

# *Executive Summary*

*Resilient Issue of Ambarawa Sub  
Region*



# 1 General Overview of Resilience

**Resilience or endurance is the ability to withstand and recover back after experiencing threats and crisis.**

Resilience according to Folke (2009) it has a feature in persistence, adaptability, and the ability to transform that each interacting from local to global scale. Resilience seems at how the community able to persistent and adaptive to avoid the critical situation to desired situation, on the other hand ; otherwise if there was a shift toward undesirable condition and can't be changed, resilience seen how the social-ecological system transform to adjust into the new condition.

The issue of Global Warming is getting warmer lately can be caused by emissions of greenhouse gases, such as CO<sub>2</sub>, CH<sub>4</sub>, Nitrous Oxide, Hidrofluorokarbon, Perfluorokarbon, and Sulfur Heksfluorida in the atmosphere. Global warming may causes rising temperature that could change the climate, causing changes in the weather patterns that causing the increase and changes of the rainfall, wind, and higher intensity & type of climate change's disaster such as flood, droughts, uncertainty of season, decreasing in agricultural production, and disease.

To face the impact of climate change are necessary to have a resistance to defend the region or the city. Anticipatory measures should be initiated as soon as possible before the situation become worse. In general, a region or city must

## Executive Summary

*Resilient Issue of Ambarawa Sub Region* have enough capacity to face the threat of danger and stress due to the climate changes. Resilient doesn't mean a region or a city to eliminate all of the threats, but ready to face that threats when it happen.

The Vulnerability assessment regarding the threats that will happen aimed to know and understand the impact of urban growth along with climate change and try to indicate a sustainable solution. The vulnerability assessment can't be separated from the diagnosis step which is the first step of strategy, because it is considered as an attempt to understand how to achieve development goal with still pay attention to the impact of climate change. The finding related to the vulnerability should be unseparated from design step, i.e. the adaption options and approaches designed adaptation. Then the adaptation approach begin to be implemented and managed, the final stage are monitoring and periodic evaluation.

## 2 Statements of the Problem

One of the resilience issues that happens in Indonesia is the issue of climate change. Climate change is a shift in the average statistics or long-term weather. Climate change itself is influenced by various factor such as the greenhouse effect and the activities undertaken by human with their environment. Climate change will cause some problems that could harm the environment as it exists at this time, the concentration of Carbon Dioxide (CO<sub>2</sub>) in the atmosphere has increasing almost 30%, the concentration of methane gas increased almost two times, and the concentration of NO<sub>2</sub> are

reduced about 15%. The increase of these gases may cause the atmosphere's ability to withstand the heat becomes larger.

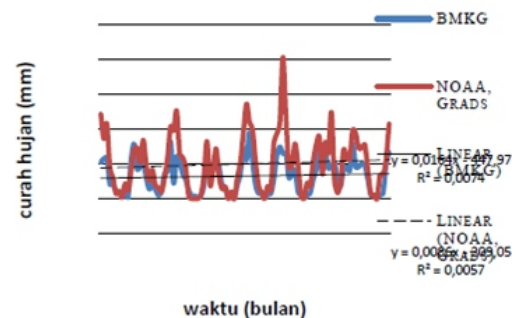
The concentration of gases are generated from the increase in the concentration of CO<sub>2</sub> is caused by the increase burning of fuel oil, coal, and other organic fuels that exceed the capacity of plants and sea to absorb it. Other than that, the effects of agriculture and livestock are also take effect in the climate change. In this sector, greenhouse gas emmissions generated from the use of fertilizers, decaying of farming's remnants, the decaying of cattle's feces, and burning of Savanna. On agricultural sector and livestock farming, methane (CH<sub>4</sub>) is the most widely produced.

Indonesia's vulnerability to climate change with the use of private vehicle as well as other activities such as environmental activities, agriculture and livestock farming are still quite high. However, the Climate Change Conference or COP 21 in Paris, France that discuss strategies to find the climate change's solution Quoted from the Daily Mail, Wednesday, December 9<sup>th</sup>, 2015. Indonesia was ranked number 24<sup>th</sup> with the score of 58,21 to surpass India at the below ranking with a score of 58,19 which at the top rank shows the countries are considered to successfully implement a strategy to overcome the global warming while the bottom of the rank shows the small country's commitment to reduce the climate change problem.

The impact of climate change has also been invading into city and even to the villages. The impact arising in these areas

*Resilient Issue of Ambarawa Sub Region* can be clearly seen in the present time, for examples are drought occurred in certain region, significantly increase in temperature that can be felt so the air become hotter, impact of health and crop failure perceived by farmers.

Semarang Regency is one of the regency of 29 Regency and 6 City located in Central Java Province. Semarang Regency with the capital of Ungaran has Geographical and topographical conditions as indicated by hilly region. The hilly region could have significant landslides risk. With the changes in rainfall patterns and rising temperature have a significant impact on stability of the soil and increases the potential of landslides.



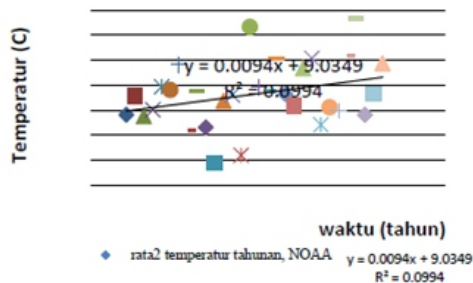
Source: *youngster physics journal*, 2015

**Comparison of BMKG & NOAA Rainfall Data Graph in the Semarang Regency at 2004 – 2011**

Based on the above picture can be seen in rainfall patterns between the data from BMKG and from NOAA satellite. Both of the data shows the maximum and minimum's rainfall patterns. Rainfall data from BMKG and from NOAA satellite shows rainfall patterns are almost the same. Both of the data shows an upward trend of rainfall every year. The majority of maximum rainfall of BMKG data is on December and January. While the majority of maximum rainfall of NOAA satellite occur on December.



The amount of uncertain rainfall each year which is approximately 1100 mm up to 2400 mm each year. The average amount of rainfall per year is obtained by 1579,86 mm.



Source: *youngster physics journal*, 2015

#### Air Temperature Graph in Semarang Regency at Last 30 years (1984 – 2013)

Based on the pictures above shows an increase in the air temperature each year. The average of air temperature has been increased each year by 0,0140 C or 0,051 % per year.

### 3 Scope

AmbarawaSub Region is a region that consist of six municipaly, which are Ambarawa, Bandungan, Sumowono, Jambu, Banyubiru and Getasan. Temanggung Regency, Kendal Regency, Magelang Regency, Salatiga City and Boyolali Regency are some of the regencies which administrative position are adjacent with AmbarawaSub Region.



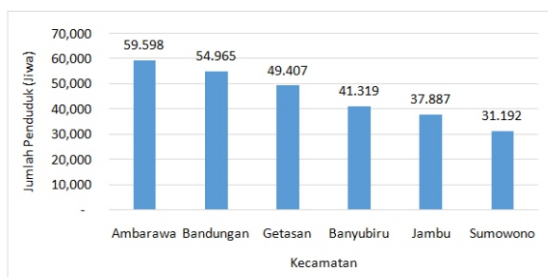
Ambarawa Raya is pressed by resilience issue in two-ways, which is from South region and from east region. One of the issue that came from east region in Ambarawa municipality is the issue of pollution that came from traffic congestion. Furthermore, oh Getasan municipality they has an issue that related with cow's dirt waste which could release Nitrogen Gas that could be one of the reason for global warming and rain acid. On the other side, the issue that came from west region is came from the national issue that related to RawaPening that located in Ambarawa municipality and Banyubiru municipality. RawaPening has some of main issue that has not been resolved which is about the sedimentation of RawaPening that has been one of the main source of natural disaster that occured in Ambarawa and Banyubiru like flooding in their rice field area.

The total population of Ambarawa Raya in 2015 is 274.368 people which consist of 136.899 men or equal with 49,9% percent and 137.469 women or equal with 50,1%. Region that has the highest population is Ambarawa municipality with the total amount is 59.598

*Resilient Issue of Ambarawa Sub Region* as the alternative planning. The recommendation from this CCVA could be use for:

1. Identify system priority, location, and people who gets the impact from the problem and gives recommendation with improve the adaptation capacity. The adaptation capacity could be support to create the resilience to face the adaptation from the help of the role of institution with resilience ir even the new opportunity output.
2. Give policy recommendation and program that related with specific issues, system, weakness to help build up the resilience to climate change. Those policies could focuses in social issues, environment and other issues that related with government management.
3. To give information about stakeholders which have a role in developing the region's resilience.

people (22% from the total amount of Ambarawa Raya). The total population density in Ambarawa Raya is 902,76 jiwa/km<sup>2</sup>. With the highest density population in Ambarawa municipality, from economy sector, Ambarawa Raya has some potential and commodities excellence from each municipality. From all of the excellence commodities, dairy cows stockbreeding and horticulture agriculture are the commodities which contribute the highest to the economy of Semarang Regency which around 80%.



## 4 Study about vulnerability and relevance theory of Resilience

**a. Study about the vulnerability of climate change consist of three analysis section:** the study about vulnerability in general which are about the exposure, sensitivity and adaptation capacity component. The analysis which conducted is the problem in Ambarawa Raya to bring out the plan to guide decision maker process about the effective response to the problem that has a link with the impact of climate change and other problem in Ambarawa Raya region. Because this appraisal is arranged through top to bottom problem analysis so that could be expected

**b. The revelation theory**

Theory	Link with the issue
<p>“To measure the effects of a program against the goals it set out to accomplish as a means of contributing to subsequent decision making about the program and improving future programming. The effect emphasizes the outcomes of the program, rather than its efficiency, honesty, morale, or adherence to rule or standards. The comparison of effects with goals stresses the use of explicit criteria for judging how well the program is doing” Carol H. Weiss (1972)</p>	<p>On the formulation program should have noticed the efficiency and the implementation standard to actualize the result. In the program formulation do an analysis about the issues and the core problem until it shows the challenge. Furthermore it shows the detail datas about the impact either from the environmental physics sector and economy sector. On the final stage, do the program formulation based on the analysis before until it shows the program that could solved the problem and have the orientation to the right goals</p>
<p>Shows the new issues of Resilience which is the reduction of the disaster's risk. Which is a paradigm in disaster management and the implementation of strategy policies extensively to reduce the vulnerability and disaster risk. RDR has a goal to reduce the social-economy vulnerability to disaster and handling the environmental danger that could generate vulnerability (Twigg, 2009)</p>	<p>Doing a problem analysis of RawaPening sedimentation that could occurred the risk of flood disaster. Doing an analysis with the actual physics data of RawaPening and the development of RawaPening. Other than that, it also analyse the role of RawaPening and the impact that could occurred if the role didn'trun properly. Furthermore it also discuss the impact in wider analysis and also analyse the region vulnerability to the sedimentation and how they handle it up until now. On the last stage, it will show strategy to handle the problem with the consideration of the previous strategy that has been done.</p>
<p>To simplify the comprehension about resilience concept, resilience could also be defined as the opponent of vulnerability to disaster risk. The vulnerability that also the concept in RDR's paradigm, defined from Djalante and Frank (2010) as a condition that very disturbed to disaster risk and also very affected from</p>	<p>On this case is not only lift up the environmental issue that attached with the impact of disaster but also on the economy impact. Therefore need an analysis throughout the area and the disadvantage in economy sector. Then how disadvantage could impact the community to the next level</p>

## 5 Resilience Issues and Challenges

### a. Getasan Farm Waste contribute to increasing the greenhouse effect

Municipality of Getasan is one of the contributors milk dairy cattle to Semarang Regency more than 80% in a year. Besides as a warmer highest contribution to Semarang Regency, cattle dairy cattle in Getasan also cause losses are quite dangerous. Based on the invention of some experts, cattle or farm waste became quite big contributor on the effects of greenhouse gas emissions and acid rain. Waste from the cattle ranches influential big enough in the climate change is happening. In accordance with the conditions Getasan where almost every house farming activities in the scale of the home where every house has an average of 2 cattles where stalls that unites with the house. So that the number of cattle in Getasan high enough or based on data BPS, The number of dairy cows numbered 16.913 tail, within the number of cattle is high of course produce a high waste also. So Getasan also contribute to climate change.



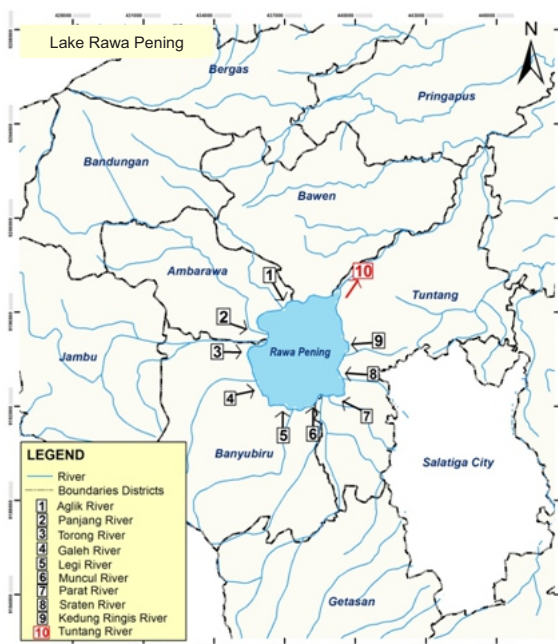
endanger effects on the health of the owner of the cattle. For example diseases acute respiratory tract infections (ISPA) that can be transmitted through the air, besides cow dung also triggered the emergence of bacteria that can interfere with the health of the digestive system. Then widowed urination in the production by the cow and flow through the drainage network with household waste that can cause air pollution and pollution of the land. Worse pools of urine that is not supervised a place breed mosquitoes such as malaria. Apart from the dangers to human health stalls that unites with this house will disturb psychology cow.

In waste dairy cows itself, contains among others of methane that comes from the breath of cows where the gas methane is two times more dangerous than carbon dioxide (CO<sub>2</sub>). While ammonia is derived from liquid waste the cow her womb four times more dangerous than from the carbon dioxide (CO<sub>2</sub>). Then the cow is a producer of nitrogen (N<sub>2</sub>) highs after the smoke of the vehicle. Each day cows produce less than six kilograms defecating. According to Livescienc, reported annually a cow produces methane gas 120 kg. Then in one day a cow produces 300-500 liters of methane = 182.500 liters/year. One of the factors causing the height of methane released by the cows because cows including the animal chews the cud where the process of digestive secretionsdone twice.



## b. RawaPening

Lake Rawa Pening become an estuary for 9 of the watercourse was in Sub Water shade Lake Rawa Pening namely River Ngreco, Panjang, Torong, Galeh, Legi, Parat, Sraten, Muncul, and Tapen. Nine watercourse formed the radial flow centripetal forces at this means that the direction of the flow toward one point to theRawapening Lake.As the river estuary from upstream areas that is, Bandungan, Jambu, Banyubiru and Getasan municipality.Overall, wide Lake RawaPening namely 2.670 Ha and widespread Lake Rawa Pening that are part of the Ambarawa Sub-region namely 1383,6 Ha or around 2.8 percent of wide Ambarawa Sub-region.



Lake Rawa Pening able to collect water around 65.000.000 m<sup>3</sup> with the depth of 15 meters. The functions of the beginning from Rawa Pening are:

1. As the irrigation rice field area of Semarang, Demak, Grobogan (39.277 Ha) to Semarang Regency (19.158 ha).

2. As a major contributor of raw water for hydroelectric power plantJelok in KelurahanDelik andTimo (15 MW) in the Tuntang municipality.
3. As the flood controller DAS Tuntang
4. As a source of raw water, urban household industry (250L/sec)
5. As a source of water for industrial activities in PT APAC Inti Corpora (textiles) and for the beverage industry packaging 100l/sec is touched by DAS Tuntang.

Lake Rawa Pening occur silting depth that the original lake depth have the depth of 15 meters in 1994 to 8 meters in 2015( BPPT's data in 2016). The rate of sedimentation in Rawa Pening around 150,000 m<sup>3</sup>/year with large sedimentation 78 tons/year or 270-880 kg/ day. As a result of this silting depth capacity of Lake Rawa Pening now reduced by 30%. Silting of the lake caused by deforestation in the upstream area. Deforestation is the cause of water resource decreases, the flow of surface water increased, and attrition occurs that swept up to Rawa Pening.

This condition is compounded by the sediments the water hyacinth die and walkthrough at the base of the lake. The current conditions, 70 % Rawa Pening area covered with water hyacinth. The existence of the weed became a breed rats. So that the agricultural land experience reduced productivity. The development of the water hyacinth after 52 days old will have wide 1m<sup>2</sup>, with the growth of 20 cm per day. In a year without cleared, wide the plants will be 7 m<sup>2</sup>.Sedimentation the roots of the

water hyacinth happened because the weed die or the roots of the remaining after a pruning will sink to the bottom of the lake and sedimented.

In addition how to harvest the water hyacinth by farmers that one with only cut stem, leftovers leaves and leaves roots make the problems increased. One of the roots of the water hyacinth can produce 5 new plants. Plus with the womb of pesticides were swept away by the flow of the river which is located in the upper Ambarawa Sub-region, water hyacinth in Rawa Pening increasingly fertile.

The silting of the lake also has resulted in a reduction in the capacity of the water accommodated. That eventually cause the water overflows into the land paddy fields around Rawa Pening Lake especially Kebondowo sub-district, Rowoboni, and Banyubiru in the Banyubiru municipality, Bejalen sub-district in the Ambarawa municipality, along with hydroelectric power plant Jelok in Kelurahan Delik and Timohat interfere with irrigation supplies rice fields, raw water and electricity produced.

The acceleration of the silting lake also decrease dam productivity freshwater fish significantly. The level of water swamps contain NO<sub>3</sub> and PO<sub>4</sub> from dissolved pesticides from water paddy field-toward Rawa Pening. This condition is not good for fisheries because the substance will binds O<sub>2</sub> so that the level of O<sub>2</sub> needed fish to breathe decreases.

Lake Rawa Pening is surrounded by rice field irrigation Ambarawa and Banyubiru that the planting and harvest depends on the time of the tides

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Rawa Pening again regularly. But the last ten years since the global warming is feeling in Ambarawa Sub-region, time the tides so not predictable. When the water subsided, paddy fields around Rawa Pening experiencing drought due to lack of irrigation. Meanwhile, when the tide the farmers could not plant because the rice fields submerged continuously. The rice fields in the Banyubiru and Ambarawa municipality which should be two times the harvest per year by considering the tides. But now the harvest is definitely can be done only once. While for the second harvest still have chance 50%-100% crop failure because it cannot ensure replace subsiding days Lake Rawa Pening.



Lake Rawa Pening has the open door system in hydroelectric power plant to overcome the flood Rawa Pening this also not enough to help the settlement of the problem of the flood. If the doors dam Jelok opened to flush excess water reservoir that exceeds the capacity downstream toward the river Tuntang that is Bawen, Bringin, Tuntang until Demak and Grobogan Regency. Otherwise, if the door Dam Jelok closed then the rice fields around Rawa Pening in Ambarawa and Banyubiru will be flooded. The rice fields that are affected by the floods that is Banyubiru municipality area of 40% (Kebondowo Village, Rowoboni, Banyubiru) with wide

### Vulnerabilities in AmbarawaSub Region

Exposure	Sensitivity	Adaptive Capacity
Does the Area have impacts?  <b>There's no waste treatments at Getesan's livestock</b>  <b>Traffic Jam</b>  <b>Season change uncertainty</b>  <b>RawaPening's tidal is unpredictable</b>  <b>Increased temperature and Drough</b>	Decreasing the productivity of farming and fishery caused by climate changes  The region is not ideal for farming because of temperature rising  The movement system interrupted and increasing pollution caused by traffic jam  Crop failures because the season change uncertainty and drought	There are community such as "KelompokTaniTernak (KTT)" to manage feces waste treatment  Getasan's people planting intercropping in agricultural production  Community initiatives program has been done at the RawaPening's revitalization  Good coordination with government  Theres opportunity to improve accessibility

### C. Pollutions Contribution of Ambarawa's Congestion on Green House Effect

Ambarawa Municipality as Local Activity Centre has functions as service center for commercial, settlement, also development center for tourism, agriculture and fishery for its surroundings. The area which triggers biggest economic growth in Ambarawa Sub Region located around Projo's Market corridor. Those corridor is commercial centre which surrounds Projo's Market as an agricultural distribution center in the regency level. The roles boost Ambarawa to have high mobility especially on the corridor which also function as connecting line for Semarang Clty-Solo-Jogja that passing Ambarawa.

Congestion in Projo's Market corridor happens twice a day on early 7 in the morning and 5 in dawn, during weekdays or weekend. It means congestion happens everyday in Ambarawa and so do the pollutions. . Shown by nearly same ratio between the number of commuters in Ambarawa who come and go on peak hours, the majority of drivers are commuting back and forth Ambarawa every day. Below are the result of traffic counting during peak hours around Projo's Market corridor.

Vehicle Type	Number Of Commuters		Total (Units)	Total (In Smp Unit)
	To Ambarawa	From Ambarawa		
Motorcycle (MC)	2326	1822	4148	2074
Low Vehicle (LV)	426	380	806	806
High Vehicle (HV)	20	108	128	166,4
<b>JUMLAH</b>	<b>2772</b>	<b>2310</b>	<b>5082</b>	<b>3046,4</b>

Pollutions Contribution from Ambarawa's congestion toward green house effect can be count by the total CO<sub>2</sub> emissions which being generated every day. CO<sub>2</sub> emissions is counted from the number of emissions generated by a liter of every fuel type (e) and multiplied by average use of fuel per day (Fuel). Each liter fuel emissions is counted from the number of vehicles, rasio of vehicles number (fraction), emission factor and the fuel type used.

$$E = e \times \text{Fuel}$$

Vehicle Type & Fuel Used		e = n x TGn x FE			Fuel (L/smp)	AMOUNT of CO <sub>2</sub> EMISSIONS / day	
		n	TGn	FE		(kg)	(tons)
		Number of Vehicles (smp)	Fraction	Emission Factor (kg/L)			
Bensin	MC	2074	0,68	2,0034	0,53	1519,90	1,52 tons
	LV	806	0,26		6,71	2859,29	2,86 tons
Solar	HV	166,4	108	2,2204	10,7	197,85	0,2 tons
<b>JUMLAH</b>		<b>3046,4</b>	<b>2310</b>			<b>4557,01 kg</b>	<b>4,58 ton</b>

From the counting above, the number of CO<sub>2</sub> emissions from Ambarawa's congestion are 4,58 tons each day. From 1 hour used to do the traffic counts, we can divide the total emission per day into per seconds. The emission power of CO<sub>2</sub> from transportation mode during congestion is 1271,39 gram/second. By 2016, the total amount of CO<sub>2</sub> emissions is 77,38 tons a year.

## 6 Stressor

### a. Climate stressor

Climate stressor is direct impact related with weather which caused by climate change and other non climate stressor in urban area. There are several impacts related with weather that caused by climate change

- Unpredictable rain
- Drought
- Flood from overcapacity water volume caused by river sedimentation
- Landslide caused by high rainfall
- Rise of the sea level
- Drastic hot temperature

### b. Stressor Non Iklim

- Smell pollution from waste
- Use of uneco-friendly detergent
- Excessive use of pesticide
- Silt of Lake RawaPening caused by sedimentation
- Wrong way to harvest water hyacinth

## 7 Exposure

### a. Getasan Dairy Farm Waste

Dairy farm contributes to the happening of climate change. Dairy farm waste generate big amount of methane (CH<sub>4</sub>) which caused green house effect and amonia (NH<sub>3</sub>) which contribute on the acid rain phenomenon. Pollution effect from methane gasses generated by cow breath are twice dangerous than carbon diokside(CO<sub>2</sub>) from vehicle's emission. But, the amount of methane gas in the atmosphere are far lower than carbon

*Resilient Issue of Ambarawa Sub Region* diokside(CO<sub>2</sub>). Research by D.P Morgavi (2008) and Live Science discovered that 1 dairy cow produce 120 kg methane gas / year. A cow generate amonia gas (NH<sub>3</sub>) from its urine in which effects are 4x higher than CO<sub>2</sub> and become the highest Nitrogen contributor after vehicle's emission. With average of 2 cows owned by every household that live together with their cows, household dairy farm waste in Getasan sure contribute great amount of pollution gas which lead to the rise of green house effect and acid rain.

### b. Sudden temperature change and drought

The most affected area from the sudden temperature change and drought is agricultural-oriented area. in Ambarawa Sub Region, Jambu Municipality is getting affected by drought that happen to their agricultural activities as well as its clean water. Drought and suddent temperature change will caused failure of argicultural producing and harvesting. This condition will worsen the amount of food supply and lead to rise of price for food material. (Sindo, 2015).

### c. High rainfall

Area with high vulnerability caused by high rainfall are hill, riverside, flood-risk urban area with and agriculture area. High rainfall risks hill area by causing landslide that can destroy the building. The risks in riverside area are flood, well contamination by bad sanitation amangement. Excessive rain fall and high humidity can also destroy agricultural land. Tobacco producers area such as Getasan Municiaplity also getting difficulties to plant in dry season as the season continuosly humid by sudden high rainfall.



**d. Congestion**

Congestion contributes 65%-80% of urban pollution. The pollution gases from congestion lead to climate change especially CO<sub>2</sub> which caused green house effect. Air pollutants also contain CO, SO<sub>2</sub>, N<sub>2</sub>, O<sub>3</sub>, and dangerous substance. Congestion happens in Ambarawa Municipality in corridor of Sudirman's Street which also commercial center with high density.

**e. Unpredictable Tidal of RawaPening**

RawaPening flood continuously swamps the surrounding rice field in Lake RawaPening such as in Bejalen and Pojoksari Village in Ambarawa Municipality and also Kebondowo, Rowoboni, Banyubiru Village in Banyubiru Municipality. Because of the flood in rice field area, paddy productivity in both municipalities has been decreased. Paddy productivity in Ambarawa has been

## 8 Sensitivity

Sensitivity is a different system and a sector from the community that is influenced by the climate danger. This sub chapter overview the impacts from any threat of climate danger and factors that influenced Ambarawa region be more vulnerable or more sensitive from others climate danger. Some of the Ambarawa's trend development that could give any vulnerable threat could be seen social, economy and also non-climate-stressor sensitivity.

Sensitivity of Economic System, economy activity such as:

**1. Agriculture and minaculture are**

**some sectors that sensitive with the climate change threat.** Agriculture and minaculture could get an impact to their activity from the high level of RawaPening river system, that on the next level could caused agriculture field being flooded and could be the reason of why agriculture deeds could be the reason of your failed harvesting.

**2. The trade and services activity which is the center activity is come from Pasar Projo Ambarawa is also have some kind of threat,** until it could generate the high level of traffic congestion in front of Pasarprojo's road toward Ambarawa city. On the next level, the traffic congestion could generate air pollution and the increase of gas emission that produced.

**Non-Climate Sensitivity**

Cow's dirt waste in Getasan municipality could give bad impact such as the bad smell from the cow's dirt waste. From that smell could disturbed the environmental balanced in Getasan municipality. And also the cows itself could produce gasses that could give an effect to gressn house effect and acid rain that could impact to other area in AmbarawaSub Regionregion.

**Climate Sensitivity**

The greenhouse effect which can affect global warming resulting wet drought which cause tobacco planting failure due to prolonged drought, then the District Getasan apply intercropping cropping system to sustain life and can continue to sell agricultural products from Getasan districts.

- **Institutional Adaptive Capacity**

Institutional Adaptive Capacity is an adaptation capability refer to organisatory capability. The form of this adaptation is could be some kind of regulation policy program of human resource and experts about the human resource managemenet and the expertise of expert from local government or central government, and also some kind of civil community. There has been an action to adapt from institution to reduce the contribution of climate change with helping to handle biogas cooperate with KTT with supply the tools. Other than that, to traffic congestion issue, government institution have been done an increasement of city alternative road from JalanKartini road even the development of JLA. Furthermore, om the problem of vulnerability to climate change is the sedimentation of RawaPening. Government with the cooperation with the civil community make a program to manage water hyacinth,such as water hyacinth quarantine.

## 9 Adaption Capacity

The adaptation capability could be classified in three type:

- **Autonomous Adaptive Capacity**


Autonomous adaptive capacity is an action from individu or family in the effort to protect the occupation and the asset from the possibility of the danger of climate change. In this case the adaptation could tried in an independently ways separated in 3 kind of issues that has been solved. The 3 issues is about the traffic congestion, cow's dirt waste management and the sedimentation of RawaPening which there hasn't been any individual adaptation that could be seen. Each person tend to care less with the contribution of climate change to their area. Other than that, from the disadvantage side, there hasn't been any effort eventhough the loss is real.

- **Collective Adaptive Capacity**

Collective Adaptive Capacity is a capability or an action by some specific group. This kind of adaptation usually exist in specific community such as initiative to reduced the risk and to increase the sensitivity. The adaptation that has been done to solve the problem of climate change could be seen from RawaPening's problem where the community have done an initiative to reduced the bad impact of Water Hyacinth. Other than that, in Getasan area have a program to manage the cow's dirt waste and use it also transform it into the type of biogas by one Stockbreeding community but not in large scale.

# 10 Recommendation

## a. Dairy Farm Waste Pollutions

ISSUES	ALREADY IMPLEMENTED SOLUTIONS	RECOMMENDATIONS	STAKEHOLDER RELATED
<b>Overcome methane gas emissions from dairy farm waste</b>	There is 1 communal dairy farm with 50 cows in capacity and manage by Getasan Farmers Group	Making of 175 communal dairy farms cage with capacity of 96 cows each.	<ul style="list-style-type: none"> <li>Æ Livestock Office,</li> <li>Æ Farmer Group</li> </ul>
<b>Biogas Processing</b>	Cow waste conversion into biogas by 1 Farmers Group in Getasan and Kopeng Village  	Cow waste conversion into biogas in each communal cage in Getasan Municipality	<ul style="list-style-type: none"> <li>Æ Livestock Office</li> <li>Æ Agriculture, Plantation, and Forestry Office;</li> <li>Æ Farmer Group</li> </ul>
<b>Processing of Organik Fertilizer</b>	-	Biogas processing waste such as mud can be convert to compos and be distributed to improve organic farm of Ambarawa Sub Region	<ul style="list-style-type: none"> <li>Æ Agriculture, Plantation, and Forestry Office;</li> <li>Æ Private Sector</li> </ul>
<b>Drough in agricultural land</b>	-	Make water reservoir to be irrigation for agriculture land during dry season.	<ul style="list-style-type: none"> <li>Public Works Office</li> </ul>

**b. Pollutions of Ambarawa Congestion**

ISSUES	ALREADY IMPLEMENTED SOLUTIONS	RECOMMENDATIONS	STAKEHOLDER RELATED
<b>Congestion in the corridor of Projo's Market</b>	Construction of Ambarawa Ring Road to decrease the number of vehicle passing Projo's Market Corridor which help decrease the congestion.	Road widening in Sudirman Street / Projo's Market corridor	Transportation Office
	Improvement of alternative road in from JalanKartini ( Rengas – Tambakboyoy – RSU ) – JalanPemuda	Arrange public transportation system which can commute people/goods in Projo's Market.	Æ Transportation Office Æ Public Works Office Æ Regional Planning Agency
		The transport need to be set to enter the transit lines given and no longer stopped in the road in front of Projo's Market  Provide public transportation such as BRT route to lessen the pollution caused by transportation emission.  The addition of BRT route can accomodate more people in a mode to and from Ambarawa Municipality.	Transportation Office



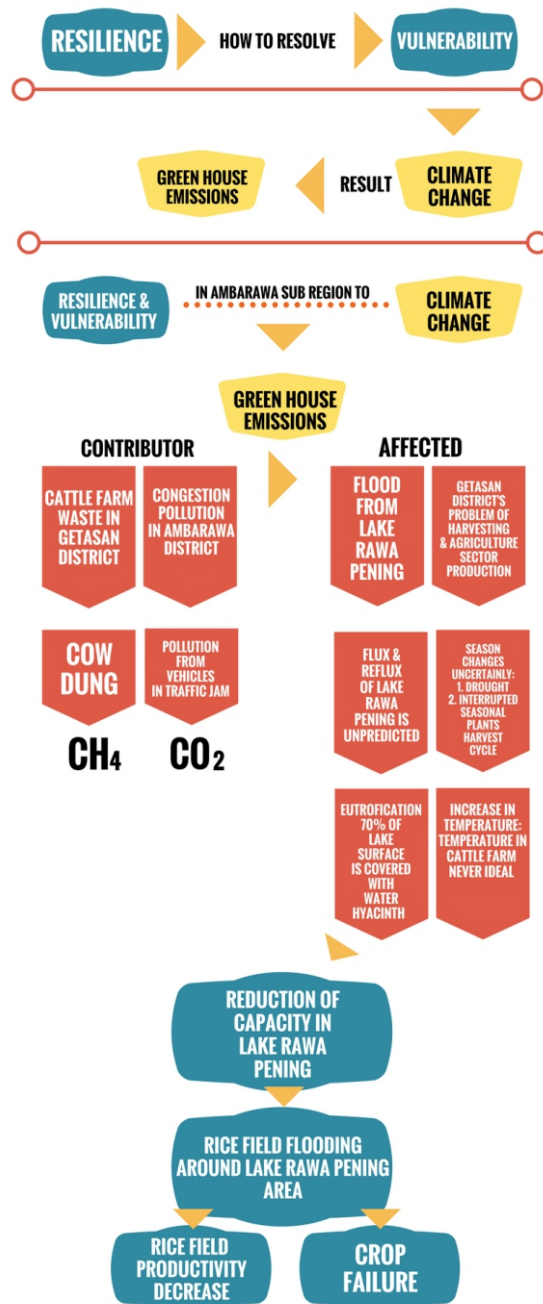
**c. Unpredictable Tidal of Lake Rawa Pening**

ISSUE	ALREADY IMPLEMENTED SOLUTIONS	RECOMMENDATIONS	STAKEHOLDER RELATED
<b>Decreasing the growth of water hyacinth</b>	-	<p>Biogas processing waste such as mud can be convert to compos and be distributed to improve organic farm of Ambarawa Sub Region.</p> <p>The use of compos can decrease the concentration of pesticide coming from agricultural land toward Rawa Pening. Pesticide fertilize the growth of water hyacinth. So the use of compos help to restrain the amount of water hyacinth in Rawa Pening</p>	<p>£ Livestock Office</p> <p>£ Agriculture, Plantation, and Forestry Office;</p> <p>£ Farmer Group;</p> <p>£ Community</p>
<b>Disruption of underwater ecosystem caused by water hyacinth</b>	-	<p>Quarantine the water hyacinth to separate the plant which can be kept in the lake ecosystem.</p> <p>Retraction of unneeded water hyacinth which disturbing lake ecosystem</p>	<p>£ Water Conservation Agency</p> <p>£ Agriculture, Plantation, and Forestry Office</p> <p>£ Private Sector</p>

**d. Disrupted Agricultural Production in  
Getasan**

ISSUES	ALREADY IMPLEMENTED SOLUTIONS	RECOMMENDATIONS
<b>Drought in agriculture due to the green house effect</b>		“Embung” / reservoir development to support the irrigation in the dry season
<b>Uncertain weather that can affectedthe agriculture sector</b>	Planting intercropping in order can be harvested in any weather condition	Using adaptive seeds and modified production with the help of modern equipment

## Relationship Scheme



In addition to the contributors greenhouse gas emissions also gives the impact, There are the overflow flood in Lake Rawa Pening and the problematic product harvest agricultural sector in Getasan municipality. As a result of the overflow flood in Lake Rawa Pening cause the tides of rawa pening not predictable. Besides the tide there are also other reason that is eutrofikasi, 70% face lake closed by the water hyacinth. From both of the reasons the capacity of the Lake Rawa Pening decreases, Land paddy fields will be logged around the lake. The overflow flood will make problem for the productivity of paddy and crop failure. Then the problem for the harvest product in agricultural sector in Getasan municipality caused by climate changes of the seasons is uncertain and the temperature increase.

Resilience is the way how to resolve a vulnerability. One form of vulnerability is climate change caused by greenhouse gas emissions (gas CO<sub>2</sub> and CH<sub>4</sub>). The resilience and vulnerability in Ambarawa Sub-Region have been compounded by the existence of climate change that can cause greenhouse gas emissions.