論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Evaluation of the Integration of Climate Change Adaptation into Development Plan by Local Government in Indonesia
著者(和文)	YULANDARIEka Dyana
Author(English)	Eka Dyana Yulandari
出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第12570号, 授与年月日:2023年9月22日, 学位の種別:課程博士, 審査員:村山 武彦,阿部 直也,木内 豪,時松 宏治,錦澤 滋雄
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第12570号, Conferred date:2023/9/22, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	要約
Type(English)	Outline

Evaluation of the Integration of Climate Change Adaptation into Development Plan by Local Government in Indonesia

A Doctoral Dissertation

By

Eka Dyana Yulandari

Under the Guidance of

Professor Takehiko Murayama

Professor Shigeo Nishikizawa

Murayama and Nishikizawa Lab

Graduate Major of Global Engineering for Development, Environment and Society

Department of Transdisciplinary Science and Engineering

School of Environment and Society

Tokyo Institute of Technology

August 2023

Tokyo, Japan

ABSTRACT

Climate change is an inevitable global threat. Many climate change impacts and risks are unavoidable and will hit vulnerable people and populations the hardest, but adaptation could avert the worst outcome of it. Recent efforts of adaptation by the government are commonly scoped through an adaptation integration into the development plan. It is seen as an effective strategy to support vulnerable populations according to their needs and achieve development goals. Since 2014, the government of Indonesia has published its plan for climate change adaptation with the role of integrating and implementing given to the local government. The role of local government in adaptation planning is considered substantial because climate change emerges most tangibly in a local context. The local government, therefore, is considered the best place to provide adaptation support to vulnerable populations through context-based measures and strategies.

However, while the growing focus of local government on adaptation is encouraging, studies have reported that most local governments need help addressing climate change, especially adaptation. Because of long timescales and inherent uncertainties, adaptation to climate change support requires different strategies than those based on predictability and optimality. The challenge is especially true in local governments of developing countries where scientific information on current climate change and methods and tools to predict climate change is still inadequate.

It, therefore, raises a question of how the local government integrates adaptation into the development plan and whether it benefits the vulnerable population. To answer this question, this study has the following objectives: 1) assess how local government integrates adaptation into the development plan in Indonesia; 2) examine how adaptation integration by local government influence households' decision to adopt adaptation measure in Indonesia. To the best of our knowledge, this study represents a novel contribution that assesses adaptation planning considering the integration process, the implementation stage, and the outcome towards vulnerable populations.

For objective 1, this study assessed twenty development plans collected from Semarang City, Malang City, East Java Province, and West Nusa Tenggara Province. Data was collected using a text mining method with NVivo software. For objective 2, this study purposively chooses Pedalangan village, Podorejo village, and Tanjungmas village at Semarang City as a case study.

As many as 304 households were surveyed face-to-face, and statistical analysis with SPSS software was applied.

The result of Objective 1 demonstrated that adaptation to climate change has been addressed and considered essential measures in the development plans of local governments. Both the medium-term and annual development plans of four local governments in Indonesia include climate change adaptation-related information, vision, and objectives, and actions. The strong correlation between adaptation and climate change in the development plans suggests that adaptation is regarded as an essential measure by local governments, despite the general nature of this information. In addition, the local government's adaptation program focuses on interventions that enable adaptation but do not directly reduce vulnerability, such as socialization of climate change, socialization of adaptation, capacity-building training, coordination between stakeholders for adaptation integration, and the establishment of a climate village, in order to facilitate the adaptation of vulnerable populations to climate change. The analysis of the influence of adaptation programs to increase household adaptive capacity was then further analyzed for Objective 2.

In objective 2, the type of support provided to households through adaptation programs is evaluated, and its impact on household decisions to adopt adaptation measures. Through the adaptation program, the local government has provided information, technological, financial, and capacity-building support for households to adapt to climate change. In addition, the results indicated that the number of households adopting adaptation measures doubled after they received local government support. However, on average, only 38% of households receive some support from the local government through the adaptation program. While in fact, almost all the survey households either agree or strongly agree that adaptation support is necessary to adopt adaptation measures effectively.

Lastly, the chi-square test and stepwise regression analysis results indicate that information support, technological support, support for capacity development, and the location where households reside are all related to their decision to adopt adaptation measures. Nevertheless, it is essential to note that most households have only employed short-term adaptation measures, as local government assistance remains extremely limited. The field surveys revealed that urban gardening and urban green space are two of the most adopted adaptation measures, which account for 221 households and 171 households adopting it, respectively. Although both actions can contribute positively to climate adaptation, there is a lack of concrete measures to reduce the impacts and risks of climate change. Very few households adopted measures that

can directly assist them in adapting to climate change, such as rainwater harvesting (87 households) or diversification of livelihoods (28 households).

This study concludes that the local government of Indonesia has integrated adaptation into the development plan and established adaptation programs that may benefit vulnerable populations. In developing nations, integrating climate change adaptation remains challenging for local governance. Therefore, local governments must collaborate with diverse stakeholders to achieve a more effective adaptation integration result.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1. Background

Climate change is defined as a modification in the condition of the climate, which may be discerned through alterations in the average and the fluctuation of its characteristics and endures over a prolonged duration (Hegerl et al., 2007). Indonesia is considered to be among the nation that has a significant susceptibility to the adverse impacts and risks of climate change, encompassing various extreme occurrences such as floods and droughts, as well as enduring alterations arising from rising sea levels, alterations in precipitation patterns, and escalating temperatures (World Bank Group, 2021). The escalating phenomenon of climate change has necessitated the implementation of measures to mitigate against more warming and to adapt to the consequences of climate change.

The initial approach, known as mitigation, involves the implementation of measures aimed at diminishing the release of greenhouse gases (GHGs) or augmenting the capacity of natural sinks to restrict the extent of forthcoming climate change (Filho, 2020; IPCC, 2014a). The endeavor at hand is of great intricacy, as the transition from fossil fuels encounters substantial technical and economic obstacles, intricately intertwined with several political controversies (van Aalst et al., 2008). Despite the potential effectiveness of emissions reductions and mitigation initiatives in the coming decades, the global annual average temperature will still rise to 2ºC. The current approach has proven inadequate in attaining global consensus over their decrease. Consequently, it is imperative to adapt to climate change as well as capitalize on advantageous prospects (Filho, 2020). The subsequent reaction to climate change is commonly denoted as adaptation (IPCC, 2014c).

The National Adaptation Plan (NAP) procedure was established by the United Nations Framework Convention on Climate Change (UNFCCC) in order to enhance adaptation efforts in developing countries and least-developed countries (IPCC, 2023; UNFCCC, 2012). Developing countries and least developed countries have been most severely impacted by the repercussions of climate change due to their lower degree of development. Integrating adaptation into development plans is perceived as a means to achieve enhanced sustainability, efficacy, and resource utilization compared to the isolated design and management of policies in relation to actual activities. (J. M. Ayers and Huq 2009; Klein, Schipper, and Dessai 2005).

The second aim of the National Adaptation Plan (NAP) is to decrease vulnerability to the consequences of climate change through the enhancement of adaptive capacity and resilience. Numerous consequences stemming from climate change are inevitable and will disproportionately affect households that are most susceptible to its impact (Tollefson, 2022). Although households are already adapting to climate change, the most vulnerable households are being predominantly burdened by the impacts and risks of climate change. The effectiveness of household adaptation is inherently impacted by governmental action and does not transpire in an institutional void. (Kiragu, 2010). The necessity of implementing the National Adaptation Plan (NAP) procedure in order to adapt the adverse effects of climate change on the vulnerable is thus unavoidable.

In 2020, 219 of the 154 developing countries have undertaken at least one activity related to the process of NAP. Indonesia's government has also given top priority to the NAP process by developing the National Adaptation Plan called RAN-API. The RAN-API is then utilized to integrate adaptation into the development plan by fifteen local governments of Indonesia. In order to adapt to the effects and potential hazards of climate change, it is imperative for local governments to implement adaptation measures. (Le 2019). Considering climate change impacts and risks that emerge in a given local context, local governments are considered the best place for climate change adaptation through context-based measures and strategies (Measham et al., 2011; Mfitumukiza et al., 2020; Wijaya et al., 2020).

Nevertheless, several studies explore that integrating adaptation into a development plan is challenging for local government (Khadka et al., 2012; Khatri et al., 2013; UNDP, 2011; Wiggins, 2011). Because of long timescales and inherent uncertainties, adaptation to climate change requires different strategies than those based on predictability and optimality. The challenges are especially true in developing countries in which scientific information on current climate change, as well as methods and tools to predict climate change, are still inadequate (UNDP, 2011; Wiggins, 2011). It calls into question whether the local governments could integrate adaptation into development plans, moreover, translate the adaptation policy into practice and benefit vulnerable households. The alignment between national and local governments' adaptation policies and interventions may not always be congruent with the specific needs of households. Local adaptation demands may arise autonomously from broader global or national activities and policies (Amaru & Chhetri, 2013). The phenomenon referred to as the global governance/local reality conundrum is observed across various policy domains, extending beyond the realm of climate change adaptation (Quandt & Kimathi, 2017).

Additionally, despite the rich information of studies about climate change adaptation, there exists a limited body of scholarly knowledge on the effectiveness of adaptation integration into development plans (Regmi et al., 2016b). The majority of extant research on climate change adaptation focuses on the content and quality of the adaptation plan, stakeholder engagement, as well as barriers and challenges. Furthermore, a significant majority of the studies are derived from developed countries. Understanding adaptation integration into development plans by local governments in developing countries, which are characterized by lower adaptation capacities and higher development requirements, can assist policymakers in formulating more effective adaptation strategies and goals (Yulandari et al., 2023).

The primary objective of this study is to assess the efficacy of the integration of climate change adaptation measures into the development plans implemented by local governments in Indonesia. In this study, the evaluation is for both the process and the outcome of the integration. Then, the study proceeds in two steps. This study introduces a comprehensive framework for assessing the efficacy of local development plans, specifically focusing on their application within the context of Indonesian local governments. Second, this study formulates analytical frameworks and hypotheses of how adaptation integration into development plans influences households' adaptation. Then the hypotheses are performed on households in Semarang City, Indonesia. This study, therefore, provides a comprehensive evaluation of adaptation integration into the development plan, from the steps taken to integrate adaptation into the development plan to the results of adaptation integration in the case of local government and households.

1.2. Problem statement

Reflecting on the above, there are three problem statements as follows:

1. Adaptation integration into development plans is still challenging for local governments due to their limited capacity.
2. Developing countries have engaged in endeavors pertaining to the integration and execution of adaptation measures within their development agendas. However, studies about it are still lacking.
3. The current situation of adaptation integration into development plans in Indonesia has not yet been fully understood.

1.3. Research objective

The primary research aim is to assess the extent to which local governments incorporate climate change adaptation strategies into their development plans and the resulting advantages for households that are particularly susceptible to climate-related risks. This study will examine the precise aims and research topics in further detail:

Objective 1:

To assess how local government integrates adaptation into the development plan in Indonesia.

Research questions:

1. Examine how adaptation is addressed over the development plan.
2. Identify what adaptation options are formulated to respond to climate change.
3. Assess what steps are taken to integrate adaptation into the development plan.

Objective 2:

To examine how adaptation integration by local government influence households' decision to adopt adaptation measure in Indonesia.

Research questions:

4. Identify the adaptation needs of households and current adaptation support provided by the local government to the households.
5. Analyze and quantify the impact of adaptation support on households' adoption decisions on climate change adaptation strategies.

1.4. Research scope

The scope of this study focuses on how adaptation is addressed in the development plan, formulated adaptation options in the development plan, adaptation support from local government to households, adaptation need of households, and adaptive measure taken by households. Through the NAP, the local government is expected to integrate adaptation into their respective development plans and implement adaptation programs to reduce climate change impacts. The local government also provides support for households to enable them to adapt to climate change impacts. In terms of adaptation programs for households, the provided adaptation support from the local government should be suitable to the household's need to enable adaptation measures. Households' needs are based on what kind of climate hazard,

impact, and risk occurred in their respective location. The presence of support for adaptation would increase households' capacity to take adaptation action. The conceptual framework of this study is depicted in Figure 1.

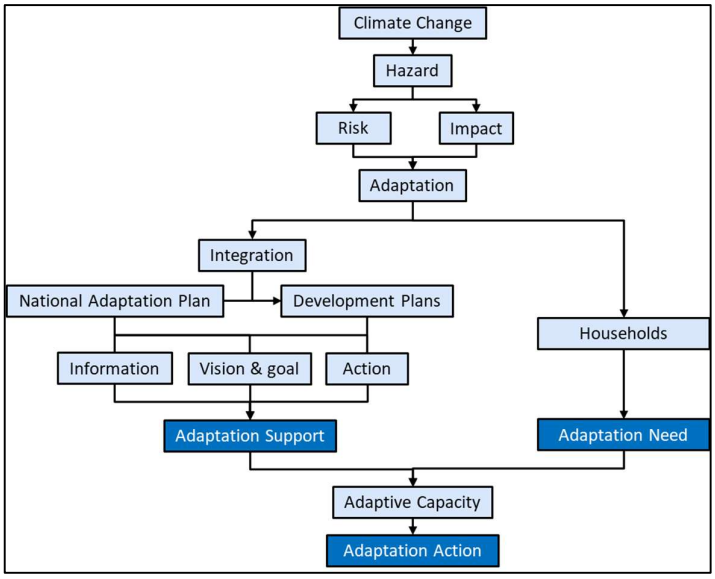

Figure 1: Conceptual framework of the research

1.5. Thesis structure

This research is divided into five chapters (Figure 2). This section elaborates on the content of each chapter.

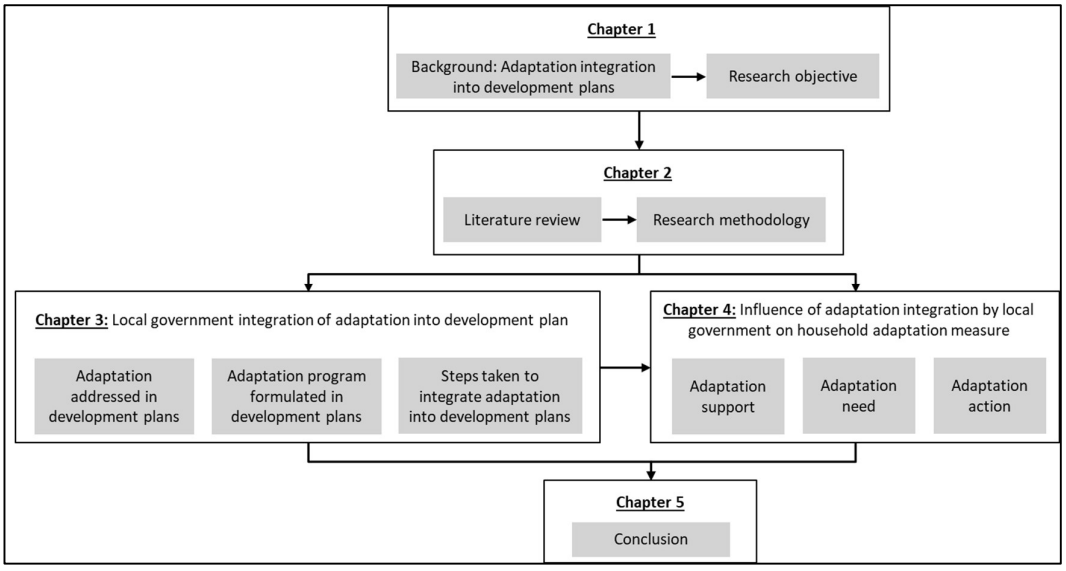

Figure 2: Research framework

Chapter 1: Introduction. This chapter provides an outline of adaptation integration into the development plan in Indonesia, the problem statement, and the research gap. All of those culminated in the research objectives and scope of research.

Chapter 2: Research framework. This chapter contains a literature review and a research methodology. The author collected literature and discussed how it is relevant to the study, then established an operational research framework for data collection. First, an overview of the development planning system in Indonesia and an overview of the national adaptation plan in Indonesia are introduced. Then the conceptual framework includes integration of adaptation into the development plan, adaptation options and policy types, adaptation need and support, as well as adaptation measures. These works of literature have gathered to design a framework for chapter 3 and chapter 4. Then, a literature review of adaptation integration into the development plan and policy implications on households, the study area, and the method are described. Finally, the author states the study innovation and its significance at the end of Chapter 2.

Chapter 3: Evaluation of climate change adaptation integration towards development plans. This chapter contains the first research objective. This chapter examines the incorporation of climate change adaptation measures into the development plan of local governments in Indonesia. It explores the specific types of climate change adaptation information, vision and goals, and actions that are addressed within the development plan. It also explores adaptation options formulated by the local government to support vulnerable populations. The author formulated a framework of assessment, then applied it in four local governments, Semarang City, Malang City, East Java Province, and West Nusa Tenggara Province. The findings of the adaptation program are led to Chapter 4 (Figure 3).

Chapter 4: Analysis on influence of climate change adaptation integration on household adaptation against climate change. Continuing the result from Chapter 3, Chapter 4 focuses on the adaptation program formulated by the local government through the adaptation integration into the development plan. The author focused on three villages (Pedalangan village, Podorejo village, and Tanjungmas Village) in Semarang City to conduct a questionnaire survey from the households regarding the need for support from the local government and the support provided by the local government. Then, an analysis was conducted on whether the adaptation support influences their decisions on adopting adaptation measures.

Chapter 5: Conclusion. This chapter draws a conclusion and highlights the important findings. The background and objectives of the research are restated. Then, the author presents a summary of the main findings from each objective, then the overall conclusion is followed. Next, several recommendations for improving adaptation integration by local government in Indonesia are presented. The author describes research limitations and suggestions for future research agenda at the end.

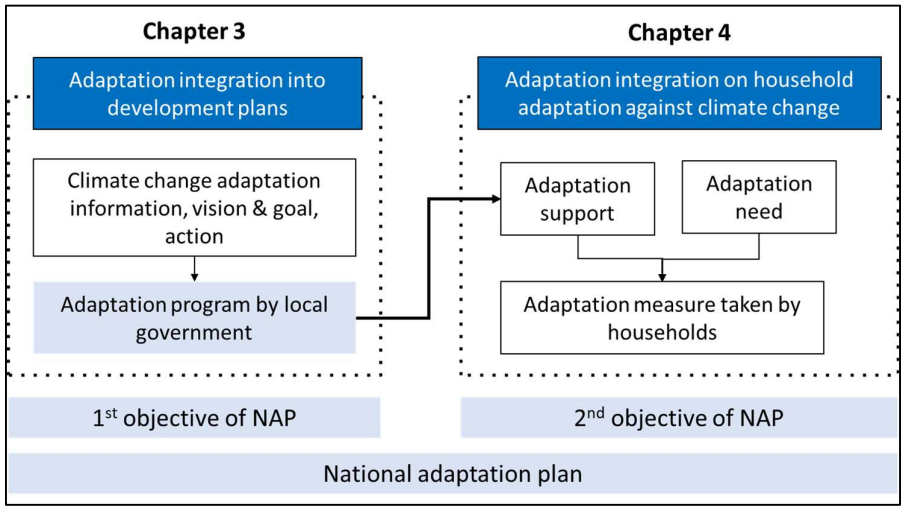

Figure 3: Relationship between chapter 3 and chapter 4

CHAPTER 2

RESEARCH FRAMEWORK

This chapter elaborates 1) conceptual framework, 2) literature review, 3) research methodology, and 4) study innovation. First, an overview of the development planning system in Indonesia and an overview of the national adaptation plan in Indonesia are introduced. Then the conceptual background includes integration of adaptation into the development plan, adaptation options and policy types, adaptation need and support, as well as adaptation measures. Second, the literature review of scientific literature on adaptation integration into development plans and policy implications on households are presented. The literature review is formulated into a novel framework containing key indicators for assessment in Chapters 3 and 4. Third, the study area is described, followed by the research method, including the method of data collection and analytical method. Finally, study innovation highlights the gap between research and originality.

2.1. Overview of development planning systems in Indonesia

The development planning system in Indonesia is divided into the national level government and local level government. The national level consists of a ministry and government agency, while the local level is divided into provincial and regency/city levels, which also consist of a government agency. For both the national level and local, each agency develops its own development plan by sector. The development plan is a planning policy document that guides development within a planning authority area by setting out detailed planning policies. In general, the development plan should include information, vision and goal, and action (Figure 4). The development plan by the agency is required to correspond with the comprehensive development plan by the development planning agency. In Indonesia, the development planning agency assumes the role of leadership in the development planning system. Its primary responsibility entails providing strategic planning guidance to various ministries at the national level, as well as agencies at the local level.

In Indonesia, the comprehensive development plan is divided into three parts: a long-term development plan for 20 years, a medium-term development plan for five years, annual development plan for one year. The long-term development plan outlines the vision, mission, and direction of Indonesia, and it consists of a general goal that wants to be achieved by the

Indonesia government in 20 years period. The long-term development plan is divided into four medium-term development plans for each five years period, parallel to the government tenure. Through the medium-term development plan, both national and local government could set their own priorities as long as it is in line with the long-term development plan. The elaboration of the medium-term development plan for each year is called the annual development plan. It gives a clearer explanation of the goals set for each working year.

Not only the comprehensive development plan is required to be in-line with each other, but it is also required to be in-line between the national level and local level. The comprehensive development plan at the national level works as a reference for the local government on how they should develop their own comprehensive development plan, but the local government still has the full power to decide the development direction. Therefore, each comprehensive development plan at the local level is different. It is developed based on the conditions, problems, and community needs in each location.

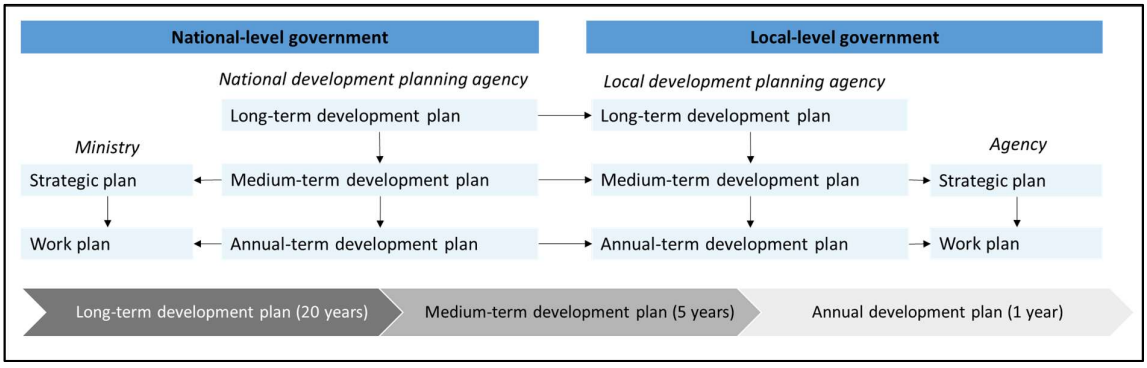

Figure 4: Development Planning System in Indonesia

2.2. Overview of the national adaptation plan in Indonesia

The provision allows participating entities to create and execute National Adaptation Plans (NAP) as a mechanism for identifying and addressing medium- and long-term adaptation requirements. This involves the development and implementation of policies and programs aimed at effectively managing those needs (UNFCCC, 2021). The National Adaptation Plan (NAP) has two primary goals: (1) reduce vulnerability to the impacts of climate change by building adaptive capacity and resilience; (2) integrate adaptation into new and existing policies and programs, especially development strategies.

In 2012, the Indonesian government unveiled a strategic plan aimed at incorporating adaption measures into the country's national development plans (Figure 5). This marked the inaugural instance in which the national government exclusively allocated attention to adaptation, with the national development planning agency being entrusted with the corresponding obligation. The integrative strategy for adaptation implementation in Indonesia aligns with the mandate outlined in the United Nations Framework Convention on Climate Change (UNFCCC) accord of 2010, which calls for the formulation of national adaptation strategies in all developing nations. (Casado-Asensio et al., 2016). In 2014, two years subsequent to the aforementioned event, the national development planning agency assumed the primary role in spearheading the formulation of the National Adaptation Plan, commonly referred to as RAN-API in the Indonesian language. The National Adaptation Plan of Indonesia (RAN-API) is an answer by the Indonesia government of UNFCCC called for a national adaptation plan. As indicated before, rather than being implemented separately, its implementation is conducted along the development process at the national and local levels.

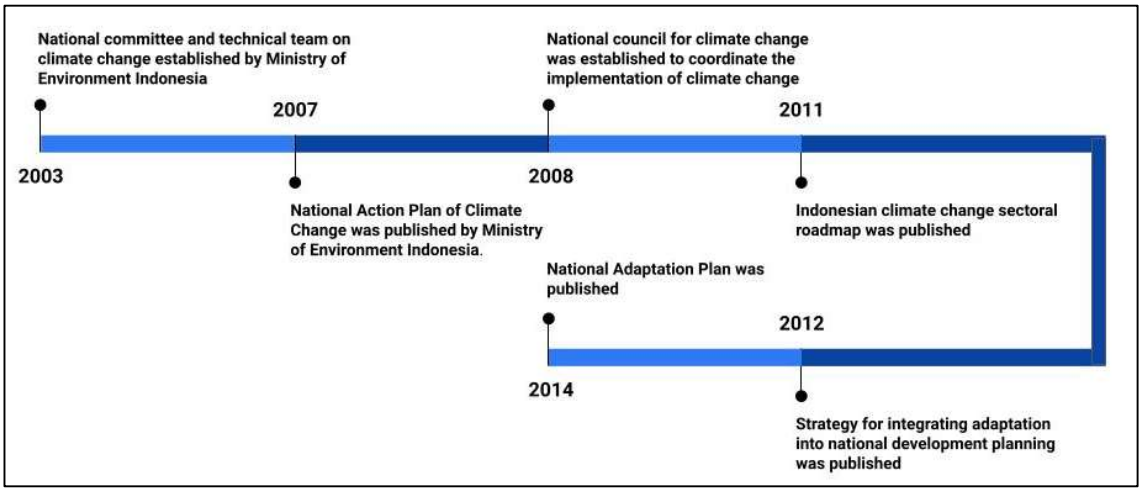

Figure 5: Overview of adaptation policy in Indonesia

The national development planning agency took the lead in formulating the RAN-API as part of the country's national action plan and carried it out in a participatory manner, involving extensive discussions and meetings with relevant technical ministries/government agencies, local government, and stakeholders. The assistance of development partners facilitated this process (National Development Planning Agency, 2012). Through the RAN-API Indonesian government puts emphasis on complimentary adaptation and development planning. Taking

into account the sectors and various development that are influenced by climate change in Indonesia, the RAN-API ensure that adaptation in the water sector, health sector, agriculture sector, marine sector, and the coastal sector is put on focus (Table 1).

The RAN-API also considers the climate change impact of the geographical aspect of Indonesia as an archipelagic nation that is susceptible to climate change. Adaptation in special regions such as small islands, coastal areas, and urban areas is also necessary. Not only that, to support the adaptation in those sectors, it is also necessary to have a supporting system towards a development system for climate change adaptation. It explains general adaptation measures that should be conducted in each sector and work as implementation guidance for the government staff. As the explanation in the RAN-API is in general condition, the implementation of RAN-API at the local level doesn't fully follow all the five sectors mentioned before. Climate change impacts and development processes are locally different. Based on the condition in each location, the local government should adjust the adaptation action that is suitable for them.

The RAN-API does not exist as an independent policy document with its own legal structure foundation. Rather, it serves as the primary input and guiding framework for incorporating adaptation measures into the creation of the national medium-term development plan. At the local level, the RAN-API is a basis for local governments to include adaptation measures in their local development plans. Figure 6 illustrates the setting of the RAN-API within the framework of the national and local development planning system.

Table 1: Sectors of the RAN-API

Sector
Water sector • Management of water resources to fulfill the demand for clean water and to prevent climate disasters caused by water damage.
Health sector • Protect the community and environmental health.
Agriculture sector • Climate-smart agriculture to maintain the food production
Marine sector • Maritime safety

Sector
Coastal sector • Coastal area protection

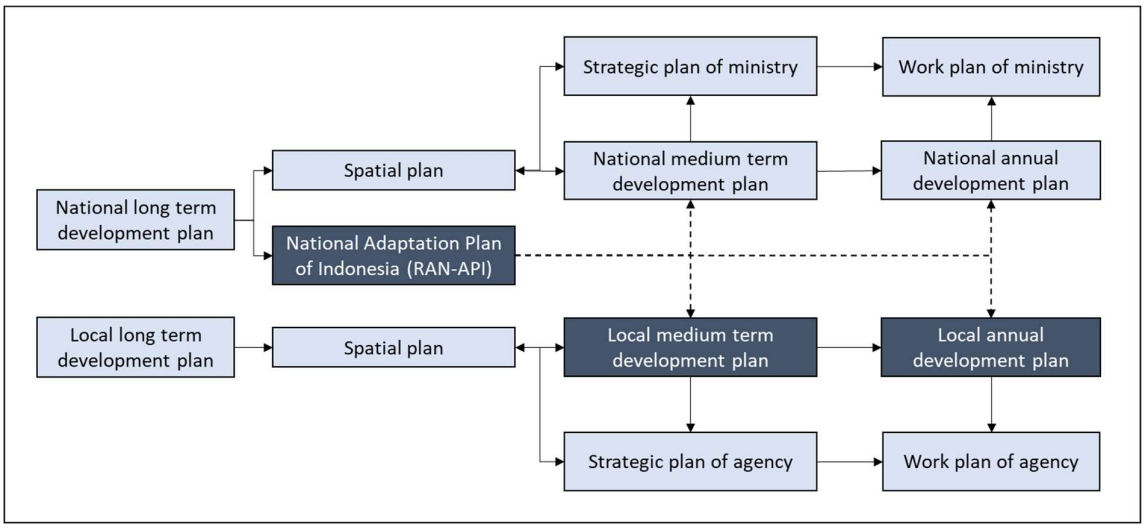

Figure 6: Position of the RAN-API in the development planning system of Indonesia

For the implementation of the RAN-API, there is no distinctive funding system. The main funding source for implementing the RAN-API is the state revenue budget at the national level and the regional expenditure budget at the local level. If necessary, the RAN-API can also be linked to other funding sources, such as the Indonesia Climate Change Trust Fund (ICCTF) or international donors. It is necessary to identify adaptation actions that can be implemented through the state revenue budget or regional expenditure budget and the adaptation actions that require other funding sources.

At the local level, only 15 locations were selected to implement the RAN-API of adaptation and development integration (Table 2). The selection was conducted by the national development planning agency as the lead agency for the RAN-API and based on several criteria: (1) vulnerability assessment; (2) local government commitment; (3) adaptation activity conducted before; (4) existence of climate change working group; and (5) compatibility with the RAN-API. These criteria expected the chosen location to have sufficient capacity to integrate adaptation and development.

Table 2: Location of RAN-API integration at the local level

No	Local governments
1.	Bali province
2.	Semarang city
3.	Pekalongan city
4.	West java province
5.	Blitar city
6.	Bandar Lampung city
7.	East java province
8.	Malang regency
9.	Batu city
10.	Malang city
11.	West Nusa Tenggara province
12.	Lombok regency
13.	Tarakan city
14.	South Sumatra province
15.	North Sumatra province

2.3. Conceptual framework

Adaptation is the process of adjustment in natural or human systems in response to actual or expected climate and its effects in order to moderate the impact of climate change (IPCC, 2012). Climate change affects all regions in the world, but the most vulnerable get hit first and the hardest by climate change. Some vulnerable households have already started adapting to climate change, but they need help overcoming obstacles, ranging from a lack of information and financial resource to behavioral biases (Noble et al., 2014).

In order to track adaptation integration into a development plan, this study will examine two main components of generalized adaptation planning (Bierbaum et al., 2013a): adaptation impetus identification in the development plan component and formulated adaptation options to respond to those impetuses. The two phases exemplify the correlation between problem-solving and resource allocation, in which the recognition of adaptation is crucial and an essential condition for the justification of the distribution of resources (Le, 2020; Schlosberg, 2012).

Owing to the proximate and root cause operating at local scales of climate change, adaptation need is shaped locally (Scoville-Simonds et al., 2020). The presence or absence of certain assets or capacities might give rise to an inherent or acquired trait in individuals or communities. Adaptation support refers to a range of methods and processes implemented to effectively address various needs; therefore also must be tailored to local circumstances. By failing to include the perspectives of the local people, adaptation integration into development plan processes would fail to provide suitable support to address the adaptation need of differential vulnerability in each location (Nagoda & Nightingale, 2017).

Nevertheless, the provision of support does not guarantee that vulnerable households would possess the capability to utilize it efficiently to adapt to climate change (Noble et al., 2014). The support from the local government should be tailored and translated into concrete respond to climate change. The success of adaptation integration into the development plan, therefore, determines not only by the suitability between adaptation needs and support but also by the adaptation measure taken by vulnerable households.

2.3.1. Adaptation integration into development plan

Numerous endeavors in adaptation are focused on decreasing the consequences of prospective alterations in the occurrence, severity, and length of weather and climate phenomena, which have the potential to significantly impact human society through extreme occurrences. The level of risk is influenced by both the climate hazard and the degree of exposure and vulnerability to that hazard. Effective adaptation needs to consider all the factors of climatic conditions, climate hazard, exposure, vulnerability, impact, and risk (Figure 7). The integration of adaptation into the development plan means these should be reflected in all components of the development plan: information base; vision and goal; and action (Baker et al., 2012).

In the present study, the climate change impact and risk caused by the climate condition and climate hazards are the impetus for adaptation options. This study doesn’t put on focus on exposure and vulnerability because it requires a specific assessment which is not available in Indonesia's development plan. Therefore, this study will examine the integration of climate change adaptation, including the factor of climatic condition, hazard, impact, and risk, and in the information, vision, and goal, and action of the development plan.

Climatic condition is the condition of climate or the average of weather. It is the fluctuating state of the atmosphere around us, characterized by temperature, wind, precipitation, sunshine, cloudiness, and other weather elements (IPCC, 2001).

Climate hazard refers to the potential occurrence of a climate-related physical occurrence that possesses the propensity to lead to fatalities, injuries, or other adverse health consequences, along with the destruction and the deprivation of assets, physical structures, means of subsistence, provision of public services, ecological systems, and natural resources (IPCC, 2014c). Climate hazard includes extreme temperature, increased air and sea temperature, extreme rain, drought, severe wind, and other extreme weather events.

Impact refers pertains to the consequences experienced by both natural and human systems as a result of extreme weather and climate occurrences, as well as the broader phenomenon of climate change. Impacts are commonly understood as the outcomes that result from the interaction between climate changes or hazardous climate events, which have repercussions on a range of dimensions, including human lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure. The impacts of climate change on geophysical systems, including but not limited to heatwaves, floods, droughts, and sea-level rise, are of significant academic interest (IPCC, 2014c).

Risk can be defined as the likelihood of hazardous occurrences or trends happening, compounded by climate change impacts, such as death, injury, ill health, food insecurity, and loss of income or livelihood (IPCC, 2014c).

Information base is an examination and evaluation of existing or anticipated regard to climate change adaptation. The provided information encompasses both quantitative statistics and qualitative analyses pertaining to the regional context, identification of determinants, and assessment (Baker et al., 2012).

Vision and goal refer to key needs and desired future. It encompasses the articulation of measurable goals and the allocation of resources aimed at the preservation of resources in the context of climate change (Baker et al., 2012).

Action refers to options taken for climate change adaptation. Its principles on how to achieve vision and goal are stated (Baker et al., 2012).

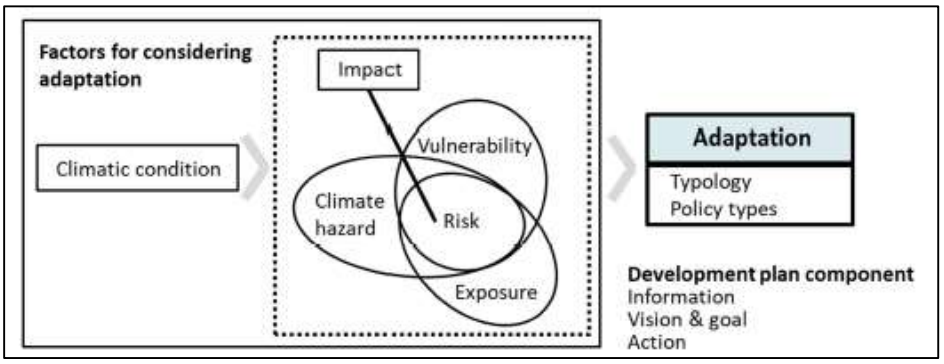

Figure 7: Conceptual framework of the integration of adaptation into the development plan

2.3.2. Adaptation options and policy types

This study employs a classification system based on the IPCC 2014 report to categorize adaptation options, taking into account the variability of these options across different places and the wide range of actions available for adaptation. As classified in Table 3, adaptation options are classified into structural/physical, social, and institutional.

The structural and physical measures are characterized by their clearly specified outputs and consequences, which are well delineated in terms of scope, spatial extent, and temporal duration. The aforementioned strategies encompass several approaches, such as incorporating structural and engineering solutions, utilizing discrete technologies, harnessing ecosystems and their services to address adaptation requirements, and providing targeted services at different scales, including national, regional, and local levels (Noble et al., 2014).

The social measures aim to address the particular vulnerability experienced by marginalized groups, with a focus on reducing vulnerability and addressing social inequalities (Noble et al., 2014).

The institutional measures encompass a wide array of strategies, including economic tools such as taxes, subsidies, and insurance systems, as well as social policies and laws (Noble et al., 2014).

Table 3: Typology of adaptation option

Adaptation options
Structural or physical options

Adaptation options
• Engineered and built environment • Technology • Ecosystem-based measures • Services
Social targeted options • Education • Information • Behavior
Institutional options • Economic • Laws and regulations • Government policies and programs

This study also distinguishes types of adaptation policy by implementing the framework developed by (Dupuis & Biesbroek, 2013). The identification of the type of adaptation policy, the degree of intentionality with which climate change is taken into account in proposed adaptation options, and the extent to which these actions would help to reduce vulnerability or enhance adaptability can be determined (Le, 2020) (Figure 8).

The contiguous policy pertains to measures addressing potential climate change risks that are presently overlooked or given minimal consideration. It has the attributes of possessing the capacity to contribute, though with limited direct impacts on decreasing vulnerability. (Dupuis & Biesbroek, 2013; Le, 2020).

The contributive policy deals with measures that have not been explicitly formulated with the primary objective of reducing the effects of climate change but yet make a significant contribution towards decreasing future vulnerability (Dupuis & Biesbroek, 2013; Le, 2020).

Concrete policy refers to deliberate measures that are purposefully formulated to effectively address the anticipated consequences of climate change, with the primary objective of significantly reducing vulnerability or strengthening the adaptability of the system (Dupuis & Biesbroek, 2013; Le, 2020).

Symbolic policies, meanwhile, are implemented in response to climate change but do not actually contribute to the reduction of vulnerability (Dupuis & Biesbroek, 2013; Le, 2020).

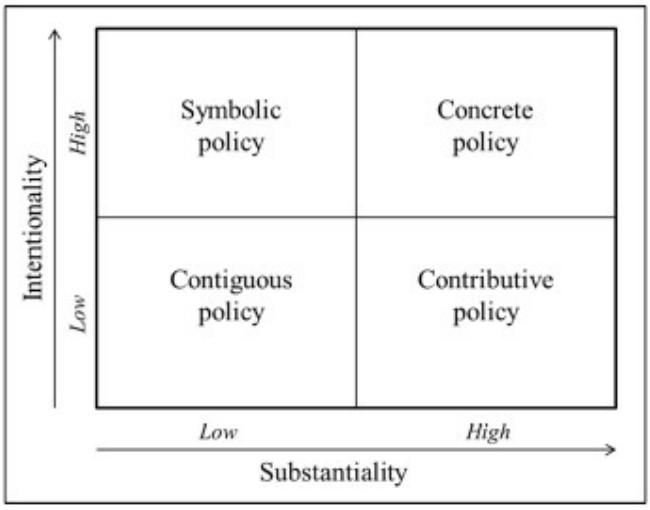

Figure 8: Policy types of adaptation options

2.3.3. Adaptation needs and support

The concept of adaptation needs refers to the discrepancy between potential climate change impacts and the desired outcomes, whereas adaptation supports encompass the aid provided to bridge this gap (Noble et al., 2014). Households demonstrate the ability to adjust to many stresses encountered in their everyday routines. Climate change, being one such stressor, is rapidly altering the way households adapt. Adapting to climate change involves making small changes in our everyday lives, managing the risk that climate change presents, and harnessing potential opportunities to become more resilient. The concept of adaptation is not universally applicable but rather manifests as a localized, site-specific, and intricately interconnected process. Everyday adaptation as a grounded, bottom-up process (Twinomuhangi et al., 2022) s. The inclusion of the hyperlocal scale is an essential element in defining adaptation and serves as a valuable perspective for examining how a significant portion of the global population currently adjusts and will further modify their lifestyles in adaptation to climate change (Castro & Sen, 2022).

One approach to classifying requirements and assistance is presented by (Burton et al., 2006), who identified many types of needs, including information, capability, financial, institutional, and technology needs. An alternative way of classifying adaptation needs and support is as those in biophysical and environmental, social, institutional, information, capacity, and resource (Noble et al., 2014). Both adaptation categories by Burton and Noble are exhaustive;

however, they comprise some types of needs and support that are not applicable at a micro level. Adapting from (Burton et al., 2006) and (Noble et al., 2014), this study then proposes classifying adaptation needs and support as those that are more advisable to be applied on the household scale: information; technological; financial; capacity building.

Information needs and support represent the availability of past weather data, current climate conditions, and future climate change scenarios. The foundation of effective adaptation relies on utilizing the most accurate and up-to-date knowledge regarding climate change, as well as the magnitude of potential consequences and dangers associated with it, within certain timeframes and geographical areas.

Technological need and support encompass a wide range of both tangible and intangible technologies, encompassing not just novel innovations but also indigenous and locally crafted acceptable technologies. Adaptation technology is often familiar and applied elsewhere, and it can be transferred and shared between one location to another location.

Financial need and support refer to specific funding directed toward adaptation measures. Impoverished populations will necessitate resources to enhance their capacity, implement targeted adaption strategies, and effectively manage the impacts and risks associated with climate change as they occur.

Capacity needs and support are learning and knowledge sharing between stakeholders, including local government agencies and vulnerable populations. The intricate nature of climate change adaptation necessitates that the demand for adaptation and the provision of support is significantly shaped by various modes of learning and knowledge dissemination.

2.3.4. Adaptation measures

Throughout history, human beings have consistently demonstrated their ability to adapt to many dynamic circumstances, including personal, societal, economic, and climatic factors. The current pace of climate change necessitates those various entities, including communities and legislative bodies, include climate change considerations more extensively in their deliberative processes and decision-making procedures compared to previous times (Noble et al., 2014). There exists a notable degree of convergence between the categories of measurements employed for assessing prevailing climate hazards in a broad sense and those necessitated for the purpose of climate adaptation. Numerous measures aimed at enhancing adaptability to climate change are implemented to address existing climate-related risks, including but not

limited to droughts and floods. These efforts are frequently integrated into wider sector-specific endeavors such as water resource management, coastal protection, and disaster preparedness (Noble et al., 2014). However, the issue of climate change necessitates a sense of urgency in undertaking these measures and calls for investments that prioritize anticipated future circumstances, which vary across different locations and are characterized by significant levels of uncertainty (Cacho et al., 2020). Climate change will increase the risk of amplifying the impacts of current climate hazards such as floods, droughts, and wildfires unless adaptation measures are undertaken.

The categorization of adaptation measures encompasses numerous approaches, and various types of adaptation measures have been recognized throughout the years. Achieving universal consensus on categorization is a challenging task. However, the objective of this approach is to consider the wide range of adaptation measures available for various sectors and stakeholders. The categorization of adaptation measures by IPCC, published in 2017, is one of that commonly used. It differentiates the adaptation measure in several dimensions of spatial scale, sector, action, actor, climatic zone, revenue, and development level of the systems in which these implementations take place.

As this study aims to identify how households actually responded and adapted to climate change, the classification of adaptation measures based on action taken is then used. The adaptation measure is categorized into structural and physical adaptation measures (Table 4) or non-structural and physical adaptation measures (Table 5). Structural and physical measures emphasize distinct adaptations that possess well-defined output and outcome, while non-structural and physical adaptation measures include social options. In dealing with climate change, households make efforts to adapt in many ways, which may start with lower-effort measures and then shift to higher-effort and more costly measures (Cacho et al., 2020).

Table 4: Structural and physical adaptation measures taken by households

Structural and physical adaptation measures
1. Urban gardening
Urban gardening can provide valuable contributions to climate adaptation through the augmentation of vegetation cover within urban areas. The deliberate cultivation of plants enhances the soil's ability to absorb water, resulting in improved stormwater runoff management and increased adaptability (Demuzere et al., 2014). Other small-scale

experiments and models show more potential for urban gardening in the context of climate change adaptation, such as cooling by shading vegetation (Rolf et al., 2020).

In terms of the study area, urban gardening is a program that turns public space into an agricultural area by planting a variety of plants, including ornamental, edible, and medicinal species. Households can consume plantation products for different kinds of vegetables. Additionally, families use their yards to cultivate what is known as medicinal plants for the family in the traditional manner. The cultivation of therapeutic plants is relatively simple and inexpensive. There are several medicinal plants grown there, including ginger, lemongrass, turmeric, lesser galangal, screw pine, galangal, and wild ginger. Typically, they are planted either directly on the ground, in pots, or in polybags (Figure 9).

Figure 9: Urban gardening in the study location

2. Urban green space

Urban green space is a greening effort by the community where new trees are planted or seeds are sown in an area where there were no trees before. Previous studies have focused specifically on analyzing the role of greening strategies in terms of climate change adaptation, such as reducing the negative impacts of heatwaves and flooding and increasing human thermal comfort (Bartesaghi Koc et al., 2018). Further, a growing body of evidence contributed to recognizing urban green space to climate adaptation in cities, including the regulation of urban temperatures, the regulation of water flow and mitigation of runoff, and the control of environmental anomalies (Gómez-Baggethun & Barton, 2013; Graça et al., 2022). The difference between urban gardening and urban garden space is the type of

plantation. In terms of urban gardening, the type of plantation is usually ornamental, edible, and medicinal species, including vegetables. While in terms of urban garden space, the plantation is trees. In this study, the term urban green space was used to replace the term afforestation. There are many definitions of afforestation, and the choice of definitions will determine how much and which land is included under the provisions of the plantation of the tree (Watson et al., 2000). Considering the size of the land that the community use for the tree plantation, this study, therefore, proceeds with the terms of urban green space instead of afforestation (Mathey et al., 2011).

Households conduct urban green space in terms of planting non-timber forest products such as fruits, spices, resins, and oils (Figure 10). The trees, such as mango, cashew, guava, teak, and eucalyptus, were planted in the community space on a scale between 100 square meters to 200 square meters. Besides that, households living in Tanjung Mas village, which is located on the coastline area of Semarang City, also conduct mangrove planting. This mangrove plantation is arranged by the Semarang City Government along with a local NGO and local university.

Figure 10: Urban green space in the study location

3. Water recycling

Water recycling is the practise of retrieving wastewater from diverse origins and subjecting it to treatment in order to meet the necessary standards for subsequent utilization. The suitability of water reuse for different secondary applications is contingent upon its quality.

Structural and physical adaptation measures

As an adaptation measure, water reuse functions encompass a range of applications, including agricultural irrigation, groundwater replenishment, provision of safe drinking water, and non-potable uses in urban settings (e.g., park irrigation, toilet flushing, etc.) (Angelakis & Gikas, 2014).

Water reuse is conducted by households in terms of reusing the water already used once and then used again. The wastewater is collected from washing clothes and cooking utensils or from ablution, then kept and used for watering crops in the household (Figure11). The water reuse in the study location is very simple as there are several barriers that mostly pertain to health issues associated with the presence of microbiological and pharmacological contaminants in wastewater without appropriate technical support to treat wastewater (Jaramillo & Restrepo, 2017).

Figure 11: Water reuse in the study area

4. Rainwater harvesting

Rainwater harvesting typically consists of three main components: collection, storage, and treatment. The collected rainwater can be utilized for various purposes, including both potable and non-potable uses. The specific usage is determined by the water demand and supply conditions in the given area. The implementation of rainwater harvesting systems has the potential to enhance the availability and dependability of water resources for the purposes of drinking, sanitation, and hygiene (Aladenola & Adeboye, 2010; Pearson et al., 2015). Multiple studies have also documented that the fulfillment of residential water demand in many communities under the influence of climate change can be achieved through the implementation of rainwater harvesting techniques (Schuster-Wallace et al., 2022).

In the study area, the water tank for rainwater harvesting is placed in a household's house, and collected water is only used by the respective family (Figure 12). During the rainy season, the water tank for rainwater harvesting is employed to capture and accumulate

rainwater. The design of the rain harvesting system incorporates the utilization of gravity to facilitate water flow, hence mitigating the requirement for electricity consumption that would otherwise be necessary for pumping. The water thereafter becomes accessible for households to use and consume, especially in dry periods characterized by a scarcity of drinkable water resources.

Figure 12: Rainwater harvesting in the study area

5. Bio pore infiltration hole

Bio pore infiltration holes are structural openings that exhibit either a cylindrical or cube-shaped morphology. The morphology of the bio pore infiltration orifice is contingent upon the land's availability. Given a sufficient land area, it is permissible to construct a bio-porous infiltration hole in accordance with the preferences of the landowner. However, in the case of a limited land area, it is advisable to construct a cylindrical hole with a diameter of 10 cm. By storing some of the surface water runoff in the ground, the bio pore infiltration hole is a concept that can be used to save water or increase groundwater reserves, and lower flood risk (Ashabie & Masjud, 2022; Syahruddin et al., 2019).

Bio pore infiltration hole is put in the community space around households (Figure 13). The location of the bio pore is selected by the households in the meeting where they think the water will be gathered, or it could be by arranging for water to flow into the hole bio pore. The tool used in the form of a metal plate box measuring 1 m^2 and height of 35 cm, bucket run off, simple rain gauge, soil drill to make a hole bio pore, rainwater run off sample bottles, and pipe for bio pore (Setiawan & Rohmat, 2019).

Structural and physical adaptation measures

Figure 13: Bio pore infiltration hole in the study area

6. Climate change-resistant seeds
It is anticipated that climate change will result in a decline in the productivity and overall yield of essential crops by as much as 30%, primarily attributable to reduced productivity and increased instances of crop failure. (Jain et al., 2015). The utilization of modified seeds serves to mitigate the adverse effects of climate change on agricultural systems while also ensuring consistent agricultural productivity. Various regions require seeds that are adapted to diverse stressors. In certain areas, there is a requirement for seeds that exhibit resilience to drought and/or harsh temperatures. Conversely, in other regions, the primary stressors may vary. Such as the development of crops or kinds that exhibit improved tolerance to salinity, as well as the cultivation of rice cultivars that possess the ability to withstand submergence (Kurnik, 2013). Households engaged in farming activities have employed short-duration variety seeds as a means of adapting to the prevailing drought conditions in the study area. The farmers, on average, employed seeds that were resistant to drought.

Table 5: Non-structural and physical adaptation measures taken by households

Non-structural and physical adaptation measures
1. Sharing local knowledge
The concept of local knowledge pertains to the cognitive frameworks and proficiencies acquired by individuals and communities, which are contextually bound to the geographical location in which they reside (IPCC, 2019). Recent studies have substantiated the beneficial impact of local knowledge in fostering resilience and adaptive capability, as well as

influencing strategies to address climate unpredictability and change. This phenomenon is especially evident within the context of households or communities, where there may exist constraints on access to, adequacy of, or proficiency in utilizing scientific information (IPCC, 2014b).

Households share local knowledge of the climatic classification system, which is classified as follows: (1) The season known as *Katiga*, alternatively referred to as the dry season, commences with the onset of leaf shedding, the formation of cracked soil, and the emergence of bamboo buds. (2) *Labuh*, a term denoting the transition from dry to wet seasons, can be interpreted as "shifting seasons." The occurrence of precipitation is linked to the verdant hue of vegetation. (3) The onset of *Rendheng*, also known as the rainy season, occurs when pests and diseases are transported through the air. (4) *Mareng*, similar to *Labuh*, denotes the transition from the rainy season to the dry season and commences during the period of blossoming.

Households commonly engage in the act of reminiscing about a specific flood or drought that occurred in the past (Figure 14). However, it is often seen that they may not possess precise recollections of the exact time frame during which these disasters transpired. Nevertheless, such recollections are typically organized in a chronological manner, aligning with significant local occurrences that have been personally witnessed or experienced by the individuals inside these households. In terms of households that work as farmers, farmers share the planting dates to avoid a delayed monsoon and reschedule the planting season.

Figure 14: Sharing local knowledge in the study area

2. Early warning system

Non-structural and physical adaptation measures
Early warning systems play a crucial role as an adaptive strategy in the face of climate change. These systems utilize integrated communication mechanisms to facilitate preparedness among various sectors and communities in anticipation of climate-related occurrences. Early warning systems consist of a network of interconnected procedures that involve the detection, analysis, prediction, broadcast of warnings, and subsequent decision-making and implementation of response measures. Early warning systems for climate-related threats should be built upon a robust scientific and technical foundation, with a specific emphasis on prioritizing individuals or sectors that are most vulnerable to these risks. This suggests the implementation of a comprehensive approach that encompasses all pertinent risk variables, including those stemming from climate-related hazards and socioeconomic vulnerabilities, as well as from both short-term and long-term processes. (Climate ADAPT, n.d.). In order to minimize the impact of floods, homes proactively established a collective known as the flood watcher group. The primary tasks undertaken by the individuals were manual monitoring of precipitation levels and wave patterns, as well as the tracking of coastal storms. When conditions indicated a heightened risk of flooding, these households would then proceed to give appropriate warnings. Households also use sirens and megaphones at a mosque to disseminate flood information to the people.
3. Household preparation and evacuation planning
Evacuation planning is one of the activities undertaken as part of disaster preparedness when extreme weather happens occurred more frequently as a result of climate change. Evacuation planning is pertinent to all climate-related risks, including slow-onset (as for drought) and rapid-onset (as for flood) disasters. The evacuation plans contain the specification of the roles and coordination between various actors, including household, community, city/municipal, and other scales. At the community level, the implementation of evacuation plans involves various components. These components include the evaluation of the requirements of individuals at high risk during evacuations, such as the elderly, children, and those with medical vulnerabilities. Forming an emergency response team, providing training and education for both responders and community residents, and ensuring the availability and readiness of essential resources, such as equipment and facilities (Asfaw et al., 2019).

Non-structural and physical adaptation measures
In terms of the study area, households had made various efforts to avoid and adapt to coastal floods, elevated their houses, or moved their goods to safer places whenever flood occurred. Households also develop evacuation paths and signs in the area close to their homes based on the consideration that the fact that flooding in the affected areas could render some roads inaccessible.
4. Livelihood diversification
Livelihood diversification means a substantial change in production activity, responding to changes in the environmental state driven by climate change. The adaptation process can include initiatives of business diversification outside the sector developing new related activities that can provide complementary sources of income (Barange et al., 2018). Farming households without the necessary means frequently seek alternative forms of income through non-farm income-generating activities and lower-paying and occasionally riskier nonfarm activities to make up for any losses experienced during agricultural production and distribution.
5. Climate observation
Household climate observations offer firsthand and comprehensive accounts of the intricate interplay between the physical and biological elements of the environment, particularly in the face of climate change-induced difficulties. These observations are particularly valuable in regions where limited or no instrumental data exists, as they contribute to bridging gaps in climate research (Savo et al., 2016). The compilation of observations made by households or communities can serve as a valuable method for documenting the diverse and intricate environmental reactions to climate change. This approach can also aid in the development of efficient solutions to address these changes on a localized scale. Changes in rainfall are the most frequent type of observation by households. Households' reports are noticing a trend for change in season, such as shortening (at both ends) of the normal November to April rainy season. It has been seen by households that these alterations are occasionally linked to reductions in precipitation and escalating durations of drought, alongside a rise in the magnitude of rainfall occurrences during brief timeframes. Households also noticed when bad weather usually occurred in the last ten years.
6. Insurance

Non-structural and physical adaptation measures
The process of insurance involves the transfer of risk from an individual, entity, or organization that is insured to an insurer. As climate change adaptation strategies are seen as invaluable due to their ability to prevent long-term economic repercussions. By promptly rebuilding or providing compensation for affected residential and commercial properties, the financial losses incurred can be adapted to climate change. To provide insurance coverage for an extreme weather event, it is imperative for an insurer to possess the capacity to identify and quantify the associated risk. In developed countries, agricultural insurance also existed, such as in the US, by offering yield insurance to farmers (Jørgensen et al., 2020). In terms of the study area, self-insurance is taken by the households for protection of their home when a disaster such as flooding happens.

The presence of specific adaptation measures taken by households in Table 4 and Table 5 and its corresponding working definition is highly advantageous when engaging in discussions regarding the adaptation approach to addressing climate change, as it serves to establish the scope of adaptation measures. Nevertheless, there are still a number of inquiries pertaining to household adaptation measures that require further examination. These include (1) the distinctions between the adaptation of human systems and natural systems and (2) the potential differentiation between adaptation to climate change and regular development and planning procedures (Noble et al., 2014).

When it comes to assessing adaptation measures, there has been a noticeable disparity between the progress made in mitigation activities and that in research and climate discussions. One of the reasons for this challenge is the difficulty faced by adaptation and development experts, governmental bodies, non-governmental organizations (NGOs), and international agencies in accurately defining and precisely identifying the components of adaptation. Additionally, they encounter obstacles in monitoring the implementation and evaluating the efficacy of adaptation measures, as well as in differentiating adaptation from successful development endeavors (Arnell, 2010; Burton et al., 2002; Doria et al., 2009). One contributing factor is the absence of standardized reference measurements for adaptation, similar to the widely used metrics of greenhouse gas emissions or radiative forcing for mitigation efforts.

Despite the extensive body of literature that has been published on the subject of climate change adaptation, metrics to measure climate change adaptation are scattered. Adopting (Brooks et

al., 2011; Graça et al., 2022), this study then applies a metric of (1) a key definition related to climate change adaptation measures and (2) a key function related to climate change adaptation outcomes to measures the adaptation action taken by households in Table 4 and Table 5. The results of the measurement of adaptation measures taken by households are presented in Table 6 and Table 7.

Table 6: Measurement of structural and physical adaptation measures taken by households

Structural and physical adaptation measures
1. Urban gardening
• Key definitions related to climate change adaptation measures: The finding of this study reveals a degree of ambiguity regarding the definition of urban gardening related to climate change adaptation, despite the fact that much of the reviewed literature emphasizes the orientation of urban gardening as a climate change adaptation measure. Urban gardening refers to the cultivation, production, and refining of food and non-food items (e.g., for decoration, materials) within an urban setting. • Key function related to climate change adaptation outcomes: Urban gardening can contribute positively to climate adaptation by increasing urban vegetation cover. The planted and cultivated vegetation increases the soil's capacity for water infiltration, which in turn improves the soil's capacity for storm water discharge management (Demuzere et al., 2014). Other small-scale experiments and models show more potential for urban gardening in the context of climate change adaptation, such as cooling by shading vegetation (Rolf et al., 2020). However, due to the larger quantities of biomass in large trees, parks and private gardens can contribute more to climate change adaptation at the city level than urban gardening. When gardens are interconnected with other green spaces, their function in microclimate regulation is increased, thereby enhancing their performance.
2. Urban green space
• Key definitions related to climate change adaptation measures: Urban green space is defined as urban and peri-urban open spaces that are either partially or entirely covered by a substantial quantity of vegetation and are accessible to the public

(Conedera et al., 2015; Hadavi et al., 2015). Ever since cities have existed, urban green space has played an essential role in developed countries (Cabral et al., 2017). The definition of urban green space is, therefore, difficult to emphasize when related to climate change adaptation measures.

- Key function related to climate change adaptation outcomes:

  Prior research has primarily concentrated on examining the significance of urban green spaces in relation to climate change adaptation. This includes their potential to decrease the adverse effects of heatwaves and flooding, as well as their ability to enhance human thermal comfort (Bartesaghi Koc et al., 2018). Moreover, an increasing body of evidence has contributed to the recognition of urban green space to climate adaptation in cities, including the regulation of urban temperatures, the regulation of water flow and mitigation of runoff, and the moderation of environmental extremes (Gómez-Baggethun & Barton, 2013; Graça et al., 2022). Yet, in general, urban green space provides a variety of important benefits, including several on an ecosystem level (Guenat et al., 2021; Randrup et al., 2021), which influence and enhance the quality of life for households (Gwedla & Shackleton, 2019; Kothencz et al., 2017; Lo et al., 2017). Given the functional benefits of urban green spaces to human well-being in particular, it is difficult to assert that urban green spaces serve primarily as climate change adaptation measures.

3. Water recycling

- Key definitions related to climate change adaptation measures:

  Water recycling is the process of reclaiming effluent from a variety of sources and treating it to a standard suitable for a second use. Any form of wastewater (domestic, municipal, or industrial) can be reused and, depending on its quality can serve a variety of secondary purposes. Water recycling is mostly implemented in response to the challenges of water shortages and insufficient sanitation, which arise due to factors such as economic and industrial progress, population expansion, urbanization, and the impacts of climate change (Wakhungu, 2019). As reported by (IPCC, 2022), approximately 50% of the global population is currently facing significant water scarcity at specific intervals throughout the year as a consequence of climate change.

- Key function related to climate change adaptation outcomes:

Agricultural irrigation, groundwater recharge, industrial processes, potable water supply, and non-potable urban applications (park irrigation, lavatory flushing, etc.) are examples of secondary uses (Angelakis & Gikas, 2014). Given the existing issues pertaining to water supply, wastewater management, and the impact of climate change, it is imperative for developing nations to transition from their current water management practices to sustainable alternatives, such as the implementation of water recycling strategies as an adaptation measure.

4. Rainwater harvesting

- Key definitions related to climate change adaptation measures:
  Rainwater harvesting is a broad concept that encompasses the processes of gathering, accumulating, storing, and utilizing rainwater runoff for many applications, including home and agricultural uses (Mwenge Kahinda & Taigbenu, 2011). In addition to its utilization in the agricultural sector, rainwater collection has the potential to be expanded for the purpose of supplying water for human consumption, various home tasks, environmental objectives, and a range of small-scale productive endeavors (Oweis et al., 2001).
- Key function related to climate change adaptation outcomes:
  Rainwater harvesting as an adaptation measure may be particularly effective in tropical monsoon regions, where the seasonal cycle in rainfall is large (Pandey et al., 2003). Many urban areas are proactively promoting the practice of rainwater harvesting as an adaptation measure, while others are currently exploring its potential benefits. Rainwater collection systems are commonly utilized by low-income households as an adaptation measure to meet their domestic water needs (IPCC, 2014a). The expansion of current communal collection and distribution systems necessitates the involvement of community financing or government interventions, alongside the need to address opposition from people with higher incomes (Cashman et al., 2010).

5. Bio pore infiltration hole

- Key definitions related to climate change adaptation measures:
  Bio pore infiltration holes are holes that can be cylindrical or cube-shaped. The shape of the bio pore infiltration hole depends on the available land. If the land is large enough,

Structural and physical adaptation measures
we are free to design a bio-pore infiltration hole according to the wishes of the owner. But if the land is narrow, then simply make a cylindrical hole diameter of 10 cm (Ashabie & Masjud, 2022). Bio pore infiltration holes can be constructed within the premises of a residential property, such as the front yard, backyard, or garden. • Key function related to climate change adaptation outcomes: The use of bio pore hole infiltration, characterized by a 20 cm diameter and 15 cm depth, at regular intervals of 2 meters, has demonstrated significant efficacy as adaptation measures for surface runoff water, erosion, and nutrient losses in arid agricultural areas (Permatasari, 2015). However, this study found that bio pore infiltration holes are only frequently mentioned as climate change adaptation measures in Indonesia, while very rarely mentioned in other literature located outside of Indonesia.
6. Climate change-resistant seeds
• Key definitions related to climate change adaptation measures: Climate-resilient seeds exhibit heightened tolerance towards both biotic and abiotic challenges from climate change. These agricultural practices are designed to sustain or enhance crop productivity in the presence of stress factors, serving as a strategy to cope with declining crop yields resulting from droughts, elevated average temperatures, and other climatic circumstances. The implementation of climate-resilient seeds, such as early maturing cereal types, heat-tolerant varieties, drought-tolerant legumes or tuber, crops or varieties with enhanced salinity tolerance, or rice with submergence tolerance, can assist farmers in effectively managing the impacts of climate-related disturbances (Acevedo et al., 2020). • Key function related to climate change adaptation outcomes: Smallholder agricultural producers in developing nations are considered to be among the most susceptible populations to the impacts of climate change. These individuals face significant climate-related challenges and possess limited abilities to effectively respond and adapt to these changes. The provision of enhanced and tailored seeds to farmers constitutes a fundamental and proactive approach to adaptation, which can be broadly implemented in regions highly vulnerable to climate change impacts. The utilization of climate change-resistant seeds within impoverished smallholder systems has been observed to result in heightened levels of productivity and income to adapt to climate

Structural and physical adaptation measures
change (Cacho et al., 2020). According to a study conducted by (Islam et al., 2016) the utilization of climate-resistant seeds that possess resistance to both drought and heat has the potential to enhance agricultural yields by as much as 25% by the year 2050, considering the projected climatic patterns under the Representative Concentration Pathway (RCP) 8.5 scenario. It, therefore, can be said that climate change-resistant seeds are related to climate change adaptation measures.

Table 7: Measurement of non-structural and physical adaptation measures taken by households

Non-structural and physical adaptation measures
1. Sharing local knowledge
• Key definitions related to climate change adaptation measures: The concept of local knowledge pertains to the acquisition and mastery of insights and competencies by individuals and communities, which are uniquely tailored to the geographical location in which they reside (IPCC, 2019). Local knowledge is derived from nature-oriented approaches that have been transmitted through generations by older members of a community. This information possesses the capacity to make substantial contributions to the development of adaptation methods at various scales, including local, national, and global levels (UNHCR, 2020) • Key function related to climate change adaptation outcomes: Recent research has provided empirical evidence supporting the positive effects of local knowledge on the development of resilience and adaptive capacity, as well as its influence on tactics aimed at mitigating the challenges posed by climate unpredictability and change. This phenomenon is especially evident within the context of households or communities, whereby there may exist constraints on the availability, reliability, or utilization of scientific knowledge (IPCC, 2014b). The function of local knowledge as adaptation measures might be significant, especially in developing countries where there is limited scientific knowledge of climate change information and projection.
2. Early warning system
• Key definitions related to climate change adaptation measures:

Non-structural and physical adaptation measures

Early Warning Systems (EWS) are intricate systems designed to mitigate the consequences of natural hazards by delivering timely and pertinent information in a methodical manner. If properly executed, Early Warning Systems (EWS) have the potential to enhance the ability of developing nations to withstand natural catastrophes and climate-related hazards. Additionally, they can provide concurrent assistance in attaining the Sustainable Development Goals (SDGs) by minimizing the loss of human life and livelihood (UNDP, 2018).

- Key function related to climate change adaptation outcomes:

  The frequency and intensity of natural calamities are escalating due to climate fluctuations, coupled with the ongoing growth of the global population. The exacerbation of this tendency can be attributed to the concentration of populations in susceptible regions, the deterioration of the natural environment, and the enlargement of areas that are prone to risks as a result of climate change. This study found that early warning system has been widely used as adaptation measures for climate-related risks, such as heatwave, flood, and drought. Numerous programs at both national and local levels have prioritized the construction of early warning systems, either as standalone initiatives or as integral components of bigger projects aimed at enhancing adaptation and resilience (UNDP, 2018).

3. Household preparation and evacuation planning

- Key definitions related to climate change adaptation measures:

  Household preparation and evacuation planning are crucial components of disaster preparedness in response to the increasing frequency of extreme weather events resulting from climate change. The implementation of evacuation plans at the community level encompasses multiple components. The components encompass the assessment of the needs and demands of those who are at heightened risk during evacuation scenarios, specifically focusing on vulnerable populations such as the elderly, children, and individuals with medical susceptibilities. The objectives include the establishment of an emergency response team, the provision of training and education for both responders and community inhabitants and the assurance of the availability and preparedness of vital resources, including equipment and facilities (Asfaw et al., 2019).

- Key function related to climate change adaptation outcomes:

Non-structural and physical adaptation measures
The implementation of household preparedness measures and the development of evacuation plans are crucial components of the process of adaptation. The phenomenon of climate change has resulted in heightened occurrences of extreme climate events, including wildfires, hurricanes, coastal storms, and heavy precipitation. These events have seen amplified frequency, severity, and duration as a direct consequence of climate change (Crimmins et al., 2016; La Greca et al., 2023). The development and implementation of a household preparedness and evacuation strategy are of utmost importance in fostering climate change awareness and facilitating prompt adaptation measures (IPCC, 2014a; Noble et al., 2014).
4. Livelihood diversification
• Key definitions related to climate change adaptation measures: Livelihood diversification refers to a significant alteration in producing activities as a response to shifts in the environmental conditions resulting from climate change. The adaptation process may encompass endeavors in business expansion beyond the industry, wherein new linked activities are developed to offer supplementary sources of income (Barange et al., 2018). • Key function related to climate change adaptation outcomes: Livelihood diversification, as a strategy for climate change adaptation, encompasses the efforts made by individuals and households to explore other means of generating income and mitigating the adverse effects and risks associated with climate change. This approach can be regarded as a proactive method to adapt to changing climate (Wu et al., 2014). The potential options vary significantly in terms of the level of autonomy in decision-making (whether to diversify or not) and the potential for reversing the outcome (Dinku, 2018; Ellis, 1999). The incentives for diversification exhibit significant variation due to disparities among varied people, cultural and economic contexts, and even the environments in which households reside. It, therefore, can be said that the livelihood diversification function is related to climate change adaptation measures.
5. Climate observation
• Key definitions related to climate change adaptation measures:

Non-structural and physical adaptation measures
Household climate observations offer firsthand and comprehensive accounts of the intricate interplay between the physical and biological elements of the environment amidst the pressures of climate change. These observations are particularly valuable in regions with limited or nonexistent instrumental data, as they can contribute to bridging the gaps in climate research (Savo et al., 2016). • Key function related to climate change adaptation outcomes: The process of gathering data from households or communities can be a good approach for documenting the various and complex environmental responses to climate change. This method has the potential to facilitate the creation of effective remedies to mitigate these changes at a local level. The observation of climate variability and change serves as a reflection of the specific problems within a particular context, as well as the tangible effects that climate events have on individuals' daily lives. They exert an impact on individuals' decision-making processes and propose appropriate courses of action to be implemented (Rodriguez, 2015). It, therefore, can be said that the function of climate observation is related to climate change adaptation measures.
6. Insurance
• Key definitions related to climate change adaptation measures: The process of insurance involves the transfer of risk from an individual, entity, or organization that is insured to an insurer. The insurance sector possesses a distinctive role in adapting to the effects of climate change by enhancing the resilience of society and the economy to its impacts (Hielkema, 2023). However, for insurance to be considered as an adaptation measure, insurance should provide incentivize climate change risk prevention. • Key function related to climate change adaptation outcomes: Farmers have the option to adapt to climate change risk by making investments in insurance, which allows for the redistribution of revenue in order to ensure a certain level of income during periods of dangerous conditions (Baumgärtner et al., 2008). In developed countries, agricultural insurance also existed, such as in the US, by offering yield insurance to farmers (Jørgensen et al., 2020). However, in developing countries like Indonesia, there is not yet specific adaptation insurance. Given the functional benefits of insurance to human well-being in particular and the unavailability of specific adaptation

Non-structural and physical adaptation measures
insurance, it is difficult to assert that the function of insurance serves primarily as climate change adaptation measures.

2.4. Literature review on climate change adaptation integration and policy implication on households

This section provides a comprehensive analysis of the current body of literature on the integration of climate change adaptation and its policy implications for households, as depicted in Table 8. In the past years, a number of studies have been conducted on analyzing the integration of climate change adaptation into the development plan. Qualitative approaches are predominantly used for analyzing the process of adaptation integration into the development plan through content analysis of the development plan and interviews with relevant stakeholders. A study (Fisher, 2013) found that local adaptation integration into development plans is being implemented through hybrid arrangements between businesses and local governments. The difference between local governments in integrating adaptation into development plans is explored by (Rauken et al., 2015). According to (Rauken et al., 2015), the level of integration of climate change adaptation measures ranged from a complete absence of action to the implementation of advanced cross-sectoral initiatives by local governments.

A number of studies also have explained how adaptation integration is articulated into adaptation programs for vulnerable households. (Braunschweiger & Pütz, 2021) Report that there exist challenges associated with transitioning from coordinating measures implemented at higher levels to the implementation of specific local actions. A similar finding is shown by (Turner et al., 2020) that conclude. There are notable disparities and discontinuities between the hierarchical form of national adaptation programming guidelines and their implementation in local village activities. While (Amundsen et al., 2010) shows that adaptation efforts that have been undertaken by local government have mostly been reactive based on historical events and thus do not incorporate new knowledge on climate change.

There is a growing body of studies assessing the challenges and barriers of adaptation integration into development plans. (Measham et al., 2011) examined the constraints to adaptation, specifically in the context of local government. It identified three main barriers, lack of information, lack of resources, and institutional limitations, that are clearly evident in the case study. Using the same qualitative approach, (Regmi et al., 2016a) explored that the

incorporation of adaptation measures into development plans is hindered by socio-structural and governance obstacles that have not effectively integrated the specific adaptation requirements of local communities into local planning processes, hence limiting the enhancement of the adaptive ability of vulnerable households.

Previous studies have assessed the policy implications on local people (Chen et al., 2014; Liang et al., 2017). (Chen et al., 2014) focused on the policy implication on farmers' adaptation to drought. The findings of the study indicate that the implementation of government policies aimed at mitigating drought, such as the provision of early warning information, post-disaster services, technical aid, and financial and physical support, has had a substantial positive impact on farmers' capacity to adapt to drought conditions. (Liang et al., 2017) also focused on government support for urban flooding by households. The findings indicate that the provision of support from the government, including the dissemination of early warning information, post-disaster services, technical assistance, financial aid, and physical assistance, can have a substantial positive impact on the extent to which communities adopt adaptation strategies. (Liang et al., 2017).

From this existing literature on climate change adaptation integration and policy implication on households, this study identified that the majority of studies of adaptation integration focused on process, barriers, and challenges and how adaptation integration is articulated into adaptation programs for vulnerable households. There is limited study of the outcome of adaptation integration in the case of the content of the development plan. Also, the assessment of how adaptation integration is articulated into an adaptation program for the vulnerable house predominantly uses a qualitative approach. Though several studies have explored the policy implication on local people, there is not yet any study that focuses on the adaptation policy influence on vulnerable households.

Table 8: Literature review

Author	Scope of research	Method
(Fisher et al., 2013)	Process of adaptation integration	Data: Text mining, Interview Analysis: Qualitative
(Rauken et al., 2015)	Process of adaptation integration	Data: Interview Analysis: Qualitative

Author	Scope of research	Method
(Braunschweiger et al., 2021)	Result of adaptation integration of the plan	Data: Interview Analysis: Qualitative
(Turner-walker et al., 2020)	Result of adaptation integration of the plan	Data: Interview Analysis: Qualitative
(Amundsen et al., 2010)	Result of adaptation integration of the plan	Data: Questionnaire survey Analysis: Quantitative
(Measham et al., 2011)	Barriers and challenges of adaptation integration	Data: Interview Analysis: Qualitative
(Regmi et al., 2016)	Barriers and challenges of adaptation integration	Data: Interview, FGD Analysis: Qualitative
(Chen et al., 2014)	Policy implication on local people	Data: Questionnaire survey Analysis: Quantitative
(Liang et al., 2017)	Policy implication on local people	Data: Questionnaire survey Analysis: Quantitative

2.5. Study area

2.5.1. Study location of local governments that integrate adaptation into development plan in Indonesia

This study found that fifteen local governments were selected as pilot sites to integrate and implement RAN-API by the national government (Table 9). The process of pilot site selection involves the consideration of multiple selection criteria: 1. The comprehensive nature of vulnerability assessment, encompassing assessment, sectors, and action clusters, is of utmost importance; 2. Regional commitment entails the presence of well-defined strategies and plans, their seamless integration into the processes of planning and budgeting, and the identification of additional financing sources; 3. he implementation of adaptation-related activities, which have received financial support from the regional budget or other financing sources such as the private sector and development partners, has been ongoing; 4. The presence of a Climate Change Working Group inside the region; 5. The adherence to the RAN-API.

Table 9: Local governments that integrate adaptation into development plans in Indonesia

Local government	Medium-term development plan availability	Annual development plan availability
Bali province	2013-2018	2016
Semarang city	2016-2021	2015, 2016, 2017, 2018
Pekalongan city	2016-2021	2016, 2017, 2018, 2019
West java province	2013-2018	2016, 2017
Blitar city	2016-2021	2015, 2016, 2017
Bandar Lampung city	2016-2021	-
East java province	2014-2019	2015, 2016, 2017, 2018
Malang regency	2016-2021	-
Batu city	2012-2017; 2017-2022	2016, 2017
Malang city	2013-2018	2015, 2016, 2017, 2018
West Nusa Tenggara province	2013-2018	2015, 2016, 2017, 2018
Lombok island	-	-
Tarakan city	2016-2021	-
South Sumatra province	2013-2018	-
North Sumatra province	2013-2018	-

According to (Yulandari et al., 2023), considering that the RAN-API was published in 2014, the study area was then selected based on the disclosure conditions of the medium-term and annual development plans from 2015 to 2018 and the development plan disclosed to the public should be a complete version. From the fifteen local governments, Semarang City, East Java Province, Malang City, and West Nusa Tenggara Province were then selected as study areas for Chapter 3 (Figure 15). Though they have different government levels, they have the same responsibility to integrate adaptation into the development plan.

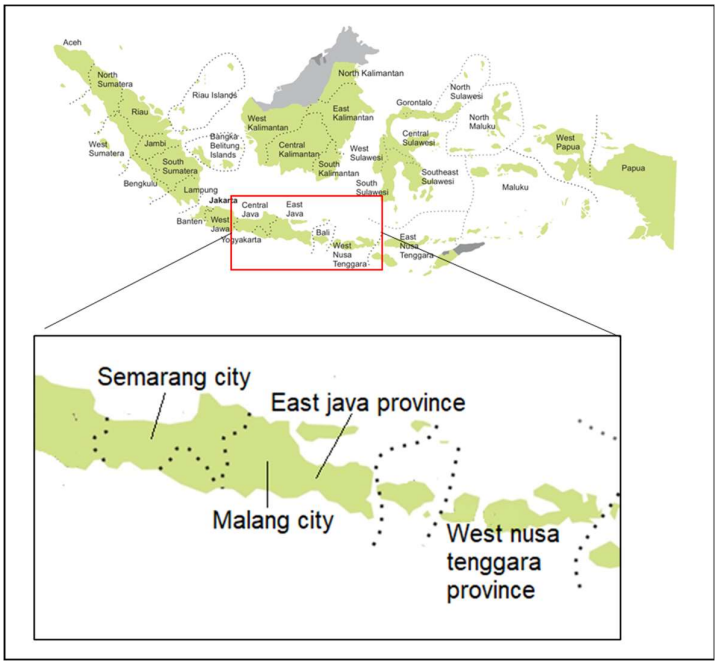

Figure 15: Local governments that integrate adaptation into development plan in Indonesia

2.5.2. Study location of adaptation integration influence on households' adaptation measures

For chapter 4, the study aims to focus more on the outcome of adaptation integration towards households. In the first preliminary survey, all four local governments, Semarang City, East Java Province, Malang City, and West Nusa Tenggara Province, studied in Chapter 3, were visited to confirm findings from Chapter 3 and find further information of adaptation program stated as the results of adaptation integration into development plan. Semarang City was then selected as it is the only local government where the location of adaptation programs is disclosed to the public.

Semarang city is one of the regions that is most sensitive to climate change impacts in Indonesia. Climate change in Semarang City has been marked by an increase in temperature, precipitation change, sea level rise, and extreme climatic events. The most tangible evidence of the occurrence of climate change in Semarang City is the increase in monthly average surface temperature over the last 100 years (Figure 16). From 1985-2016, the increased temperature of Semarang City was 0.0257º Celsius/year. This temperature increase in Semarang City from 1985-2016 is greater than the average surface temperature of Indonesia which is 0.016º Celsius/year (BAPPEDA Kota Semarang, 2019). While, in the future, it is expected the surface

temperature of Semarang City will increase 0.5-0.7º Celsius in the year 2025, 1.1-1.2º Celsius in the year 2050, and 1.9-2.9º Celsius in the year 2100 (Figure 17) (ACCCRN, 2011).

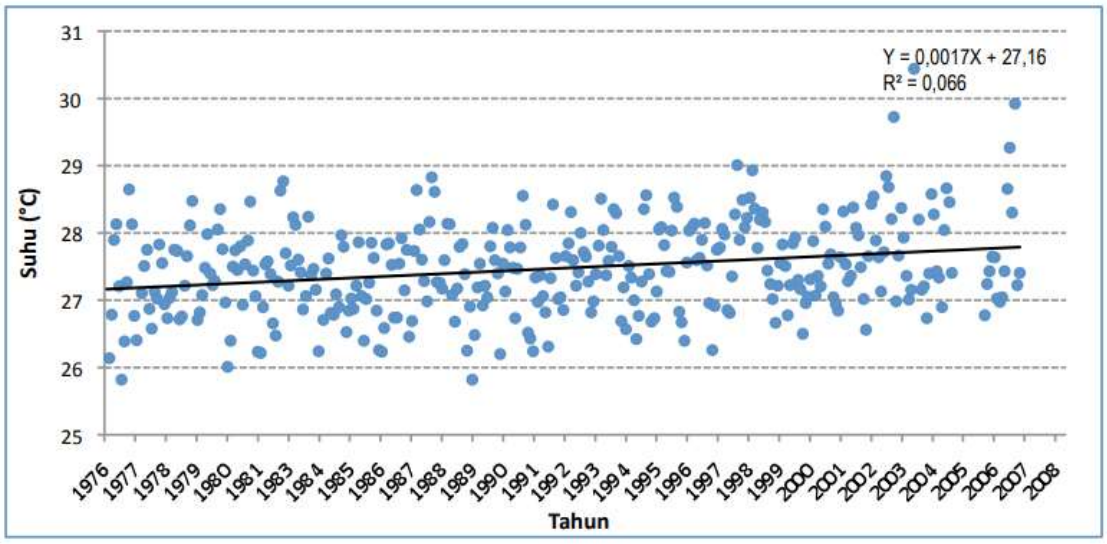

Figure 16: Increasing trend of temperature in Semarang City; Source (ACCCRN, 2011)

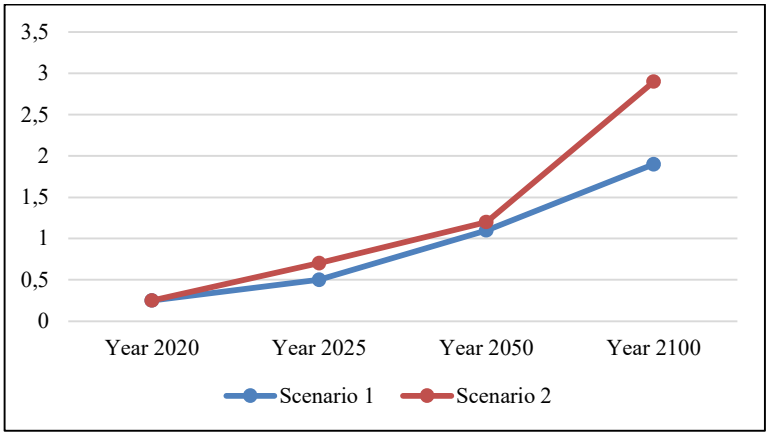

Figure 17: Prediction of temperature increase in Semarang City; Source (ACCCRN, 2011)

Rainfall in Semarang City fluctuates every month from year to year from 2001-2015 but has a relatively similar pattern each year. In some months, anomalous conditions occur, where the rainfall rate is higher than in other years (February in 2008, January in 2004 and 2006, and November in 2011) (Figure 18). This has implications for the intensity of rainfall, which has become more frequent, resulting in flooding in several areas of Semarang City (BAPPEDA Kota Semarang, 2019). Rainfall projections for 2016-2045 show that there is an increase in

rainfall until 2045. The peak rainy season continues to occur in the months of December, January, and February, and the dry season occurs during the period of June, July, August, and September. The projections also show that the likelihood of extreme climate events is high, which will impact the likelihood of increased climate hazards in Semarang (BAPPEDA Kota Semarang, 2019). The changing rainfall pattern is associated with more frequent floods in the coastline area of Semarang City, landslides in the hilly area of Semarang City, drought, and water scarcity.

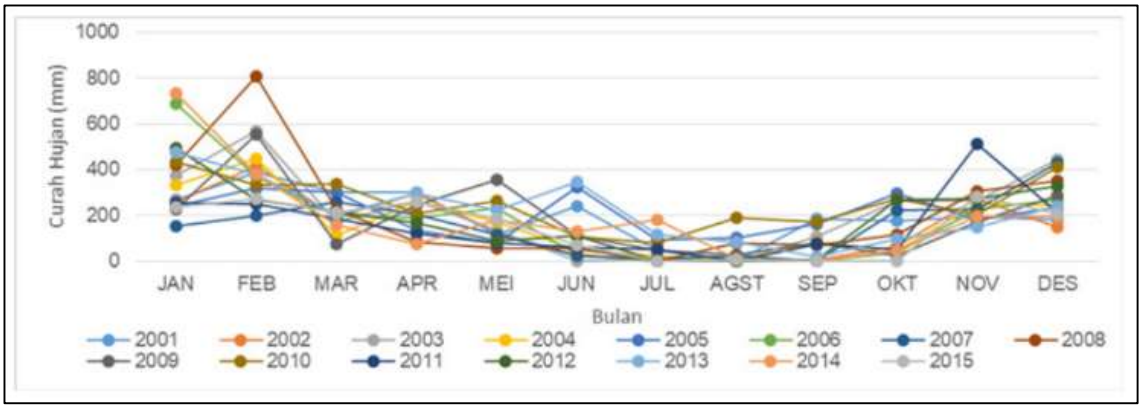

Figure 18: Monthly precipitation in Semarang City from 2001-2015; Source: (BAPPEDA Kota Semarang, 2019)

Sea levels have risen since 1985 and are expected to rise by a further 40 to 60 cm in the next 100 years (ACCCRN, 2011). From 1985-1998, the sea level rise was 58.2 cm, with an average annual sea level rise of 4.47 cm/ year (Figure 19). The sea level rise was also influenced by soil characteristics and land subsidence. To determine the level of sea level rise caused by global warming in Semarang, the difference between the rise of sea water and the total value of land subsidence at tidal stations was calculated. Utilized are sea level elevation data for the years 1985-1998 and 2003-2008. Incorporating the reduction of land subsidence into the calculation of sea level rise due to global warming yields a value of approximately 5.165 centimeters per year, or 7.8 millimeters per year due to rising sea levels due to global warming.

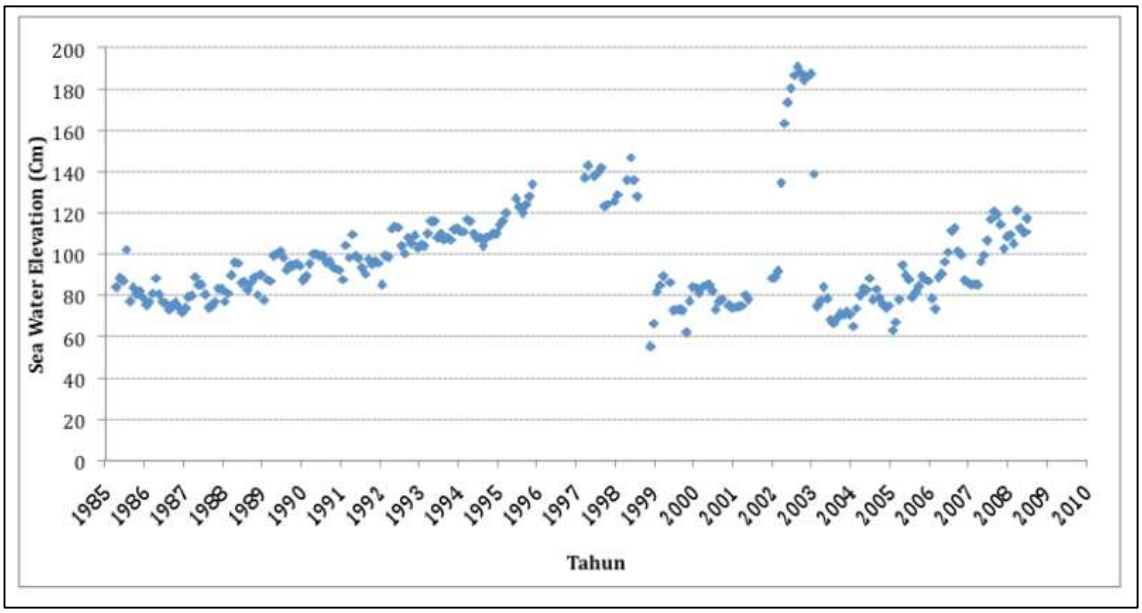

Figure 19: Sea level rise in Semarang City 1985-2010; Source (ACCCRN, 2011)

More than 1.6 million people live in Semarang City and are severely affected by climate change, and effective adaptation actions are urgently needed (BAPPEDA Kota Semarang, 2019). Through the integration of adaptation into the development plan, the local government of Semarang City has developed an adaptation program for households that aims to both achieve development goals and adapt to the adverse impacts of climate change. The forms of support offered by the local government to households for climate change adaptation are displayed in Table 10.

Semarang City is also one of the few local governments in Indonesia that has published its own local adaptation plan. The local adaptation plan of Semarang City is expected to serve as a reference in developing programs related to climate change, especially to be integrated into the medium-term development plan and annual-term development plan. The local adaptation plan of Semarang city contains the climate profile of Semarang city and climate change adaptation actions that can be taken to address climate change. The local adaptation plan of Semarang City was published in 2019 and set to help the integration of climate change adaptation into the development plan in the following year.

Table 10: Description of local government support for climate change adaptation

Local government support		Description
Information	• Monthly weather information	• Rainfall • Temperature: maximum, minimum, average • Humidity: average • Wind direction: at maximum speed • Length of sunlight
	• Past climate change information	• Average surface temperature increase (1985-2016) • Average temperature increase in the wet season (1902-2002) • Average temperature increase in the dry season (1902-2002) • Average temperature increase due to land use change (1998-2018) • Average precipitation increases (2001-2015) • Average sea level rise (1985-1998)
Technological	• Rainwater harvesting	• Rainwater harvesting is used with the aim of reducing the shortage in water supply by installing water storage tanks on the rooftops of buildings.
	• Bio pore infiltration hole	• Bio pore infiltration holes facilitate the absorption of rainwater into the soil by expanding the infiltration area.
	• Climate change-resistant seeds	• Climate change-resistant seeds have been distributed, and demonstration areas have been established to encourage households to plant new and better varieties.
	• Neighborhood drainage network development	• The implementation of neighborhood drainage systems serves as a crucial element of infrastructure aimed at enhancing

Local government support		Description
		resilience, particularly in areas that are susceptible to landslides.
Financial	• Subsidies	• Households received subsidies to improve household production and living conditions.
Capacity building	• Increase awareness of climate change adaptation.	• The objective is to enhance households' comprehension of the complexities, consequences, and obstacles associated with climate change.

From the results of in-depth interviews with the local government of Semarang City, this study found 11 villages where climate change adaptation programs were implemented by the local government (Table 11). In the preliminary survey, all 11 villages were visited to confirm whether the adaptation program is still active, the households' participation in the climate change adaptation program, and to identify the knowledge and awareness of households towards climate change adaptation. The results of the preliminary survey with 88 households show that there is no significant difference between the households in each location in the case of their participation in climate change adaptation programs, knowledge, and awareness toward climate change adaptation. This study, therefore, purposefully chooses three villages that have different characteristics of geographical conditions and vulnerability to climate change, as well as still active in climate change adaptation programs as case studies.

In the map of 11 villages where the climate change adaptation program was implemented by the local government, it can be seen that Semarang City is divided into three areas: seaside area, middle area, and hilly area (Figure 20). In the seaside area, there are only two villages which are Kemijen and Tanjungmas. In the middle area, there are three villages which are Podorejo, Purwoyoso, and Jomblang. While in the hilly area, there are as many as six villages which are Srondolkulon, Rowosari, Cepoko, Pedalangan, Karangmalang, and Plalangan. This study hypothesizes that different characteristics of the village located in the seaside area, middle area, and hilly area will influence households' decision in adopting adaptation measures, as there are different levels of climate change hazard and impact. Therefore, this study then purposefully chooses one village located in the seaside area, which is Tanjungmas Village, one village located in the middle area, which is Podorejo Village, and one village located in a hilly area,

Pedalangan Village, as a case study. These three villages are one of the few villages that accept the request for a questionnaire survey considering the COVID-19 situation in Indonesia.

Pedalangan village is in a hilly area that is prone to landslides with more intense rainfall in the wet season. The potential for land movements and landslides in certain mountainous regions of Semarang City may be heightened by climate change-induced increases in rainfall intensity during the rainy season. Additionally, wave circulation patterns may contribute to coastal abrasion in the western sections of the city's coastal regions (ACCCRN, 2011). Semarang City is frequently confronted with a significant risk due to the occurrence of high winds, which is exacerbated by extreme weather. The precise measurement of the magnitude of this occurrence remains unclear. Nevertheless, certain sub-districts located in the elevated region of Pedalangan village had an occurrence of intense wind conditions.

Tanjungmas village is characterized by sea level rise and more intense coastal flooding. Coastal regions hosting residential neighborhoods that face the imminent risk of inundation due to the rise in sea levels are home to around 300,000 individuals. The projected extent of the flooded area is expected to be around 7,500 hectares. The impacts of coastal flood in Tanjungmas village are damage to fishing infrastructure, lack of clean water, and spread of disease due to contamination of fresh water. The decline in productivity within the fisheries industry is anticipated to have a consequential effect on the livelihoods of the local population, particularly those engaged in fish farming activities in Tanjungmas village (ACCCRN, 2011). Compared to Tanjungmas village, Podorejo village is also located in a flood-prone area but is distinguished by its agricultural production system. These three villages also represent the adaptation support given by the local government of Semarang City.

Table 11: Description of local government support for climate change adaptation

Location	Adaptation program is still active
Karangmalang Village	√
Srondolkulon Village	-
Rowosari Village	√
Cepoko Village	√
Tanjungmas Village	√

Location	Adaptation program is still active
Jomblang Village	√
Kemijen Village	-
Purwoyoso Village	√
Podorejo Village	√
Plalangan Village	√
Pedalangan Village	√

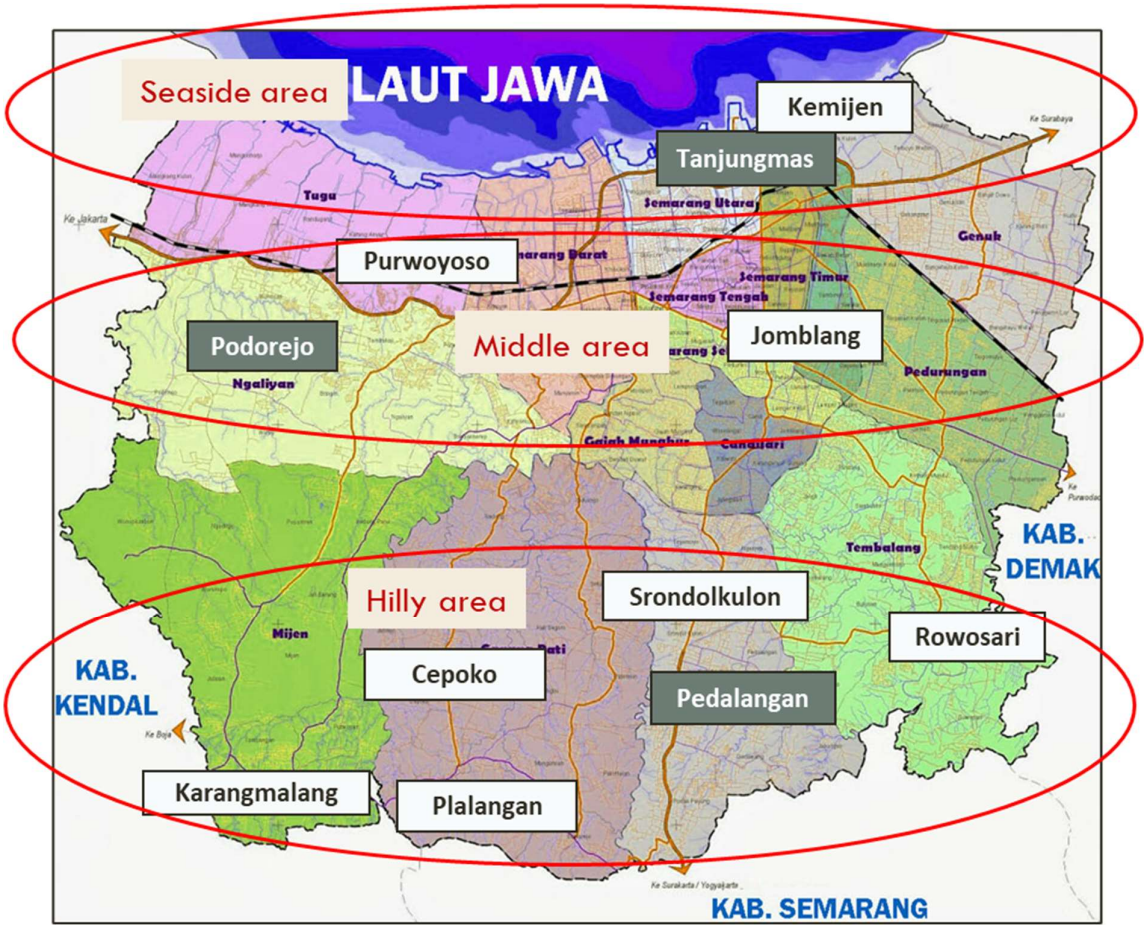

Figure 20: Study location of adaptation integration influence on households' adaptation measures

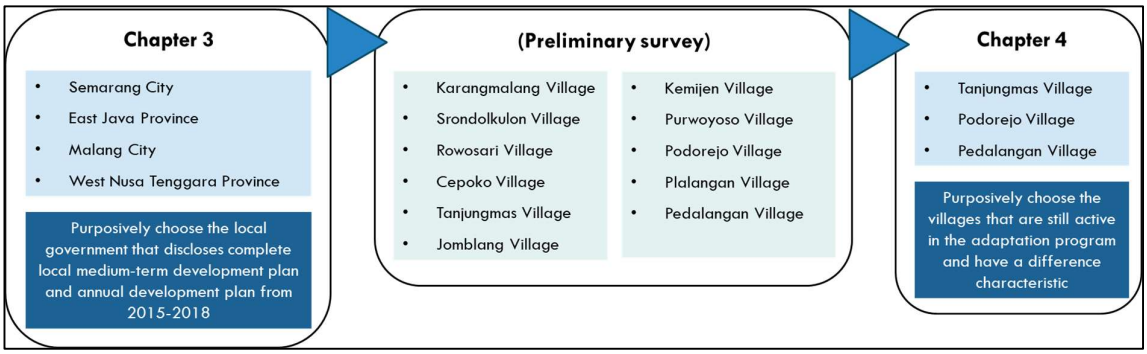

Figure 21: List of study locations in Chapter 3 and chapter 4 and their reason

2.6. Methodology

This section elaborates on the research method and comprises the method of data collection, the number of data analyzed, and the method of analysis. Table 12 shows the summary of the method.

Table 12: Summary of methodology

Summary	Objective 1 & objective 2	Objective 3	Objective 4 & objective 5
Location	• Semarang City • East Java Province • Malang City • West Nusa Tenggara Province	• Semarang City	• Pedalangan Village • Podorejo Village • Tanjungmas Village
Data collection	Text mining	In-depth interview	Face-to-face questionnaire survey
Date	March 2020	August 2022	January 2023
Number of data collected	• Four local medium-term development plans • 16 local annual development plans	Six transcripts of in-depth interviews from: 1. Local Development Planning Agency 2. Environmental Agency	• 109 households at Pedalangan village • 94 households at Podorejo village • 101 households at Tanjungmas village

Summary	Objective 1 & objective 2	Objective 3	Objective 4 & objective 5
		3. Disaster Management Agency 4. Health Agency 5. Food Security Agency 6. Agriculture Agency	
Analysis	• Coding frequency • Correspondence analysis • Co-occurrence analysis	• Descriptive analysis	• Descriptive statistics • Chi-square • Stepwise regression analysis

2.6.1. Method of data collection and the number of data collected

2.6.1.1. Text mining of development plans

To answer the objectives of chapter 3, the development plans were obtained from the website of the Indonesia national government and Semarang City, East Java Province, Malang City, and West Nusa Tenggara Province. Both medium-term development plans and annual development plans were collected. This study applies then applied text mining of the development plans using NVivo software. Text mining is a method aiming at finding interesting patterns latent in information sources and obtaining useful information. Text mining processes typically include information retrieval (methods for acquiring texts) and applications of advanced statistical methods and natural language processing (NLP) (Gabe & Rada, 2018).

The discipline of text mining is primarily categorized based on several approaches. These approaches include conversation analysis, xe "analysis of discourse positions," analysis of discourse positions, critical discourse analysis (CDA), content analysis, Foucauldian analysis, and analysis (Gabe & Rada, 2018) information (Gabe & Rada, 2018). These approaches involve the systematic and objective use of procedures to describe the content of the text (Oliveira et al., 2015). Additionally, these approaches are characterized by varying levels of analysis, namely micro, meso, and macro, and utilize distinct selection and sampling procedures.

In this study, the approach of text mining used is content analysis. At a pragmatic level, content analysis entails the construction of a coding framework that is subsequently employed to analyze textual material. The primary objective of this process is to analyze texts by dividing them into relevant units of information, enabling later coding and categorization. To conduct text mining of the development plans, NVivo software is then utilized. NVivo software offers several advantages, including time efficiency, transparency, and the ability to handle diverse types of data, including interview transcripts, videos, PDFs, or images. It is primarily utilized by researchers who deal with extremely rich text-based and/or multimedia data and require in-depth analysis of small or large data volumes (Al Nahyan et al., 2012; Paulus et al., 2017). The benefits of NVivo software have been highlighted in multiple sources (Dollah et al., 2017; Jackson & Bazeley, 2007; Leech & Onwuegbuzie, 2011; Walsh, 2015).

According to (Auld et al., 2007), NVivo facilitates the analysis process by employing a coding system that categorizes data based on a predetermined classification scheme. This system enables researchers to readily identify, index, and retrieve data as they engage in their analysis. The software additionally offers functionalities for data administration, text coding, text retrieval, and theory testing by analyzing relationships among nodes. Additionally, the fundamental building block of analysis was the node, representing a conceptual entity. During the coding process, nodes are interconnected with different sections within texts. After the coding of documents has been completed, the software can be utilized for query processing purposes. Subsequently, the researchers proceed to peruse, scrutinize, and construe the outcomes of the inquiries. Table 13 presents an overview of the primary components of NVivo, which include attributes, coding, document, and node (Auld et al., 2007).

Table 13: NVivo software key terms

NVivo key terms		
Attribute	:	Nodes or documents possess a property that is allocated to them, representing different variables such as gender.
Coding	:	The segments of text contained within a document are stored in nodes.
Document	:	A modifiable document in the format of rich text.
Node	:	An object in a project is a representation of any entity that the researcher intends to reference, including individuals, ideas, locations, and so on.

This study applied thematic analysis via coding to categorize emergent themes from the development plan documents about the indicator of climate change adaptation integration into development plan. The process of coding enables a fresh perspective on data by categorizing them based on their content rather than their source. This recontextualization of data allows for a transition from document analysis to the development of theories (Jackson & Bazeley, 2007). Since the development plan is in the Indonesian language, the text mining process of the development plan is conducted in the Indonesian language.

The node in this study is developed a priori from existing theories or concepts of climate change adaptation integration into development plans (theory-driven) (Habib et al., 2012). In the nodes, all references of indicators of climate change adaptation integration into the development plan can be seen. This methodology combined both topic coding and analytical coding at multiple nodes (co-occurring nodes). The topic coding is done through a text search query on six nodes: climate change; adaptation; climatic condition; hazard; impact; and risk (for example, codes drawn directly from the text of responses, such as 'adaptation'). It then automatically saved as nodes in a broad context that include surrounding paragraph/cell/row 20 percent. The purpose of this topic coding is to understand whether the development plans explain this theme or not and the extent of its explanation. After topic coding is done, the result then reviewed one by one and coded again into three codes: information base; vision and goal; action, based on its context in the development plans (for example, thematic categorizations interpreted from the textual responses, such as the reference of 'adaptation' is categorized as information). This process also means that one sentence will be shown in at least two codes (Figure 22).

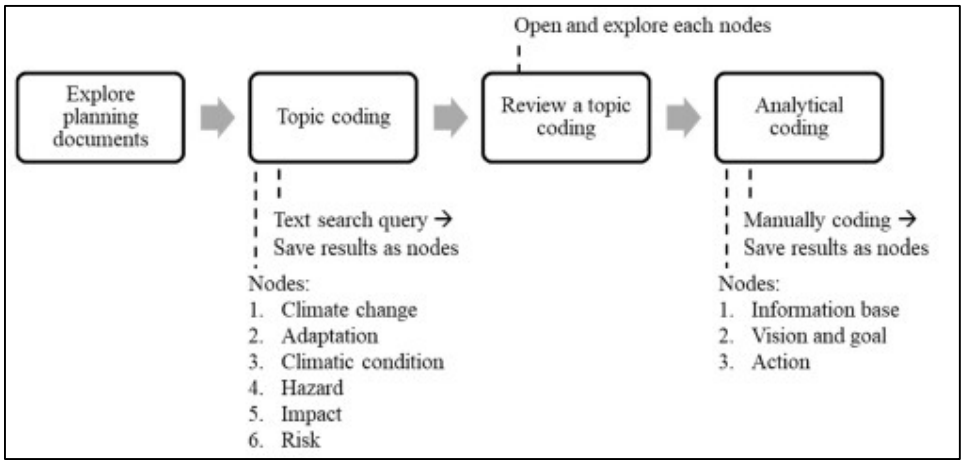

Figure 22: Process of text mining

2.6.1.2. Indicators of text mining of development plan

In Table 14, the factors for considering adaptation integration into the development plan are listed. In the present study, the two coding analysis steps applied using the NVivo software include (1) topic coding to understand the extent to which adaptation factors were addressed in the development plan and (2) analytical coding to identify the information, vision, and goal, and formulated adaptation options (Yulandari et al., 2023). According to (Yulandari et al., 2023) the indicators utilized in the coding process were developed from the conceptual framework for adaptation integration and the development plans (Table 11).

Adaptation encompasses a multitude of definitions and attributes. These variables are adapted based on guidance on adaptation integration into the development plan, which has been widely used as international principles. Each indicator contained sub-variables that may explain the factor considered for adaptation in the development plan. This study uses general types of climatic conditions, hazards, impact, and risk of climate change and does not scrutinize the type considering the variance of local governments explored in this study. In the context of this study, adaptation is operationally defined, adaptation is defined as a general plan of action for addressing the impacts and reducing the risks of climate change hazards IPCC (IPCC, 2014a; Yulandari et al., 2023). This study incorporates adaptation measures that are aimed at reducing the risks associated with climate variability and extremes (Ara Begum et al., 2022; World Bank, n.d.). Such measures may be related to development issues and not explicitly mention climate change adaptation but may facilitate adaptation or make changes that will make the system better adapted to climate change (Yulandari et al., 2023).

Table 14: Factors for considering adaptation integration into the development plan; source: (Yulandari et al., 2023)

Dimensions	Topic coding	Analytical coding
Indicators	*Climate change* 1. Climate change *Adaptation* 2. Adaptation *Climatic condition* 3. Air pressure 4. Climate	*Information* *Vision and goal* *Action*

Dimensions	Topic coding	Analytical coding
	5. Cloudiness	
	6. Humidity	
	7. Precipitation	
	8. Season	
	9. Sunlight	
	10. Temperature	
	11. Weather	
	12. Wind	
	Hazard	
	13. Coastal flood	
	14. Cold wave	
	15. Drought	
	16. Extreme weather	
	17. Flood	
	18. Heat wave	
	19. Increased air temperature	
	20. Landslide	
	21. Ocean acidification	
	22. Sea level rise	
	23. Seawater intrusion	
	24. Strong winds	
	Impact	
	25. Change in biodiversity	
	26. Change in the ecosystem	
	27. Clean water scarcity	
	28. Infrastructure damage	
	29. Fish productivity decrease	
	30. Agricultural productivity decrease	
	31. Forest fire	
	32. Land fire	
	Risk	
	33. Food insecurity	

Dimensions	Topic coding	Analytical coding
	34. Livelihood disturbance	
	35. Plague	
	36. Income reduction	

2.6.1.3. In-depth interviews with local government agencies

A set of semi-structured interviews was conducted with local government representatives of Semarang City between December to January 2021 and July to August 2022 (Yulandari et al., 2023). Participants were employed in the Local Development Planning Agency, Environmental Agency, Disaster Management Agency, Health Agency, Food Security Agency, and Agriculture Agency, all with expertise in relation to their development plans. According to (Yulandari et al., 2023) the interviews were structured around adaptation integration into development plans. In order to protect the confidentiality of certain obtained data, participants were informed prior to the commencement of the interview that their identities would be kept confidential to the extent practicable. The guidelines for in-depth interviews with the local government agencies are presented in Annex 1.

2.6.1.4. Questionnaire survey with households

Data collection was collected in January 2023. The data collection was conducted based on a door-to-door survey in an attempt to visit all households that participated in the adaptation program. A door-to-door survey is chosen as it is more effective compared to a telephone or mailing survey to get a high response rate in developing countries. Prior to survey time, all the households that participated in the climate change adaptation program are visited to invite household members to join the interview at their most convenient time.

Efforts were made to ensure that the respondents are the household members who participate most often in the climate change adaptation program to ensure the reliability of the data collected about the adaptation program. Interviewing all the household members who participate in the adaptation program is not possible due to time limitations and budgetary constraints. The questionnaire mainly covered three major issues: (1) households' need for adapting to climate change; (2) local government support for adapting to climate change; (3) households adopted adaptation measures against climate change.

The survey was conducted with the help of enumerators, undergraduate students from Universitas Diponegoro, who received training before conducting the survey. The questionnaire interview was conducted in the Indonesian language. The participants were provided with information regarding the objective of the study prior to the commencement of the interview. The interview was carried out subsequent to obtaining verbal agreement from each participant. The present work received approval from the Human Ethics Committee at the Tokyo Institute of Technology.

In 2022, as many as 109 households in Pedalangan village, 106 households in Tanjungmas village, and 101 households in Podorejo village participated in the adaptation program. All 316 households became the target respondents in this study, and 304 households were successfully interviewed using a questionnaire in a face-to-face manner in January 2023. During the survey, seven households of Podorejo and five households of Tanjungmas had difficulty meeting because of several reasons: they were unavailable until the end of the survey date or unwilling to participate.

2.6.1.5. Questionnaire design of survey with households

The questionnaire had four sections: (a) socio-demographic information; (b) households' need for adapting to climate change; (c) local government support for adaptation to climate change; and (d) households adopted adaptation measures against climate change. The questionnaire was designed with both closed and open questions. The original version of the questionnaire was developed in English and was translated into Indonesia.

Variables for each subcomponent were selected based on information collected through in-depth interviews with the local government agencies, a preliminary survey, and an extensive review of previous literature (Table 15). For example, “adaptation support” were analyzed using variables of information support, technological support, financial support, and capacity. The indicator “households adopted adaptation measure” was examined through a comparison of structural and physical adaptation measures and non-structural and physical adaptation measures. Initially, this study selected the indicators of adaptation support and needs through an extensive review of literature related to household adaptation measures. Finally, potential indicators of adaptation measures taken by households were selected considering the local context. The relationship between indicators is illustrated in Figure 23. The questionnaire used in this study is presented in Annex 2.

Table 15: Variables of household questionnaire survey

Variables	Description
Socio-demographic	
Age	Age of respondent
Sex	Sex of respondent
Level of education	Level of education of respondent
Occupation	Occupation of respondent
Monthly income	Monthly income of the household
Adaptation need	
Need information	Need information support for adapting to climate change
Need technological	Need technological support for adapting to climate change
Need financial	Need financial support for adapting to climate change
Need capacity building	Need capacity-building support for adapting to climate change
Adaptation support	
Support information	Support information is provided
Support technological	Support technological is provided
Support financial	Support financial is provided
Support capacity building	Support capacity building is provided
Adaptation measures are taken by household	
Structural and physical adaptation measures	Households adopting structural and physical adaptation measures
Non-structural and physical adaptation measures	Households adopting non-structural and physical adaptation measures

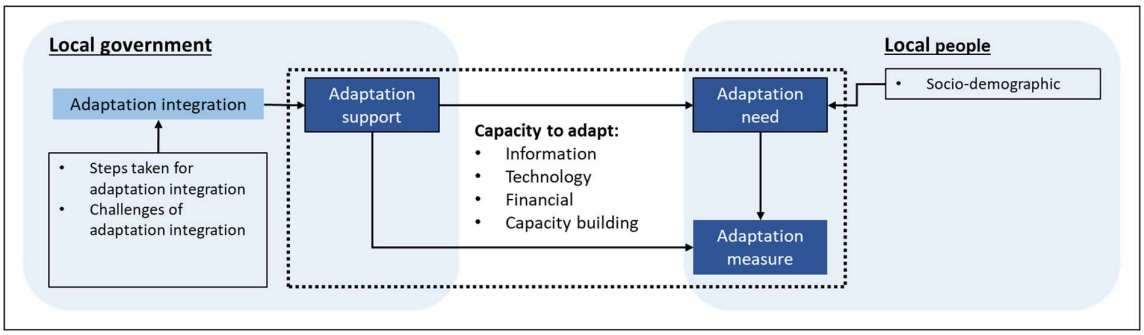

Figure 23: Framework of adaptation need, adaptation support, and adaptation measures taken

2.6.2. Method of data analysis

The research method employed a mixed method of quantitative analysis and qualitative analysis. Table 12 shows the method of analysis corresponding to its chapter. The following section describes each method.

2.6.2.1. Quantitative analysis

Coding frequency analysis

Coding frequency analysis aims to understand the themes reflected in the development plan. In this study, the analysis is conducted in NVivo software by conducting a text search query of each keyword and then saved to the node. The most frequent node represents the close attention given to those themes. A text search query allows for the identification of particular words or phrases, or a set of alternative terms, among chosen sources or text that has been coded at precise nodes (Jackson & Bazeley, 2007). The instances are thereafter kept as nodes. A text search can be employed as a strategic methodology to effectively identify, analyze, and categorize textual data. Additionally, manual coding to interpret the results of text search queries is also conducted.

Correspondence analysis

Correspondence analysis provides a spatial representation of the rows and columns of a correspondence table that preserves their similarity (Wright, 2015). The methodology is especially advantageous for assessing cross-tabulated data represented by numerical frequencies. It yields a visually appealing yet straightforward graphical representation that

facilitates quicker interpretation and comprehension of the data (Greenacre, 2017). In this study, the cross-tabulated data was collected from the results of text mining in NVivo software and further analyzed in SPSS software to develop the multi-dimensional map. In total, the results of text mining of 36 topic coding indicators of adaptation integration into the development plan (Table 14) from the NVivo software are used to show the proportion of local governments associated with 20 development plans of East Java Province, Malang City, West Nusa Tenggara Province, and Semarang City local governments. In Table 29 in annex 3, East Java Province development plans are represented by A, B, C, D, and E; Malang City development plans are represented by F, G, H, I, and J; West Nusa Tenggara Province development plans are represented by K, L, M, N, and O; and Semarang City development plans are represented by P, Q, R, S, and T.

According to (Greenacre, 2009), correspondence analysis is a multivariate method that relies on singular value decomposition (SVD), among other techniques. In the context of the geometric interpretation of the Singular Value Decomposition (SVD), the data matrix's rows and/or columns represent points in a multidimensional space. The SVD is utilized to identify subspaces with low dimensionality that effectively capture the highest sum of squares within the data. The computer algorithm for determining the coordinates of the row and column profiles in relation to the principal axes, utilizing the singular value decomposition (SVD), can be described as follows:

- Calculate the matrix of standardized residuals (Greenacre, 2009):
  $S = D_r^{-1/2}(P - rc^T)D_c^{-1/2}$
- Calculate the SVD (Greenacre, 2009):
  $S = UD_oV^T$ where $U^TU = V^TV = I$
- Principal coordinates of rows (Greenacre, 2009):
  $F = D_r^{-1/2}UD_o$
- Principal coordinates of columns (Greenacre, 2009):
  $G = D_r^{-1/2}VD_o$

This study conducts correspondence analysis using SPSS software. In general, there are four steps of correspondence analysis using SPSS software (Doey & Kurta, 2011): (1) input the data; (2) weight the data; (3) running the analysis; (4) interpreting the results.

- Step 1: Input the data.

The initial step in the data analysis process involves the input of relevant data. The data entry process can be conducted under the assumption that the frequency of each variable has been precalculated. In this study, the frequency of each variable is collected from the result of the text mining process in NVivo software. In this study, three variables were established, namely variable 1 denoting topic coding nodes (indicator of adaptation integration into development plan), variable 2 representing document (development plan documents of local governments), and variable 3 indicating frequency (Doey & Kurta, 2011).

- Step 2: Weight the data.
  After inputting all the data into SPSS, the subsequent procedure involves assigning weights to the cases based on their frequency (Doey & Kurta, 2011).
- Step 3: Running the analysis.
  After applying frequency weighting to the data, it becomes feasible to conduct the analysis using SPSS. In this study, the topic coding indicator of adaptation integration into the development plan is inserted into the Row profiles, while the development plan documents are inserted into the Column profiles (Doey & Kurta, 2011).
- Step 4: Interpreting the results.
  According to. (Doey & Kurta, 2011) SPSS software generates a Correspondence Table, which is presented in Table 29 in annex 3. The data shown in this analysis is derived from the information input for topic coding nodes (an indicator of adaptation integration into the development plan) and documents (development plan documents of local governments) in the SPSS. The analysis will encompass the frequencies of the provided row and column categories and generate a summation for each row and column category referred to as the 'Active Margin.' While Table 30 in annex 3 presents a Row Profiles table. The provided table presents the weighted frequency distribution of each row point, ensuring that the cumulative total for each row is equal to 1. Further, SPSS generates a table known as Column Profiles (Table 31 in annex 3), which is computed using the same methodology as the Row Profiles table.

Co-occurrence analysis

Co-occurrence analysis aims to illustrate the changes and stabilities in the concepts of related information by simply investigating whether the information co-occurs with one another. When information co-occurs, there is an association between them. In this study, cooccurrence

analysis was used to see the association between nodes. The analysis was conducted in Voyant Tools, an open-source web text analysis that is available through GitHub (Yulandari et al., 2023).

Descriptive statistics

Data from the questionnaire surveys were analyzed using Statistical Package for Social Sciences (SPSS version 27.0). Frequency, percentage, mean, standard deviation, and crosstabs were used to describe households' characteristics, adaptation needs, adaptation support, and adaptation measure taken by households, among others.

Chi-square test of independence

The chi-square test of independence between two variables is determined by whether two variables (nominal or categorical) are independent or related. In this analysis, the relationship between two variables is identified by a value of significance in three categories:

$p < .01$: (***), or strong

$p < .011 – p < .05$: (**), or moderate

$p < .051 – p < .1$: (*), or weak

Hypothesis for the analysis are:

a. H0: There is no relationship between the two variables.

b. H1: There is a relationship between two variables.

The result of Chi-square was executed by following criteria:

a. If Asymptotic significance (2-sided) < p, then H0 is rejected, H1 accepted.

b. If Asymptotic significance (2-sided) > p,1, then H0 is accepted, H1 rejected.

The Crosstab table is presented to support the analysis of the relationship between the two variables.

Stepwise regression

Stepwise regression is a systematic and iterative process of constructing a regression model, wherein the selection of independent variables is performed in a step-by-step manner to determine the variables that will be included in the final model. When predictor variables are investigated sequentially (also referred to as 'stepwise'), variables are sequentially entered into and/or removed from the model (Mundry & Nunn, 2009). According to (Mundry & Nunn, 2009), the final outcome of each of these stepwise techniques is intended to consist of the subset of predictor variables that significantly impact the response variable and provide the most accurate explanation of the result.

2.6.2.2. Qualitative analysis

Typology analysis

The identification of needs arising from climate risks and vulnerabilities serves as a fundamental basis for the selection of adaptation options. This study employs a thorough classification based on the IPCC 2014 report to account for the broad range of adaptation strategies available in different cities (Noble et al. 2015). The available choices for adaptation measures are classified into three overarching categories: structural/physical, social, and institutional. (Yulandari et al., 2023).

Policy type analysis

According to (Yulandari et al., 2023), this study aims to classify four distinct categories of adaptation policies in order to examine the extent to which climate change is taken into account in suggested adaptation strategies. Additionally, the study seeks to assess the effectiveness of these measures in reducing vulnerability and enhancing resilience for both the city and its residents. (Dupuis & Biesbroek, 2013). The policy type is divided into four categories: contiguous policy, contributive policy, concrete policy, and symbolic policy.

Content analysis

This method was employed to examine data from in-depth interviews with stakeholders regarding the process of adaptation integration into medium-term development plans and

annual development plans based on RAN-API. The data were transcribed from interviews and open-ended questionnaires by local stakeholders. The first step of the analysis was categorizing or labeling the data according to the three indicators: steps of adaptation integration, roles, and contribution, barriers, and strategies to overcome them. Data were organized by this category to focus on how the informants responded to each topic. The process also included checking consistencies all across the informants.

2.7. Study innovation and its significance

To the best of our knowledge, this is the first study that explores a comprehensive assessment of climate change adaptation integration into the development plan, considering the steps taken to integrate, the outcome of integration towards the content of the development plan, and the outcome of integration towards vulnerable households. This research is significant in terms of the following:

First, this research fills the gap in the current literature dedicated to climate change adaptation policies and plans. Previous studies mainly focus on processes, barriers, and challenges and how adaptation integration is articulated into adaptation programs for vulnerable households (see Table 8). There is limited study of the outcome of adaptation integration in the case of the content of the development plan. Also, the assessment of how adaptation integration is articulated into an adaptation program for the vulnerable house predominantly uses a qualitative approach. Though several studies have explored the policy implication on local people, there is not yet any study that focuses on the adaptation policy influence on vulnerable households.

Second, this study presents a novel framework from both the local government and households' side. The author assesses the adaptation integration into the development plan from the perspective of local government as the implementing organization and households as the beneficiary of the program and support.

Third, according to (Yulandari et al., 2023), the common barriers to encouraging adaptation integration among local governments are mostly related to Indonesia's climate governance, such as insufficient climate change knowledge, lack of financial resources, and the absence of regulation (Mertz et al., 2009a; Mulyani & Jepson, 2013; A. B. Rahman, 2017; Sietz et al., 2011). Indonesia presents a compelling argument for investigating the integration of adaption measures into local government development plans. The knowledge gained from the

Indonesian experience holds potential for application in other developing countries, particularly those facing similar impacts from climate change (Yulandari et al., 2023).

CHAPTER 3
EVALUATION OF ADAPTATION INTEGRATION TOWARDS DEVELOPMENT PLAN

This chapter presents an investigation into how the local governments of Indonesia integrate the national adaptation plans towards development plans. To understand the full context, the content of the development plan was explored. Then, the ways in which local governments integrate adaptation and challenges and barriers were identified.

3.1. Objective of the evaluation

In this chapter, the study objectives are:

1. To examine how adaptation is addressed over the development plans.
2. To identify adaptation options formulated to respond to climate change.
3. To analyze what steps are taken to integrate adaptation into development plans.

3.2. Summary of method

Table 16: Summary of methods in Chapter 3

No	Summary	Chapter 3
1	Case study	• Semarang City • Malang City • East Java Province • West Nusa Tenggara Province
2	Method of data collection	• Development plan documents were obtained from the official national government and local government websites. • Data from development plans were collected using text mining methodology. • In-depth interviews were conducted with local government agencies of Semarang City

No	Summary	Chapter 3
3	Number of data collected	• 1 medium-term development plan from each respective local government. In total, 4 medium-term development plans were collected. • 4 yearly development plans from each respective local government. In total, 16 yearly development plans were collected. • 6 in-depth interviews with local government agencies of Semarang City: Local Development Planning Agency, Environmental Agency, Disaster Management Agency, Health Agency, Food Security Agency, and Agriculture Agency
4	Method of analysis	• Coding frequency analysis • Correspondence analysis • Co-occurrence analysis • Typology analysis • Policy type analysis • Content analysis

Primary data were collected in two different ways. First, a text mining of development plans was carried out in September 2019. Second, a set of semi-structured interviews was conducted with local government representatives of Semarang City between December to January 2021 and July to August 2022. Participants were employed in the Local Development Planning Agency, Environmental Agency, Disaster Management Agency, Health Agency, Food Security Agency, and Agriculture Agency, all with expertise in relation to their development plans (Yulandari et al., 2023).

3.3. Results

3.3.1. Adaptation content over the development plan

To gain a deeper understanding of the relationship of climate change adaptation integration into development plan in the development plan documents, NVivo software was utilized to conduct text mining of the six indicators of climate change adaptation integration into

development plan (climate change; adaptation; climatic condition; hazard; impact; risk) and the development plan component (information, vision & goal, action) within the twenty development plan documents of East Java Province local government, Malang City local government, West Nusa Tenggara Province local government, and Semarang City local government. The results of these text mining were analyzed to determine how the six indicators of climate change adaptation integration into the development plan were mentioned in the development plan documents and how climate change adaptation integration into the development plan influenced the component development plan documents (Nair et al., 2011; Paulus et al., 2017).

Text mining using NVivo software encompasses a tripartite process with two distinct stages: The two steps of the text mining process are pre-analysis using topic-coding and exploration using analytical coding. The pre-analysis seeks to determine the frequency of subjects within the text that is being analyzed using quantitative measures. From the qualitative viewpoint, the primary objective is to ascertain the presence or absence of a specific topic within the content under examination (Oliveira et al., 2015). While during the exploratory phase of text mining, it is crucial to consider the relationship between the results topic coding in pre-analysis and the category of development plans they represent.

The pre-analysis using topic coding seeks to determine the frequency of subjects within the text that is being analyzed using quantitative measures. The content of development plan documents was assigned topic-coding nodes in order to facilitate the categorization of information based on the indicator of climate change adaptation integration into the development plan, including climate change, adaptation, climatic condition, hazard, impact, and risk. The pre-analysis of topic coding is then implemented using NVivo text search queries, as depicted in Figure 24. The text search queries of NVivo seamlessly incorporate the search functionality for text, code, and attributes such as climate change, adaptation, and flood to identify logical relationships. Additionally, it generates matrix tables that visually represent patterns (Figure 25) (Auld et al., 2007).

During the exploratory phase using analytical coding, it is crucial to examine the direct relationship between the results of topic-coding of six indicators of climate change adaptation integration into the development plan and the component of development plan of information, vision & goal, and action. In order to conduct the analytical coding, a comprehensive review of the references of topic coding nodes was conducted as a meticulous examination of each provision, line by line (Hall & Steiner, 2020). In analytical coding, the NVivo software did not

execute any automated operations using any queries (Nair et al., 2011). This study conducted analytical coding of a thorough examination of the references of topic coding results with the specific objective of identifying whether the references can be classified as information, vision, goal, or action. An example of how to conduct analytical coding can be seen in Figure 26.

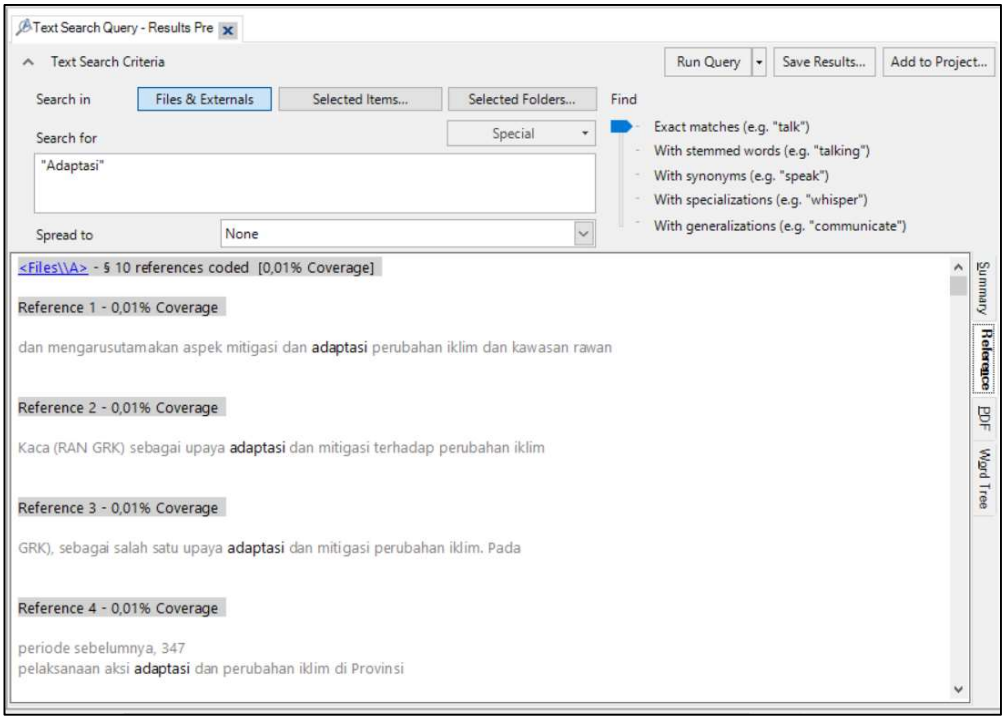

Figure 24: Topic coding using text search query in this study

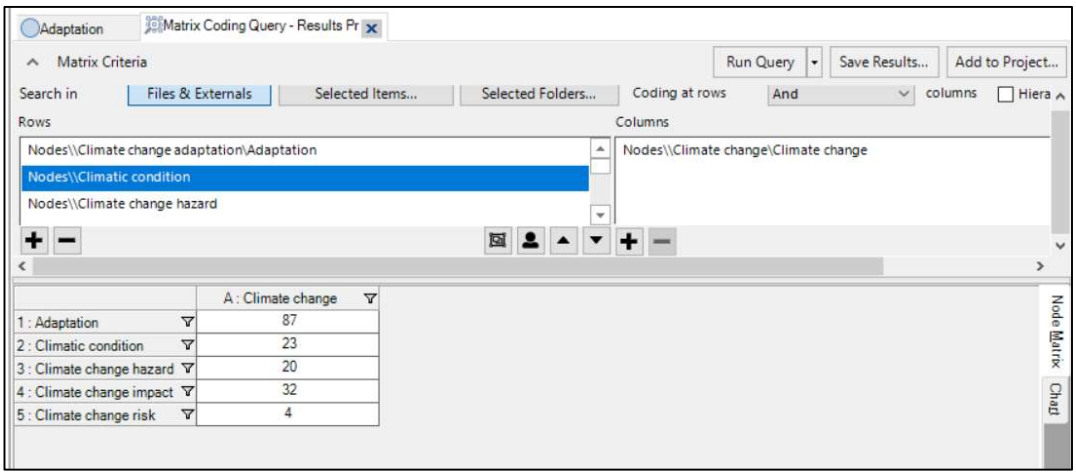

Figure 25: Matrix table from a text search query in this study

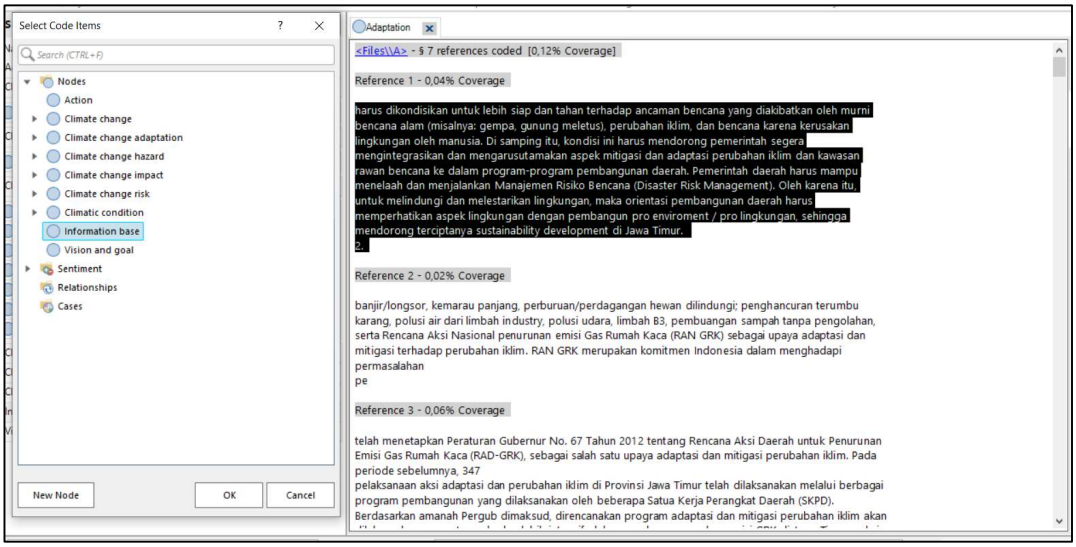

Figure 26: Analytical coding from the results of topic coding in this study

3.3.1.1. Distribution of climate change adaptation keywords in the development plans

This study analyzed six keywords represented in each topic-coding node, climate change, adaptation, climatic condition, hazard, impact, and risk, over the development plan with a total number of 1918 coding. From those six nodes, it is identified that impact has the highest frequency, followed by climatic condition, climate change, hazard, adaptation, and risk, respectively (Figure 27). With 875 codings, there is a huge gap in frequency between the impact and the other nodes. Climatic condition, which is the second most frequent node, only has 506 codings. While climate change, hazard, adaptation, and risk even have less coding, with 193 codings, 190 codings, 110 codings, and 44 codings, respectively.

The result in Figure 28 also emphasis the frequency gap between impact and other nodes. The graph illustrates that almost half of the total coding represents impact. On the other hand, the risk, which is the least frequent node, only accounts for 2% of the total coding. The climatic condition makes up around a quarter of the total coding with 26%. While climate change and hazard have the same percentage with 10% for each of the nodes, and lastly, adaptation accounts for 6% of the total coding. Both the results in Figure 27 and Figure 28 show that even though the development plan already addresses adaptation and climate change, compared to impact, it is still not mentioned much.

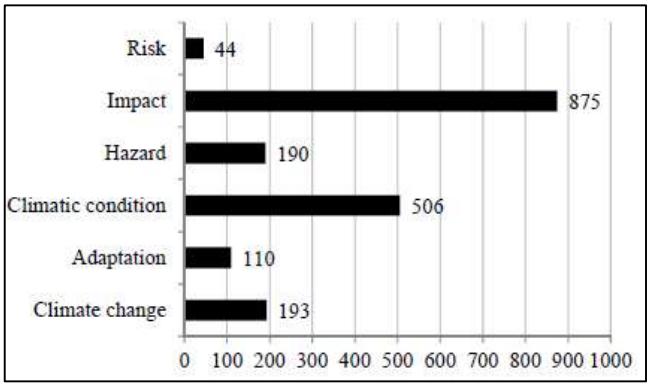

Figure 27: Number of coding in each topic node (n coding = 1918, all development plans)

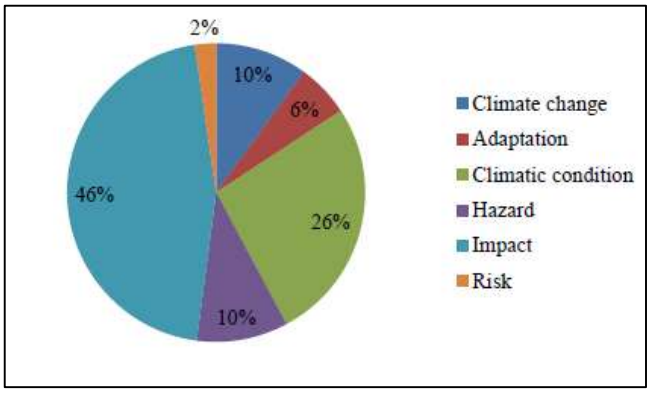

Figure 28: Percentage of coding in each topic node (n coding = 1918, all development plans)

Furthermore, this study also tries to see the distribution of the topic-coding nodes in the component of the development plan: information base, vision & goal, and action that is represented in the analytical-coding nodes with a total number of 754 codings. Figure 29 shows the information base as the most frequent (357 codings), followed by action (267 codings) and vision & goal (130 codings). In Figure 30, it can also be observed that around half of the total coding is information base (47%), while the percentage of action is 35% of all total coding, and the percentage of vision & goal is 17% of all total coding.

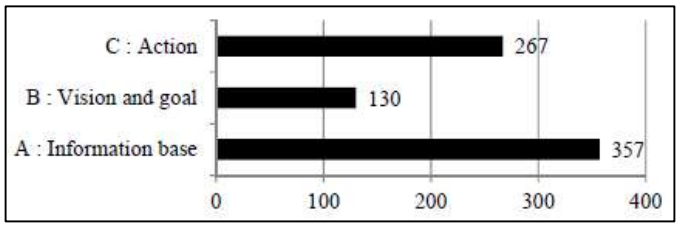

Figure 29: Number of coding in each analytical node (n coding = 754, all development plans)

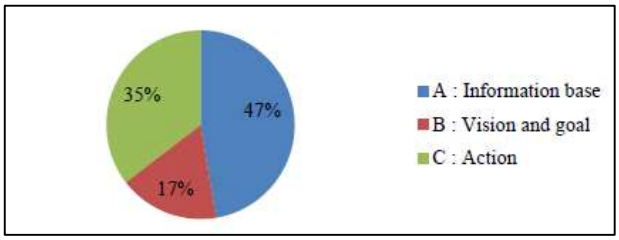

Figure 30: Number of coding in each analytical node (n coding = 754, all development plans)

Information is an important part of the development plan; it gives a good base for building the vision & goal that eventually will conduct in action. However, if there is only information available without the vision & goal, and action, it is also unnecessary. It is better to have a balance between information base, vision & goal, and action. To understand whether the information in the development plans is translated into vision & goal, and action or not for each indicator, this study analyzed the matrix coding query between the indicators and the component of the development plan.

The result in Figure 31 illustrates the distribution of information base, vision & goal, and action for a total of forty indicators of climate change, adaptation, climatic condition, hazard, impact, and risk nodes (Yulandari et al., 2023). This study found 880 occurrences of total codes. Among adaptation and its factors, hazards are the most frequently mentioned (47%), followed by climatic conditions (24%), climate change (14%), adaptation (7%), impacts (5%), and risks (3%). Overall, information is dominant relative to vision and goals, and actions, representing 61%, 13%, and 27%, respectively, of the total codes (Yulandari et al., 2023).

According to (Yulandari et al., 2023), the information is dominated by hazards and climatic conditions, with adaptation, climate change, impacts, and risks representing merely 20%. Adaptation and risks occur in the least proportions, with the frequency of 17 out of 880 occurrences exhibited by adaptation as the last but one. Typically, information on adaptation

is descriptive and concentrated in generalized situations, without specifics for local situations. Although the importance of adaptation is highlighted in the development plans, further explanations of the requirements for each local government are lacking.

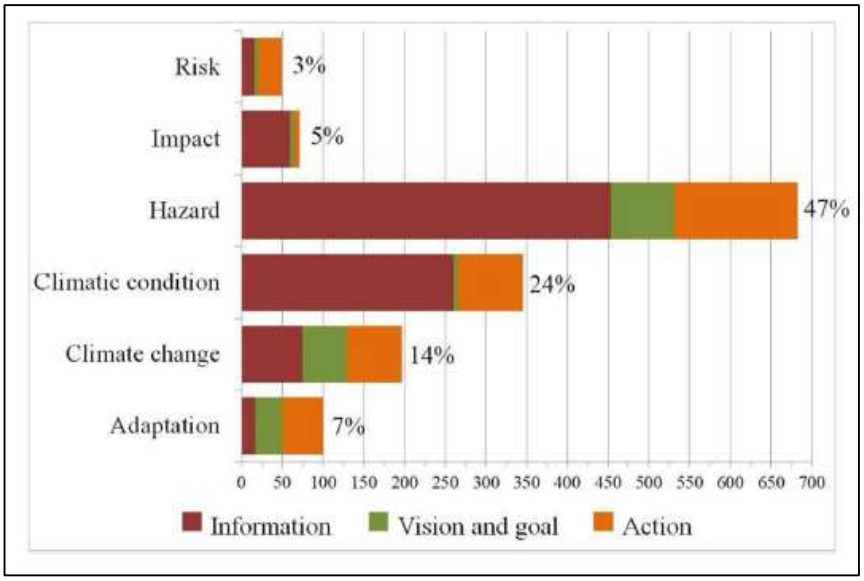

Figure 31: Codes associated with adaptation and the proportion of adaptation factors in the development plans (n coding=1918, all development plans); source: (Yulandari et al., 2023)

Regarding hazards, floods emerge as the principal climate hazard faced by local governments (Figure 32), with all but one development plan mentioning floods (Yulandari et al., 2023). The floods faced in local government areas reduced economic productivity, damaged assets, and disrupted public services. Drought and landslides, the second and third most common hazards, are mentioned in more than three-quarters of the development plans. However, some hazard indicators, such as seawater intrusion, ocean acidification, heat waves, cold waves, and coastal floods, were not identified in this study. In addition, sea level rise and increased air temperature, which represent climate change hazards, are rarely mentioned in the development plans.

(Yulandari et al., 2023) Identified that although the hazard information frequency is high, it is mostly on floods, droughts, and landslides. According to previous studies, Indonesia also faces climate hazards, such as coastal floods, increased air atmospheric temperature, and sea-level rise (BAPPENAS, 2014; Fenoglio-Marc et al., 2012; A. B. Rahman, 2017). This result shows even though information on the climatic condition and hazards is available from Meteorology

and Climatology agency, and it might be inadequate for adaptation. (Charbit & Michalun, 2009) Indicated that in addition to climate-related historical data, projections and vulnerability assessments of the future are crucial for adaptation. In fact, local governments in Indonesia are also not obliged to conduct climate change projections or vulnerability assessments. The lack of comprehensive information poses a challenge for local governments in fully incorporating climate change hazards into their development plans.

The quality of a development plan is also linked to its vision and goals (Guyadeen et al., 2019). In adaptation integration, development plans must incorporate vision and goals related to adaptation, climate change, climatic conditions, hazards, impacts, and risks. In this study, climatic conditions, impacts, and risks are identified as the weakest components of the vision and goals of local governments in Indonesia (Figure 31). Among 182 occurrences of visions and goals, 78 are associated with hazards, with almost all hazard-related visions and goals involving floods (Yulandari et al., 2023). Despite its high frequency, merely half of the development plans contain hazard-related vision and goals.

"Realizing a disaster management system to increase community resilience in the face of climate disasters."—East Java Province medium-term development plan.

In contrast, according to (Yulandari et al., 2023), most development plans contain adaptation and climate change visions and goals. However, these are commonly general and not linked to specific desired outcomes. Although efforts to integrate adaptation into the vision and goals of their development plans are considerable, the local governments generally fail to clearly formulate adaptation vision and goals. This study, however, does not examine how effectively actions align with the vision and goals stated in the development plans.

"Improving environmental quality and resilience to climate change"—East Java Province medium-term development plan.

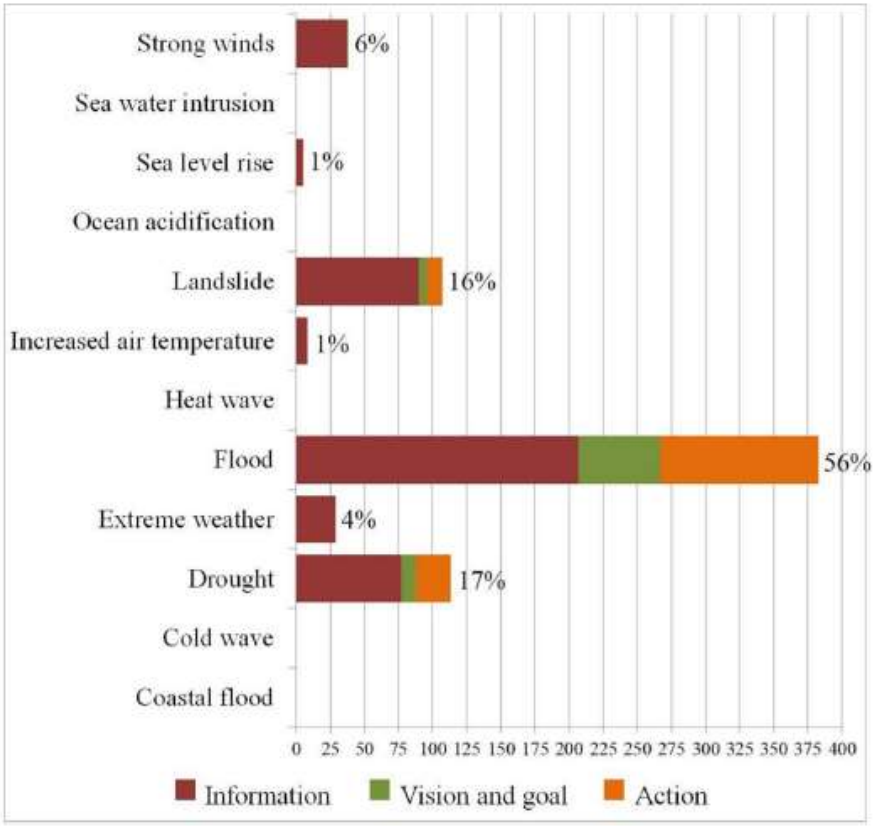

Figure 32: Proportions of hazard indicators in the development plans (n coding=901, all development plans); source: (Yulandari et al., 2023).

3.3.1.2. Main climate change adaptation keywords in the development plans

In this study, correspondence analysis aims to investigate the correlation between the indicators of adaptation integration into development plan residency and the development plans of each local government. There are a total of twenty development plans from four different locations: East Java Province (A, B, C, D, and E); Malang City (F, G, H, I, and J); West Nusa Tenggara Province (K, L, M, N, and O); Semarang City (P, Q, R, S, and T) and there are 36 indicators of adaptation integration into the development plan: climate change; adaptation; climatic condition; hazard; impact; risk (Table 11). Table 21 in annex 3 displays the contingency table with the frequencies. Let i=1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36 denote the levels of the row variable, indicators of adaptation integration into the development plan, and j=1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 represent the levels of the column variable, development plans of each local government (Table 21 in annex 3).

According to (Clausen, 1998; Sourial et al., 2010), correspondence analysis involves the examination of the contingency table by analyzing the row and column profiles, as shown in Table 22 in annex 3 and Table 23 in annex 3. The row profiles in this study represent the relative frequencies of indicators of climate change adaptation integration into the development plan within each assessed development plan document. As an illustration, among the 77 coding of drought, it was seen that drought was the most frequently mentioned in development plan document D of East Java Province, accounting for 32% of the total coding of drought in all development plan documents.

The average row profile, as shown in the last row of Table 22 in annex 3, is calculated by taking the weighted average of the row profiles. This is done by multiplying each row profile by its corresponding marginal row frequency and then dividing the sum of these weighted row profiles by the total sum of the row frequencies. In Table 22 in annex 3, the collective row profile indicates that development plan document A of East Java Province hast the most coding compared to other development plan documents.

In a similar vein, column profiles refer to the proportional frequencies of various indicators of adaptation integration into the development plan within each development plan document. For example, within the 128 coding of development plan document A of East Java Province, flood (24%) is the most frequently mentioned in the development document A of East Java Province. The average column profile, also known as the column centroid, is characterized by the marginal frequency distribution throughout the whole of the columns. In Table 23 in annex 3, the average column profile exhibits an equitable distribution across all development plan documents (Sourial et al., 2010).

The primary objective of employing correspondence analysis is to visually represent the relative frequencies by measuring the dissimilarities between individual row and column profiles, as well as their distances from the average row and column profiles, within a reduced-dimensional space (Nagpaul, 1999; Sourial et al., 2010). The chi-square metric is utilized for measuring distance (Clausen, 1998). The chi-square distance between row i and row i' ($i \neq i'$) is given by $d(I, I') = \sqrt{\sum_j \left(\frac{(P_{ij} - P_{i'j'})^2}{P_{+j}}\right)}$ Where p_{ii} and $p_{i'j'}$ are relative frequencies for row i and i' in column j and p_{ii} and p_{+j} is the marginal relative frequency or mass, as it is called in correspondence analysis, for column j (Sourial et al., 2010).

For example, the chi-square distance between climate change and adaptation is:

$$d(climate\ change, adaptation') =$$

$$\sqrt{\left(\frac{(0.062-0.064)^2}{0.107}\right)+\left(\frac{(0.041-\ .036)^2}{0.028}\right)+\left(\frac{(0.052-0.073)^2}{0.046}\right)+\left(\frac{(0.078-0.109)^2}{0.061}\right)+\left(\frac{(0.067-0.055)^2}{0.063}\right)+\left(\frac{(0.000-\ .000)^2}{0.030}\right)+\left(\frac{(0.057-0.045)^2}{0.028}\right)+\left(\frac{(0.026\ \ .009)^2}{0.005}\right)+\left(\frac{(0.041\ \ .082)^2}{0.016}\right)+\left(\frac{(0.010\ \ .027)^2}{0.022}\right)+\left(\frac{(0.031-0.009)^2}{0.032}\right)+\left(\frac{(0.031\ \ .027)^2}{0.016}\right)+\left(\frac{(0.057-0.036)^2}{0.050}\right)+\left(\frac{(0.098-0.045)^2}{0.066}\right)+\left(\frac{(0.062-0.000)^2}{0.055}\right)+\left(\frac{(0.016-0.027)^2}{0.032}\right)+\left(\frac{(0.057-\ .045)^2}{0.045}\right)+\left(\frac{(0.119-0.173)^2}{0.060}\right)+\left(\frac{(0.041-0.064)^2}{0.035}\right)+\left(\frac{(0.052-0.073)^2}{0.036}\right)}$$

= 0.4271093

The process of dividing by the marginal frequency serves to standardize the variance, so accounting for the bigger variances that are typically observed in cases with high proportions, as well as the lower variances that are typically observed in cases with low proportions (Nagpaul, 1999; Sourial et al., 2010). The purpose of this approach is to prevent the influence of larger proportions from overpowering the distance calculation in comparison to smaller proportions (Nagpaul, 1999; Sourial et al., 2010).

According to (Clausen, 1998; Sourial et al., 2010), it is important to acknowledge that distances are exclusively defined within the indicators of adaptation integration into the development plan (rows) or within the development plan documents (columns) rather than across the categories of indicators of adaptation integration into development plan and development plan documents. The weighted sum of the squared chi-square distance between each row profile and the average row profile is the total variance, or "inertia" (Λ^2) the term used in correspondence analysis to refer to the row variable is defined as follows (Clausen, 1998; Sourial et al., 2010): $\Lambda^2 = \sum_i p_{i+}\, d_i^2$, where P_{i+} is the marginal relative frequency (or mass) of row i and, $\mathrm{d}_i = \sqrt{\sum_j \left(\frac{(\mathrm{P_{ij}} - \mathrm{P_{i'j'}})^2}{P_{+j}}\right)}$ It is the chi-square distance between the row i's profile and the average row profile (Sourial et al., 2010). In terms of development plan document A of East Java Province, the row profile for drought exhibited the closest to the average profile, with a distance of 0.01. On the other hand, change in biodiversity displayed the greatest disparity from the average profile, with a distance of 0.643.

Inertia is a quantitative metric that assesses the degree of variability or scatter of individual profiles in relation to the average profile. It serves as an indicator of the extent to which the profiles deviate from independence (Friendly, 1999; Sourial et al., 2010). The larger the differences are, the larger the inertia will be. The concept of inertia exhibits a clear correlation

with Pearson's chi-square statistic (X^2): $\Lambda^2 = \frac{X^2}{N}$, where N is the total sample size (Clausen, 1998; Sourial et al., 2010).

Correspondence analysis decomposes the inertia by discerning a limited number of dimensions that are mutually independent and effectively capture the most significant deviations from independence (Friendly, 1999; Sourial et al., 2010). Dimension 1 signifies the highest proportion of accounted inertia or the most substantial departure from independence. Subsequently, dimension 2 denotes the second highest proportion, and so forth. Dimensions are created by minimizing the distance between profiles and axes while also maximizing the amount of explained inertia. The relative relevance and explanatory power of each dimension are represented by its corresponding eigenvalue (Clausen, 1998; Sourial et al., 2010). The mathematical intricacies associated with the construction of dimensions are considerable. However, the interpretation of dimensions can be derived from the manner in which the response categories of variables segregate on opposing sides of such dimensions. Additionally, the significance of a response category on a specific dimension increases as it moves farther away from the origin. This positioning also offers valuable insights into the dimensionality of each response, as well as the grouping or "loading" of responses on the same dimension (Sourial et al., 2010).

A simple correspondence analysis was performed on the contingency table using SPSS software to visualize the association (Greenacre, 2017). The Summary table (Table 24 in annex 3) is the most important table provided in the SPSS output for correspondence analysis. In the field of statistics, the chi-square statistic is employed in correspondence analysis to examine the total variance explained (Doey & Kurta, 2011). Additionally, it is accompanied by the corresponding probability of assessing the significance of the findings. In this particular instance, the result of correspondence analysis in this study exhibits a high level of significance at the .000 level and a chi-square value of 1057,516.

The total inertia of a cross-tabulation is a measure of how much variation there is in the table (Greenacre, 2017). In this study, the total inertia accounts for 56.4%. The values in the "Proportion of Inertia" column represent the percentage of variance explained by each dimension in relation to the total variance explained by the model (Table 24 in annex 3). In this particular instance, Dimension 1 accounts for approximately 28% of the total 56.4% of variance that is explained inside the model. Additionally, Dimension 2 accounts for approximately 19% of the 56.4% of the variance explained in the model. Each axis accounts

for a part of inertia; thus, the first two dimensions account for almost 47% of the inertia. The total principal inertia is 0. 564.

The inertia can be further broken down into row (Table 25 in annex 3) and column (Table 26 in annex 3) components along individual principal axes. According to (Doey & Kurta, 2011), the Overview Row Points (Table 25 in annex 3) gives information on how each of the row points is plotted in the final biplot. The column labeled 'Mass' in the above table represents the relative proportion of each age group in relation to the total population under investigation. The column labeled 'Score in Dimension' provides the coordinates for each row category in dimensions 1 and 2, indicating their respective positions on the biplot. The concept of inertia once again demonstrates variability. The column labeled "Contribution" assesses the extent to which each point aligns with the dimensions and how effectively the extraction of dimensions accounts for each point. In this particular instance, it is observed that the topic coding nodes (an indicator of adaptation integration into the development plan) have a substantial emphasis on Dimension 1, accounting for around 6.8% of the overall load (Table 25 in annex 3). According to the data presented in Table 26 in annex 3, the development plan document F of Malang City loads well onto Dimension 1 (9.4%).

Figure 33 is the two-dimensional correspondence plot of Table 21 in annex 3. The geographical location depicted on the map aligns with the centroid of each variable. The proximity of a row profile's vector location to the origin corresponds to its proximity to the average profile (Sourial et al., 2010). While there is no precise mathematical definition for the distances between categories of countries and languages, their level of "clustering" or proximity of points on a map in relation to their angle from the origin and points in the same quadrant can serve as a framework for interpreting the relationships between row and column variables (references 10 and 15) (Sourial et al., 2010). The result in Figure 33 shows that East Java Province's development plans mainly focus on climate change and impact. Malang City's development plans mainly focus on climate change and adaptation. West Nusa Tenggara Province development plans mainly focus on climatic conditions and impact. Semarang City's development plans mainly focus on climatic conditions and adaptation.

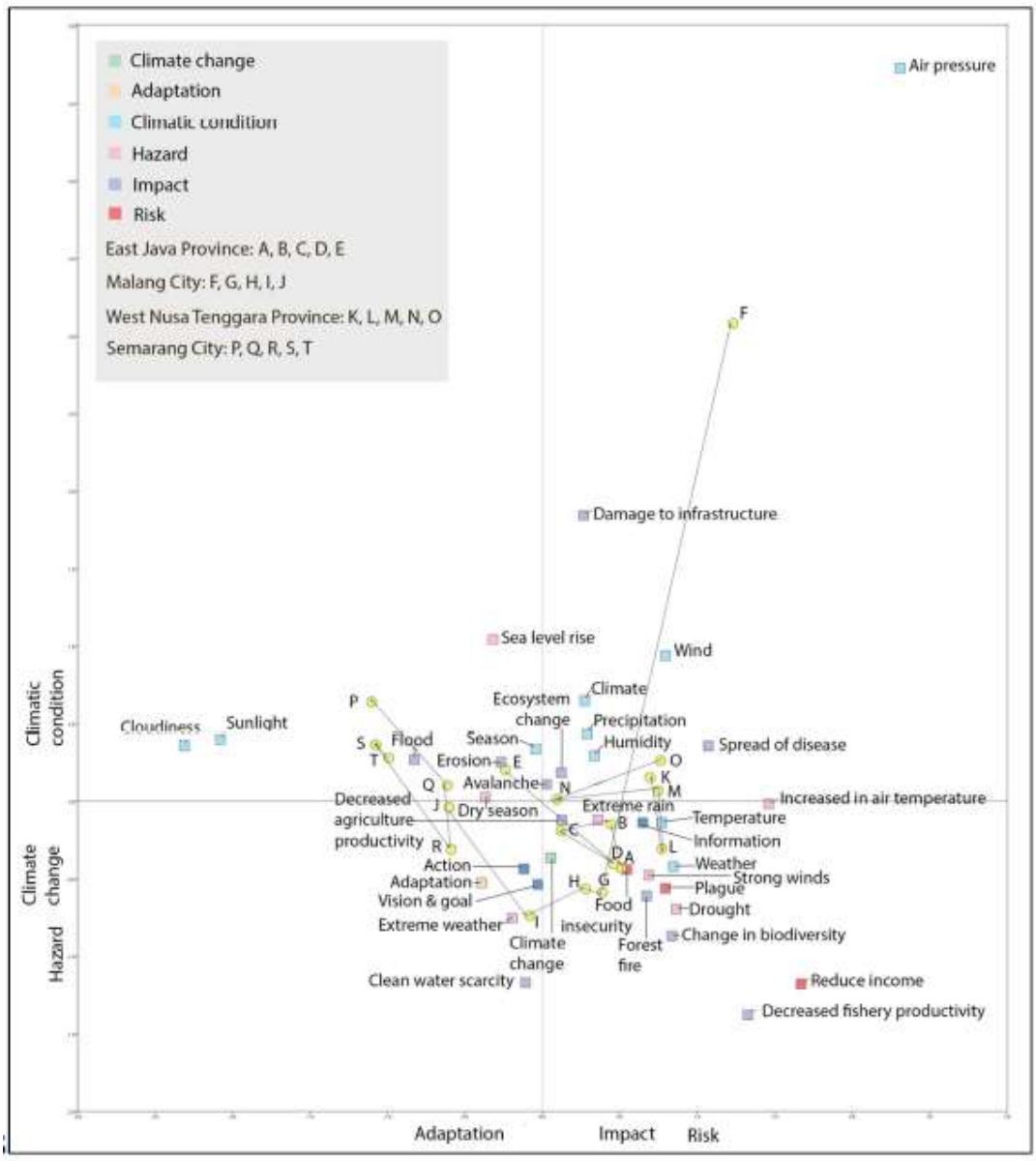

Figure 33: Correspondence analysis of all development plans

3.3.1.3. Relation between climate change adaptation keywords in the development plans

A co-occurrence network is used to confirm the relation between topic-coding nodes: climate change; adaptation; climatic condition; hazard; impact; risk. The co-occurrence network shows an association between the nodes when they are mentioned together in the development plans or when the nodes are paired together by another word, e.g., disaster, vulnerable, and program. The stronger the association means, the more related the nodes, while the weaker the

association means, the less related the nodes. In the figure, a different color is given to differentiate the topic-coding nodes and the word mentioned together with it.

Figure 34 below shows the example of the network between the topic-coding nodes in the local mid-term development plan of East Java Province. It shows the relationship between climate change, adaptation, climatic conditions, and impact. Though the risk is also observed in the development plan, it doesn't have any relationship with all the other nodes mentioned before. Besides that, mitigation is found to be linked together with the other nodes mentioned before, even though it is not the focus of this research. The results of all development plans can be found in the appendix.

The adaptation node is only related to climate change and mitigation, while the climate change node is related to adaptation, mitigation, and climatic condition. The node impact is related to hazard and mitigation. From this result, it can be concluded the relationship between nodes in the local mid-term development plan of East Java Province is as follows: (1) Climate change – adaptation; (2) Climate change – mitigation; (3) Adaptation – mitigation; (4) Mitigation – impact; (5) Mitigation – climatic condition; (6) Climate change – climatic condition; (7) Impact – hazard. This relationship between nodes applies both ways.

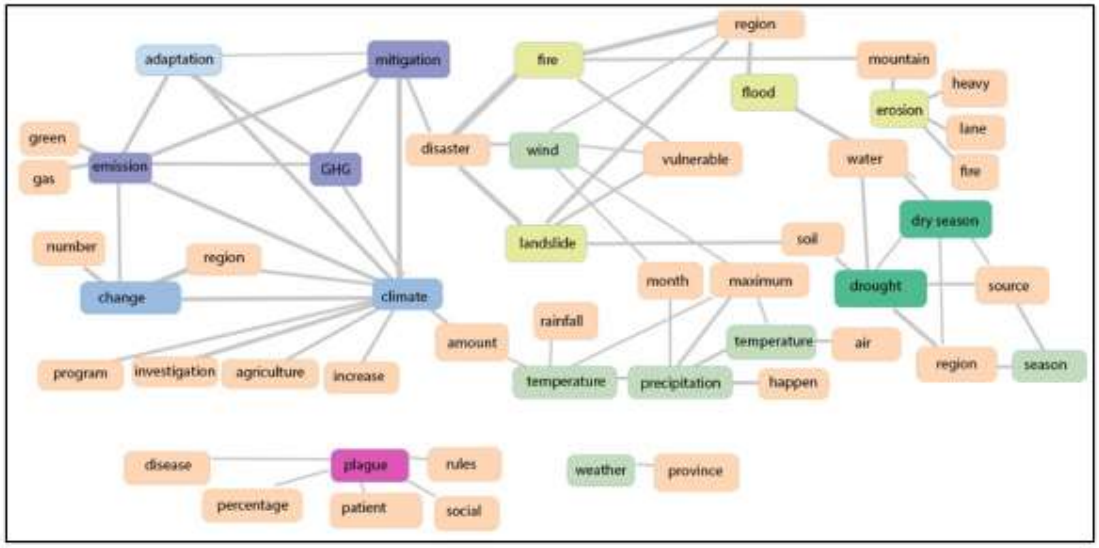

Figure 34: Co-occurrence analysis of East Java Province Medium-Term Development Plan

Table 17 summarizes the results of the co-occurrence network of each development plan. In Table 17, the number of topic coding-nodes in each development plan varies between 3 nodes to 6 nodes, while the number of networks in each development plan varies between 1 network to 8 networks. With six topic-coding nodes, the maximum number of the network for each development plan is 15 networks. The result shows that while some development plan mentions all the topic-coding nodes: climate change, adaptation, climatic condition, hazard, impact, and risk, but over the development plan, there isn't a maximum number of a co-occurrence network. This indicates that there is no case where the nodes are all related to each other.

The development plans that only have one network are West Nusa Tenggara Province's annual development plans for 2015 and 2018, which both mentioned four nodes on it. In West Nusa Tenggara Province's annual development plan 2015, adaptation, climatic conditions, hazard, and impact nodes are mentioned, but the network is only between hazard and impact. In West Nusa Tenggara Province's annual development plan 2018, climatic conditions, hazard, impact, and risk nodes are mentioned, but the network is only between climatic conditions and hazards. The lack of a network between the nodes in these two development plans implies the content of the nodes doesn't really relate to each other.

Table 17: Co-occurrence network of all development plans

Location	Development plan	Topic-coding nodes	Network
East Java Province	Medium-term development plan	1. Climate change	1. Climate change – adaptation
		2. Adaptation	2. Climate change – mitigation
		3. Climatic condition	3. Adaptation – mitigation
		4. Hazard	4. Mitigation – impact
		5. Impact	5. Mitigation – climatic condition
		6. Risk	6. Climate change – climatic condition
			7. Impact – hazard
	Annual development plan 2015	1. Climate change	1. Climate change – adaptation
		2. Adaptation	2. Climate change – hazard
		3. Climatic condition	3. Climate change – impact

Location	Development plan	Topic-coding nodes	Network
		4. Hazard	4. Hazard – climatic condition
		5. Impact	
		6. Risk	
	Annual development plan 2016	1. Climate change	1. Climate change – adaptation
		2. Adaptation	2. Climate change – mitigation
		3. Climatic condition	3. Adaptation – mitigation
		4. Hazard	4. Mitigation – impact
		5. Impact	5. Impact – climatic condition
		6. Risk	6. Impact – hazard
	Annual development plan 2017	1. Climate change	1. Climate change – adaptation
		2. Adaptation	2. Climate change – mitigation
		3. Climatic condition	3. Adaptation – mitigation
		4. Hazard	4. Climatic condition – hazard
		5. Impact	5. Climatic condition – impact
		6. Risk	
	Annual development plan 2018	1. Climate change	1. Climate change – adaptation
		2. Adaptation	2. Climate change – mitigation
		3. Climatic condition	3. Adaptation – mitigation
		4. Hazard	4. Adaptation – hazard
		5. Impact	5. Hazard – climatic condition
		6. Risk	6. Hazard – impact
			7. Mitigation – impact
			8. Climate change – impact
Malang City	Medium-term development plan	1. Climatic condition	1. Climatic condition – hazard
		2. Hazard	2. Climatic condition – impact
		3. Impact	
	Annual development plan 2015	1. Climate change	1. Climate change – adaptation
		2. Adaptation	2. Climate change – mitigation
		3. Climatic condition	3. Adaptation – mitigation

Location	Development plan	Topic-coding nodes	Network
		4. Hazard	4. Climate change – climatic condition
		5. Impact	5. Climatic condition – impact
		6. Risk	6. Impact – hazard
			7. Climatic condition – hazard
	Annual development plan 2016	1. Adaptation	1. Adaptation – mitigation
		2. Climatic condition	2. Hazard – climatic condition
		3. Hazard	3. Climatic condition – impact
		4. Impact	
		5. Risk	
	Annual development plan 2017	1. Climate change	1. Climate change – adaptation
		2. Adaptation	2. Adaptation – impact
		3. Climatic condition	3. Climate change – climatic condition
		4. Hazard	4. Climate change – impact
		5. Impact	5. Climatic condition – hazard
		6. Risk	
	Annual development plan 2018	1. Adaptation	1. Adaptation – mitigation
		2. Climatic condition	2. Hazard – impact
		3. Hazard	3. Hazard – climatic condition
		4. Impact	
		5. Risk	
West Nusa Tenggara Province	Medium-term development plan	1. Adaptation	1. Adaptation – mitigation
		2. Climatic condition	2. Climatic condition – impact
		3. Impact	
	Annual development plan 2015	1. Adaptation	1. Hazard – impact
		2. Climatic condition	
		3. Hazard	
		4. Impact	

Location	Development plan	Topic-coding nodes	Network
Semarang City	Annual development plan 2016	1. Climate change	1. Climate change – adaptation
		2. Adaptation	2. Climate change – mitigation
		3. Climatic condition	3. Adaptation – mitigation
		4. Hazard	4. Climate change – risk
		5. Impact	5. Climate change – climatic condition
		6. Risk	6. Climatic condition – risk
			7. Climatic condition – hazard
	Annual development plan 2017	1. Climate change	1. Climate change – adaptation
		2. Adaptation	2. Climate change – mitigation
		3. Climatic condition	3. Climate change – impact
		4. Hazard	4. Impact – mitigation
		5. Impact	5. Climatic condition – hazard
		6. Risk	
	Annual development plan 2018	1. Climatic condition	1. Climatic condition – hazard
		2. Hazard	
		3. Impact	
		4. Risk	
	Medium-term development plan	1. Climate change	1. Climate change – adaptation
		2. Adaptation	2. Climate change – mitigation
		3. Climatic condition	3. Adaptation – mitigation
		4. Hazard	4. Climate change – climatic condition
		5. Impact	5. Climatic condition – impact
			6. Impact – hazard
	Annual development plan 2015	1. Climate change	1. Climate change – adaptation
		2. Adaptation	2. Climate change – mitigation
		3. Climatic condition	3. Adaptation – mitigation
		4. Hazard	4. Climate change – climatic condition

Location	Development plan	Topic-coding nodes	Network
		5. Impact	5. Climate change – impact
			6. Impact – hazard
			7. Hazard – climatic condition
	Annual development plan 2016	1. Climate change	1. Climate change – adaptation
		2. Adaptation	2. Climate change – mitigation
		3. Climatic condition	3. Adaptation – mitigation
		4. Hazard	4. Climatic condition – hazard
		5. Impact	
	Annual development plan 2017	1. Climate change	1. Adaptation – mitigation
		2. Adaptation	2. Climatic condition – hazard
		3. Hazard	3. Climatic condition – impact
		4. Impact	
	Annual development plan 2017	1. Climate change	1. Adaptation – mitigation
		2. Adaptation	2. Climatic condition – hazard
		3. Climatic condition	
		4. Hazard	

According to (Yulandari et al., 2023), the calculated networks for adaptation and various factors are displayed in Figure 35. In this study, 112 networks were obtained from the development plans, and more than half of these networks are associated with climatic conditions (28%) and hazards (27%). In addition to the highest networks, climatic conditions, and hazards also produced networks with almost all other factors, excluding adaptation and risks, respectively. These results suggest that climatic conditions and hazards constitute the core of adaptation integration for local governments in Indonesia (Yulandari et al., 2023).

The climatic conditions factor exhibits its strongest relationship with hazards and vice versa (Yulandari et al., 2023). In particular, the local governments highlighted the climatic conditions responsible for hazards. Many networks between climatic conditions and hazards involve intense rainfall as the cause of floods and landslides. The endeavors of local governments to overcome the impacts and risks of floods and landslides caused by intense rainfall are also captured in the networks. Moreover, according to (Yulandari et al., 2023), climatic condition

networks are often associated with climate change. In the development plans, local governments recognize intense climatic conditions as the effects of climate change in Indonesia. Prior research, however, has demonstrated that numerous temperature extremes can be attributed to natural climate variability. Even in the absence of climate change, a diverse range of temperature extremes would still manifest (Easterling et al., 2012).

"Climate change has occurred in Semarang city, such as increasing trend in average surface temperature over the last 100 years as well as a shift in the onset of the rainy season and changes in the frequency of extreme rainfall. Decreased chance of rainfall exceeding critical limits associated with flooding, especially in the central part of the city, while in the dry season, there is an increase in rainfall which has an impact reduced likelihood of future drought in the future."—Semarang City medium-term development plan.

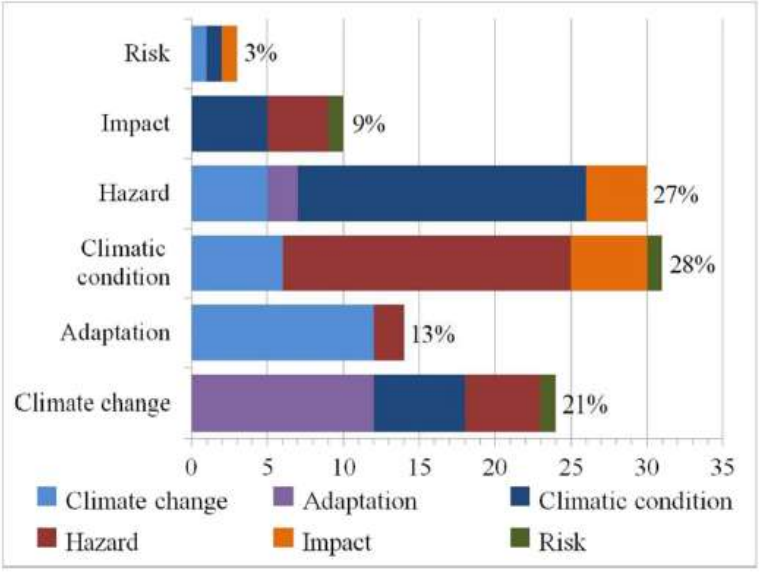

Figure 35: Results from co-occurrence analysis for adaptation and adaptation factors (n coding=1918, all development plans); source: (Yulandari et al., 2023)**.**

Climatic conditions, however, exhibited no relationship with adaptation (Yulandari et al., 2023). This suggests that local governments neglected extreme climatic conditions that are required for adaptation actions. Adaptation actions are necessary for local governments if extreme climatic conditions are linked with hazards, impacts, or risks. However, (Smit & Pilifosova, 2001) suggested that the variability in climatic conditions is necessary and must be

considered in formulating adaptation strategies. Thus, adaptation is warranted when extreme climatic conditions are associated with significant consequences (Downing et al., 1997).

Regarding adaptation, according to (Yulandari et al., 2023), among its 14 networks, 12 are associated with climate change. Notably, local governments in Indonesia perceive climate change as an emerging issue and acknowledge adaptation as an important avenue for tackling it. Consistent with (Wijaya et al., 2020), most local governments are aware of the relevance of climate change adaptation for development. Considering that the pressures of climate change commonly threaten the progress of development, local governments in Indonesia are adopting the adaptation approach.

"The phenomenon of climate change will continue to challenge development for decades to come. In this regard, this document seeks to frame a series of adaptation strategies and programs that involve all stakeholders to anticipate climate change for the sustainability of people's lives and ecosystems."- —Semarang City medium-term development plan.

However, (Yulandari et al., 2023) found that no network exists between the adaptation networks and impacts or risks, while limited networks are associated with hazards. The networks between adaptation and hazards suggest that adaptation measures are required to minimize the effects of floods, landslides, and droughts in Indonesia. However, detailed or locally relevant hazard data are unavailable. This likely reflects the limitations of local governments in providing data on specific hazards that require adaptation measures.

In addition, the relationship between climate change and hazards in the development plans is weak, suggesting that some hazards listed in the development plans are not associated with climate change projections (Yulandari et al., 2023). These are either current hazards or past extreme events faced by the local governments. Although addressing current or past hazards through adaptation by local governments is important, long-term climate change should not be disregarded. Better explanations of climatic conditions, hazards, impacts, and risks that require adaptation measures from climate change projections in the future are necessary.

3.3.2. Adaptation options available in the development plan

From the twenty development plans in four locations, this study retrieved and analyzed adaptation action through the coding process. In Indonesia's development plan, each program consists of several activities with their respective outcomes. In this study, only the action that mentions 'adaptation' in the program title/activity title/outcomes that coded as adaptation

action. The reason is that the development plan used in this study is a general development plan, not a specific adaptation development plan. Thus, to make it more accurate, only the action that mentions 'adaptation' is analyzed.

Based on the criteria, this study found ten programs over the development plans : (1) climate change adaptation and mitigation program; (2) healthy environment program; (3) natural resources protection and conservation program; (4) environmental development program; (5) partnership and environmental control program; (6) improvement of agricultural / plantation technology program; (7) strengthening climate change adaptation program; (8) spatial planning program; (9) employee competency development program; (10) climate change mitigation capacity building program (Table 18). Five out of the ten programs are conducted by the environmental agency; two programs are the responsibility of the human development agency, while the public health agency, agriculture and plantation agency, and local development planning agency each conduct one program.

Between the adaptation programs analyzed, there is a difference in activity and outcome observed. As many as 15 activities are listed: (1) climate change adaptation and mitigation; (2) GHG reduction; (3) socialization of climate change; (4) socialization of adaptation and mitigation; (5) preparation of regional action plan for climate change adaptation; (6) socialization of regional action plan for adaptation; (7) socialization of regional action plan for GHG and adaptation; (8) climate village development; (9) development of agricultural irrigation and climate change adaptation; (10) overcoming plantation disruption; (11) integrated participatory development and management of irrigation project; (12) water resources management and adaptation; (13) environmental sanitation; (14) coordination of spatial planning and environment; (15) organizing a capacity building training. Besides that, this study also identified a total of 35 outcomes. Table 18 summarizes the ten programs with 15 activities and 31 outcomes over the development plans.

Apart from the activity and outcome listed in Table 18, there is no detailed explanation of the program over the development plans. Some of the program observed doesn't include adaptation term in the title of the program and activity but mention adaptation as the outcome of the program and its activity: healthy environment program; spatial planning program; employee competency development program; climate change mitigation capacity building program in the case of climate change mitigation capacity building program, the name of the program and its activity even emphasis mitigation instead of adaptation. Nevertheless, the outcome is staff training in climate change adaptation and mitigation.

Table 18: List of programs, activities, and outcomes of all development plans

Program	Activity	Outcome	Agency
Climate Change Adaptation and Mitigation Program	GHG Reduction	Climate change adaptation and mitigation demonstration plots report	Environmental agency
		Implementation of climate village for adaptation and mitigation report	
		Implementation of biogas demonstration plots reports for climate change adaptation.	
Healthy Environment Program	Environmental Sanitation	Number of regencies/cities that have implemented the climate change adaptation strategy	Public health agency
		Percentage of regencies/cities agencies that have implemented a climate change adaptation strategy	
Natural Resources Protection and Conservation Program	Socialization of Adaptation and Mitigation	Socialization of climate change mitigation and adaptation	Environmental agency
	Climate Change Adaptation and Mitigation	Initiate the use of solar cells.	
		Establishment of climate village	
		Initiate a rainwater harvesting method.	
		Socialization of rainwater harvesting to community harvesting community	
		Building infiltration wells	

Program	Activity	Outcome	Agency
	Water Resources Management and Adaptation	Building bio pore holes	
		Socialization of bio pore	
Environmental Development Program	Socialization of Regional Action Plans for GHG and Adaptation Plans for GHG and Adaptation	Socialization of regional action plans for greenhouse gases and climate change adaptation	Environmental agency
	Preparation of Regional Action Plan for Climate Change Adaptation	Compilation information required for regional action plans for climate change adaptation	
	Socialization of Regional Action Plans for Climate Change Adaptation	Implementation of a regional action plan for climate change adaptation	
	Climate Village Development	Establishment of climate village for adaptation and mitigation	
Partnership and Environmental Control Program	Climate Village Development	Implementation of climate village for adaptation and mitigation	Environmental agency
Improvement of the Agricultural / Plantation Program	Development of Agricultural Irrigation and Climate Change Adaptation	Research on climate change and plant adaptation	Agriculture and plantation agency
	Overcoming plantation disruptions	Socialization of climate change adaptation in the plantation business	

Program	Activity	Outcome	Agency
	Socialization of Climate Change	Socialization of climate change adaptation in the plantation business	
	Development of Agricultural Irrigation and Climate Change Adaptation	Coordination of implementation of agricultural irrigation and climate adaptation	
	Integrated Participatory Development and Management of Irrigation Project (IPDMIP)	Coordination of implementation of agricultural irrigation and climate adaptation	
Strengthening Climate Change Adaptation Program	Climate Village Development	Establishment of climate village for adaptation and mitigation	Environmental agency
		Implementation of climate village for adaptation and mitigation	
	Water Resources Management and Adaptation	Socialization of rainwater harvesting to community	
		Upgrade the capacity of infiltration wells by adding the number of units.	
		Upgrade the capacity of bio pore holes by adding the number of units.	
Spatial Planning Program	Coordination of Spatial Planning and the Environment	Facilitation and coordination of climate change mitigation and adaptation activities between stakeholders	Local Development Planning Agency

Program	Activity	Outcome	Agency
Employee Competency Development Program	Organizing a Capacity Building Training	Staff training about climate change adaptation	Human resource agency
Climate Change Mitigation Capacity Building Program	Organizing a Capacity Building Training	Staff training about climate change adaptation and mitigation	

From the adaptation programs mentioned before, the total number of adaptation programs mentioned in the development plans is 22 times (Figure 36). Some programs are only mentioned once, while others are mentioned several times over the development plan. While it's possible for the program to be mentioned more than once over the development plans, the activity and outcome of the program could be different from the development plans. The programs that were only mentioned once are the climate change mitigation capacity building program; employee competency development program; environmental development program; partnership and environmental control program. On the other hand, the programs mentioned several times are: climate change adaptation and mitigation program; healthy environment program; improvement of agricultural / plantation program; natural resources protection and conservation program; spatial planning program; and strengthening climate change adaptation program. Among the ten programs identified in this study, the improvement of the agricultural / plantation program is the most frequently mentioned throughout the development plans.

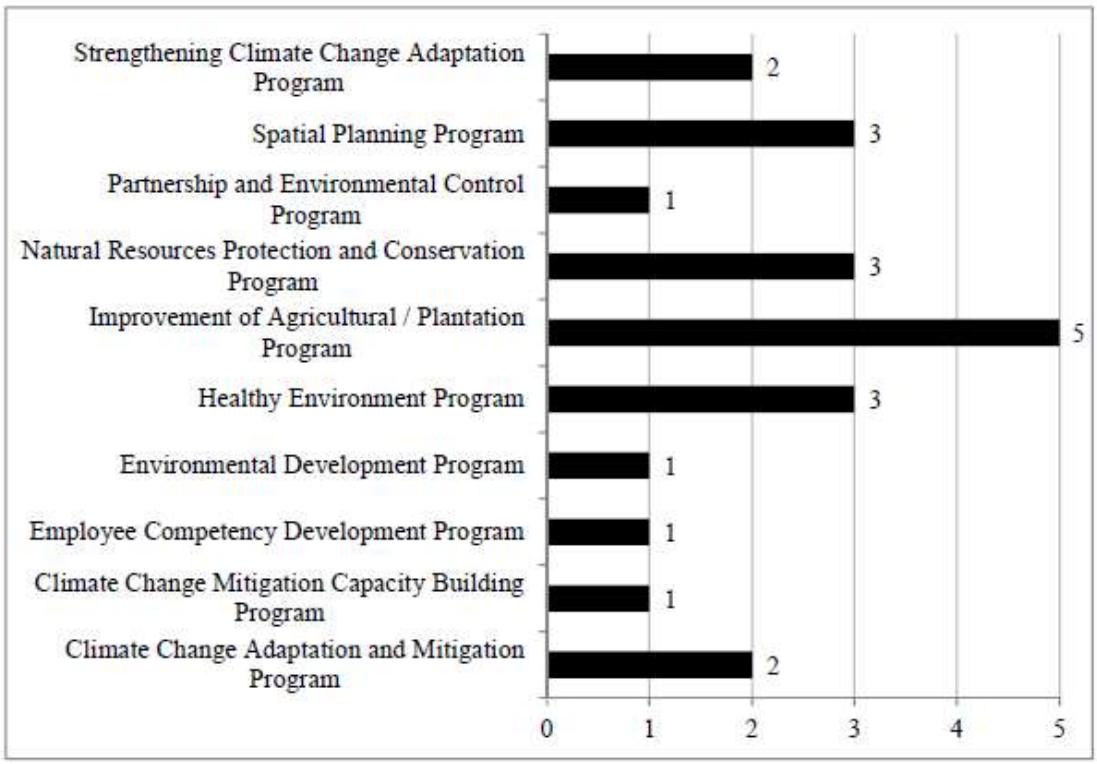

Figure 36: Number of Programs Mentioned (n program mentioned= 22, all development plans)

Figure 37 clarifies the number of each activity carried out. The result implies there is not much difference between the times each activity was carried out, within a range of 1 to 4 times with a total of 28 times. The most frequent activity conducted is climate village development, followed by another three activities that were conducted three times, another three activities that were conducted two times, and the rest seven activities that were conducted one time. Based on the result in Figure 25, the climate village development activity is conducted in three different programs: environmental development program (1); partnership and environmental control program (1); strengthening climate change adaptation program (2), making it the activity that conducted the most frequent activity carried out and appeared the most between the programs.

Further, the result in Figure 38 highlights the distribution of the activity in the adaptation programs. Each program consists of 1 to 6 activities, with the total number of all activities conducted being 28 times. As the program that is most frequently mentioned, the improvement of the agricultural / plantation program also consists of the greatest number of activities, with four different activities conducted six times in total. The activities included in the improvement

agricultural / plantation program are socialization of climate change (1 time); development of agricultural irrigation and climate change adaptation (3 times); overcoming plantation disruption (1 time); integrated participatory development and management of irrigation project (1 time). Looking at the distribution of the activity in Figure 18, most of the activity is conducted in one program only. This is to say for each program, the activity listed is different. Among the fifteen activities, there are only three activities that are conducted in several programs: climate village development, water resources management and adaptation, and organizing capacity building training.

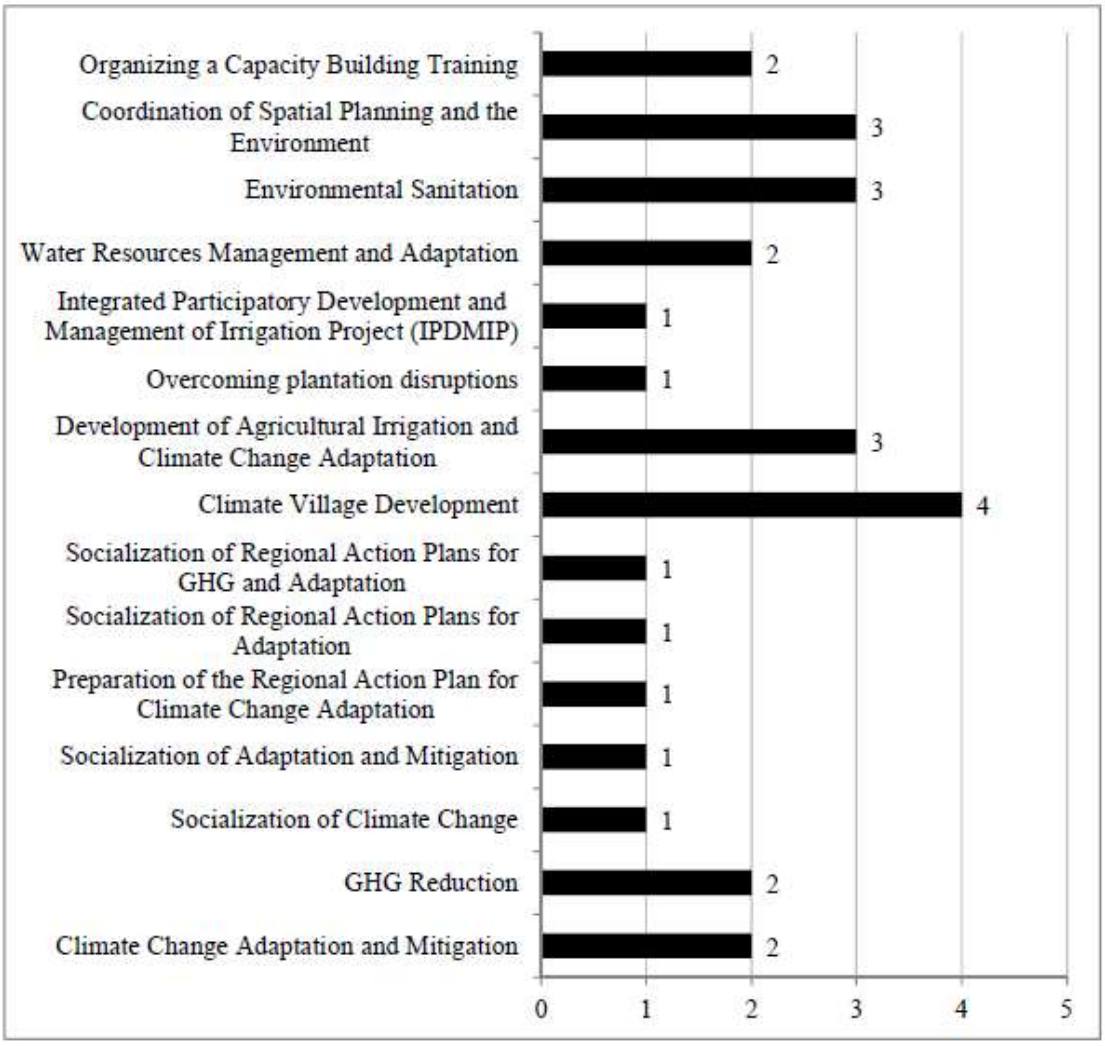

Figure 37: Number of Activity Carried Out (n activity carried out= 28, all development plans)

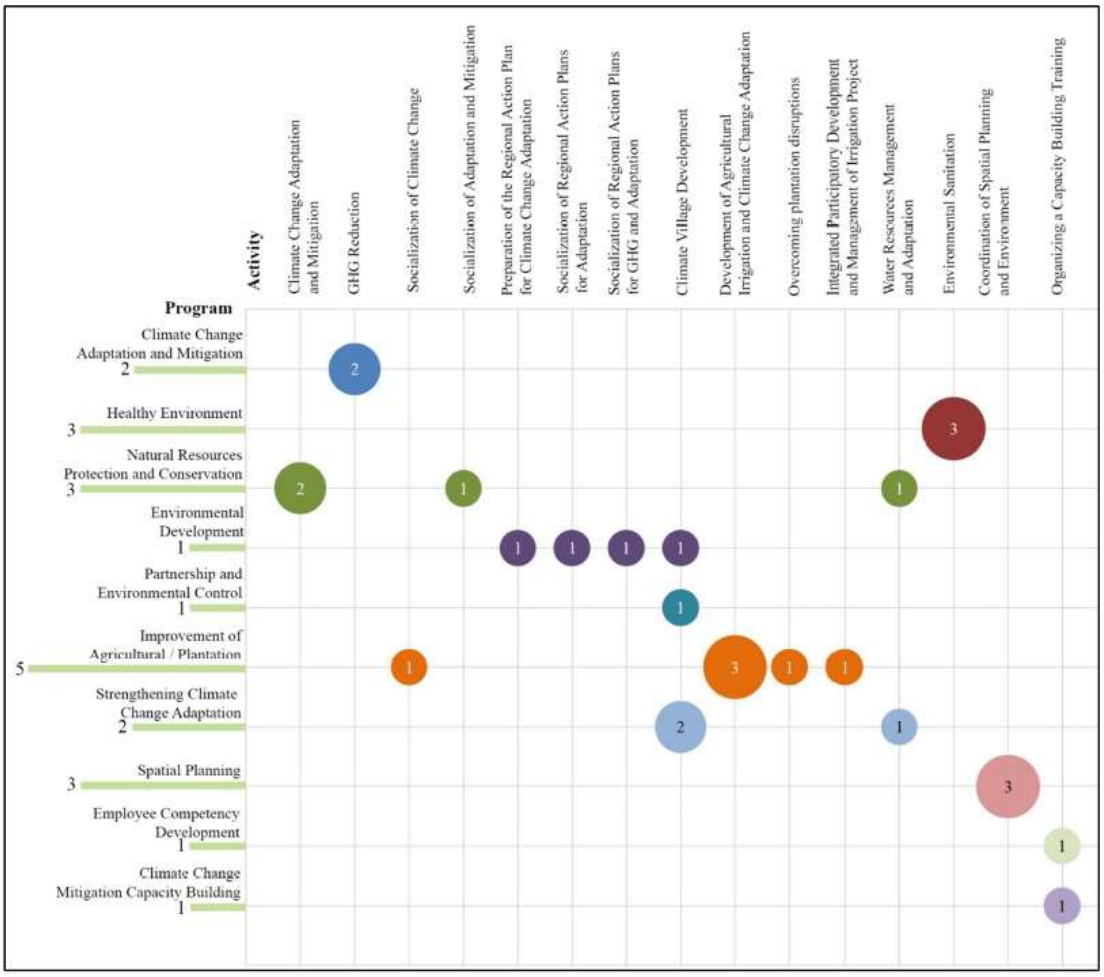

Figure 38: Distribution of Activity (n activity carried out= 28, all development plans)

3.3.2.1. Typology of adaptation options

According to a study by (Yulandari et al., 2023), adaptation options include varied actions to accommodate interrelated necessities, such as information, capacity, financial, institutional, and technological (Burton et al., 2006). In general, these adaptation options are categorized into the following categories: structural/ physical, social, and institutional (Noble et al., 2014). Combining the structural/physical, social, and institutional factors is important to moderate different types of climate change impacts and risks. Based on 20 development plans, 56 adaptation options were retrieved and analyzed in this study. Structural and physical measures appear crucial for adaptation, accounting for 43% of the adaptation measures. Conversely, social and institutional measures received lesser focus, representing 36% and 21% of all options, respectively (Figure 39).

Structural and physical measures are intended to improve the adaptation of the territory, infrastructures, and people (Yulandari et al., 2023). Among these measures, technology such as water-saving, second-generation biofuels, adequate irrigation, rainwater harvesting, and solar cells emerged as the most essential. Social measures focus on the acquisition and dissemination of information. Based on sound scientific, technical, and socio-economic data from observation systems, information sharing, and capacity modeling, better-informed decisions are made. According to this study, local governments in Indonesia acted on such a priority by developing hazard and vulnerability maps, community-based adaptation plans, and downscaling climate scenarios.

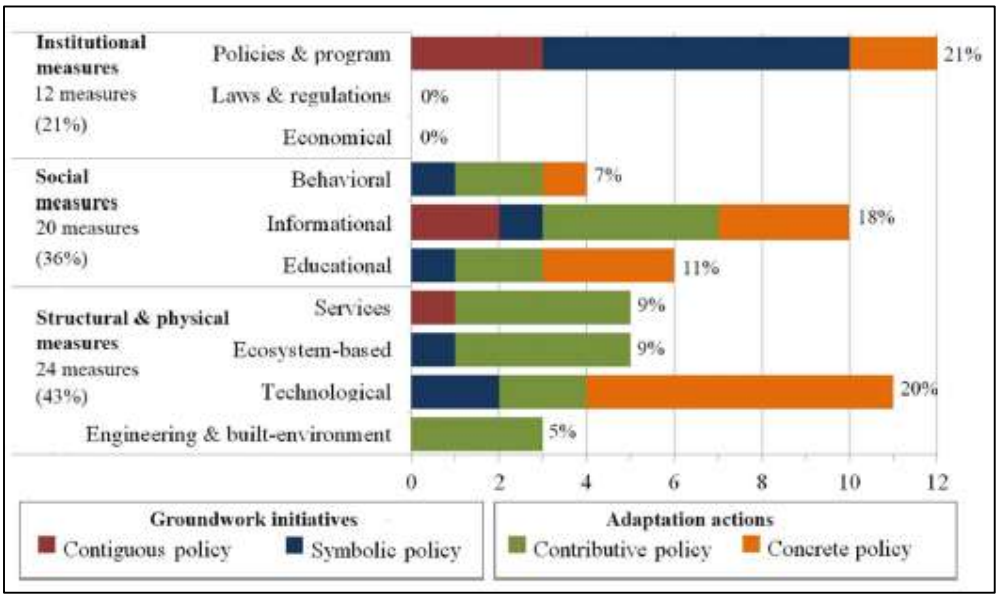

Figure 39: Typology and policy types for various adaptation options; source: (Yulandari et al., 2023)

In addition to information, the education of stakeholders is another significant social measure for proper adaptation planning and implementation (Yulandari et al., 2023). As stated by (Measham et al., 2011) and (Alhassan & Hadwen, 2017), local governments should refrain from limiting efforts to climate change information and vulnerability assessment. It is recommended that local governments allocate resources toward enhancing the awareness and capabilities of all relevant stakeholders. This will result in a transition from the conventional hierarchical method of adaptation to the incorporation of diverse factors, including climate change, hazards, impacts, and risks, within adaptation initiatives. Efforts to elevate the

adaptation awareness and capacity building of stakeholders have been undertaken previously by local governments in Indonesia. However, according to this study, the education measures, specifically including adaptation, are limited. The education measures focus rather on a knowledge-sharing and learning platform on climate change hazards for the community. Although such a platform can enhance community capacity, the capacity for stakeholders to design adaptation programs remains limited. An important implication of this study is that climate change adaptation awareness and capacity building must be promoted by local governments in Indonesia.

According to (Yulandari et al., 2023), to develop and implement comprehensive strategies, adaptation options should be fostered across existing institutions. Numerous measures from economics, law, and regulation, as well as policies and programs, are suitable for promoting institutional measures. For instance, policies and programs, such as disaster planning and preparedness, national and regional adaptation plans, and adaptive management, were identified in this study. However, institutional measures are still hindered by inadequate economic as well as law and regulation measures. Economic measures can provide local governments access to financial and management resources, while law and regulation measures can ensure accountability in making adaptation decisions.

The absence of economic as well as law and regulation measures may be because of limited financial support and regulations from the national to the local governments in Indonesia (Yulandari et al., 2023). In fact, in Indonesia, local governments conduct budget tagging, where the budget for adaptation is generated by local government agencies(Gregorio et al., 2015; Kawanishi & Mimura, 2013). According to (Kawanishi & Mimura, 2013), such budget tagging negligibly impacts the budget allocation for adaptation. Therefore, utilizing the funds from these agencies to provide economic measures for adaptation is challenging for local governments. Relatedly, in Indonesia, legislative support for adaptation from the national government is missing (A. B. Rahman, 2017). Considering that no law or regulation is provided by the national government, local governments are also under no obligation to introduce these. (Tang et al., 2010) noted that adaptation quality increases when legislative support is available. The local governments in Indonesia should ensure that economic as well as law and regulation measures are introduced in the future.

3.3.2.2. Policy types of adaptation options

In order to comprehend the level of intentionality with which climate change is taken into account in proposed adaptation measures, as well as the extent to which these measures will effectively reduce vulnerability or enhance the resilience of the city or its residents, this study aims to differentiate between four distinct types of adaptation policy (Yulandari et al., 2023). Figure 39 illustrates that in the data examined, adaptation actions are higher than groundwork initiatives (Yulandari et al., 2023). Among documented options, 66% are classified as adaptation actions that reduce vulnerability directly or enhance resilience, while 34% are groundwork initiatives to facilitate adaptation conditions without directly reducing vulnerability. Local governments in Indonesia have devoted efforts and resources to adaptation actions that promptly, efficiently, and equitably increase resilience. However, the adaptation actions introduced are primarily contributive policies, representing 38% of all adaptation options. These contributive policies were not designed to handle climate change but rather substantively contribute to vulnerability reduction (Dupuis & Biesbroek, 2013). Consequently, these are generally formulated according to current climate hazards and past extreme events (Mercer, 2010).

According to (Yulandari et al., 2023), most adaptation actions classified as contributive policies involve water-saving technology and flood infrastructures. Efforts to raise awareness and build the capacity of stakeholders on floods, landslides, and droughts have also been conducted by local governments, with at least a contributive policy reported by all local governments in this study. Our results suggest that local governments in Indonesia are overwhelmed by recurrent climate hazards, and therefore, their adaptation actions reflect reactive responses to immediate threats. Owing to the backward-looking strategies, these contributive policies are inadequate for long-term climate change prediction (Lazarus, 2009; Smit & Wandel, 2006). Managing trade-offs between short-and long-term climate change through concrete policies are crucial for local governments.

Among the 56 adaptation options identified in this study, 29% are classified as concrete policies (Yulandari et al., 2023). Most concrete policies fall in the technology, community awareness, and outreach categories. Many of the actions involve rainwater harvesting, utilizing new seed varieties in the agriculture sector, improving irrigation technology, and devising community-based adaptation plans. These concrete policies differ from contributive policies in that they involve novelty and can handle climate change in the long term. These new adaptation actions contain future climate changes in their objectives or outcomes.

The findings of this study by (Yulandari et al., 2023) align with the findings reported in prior investigations (Alhassan & Hadwen, 2017; Araos et al., 2016; Le, 2020). Considering local governments as the first responders to climate change, further adaptation actions, specifically targeting the effects of climate change and vulnerabilities, are required. As in most developing countries, the challenge is to shift the focus from current climate hazards and past extreme events to long-term climate change.

3.3.3. Steps were taken by the local governments to integrate adaptation into development plan

The steps taken by local governments to integrate adaptation into development plans provide an avenue for evaluating the progress towards adaptation integration into development plans. Semarang City is designated as one of the pilot sites for the implementation of the adaptation strategy in Indonesia. The city has successfully integrated climate adaptation measures into its development plans (Yulandari et al., 2023). From the interview, this study found several steps which were conducted by Semarang City in the process of integrating adaptation: (i) identification of climate change hazards, climate variability, and extremes; (ii) identification of climate change risks and its impacts; (iii) identification of adaptation options; and (iv) determination of climate change adaptation action priorities. These steps taken were aimed at enhancing climate change adaptation in development plans.

(Yulandari et al., 2023) Found the establishment of a working group in Semarang City has facilitated the engagement of several stakeholders, including local government agencies, non-governmental organizations (NGOs), and academic institutions. In particular, the Local Development Planning Agency, Environmental Agency, Disaster Management Agency, and Meteorology and Climatology Agency are the representative of local government agencies and are the core of adaptation integration. This evidence demonstrates that these agencies possess a fundamental understanding of climate change, its associated consequences, and the potential risks involved. Additionally, they exhibit awareness of pertinent adaptation strategies.

Notwithstanding the substantial steps that have been made by Semarang City, this study found that climate information to integrate adaptation is generally insufficient (Yulandari et al., 2023). Only climatic conditions and past and current climate hazard information were provided by the Meteorology and Climatology Agency. The participants expressed a lack of adequate scientific knowledge, which hindered their ability to engage in a discourse regarding the potential risks

associated with future climate change hazards, impact, and risks. Semarang City is one of the few local governments in Indonesia that has developed a local adaptation plan. Yet the climate change projection is still very limited. In the development plan of Semarang City, it states that there will be 1.9-2.9º Celsius, 48-60 cm increase in sea level rise. Climate change scenarios are typically developed using Global Climate Models (GCMs), generally in the form of scaled-down or localized scenarios. These variables are subsequently utilized to analyze the effects of a certain scenario on a specific target or exposure unit. The scenarios typically encompass a simplified representation of the local climate and have traditionally focused on alterations in average temperature, precipitation patterns, and sea level. The high costs of developing local climate change models and other challenges at the personnel and institutional level are other problems. Especially in developing countries, this is a major barrier to the downscaling of climate change projections (Jones et al., 2005). There exists a shortage of comprehensive data regarding the specific effects experienced by communities and households at a local level. However, it is evident that these entities are confronted with heightened levels of unpredictability and amplified vulnerabilities in relation to climatic variability and extreme events.

(Yulandari et al., 2023) Found that respondents also indicated that there had been no assessment of vulnerability or risk to climate change. Vulnerability and risk assessment used in the process of adaptation integration is mainly from previous studies and is very general. More detailed information about the vulnerability and risk of locations is not available. Even with the existence of NGOs and academia in the working group, NGOs and academia are only able to provide basic knowledge and information to local government agencies to increase awareness and capacities among government workers. Climate change adaptation necessitates a comprehensive analysis of both the risk associated with climate change and the vulnerability conditions, as this is crucial for facilitating adaption efforts and enhancing resilience. In the absence of these processes, initiatives aimed at adapting to climate change become reactive and lack integration.

3.4. Chapter conclusion

This chapter aims to discuss how the local governments of Indonesia integrate the national adaptation plans towards development plans. To understand the full context, the content of the

development plan was explored. Then, the ways in which local governments integrate adaptation and challenges and barriers were identified.

(1) The results of the present study indicate that climate change adaptation has been addressed in the development plans of the local governments because their plans contain some climate change information, vision and goals, and actions. The strong correlation between adaptation and climate change implies that adaptation is considered an important measure by local governments, although such information is relatively general. Addressing the situation for each local government is necessary to ensure context-specific adaptation.

(2) The efforts and resources for adaptation by the local governments are focused on technological, informational, and policy and program measures. As there are more contiguous policy and symbolic policies than contributive policy and concrete policies, more efforts and resources are put into an intervention that enables adaptation to take place but does not directly reduce vulnerability.

(3) Notwithstanding the substantial steps that have been made by Semarang City, this study found local government's capacity to integrate adaptation is insufficient. There had been no assessment of vulnerability or risk to climate change, and only climatic conditions and past and current climate hazard information were available. Therefore, adaptation integration into the development plan therefore might be limited as it is reliant simply on current climate hazards or past extreme events without considering future adaptation. Adapting to climate changes in the short-term or medium-term, without attention to changes that will occur and remain over the long-term, will result in poor investment decisions (UNDP 2010). Effective climate change adaptation must address long-term climate change based on current hazards and past extreme events at the national, regional, and local levels.

CHAPTER 4
INFLUENCE OF ADAPTATION INTEGRATION ON HOUSEHOLDS' ADAPTATION AGAINST CLIMATE CHANGE

This chapter presents an investigation of the outcome of adaptation integration into development plans discussed in the previous chapter. To fully understand the topic, the study conducted a questionnaire survey with households that participated in the adaptation program; then, logistic regression analysis techniques were used to identify whether the adaptation integration influenced households' decision to adopt adaptation measures.

4.1. Objective of the analysis

In this chapter, the study objectives are:

1. Identify the adaptation needs of households and current adaptation support provided by the local government to the households.
2. Analyze and quantify the impact of adaptation support on households' adoption decisions on climate change adaptation strategies.

4.2. Adaptation integration into the development plan and unresolved issues

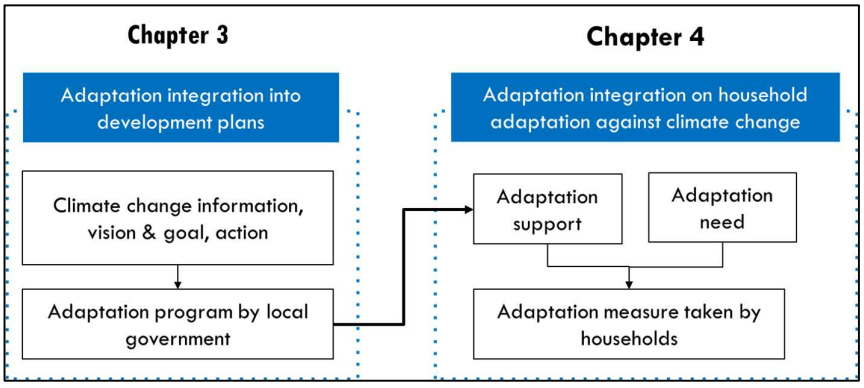

Figure 40: Relation between chapter 3 and chapter 4

There are two objectives of national adaptation plans (UNFCCC, 2012). The first objective is to facilitate the integration of climate change adaptation into existing policies, programs, and activities, in particular development planning process. The second objective of the national

adaptation plan is to reduce vulnerability to the impacts of climate change by building adaptive capacity.

Chapter 3 of this study focuses on the integration process of adaptation into development plans, as to evaluate the first objective of the national adaptation plan. It puts emphasis on the development plan content to assess whether climate change adaptation information, vision and goal, and action, as well as adaptation program, have been addressed and formulated by the local government.

Chapter 4 of this study showcases the results of adaptation integration into the development plan in terms of adaptation programs for vulnerable populations. The chapter points out in adaptation needs of vulnerable households and the support given by the local government in the adaptation program. It further analyses whether the adaptation support could benefit the vulnerable population by building their capacity to adapt to evaluate the second objective of the national adaptation plan.

4.3. Summary of method

Table 19: Summary of methods in Chapter 4

No	Summary	Chapter 4
1	Case study	• Pedalangan village • Podorejo village • Tanjungmas village
2	Method of data collection	• Face-to-face questionnaire survey
3	Number of data collected	• 109 respondents from Pedalangan village • 94 respondents from Podorejo village • 101 respondents from Tanjungmas village
4	Method of analysis	• Descriptive statistics • Chi-square test of independence • Logistic regression analysis

Primary data were collected through a structured questionnaire survey in January 2023 to households that participate in adaptation programs as the target of the survey. In 2022, as many as 109 households in Pedalangan village, 106 households in Tanjungmas village, and 101

households in Podorejo village participated in the adaptation program by the local government of Semarang City. Initially, all 316 households became the target of this study. However, seven households of Podorejo and five households of Tanjungmas could not participate owing to reasons including being unavailable until the end of the survey date or unwillingness to participate. In the end, 304 responses (96% of the total population) were obtained in this study.

4.4. Results

4.4.1. Profile of respondents

The respondents were adults from a household that participated most often in the adaptation program. Prior to survey time, all the households that participated in the adaptation program are visited to invite household members who participate most often to join the interview at their most convenient time. Efforts were made to ensure that the respondents are the ones who participate most often in the adaptation program to ensure the reliability of the data collected about the adaptation program. Interviewing all the household members who participate in the adaptation program is not possible due to time limitations and budgetary constraints.

In total, 58 males and 246 females were interviewed, for whom the age and education level were predominantly 45-64 years old (50%) and junior high school or higher (73%), respectively. The mean occupation for half of the respondents (50%) is housewife. Almost half (48%) of the households had income in the range of IDR 2,000,000 to IDR 3,000,000. Table 20 shows the profile of the respondents.

Table 20: Profile of surveyed respondents

Variables	All locations (n= 304)
Age	
< 25 years old	4%
25-44 years old	42%
45-64 years old	50%
> 64 years old	4%
Sex	
Male	19%
Female	81%

Variables	All locations (n= 304)
Level of education	
Not graduate from elementary school	7%
Elementary school	20%
Junior high school or higher	73%
Occupation	
Farmers	14%
Fisherman	2%
Housewife	50%
Others	34%
Monthly average income of household	
< IDR 2,000,000	30%
IDR 2,000,000 – IDR 3,000,000	48%
> IDR 3,000,000	23%

4.4.2. Households need to adapt to climate change.

The impacts of climate change are already evident in Indonesia and around the world. The Fourth Assessment Report (AR4) of the IPCC pointed out even the most stringent mitigation efforts cannot avoid further impacts of climate change in the next few decades (Dhungana et al., 2020). In light of climate change's existing and anticipated detrimental effects across many spatial and temporal dimensions, it is imperative to implement adaptation measures to mitigate and address the associated risks and vulnerabilities (Ehsan et al., 2022). The concept of climate change adaptation encompasses implementing various measures aimed at mitigating the susceptibility of human activities and ecosystems to the adverse effects of climate change while simultaneously enhancing their capacity to withstand and recover from such impacts (IPCC, 2014c). The failure to effectively adapt to the consequences of climate change has been identified as one of the most substantial challenges facing humanity (WEF, 2019).

Studies indicate that households are taking steps to adapt, with some measures being more effective than others (Bryan et al., 2013; H. M. T. Rahman & Hickey, 2019). However, not all households have the means to adopt these measures, particularly those in vulnerable positions (Baez et al., 2013). Due to their vulnerability, few of them are able to implement new technologies or make investments. Those households that must adapt the most frequently lack the resources to do so. Consequently, assessing the need of households to adapt to climate

change is essential for the local government's successful adaptation integration (Khatibi et al., 2021).

In Pedalangan Village, Podorejo Village, Tanjungmas Village, and Semarang City, Almost all surveyed households agree they need information, technological, financial, and capacity-building support. Financial support is especially crucial for farmers and fishermen who experience income reduction due to climate impacts. The decision to employ a strategy depends on the households' capacity to bear the associated costs to adapt to climate impacts (Ayanlade et al., 2018; Massetti & Mendelsohn, 2018; Seo & Mendelsohn, 2008). Climate information plays a role in decision-making, and better access to such information is vital. Given that households have decision-making authority in their daily lives, adequate information on observations, predictions, and projections regarding existing and anticipated weather or climate-related events could assist them in making informed choices. Technological and capacity-building support is also essential, as many households lack the means and skills to adopt climate-smart technologies.

The chi-square test shows the relation between occupation, monthly average income, participation times in adaptation programs, and households' adaptation needs. Occupations are related to the need for technology and capacity-building, while monthly average income is related to financial support. Participation in adaptation programs is related to the need for information while adopting adaptation measures after adaptation program is related to the need for technology. The result of crosstabulation between households' adaptation needs and their adoption of adaptation measures after the adaptation program indicates that although households don't express a need for adaptation support, they still engage in adaptation activities. This result suggests that households are not indifferent to climate change adaptation issues.

4.4.3. Local government support for adapting to climate change

The most severe impact and risk of climate change fall disproportionately upon underserved households who are least able to adapt to climate change (EPA, 2021). Household adaptation to climate change is a dynamic process influenced by various stressors (Burnham et al., 2018). According to a prior investigation conducted by (Agrawal et al., 2008) it was shown that household climate adaptation is contingent upon government assistance, indicating that the absence of such support hinders the implementation of adaptation measures. In addition, the study emphasizes the importance of local government support in formulating households'

adaptation strategies. This study categorized local government support as information, technological, financial, and capacity building in Pedalangan Village, Podorejo Village, and Tanjungmas Village.

Despite the presence of information, technological, financial, and capacity-building support for households, the finding of this study shows that not all surveyed households in Pedalangan Village, Podorejo Village, and Tanjungmas Village appear to receive support from the local government. Around half of the surveyed households receive information, technological, and capacity-building support. In comparison, a very small percentage of surveyed households receive financial support.

Information support is received by around half of the households, often conveyed through meetings organized by village representatives. However, the absence of future climate change scenarios might limit the effectiveness of household adaptation measures. Technological and capacity-building support is also received by around half of households respectively. The local government provides climate-resistant seeds, flood prevention infrastructure, and rainwater harvesting to address climate change. Financial assistance is less common, with only a few households receiving it, leaving many to rely on their resources to cope with climate change-related impacts and risks. Further, the average number of local governments that provide information, technological, financial, and capacity-building support for households in a year is analyzed in this study. The result shows almost all surveyed households stated the support number of times support provided is insufficient, and the support given is very limited.

4.4.4. Households' adaptation measure against climate change

The evaluation of adopted adaptation measures by households is explored in this study, both before and after the adaptation program implemented by the local government of Semarang City. The assessment encompassed twelve distinct adaptation measures, categorized as structural and physical or non-structural and physical adaptations. The structural and physical adaptation measures include rainwater harvesting, water recycling, urban gardening, improved drainage or bio pore infiltration hole, urban green space, and climate change resistance seed. The non-structural and physical adaptation comprises insurance, sharing local knowledge, early warning systems, household preparation and evacuation plans, livelihood diversification, and climate observation.

The findings indicate that, before the adaptation program, a notable proportion of households had undertaken various adaptation measures in response to climate change. This distribution involved a combination of structural and physical adaptations, non-structural and physical adaptations, or both. After the adaptation program, the number of households that adopted adaptation measures doubled.

Analysis of the specific types of adaptation measures undertaken after the adaptation program reveals a significant increase in the number of households who adopted either structural and physical adaptation measures or non-structural and physical adaptation measures, as well as both types of measures. Among them, the most significant increase was shown in non-structural and physical adaptation measures, with the number of households who adopted tripled from before adaptation program to after adaptation program.

Further examination highlights variations in the adoption rates of specific adaptation measures. Urban gardening emerges as the most commonly adopted structural and physical adaptation measure while sharing local knowledge stands out among non-structural and physical adaptation measures. These preferences remain consistent before and after the adaptation program. Conversely, certain measures remain less favored to be adopted by households. Bio-pore infiltration holes and climate change-resistant seeds exhibit low adoption rates both before and after the adaptation program, though a slight increase is observed in the after adaptation program. Similarly, specific non-structural and physical adaptation measures such as insurance, livelihood diversification, and climate observation continue to exhibit limited adoption, albeit with minor improvements to the after adaptation program.

The study underscores the increase in household adoption of adaptation measures following the local government's adaptation program. Notably, both structural and physical adaptations and non-structural and physical adaptations measures experienced comparable increases in adoption rates. This shift is particularly pronounced for measures such as water recycling, urban green space, urban gardening, insurance, livelihood diversification, and climate observation. However, it's important to note that the before the adaptation program lack of adoption for certain measures, like insurance, livelihood diversification, and climate observation, has led to seemingly dramatic the after adaptation program increases due to the low baseline adoption rates.

Further analysis shows that most households that adopted structural and physical adaptation measures after the adaptation program conduct urban gardening and urban green space. While

both measures can contribute positively to climate adaptation by augmenting vegetation cover, they cannot immediately reduce the impacts and risks of climate change. For instance, only a few households adopted water recycling and rainwater harvesting, which are more directly aimed at reducing the impacts and risks of climate change. Regarding non-structural and physical adaptation measures, around half of households adopt sharing local knowledge as an adaptation measure.

This study also compares the adoption of adaptation measures before and after implementing an adaptation program across three villages: Pedalangan Village, Podorejo Village, and Tanjungmas Village. In Pedalangan Village, the observed structural and physical adaptation measure most commonly adopted before the program was urban gardening, while urban green space was favored in Podorejo Village. Before the adaptation program, Tanjungmas Village exhibited a dual preference for water recycling and urban green space. Regarding non-structural and physical adaptation measures, sharing local knowledge emerged as the predominant choice in all three villages before and after the adaptation program. Notably, the adoption of sharing local knowledge increased in Pedalangan and Podorejo villages after the adaptation program, indicating its continued importance.

The number of households adopting either category of adaptation measures differed between the before and after adaptation programs in each village. Podorejo Village experienced the most substantial increase in adoption rates after the program, with a significant increase in both structural and physical adaptation measures and non-structural and physical adaptation measures. Tanjungmas Village also showed notable increases in structural and physical and non-structural and physical adaptation measures; however, the percentage of increase is less than Podorejo Village. Subsequently, Pedalangan village also exhibited an increase in structural and physical adaptation measures and an increase in non-structural and physical adaptation measures, with the percentage of increase being the least compared to the other villages.

E

4.4.5. Determinants of factors affecting households' adaptation measure against climate change

This study further identifies whether adaptation support provided by the local government is related to households' decision to adopt adaptation measures. The chi-square test results show that information, technological, financial, and capacity-building support are positively related

to households' adaptations. Among the households that have implemented adaptation measures, a substantial majority reported receiving information support from the local government, a higher proportion compared to those households that did not receive such information support. Similarly, when technological support and capacity-building support were provided, around half of households adopted adaptation measures, compared to the lower number of households that did not receive such support. On the other hand, the number of households that adopted adaptation measures without financial support is higher than those that did receive it. The aforementioned analysis suggests that households will likely adopt adaptation strategies if local governments offer information, technology, and capacity-building support. Despite the absence of financial support, households would still adopt adaptive strategies.

Further, the result of cross-tabulation between adaptation support and adaptation measures taken by households after the program, when information and capacity-building support is available, households are more likely to adopt structural and physical adaptation and non-structural and physical adaptation. According to the result, households with technological support are more likely to take structural and physical adaptation measures or both measures rather than non-structural and physical adaptation measures. A contrasting result is shown when technological support is not offered; only a very small percentage of households adopted structural and physical adaptation measures. In comparison, households that receive financial support are more likely to adopt both measures or structural and physical adaptation measures.

A stepwise linear regression analysis was employed to determine potential predictors influencing households' choices to adopt adaptation measures. The study incorporated a range of variables, including location, age, sex, education level, family composition, occupation, income, duration of residency, support factors (information, technological, financial, capacity-building), and perceived needs (information, technological, financial, capacity-building). Variables were selected for inclusion in the final model based on their contribution to the model's R2, adhering to a significance threshold of 0.1 to constrain the total number of variables. The result of stepwise linear regression underscores the significance of capacity-building support, technological support, information support, and location as influential factors related to households' decisions concerning adopting adaptation measures.

4.5. Chapter conclusions

Given the escalating phenomenon of climate change and its consequential effects, there is an increasing imperative to incorporate climate adaptation into the processes of deliberation and decision-making. In the forthcoming period, it is imperative to integrate top-down government-planned adaptation and bottom-up household adaptation as the most efficacious approach for dealing with climate change. Therefore, in light of current circumstances, it is of utmost significance to comprehend the manner in which households adapt to climate change in the presence of local government actions taken.

(1) Almost all surveyed households agree that they need some support from the local government to adapt to climate change. As a result of adaptation integration into the development plan, the local government has provided information support, technological support, financial support, and capacity-building support for households to adapt to climate change. However, provided support from the local government is still lacking; approximately only half of the households obtain the information, technological, and capacity-building support. While the number of households who obtained financial support is very small.

(2) The results of the chi-square test and stepwise regression analysis imply that the information support, technological support, capacity building support, as well as the location of the households live, related to the households' decision to adopt adaptation measures. Yet, it is also worth noting, as the availability of local government assistance is still very limited, that the majority of households only adopted a short-term adaptation measure.

CHAPTER 5

CONCLUSION

This research aimed to evaluate the integration of climate change adaptation into development plans in terms of the steps taken to integrate, the outcome of integration towards the content of the development plan, and the outcome of integration towards vulnerable households. Recent adaptation efforts by the government are generally scoped through the integration of development plans and climate change adaptation (Neil Adger et al., 2007; World Bank, 2010). The integration of adaptation and development plans is seen as an effective strategy and means of support for avoiding any potential trade-offs between adaptation and development strategies (J. Ayers et al., 2014; J. M. Ayers & Huq, 2009; Klein et al., 2005). As the drivers of climate change, including the provisioning of socioeconomic, ecological, and human resources, are inherently context-specific at the local scale, the role played by local government in climate change adaptation has been emphasized (Measham et al., 2011; Mfitumukiza et al., 2020; Wijaya et al., 2020).

However, several studies have explored how local governments face challenges in climate change adaptation (Khadka et al., 2012; Khatri et al., 2013; UNDP, 2011; Wiggins, 2011). Because of long timescales and inherent uncertainties, adaptation to climate change support requires different strategies than those based on predictability and optimality. These challenges are especially robust for local governments in developing countries where scientific information on the current dynamics of climate change, as well as methods and tools to predict climate change, are still inadequate (UNDP, 2011; Wiggins, 2011). Failing to account for adaptation needs results in incomparable support and constrains the effectiveness of intervention. It might even result in maladaptation, where the exposure and sensitivity of vulnerable households are increased as a result of the action taken (Garschagen et al., 2021). With the rising significance of climate change, it is therefore critical to understand the role of local government in the process of adaptation integration into the development and the outcome of the integration.

This study explored four local governments in Indonesia and carried out text mining of the medium-term development plans and annual development plans of the four local governments. Interviews with the local government agencies and a questionnaire survey with households were also conducted in this study. The last two chapters provided the results and discussion

that corresponded to the research objectives. Chapter 3 discussed the outcome of climate change adaptation integration into the development plan in terms of the development plan document and the steps taken to integrate the climate change adaptation into the development plan. Chapter 4 examined the outcome of adaptation integration into the development plan in terms of the households. The following section presents the synthesis of the research findings, which have been discussed in the previous chapters.

5.1. Main findings from each objective

To answer the overall objectives, as written in the first paragraph of this chapter, the author specifically set five objectives. Here, each objective is restated again, including the conclusion as follows.

First, the objective is to examine how adaptation is addressed in the development plan. According to (Yulandari et al., 2023), it is concluded that climate change adaptation has been addressed and considered an important measure in the local government's development plans. Both the medium-term development plans and annual development plans of four local governments in Indonesia contain some climate change adaptation information, vision and goals, and actions. The strong correlation between adaptation and climate change in the development plans implies that adaptation is considered an important measure by the local governments, although such information is relatively general. Addressing the situation for each local government is necessary to ensure context-specific adaptation.

The second objective aimed to identify what adaptation program was formulated in the development plan. The efforts and resources for adaptation by the four local governments of Indonesia are focused on technological, informational, and policy and program measures (Yulandari et al., 2023). As there are more contiguous policy and symbolic policies than contributive policy and concrete policies, more efforts and resources are put into an intervention that enables adaptation to take place but does not directly reduce vulnerability.

Next, the third objective aimed to analyze what steps were taken to integrate adaptation into the development plan. Notwithstanding the substantial steps that have been made by Semarang City, this study found local government's capacity to integrate adaptation is insufficient. There had been no assessment of vulnerability or risk to climate change, and only climatic conditions and past and current climate hazard information were available (Yulandari et al., 2023).

The fourth objective is to identify the adaptation needs of households and the current adaptation support provided by the local government. Almost all surveyed households agree that they need some support from the local government to adapt to climate change. As a result of adaptation integration into the development plan, the local government has provided information support, technological support, financial support, and capacity-building support for households to adapt to climate change. However, provided support from the local government is still lacking; approximately only half of the households obtain the information, technological, and capacity-building support. While the number of households who obtained financial support is very small.

Lastly, the fifth objective aimed to examine and quantify the relation between adaptation support on households' decisions to adopt adaptation measures against climate change. The results of the chi-square test and stepwise regression analysis imply that the information support, technological support, capacity building support, as well as the location of the households live, related to the households' decision to adopt adaptation measures. Yet, it is also worth noting, as the availability of local government assistance is still very limited, that the majority of households only adopted a short-term adaptation measure.

5.2. Overall conclusion

Finally, all the above findings arrive at the overall conclusion. The main objective is to evaluate the integration of climate change adaptation into the development plan by local governments in Indonesia. According to (Yulandari et al., 2023), as first responders, local governments in Indonesia are required to formulate measures for adaptation to climate change through integration. However, adaptation to climate change and development is complex and driven by multiple factors in developing countries. According to our investigation, adaptation integration requires a comprehensive approach involving analyzing the content of development plans and how it influences households' adaptive measures toward climate change. In all these approaches, there is an acceptance that climate change adaptation integration into development plans must operate at the micro-level of households. The goal of such investigations is generally to support the better integration of the adaptation into the development plan and develop the adaptation programs that are suitable to households' needs for national and local government priorities and adaptation activities by the households themselves.

At the national level, the national development planning agency of Indonesia has published and submitted its National Adaptation Plan to the UNFCCC. The National Adaptation Plan

was developed by referring to existing documents and work plans. The preparation begins with a review of existing documents, identifying climate change risks to various fields of life, and establishing goals, objectives, strategies, and action plans to anticipate future climate change risks, which are synchronized with the Ministry's work program (BAPPENAS, 2014).

There is a national level climate projection, hazards, and impacts, such as projection of daily rainfall and temperature changes in Indonesia, changes of monthly average sea surface temperature, sea surface height, and increase in extreme wave height. However, though the National Adaptation Plan document also has identified which adaptation sectors should be prioritized for each local government, there is no detailed explanation of how the calculation is made and detailed climate projections, hazards, and impacts for each local government.

In terms of adaptation programs, the National Adaptation Plan also has listed delivery strategy and indicative intervention of adaptation action that should be taken by local government. Yet, since the listed adaptation action is very general, it doesn't translate to the local government development plan. There is an absence of regulation and guidance from the national government to the local government in terms of integrating adaptation into development plan.

This study then further analyzed how the local government of Indonesia integrates adaptation into their respective development plans based on the National Adaptation Plan published by the national government. It is concluded that the local governments of Indonesia have conducted climate change adaptation integration into development plan. However, the local governments of Indonesia are still facing a lot of challenges in integrating adaptation into the development plan because they do not have sufficient capacity to do so. In fact, climate change impacts and risks differ from one location to another location therefore, addressing the situation for each local government is necessary to ensure context-specific adaptation. Yet, this study found that the content of climate change adaptation in the development plans is relatively general.

According to (Yulandari et al., 2023), the formulated adaptation options in the development plans also do not directly reduce vulnerability or enhance resilience. These measures may be limited if reliant simply on current climate hazards or past extreme events without considering future adaptation. Failing to consider long-term climatic changes while focusing solely on short-term or medium-term adaptations might lead to suboptimal investment decisions (UNDP 2010). Effective climate change adaptation must address long-term climate change based on current hazards and past extreme events at the national, regional, and local levels.

A similar result is also shown in the influence of climate change adaptation integration in the development plans towards households' adaptive measures. Through the adaptation program, the local government provides support for households to adapt to climate change, including information support, technological support, financial support, and capacity-building support. Local government support has significantly increased the number of households that take adaptation measures. The results of this study imply that capacity-building support has the strongest correlation with households' decision to adopt adaptation measures, followed by technological support and information support.

Related to the results of the unavailability of specific information on climate change adaptation both in the National Adaptation Plan and local government's development plan, it is, therefore, necessary to first improve the climate change projection and the adaptive capacity of the national and local government of Indonesia to provide a better information and capacity building support for the households. The ability to effectively respond to climate change is closely tied to the understanding and awareness of local climatic circumstances, as well as the socioeconomic and institutional forces at play. Numerous studies have underscored the significant impediment to climate change adaptation in developing countries, namely the dearth of information and understanding of the conditions of climate change.

Semarang City is one of the few local governments in Indonesia that has developed a local adaptation plan. Yet the climate change projection is still very limited. In the development plan of Semarang City, it states that there will be 1.9-2.9o Celsius, 48-60 cm increase in sea level rise. Based on this finding and the result of adaptation support given to households, the results imply that the information on climate change projection is not given to the households. Instead, households only receive information of monthly weather information and past climate change information. As the support provided by the local government is limited, the majority of households only adopted a short-term adaptation measure.

5.3. Recommendation

Given the above conclusion, the integration of climate change adaptation into the development plan in Indonesia needs improvement.

(1) Additional efforts and resources are required for intervention to directly reduce vulnerability or enhance resilience: Adaptation measures may be limited if reliant simply

on current climate hazards or past extreme events without considering future adaptation (Yulandari et al., 2023).

(2) Improvement of the level of adaptation assistance offered to households is required: Since local government assistance is limited, the majority of adopted adaptation measures are short-term adaptations to address familiar recurrent hazards.

(3) Local governments in developing countries still lack the capacity to address climate change issues: The anticipated consequences of climate change will persistently impose strain, thereby necessitating the involvement of the local government in addressing the unequal distribution of climate impacts experienced by households in conjunction with various stakeholders.

5.4. Limitations and suggestions for future research agenda

This research is not free from limitations related to time and resource constraints and other practical factors during fieldwork. These limitations can be an opportunity for future research agenda.

(1) The framework of climate change adaptation integration into the development plan could be improved by including more comprehensive indicators of climate change, such as vulnerability, exposure, sensitivity, and adaptive capacity.

(2) This study used the target population of households that participated in the climate change adaptation program. This was because available data were the number of households, while the number of individuals that participated in the climate change adaptation program was not available. Then, the sample was a person per household who was available when the surveyors showed up to interview. Arguably, there could be critics of representativeness regarding selecting one respondent within the household. Therefore, future research should use individuals as a target population instead of households.

REFERENCES

ACCCRN. (2011). *Semarang Climate Change Resilience Strategy, Indonesia*. www.i-s-e-t.org

Acevedo, M., Pixley, K., Zinyengere, N., Meng, S., Tufan, H., Cichy, K., Bizikova, L., Isaacs, K., Ghezzi-Kopel, K., & Porciello, J. (2020). A scoping review of adoption of climate-resilient crops by small-scale producers in low- and middle-income countries. *Nature Plants*, *6*(10), 1231–1241. https://doi.org/10.1038/s41477-020-00783-z

Adger, W. N. (2003). Social capital, collective action, and adaptation to climate change. *Economic Geography*, *79*(4), 387–404. https://doi.org/10.1111/j.1944-8287.2003.tb00220.x

Adger, W. N., Arnell, N. W., & Tompkins, E. L. (2005). Successful adaptation to climate change across scales. *Global Environmental Change*, *15*(2), 77–86. https://doi.org/10.1016/j.gloenvcha.2004.12.005

Agrawal, A., McSweeney, C., & Perrin, N. (2008). *Local institutions and adaptation to climate change*.

Al Nahyan, M. T., Sohal, A. S., Fildes, B. N., & Hawas, Y. E. (2012). Transportation infrastructure development in the UAE: Stakeholder perspectives on management practice. *Construction Innovation*, *12*(4), 492–514. https://doi.org/10.1108/14714171211272234

Aladenola, O. O., & Adeboye, O. B. (2010). Assessing the potential for rainwater harvesting. *Water Resources Management*, *24*(10), 2129–2137. https://doi.org/10.1007/S11269-009-9542-Y/METRICS

Alauddin, M., & Sarker, M. A. R. (2014). Climate change and farm-level adaptation decisions and strategies in drought-prone and groundwater-depleted areas of Bangladesh: An empirical investigation. *Ecological Economics*, *106*, 204–213. https://doi.org/10.1016/j.ecolecon.2014.07.025

Alhassan, S., & Hadwen, W. L. (2017). Challenges and opportunities for mainstreaming climate change adaptation into WaSH development planning in Ghana. *International Journal of Environmental Research and Public Health*, *14*(7), 1–29. https://doi.org/10.3390/ijerph14070749

Amaru, S., & Chhetri, N. B. (2013). Climate adaptation: Institutional response to environmental constraints, and the need for increased flexibility, participation, and integration of approaches. *Applied Geography*, *39*, 128–139. https://doi.org/10.1016/J.APGEOG.2012.12.006

Amundsen, H., Berglund, F., & Westskogh, H. (2010). Overcoming barriers to climate change adaptation-a question of multilevel governance? *Environment and Planning C: Government and Policy*, *28*(2), 276–289. https://doi.org/10.1068/c0941

Ando, H., Emori, S., Nakata, K., & Hijioka, Y. (2010). *Approaches to climate change adaptation*. https://www.env.go.jp/en/earth/cc/adapt_guide/index.html

Angelakis, A. N., & Gikas, P. (2014). Water reuse: Overview of current practices and trends in the world with emphasis on EU states. *Water Utility Journal*, *8*, 67–78.

Ara Begum, R., Lempert, R., Ali, E., & Benjaminsen, T. A. (2022). Point of Departure and Key Concepts. In *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Rep*

ort of the Intergovernmental Panel on Climate Change (pp. 121–196). https://doi.org/10.1017/9781009325844.003

Araos, M., Berrang-Ford, L., Ford, J. D., Austin, S. E., Biesbroek, R., & Lesnikowski, A. (2016). Climate change adaptation planning in large cities: A systematic global assessment. *Environmental Science and Policy*, *66*, 375–382. https://doi.org/10.1016/j.envsci.2016.06.009

Arnell, N. W. (2010). Adapting to climate change: An evolving research programme. *Climatic Change*, *100*(1), 107–111. https://doi.org/10.1007/s10584-010-9839-0

Asfaw, H. W., Sandy Lake First Nation, McGee, T. K., & Christianson, A. C. (2019). Evacuation preparedness and the challenges of emergency evacuation in Indigenous communities in Canada: The case of Sandy Lake First Nation, Northern Ontario. *International Journal of Disaster Risk Reduction*, *34*, 55–63. https://doi.org/10.1016/J.IJDRR.2018.11.005

Ashabie, A. S., & Masjud, Y. I. (2022). The Study of Biopore Infiltration Holes (BIH) Implementation to Reduce Waterlogging in President University Campus Area. *IOP Conf. Series: Earth and Environmental Science*. https://doi.org/10.1088/1755-1315/1111/1/012060

Auld, G. W., Diker, A., Bock, M. A., Boushey, C. J., Bruhn, C. M., Cluskey, M., Edlefsen, M., Goldberg, D. L., Misner, S. L., Olson, B. H., Reicks, M., Wang, C., & Zaghloul, S. (2007). Development of a Decision Tree to Determine Appropriateness of NVivo in Analyzing Qualitative Data Sets. *Journal of Nutrition Education and Behavior*, *39*(1), 37–47. https://doi.org/10.1016/J.JNEB.2006.09.006

Ayanlade, A., Radeny, M., & Akin-Onigbinde, A. I. (2018). Climate variability/change and attitude to adaptation technologies: a pilot study among selected rural farmers' communities in Nigeria. *GeoJournal*, *83*(2), 319–331. https://doi.org/10.1007/S10708-017-9771-1/TABLES/7

Ayers, J., Huq, S., Wright, H., Faisal, A. M., & Hussain, S. T. (2014). Mainstreaming climate change adaptation into development in Bangladesh. *Climate and Development*, *6*(4), 293–305. https://doi.org/10.1080/17565529.2014.977761

Ayers, J. M., & Huq, S. (2009). *Supporting Adaptation to Climate Change: What role for Official Development Assistance? | International Institute for Environment and Development*. https://www.iied.org/supporting-adaptation-climate-change-what-role-for-official-development-assistance

Baez, J. E., Kronick, D., & Mason, A. D. (2013). Rural Households in a Changing Climate. *Source*, *28*(2), 267–289. https://doi.org/10.1093/wbro/lks008

Baker, I., Peterson, A., Brown, G., & McAlpine, C. (2012). Local government response to the impacts of climate change: An evaluation of local climate adaptation plans. *Landscape and Urban Planning*, *107*(2), 127–136. https://doi.org/10.1016/j.landurbplan.2012.05.009

BAPPEDA Kota Semarang. (2019). *RAD-API Kota Semarang*.

BAPPENAS. (2014). *Rencana Aksi Nasional Adaptasi Perubahan Iklim (RAN-API)*. http://sekretariat-ranapi.org/storage/app/media/RAN-API.pdf

Barange, Bahri, Beveridge, MCM, Cochrane, KL, Funge-Smith, Poulain, & eds. (2018). *Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options*.

Bartesaghi Koc, C., Osmond, P., & Peters, A. (2018). Evaluating the cooling effects of green infrastructure: A systematic review of methods, indicators and data sources. In *Solar*

Energy (Vol. 166, pp. 486–508). Elsevier Ltd. https://doi.org/10.1016/j.solener.2018.03.008

Baumgärtner, S., Baumgärtner, B., & Quaas, M. F. (2008). Agro-biodiversity as natural insurance and the development of financial insurance markets. *AGROBIODIVERSITY, CONSERVATION AND ECONOMIC DEVELOPMENT*, 293–317.

Bierbaum, R., Smith, J. B., Lee, A., Blair, M., Carter, L., Chapin, F. S., Fleming, P., Ruffo, S., Stults, M., McNeeley, S., Wasley, E., & Verduzco, L. (2013a). A comprehensive review of climate adaptation in the United States: More than before, but less than needed. *Mitigation and Adaptation Strategies for Global Change*, *18*(3), 361–406. https://doi.org/10.1007/s11027-012-9423-1

Bierbaum, R., Smith, J. B., Lee, A., Blair, M., Carter, L., Chapin, F. S., Fleming, P., Ruffo, S., Stults, M., McNeeley, S., Wasley, E., & Verduzco, L. (2013b). A comprehensive review of climate adaptation in the United States: More than before, but less than needed. In *Mitigation and Adaptation Strategies for Global Change* (Vol. 18, Issue 3, pp. 361–406). Kluwer Academic Publishers. https://doi.org/10.1007/s11027-012-9423-1

Braunschweiger, D., & Pütz, M. (2021). Climate adaptation in practice: How mainstreaming strategies matter for policy integration. *Environmental Policy and Governance*, *February*, 1–13. https://doi.org/10.1002/eet.1936

Brooks, N., Adger, W. N., & Kelly, P. M. (2005). The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. *Global Environmental Change*, *15*(2), 151–163. https://doi.org/10.1016/j.gloenvcha.2004.12.006

Brooks, N., Anderson, S., Ayers, J., & Burton, I. (2011). *Tracking Adaptation and Measuring Development: a step-by-step guide TAMD Contents*.

Bryan, E., Ringler, C., Okoba, B., Roncoli, C., Silvestri, S., & Herrero, M. (2013). Adapting agriculture to climate change in Kenya: Household strategies and determinants. *Journal of Environmental Management*, *114*, 26–35. https://doi.org/10.1016/J.JENVMAN.2012.10.036

Burton, I., Diringer, E., & Smith, J. (2006). Adaptation to Climate Change: International Policy Options. In *Pew Center on Global Climate Change*. http://www.waterandclimateinformationcentre.org/resources/8012007_PEW_Burton2006.pdf

Burton, I., Huq, S., Lim, B., Pilifosova, O., & Schipper, E. L. (2002). From impacts assessment to adaptation priorities: the shaping of adaptation policy. In *Climate Policy* (Vol. 2).

Burton, I., Malone, E., & Huq, S. (2004). *Adaptation policy frameworks for climate change: developing strategies, policies and measures* (B. Lim & E. Spanger-Siegfried, Eds.). The press syndicate of the university of cambridge.

Cabral, I., Costa, S., Weiland, U., Bonn, A., Cabral, I., Luther, M., Costa, S., Weiland, U., & Bonn, A. (2017). Urban Gardens as Multifunctional Nature-Based Solutions for Societal Goals in a Changing Climate. *Theory and Practice of Urban Sustainability Transitions*, 237–253. https://doi.org/10.1007/978-3-319-56091-5_14

Cacho, O. J., Moss, J., Thornton, P. K., Herrero, M., Henderson, B., Bodirsky, B. L., Humpenöder, F., Popp, A., & Lipper, L. (2020). The value of climate-resilient seeds for smallholder adaptation in sub-Saharan Africa. *Climatic Change*, *162*(3), 1213–1229. https://doi.org/10.1007/S10584-020-02817-Z/TABLES/4

Casado-Asensio, J., Drutschinin, A., Corfee-Morlot, J., & Campillo, G. (2016). *Mainstreaming Adaptation in National Development Planning*. *August*, 43 pp. https://doi.org/10.1787/5jlsv0689qs6-en

Cashman, A., Nurse, L., & John, C. (2010). Climate change in the caribbean: The water management implications. *Journal of Environment and Development*, *19*(1), 42–67. https://doi.org/10.1177/1070496509347088

Castro, B., & Sen, R. (2022). Everyday Adaptation: Theorizing climate change adaptation in daily life. *Global Environmental Change*, *75*, 102555. https://doi.org/10.1016/J.GLOENVCHA.2022.102555

Charbit, C., & Michalun, M. V. (2009). *Mind the Gaps: Managing Mutual Dependence in Relations among Levels of Government*. https://doi.org/https://dx.doi.org/10.1787/221253707200

Chen, H., Wang, J., & Huang, J. (2014). Policy support, social capital, and farmers' adaptation to drought in China. *Global Environmental Change*, *24*(1), 193–202. https://doi.org/10.1016/j.gloenvcha.2013.11.010

Clausen, S. E. (1998). *Applied Correspondence Analysis* (Vol. 121). Sage.

Climate ADAPT. (n.d.). *Establishment of early warning systems*. Retrieved August 1, 2023, from https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/establishment-of-early-warning-systems

Climate-Adapt. (2016). *Climate smart urban agriculture*. Cambridge University Press. https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/urban-farming-and-gardening

Climate-Adapt. (2021). *Water reuse*. https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/water-recycling

Conedera, M., Del Biaggio, A., Seeland, K., Moretti, M., & Home, R. (2015). Residents' preferences and use of urban and peri-urban green spaces in a Swiss mountainous region of the Southern Alps. *Urban Forestry and Urban Greening*, *14*(1), 139–147. https://doi.org/10.1016/j.ufug.2015.01.003

Crimmins, A., Balbus, J., Gamble, J. L., Beard, C. B., Bell, J. E., Dodgen, D., Eisen, R. J., Fann, N., Hawkins, M. D., Herring, S. C., Jantarasami, L., Mills, D. M., Saha, S., Sarofim, M. C., Trtanj, J., & Ziska, L. (2016). *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*. https://doi.org/10.7930/J0R49NQX

Demuzere, M., Orru, K., Heidrich, O., Olazabal, E., Geneletti, D., Orru, H., Bhave, A. G., Mittal, N., Feliu, E., & Faehnle, M. (2014). Mitigating and adapting to climate change: Multi-functional and multi-scale assessment of green urban infrastructure. *Journal of Environmental Management*, *146*, 107–115. https://doi.org/10.1016/J.JENVMAN.2014.07.025

Dhungana, N., Silwal, N., Upadhaya, S., Khadka, C., Regmi, S. K., Joshi, D., & Adhikari, S. (2020). Rural coping and adaptation strategies for climate change by Himalayan communities in Nepal. *Journal of Mountain Science*, *17*(6), 1462–1474. https://doi.org/10.1007/s11629-019-5616-3

Dinku, A. M. (2018). Determinants of livelihood diversification strategies in Borena pastoralist communities of Oromia regional state, Ethiopia. *Agriculture and Food Security*, *7*(1). https://doi.org/10.1186/s40066-018-0192-2

Doey, L., & Kurta, J. (2011). Correspondence Analysis applied to psychological research. *Tutorials in Quantitative Methods for Psychology*, *7*(1), 5–14. https://doi.org/10.20982/TQMP.07.1.P005

Dollah, S., Abduh, A., & Rosmaladewi, Ms. (2017). *Benefits and Drawbacks of NVivo QSR Application*. https://doi.org/10.2991/ICEST-17.2017.21

Doria, M. de F., Boyd, E., Tompkins, E. L., & Adger, W. N. (2009). Using expert elicitation to define successful adaptation to climate change. *Environmental Science and Policy*, *12*(7), 810–819. https://doi.org/10.1016/j.envsci.2009.04.001

Downing, T. E., Ringius, L., Hulme, M., & Waughray, D. (1997). Adapting to climate change in Africa. *Mitigation and Adaptation Strategies for Global Change*, *2*(1), 19–44. https://doi.org/10.1007/BF02437055

Dupuis, J., & Biesbroek, R. (2013). Comparing apples and oranges: The dependent variable problem in comparing and evaluating climate change adaptation policies. *Global Environmental Change*, *23*(6), 1476–1487. https://doi.org/10.1016/j.gloenvcha.2013.07.022

Easterling, D., Rusticucci, M., Semenov, V., Alexander, L. V, Allen, S., Benito, G., Cavazos, T., Nicholls, N., Easterling, D., Goodess, C., Kanae, S., Kossin, J., Luo, Y., Marengo, J., McInnes, K., Rahimi, M., Reichstein, M., Sorteberg, A., Vera, C., … Midgley, P. (2012). *Changes in Climate Extremes and their Impacts on the Natural Physical Environment*. Cambridge University Press.

Ehsan, S., Begum, R. A., Abdul Maulud, K. N., & Mia, M. S. (2022). Assessing household perception, autonomous adaptation and economic value of adaptation benefits: Evidence from West Coast of Peninsular Malaysia. *Advances in Climate Change Research*, *13*(5), 738–758. https://doi.org/10.1016/j.accre.2022.06.002

Ellis, F. (1999). *Rural Livelihood Diversity in Developing Countries: Evidence and Policy Implications*. http://www.odi.org.uk/nrp/40.html

EPA. (2021). *Climate Change and Social Vulnerability in the United States: A Focus on Six Impact Sectors*. https://www.epa.gov/newsreleases/epa-report-shows-disproportionate-impacts-climate-change-socially-vulnerable

Eriksen, S. H., & Kelly, P. M. (2007). Developing credible vulnerability indicators for climate adaptation policy assessment. In *Mitigation and Adaptation Strategies for Global Change* (Vol. 12, Issue 4, pp. 495–524). https://doi.org/10.1007/s11027-006-3460-6

Fenoglio-Marc, L., Schöne, T., Illigner, J., Becker, M., Manurung, P., & Khafid. (2012). Sea Level Change and Vertical Motion from Satellite Altimetry, Tide Gauges and GPS in the Indonesian Region. *Marine Geodesy*, *35*(SUPPL. 1), 137–150. https://doi.org/10.1080/01490419.2012.718682

Filho, W. H. (2020). *Handbook of Climate Change Resilience* (W. Leal Filho, Ed.; 1st ed.). Springer International Publishing. https://doi.org/10.1007/978-3-319-93336-8

Fisher, D. R. (2013). Understanding the relationship between subnational and national climate change politics in the United States: Toward a theory of boomerang federalism. *Environment and Planning C: Government and Policy*, *31*(5), 769–784. https://doi.org/10.1068/c11186

Friendly, M. (1999). Visualizing Categorical Data. In M. G. Sirken & D. J. Hermann (Eds.), *Cognition and Survey Research* (pp. 319–348). John Wiley and Sons, Inc.

Gabe, I., & Rada, M. (2018). *An introduction to text mining: research design, data collection, and analysis*. SAGE Publications.

Garschagen, M., Doshi, D., Moure, M., James, H., & Shekhar, H. (2021). The consideration of future risk trends in national adaptation planning: Conceptual gaps and empirical lessons. *Climate Risk Management*, *34*. https://doi.org/10.1016/j.crm.2021.100357

Gómez-Baggethun, E., & Barton, D. N. (2013). Classifying and valuing ecosystem services for urban planning. *Ecological Economics*, *86*, 235–245. https://doi.org/10.1016/j.ecolecon.2012.08.019

Graça, M., Cruz, S., Monteiro, A., & Neset, T. S. (2022). Designing urban green spaces for climate adaptation: A critical review of research outputs. In *Urban Climate* (Vol. 42). Elsevier B.V. https://doi.org/10.1016/j.uclim.2022.101126

Greenacre, M. (2009). Power transformations in correspondence analysis. *Computational Statistics and Data Analysis*, *53*(8), 3107–3116. https://doi.org/10.1016/j.csda.2008.09.001

Greenacre, M. (2017). *Correspondence Analysis in Practice* (3rd ed.). Taylor & Francis Group.

Gregorio, M. Di, Nurrochmat, D. R., Fatorelli, L., Pramova, E., Sari, I. M., & No, W. P. (2015). Integrating mitigation and adaptation in climate and land use policies in Indonesia : a policy document analysis Bruno Locatelli and Maria Brockhaus November 2015 Centre for Climate Change Economics and Policy Center for International Forestry Research Wo. *Sustainability Research Institute Paper*, *90*(245).

Guenat, S., Porras Lopez, G., Mkwambisi, D. D., & Dallimer, M. (2021). Unpacking Stakeholder Perceptions of the Benefits and Challenges Associated With Urban Greenspaces in Sub-Saharan Africa. *Frontiers in Environmental Science*, *9*. https://doi.org/10.3389/fenvs.2021.591512

Guyadeen, D., Thistlethwaite, J., & Henstra, D. (2019). Evaluating the quality of municipal climate change plans in Canada. *Climatic Change*, *152*(1), 121–143. https://doi.org/10.1007/s10584-018-2312-1

Gwedla, N., & Shackleton, C. M. (2019). Perceptions and preferences for urban trees across multiple socio-economic contexts in the Eastern Cape, South Africa. *Landscape and Urban Planning*, *189*, 225–234. https://doi.org/10.1016/j.landurbplan.2019.05.001

Habib, F., Etesam, I., Ghoddusifar, S. H., & Mohajeri, N. (2012). Correspondence Analysis: A New Method for Analyzing Qualitative Data in Architecture. *Nexus Network Journal*, *14*(3), 517–538. https://doi.org/10.1007/s00004-012-0129-1

Hadavi, S., Kaplan, R., & Hunter, M. C. R. (2015). Environmental affordances: A practical approach for design of nearby outdoor settings in urban residential areas. *Landscape and Urban Planning*, *134*, 19–32. https://doi.org/10.1016/j.landurbplan.2014.10.001

Hall, D. M., & Steiner, R. (2020). Policy content analysis: Qualitative method for analyzing sub-national insect pollinator legislation. *MethodsX*, *7*, 100787. https://doi.org/10.1016/J.MEX.2020.100787

He, X., Yan, J., Yang, L. E., Zhou, H., Wu, Y., & Wu, S. (2022). The role of government interventions in household climate adaptation on the Tibetan Plateau. *Journal of Rural Studies*, *95*, 544–559. https://doi.org/10.1016/j.jrurstud.2022.10.003

Hegerl, G. C., Zwiers, F. W., Braconnot, P., Gillett, N. P., Luo, Y., Marengo Orsini Brazil, J. A., Nicholls, N., Penner, J. E., Stott, P. A., Karoly USA, D. J., Ogallo, L., Planton, S., Zwiers, F. W., Braconnot, P., Gillett, N., Luo, Y., Marengo Orsini, J., Nicholls, N., Penner, J., … Tignor, M. (2007). Understanding and Attributing Climate Change. In *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 665–744). Cambridge University Press.

Hielkema, P. (2023). *Climate change insurance needs*. The EUROFI Magazine.

IPCC. (2001). *Climate Change 2001: Impacts, Adaptation and Vulnerability*. Cambridge University Press.

IPCC. (2012). Summary for Policymakers. In: Managing the risks from climate extremes and disasters to advance climate change adaptation. In *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change*. https://doi.org/10.1017/CBO9781139177245.009

IPCC. (2014a). *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. papers2://publication/uuid/B8BF5043-C873-4AFD-97F9-A630782E590D

IPCC. (2014b). *Climate Change 2014 Impacts, Adaptation, and Vulnerability Part B: Regional Aspects Working Group II Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press, Ed.).

IPCC. (2014c). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*.

IPCC. (2019). Summary for Policymakers. In IPCC (Ed.), *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* (pp. 1–36). Cambridge University Press. https://doi.org/10.1017/9781009157988.001

IPCC. (2022). *SIXTH ASSESSMENT REPORT Working Group II-Impacts, Adaptation and Vulnerability Food production losses*.

IPCC. (2023). Summary for Policymakers. In: Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. In *Diriba Korecha Dadi*. Panmao Zhai.

Islam, S., Cenacchi, N., Sulser, T. B., Gbegbelegbe, S., Hareau, G., Kleinwechter, U., Mason-D'Croz, D., Nedumaran, S., Robertson, R., Robinson, S., & Wiebe, K. (2016). Structural approaches to modeling the impact of climate change and adaptation technologies on crop yields and food security. In *Global Food Security* (Vol. 10, pp. 63–70). Elsevier. https://doi.org/10.1016/j.gfs.2016.08.003

Jackson, K., & Bazeley, P. (2007). *QUALITATIVE DATA ANALYSIS WITH NVIVO* (J. Seaman, Ed.; Vol. 1). SAGE. https://us.sagepub.com/sites/default/files/upm-assets/114916_book_item_114916.pdf

Jain, M., Naeem, S., Orlove, B., Modi, V., & DeFries, R. S. (2015). Understanding the causes and consequences of differential decision-making in adaptation research: Adapting to a delayed monsoon onset in Gujarat, India. *Global Environmental Change*, *31*, 98–109. https://doi.org/10.1016/J.GLOENVCHA.2014.12.008

Jaramillo, M. F., & Restrepo, I. (2017). Wastewater Reuse in Agriculture: A Review about Its Limitations and Benefits. *Sustainability 2017, Vol. 9, Page 1734*, *9*(10), 1734. https://doi.org/10.3390/SU9101734

Jones, P. G., Amador, J., Campos, M., & Hayhoe, K. (2005). *Generating climate change scenarios at high resolution for impact studies and adaptation: Focus on developing countries*.

Jørgensen, S. L., Termansen, M., & Pascual, U. (2020). Natural insurance as condition for market insurance: Climate change adaptation in agriculture. *Ecological Economics*, *169*, 106489. https://doi.org/10.1016/J.ECOLECON.2019.106489

Kawanishi, M., & Mimura, N. (2013). Rice farmers' response to climate and socio-economic impacts: A case study in North Sumatra, Indonesia. *Journal of Agricultural Meteorology*, *69*(1), 9–22. https://doi.org/10.2480/agrmet.69.1.2

Khadka, R. B., Dalal-Clayton, B., Mathema, A., & Shrestha, P. (2012). *Safeguarding the future, securing Shangri-La Integrating environment and development in Nepal: achievements, challenges and next steps*. www.iied.org

Khatibi, F. S., Dedekorkut-Howes, A., Howes, M., & Torabi, E. (2021). Can public awareness, knowledge and engagement improve climate change adaptation policies? *Discover Sustainability*, *2*(1). https://doi.org/10.1007/s43621-021-00024-z

Khatri, D. B., Bista, R., & Gurung, N. (2013). Climate change Adaptation and Local Institutions: How to Connect Community Groups with Local Government for Adaptation Planning. *Journal of Forest and Livelihood*, *11*(1), 14–28. https://doi.org/10.3126/jfl.v11i1.8610

Kiragu, S. (2010). *The role of local institutions in shaping climate risks adaptation processes and practices among the semi-arid rural households of Mwingi, Kenya*. https://doi.org/10.17169/REFUBIUM-22304

Klein, R. J. T., Schipper, E. L. F., & Dessai, S. (2005). Integrating mitigation and adaptation into climate and development policy: Three research questions. *Environmental Science and Policy*, *8*(6), 579–588. https://doi.org/10.1016/j.envsci.2005.06.010

Kothencz, G., Kolcsár, R., Cabrera-Barona, P., & Szilassi, P. (2017). Urban green space perception and its contribution to well-being. *International Journal of Environmental Research and Public Health*, *14*(7). https://doi.org/10.3390/ijerph14070766

Kurnik, B. (2013). *Climate change adaptation in the agriculture sector in Europe*.

La Greca, A. M., Burdette, E. T., & Brodar, K. E. (2023). Climate change and extreme weather disasters: evacuation stress is associated with youths' somatic complaints. *Frontiers in Psychology*, *14*. https://doi.org/10.3389/fpsyg.2023.1196419

Lazarus, R. J. (2009). Super wicked problems and climate change: Restraining the present to liberate the future. *Cornell Law Review*, *94*(5), 1153–1233.

Le, T. D. N. (2020). Climate change adaptation in coastal cities of developing countries: characterizing types of vulnerability and adaptation options. *Mitigation and Adaptation Strategies for Global Change*, *25*(5), 739–761. https://doi.org/10.1007/s11027-019-09888-z

Leech, N. L., & Onwuegbuzie, A. J. (2011). Beyond Constant Comparison Qualitative Data Analysis: Using NVivo. *School Psychology Quarterly*, *26*(1), 70–84. https://doi.org/10.1037/a0022711

Liang, Y., Jiang, C., Ma, L., Liu, L., Chen, W., & Liu, L. (2017). Government support, social capital and adaptation to urban flooding by residents in the Pearl River Delta area, China. *Habitat International*, *59*, 21–31. https://doi.org/10.1016/J.HABITATINT.2016.11.008

Liverpool-Tasie, L. S. O., Sanou, A., & Tambo, J. A. (2019). Climate change adaptation among poultry farmers: evidence from Nigeria. *Climatic Change*, *157*(3–4), 527–544. https://doi.org/10.1007/S10584-019-02574-8/TABLES/5

Lo, A. Y., Byrne, J. A., & Jim, C. Y. (2017). How climate change perception is reshaping attitudes towards the functional benefits of urban trees and green space: Lessons from Hong Kong. *Urban Forestry and Urban Greening*, *23*, 74–83. https://doi.org/10.1016/j.ufug.2017.03.007

Massetti, E., & Mendelsohn, R. (2018). Measuring Climate Adaptation: Methods and Evidence. *Https://Doi.Org/10.1093/Reep/Rey007*, *12*(2), 324–341. https://doi.org/10.1093/REEP/REY007

Mathey, J., Rößler, S., Lehmann, I., & Bräuer, A. (2011). Urban Green Spaces: Potentials and Constraints for Urban Adaptation to Climate Change. In *Resilient Cities* (pp. 479–485). Springer Netherlands. https://doi.org/10.1007/978-94-007-0785-6_47

Measham, T. G., Preston, B. L., Smith, T. F., Brooke, C., Gorddard, R., Withycombe, G., & Morrison, C. (2011). Adapting to climate change through local municipal planning: Barriers and challenges. *Mitigation and Adaptation Strategies for Global Change*, *16*(8), 889–909. https://doi.org/10.1007/s11027-011-9301-2

Mercer, J. (2010). Disaster risk reduction or climate change adaptation: are we reinventing the weel? *Journal of International Development*, *22*, 247–264. https://doi.org/10.1002/jid

Mertz, O., Halsnæs, K., Olesen, J. E., & Rasmussen, K. (2009a). Adaptation to climate change in developing countries. *Environmental Management*, *43*(5), 743–752. https://doi.org/10.1007/s00267-008-9259-3

Mertz, O., Halsnæs, K., Olesen, J. E., & Rasmussen, K. (2009b). Adaptation to climate change in developing countries. *Environmental Management*, *43*(5), 743–752. https://doi.org/10.1007/S00267-008-9259-3/METRICS

Mfitumukiza, D., Sinha Roy, A., Simane, B., Hammill, A., Feisal Rahman, M., & Huq, S. (2020). *Scaling local and community-based adaptation. Global Commission on Adaptation Background Paper*. www.gca.org/global-commission-on-adaptation/report/papers.

Moalafhi, D. B., Bonduki, Y., Bucher, A., Chachibaia, K., & Ghanime, L. (2015). *Applying climate information for adaptation decision-making*. https://www.undp.org/publications/applying-climate-information-adaptation-decision-making

Mulyani, M., & Jepson, P. (2013). REDD+ and Forest Governance in Indonesia: A Multistakeholder Study of Perceived Challenges and Opportunities. *Journal of Environment and Development*, *22*(3), 261–283. https://doi.org/10.1177/1070496513494203

Mundry, R., & Nunn, C. L. (2009). Stepwise model fitting and statistical inference: Turning noise into signal pollution. *American Naturalist*, *173*(1), 119–123. https://doi.org/10.1086/593303

Mwenge Kahinda, J., & Taigbenu, A. E. (2011). Rainwater harvesting in South Africa: Challenges and opportunities. *Physics and Chemistry of the Earth*, *36*(14–15), 968–976. https://doi.org/10.1016/j.pce.2011.08.011

Naess, L. O. (2013). The role of local knowledge in adaptation to climate change. *Wiley Interdisciplinary Reviews: Climate Change*, *4*(2), 99–106. https://doi.org/10.1002/wcc.204

Nagoda, S., & Nightingale, A. J. (2017). Participation and Power in Climate Change Adaptation Policies: Vulnerability in Food Security Programs in Nepal. *World Development*, *100*, 85–93. https://doi.org/10.1016/J.WORLDDEV.2017.07.022

Nagpaul, P. S. (1999). Guide to advanced data analysis using IDAMS software. *New Delhi: United Nations Educational, Scientific and Cultural Organization*.

Nair, A., Malhotra, M. K., & Ahire, S. L. (2011). Toward a theory of managing context in Six Sigma process-improvement projects: An action research investigation. *Journal of Operations Management*, *29*(5), 529–548. https://doi.org/10.1016/J.JOM.2010.11.014

National Development Planning Agency. (2012). *National Action Plan for Climate Change Adaptation (RAN-API) Synthesis Report*.

Neil Adger, W., Agrawala OECD, S., Monirul Qader Mirza Canada, M., Conde, C., Pulhin, J., Pulwarty USA, R., Smit, B., Takahashi, K., Enright, B., Fankhauser EBRD, S., Ford, J., Gigli, S., Jetté-Nantel, S., Klein, R. J., Rosenzweig, C., Vincent, K., Wandel, J., Allali, A., Leary, N. A., … Hanson, C. (2007). Assessment of adaptation practices, options, constraints and capacity. In *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 717–743). Cambridge University Press.

Noble, I. R., Huq, S., Anokhin, Y. A., Carmin, J., & Goudou, D. (2014). Adaptation Needs and Options. In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A:Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of theIntergovernmental Panel on Climate Change* (pp. 833–868).

OECD. (2009). Integrating Climate Change Adaptation into Development Co-operation. In *Organization for economic co-operation and development*.

Oliveira, M., Bitencourt, C. C., Santos, A. C. M. Z. dos, & Teixeira, E. K. (2015). Thematic Content Analysis: Is There a Difference Between the Support Provided by the MAXQDA® and NVivo® Software Packages? *Revista de Administração Da UFSM*, *9*(1), 72–82. https://doi.org/10.5902/1983465911213

Oweis, T., Prinz, D., & Hachum, A. (2001). *Water Harvesting: Indigenous Knowledge for the Future of the Drier Environments*. http://www.icarda.cgiar.org

Pandey, D. N., Gupta, A. K., & Anderson, D. M. (2003). Rainwater Harvesting as an Adaptation to Climate Change. *Current Science*, *85*(1), 46–59.

Paulus, T., Woods, M., Atkins, D. P., & Macklin, R. (2017). The discourse of QDAS: reporting practices of ATLAS.ti and NVivo users with implications for best practices. *International Journal of Social Research Methodology*, *20*(1), 35–47. https://www.tandfonline.com/doi/abs/10.1080/13645579.2015.1102454?journalCode=tsrm20

Pearson, A. L., Mayer, J. D., & Bradley, D. J. (2015). Coping with Household Water Scarcity in the Savannah Today: Implications for Health and Climate Change into the Future. *Earth Interactions*, *19*(8), 1–14. https://doi.org/10.1175/EI-D-14-0039.1

Permatasari, L. (2015). BIOPORE INFILTRATION HOLE: “ONE DAY FOR BIOPORE” AS AN ALTERNATIVE PREVENT FLOOD. In *International Journal of Advances in Science Engineering and Technology* (Issue 3).

Quandt, A., & Kimathi, Y. A. (2017). Perceptions of the effects of floods and droughts on livelihoods: lessons from arid Kenya. *International Journal of Climate Change Strategies and Management*, *9*(3), 337–351. https://doi.org/10.1108/IJCCSM-11-2014-0132/FULL/PDF

Rahman, A. B. (2017). *Mainstreaming Climate Change Adaptation in a Developing Country Context: an Indonesian Case Study*.

Rahman, H. M. T., & Hickey, G. M. (2019). What does autonomous adaptation to climate change have to teach public policy and planning about avoiding the risks of maladaptation in Bangladesh? In *Frontiers in Environmental Science* (Vol. 7, Issue JAN). Frontiers Media S.A. https://doi.org/10.3389/fenvs.2019.00002

Randrup, T. B., Svännel, J., Sunding, A., Jansson, M., & Sang, O. (2021). Urban open space management in the Nordic countries. Identification of current challenges based on managers’ perceptions. *Cities*, *115*. https://doi.org/10.1016/j.cities.2021.103225

Rauken, T., Mydske, P. K., & Winsvold, M. (2015). Mainstreaming climate change adaptation at the local level. *Local Environment*, *20*(4), 408–423. https://doi.org/10.1080/13549839.2014.880412

Regmi, B. R., Star, C., & Leal Filho, W. (2016a). An overview of the opportunities and challenges of promoting climate change adaptation at the local level: a case study from a community adaptation planning in Nepal. *Climatic Change*, *138*(3–4), 537–550. https://doi.org/10.1007/s10584-016-1765-3

Regmi, B. R., Star, C., & Leal Filho, W. (2016b). Effectiveness of the Local Adaptation Plan of Action to support climate change adaptation in Nepal. *Mitigation and Adaptation Strategies for Global Change*, *21*(3), 461–478. https://doi.org/10.1007/s11027-014-9610-3

Rodriguez, N. (2015). *Perceptions of Climate Trends among Mexican Maize Farmers*.

Rolf, W., Diehl, K., Zasada, I., & Wiggering, H. (2020). Integrating farmland in urban green infrastructure planning. An evidence synthesis for informed policymaking. *Land Use Policy*, *99*, 104823. https://doi.org/10.1016/J.LANDUSEPOL.2020.104823

Savo, V., Lepofsky, D., Benner, J. P., Kohfeld, K. E., Bailey, J., & Lertzman, K. (2016). Observations of climate change among subsistence-oriented communities around the world. *Nature Climate Change 2016 6:5*, *6*(5), 462–473. https://doi.org/10.1038/nclimate2958

Schlosberg, D. (2012). Climate Justice and Capabilities: A Framework for Adaptation Policy. *Ethics & International Affairs, 26*(4), 445–461. https://doi.org/10.1017/S0892679412000615

Schuster-Wallace, C. J., Dickson-Anderson, S. E., Papalexiou, S. M., & Ganzouri, A. El. (2022). Design and Application of the Tank Simulation Model (TSM): Assessing the Ability of Rainwater Harvesting to Meet Domestic Water Demand. *JOURNAL OF ENVIRONMENTAL INFORMATICS*, *40*(1), 16–29. https://doi.org/10.3808/jei.202200477

Scoville-Simonds, M., Jamali, H., & Hufty, M. (2020). The Hazards of Mainstreaming: Climate change adaptation politics in three dimensions. *World Development*, *125*. https://doi.org/10.1016/J.WORLDDEV.2019.104683

Seo, S. N., & Mendelsohn, R. (2008). Measuring impacts and adaptations to climate change: a structural Ricardian model of African livestock management1. *Agricultural Economics*, *38*(2), 151–165. https://doi.org/10.1111/J.1574-0862.2008.00289.X

Setiawan, I., & Rohmat, D. (2019). Test the Effectiveness of Biopore in the Framework of Eco-Campus Development at Universitas Pendidikan Indonesia. *IOP Conference Series: Earth and Environmental Science*, *286*(1). https://doi.org/10.1088/1755-1315/286/1/012015

Sietz, D., Boschütz, M., & Klein, R. J. T. (2011). Mainstreaming climate adaptation into development assistance: Rationale, institutional barriers and opportunities in Mozambique. *Environmental Science and Policy*, *14*(4), 493–502. https://doi.org/10.1016/j.envsci.2011.01.001

Smit, B., & Pilifosova, O. (2001). Adaptation to Climate Change in the Context of Sustainable Development and Equity. In J. J. McCarthy, O. F. Canziani, N. A. Leary, D. J. Dokken, & K. S. White (Eds.), *Climate Change 2001: Impacts, Adaptation, and Vulnerability* (p. 1005). THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE. https://doi.org/10.1103/PhysRevD.87.106003

Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*, *16*(3), 282–292. https://doi.org/10.1016/j.gloenvcha.2006.03.008

Sourial, N., Wolfson, C., Zhu, B., Quail, J., Fletcher, J., Karunananthan, S., Bandeen-Roche, K., Béland, F., & Bergman, H. (2010). Correspondence analysis is a useful tool to uncover the relationships among categorical variables. *Journal of Clinical Epidemiology*, *63*(6), 638–646. https://doi.org/10.1016/j.jclinepi.2009.08.008

Syahruddin, M. H., Amiruddin, & Sakka, H. H. (2019). Groundwater Conservation with Hole Infiltration of Biopore Cube. *IOP Conf. Series: Earth and Environmental Science*. https://doi.org/10.1088/1755-1315/279/1/012021

Tang, Z., Brody, S. D., Quinn, C., Chang, L., & Wei, T. (2010). Moving from agenda to action: Evaluating local climate change action plans. *Journal of Environmental Planning and Management*, *53*(1), 41–62. https://doi.org/10.1080/09640560903399772

Tollefson, J. (2022). Climate change is hitting the planet faster than scientists originally thought. *Nature*. https://doi.org/10.1038/D41586-022-00585-7

Turner, R., McConney, P., & Monnereau, I. (2020). Climate Change Adaptation and Extreme Weather in the Small-Scale Fisheries of Dominica. *Coastal Management*, *48*(5), 436–455. https://doi.org/10.1080/08920753.2020.1795970

UNDP. (2011). *The future for climate finance in Nepal*. NPC/UNDP/UNEP/CDDE.

UNDP. (2018). *Five approaches to build functional early warning systems*.

UNFCCC. (2012). *THE NATIONAL ADAPTATION PLAN PROCESS a brief overview*.

UNFCCC. (2021). *PROGRESS IN THE FORMULATION AND IMPLEMENTATION OF NAPS*.

UNHCR. (2020). *Indigenous peoples' Knowledge and Climate Adaptation*.

van Aalst, M. K., Cannon, T., & Burton, I. (2008). Community level adaptation to climate change: The potential role of participatory community risk assessment. *Global Environmental Change*, *18*(1), 165–179. https://doi.org/10.1016/J.GLOENVCHA.2007.06.002

Wakhungu, M. J. (2019). An ethnography of policy: Water reuse policy in Kenya. *Water Policy*, *21*(2), 436–448. https://doi.org/10.2166/wp.2019.160

Walsh, M. (2015). Teaching Qualitative Analysis Using QSR NVivo. *The Qualitative Report*. https://doi.org/10.46743/2160-3715/2003.1890

Watson, R. T., Noble, I. R., & Bolin, B. (2000). *Land use, land-use change, and forestry : summary for policymakers*. WMO (World Meteorological Organization).

WEF. (2019). *The Global Risks Report 2019*. http://wef.ch/risks2019

Wiggins, S. (2011). *Adaptation United Building blocks from developing countries on integrated adaptation*. www.tearfund.org/tilz

Wijaya, N., Nitivattananon, V., Shrestha, R. P., & Kim, S. M. (2020). Drivers and benefits of integrating climate adaptation measures into urban development: Experience from coastal cities of Indonesia. *Sustainability (Switzerland)*, *12*(2), 1–16. https://doi.org/10.3390/su12020750

World Bank. (n.d.). *Mainstreaming Adaptation to Climate Change in Agriculture and Natural Resources Management Projects Guidance Notes Climate Change Team Environment Department*.

World Bank. (2010). *Economics of Adaptation to Climate Change: Synthesis Report*. https://documents1.worldbank.org/curated/en/646291468171244256/pdf/702670ESW0P10800EACCSynthesisReport.pdf

World Bank Group. (2021). *INDONESIA CLIMATE RISK COUNTRY PROFILE*. www.worldbank.org

Wright, J. D. (2015). *International Encyclopedia of the Social & Behavioral Sciences* (J. D. Wright, Ed.). Elsevier.

Wu, N., Ismail, M., Joshi, S., Yi, S. liang, Shrestha, R. M., & Jasra, A. W. (2014). Livelihood diversification as an adaptation approach to change in the pastoral Hindu-Kush Himalayan region. *Journal of Mountain Science*, *11*(5), 1342–1355. https://doi.org/10.1007/s11629-014-3038-9

Yulandari, E. D., Murayama, T., & Nishikizawa, S. (2023). Climate change adaptation through policy integration by local governments in Indonesia. *Mitigation and Adaptation Strategies for Global Change*, *28*(1). https://doi.org/10.1007/s11027-022-10039-0

APPENDIX

Annex 1. In-depth interview guidelines for Chapter 3

IN-DEPTH INTERVIEW GUIDELINES
Title: Evaluation of the integration of climate change adaptation into development plan by local government in Indonesia

Researcher	:	Eka Dyana Yulandari, Tokyo Institute of Technology
Supervisor	:	Professor Takehiko Murayama, Tokyo Institute of Technology
	:	Professor Shigeo Nishikizawa, Tokyo Institute of Technology

Hello, this is Eka Dyana Yulandari from the Tokyo Institute of Technology, Tokyo, Japan. I am a PhD student, doing research on the **Evaluation of the integration of climate change adaptation into development plan by local government in Indonesia**. To fulfill my research objective, I need to collect data from different stakeholders, including the local government agencies. As a part of the research work, I would like to conduct a 30-minute interview to learn from you about your experiences in integrating climate change adaptation into development plan. Your participation is voluntary, and your identity will not be used anywhere.

Introduction: In Indonesia, the national government published the National Adaptation Plan in 2014. One of the programs resulting from the document is the climate village program. The climate village program, if implemented effectively, can increase adaptive capacity and reduce the level of household risk to climate change. With the understanding that climate change has already been observed in Indonesia, it is crucial to understand the local government integrate climate change adaptation into development plans.

Study objective: This study aims to evaluate the influence of climate change adaptation integration into development plan towards households' adoption of adaptation measures.

Disclosure: The information you will provide us will be fully confidential and will be used only for research purposes. Whether you will participate in the discussion or not will completely depend on your personal will. If you are unwilling to answer any of the questions or feel embarrassed to answer, you may stop the discussion anytime you want or you can refrain from answering that specific question(s). At the end of the study, we will prepare a report (thesis/journal paper) and share the findings with different stakeholders engaged in climate change adaptation, but we will not identify your name and will not disclose to anybody who said what. Please feel free to ask me any questions now, or at any point during the interview, or after the interview.

Contact: If you need you can contact me by mobile phone at +6282185098727 or by email eka.dyana@yahoo.co.id

Do you have any questions about this research study or the information I provided?

- Yes
- No

Are you willing to participate in a 30 minutes interview?

- Yes
- No

1. Since the NAP document was published by the national development planning agency, the local government has been designated as one of the locations to integrate climate change adaptation into development plan document. What steps has the local government taken to integrate climate change adaptation into the development plans?
2. When did the local government start to integrate climate change adaptation into the development plan?
3. Which stakeholder is involved in integrating climate change adaptation into the development plan and what are their roles?
4. Are past climate conditions (historical climate data), current climate conditions, and future climate conditions (climate projection) available in the local government?
5. Are past climate conditions (historical climate data), current climate conditions, and future climate conditions (climate projection) considered in integrating climate change adaptation into the development plan?
6. Where did the local government get the data on past climate conditions (historical climate data), current climate conditions, and future climate conditions (climate projection)? (Government institution/literature study/development partner (JICA, ADB, USAID)/NGO/Academia/other)
7. Is vulnerability assessment to climate change available in the local government?
8. Is funding available for integrating and implementing climate change adaptation into the development plan?
9. Are there any other aspects that were considered in integrating climate change adaptation into the development plan? (Existing infrastructure/geography/vision and mission of the head of the region/other)
10. How the local governments overcome the challenges and barriers in integrating climate change adaptation into the development plan?

THANK YOU

Annex 2. Questionnaire for Chapter 4

Title: Evaluation of the integration of climate change adaptation into development plan by local government in Indonesia

Researcher	:	Eka Dyana Yulandari, Tokyo Institute of Technology
Supervisor	:	Professor Takehiko Murayama, Tokyo Institute of Technology
	:	Professor Shigeo Nishikizawa, Tokyo Institute of Technology

Hello, this is Eka Dyana Yulandari from the Tokyo Institute of Technology, Tokyo, Japan. I am a PhD student, doing research on the **Evaluation of the integration of climate change adaptation into development plan by local government in Indonesia**. To fulfill my research objective, I need to collect data from different stakeholders, including the households. As a part of the research work, I would like to conduct a 25-minute interview to learn from you about your experiences with the climate change adaptation program by Semarang City local government. Your participation is voluntary, and your identity will not be used anywhere.

Introduction: In Indonesia, the national government published the National Adaptation Plan in 2014. One of the programs resulting from the document is the climate village program. The climate village program, if implemented effectively, can increase adaptive capacity and reduce the level of household risk to climate change. With the understanding that climate change has already been observed in Indonesia, it is crucial to understand how effective the adaptation program as outcome of climate change adaptation integration into development plan have been in helping the households to adopt adaptation measures.

Study objective: This study aims to evaluate the influence of climate change adaptation integration into development plan towards households' adoption of adaptation measures.

Disclosure: The information you will provide us will be fully confidential and will be used only for research purposes. Whether you will participate in the discussion or not will completely depend on your personal will. If you are unwilling to answer any of the questions or feel embarrassed to answer, you may stop the discussion anytime you want or you can refrain from answering that specific question(s). At the end of the study, we will prepare a report (thesis/journal paper) and share the findings with different stakeholders engaged in climate change adaptation, but we will not identify your name and will not disclose to anybody who said what. Please feel free to ask me any questions now, or at any point of during the interview, or after the interview.

Contact: If you need you can contact me by mobile phone at +6282185098727 or by email eka.dyana@yahoo.co.id

Do you have any questions about this research study or the information I provided?

- Yes
- No

Do you participate in the climate village program?

- Yes (proceed to next question)
- No (end the interview and say thank you)

Are you willing to participate in 20 minutes interview?

- Yes
- No

1. Can you tell us your age?

<25 years old	1
25-34 years old	2
35-44 years old	3
45-54 years old	4
55-64 years old	5
65 years old or older	6

2. Can you tell us your sex?

Male	1
Female	2

3. Can you tell us your level of education?

Not graduate from elementary school	1
Elementary school – Junior High school	2
Senior high school – Higher degree	3

4. Can you tell us your occupation?

Farmers	1
Fisherman	2
Others	3

5. Can you tell us how much your family earns on average each month?

< IDR 2,000,000	1
IDR 2,000,000 – IDR 3,000,000	2
> IDR 3,000,000	3

6. On average in a year, can you tell us how many times you and your family member participated in climate village in one year?

1-5 times	1
6-10 times	2
More than 10 times	3

7. Does information support about climate change adaptation is provided in climate village?

Yes, the information support is about:	1
No	2

8. On average in a year, how many times is information support about climate change adaptation provided in climate village?

1 time	1
2 times	2
3 times	3
4 times	4
5 times and more	5

9. Do you think the information support about climate change adaptation provided in climate village is sufficient?

Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

10. Do you think information support about climate change adaptation is needed for you and your family member to be able to adapt to climate change?

Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

11. Does technological support for climate change adaptation is provided in climate village?

Yes, the technological support is:	1
No	2

12. On average in a year, how many times is technological support for climate change adaptation provided in climate village?

1 time	1
2 times	2
3 times	3
4 times	4
5 times and more	5

13. Do you think the technological support for climate change adaptation provided in climate village is sufficient?

Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

14. Do you think technological support for climate change adaptation is needed for you and your family member to be able to adapt to climate change?

Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

15. Does financial support for climate change adaptation is provided in climate village?

Yes, the amount of financial support is:	1
No	2

16. On average in a year, how many times is financial support for climate change adaptation provided in climate village?

1 time	1
2 times	2
3 times	3
4 times	4
5 times and more	5

17. Do you think the financial support for climate change adaptation provided in climate village is sufficient?

Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

18. Do you think financial support for climate change adaptation is needed for you and your family member to be able to adapt to climate change?

Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

19. Does capacity building support for climate change adaptation is provided in climate village?

Yes, the capacity building is about:	1
No	2

20. On average in a year, how many times is capacity building support for climate change adaptation provided in climate village?

1 time	1
2 times	2
3 times	3
4 times	4
5 times and more	5

21. Do you think the capacity building support for climate change adaptation provided in climate village is sufficient?

Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

22. Do you think capacity building support for climate change adaptation is needed for you and your family member to be able to adapt to climate change?

Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

23. Before participating in climate village, did you think you and your family members were adapting to climate change?

Yes	1

No	2

24. Before participating in climate village, which climate change adaptation did you and your family members do? (You can choose more than one option below)

Insurance	1
Sharing local knowledge	2
Early warning system	3
Household preparation and evacuation planning	4
Livelihood diversification	5
Climate observation	6
Rainwater harvesting	7
Water recycling	8
Urban gardening	9
Urban green space	10
Bio-pore infiltration hole	11
Climate change resistance seed	12
Others	13

25. After participating in climate village, do you think you and your family members are adapting to climate change?

Yes	1
No	2

26. After participating in climate village, which climate change adaptation do you and your family members do? (You can choose more than one option below)

Insurance	1
Sharing local knowledge	2
Early warning system	3
Household preparation and evacuation planning	4
Livelihood diversification	5
Climate observation	6
Rainwater harvesting	7
Water recycling	8
Urban gardening	9
Urban green space	10
Bio-pore infiltration hole	11
Climate change resistance seed	12

Others	13

THANK YOU

Annex 3. Correspondence analysis plot

Table 21: Correspondence table

	Document																				
Nodes	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	Active Margin
Climate change	12	8	10	15	13	0	11	5	8	2	6	6	11	19	12	3	11	23	8	10	193
Adaptation	7	4	8	12	6	0	5	1	9	3	1	3	4	5	0	3	5	19	7	8	110
Climate	0	4	13	11	11	6	1	1	1	1	1	1	3	3	2	3	3	3	2	2	72
Weather	5	4	3	4	3	0	3	0	1	0	0	1	4	4	4	1	1	0	0	0	38
Season	5	2	4	4	5	3	3	1	1	1	1	1	5	13	6	3	5	6	5	6	80
Air pressure	0	0	0	0	0	7	0	0	0	0	1	1	2	2	2	0	0	0	0	0	15
Cloudiness	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3
Sunlight	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	1	1	7
Humidity	0	1	1	0	2	1	1	1	1	0	1	1	2	2	2	0	1	2	1	1	21
Precipitation	8	6	15	18	17	9	3	2	3	4	2	2	7	9	8	6	8	6	3	4	140
Temperature	6	5	3	3	1	1	1	1	1	0	1	2	3	4	4	1	1	1	1	1	41
Wind	7	8	6	6	6	10	3	0	0	0	3	2	11	5	6	1	5	5	3	2	89
Increased in air temperature	1	0	0	0	0	0	0	0	0	0	0	1	2	2	2	0	0	0	0	0	8
Extreme rain	3	2	2	2	2	0	0	0	0	0	0	0	2	2	3	0	2	1	1	1	23
Dry season	3	1	2	1	2	1	2	1	1	1	0	0	2	2	1	0	4	4	3	3	34
Drought	9	2	8	25	5	0	5	0	1	1	2	3	9	2	1	1	1	0	1	1	77
Strong wind	6	3	3	3	4	0	3	0	1	0	1	1	6	1	1	0	1	1	1	1	37
Sea level rise	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	0	0	0	0	5
Extreme weather	1	0	0	1	0	0	1	0	1	0	0	0	0	0	0	1	1	0	0	0	6
Heat wave	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cold wave	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forest fire	5	3	4	6	5	0	2	0	1	1	0	1	1	1	2	0	1	0	0	0	33
Land fire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Nodes	Document																				
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	Active Margin
Flood	31	17	35	31	76	8	11	0	9	23	7	6	24	50	8	56	71	69	62	54	648
Coastal flood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Decreased agricultural productivity	3	0	1	1	3	0	1	0	0	0	1	0	0	3	1	0	1	0	1	1	17
Decrease fishery productivity	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Change in biodiversity	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Change in ecosystem	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2
Spread of disease	0	0	0	0	0	0	0	0	0	0	1	0	0	2	1	0	0	0	0	0	4
Sea water intrusion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ocean acidification	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Damage to infrastructure	0	0	1	2	4	2	0	0	0	0	0	0	0	0	1	0	0	0	1	1	12
Clean water scarcity	2	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	9
Avalanche	8	7	9	10	9	2	4	0	1	5	5	6	11	4	3	9	5	5	6	7	116
Erosion	1	1	3	3	3	1	0	0	0	1	0	0	0	0	3	1	7	4	0	0	28
Active Margin	128	78	132	159	178	51	61	13	40	44	35	38	110	136	74	92	136	156	108	105	1874

Table 22: Row profiles

Nodes	Document																				
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	Total
Climate change	0,06	0,04	0,05	0,08	0,07	0,00	0,06	0,03	0,04	0,01	0,03	0,03	0,06	0,10	0,06	0,02	0,06	0,12	0,04	0,05	1
Adaptation	0,06	0,04	0,07	0,11	0,05	0,00	0,05	0,01	0,08	0,03	0,01	0,03	0,04	0,05	0,00	0,03	0,05	0,17	0,06	0,07	1
Climate	0,00	0,06	0,18	0,15	0,15	0,08	0,01	0,01	0,01	0,01	0,01	0,01	0,04	0,04	0,03	0,04	0,04	0,04	0,03	0,03	1
Weather	0,13	0,11	0,08	0,11	0,08	0,00	0,08	0,00	0,03	0,00	0,00	0,03	0,11	0,11	0,11	0,03	0,03	0,00	0,00	0,00	1
Season	0,06	0,03	0,05	0,05	0,06	0,04	0,04	0,01	0,01	0,01	0,01	0,01	0,06	0,16	0,08	0,04	0,06	0,08	0,06	0,08	1
Air pressure	0,00	0,00	0,00	0,00	0,00	0,47	0,00	0,00	0,00	0,00	0,07	0,07	0,13	0,13	0,13	0,00	0,00	0,00	0,00	0,00	1
Cloudiness	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,33	0,33	0,33	1
Sunlight	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,14	0,29	0,29	0,14	0,14	1
Humidity	0,00	0,05	0,05	0,00	0,10	0,05	0,05	0,05	0,05	0,00	0,05	0,05	0,10	0,10	0,10	0,00	0,05	0,10	0,05	0,05	1
Precipitation	0,06	0,04	0,11	0,13	0,12	0,06	0,02	0,01	0,02	0,03	0,01	0,01	0,05	0,06	0,06	0,04	0,06	0,04	0,02	0,03	1

Temperature	0,15	0,12	0,07	0,07	0,02	0,02	0,02	0,02	0,02	0,00	0,02	0,05	0,07	0,10	0,10	0,02	0,02	0,02	0,02	0,02	1
Wind	0,08	0,09	0,07	0,07	0,07	0,11	0,03	0,00	0,00	0,00	0,03	0,02	0,12	0,06	0,07	0,01	0,06	0,06	0,03	0,02	1
Increased in air temperature	0,13	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,13	0,25	0,25	0,25	0,00	0,00	0,00	0,00	0,00	1
Extreme rain	0,13	0,09	0,09	0,09	0,09	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,09	0,09	0,13	0,00	0,09	0,04	0,04	0,04	1
Dry season	0,09	0,03	0,06	0,03	0,06	0,03	0,06	0,03	0,03	0,03	0,00	0,00	0,06	0,06	0,03	0,00	0,12	0,12	0,09	0,09	1
Drought	0,12	0,03	0,10	0,32	0,06	0,00	0,06	0,00	0,01	0,01	0,03	0,04	0,12	0,03	0,01	0,01	0,01	0,00	0,01	0,01	1
Strong wind	0,16	0,08	0,08	0,08	0,11	0,00	0,08	0,00	0,03	0,00	0,03	0,03	0,16	0,03	0,03	0,00	0,03	0,03	0,03	0,03	1
Sea level rise	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,20	0,20	0,20	0,40	0,00	0,00	0,00	0,00	1
Extreme weather	0,17	0,00	0,00	0,17	0,00	0,00	0,17	0,00	0,17	0,00	0,00	0,00	0,00	0,00	0,00	0,17	0,17	0,00	0,00	0,00	1
Heat wave	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0
Cold wave	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0
Forest fire	0,15	0,09	0,12	0,18	0,15	0,00	0,06	0,00	0,03	0,03	0,00	0,03	0,03	0,03	0,06	0,00	0,03	0,00	0,00	0,00	1
Land fire	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0
Flood	0,05	0,03	0,05	0,05	0,12	0,01	0,02	0,00	0,01	0,04	0,01	0,01	0,04	0,08	0,01	0,09	0,11	0,11	0,10	0,08	1
Coastal flood	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0
Decreased agricultural productivity	0,18	0,00	0,06	0,06	0,18	0,00	0,06	0,00	0,00	0,00	0,06	0,00	0,00	0,18	0,06	0,00	0,06	0,00	0,06	0,06	1
Decrease fishery productivity	1,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1
Change in biodiversity	0,75	0,00	0,00	0,00	0,25	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1
Change in ecosystem	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,50	0,50	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1
Spread of disease	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,25	0,00	0,00	0,50	0,25	0,00	0,00	0,00	0,00	0,00	1
Sea water intrusion	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0
Ocean acidification	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0
Damage to infrastructure	0,00	0,00	0,08	0,17	0,33	0,17	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,08	0,00	0,00	0,00	0,08	0,08	1
Clean water scarcity	0,22	0,00	0,11	0,11	0,00	0,00	0,11	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,44	0,00	0,00	1
Avalanche	0,07	0,06	0,08	0,09	0,08	0,02	0,03	0,00	0,01	0,04	0,04	0,05	0,09	0,03	0,03	0,08	0,04	0,04	0,05	0,06	1
Erosion	0,04	0,04	0,11	0,11	0,11	0,04	0,00	0,00	0,00	0,04	0,00	0,00	0,00	0,00	0,11	0,04	0,25	0,14	0,00	0,00	1
Average row profile	0,11	0,03	0,05	0,06	0,06	0,03	0,03	0,00	0,02	0,02	0,03	0,02	0,05	0,07	0,05	0,03	0,04	0,06	0,03	0,04	0,83

Table 23: Column profiles

Nodes	Document																				Average column profile
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	
Climate change	0,09	0,10	0,08	0,09	0,07	0,00	0,18	0,38	0,20	0,05	0,17	0,16	0,10	0,14	0,16	0,03	0,08	0,15	0,07	0,10	0,12
Adaptation	0,05	0,05	0,06	0,08	0,03	0,00	0,08	0,08	0,23	0,07	0,03	0,08	0,04	0,04	0,00	0,03	0,04	0,12	0,06	0,08	0,06
Climate	0,00	0,05	0,10	0,07	0,06	0,12	0,02	0,08	0,03	0,02	0,03	0,03	0,03	0,02	0,03	0,03	0,02	0,02	0,02	0,02	0,04
Weather	0,04	0,05	0,02	0,03	0,02	0,00	0,05	0,00	0,03	0,00	0,00	0,03	0,04	0,03	0,05	0,01	0,01	0,00	0,00	0,00	0,02
Season	0,04	0,03	0,03	0,03	0,03	0,06	0,05	0,08	0,03	0,02	0,03	0,03	0,05	0,10	0,08	0,03	0,04	0,04	0,05	0,06	0,04
Air pressure	0,00	0,00	0,00	0,00	0,00	0,14	0,00	0,00	0,00	0,00	0,03	0,03	0,02	0,01	0,03	0,00	0,00	0,00	0,00	0,00	0,01
Cloudiness	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,01	0,01	0,00
Sunlight	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,01	0,01	0,01	0,01	0,00
Humidity	0,00	0,01	0,01	0,00	0,01	0,02	0,02	0,08	0,03	0,00	0,03	0,03	0,02	0,01	0,03	0,00	0,01	0,01	0,01	0,01	0,02
Precipitation	0,06	0,08	0,11	0,11	0,10	0,18	0,05	0,15	0,08	0,09	0,06	0,05	0,06	0,07	0,11	0,07	0,06	0,04	0,03	0,04	0,08
Temperature	0,05	0,06	0,02	0,02	0,01	0,02	0,02	0,08	0,03	0,00	0,03	0,05	0,03	0,03	0,05	0,01	0,01	0,01	0,01	0,01	0,03
Wind	0,05	0,10	0,05	0,04	0,03	0,20	0,05	0,00	0,00	0,00	0,09	0,05	0,10	0,04	0,08	0,01	0,04	0,03	0,03	0,02	0,05
Increased in air temperature	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,02	0,01	0,03	0,00	0,00	0,00	0,00	0,00	0,00
Extreme rain	0,02	0,03	0,02	0,01	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,01	0,04	0,00	0,01	0,01	0,01	0,01	0,01
Dry season	0,02	0,01	0,02	0,01	0,01	0,02	0,03	0,08	0,03	0,02	0,00	0,00	0,02	0,01	0,01	0,00	0,03	0,03	0,03	0,03	0,02
Drought	0,07	0,03	0,06	0,16	0,03	0,00	0,08	0,00	0,03	0,02	0,06	0,08	0,08	0,01	0,01	0,01	0,01	0,00	0,01	0,01	0,04
Strong wind	0,05	0,04	0,02	0,02	0,02	0,00	0,05	0,00	0,03	0,00	0,03	0,03	0,05	0,01	0,01	0,00	0,01	0,01	0,01	0,01	0,02
Sea level rise	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,01	0,01	0,02	0,00	0,00	0,00	0,00	0,00
Extreme weather	0,01	0,00	0,00	0,01	0,00	0,00	0,02	0,00	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,01	0,00	0,00	0,00	0,00
Heat wave	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Cold wave	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Forest fire	0,04	0,04	0,03	0,04	0,03	0,00	0,03	0,00	0,03	0,02	0,00	0,03	0,01	0,01	0,03	0,00	0,01	0,00	0,00	0,00	0,02
Land fire	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Flood	0,24	0,22	0,27	0,19	0,43	0,16	0,18	0,00	0,23	0,52	0,20	0,16	0,22	0,37	0,11	0,61	0,52	0,44	0,57	0,51	0,31
Coastal flood	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Decreased agricultural productivity	0,02	0,00	0,01	0,01	0,02	0,00	0,02	0,00	0,00	0,00	0,03	0,00	0,00	0,02	0,01	0,00	0,01	0,00	0,01	0,01	0,01
Decrease fishery productivity	0,02	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Change in biodiversity	0,02	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Change in ecosystem	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Nodes	Document																				Average column profile
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	
Spread of disease	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,00	0,00	0,01	0,01	0,00	0,00	0,00	0,00	0,00	0,00
Sea water intrusion	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Ocean acidification	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Damage to infrastructure	0,00	0,00	0,01	0,01	0,02	0,04	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,01	0,01
Clean water scarcity	0,02	0,00	0,01	0,01	0,00	0,00	0,02	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,00	0,00	0,00
Avalanche	0,06	0,09	0,07	0,06	0,05	0,04	0,07	0,00	0,03	0,11	0,14	0,16	0,10	0,03	0,04	0,10	0,04	0,03	0,06	0,07	0,07
Erosion	0,01	0,01	0,02	0,02	0,02	0,02	0,00	0,00	0,00	0,02	0,00	0,00	0,00	0,00	0,04	0,01	0,05	0,03	0,00	0,00	0,01
Total	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1,00

Table 24: Summary of correspondence table

Dimension	Singular Value	Inertia	Chi Square	Sig.	Proportion of Inertia		Confidence Singular Value	
					Accounted for	Cumulative	Standard Deviation	Correlation 2
1	0,398	0,159			0,281	0,281	0,020	0,416
2	0,326	0,106			0,188	0,469	0,033	
3	0,255	0,065			0,115	0,585		
4	0,215	0,046			0,082	0,667		
5	0,201	0,040			0,072	0,738		
6	0,183	0,034			0,060	0,798		
7	0,160	0,025			0,045	0,843		
8	0,138	0,019			0,034	0,877		
9	0,128	0,016			0,029	0,905		
10	0,117	0,014			0,024	0,930		
11	0,094	0,009			0,016	0,946		
12	0,086	0,007			0,013	0,959		
13	0,078	0,006			0,011	0,970		
14	0,075	0,006			0,010	0,980		
15	0,064	0,004			0,007	0,987		
16	0,057	0,003			0,006	0,992		
17	0,052	0,003			0,005	0,997		
18	0,036	0,001			0,002	1,000		

Dimension	Singular Value	Inertia	Chi Square	Sig.	Proportion of Inertia		Confidence Singular Value	
					Accounted for	Cumulative	Standard Deviation	Correlation 2
19	0,014	0,000			0,000	1,000		
Total		0,564	1057,516	.000[a]	1,000	1,000		
a. 665 degrees of freedom								

Table 25: Overview of row point

Nodes	Mass	Score in Dimension		Inertia	Contribution				
		1	2		Of Point to Inertia of Dimension		Of Dimension to Inertia of Point		
					1	2	1	2	Total
Climate change	0,103	0,103	-0,316	0,023	0,003	0,032	0,019	0,147	0,166
Adaptation	0,059	-0,322	-0,524	0,024	0,015	0,050	0,099	0,215	0,314
Climate	0,038	0,504	0,398	0,022	0,024	0,019	0,179	0,091	0,271
Weather	0,020	0,878	-0,663	0,014	0,039	0,027	0,433	0,203	0,636
Season	0,043	0,077	0,277	0,009	0,001	0,010	0,011	0,115	0,126
Air pressure	0,008	2,568	3,907	0,068	0,133	0,375	0,311	0,588	0,899
Cloudiness	0,002	-1,940	0,441	0,007	0,015	0,001	0,353	0,015	0,368
Sunlight	0,004	-1,878	0,556	0,008	0,033	0,004	0,627	0,045	0,672
Humidity	0,011	0,427	0,377	0,008	0,005	0,005	0,099	0,063	0,163
Precipitation	0,075	0,450	0,204	0,014	0,038	0,010	0,432	0,073	0,504
Temperature	0,022	0,835	-0,335	0,014	0,038	0,008	0,440	0,058	0,498
Wind	0,047	0,895	0,601	0,027	0,095	0,053	0,562	0,208	0,770
Increased in air temperature	0,004	1,369	0,009	0,015	0,020	0,000	0,213	0,000	0,213
Extreme rain	0,012	0,444	-0,257	0,007	0,006	0,002	0,139	0,038	0,177
Dry season	0,018	-0,266	-0,017	0,006	0,003	0,000	0,085	0,000	0,085
Drought	0,041	0,908	-1,101	0,048	0,085	0,153	0,280	0,338	0,618
Strong wind	0,020	0,678	-0,805	0,013	0,023	0,039	0,274	0,315	0,589
Sea level rise	0,003	-0,023	0,740	0,012	0,000	0,004	0,000	0,040	0,040
Extreme weather	0,003	-0,127	-1,210	0,009	0,000	0,014	0,002	0,168	0,170
Heat wave	0,000								

Nodes	Mass	Score in Dimension		Inertia	Contribution				
		1	2		Of Point to Inertia of Dimension		Of Dimension to Inertia of Point		
					1	2	1	2	Total
Cold wave	0,000								
Forest fire	0,018	0,739	-0,921	0,013	0,024	0,046	0,290	0,369	0,659
Land fire	0,000								
Flood	0,346	-0,657	0,186	0,068	0,375	0,037	0,875	0,057	0,932
Coastal flood	0,000								
Decreased agricultural productivity	0,009	0,180	-0,297	0,008	0,001	0,002	0,015	0,034	0,049
Decrease fishery productivity	0,001	1,042	-2,639	0,015	0,003	0,023	0,032	0,166	0,198
Change in biodiversity	0,002	0,682	-1,894	0,017	0,002	0,023	0,023	0,148	0,171
Change in ecosystem	0,001	-0,119	0,661	0,025	0,000	0,001	0,000	0,006	0,006
Spread of disease	0,002	0,968	0,906	0,016	0,005	0,005	0,051	0,036	0,087
Sea water intrusion	0,000								
Ocean acidification	0,000								
Damage to infrastructure	0,006	0,662	1,269	0,013	0,007	0,032	0,086	0,257	0,343
Clean water scarcity	0,005	-0,245	-1,118	0,013	0,001	0,018	0,009	0,146	0,154
Avalanche	0,062	0,150	-0,118	0,014	0,003	0,003	0,040	0,020	0,060
Erosion	0,015	-0,170	0,309	0,015	0,001	0,004	0,012	0,031	0,043
Active Total	1,000			0,564	1,000	1,000			
a. Symmetrical normalization									

Table 26: Overview of column point

Document	Mass	Score in Dimension		Inertia	Contribution				
					Of Point to Inertia of Dimension		Of Dimension to Inertia of Point		
		1	2		1	2	1	2	Total
A	0,068	0,415	-0,860	0,049	0,030	0,155	0,095	0,333	0,428
B	0,042	0,517	-0,222	0,016	0,028	0,006	0,280	0,042	0,323
C	0,070	0,267	-0,145	0,014	0,013	0,005	0,140	0,034	0,174
D	0,085	0,545	-0,627	0,045	0,063	0,102	0,221	0,239	0,461
E	0,095	-0,159	0,111	0,017	0,006	0,004	0,056	0,022	0,078
F	0,027	1,547	2,560	0,094	0,163	0,547	0,276	0,618	0,894

Document	Mass	Score in Dimension		Inertia	Contribution				
					Of Point to Inertia of Dimension		Of Dimension to Inertia of Point		
		1	2		1	2	1	2	Total
G	0,033	0,365	-0,767	0,015	0,011	0,059	0,113	0,406	0,519
H	0,007	0,515	-0,235	0,016	0,005	0,001	0,047	0,008	0,054
I	0,021	-0,116	-0,696	0,020	0,001	0,032	0,006	0,168	0,174
J	0,023	-0,665	0,133	0,019	0,026	0,001	0,214	0,007	0,221
K	0,019	0,571	0,297	0,029	0,015	0,005	0,084	0,019	0,102
L	0,020	0,722	-0,230	0,013	0,027	0,003	0,319	0,026	0,346
M	0,059	0,654	-0,065	0,023	0,063	0,001	0,433	0,003	0,437
N	0,073	0,013	0,262	0,024	0,000	0,015	0,000	0,069	0,069
O	0,039	0,945	0,359	0,036	0,088	0,016	0,395	0,047	0,441
P	0,049	-0,829	0,325	0,031	0,085	0,016	0,432	0,054	0,486
Q	0,073	-0,684	0,259	0,026	0,085	0,015	0,523	0,062	0,585
R	0,083	-0,722	-0,005	0,037	0,109	0,000	0,471	0,000	0,471
S	0,058	-0,845	0,257	0,022	0,103	0,012	0,748	0,056	0,804
T	0,056	-0,751	0,180	0,018	0,079	0,006	0,718	0,034	0,752
Active Total	1,000			0,564	1,000	1,000			
a. Symmetrical normalization									

Table 27: Frequencies of nodes for correspondence table

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Climate change	193	10,1	10,1	10,1
	Adaptation	110	5,7	5,7	15,8
	Climate	72	3,8	3,8	19,6
	Weather	38	2,0	2,0	21,5
	Season	80	4,2	4,2	25,7
	Air pressure	15	0,8	0,8	26,5
	Cloudiness	3	0,2	0,2	26,6
	Sunlight	7	0,4	0,4	27,0
	Humidity	21	1,1	1,1	28,1
	Precipitation	140	7,3	7,3	35,4

		Frequency	Percent	Valid Percent	Cumulative Percent
	Temperature	41	2,1	2,1	37,5
	Wind	89	4,6	4,6	42,2
	Increased in air temperature	8	0,4	0,4	42,6
	Extreme rain	23	1,2	1,2	43,8
	Dry season	34	1,8	1,8	45,6
	Drought	77	4,0	4,0	49,6
	Strong wind	37	1,9	1,9	51,5
	Sea level rise	5	0,3	0,3	51,8
	Extreme weather	6	0,3	0,3	52,1
	Forest fire	33	1,7	1,7	53,8
	Flood	648	33,8	33,8	87,6
	Decreased agricultural productivity	17	0,9	0,9	88,5
	Decrease fishery productivity	2	0,1	0,1	88,6
	Change in biodiversity	4	0,2	0,2	88,8
	Change in ecosystem	2	0,1	0,1	88,9
	Spread of disease	4	0,2	0,2	89,1
	Damage to infrastructure	12	0,6	0,6	89,7
	Clean water scarcity	9	0,5	0,5	90,2
	Avalanche	116	6,0	6,0	96,2
	Erosion	28	1,5	1,5	97,7
	Plague	27	1,4	1,4	99,1
	Food insecurity	15	0,8	0,8	99,9
	Reduce income	2	0,1	0,1	100,0
	Total	1918	100,0	100,0	