Local government response to the impacts of climate change: a review of climate change strategies in Pekalongan, Central Java, Indonesia

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Abstract. Indonesian government has launched the Low Carbon Development (LCD) policy which is expected to internalize into the upcoming National Medium-term Development Plan (RPJMN) 2020–2024. LCD aims to support economic growth through low emissions development activities while minimizing the exploitation of natural resources. Hence, the study's goal was to decide the extent of implementing climate change programs at the local level, as a preliminary study to find the region's readiness towards LCD. This research was conducted at Pekalongan, which was categorized as a highly vulnerable region to climate change in Central Java. Data was collected using a literature study, focus group discussions (FGD), and in-depth interviews. The results suggested that The Pekalongan City planning document had several adaptations and mitigation plans in response to climate change, supported by several regulations. The energy, waste, and agriculture sectors were the highest contributors to carbon emissions. This study also outlined the implementation of programs and strategies in the energy and waste sectors to reduce greenhouse gases and the obstacles they face, excluding the agriculture sector, because of limited data availability. In general, the response of Pekalongan city to climate change was still hampered by coordination between sectors, not all were elements involved. Furthermore, greenhouse gas inventory had not been specifically budgeted.

1. Introduction
Climate change is more than just one of the 17 SDGs specified in the 2030 Agenda for Sustainable Development. It can worsen some of humanity’s greatest challenges, including health, poverty, and hunger [1]. Hence, the Indonesian government has launched the Low Carbon Development Initiative (LCDI). It aims to explicitly incorporate greenhouse gas (GHG) emissions reduction targets into the policy planning exercise, along with other interventions for preserving and restoring natural resources. It has been coordinated by Central Planning Agency (BAPPENAS) and brings together several institutions from the Government of Indonesia, the international donor community, local and international partners, distinguished experts, and civil society [2]. LCD policies have been internalized into National Medium-term Development Plan (RPJMN) 2020–2024 [3]. Hopefully, through this initiative, the development can run in balance, the economy grows and increases while climate change can be suppressed or stable [4]. However, many local governments have not been able to implement a climate change program according to the target set because they face several obstacles such as knowledge, regulatory and capacity barriers, among others [5][6][7]. Furthermore, this research is essential to perceive the extent to which local government readiness for LCD.
The Government of Central Java is the second province in 2019, chosen by BAPPENAS as a pilot project for implementing LCD by the MoU between BAPPENAS and Central Java's Government [8]. Central Java has responded to climate change issues into relevant government policies and programs. Since 2010, Central Java has implemented the RAD-GRK (Regional Action Plan for Reducing Greenhouse Gas Emissions) that would end in 2020. Therefore, 2019 is the year of transition towards LCD. After that period, Central Java would have an LCD action plan.

Pekalongan city is one of the cities in Central Java that was categorized as a vulnerable area to the impacts of climate change, based on the vulnerability maps [9]. The identification of climate hazards in Pekalongan city consists of floods, coastal inundation (ROB), and landslides [10]. Climate hazards, floods, and coastal inundation commonly occur, have caused deterioration of infrastructure, agriculture, and aquaculture land damage, soil, and water pollution [11]. Even though many actions to tackle climate change have existed since 2010 [12]. Follow by the formation of the working group that consists of local government agencies from many sectors [13]. The level of community adaptation to climate change was still weak [14]. This study aimed to explore the implementation of climate change programs at the local level as a preliminary study to find the region's readiness towards low carbon development.

2. Methods
This research was conducted between August and November 2019. The data included primary and secondary data. Primary data collection was carried out through several stages: pre-survey, Focus Group Discussion (FGD), and in-depth interviews. The pre-survey was conducted to obtain initial information and related parties, to identify the problems or obstacles in implementing the climate change program. The results of the preliminary survey were design research and research instruments. The next stage after the pre-survey was FGD. The objective of the FGD was to deeply identify the implementation of climate change actions in terms of planning, program, strategy, and implementation. FGD involved various stakeholders, such as local government agencies, universities, and the community. In-depth interviews were conducted to examine the results of the previous FGDs thoroughly. Secondary data consisted of document planning and reports on implementing climate change programs from various relevant agencies such as the Planning and Research Agency (BAPPEDA), both the Province and Local Level (Pekalongan City), the Environmental Transportation Agency. Various references, such as journals or previous research papers related to climate change, were used. The FGD and interviews were conducted and recorded by the researcher. The analysis involved grouping the responses into qualitative themes. Not all of the interview themes were directly relevant to this paper's focus, so some tangential themes have been removed. The collected data were edited, summarized, and analyzed to achieve the objective of the study.

3. Results and discussion

3.1. Greenhouse gas (GHG) profile in Pekalongan
According to the Agency of Environment and Forestry Service of Central Java, GHG inventory data had been reported to the Environment and Forestry Ministry, using an online application called SIGN-SMART. It was a simplification of the IPCC method, which was widely accessible both nationally and internationally. The system was designed to be simple, easy, accurate, concise, and transparent. However, approximately 60% of regencies/cities in Central Java had been involved, including Pekalongan city. However, the availability of GHG data for Pekalongan city was very limited.

As we can see from Figure 1, the Pekalongan’s GHG data on SIGN MART for 2000-2019 [15], only data from the agricultural sector filled in, while data on several sectors contributing to emissions only existed in 2017. According to the Head of Environmental Services, they reported GHG emissions in 2018. In 2017, the Pekalongan’s total greenhouse gas emissions were estimated at 99.04 Mt CO₂-equivalent (CO₂e). Of the total net CO₂ emissions, the energy sector contributed 69.1% (68.44 Mt), followed by the agriculture sector (12.6% -23.26 Mt) and the waste sector (7.6% -7.54 Mt).
The limited GHG inventory data in Pekalongan City was due to many constraints. Particularly, Pekalongan city Environmental Service did not have a specific budget for GHG inventory. Set of data were needed to compile a GHG inventory, such as the amount of electricity consumption, the use of fuel in the road and industrial transportation, the number of land vehicles, the number of livestock and poultry, the area of agricultural and plantation land, the amount of biogas and the area of food crops harvested. The data were collected using questionnaires and coordination meetings and the progress report was only data input to the SIGN SMART application. Consequently, Environment services did not have a GHG inventory report document.

Figure 1. Pekalongan city greenhouse gas emission during 2000-2017 [15]

3.2. Document planning
Low carbon development was an effort to realize one of the SDG (climate change) goals. The process of integrating low-carbon development into planning documents required the right instrument. The SEA, a Strategic Environmental Assessment, was the instrument used as the basis for the preparation of the regional medium-term development plans (RPJMD) so that the low carbon development concept could be implemented. SEA is a systematic process for evaluating the environmental consequences of the proposed policy, plan, or program initiatives to ensure they are fully included and appropriately addressed at the earliest appropriate stage of decision-making on par with economic and social considerations [16].

The SEA is a systematic, comprehensive, and participatory analysis used to mainstream Sustainable Development principles integrated with the policies and development plans and programs, both at national and regional levels. SEA is supported by the core beliefs that: i) Development should be sustainable; ii) Carrying capacity constraints and considerations (including GHG emissions) must play a central role in the policy framework; iii) The silo mentality and processes need to be removed from planning and policymaking in general; and, iv) Planning is an inclusive process of all stakeholders [17], such as government, private and community.

The 2016–2021 RPJMD of Pekalongan City had referred to the SEA. The SEA draft was carried out simultaneously and used to support the Amendments of the Pekalongan RPJMD 2016–2021. The results of this SEA study were integrated into the amendment document. This document became material for
both discussion at the Pekalongan Regional Consultative Council and evaluating the amendments of the local regulation draft RPJMD 2016–2021 amended by the Central Java Provincial Government [18].

Its vision was to “Create the Pekalongan City to be more prosperous, independent, cultured based on the values of religiosity”. This vision embodied the economic perspective (growth) defined as prosperity (fulfilling all basic needs) and independence for all people in Pekalongan. However, this vision did not specify how to realize this welfare with a sustainable approach. Therefore, from our review, it could be seen that there were several words “climate change, SDG, environmentally friendly” explicitly in the RPJMD of Pekalongan 2016–2021. Specifically, sustainable development was contained in missions 2, 3, and 4, namely mission (2) improve the quality of services throughout for community welfare, (3) empowering the people's economy based on local potential in the framework of sustainable development, and (4) improve both the quality and quantity of urban facilities and infrastructure with an environmentally friendly approach.

A strategic issue was an issue that must be resolved if Pekalongan pursues achieving its mission. Both SDG’s and climate change were global issues that had been considered in preparing the development planning for Pekalongan for five years. Table 1 shows several development targets related to sustainable development issues in the medium-term development plan 2016 – 2021

Table 1. Development targets related to sustainable development issues in Pekalongan RPJMD 2016 – 2021

| Sustainable Development Issues | Regional Development Goals | Performance Indicators |
|-------------------------------|----------------------------|------------------------|
| The area affected by flooding | The reduction in the area   | Percentage of flood     |
| and coastal inundation has     | affected                   | and coastal inundation  |
| increased                      |                            | area                   |
| Water and river pollution has  | Increasing the quality of   | Environmental Quality   |
| increased                      | the environment             | Index                  |
| Lack of green open space       | Increase creative public    | Percentage of the fulfil |
|                               | space                       | ment of infrastructure  |
|                               |                            | in creative public      |
| The economic contribution of   | Increasing the economy in   | GDP growth in the       |
| the fisheries and marine       | the manufacturing, trade    | manufacturing sector    |
| sectors has decreased          | and service sectors         |                        |
| The existence of socio-economic | Decreasing slum areas and   | Percentage of slum area |
| disparities between urban areas| increasing the fulfillment  |                        |
|                               | of urban infrastructure     |                        |
|                               | services                    |                        |

3.3. Local government policy

Pekalongan had responded to the climate change issues by integrating sustainable approaches into its local development into relevant to local government policies and programs. The Pekalongan government’s efforts to carry out integrated mitigation and adaptation to face climate change to cross a new sector began in 2010 through the formation of a climate change-working group [6]. According to Ahmadi et al [7], this early initiative to form a working group originated from an offer by German Corporation for International Cooperation GmbH (GiZ) to address mitigation and adaptation problems to climate change.

Several new regulations have been introduced to support the implementation of mitigation and adaptation in addressing climate-related disasters and climate change, which among others include: 1) Pekalongan Local Regulation No 3/2010 as amended by Local Regulation No 17/2017 concerning Environmental Protection and Management (PPLH); 2) Pekalongan Local Regulation No 16/2012 on Waste Management; 3) Mayor Regulation No. 14/2016 on Management of Green Open Space (RTH);
4) Mayor Regulation No. 22/2017 on Guidelines for the Implementation of Environmental Management Efforts and Environmental Monitoring Efforts (UPL-UKL) and Environmental Management Statement Letter (SPPL) in Kota Pekalongan.

3.4. Climate change program, strategies and activities
Concerning climate change mitigation and adaptation actions, most of it had been the Pekalongan Environmental Agency task, except in the energy sector, it was under the transportation agency's authority. The following was a description of several programs that had been implemented:

3.5. Creating kampung iklim (climate village)
Climate village programs implemented by community groups in Pekalongan include sustainable food houses, fishponds, vannamei shrimp cultivation, rainwater storage, organic compost management, and bio pores. So far, Pekalongan had developed nine climate villages.

3.6. Construction of coastal inundation dike
The dike was built ± 7 km long to prevent coastal inundation caused by rising sea levels flowing into normally dry residential areas. It usually happened when the peak height of the tidal wave was higher than 90cm. The seawater would flow from downstream towards the headwaters along the river or through the drainage system when the high tide occurred.

3.7. Increasing the urban green open space (GOS)
Pekalongan GOS covered an area of 529 ha of 4,225 ha or 12.5%. It consisted of 1) city parks (parks, fountain gardens, boulevards and garden islands), 2) urban forests, and 3) community yards, tours, and others. It covered an area of 50.43 ha, 5.14 ha, and 473.43 ha, respectively. Ideally, according to Law No 26/2007 on spatial planning, cities should have green open space for 30% of their total area.

3.8. Development of the mangrove park area (mangrove information center)
Mangrove Information Park is located in the Kandang Panjang sub-district, North Pekalongan Regency. It had a total area of 5.7 ha, which ± 1.5 ha had been planted mangrove; this area's function was for conservation and abrasion prevention.

3.9. Liquid waste management
The environmental service agency had built four communal units of Waste Water Treatment Plant (WWTP); there were Jenggot, Pringlang, Kauman, Banyurip, and 73 household-scale WWTP. Renewable energy produced from tofu processing waste using a biodigester was used for cooking by the community in Duwet Village.

3.10. Solid waste management
The waste management program provided to prevent the community's habit of burning rubbish, insightful education. Simultaneously, the environment service had built 3R (Reduce, Reuse, Recycle) Waste Management site in each sub-district and had created both the main waste bank and the waste bank that was managed by volunteers.

3.11. Preparing the Environmental Information System
Environmental information system document had been prepared annually, as follows: 1) The Environmental Quality Index (EQI) document provided information on environmental quality with the parameters of the Water Quality Index (WQI), Air Quality Index (AQI), and Land Cover Index (LQI). In 2019, the EQI score was 52.49, which means that the status was very low. The AQI had a value of 98.82 which means that it was in the superior category. The WPI was at 46.00, the closer to 100, the better the water quality. The Forest Cover Index in Pekalongan City was at 23.50 percent, which means a decline in performance, and 2) Regional Environmental Management Performance Information.
3.12. Landfills management
Landfills management in Pekalongan City faces some obstacles, especially the management of methane gas produced from the decomposition of wastes that had not been properly managed, resulting in fires. The landfill management system tended to be open dumping. Implementing the controlled landfill had been constrained by limited land and a pile of garbage, so it was not easy to spread red soil periodically.

3.13. Energy sector
Energy was suspected of having contributed to carbon emissions in Pekalongan. However, this sector was under the authority of both provincial and central governments. While at the city level, this had been the task of the Department of Transportation, which was related to transportation services, the programs that had been implemented were (i) Periodic testing of motorized vehicles on exhaust gas emission tests with both gasoline and diesel fuel, (ii) A roadworthy operation is a collaborative activity, involving officers from other agencies (police, army, prosecutors and courts), including the implementation of exhaust gas emission tests, (iii) Improving the use of public transportation for students and (iv) Repair of motor vehicle test equipment.

4. Conclusion
The Pekalongan City planning document had several adaptation and mitigation plans in response to climate change, supported by several regulations. The energy, waste, and agriculture sectors were the highest contributors to carbon emissions. This study also outlined the implementation of programs and strategies in the energy and waste sectors to reduce greenhouse gases and the obstacles they face exclude the agriculture sector because of limited data available. In general, the response of Pekalongan city to climate change was still hampered by coordination between sectors, and there were not all elements involved. Furthermore, greenhouse gas inventory had not been specifically budgeted.

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