chili (0.5 hectares). First 6 months of planting | 62.92 | 5.24 |
| 2,0 Tons of fresh chili (0.5 hectares)= tons of chili sauce. Second 6 months of planting. | 45.18 | 3.77 |
| Catfish (0.2 hectares) | 3.03 | 0.25 |
| Total | 176.98 | 14.75 |

The Figures in Table 1 showed that the total income of the farm communities can reach on average Rp 14.75 million per month per family. Such values could be accrued because farmers obtained financial aid from the Institute of Agriculture Fisheries and Forestry Extension (AFFE) for cost of production, and they had land area of 2.0 hectares (Sufri, Antoni and Tawaqal, 2013). If the farmers do not own or have access to land, of course they wll not be able to diversify their farming system (Pakpahan, 2004). Should the rich

farmers in the village sell their land to farmers who do not own land, how paid per month of production plants that grow in the land. Therefore for rich farmers who do want to divide their wide land, the Almighty God may gives them punishment in the form of bad climate change and food insecurity. So far, many companies have not provided good and effective Corporate Social Responsibility which actually can economically empowered village communities, especially the farmers (Gray et al , 2004).

Table 2. An example of average income of chili farm implementers in fulfilling the Standard of Living Needs in Talang Buluh Village

| No. | Description | Rp million/month/family |
|---|---|---|
| 1 | Income | 14,747 |
| 2 | Standard of Living Needs per family (4 persons).<br>Price of goods in village | 5,411 |

Table 2 shows that with the Rp 5.411 million values of Standard of Living Needs for each family with 4 persons per month in the village, the farmers' income from chili planting of Rp14.747 million per family per month were able to cover the hedonistic familiy life.

Components required for a decent family life include (1) food and beverages, (2) clothing, (3) residential, (4) education, (5) health, (6) transportation, (7) recreation, and (8) savings (Ministry of Manpower and Transmigration, 2005). Indonesian standard of living needs for education only considers components to the extent of the cost for buying newspapers, radios, books, ball point/pencil only. For health component, the expenditure includes only for buying toothbrush, toothpaste, soap, shampoo, razors, deodorant, anti-mosquito drugs, cut and comb hair with medium quality. Therefore with the revenue of Rp14.489 million per month, the farmers family has started to enter the prosperous and hedonistic society. In this lifestyle, education components can be added to include color television sets and books, and children in the family can continue their education up to high school. The additional items for health component are, when needed, family members can go to a hospital or to a specialist to get medical treatment, and so on.

# 4. Conclusions and Recommendations

## 4.1. Conclusion

1. Tactics of fair and equally distribution livelihood can be implemented by providing land from the rich to those who do not have such capital or wealth. Society with sufficient capital and land can try and produce food and other agribusiness product, and by the help of God Almighty, the climate would be normal and the food would be available. Therefore this can increase the economic life of the poor into prosperity level equivalent to hedonistic society. For those who can enter hedonistic society, they daily economic life will always remain stable.
2. Application of fair and equitable distributed livelihood by human beings would be given guarantee and ridho/blessed by God the Almighty based on their iman/faith and taqwa, so they are allowed to be in heaven.

## 4.2. Suggestion

Almighty God is always angry to human beings who misuse science and technology without showing their iman/faith and taqwa to do better activities. Thus it is important for all of us to use science and technology for the purpose of helping other people to achieve better economic life with honesty, deliberation, consensus, and transparent. By doing that, hopefully we would given blessed by Allah SWT. Our good behavior would then be compensated at least in the form of normal climate and food availability as one element of food security.

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# Effect of Micro Climatic Conditions of Oil Palm on Growth and Yield of Rice Plant in Tidal Swamp

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**Abstract.** Cultivation of oil palm monoculture in tidal swamp has been the cause of conversion of paddy fields in Indonesia. In the paddy fields planted oil palm usually still cultivated rice. This study aims to examine the micro-climatic conditions caused by the oil palm different age are 2, 3, 4, 5, and 6 years. Microclimate data measured on rice generative (January 2012) and the rice harvest (March 2013). Solar intensity was measured using a Quantum meter, and temperature and humidity measured using Environment tester. Location of sample plots a place rice is used as a measurement of microclimate. Palm oil plantations will increase in line with the addition of age, and performance oil palm as it will create an increasingly broad leaf canopy so as to decrease the number and duration of sun intensity received rice plants. When the oil palm age of 4 years, the climatic conditions occurring around the rice plants were similar to those of shade 50%, and oil palm aged 5 and 6 years may reduce the intensity received rice plants. On the age 5 years oil palm will hit high, and significantly decrease number of tillers and number of grains per panicle. Rice production per hectare of oil palm plantations age 2 and 3 years more than 3000 kg / ha, and for oil palm age 4 and 5 years to achieve production of about 2500 kg/ha, and rice production will drop sharply to less than 1000 kg /ha of oil palm age 6 years.

**Keywords:** micro climate, rice plant, oil palm, poly culture, tidal swamp

## 1. Background

Paddy or Rice plants as a food crop in Indonesia is very strategic and pursued rice production rising every year. For increase national rice production can be through the addition of planting area, intensification, and increased planting intensity. Another strategy used by the government to continue improving regional or national rice is rice cultivation in the area of paddy land conversion into oil palm cultivation area. Rice fields that have been converted into oil palm plantations have been found in several places in Sumatra and Kalimantan. For in southern Sumatra are found in areas like tidal swamp Banyuasin district. In the rice fields with palm oil can still be used for rice cultivation. Farmers cultivated rice in among the palm trees and the problems that often arises is the effect of shade canopy palm to rice.

Oil palm plant age two years will be planted in the field and the oil palm usually have 24 to 30 leaves with a plant height of about two meters (Corley and Tinker, 2010). Appearance of young of oil palm grown in paddy fields has not been greatly affect rice plants. Oil palm plant will increase as time so that more number of leaves and leaf midrib become longer. Generally, after age 8 of oil palm overlap between the leaves so that the shaded area around of oil palm will be widened.

Effect of oil palm trees shade to rice has not been much information whereas rice cultivation activities have been carried out in the area. Rice plants are C4 plants that need full sun to produce the optimal grain (Susanne *et al*, 2012). Under conditions of intense shade of oil palm would suppress the growth of rice. In addition, the presence of oil palm around the rice plants will create a specific microclimate conditions like temperature, humidity, and light intensity. Shade will lower light intensity and temperature around the rice plant and will also increase humidity. The area of of oil palm cultivation have varied age so the place rice cultivation becomes different micro-climatic conditions. Differences microclimate conditions would lead to complex interactions between the temperature, humidity and light intensity. Environmental stress like low-light conditions can negatively impact crop yield and quality (Wang *et al*, 2013). For obtain information about the condition of the existing microclimate of various ages of oil palm in the paddy field needs to be measured to the variables that influence the shade of oil palm can be obtained accurately. This research was

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conducted becomes two groups: micro-climate measurements, and the response of rice to different ages of oil palm in rice fields so as to obtain information causes growth decline and yield of rice due to of oil palm.

## 2. Methodology

The experiment was conducted in the village of Suka Tani, Tanjung Lago, Banyuasin district, south Sumatra. Research activities done in October 2012 until March 2013. Rice cultivation implemented rice area has been conversion to oil palm plantations. Palm oil plantations have a spacing of 9 m x 9m x 9 m, and oil palm plantations as a place of research have aged 2 years, 3 years, 4 years, 5 years, and 6 years. Age of oil palm plantations will specify performance the plant so the plant age is used as a treatment and each treatment has 3 replications. This research uses Ciherang varieties and paddy seedlings were planted as 20 x 20 cm. NPK Phonska used 100 kg / ha and was given by way of sowing, and application one day before planting rice. After planting rice in paddy fields was given insecticide as 5 kg / ha. Rice sample plots dimension 1 m x 2 m was placed in the middle row of palm oil, and palm oil each age group there are three replicate plots of rice samples. At the rice sample plots selected 5 plants as plant samples and determination done at random. At the plant samples measured chlorophyll content of leaves, growth variables and yield components of rice.

Microclimate data measured when rice generative (January 2012) and the rice harvest in March 2013. Light intensity was measured using a Quantum meter of MQ-200 models. Environment tester model LM-800 is used to measure temperature and humidity. Measurement of intensity, temperature and humidity carried out in the afternoon (12 pm - 13 pm) with full sunlight conditions. Location of sample plots a place rice is used as a measurement of microclimate. Data from two further observations used as averages microclimate. All data microclimate, growth of rice, and rice crops there are processed using a randomized block design and regression analysis.

## 3. Result and Discussion

Oil palm age significantly affected intensity the sun, temperature, and humidity for the rice plant environment. The larger the size of the oil palm can reduce the intensity of solar and temperatures around rice plants. There is a significant correlation between the age of oil palm with light intensity, temperature and humidity around the rice crop (Table 1).

Table 1. Average value of the solar intensity, humidity, and temperature received rice, and regression between the elements of microclimate with palm plant age

| **Oil palm age** (year) | **Solar intensity** (μ mol.m-$^{2}$.sec-$^{1}$) | **Humudity** (%) | **Temperature** ($^{o}$C) |
|---|---|---|---|
| 2 | 1877 | 50.8 | 38.17 |
| 3 | 1705 | 55.23 | 36.00 |
| 4 | 1152 | 62.43 | 34.87 |
| 5 | 985 | 61.30 | 33.97 |
| 6 | 870 | 68.53 | 30.73 |
| regression equation | y = -273.4x + 2411 | y= 2.26X+42.59 | y =-1.60X+41.15 |
| $R^2$ | 0.93 | 0.97 | 0,85 |

Rice plants in the middle row of palm oil 2-year age get relatively similar solar intensity with no palm oil which is about 1900 μ mol.m-$^{2}$.sec-$^{1}$ and the lower solar intensity received paddy after 4-year old palm oil is 50% under normal intensity. Apparently, the older the palm oil causes a decrease in the intensity of solar and increasingly shaded area. The dynamics of solar intensity at a specific environmental conditions will affect the temperature and as a result of the low intensity could lower the ambient temperature. The temperature of palm oil age 2 years was higher than 4 ° C in palm oil age of 4 years, and there will be a

difference of up to 7°C than 8 years old palm oil. Solar intensity is suspected as a key factor in controlling the temperature and humidity in the micro-environmental conditions, and the lower the number of photons that arrive at a surface causes accumulation of heat will decrease. Increasingly wide close canopi palm area will reduce the number of photons to the ground that the accumulated heat will be lower, and these conditions will reduce the temperature below canopi oil palm. On the other hand, the increase in temperature canopi will increase the amount of water vapor in the loose around the oil palm that the moisture will increasingly. Thus, for greater oil palm (5 and 6 years old) will create conditions relative lower solar intensity and temperature, and humidity higher than the oil palm ages 2 and 3 years.

Plant height is influenced by solar intensity, and the more limited the intensity received rice leaves will stimulate additional plant height (Cai and Shiming, 2012). Conditions more down the intensity of the current oil palm age of 4 years resulted in higher than rice growing in oil palm shading conditions 2 and 3 years age. Rice under conditions of oil palm plantations age 5 and 6 years showed decreased plant height (Figure 2). The intensity of solar received by the leaves of rice until 1100 µ mol.m-$^{2}$.sec-$^{1}$ could lead to a high increase in rice.

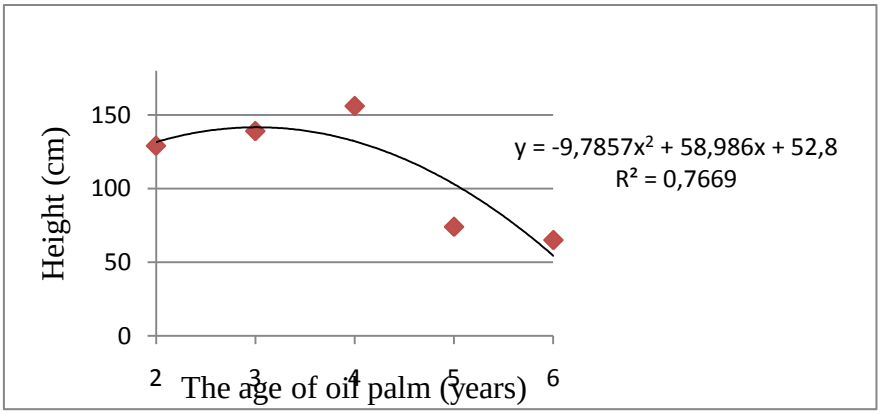


Fig. 1: Relationship between the age of oil palm and height of rice

It seems shading to the extent of about 50% intensity will control the dominant height of rice plants, and greater shading will actually cause high suppress plant. Rice plants under oil palm age 5 and 6 years showed leaf chlorosis and leaf performance were stunted. This means that the process of assimilation is not optimal and therefore contributes to the growth of plant height.

A relatively large number of rice tillers with oil palm condition age 2 years, and will decrease the amount tiller/hill with increasing palm age. Shading conditions can reduce tillering of rice by 50% (Figure 2). Shading can reduce the rate of photosynthesis thus inhibiting the formation of plant organs including rice tillers.

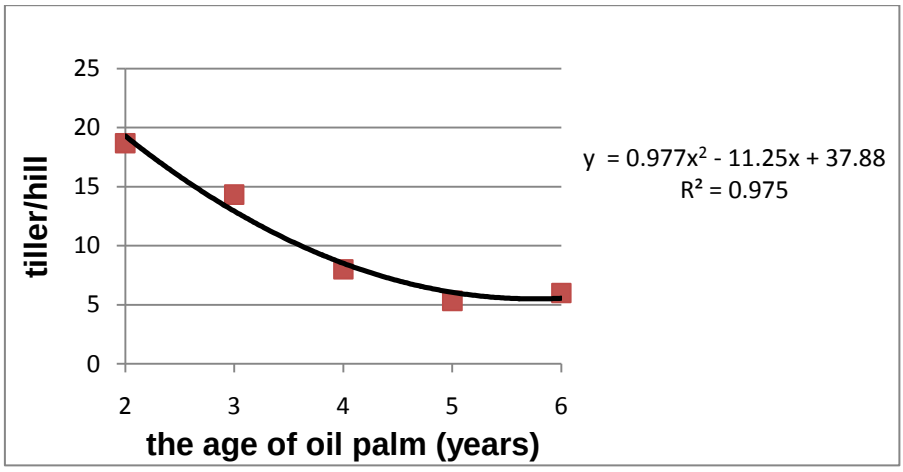


Fig. 2: Relationship between the age of oil palm and tiller/hill

Grain number per-panicle is one of the most important components for rice yield. Spikelets on the primary and secondary branches determine the grain number per-panicle in rice (Zhang *et al*, 2011). Number of grains per panicle associated with optimal plant height so that the rice is not under pressure shade will have more grain. Shade of conditioned trigger high increase actually reduce the number of grains of rice, and greater influence of shade would decrease number of grains of rice (Figure 3). Grain is a place photosynthate accumulation of leaves so that more effective leaf photosynthesis would increase the amount of grain containing the panicle. The existence of length leaves and green color certainly has the potential photosynthesis rate greater than the stunted and chlorosis leaves so that the amount of grain more.

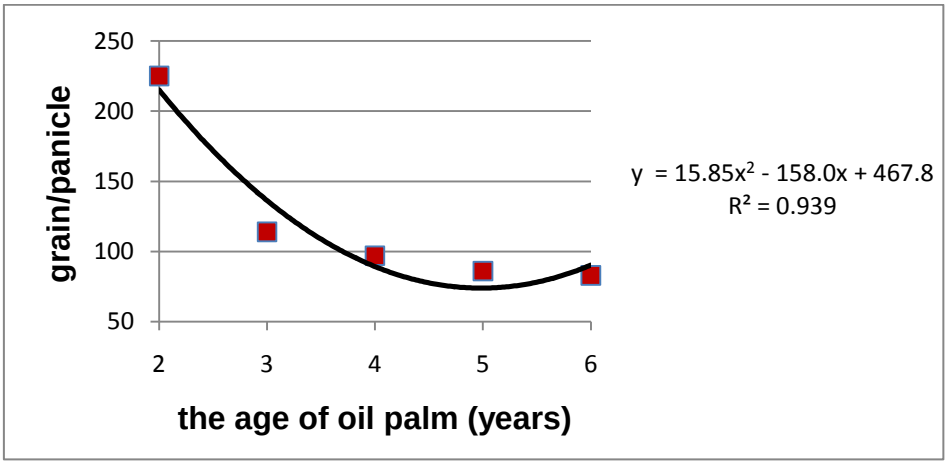


Fig. 3: Relationship between the age of oil palm and grain/panicle

Grain production per unit area of land is determined by the amount of rice population, the growth and development of rice and external factors (Yao, 2000). Environmental conditions such as the intensity of solar grows predictably control also influence the rate of growth and accumulation of photosynthate rice. Shading conditions created large oil palm plantations would simultaneously suppress the growth and metabolism of rice so that the number of grains per unit area of the lower. age difference creates oil palm leaf canopy size and length of the shade so that the number of grains per unit area would different (Figure 4). Thus, rice plants are experiencing growing pressure due to shade conditions would produce fewer grain weight. Shading not only affects the filling rate, carbohydrate accumulation of grain, and dry matter transportation in stem-sheath, but it also affects starch synthase and related enzyme activities (Wang *et al*, 2013).

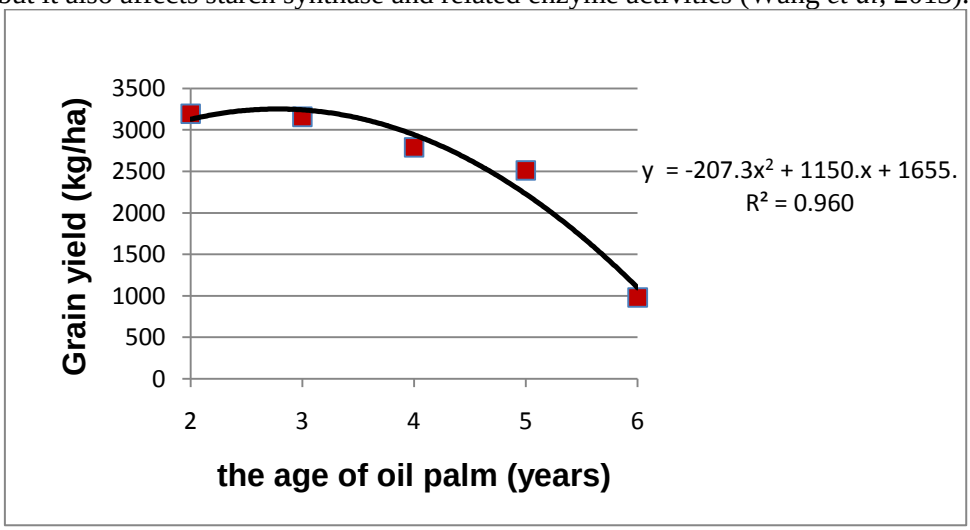


Fig. 4: Relationship between the age of oil palm and grain yield

## 4. Conclusion

Microclimate factors play an important role in controlling the growth of rice is the intensity of light, and the rice crop will receive almost 50% shading effect on palm 4 years. Ciherang rice varieties are still able to produce economically in poly culture system with the palm up to the age of 4 years, and for older palm oil will inhibit the growth and yield of rice plants.

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# Climate Change Influences The Distribution of Parasitic Plants on Duku Tree (*Lansium domesticum* COOR.)

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**Abstract.** Duku tree (*Lansium domesticum* COOR.) is commonly grown in several region in Sumatra. The area of duku planting is remained unchanged and the recent trees have been cultivated in the 1920s. The Farmers are not interested in planting duku because the tree takes too long to start fruiting. The old duku trees do not receive either fertilizer or good cultivation practives. Based on surveyes in Muara Enim, Sekayu, and Komering area about 90% of the tree was parasitized by *Loranthus* sp. (Lorantaceae), and approximately 50% was overgrown by an epiphytic plant, *Drymoglossum* sp. According to thefarmers, the parasitic plants have been prominently occured and the incidence was 10 to 20%. The rapid spreading, and infestation of *Loranthus* and *Drymoglossum* likely related to the climate change. Increase in temperature in the recent years may accelerate the metabolism of both host and the parasitic palnts. It is likely that, the warmer climate could benefit both vegetative and generative growths of the parasitic plants on the duku tree.

**Keyword:** Loranthaceae, *Drymoglossum*, Parasitic plant, *Lansium domesticum*

## 1. Background

Duku trees grown in several region in Sumatra. Duku tree usually grows near to streams or watersheds. The recent duku trees were planted more than 100 years ago [1]. Broad expanse of trees duku not much increased. The fact that some of the duku trees have died because of old, attacked pest, disease or deliberately felled for the development or manufacture of home.

Duku tree belonging orthodox crop was be characterized by flowering and fruiting [2]. Flowers and fruits duku appear in branches or twigs. Large or small diameter of duku branch or twig is an indicator of bring flowers. The flowers that appear in the same place at the same brances. Flowers and fruit appear in the branch or branches do not occur every year [3]. In general duku tree have fruitful about 4 years times, following years bear little or no fruit at all. Duku fruit is harvested by plucking its away from the stem or knocked out of the shaft [4]. Duku fruit are harvested with the trung which has a longer shelf life than fruit harvested by threshing.

Problems arising in duku trees lately is the disruption of parasitic or epiphytic plant. Parasitic plant that grows on the branches and twigs duku. Growth and development of the parasitic plant covered and depressed twigs that can cause it's death. Branches are covered by epiphytic plants can cause reduced fitness of the tree. Closure of branch surfaces by epiphytic plants cause flower can not appear. Finally parasitic and epiphytic plants will very detrimental to the growth of duku tree and production duku fruit.

Parasitic plant on duku trees including higher plants, it has a complete organ as a stems, roots, leaves, flowers and fruit. Parasitic plants attached to twigs of duku by root haustoria. Root suction will suck and drain the water or other nutrient substances into the parasitic plant [5]. As a result, the growth of the duku twigs that parasitized be depressed.

Epiphytic plants grow spread and enveloped branches duku tree. Epiphytic plants have roots and leaves but no fruit, It's produce spores to spread to ather place in the same or difference duku tree. Epiphytic plants do not parasitized duku tree, It's attached on the surface and branch duku tree utilize existing water there. Spore will blown by the wind to reach the ather tree, then grow and develop in appropriate environmental conditions [6]. The existence roots of epiphytic plants in the surface of branch can close lenticels and roads disrupt the appearance of flowers.

Currently almost all of the duku trees can be found parasitic plant *Loranthus* sp. and epiphytic plants *Drymoglossum* sp. Duku trees are overgrown by *Loranthus* sp. and *Drymoglossum* sp. must be treated in

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order to have grow and produce well. If the parasitic and epiphytic plants it is not controlled, they can depressed growth the duku tree. Duku tree will reduced leaves, dull yellowish color and eventually die. It should not happen, because very few farmers do develop the duku tree.

The increasing number of plant parasitic, *Loranthus* sp. and *Drymoglossum* sp. This becomes an interesting phenomenon in the last 10 years. Ten years ago, only a few duku trees are overgrown by parasitic and epiphytic plants limited distribution. In the number of duku tree were parasitized bya parasitic and epiphytic plants was allegedly closely associated with the issue of global warming. The hypothesis needs to be traced through a study. For interviews and a review was carried out into the duku garden. Interviews were conducted to obtain information and responses of farmers who has duku tree to the phenomenon ofparasitic plants are growing rapidly in their duku trees. A review of the garden aims to see the condition of the existing direct principal parasitic and epiphytic plants in duku tree.

## 2. Method

The study was conducted through a survey to the area were has planted duku trees. Based on these criteria was selected three regions of the District, e.a. Muara Enim, Banyuasin and Ogan Ilir. In each region was selected 10 farmers who has duku garden. Farmers were selected which has duku more than 100 tree. The farmer was choosen was given a few questions to get the information and their response to the parasitic or epiphytic plants that grows on their duku trees. Interview were followed by direct observation to duku garden to chek the real conditions of duku trees. Duku tree in the garden which was selected 10 stems. Each duku tree is observed the plant parasitic and epiphytic plants. The data obtained were inserted into the table and then analyzed.

## 3. Result and Discussion

Information obtained from the interviews showed that farmers already know the parasitic plant was inflenced the grown of their duku trees. but some of them do not know about the epiphytic plant. Most of farmers duku do not understand that a parasitic and epiphytic plant can threaten their survival Duku tree. Therefore they leave the plant parasite living in his Duku tree . However, there are some farmers knew that a parasitic and epiphytic plant can harm their duku trees. but they allow a parasitic plant grows on their duku tree. Because they do not know how to control it.

Farmers duku was worry that their duku tree will be uninterrupted or die by the influence of parasitic or epiphytic plants. The farmers said that in ten years ego was difficult to find a parasite or epiphytic plant on duku trees. But now almost every duku tree overgrown by parasitic and epiphytic plants. The parasitic plant that is increasingly felt by the people of their effects on tree growth Duku, Parasitic plant can decreased the production of fruit and the growth of the tree was poor. Now the farmers need help in controlling the parasitic and epiphytic plant that grows on their duku trees.

The results of direct visits to the duku garden or expanse of duku showed that duku trees at the district Banyuasin, Muara Enim and Ogan Ilir were almost entirely covered by parasitic and epiphytic plants. Only a few trees that are free from vegetation of duku parasitic or epiphytic plant. In one duku trees can be found 1 to 12 parasitic plant (Tables 1, 2 and 3). The amount of variation is influenced by the location of the duku trees in the garden. Duku trees are located at the side or fringe garden more common found the parasitic plant than duku tree that is located in the middle of the garned or in the crowd duku tree. Amount of a parasitic plant on duku trees was influenced by age, more older the age of the tree duku tend more and more overgrown by parasitic plant. It olso happen with epiphytic plants. The older of the age of duku tree will be more and more epiphytic plants were founded.

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Table 1. Result of observed the parasitic plants was found in each tree in each farmers duku garden in the District of Muara Enim

| Garden was observed | Amount parasitic plant were founded in each duku trees | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| First | 3 | 6 | 5 | 7 | 6 | 4 | 8 | 9 | 4 | 5 |
| Second | 5 | 5 | 6 | 4 | 7 | 6 | 3 | 8 | 6 | 7 |
| Threeth | 2 | 5 | 9 | 9 | 10 | 11 | 8 | 6 | 4 | 5 |
| Fourth | 8 | 6 | 9 | 4 | 5 | 7 | 11 | 8 | 6 | 7 |
| Fiveth | 6 | 6 | 8 | 7 | 9 | 4 | 5 | 4 | 6 | 3 |
| Sixth | 5 | 8 | 6 | 8 | 7 | 3 | 6 | 5 | 4 | 9 |
| Sevent | 0 | 5 | 7 | 6 | 4 | 3 | 0 | 5 | 4 | 1 |
| Eighth | 7 | 5 | 6 | 7 | 9 | 10 | 9 | 8 | 6 | 7 |
| Nineth | 7 | 6 | 7 | 8 | 5 | 6 | 4 | 5 | 7 | 8 |
| Tenth | 6 | 7 | 5 | 4 | 7 | 6 | 7 | 8 | 5 | 6 |

Table 2. Result of observed the parasitic plants was found in each tree in each farmers duku garden in the District of Banyuasin

| Garden was observed | Amount parasitic plant were founded in each duku trees | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| First | 2 | 4 | 3 | 6 | 4 | 5 | 8 | 6 | 5 | 4 |
| Second | 0 | 2 | 3 | 5 | 4 | 0 | 2 | 3 | 2 | 2 |
| Threeth | 4 | 5 | 7 | 5 | 3 | 2 | 1 | 0 | 4 | 1 |
| Fourth | 2 | 5 | 4 | 6 | 3 | 3 | 4 | 3 | 5 | 2 |
| Fiveth | 4 | 0 | 3 | 6 | 3 | 4 | 3 | 6 | 4 | 3 |
| Sixth | 6 | 7 | 5 | 9 | 2 | 4 | 3 | 6 | 9 | 4 |
| Sevent | 3 | 4 | 7 | 6 | 9 | 7 | 5 | 4 | 7 | 5 |
| Eighth | 1 | 3 | 2 | 0 | 4 | 2 | 0 | 1 | 2 | 2 |
| Nineth | 3 | 2 | 8 | 4 | 0 | 6 | 6 | 3 | 5 | 7 |
| Tenth | 2 | 2 | 0 | 4 | 5 | 6 | 7 | 0 | 4 | 3 |

Table 3. Result of observed the parasitic plants was found in each tree in each farmers duku garden in the District of Ogan Komering Ilir

| Garden was observed | Amount parasitic plant were founded in each duku trees | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| First | 1 | 3 | 2 | 4 | 3 | 0 | 1 | 0 | 2 | 1 |
| Second | 5 | 6 | 5 | 7 | 5 | 9 | 8 | 10 | 6 | 4 |
| Threeth | 9 | 8 | 6 | 7 | 12 | 9 | 11 | 7 | 8 | 9 |
| Fourth | 6 | 6 | 9 | 4 | 9 | 11 | 9 | 5 | 4 | 6 |
| Fiveth | 4 | 3 | 6 | 5 | 8 | 6 | 7 | 5 | 9 | 7 |
| Sixth | 5 | 6 | 4 | 6 | 8 | 10 | 9 | 6 | 8 | 7 |
| Sevent | 10 | 5 | 6 | 4 | 7 | 6 | 9 | 7 | 9 | 9 |
| Eighth | 0 | 4 | 6 | 5 | 8 | 2 | 0 | 1 | 4 | 3 |
| Nineth | 4 | 6 | 5 | 8 | 9 | 4 | 5 | 3 | 7 | 5 |
| Tenth | 5 | 10 | 5 | 6 | 8 | 1 | 8 | 4 | 3 | 8 |

Parasitic plant are found living in the duku tree belonging to the family Loranthaceae, i.e. *Loranthus* sp. (Figure 1). Parasitic plant grows produced flowers and fruit. The fruits has sweet taste and when this fruit was ripe it will be become bird food [7]. The seed-eating birds are the primary vector who doing dispersal of parasitic plant from duku trees to another duku trees or to another branch in the same of duku tree.

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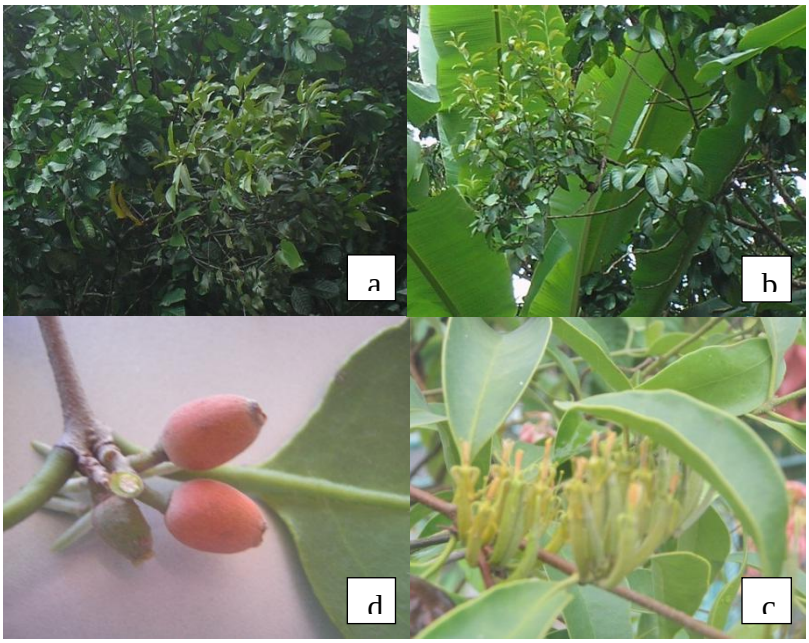


Fig. 1: *Loranthus* sp. plant on tree and twig of duku tree (a & b). Flowers and fruit of *Loranthus* sp. (c & d)

Epiphytic plants that grow on duku trees was *Drymoglossum* sp. (Figure 2). *Drymoglossum* sp. Usually founded in places that are hidden or not exposed to direct sunlight. Suitable environmental conditions can spur growth *Drymoglossum* sp. [8]. It's can caused branches and twigs of duku were covered by epiphytic plant. The result of identification show that the species of *Drymoglossum* were live on branches or twig duku was *Drymoglossum piloselloides*.


Fig. 2: Epiphytic plant were covering branches of duku (a), and cavered epiphytic can caused leaves fall and consequently can causing duku tree die (b)

Maintenance is an important factor influencing phenology of duku tree. Duku trees was maintained to grow healthier plants and a bit overgrown by parasites or epiphytic plant. It happened because farmers as owners duku tree make action by catting or through out the parasitic and epiphytic plant where were living at their branches or twig of duku tree. They will cut twigs to break the link between a parasitic plant with the trunks duku tree or revoke epiphytic plant manually to remove it from a branch of duku tree.

Literature study shows that global warming has caused many changes in plant life. The heat has driven the parasitic plant *Loranthus* sp. quickly multiply [9]. Sunlight spur the transpiration, the rate of transpiration it led to an influx of more nutrients into the body of parasitic plant. As a result it nutrient in a

parasitic plant managed to produce flowers and seeds [10]. Seeds were formed invaited birds to come and feed on the seeds of parasitic plant. Thus the seeds of parasitic palnt were more dispersed with the help of birds.

*Drymoglossum* sp. as epiphyticplant also increased. High rainfall causing moisture in the air around the branches and twigs was higher and it's can cause epiphytic roots growing rapidly [11]. The root epiphytic gripping and enveloping branches or twif of duku tree, It's can cause the flowers of duku can not be out of branche or twigs. Epiphytic plant may increase the temperature and transpiration in duku branches. Duku tree were covered by epiphytic plant will experience a shortage of water, the leaves turn yellow and eventually can lead to the death of shoots, twigs and parts of duku trees.

## 4. Conclusion

Global warming has pushed the dispersal of plant parasitic *Loranthus* sp. and *Drymoglossum* sp. Epiphytic and parasitic plants that cause the survival and fruit of duku production depressed. Need to shape movements and eradicate parasitic plants by throught out of them where that live in duku trees.

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**Proceeding of 2013 International Seminar on Climate Change and Food Security (ISCCFS 2013)**
*Palembang, South Sumatra-Indonesia, 24-25 October,2013*

# APPENDIX

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# Notulency of International Seminar on Climate Change and Food Security (ISCCFS 2013) Palembang, South Sumatra-Indonesia 24-25 October 2013

## KEYNOTE SPEECH PRESENTATION

**Speaker : Dr. Perdinan and Dr. Rizaldi Boer (CCROM-SEAP/PERHIMPI)**
**Session Chair : Dr. Sabaruddin**
**Topic : Innovation to address the Potential Impacts of Climate Change on Agriculture in Indonesia: Research Needs**

**Contents :**

1. In a few last decades, ASEAN countries have been exposed to increasing trends of extreme climate hazards which has been considered due to global warming and climate change.
2. Late action to address this will lead to more severe impact and the adaptation will be very costly and may be impossible to be handled.
3. A global study by Cline (2007) suggested that in 2080, the economic loss due to global warming (worse scenarios) on agriculture sector would be equivalent to about 6.33 billion USD (without $CO_2$ fertilization) and 1.967 billion USD (with $CO_2$ fertilization).
4. Innovations to Address the CC Impacts
   a. Critical issue on climate change assessments
   b. The development and application of climate models
   c. The application of information technology
   d. Climate-agricultural technology

   Climate Forecast Application
   - The benefits of progress in computer power and understanding on global teleconnection
     a. development of methods to predict the onset dates of the rainy season based on global forcing factors (e.g., MJO, IOD, SST, SOI)
     b. evaluation of the skill of forecast for Indonesia
     c. development of dynamic cropping calendar based on the global forcing factors

   Climate Index Insurance
   - Philosophy and initial application
     a. payment will be made on the basis of unexpected climate condition regardless of crop loss/failure
     b. has been developed in developing countries, i.e., africa, India, and the Phillipines
   - Research needs:
     a. development of climate index and the insurance package (i.e., claim policies) in Indonesia
     b. the inclusion of climate index into farming management in Indonesia as an adaptation option
   - Management of Pest Infestations
     a. Understanding on climate change and pest infestations
     b. an increase in pest infestations under climate change
     c. invasion of pest and disease to a new region
     d. Research needs:
     e. development of climate-pest/disease models to estimate pest infestations under the 'new' climate regime
     f. development of climate index insurance for pest infestations

**Discussion :**

1. Prof. Supli Effendi Rahim
   how to improve agriculture related to climate change, and how the connection with the cultivation of cassava.
2. Mrs. Hera
   suggestions for the Indonesian government in terms of climate changes and food security.
3. Dr. Suwandi
   how climate change correlation with the increase in pests and plant diseases.

**Speaker : Olaf de Jongh (Netherlands Senior Expert)**
**Session Chair : Dr. Sabaruddin**
**Topic : Crop production management (with focus climate change and food security)**

**Contents :**

1. Crop production management refers to the various processes applied toward the effective cultivation and harvesting of crops.
2. A crop is the same kind of plants grown and cultivated on a large scale at a certain place.
3. Production is the **making of goods** or products. However, the word production refers to the process as well as to the **result of the process**.
4. Management - in general - is combining labor and capital.
5. In relation to crop production we talk about management systems; this usually includes considerations regarding:
   - the selection of the crop and a certain cultivar to plant,
   - the preparation of the land,
   - the application of fertilizers
   - the application of biocides (herbicides, fungicides, insecticides etc.) and growth regulators
   - practices like sprinkling or flooding
   - the involvement of people and machinery
6. One of the first considerations in crop production management is of the determination of the type of crop to be planted.
7. Every crop requires specific (growing) conditions:
   - soils
   - climate
   - geographical area
   - market conditions.
8. More Maintenance
   - **nutrient management**: this can be done by fertilizer or manure; a fertilizer is an inorganic chemical salt and manure is a natural substance obtained by decomposition of cattle dung, human waste and plant residues (green manure)
   - **disease and pest management**: this is to fight pathogens or pest in crops. It can by application by pesticides that target the particular pest for that particular crop. ( image ..)
   - **herbicide application or weeding**: this is the process of removal of weeds or unwanted plants from the fields.
   - weeding is important because the weeds compete with the crop plants with water, nutrients, space and light.
   - **irrigation management**: irrigation is a means of providing moisture when this is an issue.
9. **Levels" of crop production management**
   - Scientific or academic level
   - Vocational level
   - Farmers level

   The farm structure covers these elements, and also includes the ownership and organization of farm businesses; the links among farms, farm households, buyers, input providers, and contractors; and the mix of inputs and products on farms. The economics of the farmer and their households and low and higher levels of wealth. The farm management includes all the aspects.
10. **green revolution**
    - The '**green revolution**' and industrialization of agriculture is leading to increases in crop production around the world.
    - The 'green revolution' which combined use of high-yielding varieties, the application of fertilizers and pesticides, the increased use of irrigation and cheap transport fuels, has led to huge increases in food crop production.
    - Climate change may affect food systems in several ways ranging from direct effects on crop production (e.g. changes in rainfall leading to drought or flooding), or warmer or cooler temperatures leading to changes in the length of growing season, etc. Often, higher temperatures occur which speed up development, shorten the growing season and so reduce yields. The relative importance of climate change for food security differs between regions.
    - Population grows will affect food systems maybe more

- Food security ( enough food available) in general is most influenced by economics and policy. Prices and markets are very important for the magnitude of production; reserves are essential to withstand the minor yield variations by climate change. The effects on yields per ha of climate change will indeed be marginal, unless the climate change implies matters as floods, tsunami's, persistent droughts, etc.

**Discussion :**

1. Prof. Zainal Ridho
   Provide suggestions on how to develop sustainable agriculture with regard to climate change and food security. as we know Indonesia is a country that is potentially in the development of organic farming, how to improve organic agriculture on climate change
2. Double degree Students
   The basic thing what should be improved in order to create agricultural farms that can improve people's economy and government.

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## SUPPORTING PAPER PRESENTATION

**SESSION 1**

**Session Chair : Dr. Kiki Yuliati**

**Panel 1**

**Presenter:**
1. Maman Rahmansyah
2. Supli Effendi Rahim
3. Najib Asmani

**Discussion:**

1. Marlina: What was the variety of rice used in the tillage system?
   *(Najib Asmani): Ciherang.*
2. Marlina: What policy that Government or other agricultural communities' have related to the climate change impacts on agriculture? Is there any possibility to get a funding for research especially for student?
   *(Supli Effendi Rahim): The opportunity is wide open as long as we have a good proposal and an intensive communication with them.*
   *(Najib Asmani): HTI offers research grant for undergraduate and post graduate student.*

**Panel 2**

**Presenter:**
1. Nandika Pratiwi
2. Yudhi Zuriah WP
3. Lazarus Dawa

**Discussion:**

1. Dr. Umar Harun (to presenter 3): How to increase soy production considering the soil in Indonesia is high in acidity?
   *We can try to do some treatments to the soil for example, increasing the pH of the soil; using a good soy bean variety.*
2. Erni Purbiyanti (to presenter 1): What is the explanation for the negative sign of the average labor wages?
   *The negative sign represents the decreasing of average labor wages as other variables (cost) increase.*

3. Dr.Najib Asmani (to presenter 3): How to overcome the decreasing of soy bean production in Indonesia?
   *Applying and improving technology for soy bean farming. Government should increase the incentive for soy bean farmer through the soy bean price control policy, so the farmer will be encouraged to plant soy bean.*
4. Prof. Supli Effendi Rahim (to presenter 2): Why the efficiency of the land differ from each other?
   *Because each types of the tidal land has a different condition as the impacts of typologies differences.*

**Panel 3**

**Presenter:**
1. Erni Purbiyanti
2. Edison
3. Dessy Adriani
4. Faharuddin

**Discussion:**

1. Puspitahati (to presenter 1): How to decide whether the model created is fit to the real condition/ problem? Can we use the model for other areas?
   *The model was developed based on the experimental data and the theoretical approach. It can be used for other areas with some adjustment.*
2. Prof. Supli Effendi Rahim (to presenter 3): What is the level of total consumption and production of rice in Indonesia? How is it impact the decision whether to import or export the rice?
   *The approximate data of total production of rice and the level of consumption in Indonesia show a surplus condition. However, the important thing is how to make sure the policy is working.*

**Panel 4**

**Presenter:**
1. Marwan Sufri
2. Umar Harun
3. Puspitahati

**Discussion:**

1. Prof. Supli Effendi Rahim (to presenter 3): What is the proper water management in swampland?
   *It depends on the typology, characteristic of the soil and water table level.*
2. Marlina (to presenter 2): how the open and shading area affected the growth of the plant?
   *The open area and shading condition influence the soil condition, such as temperature and humidity, thus affected the plant growth.*
3. Prof. Supli Effendi Rahim (to presenter 1): Why you use money as the standard for hedonistic?
   *It's refers to Indonesia Labor Department standard.*

**SESSION 2**

**Session Chair : Dr. Andi Wijaya**

**Panel 1**

**Presenter:**
1. Edi Armanto
2. Suwandi
3. Nurhayati

**Discussion:**

1. Prof. Ridho Djafar (to presenter 3): Which the climate factors that the most impact for the pest growth?
   *Temperature and humidity are the climate change that effect the pest growth.*

**Panel 2**

**Presenter:**
1. Agus Hermawan
2. Tamrin
3. Mohd. Ghazali

**Discussions:**

1. Dr. Suwandi (to presenter 1): Did you apply the measure of chicken-swamp rice? Because it maybe contains of silicat.
   *Maybe next will corporate and combine with others reasercher to measure the silicat contain.*
2. Dr. Suwandi (to presenter 3): Can you tell the name of microbia formula (product), its contain and how it's mechanism?
   *The formulation is secret "depend on the constitution, it is normal aquatic microba that can reduce "pencemaran in the water. It can develop with nutrient as it food in the environment.*
3. Prof. Filli Pratama (to presenter 3): How many dosis and can it apply to all water?
   *Yes it can do. This probiotic is already served in the market with dosis.*

**Panel 3**

**Presenter:**
1. Filli Pratama
2. Prima Septika
3. Railia Karneta

**Discussions:**
1. Dr. Marsi (to presenter 1): How long the minimum time to produce non significant standart quality?
   *It's less than 7 days*

**Panel 4**

**Presenter:**
1. Zaid Subrata
2. Yuanita Windusari
3. Neni Marlina

**Discussions:**
1. Prof. Filli Pratama (to presenter 2): How can the capture CO2 happened? How if the carbon is too much on the air? How the mechanism capture?
   *2 can estimated in plant because the highest plant, easier plants to result CO2.*
2. Someone (to presenter 1): There was no data, the effect climate change that show the growth of climate change as long as 5 years until 10 years (suggestion).
   (to presenter 3): When the fertilizer is given? How many spesies of bacteria that can used as fertilizer? (suggestion) make clear the method.

**Panel 5**

**Presenter:**
1. Chandra Irsan
2. Ria Liuhartana

**Discussions:**
1. Cristin (to presenter 1): Is there any direct impact parasitism plant on Duku?
2. Prof. Ridho Djafar: How to protect parasitic plants by AA, ABA as hormone?