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The Livelihood Vulnerability of Spesific Organic Rice Farmers' Household as the Effect of Climate Change in Tanggamus Region Lampung Province

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Abstract
The study aimed to analyze the livelihood vulnerability index of both organic and non-organic rice farmers' household as the effect of climate change. The sample was determined by a census comprising of 60 organic rice and 80 non-organic rice farmers who lived in Pematang Sawa Subdistrict, Tanggamus Region, Lampung Province. To measure the livelihood vulnerability of farmer's household, the index of livelihood vulnerability was employed.
The results showed that the organic rice farmer's household was more vulnerable to natural disaster and climate variability, water, consumption, education, and income than that of the non-organic rice farmer's. Meanwhile, the non-organic rice farmer's household was more vulnerable to agriculture and food. Based on the contribution, the LVI-IPCC of non-organic rice farmer's household was more vulnerable to climate change than that of the organic rice farmer's. To observe the household's vulnerability to the effect of climate change, it was better to carry the study out in some different areas far away in distance (different regions/province), by expecting that the different climate components could significantly be influential. The effort to decrease the vulnerability level of rice farmer's household was shown by delivering some information about climate objectively and continuously, thereby encouraging the farmers to adapt the effect of climate change well. Therefore, there must be some support needed in form of resources aid programs such as irrigation system or pumping well, and some breeds useful to increase the farmers' income, alongside their agricultural businesses.
Keywords : vulnerability, climate change, organic rice, Lampung Province

1. INTRODUCTION

In general, the agricultural organic business conducted by farmers is based on the existence of knowledge, information, and their self-awareness to the negative effects of chemical input use in agriculture. However, the business of organic rice done by farmers in location of study was a lot based on some unwillingness due to the non-strategic location hard to go overland, and the only access available was by sailing the sea by ships setting out once a day. Indeed such a condition caused production inputs to be expensive and rare, thereby forcing the farmers to use straws and some plants' leaves as fertilizer. Besides, the location bordered by sea was so vulnerable to the effect of climate change such as raising of sea water level, storms, and deadly dry season.

The alternative usable to identify how climate is changing is by asking farmers (Adiyoga, et al. 2012). Basically, farmers are the most important stakeholder playing role in debates about climate change, since they are the spearhead of agricultural sector maintenance. However, their knowledge about climate change is very limited. Therefore, there is a need of full information related to climate and its changes, and then guides farmers to take appropriate actions in doing agricultural business. In addition, farmers are so vulnerable to the effect of climate change, since their life is depending highly on natural resources, and it is hard for them to adapt to climate change (Rasmus and Misha 2010).

Lampung as one of some provinces relying its economy on agricultural sector, whose field is so wide, agroclimate and agroecology are so good to develop food commodity, rice in particular, has a big opportunity to cultivate organic rice. Just like the others, however, Lampung cannot get rid of the effect of global climate change. Therefore, in order to anticipate and to adapt to such a change, there was increasing cultivation of organic rice begun in 2002. One of many regions having done so is Tanggamus, more exactly in Pematang Sawa subdistrict, Village Tampang Tua, since 2009.

Tanggamus region had been experiencing such a climate change from D1 (rain fall data 1976-1990) to D2 (rain fall data 1991-2010), showing that there were some changes of climate type leading to be much hotter. In 2012, this region in particular Pematang Sawa subdistrict was attacked by deadly dry season, thereby causing to some production decrease, and even poor harvest. By taking such a harvest caused by long dry season into account, there is a study ncessary to identify how high the livelihood vulnerability level of both organic and non-organic rice farmers' household as the effect of climate change in Tanggamus region is.

II. METHODOLOGY

a. Location, Respondent andTime of Research

The location of study, Tanggamus Region, Pematang Sawa subdistrict, Village Tampang Tua was decided intentionally by considering that this area is a centre of organic rice cultivated in rain-fed rice field production certificated by Indonesian Organic Farming Certification (INOFICE) and used to deal with deadly dry season in 2012. The sample was determined in a census, by involving all the farmers cultivating organic rice in Village Tampang Tua, about 60 people in number and, as the compared, 80 non-organic rice farmers from Tampang Muda Village. The study was taken in February-July 2013.

b. Data Analysis

To analyze the livelihood vulnerability level of both organic and non-organic rice farmers' household as the effect of climate change, the livelihood vulnerabilityindex (LVI) was taken based on the indicators employed by the Intergoverment Panel On Climate Change/IPCC (2007), the UNDP (2007) dan Hahn et al. (2009) such as Exposure, Sensitivity, and Adaptive Capacity adapted to the condition of farmers working in rain-fed rice field. In detailed, the main indicators and their sub-indicators of vulnerability are described in Table 1.

The LVI measurement employs an weighted average approach (Sullivan *et al*.2002) in which each component equally contributes to the total index in spite of the main components having different sub-components. The steps to measure the livelihood vulnerability index (LVI) are:

(1) Standardizationof LVI Measurement

Since each indicator has different measurement, a standardization based on the index of human life expectancy (UNDP 2007) needs to be taken with the formula as described below:

$$\text{Index}_{\text{sub-indicator}} = \frac{S - S_{min}}{S_{max} - S_{min}} \quad \ldots\ldots(1)$$

S = *real score of each sub-indicator*

S_{min} = *minimum score of each-indicator*

S_{max} = *maximum score of each -indicator*

(2) *Average* sub-indicator*indices* (Hahn et al. 2009)

$$M_{\text{sub-indicator}} = \frac{\sum_{i=1}^{n} \text{Index}_{\text{of sub-indicator}}}{n} \quad \ldots\ldots(2)$$

(3) *Calculating* main-indicator *indices*

$$\text{LVI}_{\text{main indicator}} = \frac{\sum_{i=1}^{7} W_{Mi}\, M_{\text{sub-indicator}}}{\sum_{i=1}^{7} W_{Mi}} \quad \ldots\ldots(3)$$

W= Weighing factor

(4) Contributing IPCC-Vulnerability Index

$$CF_{org} = \frac{\sum_{i=1}^{7} W_{Mi} M_{\text{main-indicator}}}{\sum_{i=1}^{7} W_{Mi}} \quad \ldots\ldots.....4)$$

CF= contribution factor of e (exposure), a (adaptive capacity), s (sensitivity)

$\text{LVI}_{IPCC} = (e_{org} - a_{org})*s_{org}$ ……(5)

The contribution factors of main components of LVI into the nature of IPCC definition is described inTable 2.

III. FINDINGS AND DISCUSSIONS

a. The Characteristics of Responden

Based on the result, the average age of both organic and non-organic rice farmers was 45 years. In addition, the level of these farmers' academic background was various, yet most of them were graduates of elementary school (SD) 50% and 42.5%; 28.33 and 26.25% (pre-SD); 16.67 % and 21.25% of junior high school (SLTP), and the rest, 5.00% and 10.00%, weregraduates of senior high school (SLTA) andhigher education.Then, they had been not experienced in cultivating organic rice since they started such a business about one to ten years, with the average experience of farmers was four years, and that of non-organic farmers was fifteenth years. Averagely, the number of both farmers' family was in turn 5 and 4 people.

Working in agricultural business was the primary job the farmers had to satisfy their needs. In Village, most of both organic and non-organic rice farmers which were 44 people (73.33%) and 41 people (51.25%) relied their life only on agriculture and the rest (26.67%) and 48.75% had any side jobs like civilian government employee (PNS),*ojek* driver, vendor, labour, and fisherman. The average width of field in which organic rice was cultivated was 0.64 hectare, while the average width of non-organic rice field was 0.74 hectare.

b. The Analysis of Livelihood Vulnerability Index (LVI) of Both Organic and Non-Organic Rice Farmers' Household

The study result about the maximum and minimum scores of sub-indicators resulting in both groups' LVI was displayed in Table 3.1, while the main indicators and components constructing LVI was described in Tabel 3.2. This table showed that the index scores of organic rice farmers' households having no information about climate change was 0.17, greater than that of non-organic rice farmers'(0.12). However, statistically the percentage of households having no information about climate change was not significantly different due to its t-test score of 1.060 with significant score of 0.291 > 0.05 meaning that Ho was accepted. It indicated that there was no difference in the percentage of both organic and non-organic rice farmers' households. Most farmers said that knowledge of climate change came from TV and agriculture groups, while only 5% of total households admitted the agricultural informer as the party telling them about such a matter.Then, on average the households of both organic and non-organic rice farmers said the same thing related to flood disaster, landslide, storm, and dry spell for the last three years. In addition, the average scores of both monthly temperature and rainfall deviation according to both groups were similar. Such an occurence happened due to the adjacent villages of both groups of farmer, included in the same subdistrict, so that the climate components would be alike. Based on such a sub-indicator, the households of organic rice farmer had higher vulnerability (0.445) than that of non-organic farmer's (0.438) in terms of natural disaster and climate variability.

The households of organic rice farmer had smaller index score in term of width of field employed than that of non-organic farmer's. Furthermore, the average width of field employed by organic rice farmers was 0.64 hectare, while the width of field employed by non-organic rice farmers was 0.74 hectare. Statistically, the average width of field employed by both organic and non-organic farmers was negligibly different, indicated by the score of t_{count} by 0.693, with the significance score by 0.489 bigger than $\alpha = 0.05$, meaning that Ho was accepted. It indicated that there was no difference in average field width of both organic and non-organic rice farmers. Then, the percentage index score of households whose income only came from agriculture was smaller than that of non-organic rice farmers'. In addition, the t-test result showed t_{count} was 5.447 with the significance score by 0.000 smaller than 0.05, meaning that Ho was rejected, indicating that there was some difference in percentage of households whose income came only from agriculture between both organic and non-organic rice farmers.Most organic rice farmers earned living only from agriculture, while they who were non-organic rice farmers had the other side jobs promising like civilian government employee (PNS), *ojek* driver, and entrepreneur. The households of organic rice farmers had bigger percentage index score of households cultivating plants, and breeding, than that of non-organic rice farmers'. The result of t-test revealed score of t_{count} by 7.533 with the significance by 0.000 smaller than 0.05, meaning that Ho was rejected. Furthermore, it indicated that there was difference in percentage of households cultivating plants, and breeding of both organic and non-organic rice farmers. The majority (73%) of organic rice farmers' households were cultivating plants, breeding, and fishing, while the rest (30%) was the non-organic rice farmers doing so. In conclusion, the households of organic rice farmers had lower vulnerability than that of non-organic rice farmers in term of agriculture (0.326; 0.355).

Then, it was the percentage index score of households having no food reserve for the next cultivating season compared to that of non-organic rice farmers' households.The result of t-test revealed the score of $t_{count}$was 2.025 with the significance score by 0.045 smaller than 0.05, meaning that Ho was rejected, indicating there was difference in percentage of households having no food reserve for the next cultivating season of both organic and non-organic rice farmers. The average food reserve of organic rice farmers' households was enough for 787 days. Meanwhile, the average food reserve of non-organic rice farmers' households was enough for 553 days. There was 63% of organic rice farmers' households having food reserve, while there was only 53% of non-organic rice farmers doing so. Moreover, the farmers' seeds reserve came from the best harvest production, and it was about 50-200 kg. In term of food consumed produced by their own field, the organic rice farmers' households had smaller percentage index score than that of non-organic rice farmers' households. The result of t-test revealed the score of $t_{count}$was 3,229 with the significance score by 0.02 smaller than 0.05, meaning that Ho was rejected, indicating there was difference in percentage of households' food produced by their own field of both organic and non-organic rice farmers. There was 24% of organic rice farmers' households whose food consumed was not produced by their own field, while there was only 49% of non-organic rice farmers doing so, but rather renting field to be exploited. Based on such an indicatore, the households of organic rice farmers had lower vulnerability than that of non-organic rice farmers in term of food.

Table 3.2 also showed that the majority of both organic and non-organic rice farmers had the same problem with water, especially in dry season. Such a matter was caused by the unavailable irrigation so that the water exploited for watering the fields was relying only on rainfall. The average water needs of organic rice farmers' households per day was 426 litres, while the average water needs of non-organic rice farmers' per day was 415 litres. The time the organic rice farmers' households needed to reach the natural water resources was greater than that of the non-organic rice farmers'. Such a matter was caused by 30% of organic rice farmers'

households exploiting water resources located in mountain, about 100-400 metres in distance. Meanwhile, each of the non-organic rice farmers' households had well as water resources located nearby. Based on such an indicatore, the households of organic rice farmers had higher vulnerability than that of non-organic rice farmers in term of water.

Furthermore, table 3.2 also showed that the organic rice farmers' households was more vulnerable (0.492) to consumption problem than that of the non-organic rice farmers(0.482). The average food consumed in the organic rice farmers households was bigger (1.57 kg/day) than that of the non-organic rice farmers (1.48 kg/day). The result study also indicated that the percentage of organic rice farmers households having 9-year education or higher was 5 %, while the percentage of non-organic rice farmers' households having the same level education was 10%. In addition, the non-organic rice farmers' households mostly earned living from both agricultural and non-agricultural business like teacher, health official, owner of rice grinding machine, and vendor, while the organic rice farmers' households mostly relied only on agriculture.

Based on the indicators of natural disaster and climate variability, agriculture, water, food, consumption, education, and income, both organic and non-organic rice farmers households happened to have the same livelihoodvulnerabilityindex/LVI (0.45). Indeed, it indicated that both organic and non-organic rice farmers' households had equally high vulnerability to climate, due to the LVI score approaching 0.5.

In addition, the measurement result of main indicators resulting in LVI was completely described in Image 1. The scale range of spidergram started from 0 (low vulnerability) in the center of diagram, to 0.5 (high vulnerability) at the outsides, whose increase level was 0.1. Also, Image 1 indicated that the organic rice farmers' householdswere more vulnerable to natural disaster and climate variability, agriculture, water, consumption, education, and income than that of the non-organic rice farmers'. Meanwhile, the non-organic rice farmers' households were more vulnerable to agriculture and food.

c. The Contribution of LVI-IPCC to Both Organic and Non-Organic Rice Farmers' Households

The analysis result of LVI-IPCC's contribution to both organic and non-organic rice farmers' households and the scores of contribution factors; exposure, adaptive capacity, and sensitivity were described in Table 3, depicted in vulnerability triangle explained in Image 2.

Based on both Table 3 and Image 2, the vulnerability triangle illustrated that the organic rice farmers households were more exposed (0.445) to the effect of climate change than that of the organic rice farmers(0.438). Next, based on the indicators of food, agriculture and water, the non-organic rice farmers households were more sensitive to the effect of climate change than that of the organic rice farmers (0.441 compared to 0.417). Meanwhile, according to the indicators of consumption, education, and income, the organic rice farmers' households had higher adaptive capacity than that of the non-organic rice farmers'(0.549 compared to 0.489).

Overall, based on the LVI-IPCC contribution score, the organic rice farmers' households had lower vulnerability to climate change than that of the non-organic rice farmers' (-0.04324 compared to. -0.02263). It was believed that such a matter happened, though the organic rice farmers' had higher exposure to climate change, due to the result of practical adaptation on consumption, agriculture, and foodreducing the LVI-IPCC score completely. However, both organic and non-organic rice farmers' households had the same medium vulnerability to the effect of climate change because of their LVI-IPCC contribution index between -1 and +1.

IV. CONCLUSIONS AND IMPLICATIONS OF POLICY

The study result showed that the organic rice farmers' households were more exposed to the effect of climate change than that of the non-organic rice farmers'. Furthermore, the non-organic rice farmers' households were more sensitive to the effect of climate change than that of the organic rice farmers'. Meanwhile, based on the indicators of consumption, education, and income, the organic rice farmers' households had higher adaptive capacity than that of the non-organic rice farmers'. According to LVI, both organic and non-organic rice farmers' households had highvulnerability to the effect of climate change, indicated by the index score by 0,45. However, by considering the LVI-IPCC contribution, the non-organic rice farmers' households were more vulnerable to the effect of climate change than that of the organic rice farmers'.

The implication of policy related to the findings of study was to examine the vulnerability level of households to the effect of climate change, and it was better to execute it in different areas far away (different region/province), so that the differences of climate components could be more significantly influential. Because of organik rice farmers' less vulnerable than that non-organic rice farmers', so will be better if non- organic rice farmers' change their cultivate to organic rice farming. Besides, the effort to decrease the vulnerability level of rice farmer's household in this location was shown by delivering some information about climate objectively and continuously, thereby encouraging the farmers to adapt the effect of climate change well. Therefore, there must be some support needed in form of resources aid programs such as irrigation system or pumping well, and some breeds useful to increase the farmers' income, alongside their agricultural businesses, getting them in ease to

adapt to the effect of climate change.

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Tables and figures

Tables

Table 1.the main and sub-indicators of vulnerability

Main Indicators	Sub Indicators	Measurements
Natural Disaster and Climate Variability	1. The percentage of households having no information about climate.	Percentage
	2. The number of flood disaster for the last three years.	Number
	3. The number of dry spell disaster for the last three years.	Number
	4. The number of very strong wind disaster for the last three years.	Number
	5. The number of landslide disaster for the last three years	Number
	6. The monthly temperature on average in 2012	Celcius
	7. The monthly rainfall deviation from 1976 to 2010.	Millimeter
Agriculture	1 . The width of field employed.	Hectare
	2. The inverse of staple food plants employed.	1/# plant
	3. The percentage of households relying on only agriculture.	Percentage
	4. The percentage of households cultivating no plant, and having no breed or fish	Percentage
Food	1. The percentage of households having no food reserve for the next cultivating season	Percentage
	2. The percentage of households having some food reserve.	Percentage
	3. The percentage of households having no food reserve.	Percentage
	4. The percentage of households having no seeds reserve for the next cultivating season.	Percentage
	5. The percentage of households whose food is from the others' agricultural business.	Percentage
	6. The average number of months in which it is hard for households to gain food.	Average month
Water	1. The percentage of households having problems of water.	Percentage
	2. The percentage of households exploiting water of natural resources for agricultural business	Percentage
	3. The percentage of households exploiting water of natural resources for domestic needs	Percentage
	4. The time necessary to reach the natural water resources.	Minute
	5. The water needs of each household	Litre/day
Consumption	1. The amount of food consumed (rice) by households per day.	Kg
	2. The amount of staples except rice consumed per day	Kg
	3. The percentage of households doing no combination of staples consumed	Percentage
Education	1. The percentage of households having academic background, below 9-year education	Percentage
Income	1. The number of household's income (agricultural/non-agricultural/the others)	Number
	2. The percentage of households having no income from the others except agriculture.	Percentage

Source: IPCC (2007) and Hahn (2009), with some modifications

Table 2.The categorization of main components into the contribution factors from the IPCC definition to measure the contribution of LVI-IPCC

The contribution factors of IPCC into the main components of vulnerability	
Exposure	Natural Disaster and Climatevariability
Adaptive capacity	Consumption, Education, and Income
Sensitivity	Agricultur,Food, and Water

Source: Hahn *et al*. 2009, with some modifications

Table 3.The maximum and minimum scores of sub-indicators, and main indicators composing the vulnerability index ofboth organic and non-organic rice farmers' households

Main Indicators	Sub Indicators	Measurements	Organic	Non Organic	Max	Min
Natural Disaster and Climate Variability	The percentage of households having no information about climate.	Percentage	17	12	100	0
	The number of flood disaster for the last three years.	Number	0	0	0	0
	The number of dry spell disaster for the last three years.	Number	1	1	1	0
	The number of very strong wind disaster for the last three years.	Number	6	6	6	0
	The number of landslide disaster for the last three years	Number	0	0	0	0
	The percentage of households having no information about climate.	Percentage	17	12	100	
	The number of flood disaster for the last three years.	Number	0	0	0	0
	The monthly rainfall deviation from 1976 to 2010.	Millimeter	110,02	110,02	163,97	74,27
	The monthly temperature on average	Celcius	28,0	28,0	32,65	22,35
Agriculture	The width of field employed.	Hectare	0,64	0,74	3,0	0,12
	The inverse of staple food plants employed.	1/number of plants +1	0,3705	0,3382	1	0,2
	The percentage of households relying on only agriculture.	Percentage	75	33	100	0
	The percentage of households cultivating no plant, and having no breed or fish	Percentage	17	70	100	0
Food	The percentage of households having food reserve for the next cultivating season	Percentage	12	24	100	0
	The percentage of households having some food reserve	Percentage	100	100	100	0
	The percentage of households having no food reserve	Percentage	0	0	0	0
	The percentage of households having no seeds reserve for the next cultivating season	Percentage	37	47	100	0
	The percentage of households whose food is from the others' agricultural business	Percentage	24	49	100	0
	The average number of months in which it is hard for households to gain food	Number	0	0	0	0
Water	The percentage of households having problems of water.	Percentage	93	77	100	0
	The percentage of households exploiting water of natural resources for agricultural business	Percentage	100	100	100	0
	The percentage of households exploiting water of natural resources for domestic needs	Percentage	100	100	100	0
	The time necessary to reach the natural water resources.	Minute	3,36	1.34	30	0.01
	The water needs of each household	Litres/day	428	41	210	50
Consumption	The amount of food consumed (rice) by households per day.	Kg	1,56	1,48	3,0	0,25
	The amount of staples except rice consumed per day	Kg	0	0	0	0
	The percentage of households doing no combination of staples consumed	Percentage	0	0	0	0
Education	The percentage of households having academic background, below 9-year education	Percentage	5	10	100	0
Income	The number of household's income (agricultural/non-agricultural/the others)	Number	1,23	1,52	3	1
	The percentage of households having no income from the others except agriculture.	Percentage	75	33	100	0

Source: Primary Data Analysis, 2013

Table 4. The index of main, sub-indicators and LVI scores of both organic and non-organic rice

Main Indicators	Sub-Indicators	Average IndexScores of Organic Farmers (X)	Average Index Scores of Non-Organic Farmers (Y)	Average Index Scores of Main Indicators of Organic Rice (∑X/n)	Average Index Scores of Main Indicators of Non-Organic Rice (∑Y/n)
Natural Disaster and Climate Variability	1. The percentage of households having information about climate. 2. The number of flood disaster for the last three years. 3. The number of dry spell disaster for the last three years. 4. The number of very strong wind disaster for the last three years. 5. The number of landslide disaster for the last three years 6. The monthly temperature on average in 2012 7. The monthly rainfall deviation from 1976 to 2010.	0,17 0 1 1 0 0,548 0,398	0,12 0 1 1 0 0,548 0,398	0,445	0,438
Agriculture	1 . The width of field employed. 2. The inverse of staple food plants employed. 3. The percentage of households relying on only agriculture. 4. The percentage of households cultivating no plant, and having no breed or fish	0,17 0,213 0,75 0,17	0,215 0,173 0,33 0,70	0,326	0,355
Food	1. The percentage of households having no food reserve for the next cultivating season 2. The percentage of households having some food reserve. 3. The percentage of households having no food reserve. 4. The percentage of households having no seeds reserve for the next cultivating season. 5. The percentage of households whose food is from the others' agricultural business. 6. The average number of months in which it is hard for households to gain food.	0,12 1,00 0,00 0,37 0,24 0,00	0,24 1,00 0,00 0,47 0,49 0,00	0,288	0,367
Water	1. The percentage of households having problems of water. 2. The percentage of households exploiting water of natural resources for agricultural business 3. The percentage of households exploiting water of natural resources for domestic needs 4. The time necessary to reach the natural water resources. 5. The water needs of each household	0,93 1,00 1,00 0,1117 0,184	0,77 1,00 1,00 0,0443 0,178	0,645	0,598
Consumption	1. The amount of food consumed (rice) by households per day. 2. The amount of staples except rice consumed per day 3. The percentage of households doing no combination of staples consumed	0,476 0,00 1,00	0,447 0,00 1,00	0,492	0,482
Education	1. The percentage of households having academic background, below 9-year education	0,95	0,90	0,95	0,90
Income	1. The number of household's income (agricultural/non-agricultural/the others) 2. The percentage of households having no income from the others except agriculture.	0,115 0,75	0,260 0,33	0,433	0,295
LVI of organic rice farmers = ((0,445x7)+(0,326x4)+(0,288x5)+(0,645x5)+(0,492x3)+(0,95x1)+(0,433x2))/28 = 0,45 LV of non-organic rice farmers = ((0,438x7)+(0,355x4)+(0,367x5)+(0,598x5)+(0,482x3)+(0,900x1)+(0,295x2))/28 = 0,45					

Source: Primary Data Analysis 2013

Table 5 The Measurement of LVI-IPCC's Factors Contribution of Both Organic and Non-Organic Rice Farmers' Households inTanggamus Regency

The IPCC's contributionfactors of vulnerability	OrganicFarmer	Non Organic Farmer
Exposure	0.445	0.438
Adaptive capacity	0.549	0.489
Sensitivity	0.417	0.441
LVI-IPCC	-0.0432	-0.0226

Source: Primary Data Analysis 2013

Figures

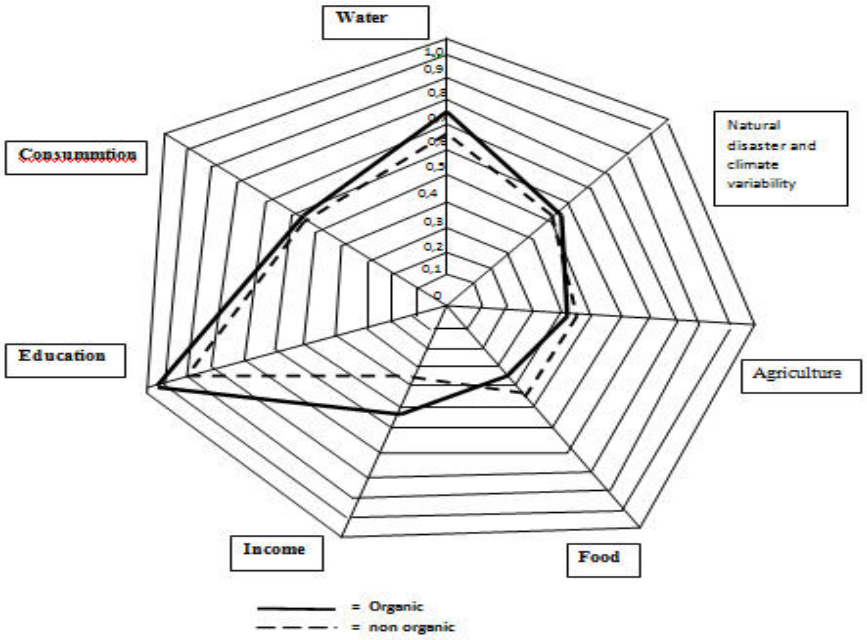

Figure 1. The vulnerability spidergram of LVI main indicators of both organic and non-organic rice farmers' households.

Notes: = Organic
= Non-organ

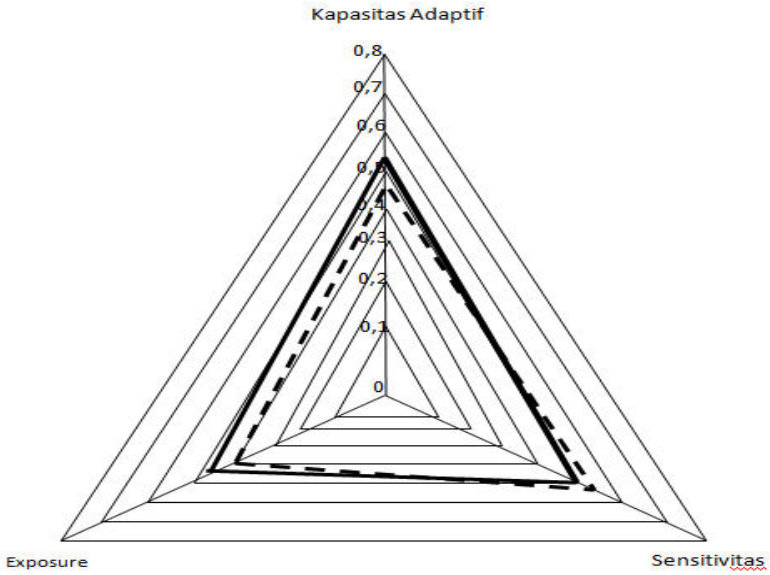

Figure 2. The vulnerability triangle diagram of both organic and non-organic rice farmers' households to the effect of climate change in Tanggamus region

Notes: = non-organic
= organic

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