CLIMATE
RESILIENT
AND INCLUSIVE
CITIES

URBAN ANALYSIS REPORT *2020*

01

PEKANBARU

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UCLG
ASPAC

ALL INDIA INSTITUTE OF
LOCAL SELF-GOVERNMENT

ACR+

Pilot4DEV
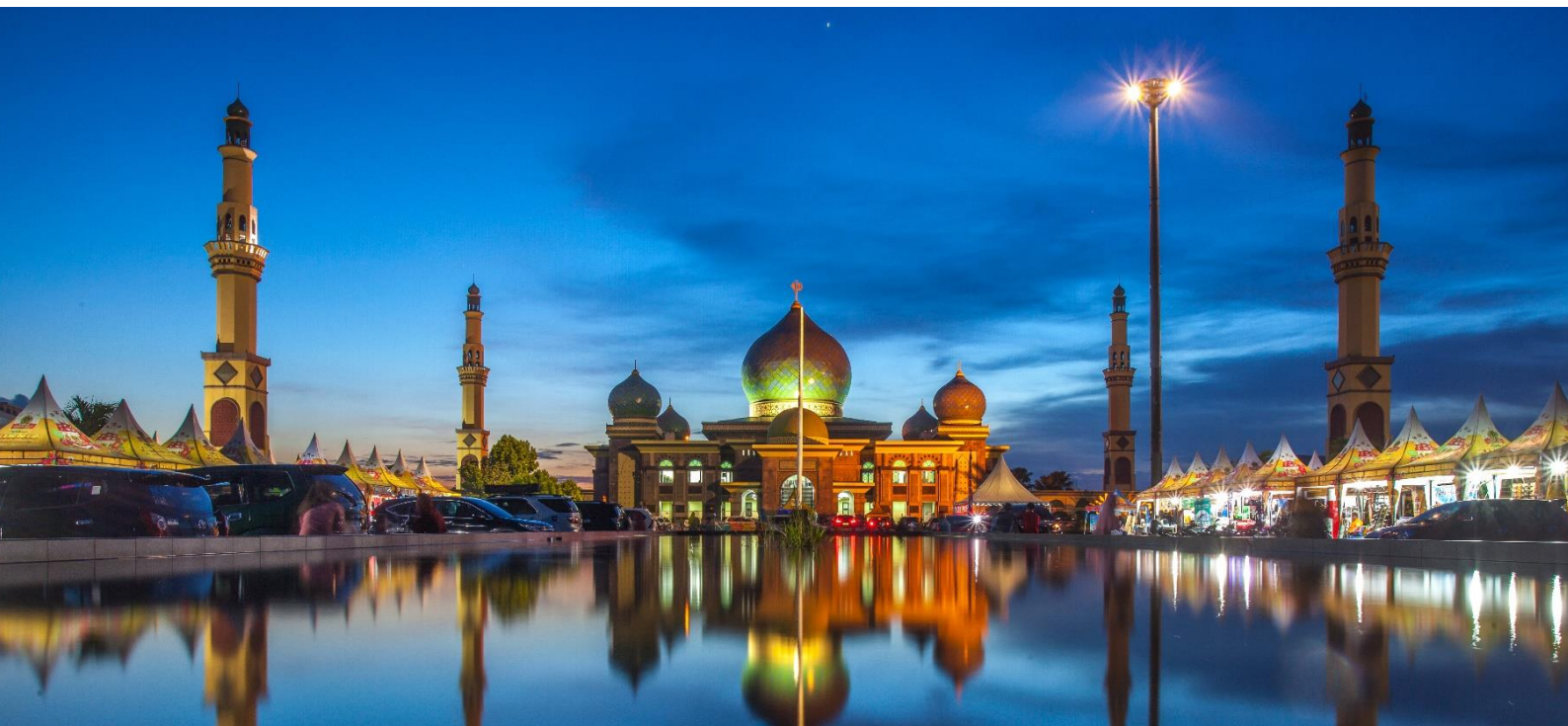
ECOLISE
EUROPEAN NETWORK
FOR COMMUNITY-LED
INITIATIVES ON CLIMATE
CHANGE AND SUSTAINABILITY

Université
Gustave Eiffel

FOREWORD

Addressing the threat of climate change remains a top priority for the European Union (EU). The European Green Deal is a response to these challenges; it aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy with zero net emissions of greenhouse gases by 2050.

Through the Climate Resilient and Inclusive Cities (CRIC) project, the EU and Indonesia are working together to help cities build a resilient and inclusive future. We do so by building partnerships between governments, businesses, local communities and research institutes in Europe, South Asia and Southeast Asia.

Clearly, there are hurdles along the way, especially in the midst of the COVID-19 pandemic. However, our response to this pandemic needs to be a sustainable one, addressing the challenges of climate change as well as economic recovery. Just last month, in Sukabumi City of West Java Province, a flash flood cost lives and forced hundreds of citizens to leave their houses. According to the Indonesian National Disaster Management Agency, Indonesia is about to experience more hydrometeorological disasters due to climate change. The CRIC Urban Analysis Report is a timely reminder that cities cannot delay their sustainable transition.

This Urban Analysis Report for ten Indonesian pilot cities under the CRIC project offers a comprehensive overview of city characteristics, policy gaps and climate-related policies in the cities of Pangkalpinang, Pekanbaru, Bandar Lampung, Cirebon, Banjarmasin, Samarinda, Mataram, Kupang, Gorontalo and Ternate.

The report provides empirical evidence to help cities develop policies and tools to strengthen climate change-affected sectors. I am happy to note the consultations among a wide range of stakeholders including government officials, academicians, civil society, professional practitioners, NGOs, and the private sector, ensuring that the proposals are inclusive.

We look forward to seeing how the cities will take up the given recommendations by transforming them into local climate-proof policies and programmes and to further working together to build climate resilient and inclusive cities.

Jakarta, October 2020

Vincent Piket

EU Ambassador to Indonesia and Brunei Darussalam

Mayor of Pekanbaru

FOREWORD

On behalf of Pekanbaru City Government, I am pleased to present this Urban Analysis Report, a result of 3-month-study from a panel of urban experts, under the *Climate Resilient and Inclusive Cities* (CRIC) Project. This Report provides us valuable inputs to align city-level policies and programmes with national-level policies and programmes, as part of our contribution to Indonesia's NDC commitment.

This report is guiding the city-scale strategies in mainstreaming climate change mitigation and adaptation actions into development planning. Report results point out relevant recommendations that help Pekanbaru tackle some pressing problems in its strategic sectors such as waste management, water pollution, air pollution, and access to clean water.

The Government has implemented polices and programmes to address these problems, as an example, we are implementing a national initiative "Blue Sky Programme" to reduce green house gas emissions. In 2014 and 2017, we also conducted a GHG Inventory showing that the largest GHG emissions came from land-use activities.

We acknowledge the urgency to have climate change mitigation and adaptation strategies that are comprehensive, integrated and are developed in collaboration with different stakeholder groups to address urban challenges. The experts have offered us, as stated in this report, policy and tools recommendations that can help us build more climate resilient strategic sectors. This report is just a beginning. We look forward to implementing the project and providing a sustainable, decent and safe city for our communities. Thank you.

MAYOR OF PEKANBARU

Dr. H. Firdaus, ST, MT

Climate Change is an issue of humanity, it is not merely a threat to the environment only. It is one of most visible humanitarian crises of the century. On very many occasions, we have seen how climate-induced disasters disrupted local economy, food system, basic services and left vulnerable groups more powerless. As an association connecting more than 10,000 cities and local governments in the Asia-Pacific region, UCLG ASPAC is responsible for supporting cities to be climate-resilient, something that we take seriously.

The cost of inaction now is huge. It is therefore urgent for cities to act and find solutions that should be based on data and scientific rigour enabling evidence-based decisions that subsequently reduce the impact of climate change. I emphasise, continual and periodic assessment of risks and change in attributes of cities are critical in enhancing resilience. In light of this, I commend the Climate Resilient and Inclusive Cities (CRIC) team and our urban experts for their hard work to publish this Urban Analysis Report. Great thanks to all the pilot cities of CRIC for their support in producing this Report. It presents a comprehensive outlook on climate risks, programmes and policies at a city level and provides recommendations and solutions to tackle climate change.

This report also underlines the importance of coordination that transcends administrative boundary as climate has no border! It is something that UCLG ASPAC can contribute through the CRIC Programme, by connecting the dots between cities in Asia and the Pacific and beyond within the framework of sub-national and national governments for vertical integration. We intend to bring cities on the centre stage of "Blue Ocean" and "Blue Sky" agenda through action-based proposals and approaches on circular economy, air pollutions and cross-cutting issues. And we are committed to ensuring that climate change best practices can be up-scaled and replicated for greater multiplier impact.

I look forward to seeing how the plans are put into actions to create climate resilient and inclusive cities. Our future will depend on how cities act today. Every concrete step on climate action we make now will bring closer our dream for inclusive, prosperous and sustainable cities and communities.

Dr. Bernadia Irawati Tjandradewi

Secretary General of UCLG ASPAC

As President of Pilot4Dev, I have had the honor to be directly involved in the Climate Resilient and Inclusive Cities Project from its very inception. It was with great pleasure that I attended the CRIC Kick-off event back in January 2020 which allowed us to meet up with our Indonesian partners in order to prepare and launch the project. A great added value from this event was the possibility to meet up with the mayors of the cities piloting the implementation of the project. Today, there is a myriad of cities in need of support in terms of urban environment and climate change resilience.

Pooling the expertise and knowledge of EU partners including ACR+, Pilot4DEV, University Gustave Eiffel, ECOLISE and Asian partners UCL ASPAG and AIILSG, this very ambitious five years project aims to establish a long lasting and unique cooperation. It is carried out through a triangular cooperation between cities and research centres in Europe, South Asia (India, Nepal, Bangladesh), and Southeast Asia (Indonesia, Malaysia, Philippines, Thailand). It aims to contribute to sustainable integrated urban development, good governance, and climate adaptation/mitigation through long lasting partnerships, and tools such as sustainable local action plans, early warning tools, air quality and waste management in consultation with experts' panels. The final beneficiaries include the local community of the cities/provinces, including women, marginalised sector, civil society and private sectors.

Now entering the 10th month of its implementation, this project has already proven to be a fruitful endeavor now implemented in 10 different cities in Indonesia. Among the chief results obtained so far, 10 urban analysis reports have been written and edited, and assess the current capacities of the different target cities. The project in itself has required the direct involvement of local authorities' officials, generating a real eagerness to make the cities more resilient and inclusive at the local level. The next steps of this project will involve the release of the Urban Analysis Reports along with policy briefs and recommendations adapted to the different pilot cities which have been involved in the project so far. This release will be completed by the creation of tools put together by the International Partners of the CRIC project, in order to equip local authorities and possibly tackle the urban and environmental challenges they face.

Due to high urban growth rates in countries such as Indonesia, Vietnam and the Philippines it is predicted that a significant share of the population of those countries will be living in cities in the next ten years. Cities in the South Asian and South East Asian regions are already impacted by climate change, and they could substantially benefit from long lasting solutions in terms of climate resilience and inclusiveness. The CRIC Project aims to inform and facilitate the equipment of local governments, cities, urban stakeholders working on climate resilience, mitigation and adaptation of those cities by pooling the best resources available and transferring and adapting as much knowledge as possible. Since urban areas host most of the vulnerable populations, as well as vital and social infrastructure, and local governments get increased pressure to develop services, infrastructure and employment, it is therefore of utmost urgency to make sure that we are all up for the challenge presented by climate change.

Isabelle Milbert, President of Pilot4Dev

The CRIC project represents for the Association of Cities and Regions for sustainable resource management (ACR+) – a network of local and regional authorities mainly based in the EU and the Mediterranean Area – a unique opportunity to cooperate and strengthen the role of cities to deliver on resiliency and inclusiveness.

ACR+'s core mission is to develop sustainable resource management initiatives involving local and regional authorities; in particular regarding waste management, one of the priorities raised by the urban analysis report. As such and for more than 25 years, we have been designing and implementing initiatives on circular economy, waste prevention, and waste management, building through this an extensive knowledge basis. Several ACR+ members have been already cooperating in the South-East region, whose experiences could be capitalized on and further developed through CRIC.

Conversely, this project provides a great learning opportunity for ACR+ members, to understand how local initiatives make a difference at global level. The present report contributes to effectively comprehend the local context, shedding the light on the key challenges and priorities. It shows that the exchange of methodologies to support decision-making processes rather than transfer solutions is crucial to successfully deliver sustainable projects.

However, more than a mere exchange of experiences, CRIC is a timely reminder that cooperation is key, at all levels and between countries. The EU cannot deliver alone the ambition of the European Green Deal for a climate-neutral, resource-efficient and circular economy. Activities like the ones developed within the CRIC project (trainings, stakeholder engagement, tools development, local action plans) can provide solid evidences to support bilateral and regional policy dialogue actions aimed at implementing the Green Deal and 2030 Agenda's objectives beyond the EU. Unfortunately, we cannot and should not forget the wider context in which the project is unfolding: the COVID-19 outbreak has been posing tremendous challenges at local level. With the hindsight we have so far, we see that local agenda based on resilient models contribute to better adapt and mitigate the negative impacts of the pandemic. Having this in mind, ACR+ has been supporting its members in overcoming the situation and is determined to also follow this path in CRIC.

Françoise Bonnet

ACR+ Secretary General

ABOUT THE AUTHORS

Wahyu Mulyana is an independent consultant with more than 24 years of experience in the areas of urban and regional development, housing and human settlement management, spatial planning, environmental management and climate change adaptation. He obtained his Doctoral Degree in Environmental Science from the University of Indonesia in 2019; his Master of Arts (M.A) in Urban Management from the Erasmus University of Rotterdam and Institute for Housing and Urban Development Studies (IHS) in 2001 and his Bachelor Degree in Urban and Regional Planning from Bandung Institute of Technology (ITB) in 1995.

He is a founder and director of WMK [associates], an Indonesia boutique consulting firm focusing on progressing local viable social, ecological and economic investment. Prior to joining WKM [associates], he worked with the Urban and Regional Development Institute (URDI), an independent nonprofit organization aimed at promoting sustainable urban and regional development in Indonesia.
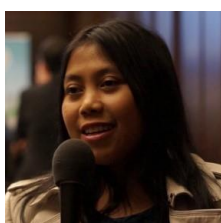
Nila Ardhyarini H. Pratiwi is a regional development, environmental management, and climate resilience specialist who has more than ten years of experience providing consultancy and research services to national and local governments as well as research institutes. She obtained her Master Degree in Environmental Science from the University of Indonesia in 2018 and Bachelor Degree in Urban and Regional Planning from the University of Diponegoro in 2009. She is a Deputy Director of Networking and Public Outreach at the Urban and Regional Development Institute (URDI). Besides, she has been involved in several collaboration studies and disseminations related to climate change vulnerability and adaptation between URDI and other institutions, including Mercy Corps through Asian Cities Climate Change Resilience Network (ACCCRN), the Asian Institute of Technology (AIT), Abt Associates under Millenium Challenge Corporation (MCC) Compact Program, the United Nation Population Fund (UNFPA), and Climate and Land Use Alliance (CLUA).

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GLOSSARY

API PRB	*Adaptasi Perubahan Iklim dan Pengurangan Risiko* Bencana/Climate Change Adaptation and Disaster Risk Reduction
AQMS	Air Quality Monitoring System
BAPPEDA	*Badan Perencanaan Pembangunan* Daerah/Local Development Planning Board
BAU	Business-as-usual
BOD	Biological Oxygen Demand
BPBD	*Badan Penanggulangan Bencana* Daerah/Local Disaster Management Board
BPDLH	*Badan Pengelolaan Dana Lingkungan Hidup*/Environmental Fund Management Agency
BRT	Bus Rapid Transit
CBS	Central Bureau of Statistics
COD	Chemical Oxygen Demand
CRIC	Climate Resilience Inclusive Cities
DAS	*Daerah Aliran Sungai*/ Watershed
DIKPLHD	*Dokumen Informasi Kinerja Pengelolaan Lingkungan Hidup Daerah*/ Regional Environmental Management Performance Document
DINKES	*Dinas Kesehatan*/Health Agency
DISHUB	*Dinas Perhubungan*/Transportation Agency
DLHK	*Dinas Lingkungan Hidup dan* Kebersihan/Environment and Cleaning Agency
DPKP	*Dinas Perumahan dan Kawasan* Permukiman/Settlement and Housing Agency
DPRD	*Dewan Perwakilan Rakyat Daerah*/Regional People's Representative Assembly
DPUPR	*Dinas Pekerjaan Umum dan Penataan* Ruang/Spatial Planning and Public Works Agency
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GRDP	Gross Regional Domestic Product
HDI	Human Development Index
IKA	*Indeks Kualitas Air*/Index of Water Quality
INDC	Intended Nationally Determined Contributions
ISPA	*Infeksi Saluran Pernapasan Akut*/Acute Respiratory Diseases
ISPU	*Indeks Standar Pencemar Udara*/Air Pollution Standard Index
KIT	*Kawasan Industri Tenayan*/Tenayan Industrial Estate
KOTAKU	*Kota Tanpa Kumuh*/Cities Without Slums
KPBU/ PPP	*Kerjasama Pemerintah dan Badan Usaha*/Public Private Partnership
LAP	Local Action Plan
LULUCF	Land Use, Land Use Change, and Forestry
MRT	Mass Rapid Transit
NDC	Nationally Determined Contribution
NGO	Non-Government Organisations
NMT	Non-Motorized Vehicle

PAMSIMAS	*Penyediaan Air Minum dan Sanitasi Berbasis Masyarakat*/Community Based Water Supply
PDAM	*Perusahaan Daerah Air Minum*/Local Water Company
PEKANSIKAWAN	Pekanbaru, Siak Regency, Kampar Regency and Pelalawan Regency
PROPER	Company's Performance Rating
RAN GRK	*Rencana Aksi Nasional Gas Rumah Kaca*/National Action Plan for Green House Gas Emission Reduction
RAD GRK	*Rencana Aksi Daerah Gas Rumah Kaca*/Local Action Plan for Green House Gas Emission Reduction
RAN API	*Rencana Aksi Nasional Adaptasi Perubahan Iklim*/National Action Plan for Climate Change Adaptation
REDD	Reducing Emissions from Deforestation and Forest Degradation
RPJMD	*Rencana Pembangunan Jangka Menengah Daerah*/Local Medium-term Development Plan
RPJMN	*Rencana Pembangunan Jangka Menengah Nasional*/National Medium-term Development Plan
RPPLH	*Rencana Perlindungan dan Pengelolaan Lingkungan Hidup*/ Environmental Management and Controlling Plan
RPPKPKP	*Rencana pencegahan dan Peningkatan Kualitas Permukiman Kumuh Perkotaan*/Slum Prevention and Quality Improvement Plan
RRR (3R)	Reuse, Reduce, dan Recycle
RTRW	*Rencana Tata Ruang Wilayah*/Spatial Plan
SANIMAS	*Sanitasi Berbasis Masyarakat*/Community Based Sanitation
SDGs	Sustainable Development Goals
SIDIK	*Sistem Informasi Data Indeks Kerentanan*/Vulnerability Index Data Information System
SIGN SMART	National GHG Inventory System
SLHD	*Status Lingkungan Hidup Daerah*/Regional Environmental Status
SPAM	*Sistem Penyediaan Air* Minum/Regional Water Supply Provision System
SRF	Solid Refused Fuel
SSK	*Strategi Sanitasi Kota*/City Sanitation Strategy
SSLTES	Sustainable Sanitary Landfill to Energy System
Susenas	*Survei Sosial Ekonomi Nasional*/National Socio-Economic Survey
SWM	Solid Waste Management
TPA	*Tempat Pembuangan Akhir*/Final Disposal Site
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar

INTRODUCTION

Indonesia is experiencing a high rate of urbanization which will continue in the next decades. It is expected that 72.8% of the population will live in urban areas by 2045 (Bappenas *et al*., 2018). Rapid urbanization was characterized by the urban agglomeration in large cities and metropolitan areas as well as the fast growing of small and medium cities. As an archipelagic country with extensive low-lying areas, Indonesia is highly vulnerable to adverse impacts of climate change and extreme climate events such as floods, drought and the rise of sea level. Climate change induced natural disasters will also affect a greater number of people and their assets in urban areas. Many cities are located in coastal, riverbanks and low-lying areas which have a high risk of coastal inundation, sea level rise and flooding. Pekanbaru is one of the cities located in the riverbanks on Sumatra Island.

Pekanbaru is the capital city of Riau Province and has a strategic role as a major economic centre on the Eastern part of Sumatra Island. As we know, Riau Province is the home of mega-companies in sectors such as pulp and paper, oil and gases exploitation, plantations, wood-sawmill, crude palm oils and rubber-processing. Pekanbaru city gets a lot of benefits as a trade and service centre to support the industrial development in the surrounding areas, and it is often said that the city has the highest money circulation in Indonesia.

The city is surrounded by regencies prone to forest and land fires. With these conditions, Pekanbaru city is highly vulnerable to land, forest fires and haze from surrounding districts. As a riverbank city, it is also vulnerable to flood and inundation, due to rivers' water overflow.

The Urban Analysis Report for Pekanbaru city is aimed to analyse the situation, policies and baseline data about the city. This report employs a qualitative research method combining a desk-study approach and interviews with key informants. The systematic desk study is a research technique which essentially involves collecting data from existing secondary data sources, including journal or published articles, government statistical reports, city and sectorial planning documents. Interviews were conducted with key informants representing local stakeholders such as local government officers, non-government organisations, private sector and academia. Descriptive analysis was used to assess key problems, challenges and opportunities in related sectors. The report comprises of an introduction, the overview of the city, the challenges and opportunities, and recommendations.

CHAPTER 1
Overview of Pekanbaru

1.1 General Description

Pekanbaru is located on Sumatra Eastern Crossroad, and is connected with several cities in Sumatra Island such as Medan, Padang and Jambi. It has an intermediary position in strategic trade activities with neighboring countries such as Malaysia and Singapore. It is the capital of Riau Province and one of the largest economic centers in Sumatra Island, with a high rate of urbanization growth. The city is surrounded by other regencies including Kampar Regency, Siak Regency and Pelalawan Regency.

Pekanbaru has an area of 632.26km² comprising of 12 subdistricts and 83 villages. The area of each subdistrict varies greatly. The subdistricts located in the outer city have large areas such as: Tenayan Raya, Rumbai Pesisir and Rumbai. The subdistricts located nearby the city centre including Pekanbaru Kota, Sail, Sukajadi, Senapelan and Limapuluh have smaller areas compared to other subdistricts. The city is divided by Siak River which flows from west to east and has several tributaries including Umban Sari, Sail, Air Hitam, Sibam, Setukul, Kelulut, Pengambang, Ukai, Sago, Senapelan, Limau dan Tampan.

The economic activities in Pekanbaru extend beyond the administrative boundaries and encompass a much larger urban agglomeration. The concept of metropolitan area has been introduced to accommodate future urban growth. It is known as Metropolitan Pekansikawan, which consists of Pekanbaru, Siak Regency, Kampar Regency and Pelalawan Regency and covers an area of 32,629km².

The history of Pekanbaru was initially inseparable from the function of the Siak River as a means of transportation in distributing crops from the inland and the highlands of Minangkabau to the coastal areas of the Malacca Strait. In the 18th century, the Senapelan area on the banks of the Siak River became a market (*pekan*) for Minangkabau traders. Over time, Senapelan area developed into a bustling residential area. In 1762, the Sultan of Siak moved the centre of Siak Sultanate from Mempura to Senapelan, and the city's name was later changed to Pekanbaru on 23rd of June 1784. This date is celebrated as the city's anniversary.

After the Indonesian independence, Pekanbaru became a small autonomous region within the Province of Central Sumatra. Since 1957, Pekanbaru was included in the newly formed Riau Province and later on became the capital of Riau Province in January 1959. Pekanbaru grew rapidly as a trade and service centre to support mega-industries such as petroleum, pulp and paper and palm oil industries in the surrounding regencies. The city gets a lot of benefits from its advantageous location.

1.2 Topography and Climatology

Pekanbaru is located at an altitude of 5-50 meters above sea level. The downtown area is relatively flat with an altitude of 10-20 meters above sea level. Tenayan and its surrounding area are around 25-50 meters, while the northern part of the city is a hilly area, especially in Rumbai and Rumbai Pesisir Subdistricts with an altitude of 50 meters above sea level.

Pekanbaru has a tropical climate. The average temperature in the period from 2011 to 2015 was 28.30°C. The minimum temperature of 19.90°C occurred in October 2011, and the maximum temperature of 35.80°C occurred in May 2011. In the period of 2012 to 2016, the highest rainfall occurred in December 2013 which was 614mm and the lowest rainfall occurred in February 2014 which was 13.8mm.

Figure 1 Map of Pekanbaru
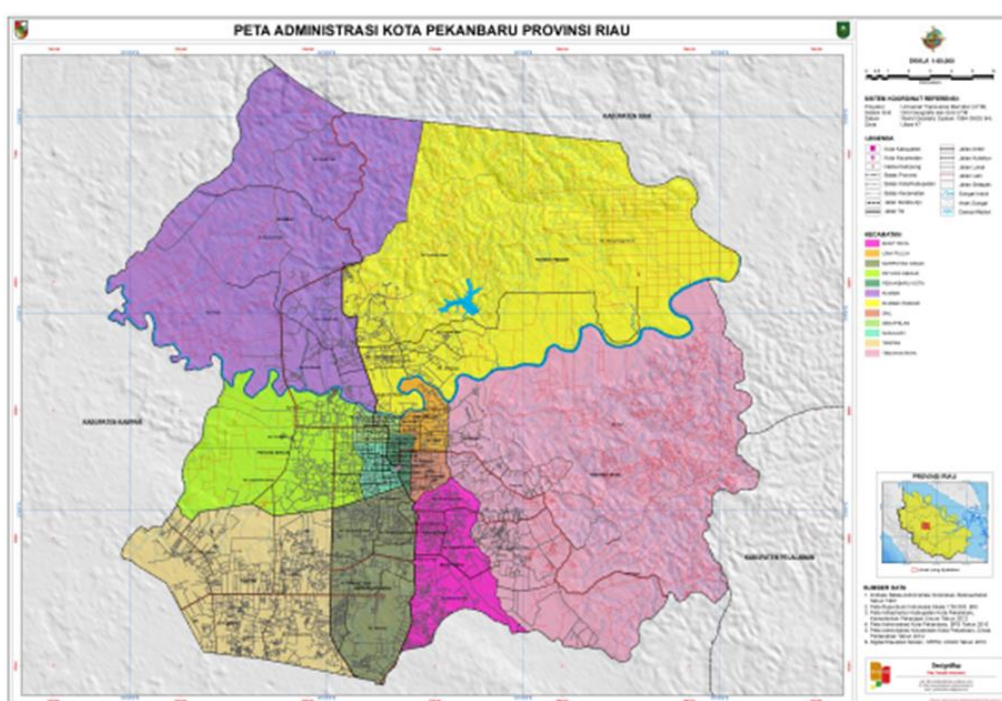
Source: The Local Medium Term Development Plan (RPJMD) of Pekanbaru

1.3 Demographic Characteristics

Pekanbaru is an autonomous region with the smallest area in Riau Province but is inhabited by a relatively large population with a total in 2019 of 1,143,359 people, an increase of 214,320 people from 2010. Pekanbaru accounts for 62% of the population in Metropolitan Pekansikawan. The number of inhabitants in Pekanbaru steadily increases every year and is affected by natural growth and migration. As a regional economic centre, Pekanbaru became a destination area for people who are looking for employment opportunities.

Metropolitan Pekansikawan also experienced rapid population growth between 2000 and 2010, by 5.16% per year, and is still increasing steadily at 3.35% per year from 2010 to 2019. The population growth has been concentrated in surrounding regencies. Pelalawan Regency grew by 7.30% per year between 2000 and 2010 and 5.27% between 2010 and

2019, while Siak regency grew by 4.74% per year from 2000 to 2010, and by 2.89% between 2010 and 2019.

Pekanbaru is a densely populated area and has the highest population density, which is 1,808 people per km². Other surrounding regencies have low population density, mostly below 80 people per km².

Table 1. Population Growth in Metropolitan Pekansikawan

City/Regency	2019 Population	Annual Population Growth (%)			Area (km²)	2019 density (pop/km²)	Sub-district
		1990-2000	2000-2010	2010-2019			
Pekanbaru City	1,143,359	3.92	4.49	2.66	632	1,808	12
Siak Regency	489,996	-	4.74	2.89	8,275	59	14
Kampar Regency	871,117	-2.36	4.13	2.59	10,983	79	21
Pelalawan Regency	483,622	-	7.30	5.27	12,758	38	12
Pekansikawan	2,988,094	3.95	5.16	3.35	32,649	92	69

Source: Analysis, 2020

Note: Siak Regency and Pelalawan Regency established in 1999 based on Law No 53 year 1999 on the establishment of 8 (eight) Regency/City in Riau Province

In 2010, there were 4 subdistricts that had a population of over 100,000 people, namely Tampan, Tenayan Raya, Marpoyan Damai and Bukit Raya. In the period of 2015 to 2018, Tampan subdistrict has the highest population growth compared to other subdistricts in Pekanbaru. The value of population in Tampan reached 307,947 people in 2018. Likewise, Tenayan Raya sub-district had a population of 167,929 people in 2018, an increase from 124,201 in 2010. These two subdistricts are experiencing rapid urban development. The subdistricts in the older part of the city tend to experience more stable population growth with high population density, as occurred in the subdistricts of Pekanbaru Kota, Sukajadi and Limapuluh.

Table 2. Population Distribution and Density by Sub-District, 2010-2018

Sub-District	Area (km²)	Number of Population			Pop. Growth		Pop. Density		
		2010	2015	2018	2010-2015	2015-2018	2010	2015	2018
Tampan	59.81	171,830	201,182	307,947	3.2%	11.2%	2,873	3,364	5,149
Payung Sekaki	43.24	86,949	101,128	91,255	3.1%	-2.5%	2,011	2,339	2,110
Bukit Raya	22.05	92,433	109,381	105,177	3.4%	-1.0%	4,192	4,961	4,770
Marpoyan Damai	29.74	126,220	146,221	131,550	3.0%	-2.6%	4,244	4,917	4,423
Tenayan Raya	171.27	124,201	148,013	167,929	3.6%	3.2%	725	864	980
Limapuluh	4.04	41,335	44,481	41,466	1.5%	-1.7%	10,231	11,010	10,264
Sail	3.26	21,439	23,124	21,492	1.5%	-1.8%	6,576	7,093	6,593
Pekanbaru Kota	2.26	25,063	27,224	25,103	1.7%	-2.0%	11,090	12,046	11,108
Sukajadi	3.76	47,178	49,650	47,420	1.0%	-1.1%	12,547	13,205	12,612
Senapelan	6.65	36,436	38,340	36,581	1.0%	-1.2%	5,479	5,765	5,501
Rumbai	128.85	64,893	74,977	67,654	2.9%	-2.5%	504	582	525
Rumbai Pesisir	157.33	65,061	74,397	73,784	2.7%	-0.2%	414	473	469
PEKANBARU	632.26	903,038	1,038,118	1,117,358	2.8%	1.9%	1,428	1,642	1,767

Source: CBS of Pekanbaru, 2011-2019

1.4 Economic Structure

1.4.1 City's Economic Growth

Pekanbaru's economic growth has been quite volatile in the last ten years. Between 2011 and 2019, the city's economic growth reached 7.54% and then 6.01%. Despite the decline, the economy of Pekanbaru tends to be stable because it can still be controlled so that there is an increase from year to year. This condition can also be seen from the Pekanbaru GRDP, which has increased.

In the period of 2011 to 2019, Pekanbaru's economic growth was relatively higher compared to the economic growth of Pekansikawan region and Riau Province. Even when economic shocks occurred in 2015 due to falling oil and coal prices, the city's economic growth did not experience a significant decline, as happened in surrounding areas which are highly dependent on land-based investment. This condition shows that Pekanbaru has a strong economic growth. The main economic contributor is the wholesale and retail trade, car repairs and motorbikes sectors, which are relatively unaffected by oil and coal prices.

Between 2011 and 2019, the GRDP of Pekanbaru grew by 6.13% from USD2.9 Billion (IDR 41.8 Trillion) to USD5.1 Billion (IDR 72.2 Trillion). The city contributed to 14.6% of Riau Province GRDP, higher than other regencies. Collectively, the share of Metropolitan of Pekansikawan to Riau GRDP reached 42.7%. Compared to other regencies, the Pekanbaru

GRDP steadily grew between 5.4% and 6.1% and relatively higher than Siak Regency (3.2% – 4.5%), Kampar Regency (1.9% – 3.9%) and Pelalawan Regency (3.8% – 3.9%).

Figure 2. GRDP Growth in Riau Province, 2011-2019
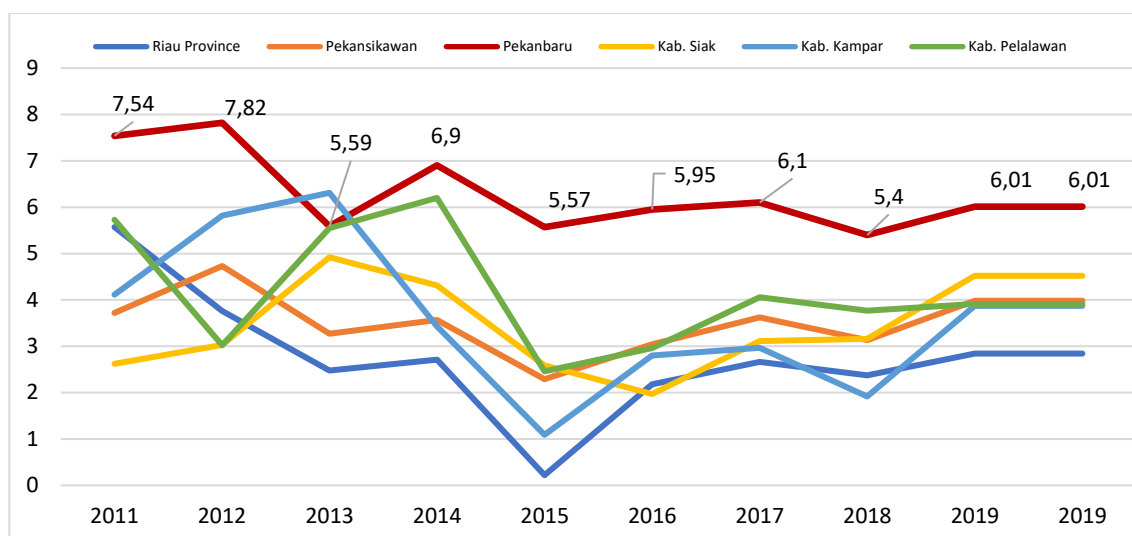
Source: CBS of Riau Province, 2011-2019

1.4.2 GRDP Per Capita

In terms of GRDP per capita, Pekanbaru has lower per capita income compared to Riau Province and surrounding regencies. The city's per capita income grew annually by 6.1%, which valued from USD3,442 (IDR 48.2 million) in 2011 to USD4,507 (IDR 63.1 million) in 2019. The Riau Province per capita income reached USD5,085 (IDR 71.2 million) in 2019. The other regency with highest per capita incomes is Siak Regency, which reached USD7,792 (IDR 109.1 million) in 2019 due to contributions from the increasing manufacturing industries.

1.4.3 City's Economic Sector

Pekanbaru's economic structure does not depend on land-based investment. The dominant economic sectors in 2019 were wholesale and retail trade, car repairs and motorbikes sectors (28.87%), construction (28.73%) and manufacturing (21.78%). These three sectors experienced high growth above 10% in the period of 2010 to 2019. The high sectoral growth has also been experienced by other service activities, business, human health and social work, information and communication. It shows that tertiary sectors will dominate the city's economy in the future. The share of the primary sector, such as agriculture and mining, are decreased every year.

Table 3. GRDP Structure of Pekanbaru, 2019

No.	Sector	Share 2010	Share 2015	Share 2019	Growth 2010-2019
1	Agriculture, Forestry and Fishing	1.76%	1.56%	1.48%	7.8%
2	Mining and quarrying	0.02%	0.02%	0.01%	4.1%
3	Manufacturing	20.86%	21.84%	21.78%	12.6%
4	Electricity and gas	0.22%	0.20%	0.24%	13.2%
5	Water, sewage and waste management	0.03%	0.02%	0.02%	1.3%
6	Construction	28.93%	27.73%	28.73%	11.4%
7	Wholesale and retail trade, repair of motor vehicles and motorcycles	28.45%	27.97%	28.87%	11.9%
8	Transportation and Storage	2.41%	2.57%	2.22%	9.8%
9	Accommodation and food service activities	1.81%	1.74%	1.60%	8.9%
10	Information and communication	2.60%	2.94%	3.07%	15.4%
11	Financial and insurance activities	3.25%	3.80%	3.36%	12.3%
12	Real Estate activities	2.88%	2.97%	2.70%	10.2%
13	Business activities	0.02%	0.02%	0.02%	17.6%
14	Public administration and defense, compulsary social securities	4.37%	3.99%	3.27%	5.3%
15	Education	1.16%	1.06%	0.95%	7.3%
16	Human health and social work activities	0.41%	0.48%	0.51%	16.4%
17	Other services activities	0.84%	1.08%	1.16%	19.1%

Source: CBS of Pekanbaru

1.4.4 Employment

In line with the city's economic sector, the majority of people in Pekanbaru are employed in the trade, hotel and restaurant sector with a total of employee amounting to 400,231 in 2019. The number of people working in the manufacturing sector reached 93,244, while the number of employee in the agriculture sector is only 20,745. On the contrary, the majority of people in Metropolitan Pekansikawan work in the agricultural sector. The unemployment rate reached 8.42% or the equivalent to 35,000 of the workforce. This unemployment rate is above the provincial and national level.

1.5 Social Structure

1.5.1 Human Development Index

The progress of social development in Pekanbaru reflected by the Human Development Index (HDI) comprises three dimensions: (1) long and healthy life, (2) education and (3) decent standard of living. Between 2010 and 2019, the HDI of Pekanbaru increased from

77.34 to 81.36. It is classified as a high rank of HDI (70 ≤ HDI < 80). The City HDI was above the Riau HDI (73.00) and the Indonesian HDI (71.92).

Table 4 : Human Development Index 2010-2019

Indicator	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Life expectancy at birth	71.42	71.46	71.51	71.54	71.55	71.65	71.70	71.75	71.94	72.22
Expected years of schooling	13.64	13.74	13.83	13.93	14.07	14.86	14.87	14.93	15.34	15.37
Mean years of schooling	10.67	10.84	10.88	10.93	10.95	10.97	11.20	11.21	11.22	11.43
Income per capita	13,633	13,719	13,805	13,891	14,023	14,126	14,225	14,547	14,778	15,206
HDI Pekanbaru	77.34	77.71	77.94	78.16	78.42	79.32	79.68	80.01	80.66	81.35
HDI Riau Province	68.65	68.90	69.15	69.91	70.33	70.84	71.20	71.79	72.44	73.00
HDI Indonesia	66.53	67.09	67.70	68.31	68.90	69.55	70.18	70.81	71.39	71.92

Source: CBS of Pekanbaru

1.5.2 Ethnic Groups

Pekanbaru is highly urbanised, drawing many of its people from the neighbouring province of West Sumatra. Since many centuries ago, Pekanbaru has been one of the Minangkabau migration areas (*rantau*). Many Minang have lived there for generations and have become assimilated into the Malay community. They are the largest ethnic group with a total of 41% of the population and mostly work as professionals and traders. In addition to the Minangkabau, the Riau Malays natives are the second largest ethnic group in Pekanbaru, making up to 26% of the population.

The Javanese, Batak and Chinese are the other main ethnic groups inhabiting Pekanbaru. The Chinese mostly work as entrepreneurs, traders and economic agents. They originated from Pekanbaru, coastal areas of Riau Province and other cities such as Medan and Padang. They came to Pekanbaru due to the city's rapidly growing economy. The Javanese came as farmers during the colonial period to work in railway construction project. Until 1950, they occupied a significant portion of land in the city. The development of petroleum industries has created many job opportunities and attracted the Batak people to the city.

1.5.3 Poverty

The concept of poverty refers to the ability to meet basic needs measured by two indicators of the poverty line. First, the food poverty line is the value of the minimum food expenditure equivalent to 2,100 kilo-calories per capita per day. Second, the non-food poverty line is the minimum needs for housing, clothing, education and health.

Despite a significant reduction in Pekanbaru's poverty level, a large segment of population continues to live under the poverty line. Between 2010 and 2019, the number of poor people declined from 38,200 to 28,600, decreasing the poverty rate from 4.2% to 2.52%. The reduction of the number of poor people in Pekanbaru is affected by the Community Empowerment Program which integrated social, economic and environmental empowerment. The approach was stipulated through the Mayor Regulation No. 20 Year 2018 on Neighborhood-Area (*Berbasis RW*) Community Empowerment Program.

Figure 3. Poverty in Pekanbaru, 2010-2019

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Poor People	38.20	32.34	32.66	32.46	32.29	33.76	32.49	33.09	31.62	28.60
Percentage	4,20%	3,45%	3,38%	3,27%	3,17%	3,27%	3,07%	3,05%	2,85%	2,52%
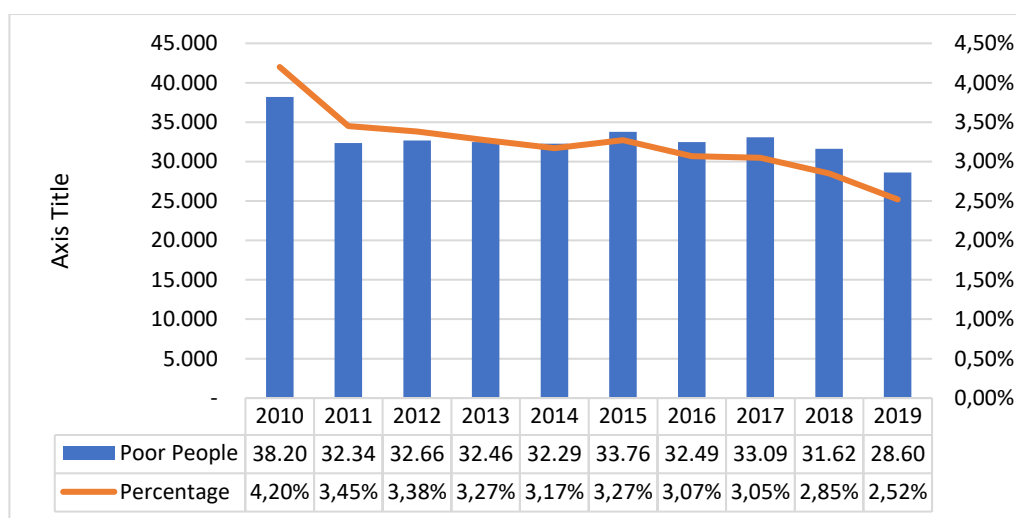
Source: CBS of Pekanbaru 2010-2019

1.5.4 Slum Settlements

Rapid urbanization has resulted in the growth of slum settlements characterized by the deprivation of physical infrastructure and basic service conditions. Pekanbaru city government has identified slum settlements covering 113.56 hectares in seven locations. Most of the slum settlements are located in community-owned land, but with the lack of infrastructure and basic services provision. Slum settlements location were determined under the Mayor Decree No. 15 Year 2016.

Table 5. Slum Settlements in Pekanbaru

No	Location	Area (Ha)	Land Status	Priority
1.	Sungai Sago	24.23	Community	High
2.	Kota Lama	8.18	Community	High
3.	Pesisir	23.04	Community	High
4.	Meranti	21.32	Community	High
5.	Rumbai Pesisir	28.39	Community	High
6.	Sumahilang	3.10	Community	High
7.	Padang Terubuk	5.30	Community	High
	Total	113.56		

Source: Mayor's Decree of Pekanbaru No. 15/2016

1.6 Environment Condition

1.6.1 Air Quality

Rapid economic growth combined with urbanization has caused severe air pollution problems in Pekanbaru. The main sources of air pollution are coming from traffic, domestic fuel burning and industrial activities. Pekanbaru is also prone to forest and land fires resulting in haze which worsens air quality. A systematic air quality monitoring is needed to control the impacts of air pollution.

Pekanbaru Government routinely monitors ambient air quality which is measured by three Air Quality Monitoring System (AQMS) stations, namely PEF 1 (Pekanbaru fixed station 1) located on Jl. Utama Gang Kulim Education, PEF 2 on Jl. Ahmad Yani Sukajadi and PEF 3 on Jl. H. R. Soebrantas Panam. In 2017, PEF 3 stopped functioning due to technical damage. Ambient air quality is monitored using SO_2, CO, NO_2, O_3 and PM_{10} parameters. The results of air quality monitoring are displayed to the public through displays that can be seen in front of the Pekanbaru Mayor's office and on Jalan Tuanku Tambusai at the Soekarno Hatta intersection. With this monitoring tool, an early warning if air quality is in dangerous condition can be given.

In the last five years, the condition of air quality has been threatened due to the worst forest, and land fires occurred intensively in the long dry season affected by the El Nino phenomenon. In 2015, the condition of Pekanbaru's air quality reached a dangerous level because of the very thick haze that could potentially worsen the respiratory health of the community.

Like the haze incident in 2015, Pekanbaru's air quality in 2019 also reached dangerous levels due to the massive forest and land fires which occurred again that year. The city's socio-economic activities stopped, including schools which were temporarily closed. In addition, acute respiratory infections suffered by the community have increased due to exposure to dust and smoke. It is still the disease with the highest presence, which contributed to 81.738 cases or 36.7% of all major types of diseases in Pekanbaru (DIKPLHD of Pekanbaru, 2017).

Figure 4. Pekanbaru Air Quality Monitoring Results 2013-2017
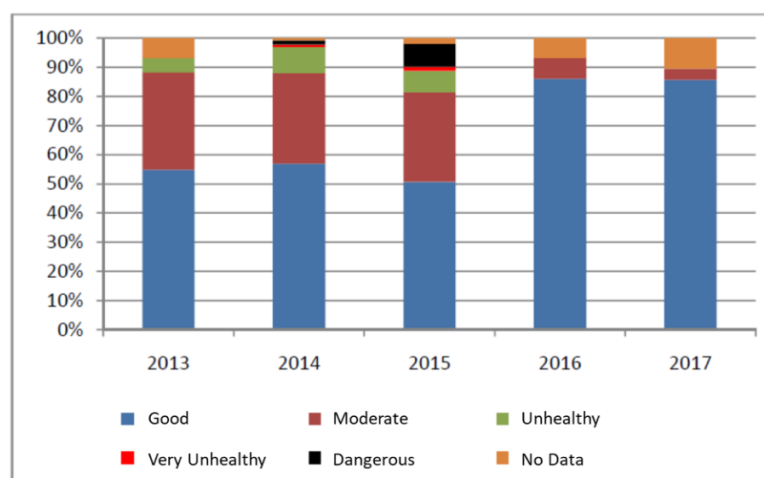
Source: DIKPLHD of Pekanbaru, 2017

1.6.2 River Water Quality

Siak River is the main source of surface water and has various vital functions as a raw water source for clean water and industry, transportation, fisheries, recreational, river conservation and others. Pekanbaru is passed by the 59km long Siak River, which is the deepest river in Indonesia and crosses through Rokan Hulu Regency, Bengkalis Regency, Kampar Regency, Siak Regency and Pekanbaru. In addition, Siak River has 53 tributaries.

The water quality measurement of Siak River is carried out in four locations, namely the bridge of Siak II-Palas, the Sei Senapelan estuary, Duku River Port (Pelindo) and Sei Sail estuary. In 2016, water quality was measured four times within a year, and results showed that some parameters did not meet the class-II water quality standards. Most of the water quality parameters in Pekanbaru are quite deteriorated. The results showed that the water pollution index in Siak River is in the range of light to moderate pollution.

The status of water quality in each location is as follows: meeting the quality standard (6.25%), lightly polluted (87.5%) and moderately polluted (6.25%). These conditions are caused by several reasons such as: the river passes through densely populated settlement areas with high community activities, and the large number of businesses activities that still dispose their waste into water bodies, which eventually empties into the Siak River.

The large contribution of domestic waste to Siak River can be seen based on the condition of water quality in each monitoring location. The water Pollution Index for Pekanbaru is 5.0. Water pollution is caused by untreated wastewater from commercial activities, business and industries. Large industries should treat their wastewater properly before discharging into the river.

Greenhouse Gases

Pekanbaru conducted the GHG inventories in 2014 and 2017. The trend of emission and absorption of greenhouse gases (tons CO_2eq) from 2012 to 2016 has decreased. The total GHG emissions in 2012 were 0.068 Gg CO_2eq. The sources of emission are coming from procurement and energy use sector (56,470 Gg CO_2eq), livestock (11,13 Gg CO_2eq), land-based activities (10,887,476 Gg CO_2eq), agriculture (36.64 Gg CO_2eq), and waste (786,005 Gg CO_2eq). In contrast, the process sector and industrial products are not counted in this inventory report due to data limitation. Land based activities are still the largest contributor of GHG emissions.

The National GHG Inventory System (SIGN SMART) also confirms that the largest emitter is land use(LULUCF). The GHG emissions from all sectors tend to increase in the period of 2010 to 2013. The highest GHG emission occurred in 2010 at about 285,947,927 tons CO_2 with the largest emitter being the LULUCF sector of 285,867,141 tons CO_2 (99.97%). Nevertheless, GHG emissions in 2014 decreased to 125,242,889 tons CO_2 with the largest emitter in the LULUCF sector at about 125,119,144 tons CO_2 (99.90%).

Figure 5. Green House Gases Emission

Total of Emissions From All Sectors
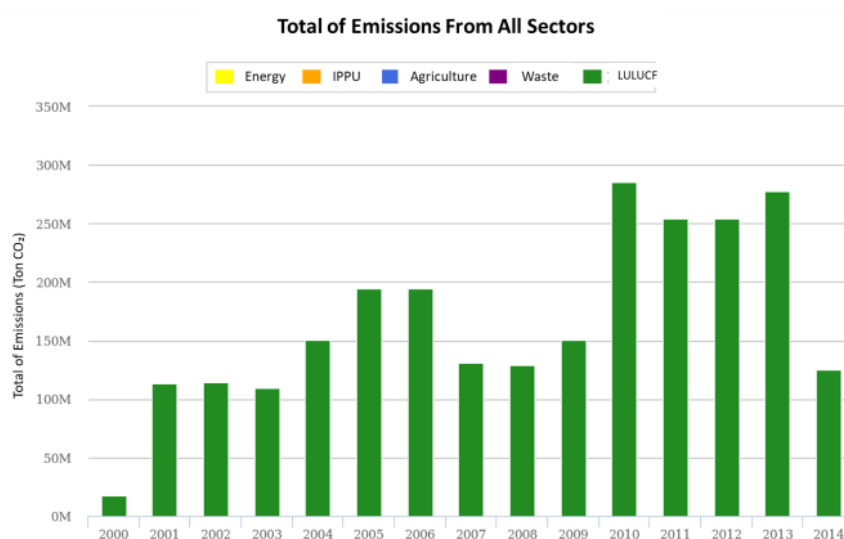
Source: SIGN SMART

.6.3 Solid Waste

Increasing population numbers put pressure on the urban environment through the amount of waste generated every day. Based on its sources, waste is coming from settlements, commercial activities, public facilities, education areas, health facilities, public markets and industries. The largest amount of waste is generated from households or settlements areas.

In 2019, the population of Pekanbaru reached 1,143,359 people, distributed unevenly in 12 subdistricts with differents categories of settlements, namely; modest, moderate and luxurious. Based on the population number in each subdistrict, it was calculated that the total volume of waste generated in settlement areas is 1.48 million litres per day or 1,488 m3/day, and the total weight of waste generated is 418.5 tons per day (Masterplan of Solid Waste Management, 2014).

Commercial activities and other activities also significantly contribute to the amount of waste generated. These activities include hotels, restaurants, entertainment centres, offices, tourism areas, malls, shopping centres, shops, markets, public facilities, education centres, health centres and industrial activities. The total waste generated reached 2.43 million litres per day or 2,474 m^3 per day (Masterplan of Solid Waste Management, 2014). In general, the composition of waste in Pekanbaru divides into 70% of organic waste and 30% of non-organic waste.

Based on the Local Policy and Strategy of Solid Waste Management (Jakstrada) published in 2018, the total waste generated in Pekanbaru was 403,757 tons/year or 1,106 tons/day in 2018, whereas the amount of waste managed is 293,517 tons/year or 73% of the amount of waste generated (Jakstrada, 2018). Waste reduction in 2018 was 71,627 tons/year or 18% of total generated waste. The muncipal government sets the target of waste reduction from 18% of total waste in 2018 to 30% of total waste in 2024. Likewise, the target of waste transported

to the final disposal site decreases from 73% in 2018 to 70% in 2024.

1.6.4 Water Supply and Sanitation

The increasing numbers of urban population and urban activities have increased the need for water supply. The provision of water supply is served through PDAM Tirta Siak, a locally owned water company. The source of water for PDAM Tirta Siak comes from Siak River and covers all districts in Pekanbaru. However, the coverage of piped drinking water is less than 10% of the total population. Therefore, the City of Pekanbaru Public Works Agency has a role in helping the community in providing clean water facilities and infrastructure for areas not yet reached by the PDAM. The use of groundwater is still high for domestic purpose.

In addition to water needs, this rapid increase in population and settlement also requires the support of sanitation facilities and infrastructure. Provision of adequate sanitation facilities and infrastructure is a prerequisite for public health and environmental health.

Wastewater is divided into two categories, namely domestic waste from household activities and non-domestic waste from industrial, hospital and commercial activities. Pekanbaru does not have a centralized wastewater treatment to serve all the city's areas. There is only a centralized system to serve a new settlement area with limited capacity. Domestic wastewater is heavily relying on a decentralized system or an on-site water treatment which has a coverage of 87% (individual septic tank and public community toilets). However, there is a little portion of households that still practice open defecation.

1.6.5 Transportation

The transportation sector is affected by the number of vehicles and the length of roads. The increase in the number of motorized vehicles in Pekanbaru is followed by the construction of road networks. According to the Public Works and Spatial Planning Agency of Pekanbaru, there is an increase in the length of class III C roads in Pekanbaru from 2,818.54 in 2015 to 2,872.92 in 2017. Based on the type of road, the length of existing roads in Pekanbaru is as long 3,079.61km with details of city roads 2,872.92km, provincial roads 123.24km and national roads 83.45km.

Increasing the number of motorized vehicles occurs every year. However, complete data regarding the number of motor vehicle sales is not available. At present, the number of vehicles that use premium fuel/gasoline including two-wheeled vehicles, private and public passenger vehicles is around 1,504,769 units with 31,163 units of vehicles using diesel fuel. Diesel fuel is mostly from small and large trucks and small and large buses. The need for fuel from gasoline/premium types is higher compared to motor vehicles that run on diesel fuel. This will correlate with the amount of premium fuel/gasoline that must be provided and its retention in nature. Furthermore, it is correlated with the decreasing stock or reserves of fossil natural resources and will also increase emissions from the combustion of fuel from the air.

Pekanbaru Government has conducted a motor vehicle emission test that is measuring the exhaust gas of a vehicle to detect whether the performance of vehicle engines are in good condition or not. This emission test is carried out in order to monitor the effectiveness of the fuel combustion process in motor vehicle

engines after analyzing the CO_2 and HC content in the exhaust gases. Through this emission test, the hope is to reduce air pollution, to prevent the operation of motor vehicles that are not environmentally friendly and to have emissions outside the threshold or high air pollution. This motor vehicle emission test took place in 2018, but in subsequent years it couldn't be continued due to budget constraints.

1.6.6 Energy Consumption

Electricity plays a very vital role as a source of lighting and other energy for households and industries. The sources of electricity are coming from Diesel and Gases Power Plants in Teluk Lembu and the South Sumatera Interconnection with the capacity of 114 MW. To support the industrial area development, the Steam Power Plant using coal in Tenayan Raya is under construction with the capacity of 220 MW and will be operated in 2021.

In 2019, total electricity production was 1.8 Billion KWh which was used by households (46.7%) and business (30.5%). The number of electricity customers in Pekanbaru reached 391,000 households in 2016; 45,000 businesses, and the rests covering Social/General, Multipurpose, Government, Industry, Street Lighting, and Business. The existing demand is high, while the supply capacity is limited. Some areas experienced rotating blackouts.

The use of fuel at the household level can also produce emissions that indirectly affect air quality in Pekanbaru. The availability of fuel consumption data for household use only exists for six subdistricts (from a total of 12 districts) namely Payung Sekaki, Bukit Raya, Sail, Sukajadi, Rumbai and Coastal Rumbai Districts. Based on these data, LPG fuel

and firewood are most widely used by households in Bukit Raya subdistrict, kerosene in Payung Sekaki Subdistrict and briquettes in Payung Sekaki Subdistrict (DIKPLHD of Pekanbaru 2017).

1.7 Spatial Planning and Land Use Changes

1.7.1 Spatial Structure and Pattern

The city's service centers are spatially determined by area characteristics and road network system and following these considerations: (a) Strengthening the existing function of the city's service centers through synchronization between the road network function and its activities; (b) The city's Service Centers comprise one City-Wide Service Centre (first hierarchy) along the main road of Sudirman Street and four City Service Sub-Centers, and some neighborhood centers; (c) The criteria of sub-centers are: service coverage, acceleration in the potential growth areas along the Outer Ring Road in Tenayan Raya and Rumbai Pesisir and balanced function of sub-centers. The development of Sub-Center in the northern part of Siak River is directed to the activities which provide low impact to the environment. While the Southern part of Siak River is directed to built-up area development particularly for trade and services, industry, settlement and education. In the Eastern part, the development priorities are for industry, warehouse, trading and transportation service

Figure 6. Spatial Pattern of Pekanbaru
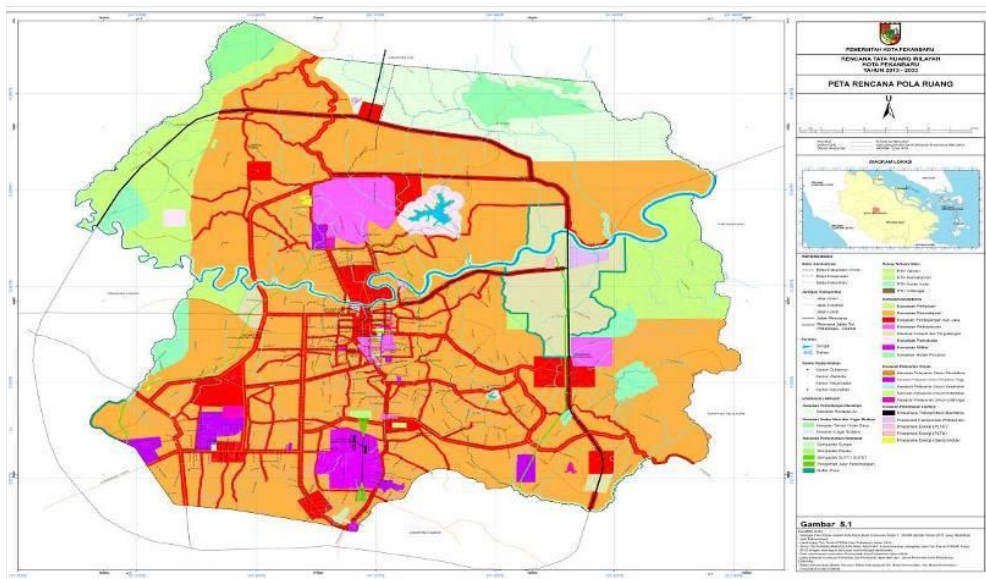
Source: Spatial Plan of Pekanbaru

1.7.2 Land Cover Changes

Since 2000 until now, Pekanbaru has experienced significant changes in land cover. This is marked by the increasing construction of settlements, shop houses, office buildings and roads, and the decreasing green open space area.

Pekanbaru has an area of 632.26 km² or 63,226 hectares dominated by bushes and shrubs (39% of the total area of Pekanbaru). The dynamics of land use in the period 1989 to 2012 (23 years) can be seen in the decrease in the area of forests and bushes/shrubs/grasses, as well as an increase in built up land and vacant land as a result of urban growth. The decline in forest area reached 12.9 thousand hectares while decline in bushes/shrubs/grass reached 12.8 thousand hectares. At the same time, the increase in built up land reached 2.7 thousand hectares, and vacant land reached 11.9 thousand hectares.

The increase in the area of vacant land is intended as developed land such as settlements and offices, and also for agricultural activities and oil palm plantations. At present, the forest area covers only about 3.9% of the total area of Pekanbaru contained in the area of Chevron and the Lancang Kuning University area, and the Tahura Sultan Syarif Hasim conservation forest.

Table 6. Land Cover Changes, 1989-2012

No.	Land cover	1989		2012	
		ha	%	ha	%
1.	Forest (secondary)	15.337,1	21,6%	2.359,89	3,9%
2.	Vacant land	5.910,6	8,3%	17.811,30	29,5%
3.	Water bodies	994,2	1,4%	869,76	1,4%
4.	Built up area	8.499,9	12,0%	11.202,40	18,6%
5.	Grass	7.697,4	10,8%	-	-
6.	Shrubs	28.764,0	40,5%	23.595,10	39,1%
7.	No data	3.770,0	5,3%	4.549,68	7,5%
	Total	70.973,2	100%	60.388,13	100,0%

Source: Local Medium Term Development Plan (RPJMD) of Pekanbaru

Rapid urban development in Pekanbaru has also contributed to environmental changes, including the increase of surface temperature in some urbanized areas of Pekanbaru. The increase of surface temperature leads to the increasing of air temperature and a decrease in comfort. This condition is caused by increasing built-up areas and declining green open space.

Research exists with the aim to identify the phenomena of Heat Island in Pekanbaru by using the satellite image data to measure the distribution of surface temperature. The results show that surface temperatures in urbanized areas such as residential, office, road and bare land are higher than the surface temperature in green open space areas. This condition indicates that the phenomena of Heat Island occur in Pekanbaru. Furthermore, the green open space should be built to decrease air temperature and create a comfortable micro-climate. Green open space should be developed at locations with high air temperature to reach its efficiency.

1.8 Disaster Risks

Pekanbaru is vulnerable to flood and inundation in several city areas. Flood is mostly caused by the high intensity of rainfall and insufficient drainage capacity to accommodate the overflow of water. The overcapacity of Siak River also causes floods in the riverbanks of Siak River on Rumbai Pesisir, Tenayan Raya and Payung Sekaki.

In 2016, there were 4 (four) subdistricts affected by flooding and inundation, namely Tampan District covering 10ha, Bukit Raya District covering 31.5ha, Rumbai Pesisir District covering 21.5ha and Rumbai District covering 3.45ha. Flooding and inundation are caused by the overflow of Siak River and heavy rainfall. The inundation varies in terms of height (0.3-1 metre), the area of inundation (0.5 to 7ha), duration (1.5-48 hours) and frequency (3-15 times/year).

The flood occurred on June 23rd 2017, in the city centre. Heavy rainfall with long duration had caused flooding on several main roads, Terminal Area and in front of Grand Central Hotel. Flooding near Grand Central Hotel was above 50cm and made water overflow into

the hotel basement, resulting in 8 cars and 20 motorbike submerged in the basement. The total loss due to this flood is estimated to reach USD 571,428 (IDR 8 billion).

Figure 7. Flood-prone Area in Pekanbaru
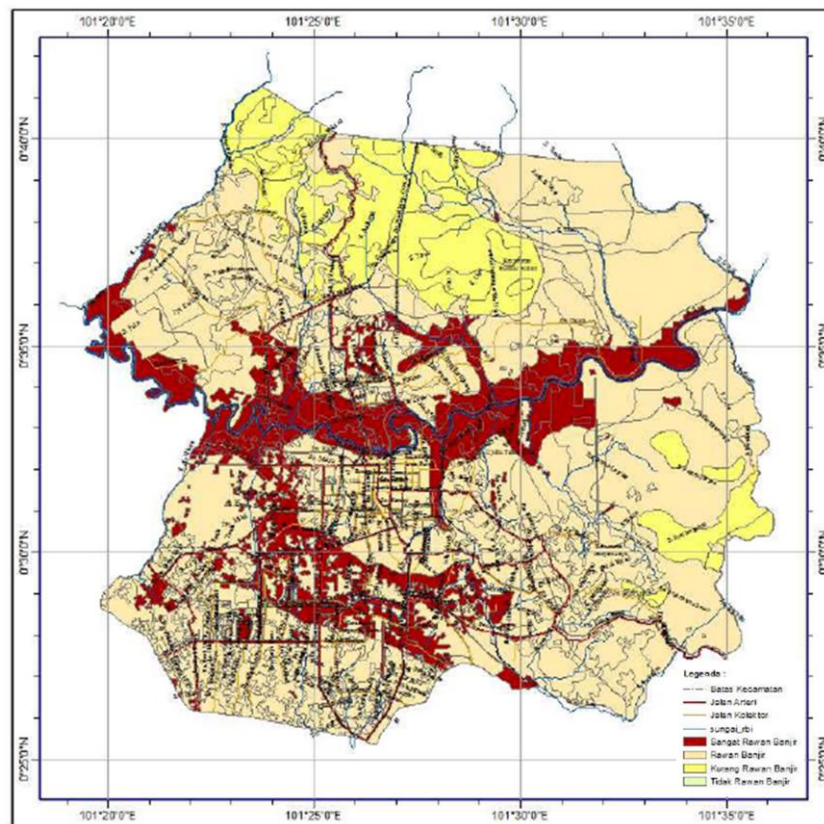
Source: Nurdin & Suprayogi, 2015

Pekanbaru is surrounded by areas prone to forest and land fires, which makes the city vulnerable to haze. In addition, Riau Province is a province with a large area of forest and burnt land on Sumatra Island. The direction of the wind that gives impact to the haze in Pekanbaru is certainly difficult to control. This condition further affects the increase of air pollution and impacts on community health with acute respiratory infections. The haze spreads to areas on the island of Sumatra and can also reach the territory of Malaysia and Singapore, as happened in 2015.

Forest and land fires have occurred in the western part of Pekanbaru, close to the border of Kampar District where the land was dominated by peat. In the dry season, this area is prone to burning and fires are difficult to extinguish. Therefore, it needs special attention to build canal blocks and drill wells to anticipate land fires that cause haze pollution.

Figure 8. Forest and Land Fires Area in Three Provinces on Sumatra Island (Ha)
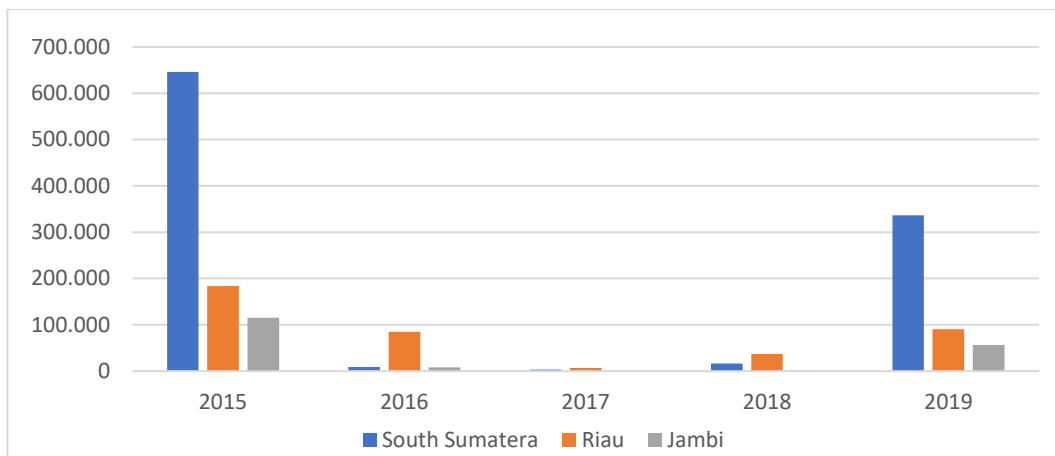
In the last five years, the highest intensity of forest and land fires occurred in 2015 with an area of 230.25ha and decreased dramatically to 49.78ha in 2016. The largest area of land fires occurred in Payung Sekaki and Tampan Districts. The last forest and land fires occurred in 2019 with an area of 225.50ha. There were 173 cases of forest and land fires including 42 cases in Payung Sekaki District, 42 cases in Bukit Raya District, 33 cases in Tampan District, 18 cases in Rumbai District, 18 cases in Marpoyan Damai District, and 14 cases in the District of Tenayan Raya (Bisnis.com, 2019).

Figure 9. Forest and Land Fires Hotspot in Riau Province 2015 and 2019
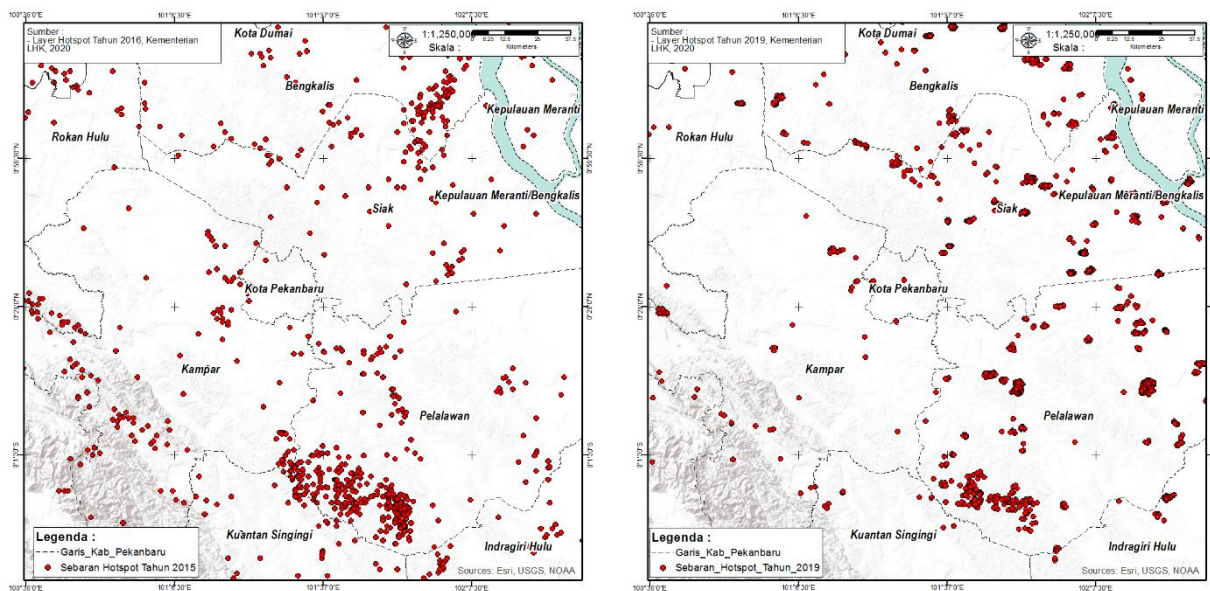
Source: Ministry of Environment and Forestry, 2016 and 2019

1.9 Climate Change Risk and Vulnerability

With regard to climate change vulnerability and risk assessment, the Ministry of Environment and Forestry has developed a Vulnerability Index Data Information System (SIDIK) which provides data and information on climate change vulnerability and risk at the provincial, district, city and village scales. SIDIK calculates a vulnerability index based on the sensitivity-exposure index and adaptive capacity index that use village potential data by CBS. This system also calculates the climate risk area which is divided into two kinds of climate related hazards that cover flood and drought. The climate risk is calculated based on the class of vulnerability and the chance of climate distortion (rainfall).

Based on the SIDIK's reports, there are 82 villages in Pekanbaru that have a moderate level of vulnerability, and only one village at a very low level of vulnerability, which is the Simpang Empat Village. Furthermore, the results of climate risk calculations show that there are 57 villages at a moderate level for flood risk and low level for drought risk. In the dry season, the western part of Pekanbaru is prone to land and forest fires, especially the villages nearby the border of Kampar Regency which is dominated by peatlands.

Figure 10. Indicative of Climate Risk in Pekanbaru

(a) Flood Risk   **(b) Drought Risk**
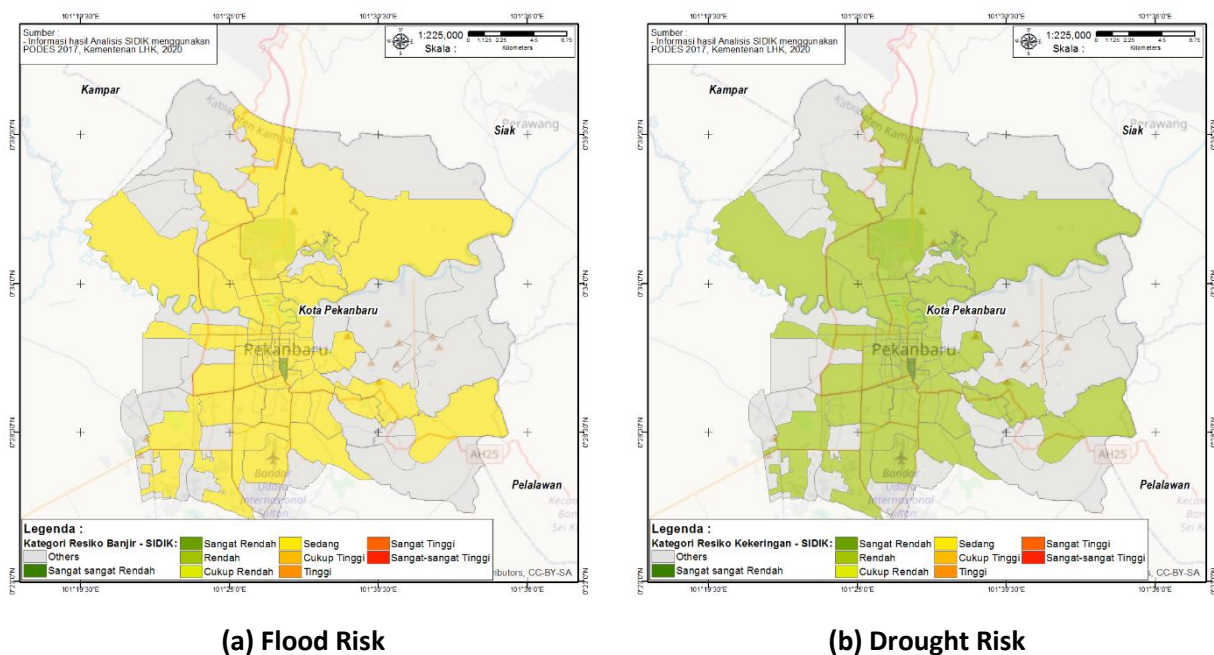
Source: SIDIK MoEF, 2020

Most of Pekanbaru area is indicated to be prone to floods. This is in accordance with the real conditions that flood events often occur in Pekanbaru, especially during high rainfall intensity. The results of climate vulnerability and risk assessment in SIDIK can be used in supporting development planning that is adaptive to climate change.

1.10 Urban Governance

1.10.1 Pekanbaru Government Structure

Pekanbaru Government is divided into two main elements. First, the executive element includes the Mayor, Vice Mayor and Local Government Agency (*Organisasi Perangkat Daerah*). The Mayor and Vice Mayor are in a political position which is directly elected by the citizen every five years. The Local Government Agency in Pekanbaru comprises of the Secretary of City, Inspectorate, 23 Local Agencies, 7 Local Boards, 12 Sub-Districts and 83 Urban Villages. The City Government could establish Locally Owned Entrepises (BUMD) to support the city economic development, particularly on the types of investment which are not yet attracted for private sector and public services obligation.

Second, the legislative element known as the Regional People's Representative Assembly (DPRD) is the people's representative institution and acts as the element of regional administration at the city level. DPRD comprises the members of political parties, which are elected through general election every five years. In the period of 2019 to 2024, the members of legislative (DPRD) in Pekanbaru are 45 people representing 9 political parties. The Chairman of DPRD is mostly coming from the winning political party and accompanied with three Vice-Chairman from other largely voted-for political parties. There exists a Secretariat of DPRD to provide administrative services to legislative members.

Figure 11. Pekanbaru Government Structure
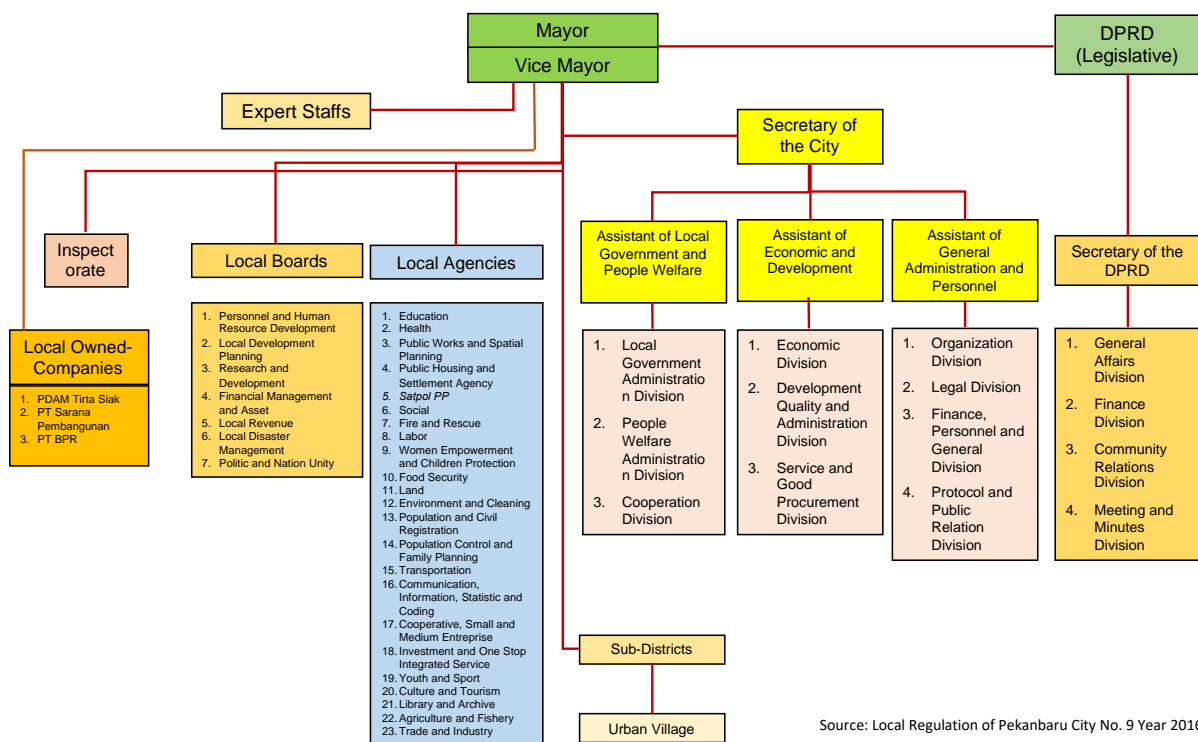
Source: Local Regulation of Pekanbaru City No. 9 Year 2016

1.10.2 Local Stakeholders in Pekanbaru

With regard to climate resilience and inclusiveness, local stakeholders in Pekanbaru comprise these categories: (1) Local Government Agencies; (2) Non-Government Organization (NGOs); (3) Academia; (4) Professional Association; and (5) Private Sector. The details of stakeholders' identification with their tasks and potential contributions can be seen in the following Table.

Table 7. Stakeholder Involvement in Climate Resilience and Inclusive Policy Making

Stakeholder	Tasks and responsibilities	Potential contributions to CRIC
I. Local Government Agency		
Local Development Planning Board (Bappeda)	Policy formulation, coordination of development planning and monitoring	Coordinating role in preparing Local Action Plan and mainstreaming Local Action Plan into the Medium Term Development Plan (RPJMD)
Local Disasater Management Board (BPBD)	Policy formulation, coordination of disaster management and monitoring	Implement disaster risk reduction activities including community awareness and Early Warning System
Cleaning and Environmental Agency	Develop and implement policies and programmes on environmental issues, i.e air pollution, waste and solid waste management	Coordinating role in preparing Local Action Plan and implement activities on air pollution, waste and SWM
Settlement and Public Housing Agency	Develop and implement policies and programmes on water and sanitation, livable house and slums	Implement activities on water, sanitation, housing and slums and integrate with ongoing project
Spatial Planning and Public Works Agency	Develop and implement policies and programmes on spatial plan and open green space	Mainstreaming Local Action Plan into the Spatial Plan (RTRW) and implement activities on open green space and spatial plan controlling
Transportation Agency	Develop and implement policies and programmes on transport and urban mobility	Formulate and implement sound environmental programmes to improve transport and urban mobility
Agriculture and Fishery Agency	Develop and implement policies and programmes on agriculture and fishery sector	Implement sustainable urban agriculture and aqua farming program and mainstreaming urban agriculture as strategy for city resilience
Food Security Agency	Develop and implement policies and programmes on food security	Implement urban food security and promoting urban food system in relation to urban sustainability
Health Agency	Develop and implement policies and programmes on health	Implement health related programs and environmental health
II. Non Government Organisations (NGOs)		

Stakeholder	Tasks and responsibilities	Potential contributions to CRIC
Wahana Lingkungan Hidup Indonesia (Walhi)	Advocacy on environmental issues	Campaign and policy advocacy
Youth For Climate Change (YFCC) Riau	Advocacy on environmental issues	Campaign and policy advocacy
World Wild Fund (WWF) Riau	Advocacy on environmental issues	Campaign and policy advocacy
Jikalahari	Advocacy on environmental issues	Campaign and policy advocacy
III. University		
Environmental Study Center (PSLH), University of Riau	Learning and education; research and development and community services	Technical support to formulate Local Action Plan and community services on climate resilience
Community Service and Research Institute (LPPM), Islamic University of Riau	Learning and education; research and development and community services	Technical support to formulate Local Action Plan and community services on climate resilience
IV. Professional Association		
Indonesia Association of Planner (IAP) Riau Province	Advisory services on city planning and environmental issues	Technical support to formulate Local Action Plan
V. Private Sector		
Chamber of Commerce (KADIN) Riau	Implement programmes on social and environmental	Engages in campaigns for environmental improvements and conducts several environmental improvement activities
Apindo Pekanbaru	Implement programmes on social and environmental	Engages in campaigns for environmental improvements and conducts several environmental improvement activities
DPD REI Provinsi Riau	Implement programmes on social and environmental	Engages in campaigns for environmental improvements and conducts several environmental improvement activities

Source: Analysis, 2020

CHAPTER 2
Policies and Strategies for a
Climate Resilient and Inclusive City

2.1 National Development Policies

The Government of Indonesia has committed to addressing climate change. In 2015, Indonesia submitted its post-2020 climate pledges to the UNFCCC known as Intended by the Nationally Determined Contributions (INDC). Since then, it has signed and ratified the Paris Agreement and later formally submitted its first Nationally Determined Contribution (NDC) in 2016 reiterating its commitment to a low carbon, climate-resilient future. In its NDC, Indonesia committed to reducing unconditionally GHG emissions by 29% against a 2030 business-as-usual (BAU) scenario and GHG emissions by up to 41% below the 2030 BAU level, subject to international assistance for finance, technology transfer, and capacity building. To achieve these targets, the Government of Indonesia has identified and implemented climate change policies and actions particularly on these priority sectors on mitigation: energy; industrial processes and product use; agriculture; land use, land use change and forestry including forest fires and waste.

In addition, Indonesia NDCs also pointed out the framework of climate change adaptation focusing on improving economic, social and livelihood resilience as well as ecosystems and landscapes with priority in the affected sectors of food, water and energy. (Indonesia NDC, 2017). Indonesia's medium term goal of climate change adaptation strategy is to reduce risks to all sectors of development (agriculture, water, energy security, forestry, marine and fisheries, health, public services, infrastructure and urban systems) by 2030 through strengthening local capacity, knowledge management, the convergence of climate change adaptation and disaster risk reduction (API-PRB) policies as well as the adoption of adaptive technologies.

Prior to the 2015 Paris Agreement, the Government of Indonesia has enacted policies and programs to combat climate change by committing to reduction goals, setting domestic sectoral targets, and passing legislation and regulations. Presidential Regulation of the Republic of Indonesia No. 61 Year 2011 on The National Action Plan for Greenhouse Gas Emissions Reductions (RAN-GRK) was enacted to establish the national emissions reduction target of 26% below BAU by 2020, with a further reduction of up to 41% below BAU with adequate international support. The RAN-GRK provides the basis for the implementation of various mitigation actions in forestry, agriculture, energy, transport, industry, and waste sectors. It reshapes Indonesia's commitments in its INDC and NDC submissions.

With regard to adaptation efforts, the Ministry of National Development Planning (Bappenas) was prepared the National Action Plan on Climate Change Adaptation (RAN-API) in 2014. This plan is designed to contribute to the RPJMN 2015-2019 (National Medium Term Development Plan). Adaptation strategy and actions have become part of a cross-sectoral program. The RAN-API strengthens endeavours on mitigation that have been formulated in the RAN-GRK.

The Government of Indonesia continues to mainstream climate change mitigation and adaptation into the National Medium-Term Development Plan 2020-2024. It envisions an economy that is socially inclusive and environmentally sustainable and emphasizes seven development priorities; one of them is the environment, disaster and climate change resilience. This priority agenda elaborates into 3 Priority Programs (PPs), namely PP-1 on Improving Environment Quality, PP-2 on Enhancing Disaster and Climate Resilience and PP-3 on Low Carbon Development. Each of the priority programs derived into several Priority Activities in related development sectors.

Since 2014, the Ministry of Environment and Forestry (MoEF) plays a significant role in leading the climate change agenda with the establishment of the Directorate General of Climate Change Controlling. Their main functions are related to mitigation, adaptation, reducing Green House Gases, resource mobilisation, GHG inventory, monitoring, reporting and verification of mitigation efforts and controlling land and forest fires. Some initiatives on climate change information systems have been developed as tools for controlling climate change and among others are: Information System on the Data of Vulnerability Index (SIDIK), Land and Forest Fires Monitoring System, Climate Change Knowledge Centre, Inventory System of National GHG, Information System on National Safeguard REDD+ and National Registry System on Climate Change Controlling.

The Ministry of Environment and Forestry is also supporting the implementation of various mitigation and adaptation efforts at the provincial and the city/regency levels, among others. The measures are: Climate Fields School to support the resilience in the agriculture sector, Climate Village Program *(Program Kampung Iklim)* to strengthen community resilience and other jointly-initiatives with sectoral ministries. In addition, to support the implementation of GHG reduction and climate resilience efforts, the Government of Indonesia has newly launched an Environmental Fund Management Agency (BPDLH). It is a public service agency that can receive and manage both state and non-state funds coming from domestic and international sources for climate change management.

Resilience to disaster and climate change risks is critical for achieving the Sustainable Development Goals (SDGs). Integrating climate adaptation and mitigation within SDGs can be beneficial for building resilience. The coherence of action to implement those frameworks can save money and time, enhance efficiency, and further enable adaptation action. The Government of Indonesia has committed to successfully implement the Sustainable Development Goals by achieving the 2030 development agenda. The Presidential Decree No. 59 Year 2017 on the Implementation of SDGs in Indonesia was issued to provide the Roadmap of SDGs Indonesia.

2.2 Sector-Specific Policies

Integrating climate resilience at the sectoral level is important because the response options are highly-sector specific. Sectoral Ministries, therefore, need to assess the risks of climate change and undertake necessary measures in their respective sectors. Recent legislation, decrees, and government regulations relevant to achieving climate commitment and sectoral targets are listed and explained in this section. These policies show a significant effort to create an integrated approach to addressing climate change issues and inclusiveness in Indonesia but have generally focused on the needs of specific sectors. Most policy documents have addressed climate change mitigation and adaptation according to

the needs of specific sectors including: Disaster Risk Reduction; Climate Change Adaptation and Mitigation, Energy and Transport, Water and Sanitation, Solid Waste Management, Sustainable Use of Resources etc.

Table 8. Sector Specific Policies, Plans and Programs Related to Climate Resilience

Sector	Main Policies and Plans	Flagship Programs
Air Pollution	Government Regulation No. 41 Year 1999 on Air Pollution Control Minister of Environment Regulation No. 12 Year 2010 on The Implementation of Air Pollution Control	Program Langit Biru (Blue Sky Program)
Water Pollution	Law No. 32 Year 2009 on Environment Government Regulation No. 82 Year 2001 on Water Quality Management and Water Pollution Control	The Company's Performance Rating (PROPER)
Water Supply	Law No. 17 Year 2019 on Water Resources Government Regulation No. 121 Year 2015 on Water Resource Exploitation Government Regulation No. 122 Year 2015 on Water Supply Provision System	Regional Water Supply Provision System (SPAM) Community Based Water Supply (PAMSIMAS)
Wastewater	Presidential Regulation No. 185 Year 2014 on The Acceleration of Water Supply and Sanitation Provision	Community Based Sanitation (SANIMAS)
Solid Waste Management	Law No. 18 Year 2008 on Solid Waste Management Government Regulation No. 74 Year 2001 on The Management of Toxic and Hazardous Materials Government Regulation No. 81 Year 2012 on The Management of Household Solid Waste and Other Related Household Solid Waste Presidential Regulation No. 97 Year 2017 on National Policy and Strategy on Solid Waste Management Government Regulation No. 27 Year 2020 on Specific Solid Waste Management	Clean City Program (ADIPURA)
Slum Settlement	Law No. 1 Year 2011 on Housing and Settlement Government Regulation No. 14 Year 2016 on The Management of Housing and Settlement Area	Cities Without Slums (KOTAKU)
Energy	Law No. 30 Year 2007 on Energy Government Regulation No. 79 Year 2014 on National Energy Policy President Regulation No. 22 year 2017 on National Energy Planning (RUEN) President Regulation No. 35 Year 2018 on The Acceleration of Waste Processing Plant for Environmental Based Technology Electricity Energy	Energy Efficiency Reward Initiative on New and Renewable Energy
Transportation	Law No. 22 of 2009 on Traffic and Road-Based Transportation Law No. 38 Year 2008 on Road Government Regulation No. 17 Year 2017 on Traffic and Road Transportation Safety	Bus Rapid Transit Environmentally Sustainable Transport

Sector	Main Policies and Plans	Flagship Programs
Disaster management	Law No. 24 Year 2007 on Disaster Management Government Regulation No. 21 Year 2008 on The Arrangement of Disaster Management	Indonesia All Hazard Warning Risk Evaluation (InaWARE) Disaster Resilience Village (Desa Tangguh Bencana)
Climate Adaptation	Law No. 32 Year 2009 on Environment Government Regulation No. 46 Year 2017 on Environment Economic Instruments Minister of Environment and Forestry Regulation No. P.7/Menlhk/Setjen/Kum.1/2/ 2018 on The Guidelines of The Assessment of Climate Impacts, Risks and Vulnerabilities Minister of Environment and Forestry Regulation No. P.33/Menlhk/Setjen/Kum.1/3/ 2016 on The Formulation of Climate Adaptation Action Minister of Environment and Forestry Regulation No. P.84/Menlhk/Setjen/Kum.1/11/ 2016 on Climate Village Program	Information System on the Data of Vulnerability Index (SIDIK) Climate Village Program (Program Kampung Iklim) Climate Fields School
GHG Inventory	Minister of Environment and Forestry Regulation No. P.73/Menlhk/Setjen/Kum.1/12/ 2017 on The Guidelines for Implementation and Reporting on GHG Inventory	Inventory System of National GHG
Financing	Presidential Decree No. 77 Year 2018 on Environment Fund Management	Environmental Fund Management Agency (BPDLH)

Source: Analysis, 2020

2.3 Local Policies, Plans and Programs in Pekanbaru

Local government plays an important role in addressing climate change issues within the city, and the provincial government is critical in fostering vertical coordination between local authorities and the central government. The issue of coordination across the different levels of government is one of the main challenges in planning and implementing climate change policies in Indonesia. This is largely because of the decentralised political structure and system of governance. The implementation of climate change policies does not depend on only one ministry/government agency, but involves various sectors across all levels of government, the private sector, and the public at large.

Pekanbaru has formulated the Long Term Development Planning 2025 enacted into Local Regulation No. 1 Year 2011 on Long-term Development Plan of Pekanbaru 2005-2025. It envisions the city as the centres for trade and service and education as well as the Melayu's cultural centre toward the achievement of people's welfare based on faith and religion. This plan elaborates into a Medium Term Development Plan (RPJMD) following the political election every five years.

The current Medium Term Development Plan 2017-2022 was enacted by Local Regulation No. 7 Year 2017 on The Medium-term Development Plan of Pekanbaru 2017-2022. The plan is the fourth stage of Long-term Development Plan of Pekanbaru 2005-2025 that envisions to achieve Pekanbaru as Smart City Madani, a civilized and modern city. This vision elaborated into six main missions which are:

1. Smart People includes mentality, physical, competency, morality and culture.

2. Smart Economy includes business actor, qualified good/service product, enabling investment.

3. Smart Environment includes quality of the environment, environmental management and smart building.

4. Smart Government includes smart apparatus, working culture and working system.

5. Smart Living includes quality of settlement, utility, security, society and social facilities.

6. Smart Mobility includes smart transport mode, qualified infrastructure and transport system.

Detail policies, plans and program related to climate resilience in Pekanbaru can be seen in the following table.

Table 9 : Local Policies, Plans and Programs in Pekanbaru

Sector	Main Policy and Regulation	Plan and Program
Air Pollution	Local Regulation No. 10 Year 2017 on The Arrangement of Transportation	Vehicle Emission Test Greenhouse Gas Emissions Inventory Report (2014 and 2017)
Water Pollution	Local Regulation No. 10 Year 2006 on Water Resource and Absorption Wells	Prokasih (Clean River Program)
Water Supply	Local Regulation No. 9 Year 2019 on Management and Development of Drinking Water Provision System in Pekanbaru	Masterplan of Water Supply Provision System (RISPAM), 2015 Public Private Partnership on Regional Water Supply Project (KPBU SPAM Kota Pekanbaru)
Wastewater	Local Regulation No. 13 Year 2016 on Slum Prevention and Quality Improvement	City Sanitation Strategy (SSK) 2018 Community-Based Wastewater treatment plant and City-Wide Waste Water Treatment Projct funded by Ministry of Housing and Public Works and Asian Development Bank (ADB).
Solid waste management	Local Regulation No. 8 of 2014 on Solid Waste Management Mayor Regulation No. 154 Year 2018 on Policies and Strategies of SWM	Regional Waste Management Policy and Strategy in Pekanbaru 2018-2025 GIZ NEXUS Program on The Pre-liminary Feasibility Study of implementing the Sustainable Sanitary Landfill to Energy System (SSLTES)

Sector	Main Policy and Regulation	Plan and Program
		Daehan Consortium Kore Processing Waste to solid refused fuel (SRF)
Green Open Space	Local Regulation on Spatial Planning	Partnership among City Government, Universities and Communities
Slum Settlement	Local Regulation No. 13 Year 2016 on Slum Prevention and Quality Improvement Local Regulation No. 1 Year 2015 on The Management of Flat Housing	Slum Prevention and Quality Improvement Plan (RP2KPKP) National Flagship Program on Cities Without Slums (KOTAKU)
Transport	Local Regulation No. 10 Year 2017 on The Arrangement of Transportation	Trans Metro Pekanbaru Development Monorail Development
Disaster management	Local Regulation No. 6 Year 2017 on The Establishment of Local Disaster Management Board (BPBD) Local Regulation No. 7 Year 2017 on Medium-term Development Plan of Pekanbaru 2017-2021	Program Kampung Iklim (Climate Village Program)

Source: Analysis, 2020

CHAPTER 3
Key Problems, Challenges
and Opportunities in Priority Sectors

3.1 Climate Adaptation and Disaster Risks Reduction

As explained in the previous section, Pekanbaru is prone to flooding and inundation during the rainy season and prone to haze and forest/land fires during the dry season. Those are known as hydrometeorological hazards, which are caused by extreme meteorological and climate events.

The frequency of flooding is increased due to the extreme climate event, including heavy rainfalls with long durations. This condition is exacerbated by the inadequate drainage capacity. The overflow of Siak River has affected flooding in the banks areas including in Rumbai Pesisir, Tenayan Raya and Payung Sekaki. Flooding and inundation are caused by several factors which among others are: high intensity rainfall, loss of catchment area, inadequate drainage system, morphology of the city as flood plain and land use changes. Pekanbaru is naturally located in floodplains and swampy land along the Siak River and Kampar River. Many swampy land areas are stockpiled for settlements without adequate drainage. These built up settlements became prone to flood and inundated areas.

Pekanbaru is also vulnerable to haze due to forest and land fires from surrounding regencies and other provinces including South Sumatera and Jambi. Pekanbaru is located in a lowland area which is highly exposed to haze from forest and land fires. Forest and land fires mostly occur during long dry seasons which are also affected by El Niño phenomenon, as occurred in 2015 and 2019. Response to address forest and land fires should be coordinated both horizontally with surrounding regencies and vertically with provincial and central government. Since forest and land fires became an international issue, the Ministry of Environment and Foresty has established a Taskforce to mitigate and undertake emergency response to deal with forest and land fires. The Military and Regional Police are Taskforce members to support on law enforcement.

With regard to disaster management, the municipal government has established a Local Disaster Management Board (BPBD) which has responsibilities to implement policies and measures in disaster preparedness, emergency responses and post-disaster management. The establishment of BPBD was enacted through Local Regulation No. 6 Year 2017 on Establishment of Local Disaster Management Board (BPBD). Since disaster management involves many sectors and actors, the effectiveness of disaster management also relies on the collaboration with other agencies and with the local stakeholders.

The municipal government has carried out several structural and non-structural measures to address flooding and inundation. In 2019, there were 39 flooding areas identified by the Public

Work Agency in Pekanbaru (DPUPR, 2019). Structural measures have been done by improving drainage systems and river capacity as short-term efforts to address flooding. In the long-term, the Masterplan of Flood and Drainage System should be prepared as a comprehensive approach to address flooding as well as the impacts of uncontrolled urban development. Non-structural measures have been implemented by empowering community awareness and preparedness to flood disasters, law enforcement with regard to maintain catchment areas, water retention and green open spaces.

With regard to forest and land fires, Pekanbaru city government has provided emergency response actions, such as evacuating vulnerable groups to evacuation halls and sports stadiums, but the emergency response does not adhere to health protection standards. The rooms and halls are not equipped with air conditioners and ventilation for good airflow, and the victims are not provided with N95 masks. In addition, the budget allocated for the management of forest fires on public health is still far from adequate. Such a response will only deteriorate the health of women, especially pregnant mothers, and children.

Monitoring of air quality through AQMS (Air Quality Monitoring System) has been done to monitor real time data on air quality. The results of air quality monitoring are displayed to the public, which can be used as early warnings if the air quality reaches dangerous levels. The AQMS was established in 1998, which is already more than 20 years ago and should be renewed. Beside the AQMS, Pekanbaru has also conducted the GHG Inventory measuring only several sectors excluding industry sector. The GHG inventory should be conducted regularly

covering all emissions sector and involve other sectoral agencies.

At the community level, Pekanbaru Government supports the implementation of Climate Village Program (Kampung IKLIM) which has been initiated by the Ministry of Environment and Forestry to increase community involvement in strengthening adaptive capacity to the impacts of climate change and GHG reduction. One village in Pekanbaru is now under evaluation by the Ministry to be nominated for the award of Climate Village Program.

Although Pekanbaru Government does not have a specific policy to combat climate change, on the one hand, addressing environmental problems has become one of the aspects considered in local development policies (Medium-term Development Plan/ RPJMD). On the other hand, the vulnerability, risk and impact assessment of climate change, including the impacts of forest and land fires are not yet available. Likewise, the geospatial map of disaster prone areas is also not available. In order to increase the city's resilience to climate change, the municipal government should conduct several activities to map the climate-related disaster prone areas, the vulnerability, risk and impact assessment of climate change and strengthening the GHG inventory and monitoring system.

3.2 Access to Drinking Water

The key issue on water supply is the low quantity and quality of water supply provided by the Pekanbaru Government through its local water company (PDAM Tirta Siak). With a population of more than 1 million and assuming per capita water standard is around 100 liter per day, it is estimated the water supply need is about

100 million litres per day. The quantity of water provided by PDAM Tirta Siak is only 2,165 million m² which is about 6% of water supply. The piped water quality is still a problem due to its continuity and turbidity of water. Most households and industries still rely on clean water from shallow bore wells and groundwater without ever measuring water quality.

In Pekanbaru, there are two local regulations related to water supply provisions which are: the local Regulation No. 9 Year 2019 on Management and Development SPAM and the local Regulation No. 10 Year 2006 on Water Resources and Retention Wells. These regulations provide legal framework for piped and non-piped water supply provision systems and the utilization of water resources and groundwater extraction. The Masterplan of Water Supply Provision System (RISPAM) was prepared in 2015, outlining the current need and condition of water supply and alternative scenario and program development of water supply provision in Pekanbaru.

Currently, two on-going projects on water supply provision are already developed. First, the B to B partnership on water supply provision serves 3 sub-districts in Pekanbaru and Kampar with the capacity of 1,000 litre/second. It is under the cooperation of Pekanbaru and Kampar Regency facilitated by Provincial Regional-Owned Enterprise (BUMD) and private investor. Second, the Public and Private Partnership (PPP/ KPBU) for Regional Water Supply Provision serve Pekanbaru and surrounding areas with the capacity of 750 litres/second and 61,000 house connections. It is now in procurement process funded through the national budget. Regarding the institutional arrangement, the drafting of local regulation on the changing business entity of local-owned water company (PDAM) is

on-going process as required by Government Regulation No. 54 Year 2017 on Locally Owned Enterprise.

The provision of piped water supply is facing some obstacles including the continuity of water sources, the quality of water source, affordability of community, non water revenue (NRW) or water leakage and lack of investment capacity. Access to pipe water supply is less than 7% and needs to be increased with the growing demand due to population growth. Due to limited piped water access, groundwater is still dominantly used as water sources for household, industries and others without any quality measurement.

Pekanbaru Government should accelerate infrastructure investment in water supply provision and improve the performance of the locally owned water company to expand the piped water network and more efficient in doing business. Since the dependency on groundwater is still high, the city government should put more attention on how to control groundwater extraction and its water quality to maintain water balance.

Partnerships with central government is also needed to access more alternative financial sources. The central government supports inter-municipal cooperation on regional water supply provision system (SPAM Regional). For those areas which have difficulties to connect with piped drinking system, the government support the development of community based water suppy provision (PAMSIMAS).

3.3 Sanitation and Domestic Wastewater

The coverage of sanitation is still limited to achieve the target of universal access. Sanitation planning is partial and sectoral,

poorly integrated with wastewater, solid waste and drainage. A centralized wastewater system is not yet developed and is heavily reliant on decentralized wastewater systems including individual toilet and septic tank. Lack of a wastewater management system has caused water pollution both at surface water and groundwater sources.

Siak River is the main source of surface water in Pekanbaru and has a vital function for raw water source for piped drinking water, industrial process, fishery, recreation etc. The results of monitoring and analysis of water quality in 5 points along Siak River showed that there are some water parameters that haven't fulfilled the quality standards (class III). Likewise, the water quality monitoring in 11 tributaries of Siak River showed that some water parameters do not fulfill the quality standard (Class II).

Water pollution in Siak River is caused by the discharge of wastewater from several activities including domestic wastewater discharge, open defecation, industrial wastewater and dense settlement areas. Deterioration of the water quality in Siak River is also caused by the discharge of domestic water and solid waste as well as hazardous waste disposal in the river from transportation, health facilities and tourism activities. Polluted water will cause several water-borne diseases and affected the community health.

The municipal government has conducted several efforts to control river and water pollution. The water quality measurement system in Siak River was established since long time ago and should be renewed. City Sanitation Strategy (SSK) has been formulated in 2018 as a guide to achieve universal sanitation access. Wastewater treatment is a key aspect in improving the slum settlement quality as stipulated through Local Regulation No. 13 Year 2016 on Prevention and Quality Improvement of Settlement Environment.

Currently, the municipal government under the MSMIP ADB and MPOPH is in the process of constructing city-wide wastewater treatment systems (IPAL) with the capacity of 8,100 m³/day and piped network to connect 11,000 household connections. The IPAL will serve and benefit 55,000 people. The land for the IPAL location has been acquired.

Since the city-wide wastewater treatment is still limited, Pekanbaru Government should continuously support and expand the decentralized wastewater system, including a communal IPAL and domestic wastewater treatment plant. The acceleration of wastewater infrastructure investment is needed, along with the formulation of local regulation on wastewater and sanitation management.

3.4 Solid Waste Management

The increasing population puts pressure on the environment and the daily waste generated. Pekanbaru had 1.11 million people in 2018 and generated daily waste around 1,106 tons. Almost 73% of generated waste is transported into a final landfill site (807 tons per day).

Solid waste management in Pekanbaru is divided into two approaches. First, waste reduction is carried out through composting in 5 locations with a total of 2.1 tons per day, recycling with a total of 1.1 ton per day and waste banks in 3 location with a total of 1.5 tons per day. Second, the processing in the final landfill site is located in TPA Muara Fajar 1 and 2 with a total land area of 8.6ha and 4.95ha, respectively. There is also specific hazardous waste produced by hospitals and industries that should be separately

treated from households waste. The total amount of solid hazardous waste is 2.2 tons per month, and liquid hazardous waste is 0.44 tons per month.

Waste treatment facilities are limited with a lifetime of fewer than 5 years, and the existing landfills are still open to dumping. Regional landfill has not been realized even though there has been a location designation in the Kampar area. The municipal government is implementing a pilot project for processing solid waste to solid reused fuel (SRF).

The challenges of solid waste management in Pekanbaru include the rapid urban population growth, which affected the increase of waste generated, as well as the limited temporary disposal sites (TPS) and lack of community awareness and participation on waste reduction.

Pekanbaru Government has issued the policies and strategies in solid waste management through Local Regulation Number 8 Year 2014 on Solid Waste Management and Mayor Regulation Number 154 Year 2018 on Policy and Strategy in Management of Household Waste and Household Trash.

Pekanbaru Government has made several efforts to deal with the waste management problems. Due to the limitations of the fleet in the transportation of waste, Pekanbaru Government has been working with the private sector since 2018. The scope of the waste transportation area is divided into three management zones, namely one zone managed by the Environment and Hygiene Agency of Pekanbaru and two zones managed by the private sector with different companies. In addition, the city also continues to optimize waste processing with the 3R (Reuse, Reduce, and Recycle) through compost houses, recycling activities and waste banks.

The role of the community in waste management has been carried out in several places with the establishment of a waste bank in an effort to reduce landfill waste then recycle waste. In addition, in several housing locations, a composter box is placed, which functions as a composting process in a residential environment. Pekanbaru Government has conducted various socialization and coaching initiatives to increase community participation in waste management and ensure that these activities will be sustainable. Strengthening the efforts by city government and community is important to maintain the performance of solid waste management in Pekanbaru.

3.5 Air Pollution Control

The conditions of air quality in Pekanbaru have been regularly monitored by Air Quality Monitoring System (AQMS) in three fixed stations within one year. The results of monitoring showed that the concentrations of air parameters are still under the ambient standard. The number of days with a good condition of air quality reached 313 or 85.75% in 2017. While the dominant parameter of air quality is the PM10 in the period 2013-2017. The PM_{10} parameter represents dust particles coming from haze and diesel fuel emissions. The conditions of air quality affected the rising of air temperature, the quality of rainwater and increasing acute respiratory diseases (ISPA).

The air pollution in Pekanbaru is unavoidable due to the haze from forest and land fires, as occurred in 2015 and 2019. In the last 18 years, forest fires have occurred almost every year in Pekanbaru, resulting in haze and smoke and polluting the whole city. The status of the haze is highly polluted with the Air Pollution

Standard Index (ISPU) hitting more than 400. It is a hazardous level for human life, especially for vulnerable groups such as women and children.

Forest and land fires have increased the number of unhealthy and dangerous days which reached 61 in 2015. During this period, the concentration of particulate matter (PM_{10}) in the air had risen and was considered unhealthy, as it had exceeded 150 micrograms per cubic meter. The visibility rate dropped to 2km and make difficulties for aircraft landings.

Research shows that intensive exposure to the haze creates a risk of pneumonia and lung cancer, of which the symptoms will only be apparent in 10 or 15 years. Thus, the thousands of women and children exposed to the haze with worrying levels of ISPU are more vulnerable to these diseases in the future, a costly price which may very well happen if the government does not immediately take more comprehensive and coordinated steps in handling the impacts of haze in line with the health protection standards.

The conditions of air quality in Pekanbaru are highly related to the increasing activities of emission sectors including transport, waste, industrial process, energy consumption and animal farms. The increasing number of motorized vehicles will increase the risks of air pollution due to gas emissions from burning fuels. In addition, the road network condition is also contributing to the increase in gas emissions from vehicles. Controlling air quality should be integrated with the efforts to implement low carbon development in the above emission sectors.

Pekanbaru Government has carried out several efforts on monitoring and managing the air quality, which among others are: [1] conduct regular monitoring on air quality both using the AQMS for

mobile emission source and passive sampler in locations representing transport, industry, housing and office areas; [2] conduct air quality monitoring in the basement of Mall and emission test in industrial areas; [3] vehicle emission test for private cars by DLHK and freight transport by Dishub; [4] performance based measurement such as Proper, Kampung IKLIM, Adiwiyata; [5] promote car-free days and non-motorized vehicle and [5] Mass rapid transport.

3.6 Sustainable Use of Resources: Green Open Space, Micro Climate and Urban Agriculture

Rapid urban development has caused environmental changes and land use changes, especially the deterioration of green open space. These conditions have also contributed to the increase of surface temperature in urbanized and built-up areas which has led to an increase of air temperature in Pekanbaru. As mandated by law, the provision of green open space is a requirement to achieve, with the target of 20% of public open space and 10% of private open space. Currently, the public open space owned by the city government is only 8%, which is far below the target of 20% of public green open space.

The high air temperature in urban areas is caused by increasing built-up areas and declining green open space. Green open space should be provided to reduce air temperature and create a comfortable micro-climate. If possible, the provision of green open space should cover the locations with high air temperature to reach efficiency. Research on temperature trends shows that the city's temperature

has increased in the last 20 years. This is mainly related to land cover changes since 2000. It is predicted that the city's temperature slightly increases and will reach around 40°C. There is also heat from peatland under the earth's surface.

Pekanbaru Government has made several efforts to improve the micro-climate through greening, tree planting and the provision of green open space. The City Government should widely promote greening and tree planting initiatives to develop a cleaner and greener city. The provision of green open space should be continued through partnerships with the City Government, Universities, Private Developers and Communities. This effort could also be combined with urban

agriculture by utilising the abandoned land in Pekanbaru.

Urban agriculture can be an alternative strategy to increase food security and resilience. Pekanbaru has limited agricultural and horticultural land. The food crops production heavily relies on other regions such as West Sumatra, North Sumatra, Jambi, South Sumatra and Java (Leksono, R.B. *et al*., 2020). Pekanbaru has many abandoned and vacant lands in the city expansion area, which can be used for urban agriculture.

CHAPTER 4
Recommendations for Priority Sectors

This section briefly describes proposed recommendations for priority sectors with regard to climate resilience and inclusive city. These recommendations have been developed based on the analysis of priority sectors and existing policies, plans and programs on priority sectors. Types of recommendations are divided into three categories including: instrument and tools; policy, regulation and document; and capacity building.

4.1 Climate Adaptation and Disaster Risks Reduction

- Develop Early Warning System (EWS) for flooding during rainy season and forest and land fires hotspots nearby Pekanbaru during the dry season.

- Develop an integrated monitoring system to anticipate forest and land fires.

- Support the formulation of Environmental Management and Controlling Plan (RPPLH) in Pekanbaru in 2021 and then continue to proceed as Local Regulation on RPPLH in 2022.

- Facilitate and supervise the construction of biopore infiltration holes that are vertically drilled in the ground to prevent flooding and increase groundwater reserves, retention wells and retention ponds.

- Support policy formulation on emergency responses for forest and

land fires and health impacts due to haze.

- Technical capacity on the formulation of Environment Protection and Management Plan (RPPLH) about climate adaptation and mitigation, vulnerability, risk and impacts of climate change assessment.

- Technical capacity on the provision of geo-spatial data on climate change.

- Community preparedness especially for vulnerable groups and health standard prior to dry season.

4.2 Access to Drinking Water Supply

- Repairing of networks (JDU, JDP, JDS, SR)

- Customer reporting/complaint system

- Improved 3K in the piped water supply (PDAM)

- Reforming the Institutional of PDAM followed GR No. 54 Year 2017

- Water tariff restructuration

- Cost recovery water tariff (Local Regulation)

- Water tariff based on Classification and water consumption rate

- Controlling groundwater volume extraction and maintaining groundwater balance

- Finalization of Local Regulation on Local-Owned Company (Perumda) to

replace Local Regulation on PDAM Year 1997

- Applying clean water and drinking water fulfilling quality standard

- Improving the capacity of locally owned water companies in financial management and PPP scheme

- Increasing community and industrial awareness and capacity in controlling groundwater extraction

4.3 Sanitation, Wastewater and Surface Water Quality

- Provide real-time and online water quality monitoring system

- Develop the decentralised system of domestic wastewater treatment system

- Accelerate infrastructure investment on domestic wastewater treatment

- Finalization Local Regulation on Domestic Wastewater

- Community awareness on healthy and clean lifestyle (PHBS)

4.4 Air Pollution Control, Transportation and Energy

- Renewal/revitalization of AQMS station

- Develop pedestrian lanes equipped by green and environmental-friendly areas

- Policy/regulation on air pollution control and strengthening urban air quality standard

- Development of Bus Rapid Transit (BRT) and Mass Rapid Transit (MRT)

- Formulation of policy/regulation on energy efficiency and renewable energy

- Strengthening the capacity of community in Blue Sky Program through promoting Non-Motorized Vehicle (NMT)

- Capacity building on energy efficiency and renewable energy

4.5 Solid Waste Management

- Renewal/revitalizing

- Strengthening the management capacity of Waste Bank

- Training for the informal sector and waste cooperatives

- Technical training on waste to energy

- Strengthening the capacity of women group in waste management

  1. Collecting waste to Waste Bank

  2. Making Eco Enzyme

  3. Composting

  4. Biopore infiltration holes

  5. Liquid Organic Fertilizer (POC)

4.6 Sustainable Use of Resources

- Extend the area of green open space (RTH) through land acquisition for RTH

- Policy on the provision of 30% RTH and tree planting in government-office areas; university and housing estates

- Policy on the utilization of vacant land for urban agriculture

- Improving the capacity of community in urban agriculture

4.7 Greenhouse Gases Inventory

- Provide a standardized GHG emission measurement system

- Improving technical capacity on GHG emission inventory (across sector)

- Improving the capacity to utilize GHG inventory result for controlling emission and integrating into development planning

- Improving the capacity in analysing GHG emission reduction that could be controlled (especially caused by forest and land fire)

4.8 Financing

- Toolkit for investment prioritization

- Acceleration infrastructure investment on wastewater treatment

- Integrating planning and budgeting

- Improving technical capacity on investment proposal development

- Training on prioritization and Pre-Feasibility Study (FS)

Table 10 : Recommendations of Priority Sectors in Pekanbaru

Output CRIC	Sector	Policy/ Regulation/ Document	Program/ Activity	Gap Analysis	Approaches		
					Instrument and/or Tools	Policy/ Regulation/ Document	Capacity Building (CB)
Climate Resilience/ Early Warning System	Climate Adaptation and Disaster Risk Reduction	Local Regulation No. 6 Year 2017 on Establishment of Local Disaster Management Board (BPBD)	Monitoring of Air Quality through AQMS (Air Quality Monitoring System) Master Plan of Flood/ Inundation (2020) Climate Village Program (Program Kampung Iklim/ProKlim)	Vulnerability, Risk and Impact Assessment of Climate change (including the impacts of forest and land fires) is yet available. Map of Disaster Prone Areas is yet available. There is no policy and regulation related to disaster	Early Warning System for flooding (rainy season) and forest and land fires hotspots nearby Pekanbaru (dry season) Integrated monitoring system to anticipate forest and land fires	Formulation of Environment Management and Controlling Plan (RPPLH) in 2021 and Local Regulation on RPPLH in 2022 Facilitation and supervision on the construction of Biopore, retention wells and retention ponds Policy on emergency responses for forest and land fires and health impacts due to haze	Formulation of RPPLH with regard to climate adaptation and mitigation and Vulnerability, Risk and Impact to climate change Assessment. Provision of geo-spatial data on climate change Community preparedness especially for vulnerable group and health standard prior to dry season
	Access to Drinking Water	Master Plan of Water Supply Provision System (RISPAM) (2015) Local Regulation	Partnership on Water Supply Provision 1000 L/s Pekan Kampar with B to B (Provincial BUMD and Investor)	Access to piped water supply less than < 10% Hight Non Revenue Water (NRW), continuity of pipe water	Repairment of networks (JDU, JDP, JDS, SR) Customer reporting/complaint system	Water tariff restructuration Cost recovery water tariff (Local Regulation) Water tariff based on Classification and	Improving the capacity of local-owned water company in financial management and PPP scheme Increasing community and

Output CRIC	Sector	Policy/ Regulation/ Document	Program/ Activity	Gap Analysis	Approaches		
					Instrument and/or Tools	Policy/ Regulation/ Document	Capacity Building (CB)
		No. 9 Year 2019 on Management and Development SPAM Local Regulation No. 10 Year 2006 on Water Resources and Retention Wells	(financial closing) in 3 subdistricts Public Private Partnership (KPBU) on Water Supply Provision (SPAM) Pekanbaru (750 L/s and 61.000 SR (Procurement Process) Drafting Local Regulation on Local-Owned Company on Water Supply (Perumda) followed GR No. 54 Year 2017	supply service (PDAM) Groundwater extraction without water quality monitoring fulfilled quality standard	Improved 3K in piped water supply (PDAM) Reforming the Institutional of PDAM followed GR No. 54 Year 2017	water consumption rate Controlling groundwater volume extraction and maintaining groundwater balance Finalization of Local Regulation on Local-Owned Company (Perumda) to replace Local Regulation on PDAM Year 1997 Applying clean water and drinking water fulfilling quality standard	industrial awareness and capacity in controlling groundwater extraction
	Sanitation and Surface Water Quality	Local Regulation No. 13 Year 2016 on Prevention	Clean River Program Plan for Prevention and Settlement	Water quality of Siak river in Pekanbaru section is light to medium polluted	Provide real-time and online water quality monitoring system	Accelerate infrastructure investment on domestic wastewater treatment	Community awareness on healthy and clean lifestyle (PHBS)

Output CRIC	Sector	Policy/ Regulation/ Document	Program/ Activity	Gap Analysis	Approaches		
					Instrument and/or Tools	Policy/ Regulation/ Document	Capacity Building (CB)
		and Quality Improvement of Settlement Environment City Sanitation Strategy (SSK) 2018	Improvement Quality (RP2KP) City Without Slum Program (Kotaku) Wastewater Treatment System (SPAL) (2018-2020 funded by ADB and APBN) Construction of Wastewater Treatment Plant (IPAL) (end of 2020 contract signing) Land acquisition for IPAL Construction (13,2 Ha)	Communal IPAL is yet available Domestic wastewater infrastructure is not connected, only a few subdistricts	Develop the decentralised system of domestic wastewater treatment system	Finalization Local Regulation on Domestic Wastewater	
Air Pollution and Energy Efficiency	Air Pollution Control and Transportation	Local Regulation No. 10 Year 2017 on Transportation Arrangement	Vehicle emission test for individual transport (DLHK) Vehicle emission test for	Policy/regulation on air quality control is yet available AQMS station has 20 years old (1998)	Renewal/revitalization of AQMS station Develop pedestrian lanes equipped by green and environmental-friendly areas	Policy/regulation on air pollution control and strengthening urban air quality standard Development of Bus Rapid Transit (BRT)	Strengthening the capacity of community in Blue Sky Program through promoting Non-Motorized Vehicle (NMT)

Output CRIC	Sector	Policy/ Regulation/ Document	Program/ Activity	Gap Analysis	Approaches		
					Instrument and/or Tools	Policy/ Regulation/ Document	Capacity Building (CB)
			Logistic Transport (Dishub) Air Quality Monitoring (AQMS) Passive Sampler Monitoring Monitoring of Heavy Metal in air ambient Development of Mass Public Transport System/SAUM (Trans Metro) Pekanbaru Pedestrian and bicycle lanes Car Free Day Blue Sky Program Campaign			and Mass Rapid Transit (MRT)	
	Energy			Policy/regulation on energy efficiency is yet available		Formulation of policy/regulation on energy efficiency and renewable energy	Capacity building on energy efficiency and renewable energy

Output CRIC	Sector	Policy/ Regulation/ Document	Program/ Activity	Gap Analysis	Approaches		
					Instrument and/or Tools	Policy/ Regulation/ Document	Capacity Building (CB)
Waste Management	Solid Waste Management	Local Regulation No. 8 Year 2014 on Solid Waste Management Mayor Regulation No. 154 Year 2018 on Local Policy and Strategy on Solid Waste Management in Pekanbaru	Waste reduction at sources (3R, waste banks) Education on organic and non-organic waste Pilot Project on waste to Solid Refused Fuel (SRF) in cooperation with Sugan, Korea (since 2020)	Solid waste processing at FDS is still open dumping, limited controlled landfill Limited Final Disposal Site (FDS) lifetime	Renewal/revitalizing FDS		Strengthening the management capacity of Waste Bank Training for informal sector and waste cooperatives Technical training on waste to energy Strengthening the capacity of women group in waste management: Collecting waste to Waste Bank; Making Eco Enzyme; Composting; Biopore; Liquid Organic Fertilizer (POC)
Sustainable Use of Resources			Provision of Green Open Space (RTH) Urban Forest Movement	Limit green open space (RTH)	Extent the area of green open space (RTH) through land acquisition for RTH	Policy on the provision of 30% RTH and tree planting in government-office areas; university and housing estates Policy on the utilization of vacant	Improving the capacity of community in urban agriculture

Output CRIC	Sector	Policy/ Regulation/ Document	Program/ Activity	Gap Analysis	Approaches		
					Instrument and/or Tools	Policy/ Regulation/ Document	Capacity Building (CB)
			Greening and Tree Planting Movement			land for urban agriculture	
Green House Gases (GHG) Inventory	Inventory of GHG Emissions		GHG Emission Inventory Report (2014 and 2017)	GHG Inventory is yet regularly Trend analysis of GHG emission is yet available Lack of resource capacity and data sources from GHG emission analysis	Provide a standardized GHG emission measurement system		Improving technical capacity on GHG emission inventory (across the sector) Improving the capacity to utilize GHG inventory result for controlling emission and integrating into development planning Improving the capacity in analysing GHG emission reduction that could be controlled (especially caused by forest and land fire)
Financing	Financing	Financing scheme through PPP (KPBU)		Lack of technical capacity in investment proposal preparation	Toolkit for investment prioritization	Acceleration infrastructure investment on wastewater treatment	Improving technical capacity on investment proposal development

Output CRIC	Sector	Policy/ Regulation/ Document	Program/ Activity	Gap Analysis	Approaches		
					Instrument and/or Tools	Policy/ Regulation/ Document	Capacity Building (CB)
						Integrating planning and budgeting	Training on prioritization and Pre-FS

CHAPTER 5
Conclusion

As mentioned, this urban analysis report is aimed to develop a knowledge base in critical areas in Pekanbaru with regard to disaster risk management, climate change adaptation and mitigation, solid waste management, energy and transport and water and sanitation. It comprises the status, problems, challenges, and opportunities in each priority sectors. The report can be used as an initial scoping for the preparation of Local Action Plan (LAP).

The Local Action Plan in Pekanbaru can be used for prioritizing programs and activities and become an input in preparing technical drafts of the next Local Medium-Term Development Plan (RPJMD). It is important to established City Teams and engaging multi-stakeholders as well as designing collaborative processes in LAP preparation. The City Team needs to determine the Technical Team that will be the core team for LAP formulation.

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