FROM SCIENCE TO PLANNING: NEGOTIATING CLIMATE CHANGE ADAPTATION IN LAND USE PLANNING IN QUY NHON CITY, VIETNAM

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This dissertation is dedicated to late Cao Huynh Van who worked relentlessly to make the Quy Nhon City resilient to climate change impacts.

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ABSTRACT

Scientific knowledge of climate change (including climate change scenarios, sea level rise projections, and temperature forecast) has a significant influence on adaptation and mitigation measures. It plays a crucial role in the context of land use planning to elucidate decisions concerning adaptation and mitigation tools. Land use planning has been a proven approach to reduce disaster risks and climate change impacts. However, successful utilization of climate science to improve practices on the ground involves a complex process. Scientific knowledge of climate change streams from multiple sources, across multiple scales, and in multiple forms. This influences how local decision makers' use of knowledge is translated into plans and policies, and in a top-down hierarchical planning system like Vietnam's, the process is uniquely complex.

Utilization of climate science in the course of land use planning involves a complicated process in a rapidly changing city of a developing country like Quy Nhon City in Vietnam. Transmission and understanding of scientific knowledge and concurrent planning can be achieved through the boundary works and externally funded projects (e.g. ACCCRN in case of Quy Nhon City). The implementation faces a myriad of challenges, especially in land use planning because land management in Vietnam already suffers from political-economic problems. Implementation requires major institutional changes from national to local levels in a rigid top-down administrative system like that in Vietnam. Strong centralization of the administrative system can provide an opportunity to enforce the mainstreaming of climate science in the land use plans and decisions. With a case study of Quy Nhon City in Vietnam, this research sheds light on the unique contextual challenges of developing countries in the course of knowledge utilization (especially in implementation) which is lacking in previous models. The major conclusion of my research is that while the transmission and understanding of climate science are strong in Quy Nhon City with the work of ACCCRN and other funded projects, additional attention to the politics and processes of implementation is needed. This includes a change in land governance systems, reforming institutions of science-policy interactions and land use planning, and arranging additional resources (human and financial) for climate change adaptation.

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LIST OF ABBREVIATIONS

AAA	Awareness, Assessment and Action
ACCCRN	Asian Cities Climate Change Resilience Network
ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
CAP	Climate Action Plan
CCCO	Climate Change Coordination Office
CSIRO	Commonwealth Scientific and Industrial Research Organization
DANIDA	Danish International Development Agency
DARD	Department of Agriculture and Rural Development
DOC	Department of Construction
DONRE	Department of Natural Resources and Environment
DPI	Department of Planning and Investment
DURP	Department of Urban and Regional Planning
FDI	Foreign Direct Investment
GCM	Global Circulation Model
GDP	Gross Domestic Product
GIZ	German Corporation for International Cooperation
GRC	Globalization Research Center
HUS	Hanoi University of Science
ICLEI	International Council for Local Environmental Initiatives
IMHEN	Vietnam Institute of Meteorology, Hydrology and Environment
INGO	International Non-Governmental Organization
InVEST	Integrated Valuation of Ecosystem Services and Tradeoffs
IPCC	Intergovernmental Panel on Climate Change
ISET	Institute for Social and Environmental Transition
KV	*Khu Vuc (Area, A collection of villages, lowest formal administrative unit)*
MARD	Ministry of Agriculture and Rural Development
M-BRACE	Mekong-Building Resilience to Climate Change in Asian Cities
MONRE	Ministry of Natural Resources and Environment

MOT	Ministry of Transportation
MPI	Ministry of Planning and Investment
NGO	Non-Governmental Organization
NTP	National Target Program
PCC	Provincial People’s Committee
Ppm	Parts per million
RCPs	Representative Concentration Pathways
SRES	Special Report on Emission Scenarios
UK	United Kingdom
UKCIP	UK Climate Impacts Program
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USD	United States Dollar
VCN	Vietnam Communist Party
VIAP	Vietnam Institute of Architecture and Urban and Rural Planning
VND	Vietnamese Dong
VUDPA	Vietnam Urban Development and Planning Association
WB	World Bank

CHAPTER 1. INTRODUCTION

"The problem we have today as a result of our thinking so far cannot be solved by thinking the way we thought when created them."

- Albert Einstein

1.1. Planning with Uncertainty and the Role of Scientific Knowledge

Disaster risks and the impact of climate change amplify the complexity of planning problems. They are considered as "wicked" (Innes & Booher, 2010; Rittel, 1972; Rittel & Webber, 1973) because these problems lack a fixed definition and solution. Their nature demands multiple sources of knowledge and the involvement of multiple actors to define and find solutions. The process is called "collaborative rationality" (Innes and Booher, 2010) in which impact bearers participate in defining, framing, and resolving the problem. This is the foundation of collaborative planning. As the planning evolved from rational to collaborative, Innes and Booher (2010) have identified a shift in the sources of knowledge as one of three changes in planning. The other two changes are shifts in planning approaches and in reasoning (Innes & Booher, 2010).

Planning connects knowledge to action. In the rational approach, knowledge is technically produced by experts in a distinct institutional setup (Rydin, 2007). The source of knowledge is singular and planners are experts. The viewpoint has changed, however, as planning shifts from rational to collaborative. This led to knowledge production and utilization as social processes with multiple sources and uses (Rydin, 2007). The scientific-analytical view has been criticized for the lack of consideration of multiple sources of knowledge. In contrast, the validity of multiple knowledge claims is also challenging in planning (Pelzer, Geertman, & van der Heijden, 2015).

The need for scientific knowledge is not eliminated from planning processes and outcomes. For newer and uncertain problems such as climate change impacts and disaster risks, scientific knowledge has a crucial role in informing planning decisions. It feeds information for policy formation, planning, and decision making. Its production, dissemination, and utilization has to be adjusted to address the climate change impacts and disaster risks in planning. Even though there is an argument to be made concerning the relevance of collaborative production, dissemination and utilization of knowledge among producers and users, the practices on the ground are different. There are contextual issues that influence the process. The major question is how scientific knowledge is produced, disseminated, and utilized in dealing with complex problems in planning, and it is more crucial with challenges such as disaster risks and climate change impacts.

1.2. Climate Science Knowledge and Adaptation in Land Use Planning

Climate science research and modeling improved significantly with the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988. The IPCC has published climate change regional impact assessments since 1998. The fourth version published in 2007 highlights the risk, vulnerabilities, and adaptation to climate change in different regions around the globe. There are many studies involving downscaling and upscaling of climate change impacts.

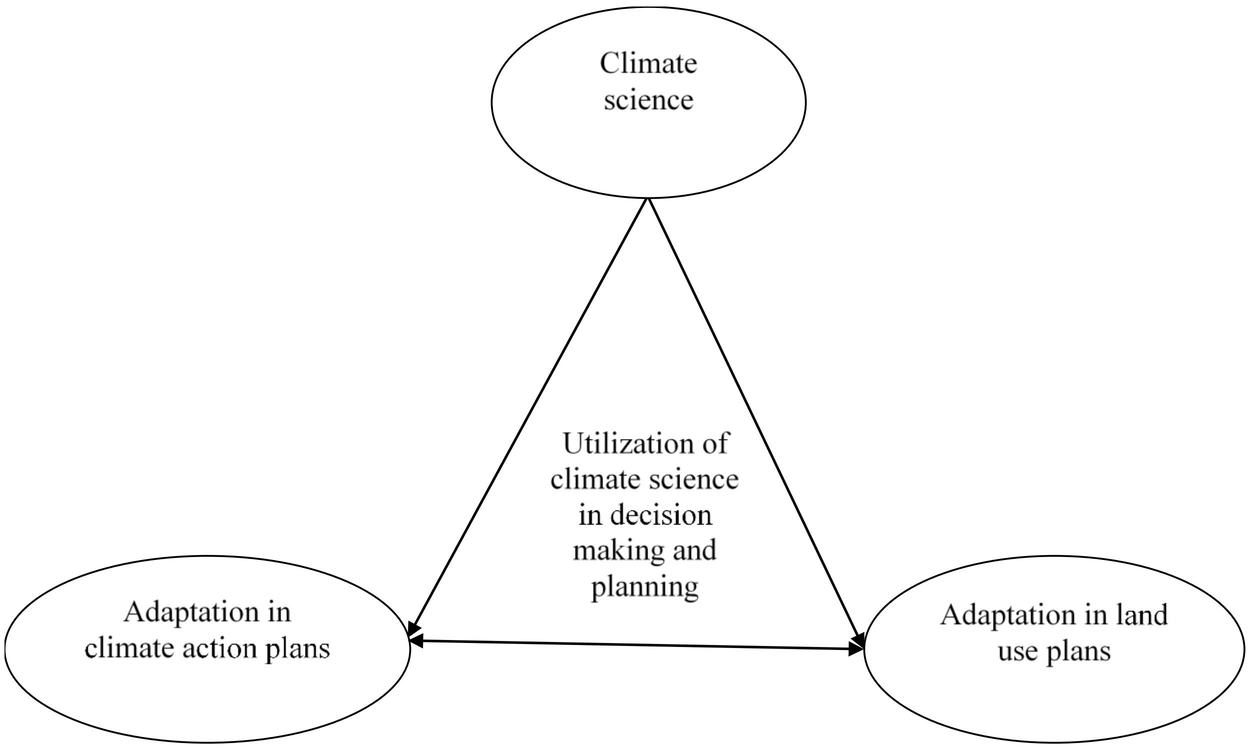
Climate research has been generating a large body of knowledge, but there is lack of certainty when and how the impacts will occur in different geographies (Lange & Garrelts, 2007). Climate change research is typically not conducted to meet the information needs of decision makers (Moser & Luers, 2008). It questions the interface between decision making and climate science (Dow & Carbone, 2007). Even though there is uncertainty with respect to the impacts of climate change, its influence on hydro-meteorological disasters cannot be denied. The influence of climate change on extreme disaster events cannot be assessed on a case-by-case basis; rather, the impacts must be understood in the trend and severity of these events. 2005 and 2010 have been the warmest years in the global history, and 2010 has been the wettest year since 1900 (Huber & Gulledge, 2011). The influence of climate change is ascertained by scientific research on flooding, typhoons, snowstorms, sea level rise, droughts, and heat waves.

In addition to local experiences, climate change adaptation is informed by scientific research. Climate change scenarios and forecast of impacts have a strong role to play in aiding adaptation measures. Climate change adaptation is local and has multiple ways of categorization: (1) intent - autonomous and planned (Fankhauser, Smith, & Tol, 1999; Malik, Qin, & Smith, 2010; Pittock & Jones, 2009; Shaw, Pulhin, & Pareira, 2012; Smit, Borton, Klein, & Wandel, 2000); (2) timing of climate impacts – anticipatory, concurrent, and reactive (Smit et al., 2000); (3) actors - private and public (Malik et al., 2010); (4) temporal scope – short-term and long-term (Malik et al., 2010); (5) intervention – incremental and transformational (Kates, Travis, & Wilbanks, 2012), (6) based on the institutional extent – localized and widespread (Smit et al., 2000); and (7) policy process – top-down and bottom-up (Dessai & Hulme, 2004). A holistic categorization of adaptation measures was conducted by Biagini *et al.* (2014). A total of 158 adaptation activities were identified under Global Environment Facility funds (Special Climate Change Fund, Least Developed Countries Fund and Strategic Priorities for Adaptation). These adaptation activities are categorized into ten types: capacity building, management and planning, practice and behavior, policy, information, physical infrastructure, warning and observing system, green infrastructure, financing, and technology (Biagini, Bierbaum, Stults, Dobardzic, & McNeeley, 2014). On-site evaluation of adaptation measures, however, is lacking in this categorization (Biagini et al., 2014). The scientific information of climate change has a critical role in each type of adaptation mentioned above.

Land use planning minimizes the risks of climate change and disasters in urbanization and development. It is can reduce disaster risks and promote sustainable development (Burby, 1998). Integrating land use and hazard mitigation can limit development in hazard-prone areas (Godschalk, Kaiser, & Berke, 1998). A review of 176 land use plans by Burby and Dalton (1994) shows that land use plans can serve to limit development in hazardous locations (Burby & Dalton, 1994). It reduces disaster exposure and improves long-term community resilience.

The role of land use planning to reduce climate change impacts is not, however, enforced in planning practices. A major challenge is posed by spatial and temporal uncertainties of impacts across time and space. The role of climate science is crucial in mitigation and adaptation alternatives under such uncertainties. Alternatives can be part of comprehensive land use plans or stand-alone climate action plans. In either case, climate science supports potential impacts and thresholds of adaptation measures. This relationship between the climate science, adaptation measures, and land use planning is shown in Figure 1.1 below.

Figure 1.1: Relationship among Climate Science, Adaptation and Land Use Plans



(Author, 2018)

Figure 1.1 shows that climate science can be used in two ways in land use planning. The first is through stand-alone climate action plans for adaptation. Cities are forming climate action plans using climate science to prioritize adaptation policies and actions. In the normal practice of stand-alone plans, a detailed impact analysis of climate change is conducted and adaptation actions are identified for different sectors. The second is through comprehensive or general land use plans. The potential impacts of climate change are normally included and land use planning tools are identified to address them. One example is the recent master plan of Quy Nhon City of Vietnam that was completed in 2015. It includes sea level rise scenarios, changes in temperature, and changes in precipitation in the city. Adaptation measures in the plan are based on these forecasts.

In either stand-alone or comprehensive plans, climate science is used as a basis for adaptation. Although there are examples of using local experiences in interventions, planning efforts for climate change tend to rely heavily on scientific knowledge without adequate attention given to local experiences. Perception towards climate change phenomena (temperature changes, rainfall changes, changes in climate disasters, etc.) is normally influenced by local weather patterns (Goebbert, Jenkins-Smith, Klockow, Nowlin, & Silva, 2012). In a best-case scenario, scientific knowledge supplements and verifies perception-based knowledge.

The most established approach for using climate science is vulnerability assessment which identifies risk from weather-related disasters. Perceived risk from a disaster can be amplified in absence of information and limited forecasting capacity (Dinh, Nhung, Van, & DiGregorio, 2010). Actual risk, which is different from perceived risk, is derived using probability and consequences of hazard or threat. Perceived risk is normally derived from the experience with the hazard or threat. Vulnerability assessment is used in integrating hazard mitigation with land use planning. It is an essential step to reduce the negative consequences of natural hazards (Fuchs, Birkmann, & Glade, 2012). Vulnerability is the susceptibility to harm from exposure to stressors associated with environmental and social changes and from the absence of capacity to adapt (Adger, 2006). It is susceptibility to loss (Cutter, 1996; Cutter, Boruff, & Shirley, 2003). It has been described in multiple ways; one categorization is social, economic and environmental (Pine, 2009). A second categorization is physical, social, and human (Pelling, 2003) and a third is as exceptional and every day (Lavell, 2004). Vulnerability assessment is not being carried out in an organized and universal way because it varies with contexts of disasters and communities (deLéon, 2006).

Whether there is a stand-alone climate action plan or adaptation in land use plans, the role of climate science is crucial in selecting intervention measures. There are other sources of knowledge beyond science, including experienced-based knowledge. One unexplored question is this: How are different forms of knowledge prioritized in post-positivist planning to deal with impacts of climate change, and does climate science play a role in land use planning to select or customize adaptation interventions? This question is typically not covered in planning research. This dissertation will explore the gap in evaluation of utilization of climate science in Quy Nhon City of Central Vietnam.

1.3. Climate Change Research and Land Use Planning in Vietnam

Although Vietnam regularly faces hydro-meteorological disasters, the realization of climate change is relatively new. The first scenarios on climate change were published by the government in 2009 and later updated in 2016. Climate research took off in Vietnam after 2000. Since then, it has bilateral and multilateral climate change projects. The selection of three cities (Da Nang, Quy Nhon and Can Tho) as a part of Asian Cities Climate Change Resilience Network (ACCCRN) is a major milestone to speed up climate change initiatives in the country. The ACCCRN triggered different initiatives at the national, provincial, and local levels on climate change adaptation and mitigation.

The master plan guides overall land use in Vietnamese cities. With the beginning of economic reform (Doi Moi) in 1986, the socialist planning system was coupled with a market-based economy in cities. Each city develops its own master plan to manage growth and development while following the national targets and interests. Master plans provides a long-term vision for the city. They are revised every 10 years to incorporate new growth and development. Detailed plans for smaller geographic areas within a city are prepared based on the master plan. From the practice of disaster risk reduction and climate change adaptation, the master plan has a key role to play in reducing climate change impacts. Vietnam started to realize this at national, provincial and local levels. In Country Development Strategy to 2035, national and regional climate change impacts are discussed (World Bank Group Vietnam & Ministry of Planning and Investment, 2016).

The utilization of scientific knowledge on disasters and climate change is crucial in the master plan to adapt with impacts. It becomes especially pertinent to climatic issues because the future impacts of climate change may not be reflected solely through local experiences. The coupling of climate science and local experience improves the certainty of impacts. The scientific knowledge is crucial for mainstreaming climate change adaptation in the course of land use planning.

The mainstreaming of climate change impacts in national, provincial, and local policies is imperative in Vietnam. Climate science should play a key role to inform policies in the realm of post-modern planning, but research is limited on science-policy interaction in low and middle-income countries (Vanyoro, 2015), including Vietnam. This dissertation explores how planners and government officials use climate science at national, provincial and local levels to address climate-related disasters in planning. Findings facilitate institutional relationships between climate scientists and policy makers at national, provincial and local levels to address climate change impacts in Vietnam. The role of local knowledge and experience is an important aspect of climate change adaptation, but that will not be sufficient. With the case study of Quy Nhon City, this dissertation explores the utilization of climate science in land use planning to adapt to climate change impacts.

1.4. Objectives of the Research

The overall objective of this research is to explore how the scientific knowledge of climate change informs land use planning to better adapt to climate change impacts in Vietnam. The case study is the Quy Nhon City of South Central Region. Specific research questions are as follows:

- How is climate science produced, disseminated, and utilized in Vietnam?
    - How is scientific knowledge of climate change produced in Vietnam?
    - What are the mechanisms of transferring climate science from national research organizations to cities and provinces in Vietnam?
    - What are the sources of climate knowledge among planners and decision makers of the Quy Nhon City?
- How does the governance of urbanization and land management influence the utilization of climate science in land use planning?
    - What are the legal, administrative and institutional setups of land management and urbanization in Vietnam?
    - How do current practices of land management and urbanization influence the utilization of climate science in land use planning in the Quy Nhon City?
    - To what extent does scientific knowledge of climate change inform decision making on land use?

        - How is the scientific knowledge of climate change used in master plans of Quy Nhon City?
    - What are the challenges and opportunities of the climate science utilization in land use planning in Vietnam?
        - What are the constraints of using scientific knowledge of climate change in land use planning?
        - What are the unique characteristics of climate science utilization in the Quy Nhon City that facilitate knowledge utilization approaches for the developing countries?

1.5. Organization of the Dissertation

This dissertation consists of eight chapters, each with its own focus, but all coalesce with the overall theme of knowledge utilization in planning. The dissertation sets forth the problem in Chapters 1 and 2. Chapter 3 focuses on the research design and methods. Chapters 4 and 5 elucidate the land management system and climate science production in Vietnam. Chapter 6 and 7 analyze the data from interviews, household surveys, community meetings, and document reviews. They draw results based on the climate science utilization in land use planning in Quy Nhon City. Chapter 8 wraps up the dissertation with additional discussion, conclusion, and future direction.

This first chapter provides an overview and relevance of the dissertation. Chapter 2 reviews three bodies of literature: planning with uncertainty, knowledge utilization, and plan evaluation from the perspective of climate change adaptation. The discussion on planning with uncertainty focuses on the limitation of the rational planning and "wicked" problems as well as the role of knowledge is discussed to deal with uncertainties in planning. Knowledge utilization is divided into three parts: overview (theoretical and practice-based), knowledge utilization in planning, and climate science utilization. Based on the characteristics, knowledge utilization theories are divided into rational and collaborative. Rational models focus on the science-driven or problem-focused whereas collaborative theories focus on the interactive relationship between producers and users of knowledge. From the practice, knowledge utilization is categorized as conceptual, symbolic and instrumental. The process of knowledge dissemination is discussed in the steps (ladder) of knowledge utilization. The plan evaluation presents awareness-assessment-action framework as an approach of evaluating land use plans from the perspective of climate change adaptation in case of Quy Nhon. The major gaps in literature are on the role of scientific knowledge in collaborative planning and empirical research from developing countries.

Chapter 3 covers research method. The research follows pragmatism as its broad theoretical foundation. The conceptual framework shows the steps (transmission, understanding, and implementation) of climate science utilization augmenting three approaches: a social engineering approach of knowledge utilization, ladder of knowledge utilization, and awareness-assessment-action framework of plan evaluation. Verifiable propositions are developed for each research question. Some questions do not have propositions because they describe land use planning and urbanization in Vietnam. The research design is a combination of mixed method and case study. Interviews, household surveys, focus group discussions, and document reviews are methods of data collection. Transcripts of interviews and master plans of Quy Nhon City are analyzed using computer software Nvivo, which is qualitative data analysis software. A linear regression model is presented to explain the relationship between the land use changes and flooding pattern in Quy Nhon City.

Chapter 4 describes the urban planning and land management system in Vietnam. Urbanization and land management evolved along the political history of the country. Urbanization is presented into three phases: the colonial period, the communist era and the Doi Moi system. During the French colonial period, architecture and design of cities were influenced by the urban planning in contemporary France. Planning was trapped between politics of colonial administrators and business interests. After 1954, the nation was divided into two countries: North and South, resulting in differences in urbanization and land management. North Vietnam was rigid and against the expansion of large cities, whereas South Vietnam was the opposite. That led to depopulation in large cities in the North Vietnam and rapid growth and urbanization in the South. After unification in 1975, the Northern urban planning system was enforced in the South, but success was limited. With the introduction of the Doi Moi in 1986, urbanization became rapid through rural-urban migration, industrial development, infrastructure expansion, and service sector promotion. Growth was focused in smaller cities, and urbanization became a stronger economic generator for the nation. Land use planning became key, but it suffered from myriad of problems. Unbalanced political and economic rights among government, private investors, and locals generated conflict, resulting in public dissatisfaction with government-led land management. These problems bear a strong influence on the utilization of climate science in land use planning to inform adaptation measures.

Chapter 5 sheds light on the production and dissemination of climate science in Vietnam. Climate science is produced by the government and projects in the country. On the government side, production of climate science data is led by the Ministry of Natural Resource and Environment (MONRE). The Hanoi University of Science (HUS) under the Vietnam National University partners with the Institute of Meteorology, Hydrology and Environment (IMHEN) under MONRE to produce national climate change scenarios. NGO-led bilateral and multilateral projects also produce climate science for their project areas, as do local consultants and government organizations to update climate science for their localities. Dissemination occurs through boundary agents such as climate consultants (e.g. climate scientists), climate change coordination offices, and projects. Local planners and decision makers receive climate science through multiple sources. The accessibility of climate science between national and local government officials, however, is not the same.

Chapter 6 evaluates the two recent master plans (2004 and 2015) in Quy Nhon City using the framework of climate science utilization discussed in Chapter 3. Master Plan 2004 has scant use of climate science, whereas the Master Plan 2015 is the opposite. The Master Plan 2015 has addressed climate change impacts quite well. It discusses sea level rise scenarios, changes in rainfall, and increase in temperature and proposes adaptation measures for the flood-prone areas, including dike improvements, elevating houses, riverbank setback, and expansion of floodways. The main reason behind this is the introduction of the Asian Cities Climate Change Resilience Network (ACCCRN) Project in the city. The chapter discusses how the ACCCRN Project improved the awareness among decision-makers on climate change. Interviews with local government officials were frequently quoted the Climate Change Coordination Office (CCCO) as the leader of climate change initiatives in Binh Dinh Province and in the Quy Nhon City.

Chapter 7 covers the utilization of climate science in land use planning practice in Quy Nhon City. The knowledge utilization framework from Chapter 3 is used to assess overall land use practices. Based on interviews and household surveys, the lowest performing aspect is the implementation of climate science. It includes a lack of adaptation in legislation and building codes to climate impacts, increasing flooding impacts in the city, and dominance of top-down rational planning approach. Nevertheless, the influence of climate science on flood preparedness, awareness of climate change, and the early warning system has been successful. The Chapter also discusses six challenges of successful utilization of climate science in the land use planning in the city. They are resource limitation, contestation of interests over land, centralization of standards and large-scale projects, lack of compatibility of climate science with the city's needs, competing priorities of socioeconomic development, the dominance of top-down approach in land use planning, and lack of capacity of government offices. The role of ACCCRN Projects and CCCO is identified as an enticer of transmission and understanding of climate science in the city.

Chapter 8 wraps up the dissertation with discussion, conclusion and future directions. It is ascertained that the existing knowledge utilization models are relevant to evaluate climate science utilization in developing countries, but contextual aspects need to be considered. Since climate science is only one factor in land use planning to adapt with flood and other impacts of climate change, a new framework is proposed that incorporates contextual challenges of rapidly transforming cities of developing countries. The role of boundary agents is highlighted to disseminate climate science. Production and implementation of science are linked in this new framework to better inform adaptation measures in land use decisions.

CHAPTER 2. LITERATURE REVIEW

This review covers three topics: planning with uncertainty, knowledge utilization, and land use plan evaluation from the perspective of climate adaptation. The first, planning with uncertainty, discusses the wicked nature of planning issues and how they are amplified with new challenges of climate change impacts and disaster risks. The uncertainty and complexity of natural disasters and climate change impacts increase in planning with socioeconomic disparities and environmental degradation. Under rational planning in the past, scientific capabilities were perceived as means of controlling the natural world. But science is not sufficient to deal with current planning problems. At present, the role of science is limited (Funtowicz & Ravetz, 1990) to addressing planning issues because it only offers temporary solutions to these problems. This leads to the second topic of this dissertation: knowledge utilization. The focus is the utilization of climate science in planning and policies. The review covers theoretical discourses of knowledge utilization and the trend of empirical approaches to measure knowledge utilization. Among different stems of planning, land use planning has been proven to reduce disaster risks in cities, and I will review the role of climate science in land use planning to adapt with impacts. The third topic in this review explores methods of plan evaluation from the perspective of climate change adaptation. Gaps in the literature on knowledge utilization and plan evaluation are addressed through the analyses in the subsequent chapters of the dissertation.

2.1. Definition of Terms

- **Knowledge:** One of the broadest definitions of knowledge in planning is presented by Campbell (2012). She states that knowledge is evidence, information, expertise, data, facts, research, proof, statistics, interpretations, values, and intelligence (Campbell, 2012). Knowledge typically utilizes some sense of causality to determine appropriate actions and providing some insights (Campbell, 2012). A similar explanation is presented by Von Krogh (1998), who understands knowledge as representations of the world that consists of a number of objects and events, and the key tasks of the brain are to represent or model these as accurately as possible, resulting in the understanding of knowledge as universally applicable (Von Krogh, 1998).

- **Institution:** North (1991) defines institutions as the humanly devised constraints that structure political, economic, and social interaction. This includes sanctions, taboos, customs, and code of conduct in the informal setting. In a formal setting, it includes constitutions, laws and property rights (North, 1991). Organizations also fall under this definition of institutions.
- **Boundary organizations:** Boundary organizations are defined as the organizations that facilitate and manage the flow of knowledge, resources, and materials across the boundaries of science and politics (Guston, 2001; Mahony, 2013). These organizations facilitate the creation of space between the producers and users of the research that is favorable for their individual interests (Guston, 2001). Normally, boundary organizations are related to boundary objects which are products to establish a connection among different parties (Mahony, 2013). In many instances, boundary functions are done by individuals. For this dissertation, both organizations and individuals are called "boundary agent".
- **Knowledge utilization:** For this dissertation, I will use the definition of knowledge utilization from Larsen (1980) and Eastabrooks (2001). Larsen (1980) defines knowledge utilization as a complex process involving political, organizational, socioeconomic and attitudinal components in addition to the specific information of knowledge (Larsen, 1980). Eastabrooks (2001) presents knowledge utilization from the perspective of users which does not include the production and dissemination.
- **Climate change:** The Intergovernmental Panel on Climate Change (IPCC) refers to a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer (IPCC, 2014). Climate change information is a combination of weather-related data and several computer-based simulations.
- **Climate change adaptation:** For this dissertation, I will use the standard definition of IPCC (2014). It defines adaptation as the process of adjustment to actual or expected climate and its effect. In human systems, adaptation seeks to moderate, avoid harm, or exploit beneficial opportunities (IPCC, 2014).
- **Land use planning:** From the perspective of disaster risk reduction and climate change adaptation, land use planning is the means for gathering and analyzing information about the

suitability for development of land exposed to natural hazards so that the limitations of hazard-prone areas are understood by citizens, potential investors, and government officials (Burby, Deyle, Godschalk, & Olshansky, 2000).

- **Plan evaluation:** Plan evaluation is focused on the content and outcome of plans. It partially focuses on the planning process to understand climate science dissemination to plans. Plan evaluation is the assessment of the comparative merits of a different course of action (Lichfield, Kettle, & Whitbread, 1975) and can be viewed as a systematic evaluation of plans, planning process, planning outputs, or outcomes as the object or intervention (Connell & Daoust-Filiatrault, 2017).

2.2. Planning with Uncertainty

Implication of complexity theories in policy and planning was realized a half-century ago. Although the origin of complexity theories stems from chaos theories of natural science, their application in the social world is increasing because of growing non-linearity and unpredictability of policy issues in society. The conventional rational strategies are not applicable to these new class of problems (Newman & Head, 2017). Evidences are sources of information rather than the basis of solution of these complex problems (Cairney, 2012).

Current planning problems are “wicked” (Innes & Booher, 2010; Newman & Head, 2017; Rittel & Webber, 1973) and their solutions cannot be found by following a rational approach because rational behavior anticipates consequences of contemplated action (Rittel, 1972). The planning action to wicked problems may not result in an expected outcome. Some unique characteristics of these problems are lack of definitive formulation, lack of any stopping rules, an overly simplistic dichotomy of only good or bad solutions, lack of immediate and ultimate remedies, uniqueness in every problem and solution, a problem that is a symptom of another problem, lack of tolerance of conventional hypothesis testing method, and determination of nature of problem through explanation (Rittel & Webber, 1973).

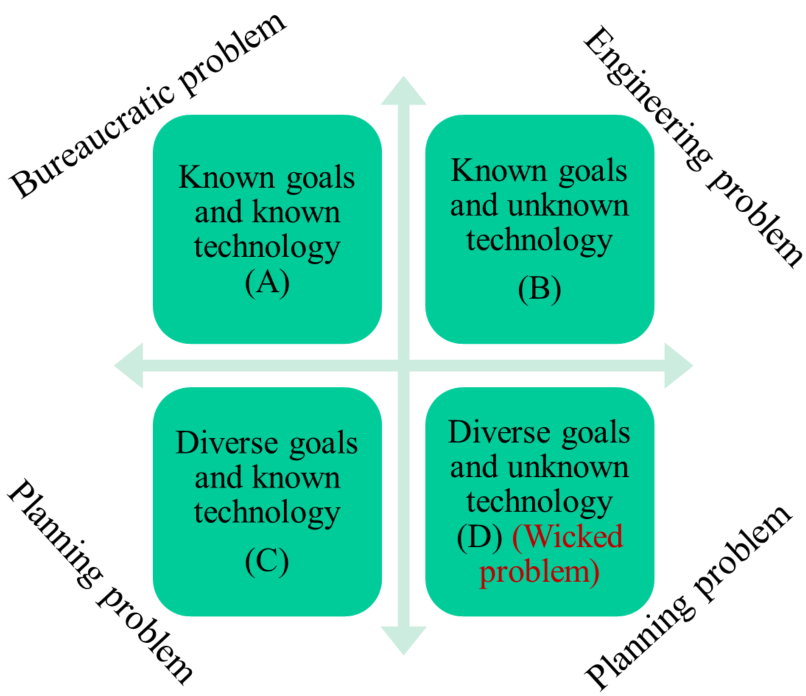
The wicked problems augur for the complex and nonlinear solutions, but there is no consensus on their definitions and solutions. The planning interventions can be good or bad (Innes & Booher, 2010; Morçöl, 2013) but do not offer optimum and permanent solutions. An example of this complexity is the relationship between environment and economy in planning

(Innes and Booher, 1999). The simplified dichotomous relationship between economy and environment leads to unsustainable results. An understanding of the complementary role of environment and economy is required for sustainable urban planning (Innes and Booher, 1999). The planning intervention with this complementary role of economy and environment is complex because it needs new ways of defining, understanding and offering solutions.

While defining uncertainties and complexities of wicked planning problems, Christensen (1985) has categorized them into four categories. They are presented in the Figure 2.1 below.

- **Problems with known methods and goals (A):** This category of problems is rational. Their goals are known, and means to achieve those goals are also known. Normally, the prescribed standards and solutions are replicable.
- **Problems with the unknown method and known goals (B).** The uncertainty lies in the means. The goal is defined but the means to achieve those goals needed to be innovative. Normally, planning problems are segmented and resolved in smaller scales in this category.
- **Problems with the known method but not agreed on goals (C):** Stakeholders have contesting goals for a planning issue. Means to achieve the goal are known but the goals themselves are uncertain. Each actor tries to maximize its own individual interest. The situation can be chaotic and planners can be confused when attempting to resolve the situation under this category.
- **Unknown method and not agreed goals (D):** This is a chaotic situation. There is uncertainty in methods and goals. Government authorities establish law and order. The role of the planner is to articulate the problem to make it more compelling and comprehensible to different actors.

Figure 2.1: Planning Problems and Complexity



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Based on four dichotomous relationships between goals and methods, the roles of planners also shift to deal with uncertainty and complexity. Christensen (1985) presents planners' roles for each category. For category A, planners are programmers, standardizers, regulators, schedulers, and administrators. For category B, they are pragmatists, adjusters, experimenters, and innovators. For category C, they are advocates, participation promoters, facilitators, mediators, and bargainers, and for category D, they are problem finders, charismatic leaders, and solution proposers.

Innes and Booher (2010) discuss the complexity and uncertainty in addressing wicked planning problems. They argue that existing institutional mechanisms are not sufficient to deal with complexities and uncertainties in planning. As a result, three new evolutions are taking place in planning and policy making.

a) The traditional linear approach of planning and decision making is being replaced by nonlinear socially constructed approaches.

b) The sources of knowledge that inform planning and decision making are also changing. The new collaborative approaches respect the multiplicity of knowledge in understanding policy problems and offer solutions which is lacking in rational approaches.

c) The form of reasoning has been changed. It is not only instrumental and logical steps, but it is also transmitted through storytelling and expressing experiences from multiple actors.

Innes and Booher (2010) propose collaborative planning to deal with uncertainty and complexity. Collaborative planning allows deliberation from all affected interests and agents because it has the following characteristics:

1) Collaborative planning presents options for solutions to wicked problems through diversity of knowledge, experiences, and ideas from actors.

2) It brings groups together and explores opportunities for discovering mutually beneficial options while welcoming opposing viewpoints.

3) It facilitates changes in larger systems and institutions to make them effective, adaptive, and more resilient in the context of changing problems.

They strongly emphasize the role of knowledge in collaborative planning. They argue that newer planning and policy issues require diverse sources of knowledge, including experience-based and scientific sources. Other scholars have also supported the multiplicity of knowledge in post-modern planning practices (Lemay & Sá, 2012; Sanderson, 2006).

Climate change is an uncertain and complex wicked problem. Uncertainties burgeon from emission scenarios to possible impacts. The least amount of uncertainty is on emission scenarios, and the greatest amount of uncertainty is on possible impacts (Heaphy, 2014; Schneider & Moss, 1999). Data, models, spatial extent, confidence level, and projection of human behavior on consumption are major sources of specific uncertainties in climate change (Schneider & Moss, 1999). The uncertainties make impossible to use a single model as a basis for planning interventions (Hallegatte, 2009). Science confirms impacts of climate change but the solutions are complex and linked to technologies, economics, and politics as well as multiple actors with competing interests (Incropera, 2015). This increases complexity.

While discussing challenges to address climate change, Levin et al (2007, 2012) outline it as a "super wicked" problem based on four characteristics (Levin, Cashore, Bernstein, & Auld, 2007, 2012).

- Limitation of time for reiteration of policy decision in case of failed attempts,
- Lack of central authority to deal with the problem and involvement of multiple countries, sectors and policy subsystems,
- Lack of discrete protagonists and antagonists of the problem (the end-seekers of the problem also cause of the problem),
- Problem situations in which short-term decisions overrule more prudent considerations despite overwhelming evidence of significant impact.

There is high complexity and uncertainty when addressing climate change impacts in planning practices through adaptation and mitigation. Measham et al. (2011) mention the challenges of addressing climate change in municipal plans and policies. They explain that, besides resource and information constraints to cities, factors such as leadership, institutional context, and competition for planning agendas are equally important in the course of climate change adaptation in municipal plans and policies (Measham et al., 2011). Climate science has a critical role to inform the planning, but utilization of climate science is not straightforward. In the continuum of complexity between climate change and planning issues, climate science informs planning decisions to better adapt with impacts. The solution to this question can redefine the role of science in current municipal land use planning. This dissertation responds to this question by explaining the role of climate science to inform land use planning in developing countries, specifically with a case study of Quy Nhon City of Central Vietnam.

2.3. Utilization of Knowledge

Knowledge utilization has been in planning narratives for a long time, but the idea was first introduced in sociology and in the public service sector. Davies, Nutley, and Smith (2009) describe how the positivist perspective of knowledge utilization was prominent in the public service sector at the beginning of the 20th century, a time when few experts provided recommendations to governments on policy paths, and how their recommendations were not questioned (Davies, Nutley, & Smith, 2009). Knowledge utilization evolved as an important field in healthcare and public education sector to bring knowledge to action.

Multiple terms and concepts are used in the field of knowledge utilization. Lamay and Sá (2012) collected nineteen terminologies that reflect knowledge use. Out of the nineteen, thirteen are used in the healthcare sector (Lemay & Sá, 2012). Some popular terminologies are as follows: knowledge translation (Straus, Tetroe, & Graham, 2009; Sudsawad, 2007), knowledge to action (Best & Holmes, 2010), knowledge transfer (Mitton, Adair, McKenzie, Patten, & Perry, 2007) and knowledge sharing (Wang & Noe, 2010). Recently, this field has been described as an evidence-based practice (Estabrooks, 2001). The research is linked to practice in a more creative and critical way through these different metaphors (Greenhalgh & Wieringa, 2011). These knowledge to action metaphors should also incorporate situation-specific knowledge, tacit knowledge, link of knowledge and power, and partnerships between researchers, practitioners, policymakers, and commercial interests (Greenhalgh & Wieringa, 2011), which broadens the scope of the field.

The body of literature on knowledge utilization can be classified into two broad categories. The first is theories and models. They consider knowledge utilization as a process of production, dissemination, and utilization. The second is the practices of use. They consider knowledge utilization as different approaches of knowledge use by decision makers. They do not considered the production process as part of utilization.

2.3.1. Knowledge Utilization in Theories and Models

Based on the nature of knowledge production, dissemination, and utilization processes, theoretical perspectives can be categorized as positivist/rational and post-positivist/ collaborative. Lamay and Sá (2012) explain that the research use is framed as a linear and predictable process independent of the context in positivist perspective. It assumes the supremacy of science over social problems (Huberman, 1994), and proposes the linear superiority of knowledge over the complexity of social problems (Van Buuren & Edelenbos, 2004). Scientific research was assumed to be a major driver of change on its own.

The rational perspective does not discuss the limitation of accessibility and search for knowledge. There is also a lack of clarity on the distinction between acquisition and use of the information. Rich (1991) criticizes the tendency of organizations to use information produced in-house rather than from external sources (Rich, 1991). This leads to less prioritization of search and acquisition of knowledge from external sources among organizations.

Limitations of science in dealing with wicked problems led to the evolution of post-positivist narratives of knowledge utilization. The diffusion of innovation is the early theoretical work in this stream. In simplest terms, the diffusion of innovation is the process that occurs as people use new ideas, technologies, philosophies, products, and practices (Kaminski, 2011). It is considered as a dominant theory in academic traditions of knowledge utilization (Estabrooks, 2001; Estabrooks et al., 2008) that examines human psychology and behavior towards new technology and new knowledge over time. The first organized theory on the diffusion of innovation was proposed by Everett Rogers in four editions of his book, *Diffusion of Innovations* (Greenhalgh, Robert, Bate, Macfarlane, & Kyriakidou, 2008). But he is not the first scholar to put forward this theory.

Early diffusion of innovation research was cited in scholarship of anthropology, sociology, geography, and school education during late 19th century to early 20th century. French sociologists Gabriel de Tarde and German political philosopher Georg Simmel explained interaction (Green, Ottoson, Garcia, & Robert, 2009) and social networks (Dearing, 2008; Dearing & Kee, 2012) among people to improve the utilization of knowledge. In the United States, the work of Bryce Ryan and Neil C. Gross was the first spark in this field. Their publication in 1943 on the diffusion of hybrid seed corn in two farmers' communities of Iowa was a major milestone (Dearing, 2008; Dearing & Kee, 2012; Rogers, 2003). This publication became the basis for hundreds of empirical research projects on diffusion of innovation in the United States.

The diffusion of innovation is the process in which an innovation is communicated through certain channels over time among members of socials systems (Dearing, 2008). At the beginning, there will be a few people who are open to innovations. They are early adopters (Kaminski, 2011; Rogers, 2003) and are typically educated leaders and champions. Early adopters will spread the word and more members of community then start to adopt new knowledge, leading to critical mass of adoption. New innovation continues to diffuse until saturation is achieved. The diffusion of innovation is presented in an “S” shaped curve in which the x-axis is time and the y-axis is the number of adopters. Rogers (2003) presents five categories of adopters: innovators, early adopters, early majority, late majority, and laggards. This theory includes interpersonal practices as an explaining factor of ideas and culture within and across communities (Green et al., 2009).

Figure 2.2: Theories and Models on Knowledge Utilization

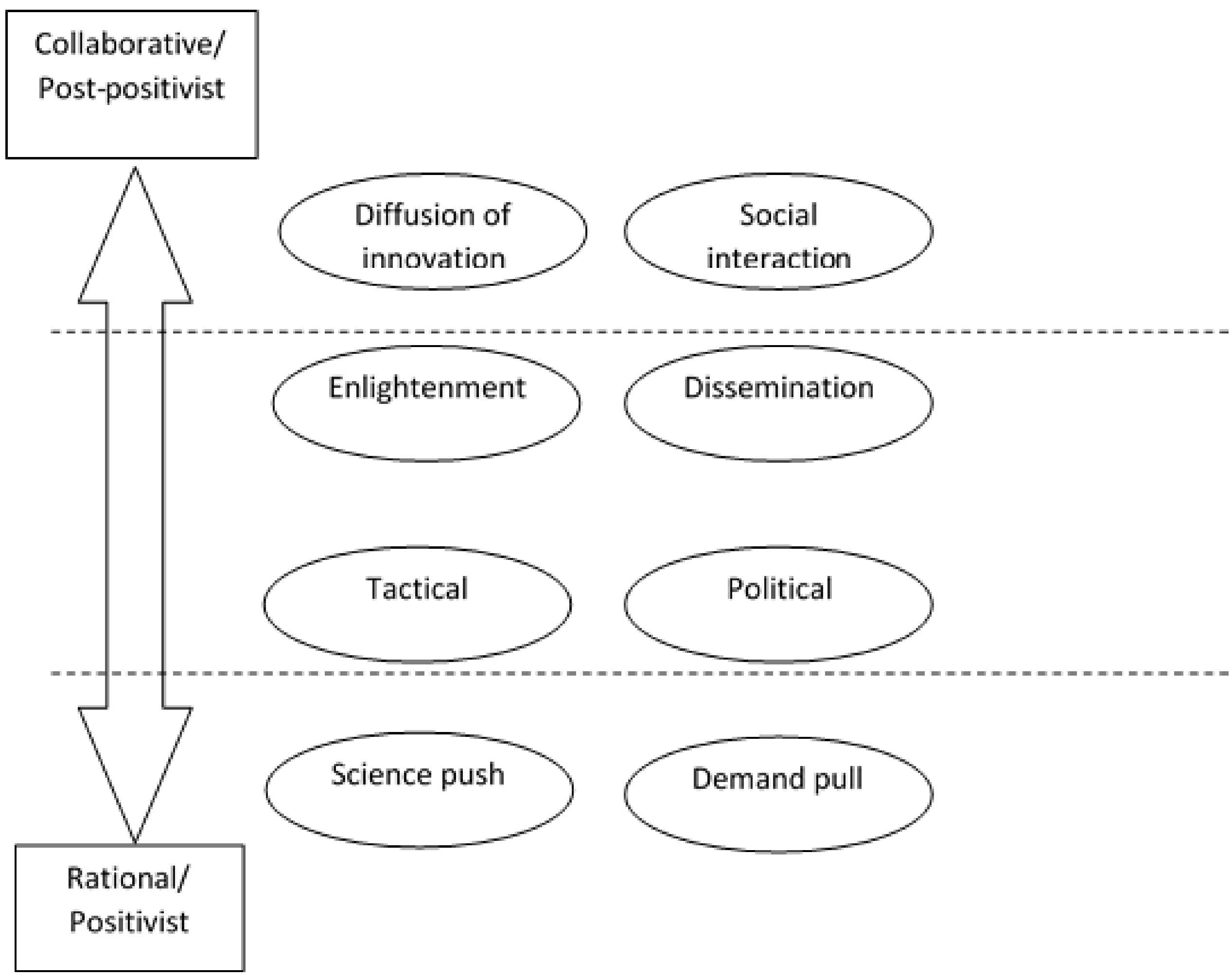

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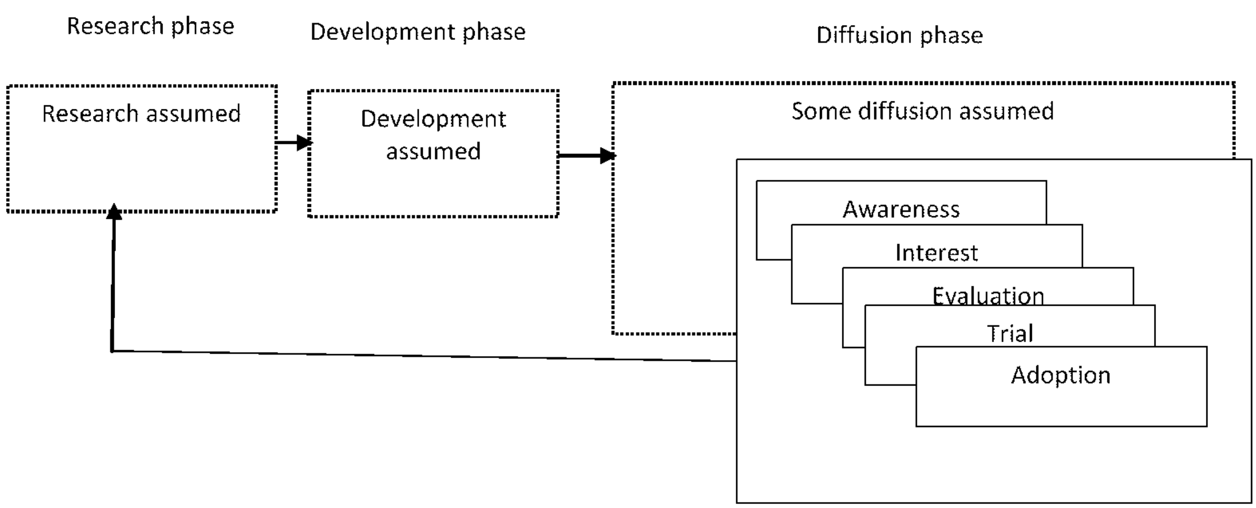
Figure 2.2 presents classification of theories and models of knowledge utilization in terms of positivists and post-positivists. Diffusion of innovation and social interaction perspective are post-positivist theories, whereas demand-pull and science-push perspectives are positivist theories. There are many others that fall in-between, including tactical, political, enlightenment, and dissemination models. Other models only focus on the knowledge use in practice of policy makers and will be discussed later in this chapter.

Following diffusion of innovation theory, a number of theories and models of knowledge utilization emerged. One of them was the two communities theory which was first proposed by Caplan in 1979. The basic assumption is that there is a significant lag between production and utilization of research knowledge because of differences between researchers and policymakers in their culture, thinking, priorities, norms, affiliations, and incentives (Caplan, 1979; National Research Council, 2012). Evidence has shown that decision-makers have to pay attention to multiple factors in the course of decision making, and research knowledge is only one of them (Neilson, 2001). The goal of scientists is to understand the world through scientific research, whereas the goal of the policymakers is to respond to a particular policy issue (National Research Council, 2012). This theory argues that the gap between two groups is sustained due to lack of linkage between them. Policy makers are not aware of scientific research on policy agenda and scientists are not aware of the knowledge need of policymakers.

Theories have advocated different approaches to narrow down this gap between production and utilization of research knowledge. The most widely discussed perspective is social interaction theory (Estabrooks, Thompson, Lovely, & Hofmeyer, 2006; Havelock, 1975; Landry, Amara, & Lamari, 2001b; National Research Council, 2012), which is also framed as an interactive model of knowledge utilization (Weiss, 1979). Social interaction theory argues that the sustained interaction between researchers and policymakers during production, dissemination, and use of knowledge is the most effective approach to reduce the utilization gap. It assumes that the relationship between policymakers and researchers is iterative and non-linear. Its initial use was in school education and health sector where the policymakers and researchers collaborate and interact to inform policy and practices (National Research Council, 2012). The use of this theory was extended to other sectors such as natural resource management, public policy, and planning.

Interaction includes informal and formal communications between producers and users of knowledge, including personal connections. It improves mutual understanding of the knowledge between producer and user. Users are engaged in the process of knowledge production, which allows streamlining the research with the information needs of the users. Besides the work of Rogers (1983), Havelock (1975) and Weiss (1979), current empirical research has also shown that the continuous and regular interactions among practitioners, policymakers, and consumers can improve knowledge utilization. Thematic analysis of publications conducted by Mitchell et al. (2010) shows that a formalized process of regular interactions among producers and users of knowledge improves the application of clinical research (Mitchell, Fisher, Hastings, Silverman, & Wallen, 2010). A case study conducted by Mushkolaj (2013) on the science-policy interface for climate change adaptation strategies in Maryland identified social capital among climate scientists, decision-makers, citizen groups and other stakeholders as an integral part of science-policy interaction for climate change adaptation planning (Mushkolaj, 2013). The overall process of knowledge diffusion and utilization proposed by social interaction theory is shown in Figure 2.3.

Figure 2.3: Social Interaction Perspective of Knowledge Utilization

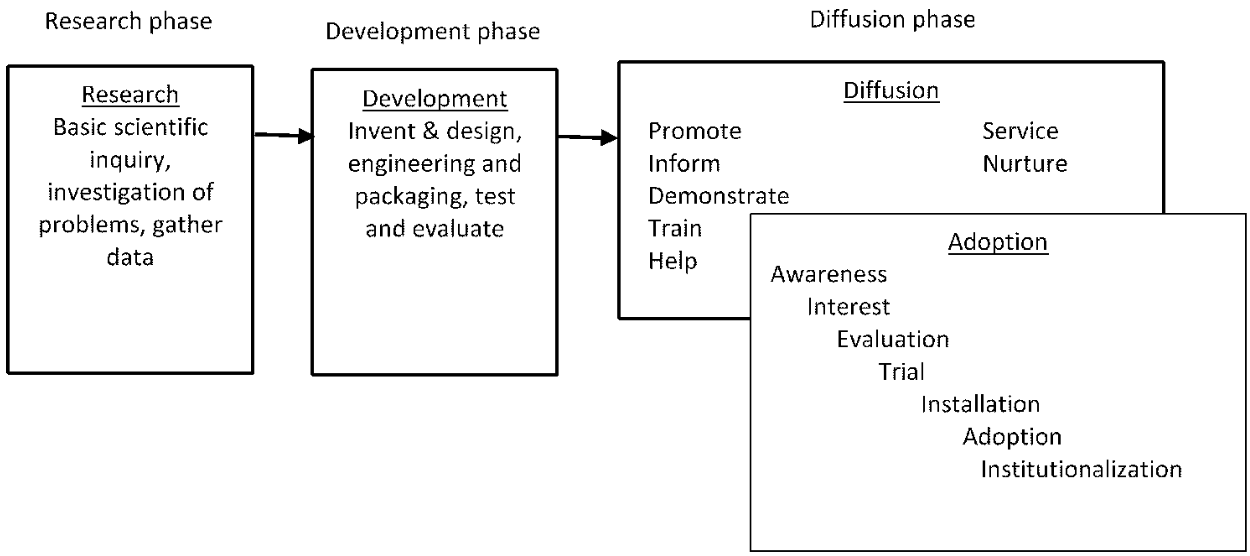


(Estabrooks et al., 2006; Havelock, 1975; Landry et al., 2001b; National Research Council, 2012)

Besides the diffusion of innovation and social interaction theory, two other rational theoretical perspectives (Almeida & Báscolo, 2006) explain knowledge utilization. They are the research, development and diffusion perspective and the problem solver perspective (Havelock, 1975; PARKER, 1981; Weiss, 1979). They are also described as a demand-pull model and science-push model of knowledge utilization, respectively.

The research, development and diffusion perspective (Science-push model) is the first paradigm of knowledge utilization. It considers science as the solution to social problems. This is also called the knowledge-driven model of knowledge utilization (Weiss, 1979). Boundary organizations such as laboratories, consulting firms, and research centers play a crucial role in transferring knowledge from scientific entities to user groups (Huberman, 1994). The feedback loop in knowledge production, however, is missing. Knowledge users are just receivers and implementers of the research packages (Landry et al., 2001b). Users do not have access to the research process; they are completely passive in production and transfer of knowledge. All users receive the same understanding of innovation. Producers of knowledge will train, inform and help users. Utilization follows the linear sequence from supply of research to utilization (Landry et al., 2001b) and offers follow-up services. Once the knowledge is successfully adopted by certain users, it can be diffused to others. Detailed phases and steps of adoption are presented in Figure 2.4.

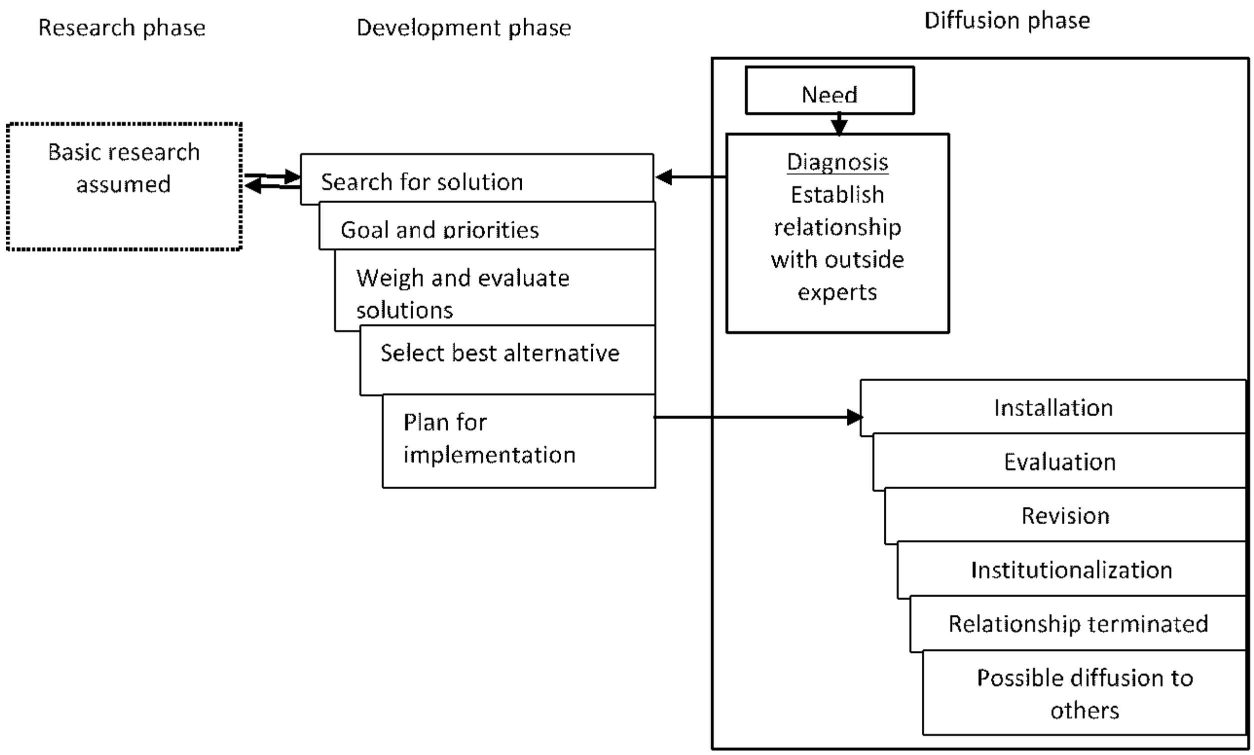
Figure 2.4: Research, Development and Diffusion Perspective of Knowledge Utilization (Science-Push Model)



(Havelock, 1975; Landry et al., 2001b)

The problem solver perspective is narrower. The users demand becomes the major direction of research under this perspective (Landry et al., 2001b). It starts with a policy problem, then provides empirical evidence and has direct application to solve a policy problem (Contandriopoulos, Lemire, Denis, & Tremblay, 2010; Weiss, 1979). This model is applicable to the diffusion of scientific innovations in practice-based sectors such as public health and school education. Basic understanding of a problem may exist, but the search for a specific solution will begin as the need arises. The knowledge user contacts an external expert to diagnose the problem. External experts help to achieve a certain goal in this model (Thompson, Estabrooks, & Degner, 2006). The relationship between researchers and practitioners/policy makers is a customer-contractor relationship. Customers define types of research they want and researchers execute the research in exchange of payment (Landry et al., 2001b). This model is well suited to rational planning. Goals and priorities are set based on the problem or the policy issue at hand. Alternatives are identified and the best option is selected to address the given policy challenge. Knowledge is evaluated at the beginning of its implementation and revision is conducted if necessary. Once knowledge addresses the targeted problem/issue, it will be institutionalized and the relationship between producer and users will be terminated. Further diffusion can take place with other users based on the interest of the first user and the quality of knowledge. The phases and steps of utilization of this model are shown in Figure 2.5.

Figure 2.5: Problem Solver Perspective of Knowledge Utilization (Demand-Pull Model)



(Havelock, 1975)

Among four theoretical models (diffusion of innovation, social interaction theory, science-push perspective, and demand-pull perspective) mentioned above, the social interaction theory is most widely discussed in literature. It is developed on the criticism of the other two theories (demand-pull model and science push model) (Landry et al., 2001b). It is flexible enough to incorporate diverse challenges posed by complex planning problems. The base assumption of social interaction theory is that continuous interaction between producers and users during production and use of knowledge adds to utilization.

2.3.2. Knowledge Utilization in Practice

Utilization of knowledge is measured based its use in practices of policy and planning. Three roles of knowledge in policy making are instrumental, intelligence and enlightenment (Oh, 1996; PARKER, 1981). The instrumental role is specific use of science to inform decisions. It is also called the engineering approach of knowledge utilization (PARKER, 1981) and has direct and concrete impacts. The intelligence role aims to clarify goals and alternatives. It offers information on the decision-making process. By developing intelligence of knowledge, it widens the scope of utilization. It does not, however, provide decision makers clear choices like the instrumental perspective. The enlightenment role argues that government officials and decision-makers should use knowledge as a source of ideas, information, and orientation rather than as data (Weiss, 1977). It argues for the broader use of knowledge to inform the decision making rather than narrowly using facts to support certain decisions.

In practice, knowledge utilization is measured based on how knowledge as an end product can impact policy and planning. It emphasizes research utilization as the implementation of research-based knowledge (science) in practice (Estabrooks & Wallin, 2004). Based on characteristics of use, utilization is categorized into three types: conceptual, strategic, and instrumental (Beyer & Trice, 1982; Estabrooks, 1999; Estabrooks & Wallin, 2004; McKenzie et al., 2014; Nutley, Walter, & Davies, 2007; Pelz, 1978; Waylen & Young, 2014). Instrumental use offers alternatives to resolve the policy issues. Conceptual use focuses on gathering information about policy issues, and informs the policy process without necessarily creating a specific solution. Strategic use offers knowledge to support or deny a specific policy or planning interest.

Instrumental use precipitates when decision makers use knowledge to make rational decisions (McKenzie et al., 2014). There are no measurement criteria and variables for the instrumental use. Rather, they are determined based on contexts and fields of application. In an international comparative case study on ecosystem services, McKenzie et al. (2014) explored the use of InVEST (mapping software model to assess ecosystem services) from the perspectives of conceptual, symbolic, and instrumental uses of knowledge. Under this study, they asked research participants whether InVEST helped to select policy alternatives, helped to improve policy mechanisms, or influenced to any policy decisions (McKenzie et al., 2014). These questions are designed to evaluate the instrumental use of knowledge.

The second use in practice is symbolic. It is also labeled the strategic or tactical use of research (Nutley et al., 2007). Knowledge is used as a support for the political system or to challenge the position of others. It involves using research results to legitimate and sustain predetermined positions (Beyer & Trice, 1982). McKenzie et al. (2014) explore the symbolic use of InVEST by asking whether participants use it to illustrate the value of particular planning option, whether it helps the policy issue to gain the momentum, or whether the scientific information of ecosystem services helps to mediate conflict. Symbolic use may not always have negative connotation. In the planning process, it can help to advocate for a planning option and clears some of the confusion in communities.

Conceptual use is indirect utilization. It does not have concrete use like instrumental and symbolic uses. If knowledge clarifies concepts and impacts on attitudes and understandings among policy makers or planners that is conceptual use (Nutley et al., 2007). McKenzie et al. (2014) ask whether InVEST brought new information to stakeholders, whether it helped to identify planning and policy issues, or what participants learned during the planning process (McKenzie et al., 2014).

There are multiple empirical studies on instrumental, symbolic and conceptual utilization of research. But the example presented above about InVEST is relevant in planning. All three types of utilization exist in a continuum (Nutley et al., 2007) and they can prevail in the same planning process simultaneously. McKenzie et al. (2014) identified all three modes of knowledge utilization in their three case studies of Coastal Belize, West Coast Vancouver Island, and Kamehameha Schools on Oahu, Hawaii.

A seven-step framework of knowledge utilization, proposed by Knott and Wildavsky (1980), focuses on transmission and final use of knowledge. Steps are reception, cognition, reference, effort, adoption, implementation, and impact (Knott & Wildavsky, 1980a; Lester, 1993). Reception is availability and exposure of research to policymakers. Utilization initiates if research information/findings reach to the policymakers. The cognition step considers the understanding of research findings by policymakers. The reference step tracks changes in perception of certain problems because of cognition of new knowledge. If decision makers start to believe in the new research and put in effort to implement, this is the effort step. If the research information is included in the policy outcomes, it is the adoption step. Implementation is the second to the last step of utilization in which research knowledge is implemented in policy. The final step is the impact of research knowledge on the broader community (Lester, 1993). Landry et al. (2001), Cherney and McGree (2011), Cherney et al. (2012) modified this framework as a six-step ladder of knowledge utilization: transmission, cognition, reference, effort, influence, and application (Cherney & McGee, 2011; Cherney, Povey, Head, Boreham, & Ferguson, 2012; Landry, Amara, & Lamari, 2001a). Through a case study on utilization of social science research in Canada, Landry, Amara and Lamari (2001b) identified the linking mechanisms (researchers and users), dissemination efforts, adaptation of research outputs, user contexts and publication assets as determinants of utilization of knowledge (Landry et al., 2001b). Using the same ladder of knowledge utilization, Cherney et al. (2012) measured the utilization of educational research in Australia. They found the intensity of interaction between academics and research-users and the dynamics of collaboration as determinants of utilization (Cherney et al., 2012). In both studies, the evaluation of knowledge utilization was conducted independently for each step of the ladder. It means that research can score low on the transmission step but can have a higher value in cognition.

Practice-based knowledge utilization models are not independent from the theoretical perspectives discussed in the previous section. Three knowledge utilization theories may be applied to the flow of knowledge from producers and users. Two practice-focused knowledge utilization models cover the diffusion stage of these theories. There are different steps of knowledge diffusion in theories. The overlap of diffusion and utilization of knowledge between theories and practice-focused models are shown in Table 2.1.

Table 2.1: Common Steps among Theories and Practices of Knowledge Utilization

Ladder of knowledge utilization	Knowledge utilization in practice	Social interaction perspective	Science-push perspective	Demand-pull perspective
Dissemination/ cognition	Conceptual	Awareness	Awareness	Problem awareness
Reference, effort, influence	Symbolic	Interest Evaluation Trial	Interest Evaluation Trial	Installation Evaluation Revision
Application	Instrumental	Adoption	Installation Adoption Institutionalization	Institutionalization Relationship termination Possible replication

(Author, 2018)

Practice-focused knowledge utilization models cover the diffusion stage of theories. They do not, however, have details of interaction between knowledge producers and users. Based on the definition, knowledge utilization is not only the use of knowledge as a source of information in policy and planning, but also the process of production and dissemination. The ladder of utilization and conceptual, symbolic, and instrumental uses can provide insights, but categorization falls short in explaining the complexity posed in ideas of knowledge utilization (Landry et al., 2001a, 2001b). The measurement of knowledge utilization should include a series of events from production to adoption of knowledge. Rich (1991) proposes a four-step framework to measure it. Steps include information transmission, pickup, processing, and application (Rich, 1991).

Empirical evaluations of knowledge utilization are diverse. Some follow the practice-focused approach without any consideration given to production and dissemination. Others consider it as the process from production to implementation. This dissertation uses the combination of both to develop a knowledge utilization framework. It evaluates the framework with the case of climate science use in the Quy Nhon City, Vietnam.

2.3.3. Knowledge Utilization in Planning

Scholarship of knowledge utilization is small in planning. Much of the progression on planning theories before the 1960s was based on the scientific qualities of the decision-making process with a strong belief in the credibility of natural science as the foundation of policy making (Campbell, 2012). Friedman (1987) mentioned that planners refer to their advance degrees and technical know-how as their knowledge, which is a reinforcement of the rational approach of decision making. There are two assumptions on knowledge utilization among positivist planners. The first is that the world is knowable through science, and the second is that there is a continuum in evolution between natural and sociocultural worlds. Friedman (1987) argues that knowledge based on science (such as astronomy) is manipulative, and the knowledge that helps to create just and the satisfying society is not based on scientific inquiries. Planners' knowledge needs are different than the positivist approach of knowledge production because of the following factors:

- Planners need knowledge about future events. They should know about uncertainty, risk, and assumptions of future projections and predictions.
- The conventional method of knowledge production through hypothesis tests, theories, and models have static assumptions of the outer world's phenomena. But in planning, the outer conditions are dynamic and have a role to play in the inquiry. They cannot remain static in the planning process.
- Theoretical and methodological knowledge is produced through costly scientific inquiries which are not available to planners. They use other methods of knowledge production that utilize more personal and experience-based knowledge.
- Since knowledge is validated before the action is taken, the production of knowledge is a social process with interpersonal and group dynamics.

- Personal or shared beliefs shape the knowledge of planners when they investigate the world, and the unique nature of personal or shared beliefs allows planners to challenge objective knowledge.
  (Friedmann, 1987)

These assumptions about a uniqueness of knowledge in planning frame the creation of knowledge as a social process which remains flexible and open to further advancement during production.

Single-source knowledge is in service to particular political and economic interest, which led planning to be inclusive of multiple knowledge sources (Campbell, 2012). The value of multiple knowledge in planning is reinforced by the work of Rydin (2007). She argues that knowledge in planning is not only the domain of experts; rather, it is associated with a variety of actors and social domains (Rydin, 2007). It is related to post-positivist approaches, including communicative and collaborative planning, and the demand for the multiplicity of knowledge and stakeholders in the process of achieving consensus over planning issues. She presents six types of knowledge claims in planning. They link current state (she calls it as 'State A') to future states (she categorizes future states as B –Predicted State, B1- Planned State, and B2-Outcomes State) (Rydin, 2007).

Rydin's (2007) argument on recognition of knowledge in planning is supported by Alexander (2008). He argues that knowledge in planning is socially constructed and involves material reality of society (Alexander, 2008). The role of material reality is suitable for planning because it acknowledges some absolute truth claims as valid, unlike assumptions made in the social construction of knowledge production (Alexander, 2008).

Kouwen et al. (2009) recognize a gap in knowledge and planning. They argue that limited use of planning support systems is one of many reasons for the gap between knowledge and practice in planning that occurs because of incompatibility of planning support systems with wicked planning problems. Planning support systems are mainly designed for well-defined problems. But in practice, there is a lack of consensus among stakeholders on the structure of planning problems (van Kouwen, Dieperink, Schot, & Wassen, 2009). van Stigt et al. (2015) argues that decision makers utilize expert knowledge during the planning process, but expert knowledge is not the sole driver of planning. They must also include political and public support for planning decisions. The study was conducted among urban planners of the Netherlands to understand the utilization of expert knowledge in the course of urban planning (van Stigt, Driessen, & Spit, 2015).

The planning literature on knowledge utilization evolved along with the history of planning theory. Planners' technical knowledge was dominant when there was a stronger belief in of positivist perspectives. With the evolution of post-positivist planning theories (communicative, collaborative, indigenous, radical, etc.), multiplicity of knowledge was required. That included informing planning through scientific and non-scientific knowledge. Forms of non-scientific knowledge are storytelling, experience-based, and observation-based. The major question is how scientific knowledge can play a role in finding the best alternative when addressing a wicked problem. This is the major quest of this research, and it aids in understanding how climate science can play a role in finding the best adaptation options in land use planning in Quy Nhon City, Vietnam.

2.3.4. Utilization of Scientific Knowledge of Climate Change

Research shows that there is a gap between production and utilization of climate science. Lack of understanding of decision-making contexts and false perception of complete use of climate science in policy processes are two major reasons for the gap (Lemos, Kirchhoff, & Ramprasad, 2012). As mentioned in the two communities theory of knowledge utilization, demand and supply of climate science do not match, which limits the implementation of adaptation strategies (Kiem & Austin, 2013) in plans and policies. Co-production of science, interaction between producers and users, and facilitation of transmission to users through boundary organizations are strategies to narrow the gap between demand and supply of climate science. Meinke et al. (2009) argue that a major cause of mismatch between supply and demand of science is that the demand for science is often broad, general, and vague, whereas supply is narrow, specific and precise. They further claim that climate science (also called "adaptation science") can be relevant to adaptation if production and transmission processes are context specific and participatory (Meinke et al., 2009). This highlights the importance of the linkage between producers and users of climate science during production.

Boundary organizations can create a network to increase interaction between producers and users of climate science in decision making (Kirchhoff, Esselman, & Brown, 2015). These networks are called boundary chains. They link complementary boundary organizations together. If boundary organizations create connections, they can supplement each other for resources and expertise (Kirchhoff, Esselman, et al., 2015; Kirchhoff, Lemos, & Kalafatis, 2015). Kasperson (2010) recognizes the role of boundary organization in connecting science to decision making in disaster risk reduction. In order to improve the utilization of science in environmental decision making, production should be more collaborative considering human interaction with environmental systems. The policy and decision process should follow adaptive management rather than the command and control approach (Kasperson, 2010).

Although empirical research on climate science utilization is limited, adaptation practices have realized its importance. Research has shown that the combination of bottom-up (community experiences, contextual knowledge, empirical evidence, etc.) and top-down knowledge (experiment-based, lab-based, scientific modeling-based, etc.) can be the most appropriate approach in addressing vulnerabilities caused by climate change (Mastrandrea, Heller, Root, & Schneider, 2010), but it is not free from constraints. Beyond resource and institutional constraints, contextual factors of policy and planning have a higher influence on framing adaptation measures. Financial challenges generate another limitation (Liu et al., 2016). Climate science should inform decision making on adaptation and mitigation measures. But it is not occurring in the practice of planning and decision making, resulting in adaptation deficit to climate change impacts (Preston, Mustelin, & Maloney, 2015). Uncertainty, larger geographic extent, and the abstract nature of climate science hinder its consideration in decision making (Lewis & Lenton, 2015). Other factors that influence the usability of climate science are the context of use, process of science production, and iteration of interaction between producers and users (Dilling & Lemos, 2011).

The best utilization of climate science in the adaptation practice requires interaction between climate scientists and decision makers. The science should also be context relevant. Lack of institutional structures and limitation of resources are other challenges in utilization. In the context of Vietnam, climate science research is young. Planning and decision-making process is top-down with no people's participation in the planning process. That results in unique opportunities and challenges in the utilization of climate science in plans and policies.

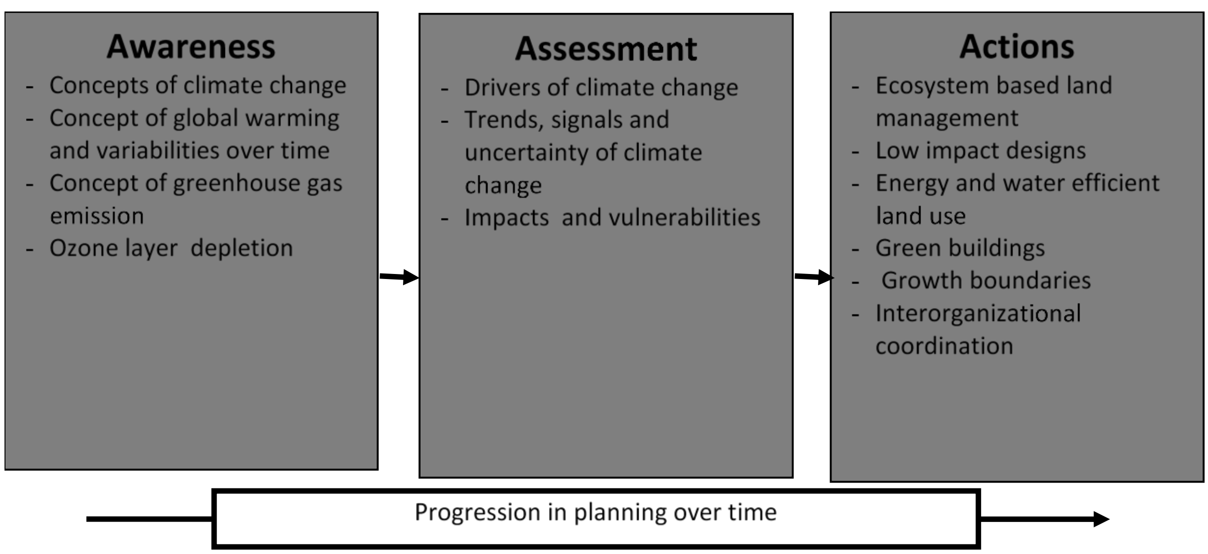
2.4. Plan Evaluation from the Perspective of Climate Change Adaptation and Climate Science Utilization

Plan evaluation can be administered in different stages of plan making and implementation. Multiple criteria are recommended to evaluate the plan quality. Baer (1997) recommended five categories of plan evaluations: plan document assessment, plan testing, plan critique, comparative research and professional evaluation, and evaluation of outcomes (Baer, 1997). Empirical research points out the evaluation of different components of a plan. Common assessment criteria include factual basis, goals and vision statements, and policies and strategies (Berke, Smith, & Lyles, 2012; Berke, 1996; Horney et al., 2012; Kang, Peacock, & Husein, 2010; Srivastava & Laurian, 2006). Intergovernmental-coordination, participatory planning process, and implementation and monitoring are added as criteria of plan evaluation from the perspective of disaster risk reduction (Berke et al., 2012; Horney et al., 2012; Kang et al., 2010).

There is a gap in evaluation of land use plans because they are highly contextual and future-oriented (Berke & Godschalk, 2009). Existing plan evaluation literature does not offer a suitable approach to assess climate change adaptation in land use plans, especially for small geographic areas. This is also not a topic of discussion in conferences of climate change adaptation (Roggema, 2012). Although there are studies on the evaluation of local plans from the perspective of hazard mitigation (Lyles, Berke, & Smith, 2014), studies are focused in large geographic areas covering multiple plans. Using principles of climate change adaptation to determine the criteria of plan evaluation is an alternative approach. The same method is used to evaluate sustainable development in plans. Berke and Conroy (2000) use six principles of sustainable development to evaluate 30 comprehensive plans (Berke & Conroy, 2000).

Discourse on climate change adaptation is built on empirical evidence. There are multiple approaches and scales of adaptation. The role of institutions, governments, communities and tools are also diverse. There are efforts to lift up experiences of adaptation for replication. One such effort is in plan evaluation. As a result, approaches of plan evaluation from the perspective of climate change adaptation are developed. One approach is plan evaluation through *awareness,* *assessment, and action (AAA)* (Baynham & Stevens, 2014; Luers & Moser, 2006; Moser & Luers, 2008; Tang, Hussey, & Wei, 2009; UKCIP, 2003). The *AAA framework* has been used to evaluate land use plans (Baynham & Stevens, 2014; Tang et al., 2009), climate action plans (Tang, Brody, Quinn, Chang, & Wei, 2010), and climate preparedness actions of local governments (Tang, Ting, Quinn, & Zhao, 2012; UKCIP, 2003). It is also used to assess Master Plans (2004 and 2015) of Quy Nhon City (Ghimire, Vu, & Thuy, 2018). This framework was first proposed by the UK Climate Impact Program for local communities to deal with potential impacts of climate change (UKCIP, 2003). It is an approach of evaluation coping capacity to climate change among decision makers in California (Moser & Luers, 2008). Heidrich et al. (2013) have used a modified version of this framework to assess mitigation and adaptation efforts in 30 urban areas in the United Kingdom (UK). Steps are assessment, planning, action, and monitoring (Heidrich, Dawson, Reckien, & Walsh, 2013). The details of the AAA framework are presented in Figure 2.6.

Figure 2.6: Awareness Assessment Action Framework



(Adapted after Tang et al., 2009)

The first step is awareness about potential impacts of climate change in planning in public and private sectors. Climate science plays a key role in creating awareness. A higher level of awareness among state agencies in California is facilitated by the role of climate science (Moser & Luers, 2008). Evaluation of awareness of climate change can be contextual and subjective, and depends on the scope of research. Some factors in measuring climate awareness are knowledge on climate change, variabilities, and global warming; the concept of greenhouse gas emission; and concepts of ozone layer depletion (Tang et al., 2009).

Assessment (also as analysis) includes identification of climate change impacts in a sector or geographic area. In the case of land use planning, it includes risk and vulnerability assessment, historical pattern of climatic disasters in a geographic area, and modeling future impacts. Some variables are identifying major sources and drivers of climate change; analyzing the trend, signals, and uncertainty of impacts (temperature change, precipitation change, sea level rise, change in extreme events); and vulnerability assessments (to ecosystems, food security, residential areas, human health, etc.) (Tang et al., 2009). A study conducted by Moser and Luers (2008) showed a higher knowledge and assessment capacity of climate change among resource managers in California. They identified lack of compatibility of science with the existing decision-making procedures as a major challenge (Moser & Luers, 2008).

Actions are tools and methods proposed to address climate change impacts. They depend on interest of users and contexts of planning. Some variables to measure actions are green building and green infrastructures (i.e. urban forests, park and open spaces, natural drainage systems); ecosystem-based land management; low impact design for impervious surface; water conservation initiatives; establishing growth boundaries; promoting compact development; establishing inter-organizational coordination procedures; and establishing/executing disaster-resistant land use and building codes (Tang et al., 2009).

The AAA framework is used to assess quality of 53 land use plans of California (Tang et al., 2009). Local land use plans are low in awareness and in analysis of climate change impacts. The actions for climate change varies tremendously in scope and content of these plans. Through this evaluation, they also identify a dual complementary approach (mitigation and adaptation) of land use planning to deal with climate change impacts (Tang et al., 2009).

The role of climate science to inform land use planning is not always clear. It can be assessed using the three theories and two practices of knowledge utilization mentioned above. In the case of Quy Nhon City, the AAA framework is appropriate because it is flexible in assessing the content of plans without considering planning process. Components of knowledge utilization in practice mentioned in Table 2.1 juxtapose with the AAA framework. The conceptual use of knowledge completely overlaps with the awareness component of plan evaluation. The symbolic and instrumental utilizations of knowledge overlap with assessment and action components of plan evaluation, respectively. The three components of knowledge utilization, however, do not cover the complexity of knowledge transmission of climate science. The relationship among these evaluation frameworks (AAA framework and knowledge utilization) will be discussed in the following chapters of this dissertation.

2.5. Gaps in Literature

Knowledge utilization in a post-positivist context is not linear. The role of science in decision making and planning is not clear, and this applies to climate science as well. There is a large pool of literature on collaborative and communicative planning. This literature advocates for a multiplicity of information sources in the planning process. But the topic of how the scientific knowledge can be used in this context is not in the discussion of literature.

Climate science has improved tremendously in last 5 decades. Literature points out gaps between production and application of climate science in decision making. There is very little research on how climate science can inform land use planning to better adapt with impacts.

Previous research has identified the need for evaluation of knowledge utilization in different disciplines (Landry et al., 2001a). There is not any research, however, assessing how components of knowledge utilization mentioned in Table 2.1 perform in urban land use planning in a developing country like Vietnam to deal with uncertain but inevitable impacts of climate change.

Land use planning has been proven to minimize risks and impacts of disasters and climate change. Decision support systems such as scenario planning, computer-based applications, and scientific basis are required to achieve optimal decisions to deal with them. Climate science has a strong influence on determining land use decisions in many cities. The

Climate Action Plan of Quy Nhon City has recommended many direct and indirect measures of land use planning to make city resilient of climate change impacts (Dinh et al., 2010). Besides climate science, social, economic and political environments are equally important in the process. There is no discussion in literature on how climate science informs land use planning in adapting to impacts in the context of competing priorities (socioeconomic, political, environmental, etc.), especially in developing countries. There is also a lack of empirical studies on how the awareness, assessment, and action framework can be used in the context of developing countries.

Sustained interaction between scientists and planners/policy makers is considered a legitimate approach promoting utilization of science. It is widely discussed across disciplines. Literature on knowledge utilization is based on empirical evidence derived from research in developed countries. There is no single case study from developing countries where economic and social development deficits overshadow environmental issues. Furthermore, collaborative planning takes a different form in the context of a centralized planning like Vietnam.

This dissertation strives to fill the above mentioned literature gaps with a case study of Quy Nhon City of Vietnam, and it relies on theories and models of knowledge utilization to assess how climate science informs land use planning in the city to adapt with impacts. It also elaborates on the complexity of knowledge utilization in the context of the socialist top-down planning system of Vietnam.

CHAPTER 3. RESEARCH METHODOLOGY

This research uses mixed method in a case study. Concurrent and sequential (Creswell, 2009) approaches are used to evaluate climate science utilization in land use planning of Quy Nhon City. Chapter 3 is divided into seven sections: research worldview, conceptual framework of climate science utilization, research design, justification of method and case study, research questions and propositions, data sources, and data analysis and interpretation. Research follows a pragmatic worldview because the complexity of planning problems demands multiplicity of knowledge sources and means of understanding. Data sources are interviews, survey, community meetings, document reviews, and non-participatory observations. Utilization of climate science in land use planning is assessed through its transmission, understanding, and implementation. The Likert scale (low, fair and strong) is used to measure the three components of utilization. NVivo is used to analyze the qualitative data collected through interviews and document reviews. Impacts of land use changes on flooding patterns in Quy Nhon are evaluated using a regression model based on 359 household surveys and 3 community meetings. Transmission, understanding, and implementation are assessed using 49 interviews conducted at provincial, city and national levels. Research questions are parsed into measurable propositions. Some questions, however, did not have propositions because they are explanatory.

3.1. Research Worldview

Pragmatism is a philosophy of action rather than knowing or being (Hoch, 1984). It is the most relevant worldview to understand and find solutions of complex and uncertain planning problems. Some of founding philosophers of this worldview are Charles Peirce, William James, and John Dewey. They valued social context as a determinant of understandings, meanings, and values in human beings (Healey, 2008).

Traditionally, social research is divided in a spectrum of positivist and interpretivist philosophies. Pragmatism refuses to choose sides in this dialectical war (Wahyuni, 2012). It argues that a combination of objectivist and subjectivist approaches is the most appropriate way to understand social phenomena because ultimately, it is about what works best to find the answer of a research problem at hand. Pragmatist researchers favor using both qualitative and quantitative data to better understand social reality (Wahyuni, 2012).

Planning is defined as a form of governance that deals with complex futurist phenomena. It evolved through the influence of philosophy (Healey, 2008). Planning is negotiation among multiple interests and values (Lawrence, 2000). This research strives to understand utilization of climate science in land use planning in Quy Nhon City. It explores political economy of land management, institutions of climate science production and dissemination, and governance of land use planning in the context of Vietnam.

The complexity of planning problems demands new methods of research and intervention. They require new institutional setups and governance mechanisms (Healey, 2008). Complexity increases with the mix of existing problems and new challenges brought on by climate change impacts and disaster risks. They are difficult to tame with rational planning efforts. Challenges are dire in developing countries where local planning capacities are low and existing planning practices are not flexible.

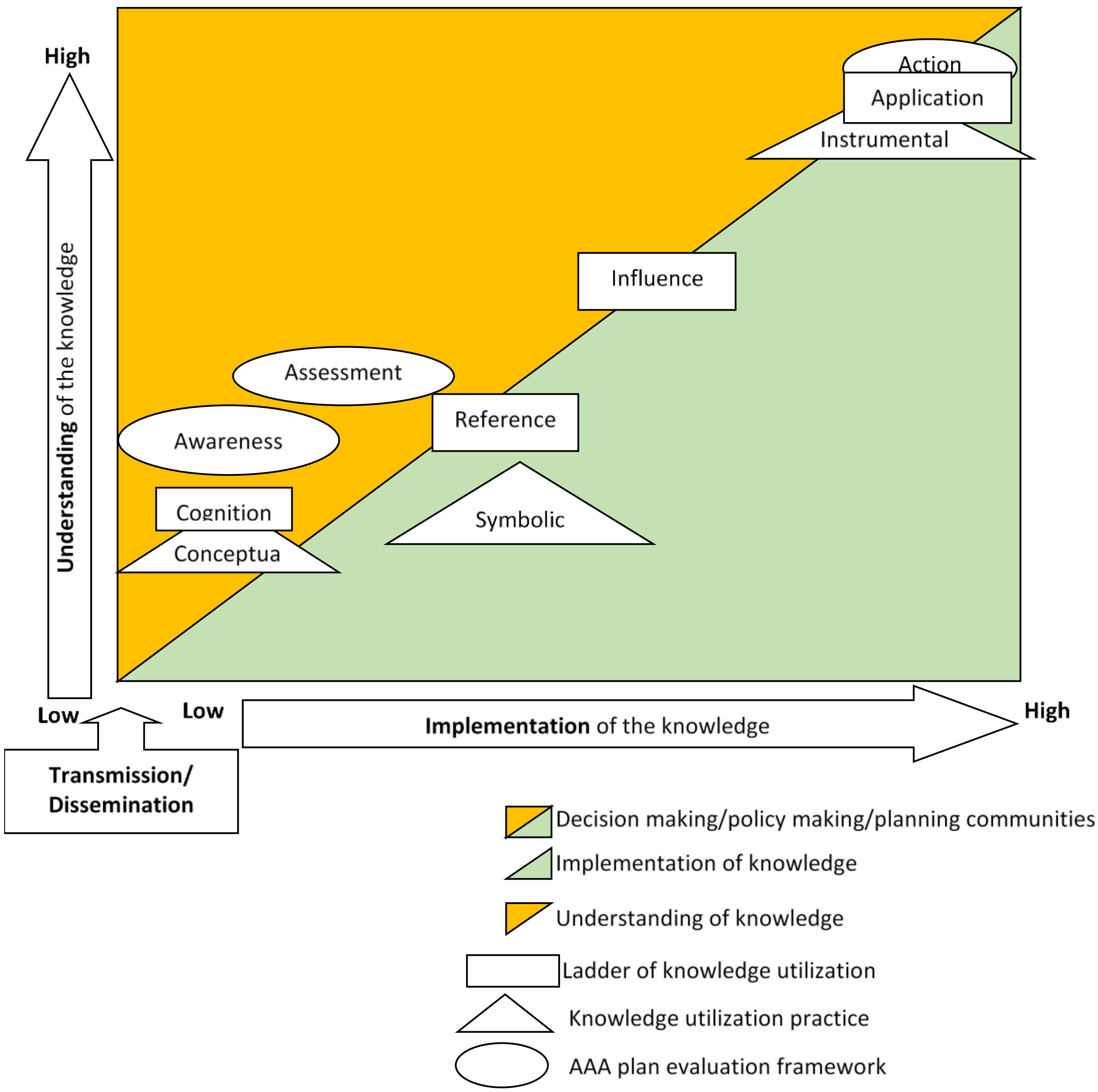
Incrementalism is a major aspect of pragmatism in planning. It has been favored in planning of cities in developing countries to address the challenge of climate change because it allows a slow and gradual change in perceptions, policies, and institutions. Transformative changes are not feasible in developing countries. Cities are focusing to achieve their development deficiencies while dealing new challenges of disasters and climate change. This research strives to assess climate change adaptation in land use planning in the context of Quy Nhon City of Vietnam from a lens of climate science utilization in planning and decision making.

3.2. Conceptual Framework

As mentioned in Chapter 2 (Literature Review), this research explores utilization of climate science on the basis of three approaches of knowledge utilization and plan evaluation. The first and second approaches are from the domain of knowledge utilization, and the third is on plan evaluation. The first approach is the *social engineering approach* (Knott & Wildavsky, 1980b) of knowledge utilization. It includes conceptual, symbolic, and instrumental uses of knowledge (Beyer & Trice, 1982; Estabrooks, 1999; Estabrooks & Wallin, 2004; McKenzie et al., 2014; Nutley et al., 2007; Pelz, 1978; Waylen & Young, 2014). It does not recognize production and dissemination processes as parts of knowledge utilization. The second approach is the *ladder of knowledge utilization.* It proposes a six-step framework: transmission and dissemination, cognition, reference, effort, influence, and application (Cherney & McGee, 2011; Cherney et al., 2012; Ghimire et al., 2018; Landry et al., 2001a). The third approach is *awareness, assessment and action (AAA) framework* (Baynham & Stevens, 2014; Ghimire et al., 2018; Luers & Moser, 2006; Moser & Luers, 2008; Tang et al., 2009; UKCIP, 2003) of plan evaluation.

Steps in AAA framework overlap with previous two models of knowledge utilization. The first step of this framework is the same as the cognition step of ladder of knowledge utilization and conceptual use of knowledge in social engineering approach. The assessment step of plan evaluation is same as reference and effort steps of ladder of knowledge utilization. Finally, the action step is the same as instrumental use of knowledge in the social engineering approach and the application step of the ladder of knowledge utilization. Overlapping characteristics of the three approaches are presented in Figure 3.1.

Figure 3.1: Commonalities among Frameworks of Research Utilization and Plan Evaluation



(Author, 2018)

Based on their characteristics, steps of the three frameworks can be categorized into three broad classes of knowledge utilization: transmission, understanding, and implementation of knowledge. In Figure 3.1, the lower triangle (light-green) represents implementation and upper triangle (orange) represents the understanding of a knowledge. The x-axis presents the progression of implementation and y-axis measures the progression of understanding of knowledge. The dividing diagonal line from lower left corner to upper right corner is the balance line between understanding and implementation. The total square area (light-green and orange) is the arena of decision making and planning. Knowledge gets transmitted to the rectangle through the lower left corner where understanding and implementation are low among planners and decision makers. Understanding and implementation increase at balance in case of ideal knowledge utilization. As steps of the three frameworks show in Figure 3.1, understanding and implementation are not straightforward and balanced. Conceptual use (the social engineering approach to knowledge utilization), awareness (the AAA plan evaluation framework) and cognition (the ladder of knowledge utilization) are inside the understanding triangle, which is the beginning of utilization in planning. There is very little implementation at this stage. Once progress moves to symbolic utilization in the case of a social engineering approach, it leans more towards implementation because the use of knowledge at this point is interest-specific. There may not be a higher understanding of knowledge. Decision makers or planners use knowledge to influence certain interests of decision making. An example can be the use of climate change science to influence certain political decisions. In the case of the plan evaluation framework, assessment falls in the understanding segment because an assessment of knowledge deepens and broadens understanding. It may not, however, have an implementation aspect. In the case of the ladder of knowledge utilization, there are reference and influence steps before final use of knowledge. The reference is a citation of knowledge by practitioners and professionals, and there is some level of understanding. The next step is the influence in the ladder, which means decision makers and planners understand knowledge and it has some influence on the decision choices (Landry et al., 2001a). The last cluster of utilization is action, application, and instrumental use of knowledge in the AAA framework, ladder of knowledge utilization, and social engineering approach, respectively. This is implementation in which there is a strong understanding of knowledge among decision makers and planners, and they utilize it in their policies, plans, and projects in order to deal with problems. This is the ideal goal of knowledge utilization.

There are discrepancies among three approaches. They concur in that there are understanding and implementation in a course of knowledge utilization. But in terms of dissemination, only the ladder of knowledge utilization talks about transmission of knowledge. None of them talks about the production process of knowledge as a part of utilization.

For this research, aspects of production and dissemination are equally important. The three frameworks are combined to assess utilization of climate science in land use planning. Utilization of climate science is evaluated through a lens of dissemination/transmission, understanding, and implementation in land use planning practices, including utilization in land use plans and their implementation. There is an assumption that production and dissemination are initial steps of knowledge utilization, but they are outside of the scope of planning. Other steps are understanding and implementation, and they fall within arena of decision making and planning. Understanding begins before implementation of climate science in planning. After basic understanding, implementation starts and progresses in a proportionate manner. This framework of transmission, understanding, and implementation applies to the utilization of climate science in land use planning in any context.

Transmission explains how climate science goes from the domain of scientific research to scopes of planning and decision making. It implies a knowledge production process, and interaction between decision-makers and climate scientists in a course of scientific knowledge production. Understanding encourages the implementation of climate science. In an ideal scenario, they can be balanced on the diagonal line in Figure 3.1. Often higher understanding may not result in higher implementation due to multiple reasons. Approaches to measuring the transmission, understanding, and implementation of climate science in planning and policies are presented in Table 3.1.

Table 3.1: Measurement of Dissemination, Understanding, and Implementation of Climate Science

Steps of climate science utilization	Measurement concepts
Transmission/dissemination	• Communication of climate knowledge to decision makers (Knott & Wildavsky, 1980b) • Relationship between climate scientists and planners/ decision makers to share/access climate science • Discussion on sources of climate science • Discussion on context of interaction between policymakers and scientists (Economic, social and organizational conditions) (Knott & Wildavsky, 1980b) • Temporal aspects of demand and supply of scientific knowledge (Knott & Wildavsky, 1980b)
Understanding	• Reference to climate science • Change in worldview of decision makers and planners • Awareness of climate change • Discussion on potential impacts of climate change • Explanation of risk and vulnerabilities of climate change
Implementation	• Efforts of decision makers to use science in policy and planning • Use of science in policy processes and policy documents • Use of climate science in land use change decisions zoning, development, and urbanization • Change in impacts of disasters as a result of climate science utilization in land use decisions

(Author, 2018)

Table 3.1 shows a measurement of transmission, understanding, and implementation of climate science. Measurement concepts for each step are based on the three approaches presented in Figure 3.1 and the context of climate change adaptation in Vietnam. Transmission is measured through migration of climate science from scientists' arena to decision makers' and planners' domain. That includes formal and informal communications, proactive dissemination of reports and data by scientists, acquiring data and reports by decision makers based on needs, and discussion of conditions of interactions. The second step is understanding, which is measured based on reference of climate science by decision makers, change in worldviews of decision makers, awareness of climate science such as sea level rise scenarios, understanding of potential impacts, and explanation of risk and vulnerabilities. The final step of climate science utilization is implementation, which consists of efforts of decision makers to use science in policy. It includes its use in plan documents and land use decisions such as change in building codes, zoning ordinances, development patterns, and overall design of cities based on risks and vulnerabilities identified by climate science. All the steps of climate science utilization are part of the mainstreaming process of climate change in planning and decision making.

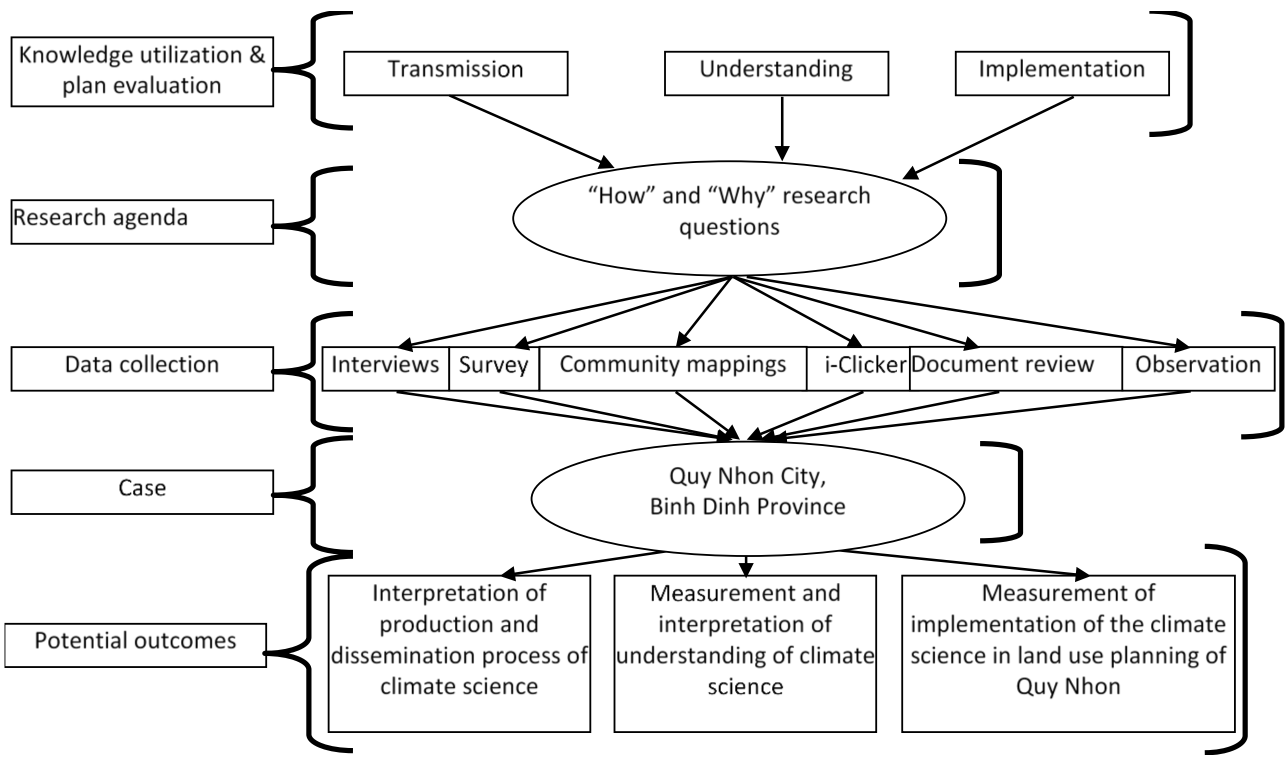
The complexity of praxis among climate change adaptation, urban planning, and land governance leads to changes in measurements of knowledge dissemination, understanding, and implementation. Measurement concepts used by previous research in the fields of public health, public administration, and knowledge management may not be sufficient and appropriate in Vietnam to measure utilization of climate science in land use planning. Some context-specific measures are presented in Table 3.1 above.

3.3. Research Design

This research uses mixed design (Creswell, 2010) in a case study (an intensive study where the purpose is to shed light on a larger number of cases that is, a population) (Gerring, 2004, 2006). This dissertation is focused on transmission, understanding, and implementation of climate science in land use planning of Quy Nhon City of Vietnam. It explains causal mechanisms of climate science utilization such as perceptions, institutions, and priorities of different planning actors of Vietnam. It follows an exploratory case study (Streb, 2010). The primary aim is an exploration of unknown phenomenon to make it apparent (Streb, 2010). The exploratory case study is especially relevant in Vietnam where researcher faces limitation in terms of data access due to a restrictive research environment (Streb, 2010).

The Vietnamese context and nature of the topic needs a case study approach, which in this dissertation is Quy Nhon City of Vietnam. Master plans and their implementations are assessed using the framework of climate science utilization, which is a new area of research in developing countries. The major research question focuses on how utilization of climate science informs land use planning to adapt with potential impacts. If the research questions are "how"-focused and the research topic is about a current phenomenon rather than on information gleaned from historical records, the case study method is more relevant than others (Yin, 2013). Overall research design and flow are presented in Figure 3.3.

Figure 3.2: Research Flow and Design



(Author, 2018)

The mixed method used in this dissertation combines positivistic elements of quantitative research with specific elements of qualitative methods (Kitchenham, 2010). It is a type of research in which researchers combines elements of qualitative and quantitative approaches (e.g., use of qualitative and quantitative viewpoints, data collections, analyses, and inference techniques) for broad purposes of breadth and depth of understanding and corroboration (Creswell, 2010; Johnson, Onwuegbuzie, & Turner, 2007). Creswell (2010) elaborates that it involves connection, integration or linking of qualitative and quantitative strands of data in a research project. As Creswell (2010, 2007) mentioned, researchers can mix qualitative and quantitative approaches throughout the study: posing research questions, administering data collection, and drawing interpretations.

Although knowledge utilization is an established field in other disciplines (e.g. sociology, anthropology, public health, medical practices, education, and natural resource management), it is young in urban planning. Climate science utilization is a newer field in the domain of knowledge utilization. The works of Rydin (2007), Friedman (1987), Booher and Innes (2010) are focused on the use of knowledge in planning. Details of their contribution are discussed in Chapter 2. But there is limited empirical research on the role of climate science in specific planning domains (e.g. land use planning, environmental planning, transportation planning, or others) to adapt and mitigate with impacts.

The mixed method allows researchers to integrate multiple research approaches to draw results on the utilization of climate science in land use planning. In this research, the mixed method is used in data collection, analysis, and interpretation. The data collection was completed through four attempts, and the first effort was done in 2012. There was a workshop organized by the University of Hawai‘i at Manoa and Hanoi Architecture University with funding from the Ford Foundation. The workshop was organized in Da Nang City. Participants were from government offices of coastal cities and provinces in Central Vietnam. During group exercises, participants mentioned flooding and typhoons as major disasters in Central Vietnam. This workshop allowed the author to form a scope of this research. Meeting with some experts from Quy Nhon City allowed understanding of vulnerability of Quy Nhon to different coastal disasters that are exacerbated by climate change impacts.

The second visit to Vietnam was from August to December of 2014. The trip aimed to administer surveys and interviews, which were conducted among government officials at national, provincial, and city levels. A total 359 household surveys were conducted in Nhon Phu

(*Khu Vucs* (KVs) 3 and 8) and Nhon Binh (KVs 3 and 5) wards of Quy Nhon City. *Khu Vucs* are hamlets in a city in Vietnam which also represents lowest administrative unit. GIS data were gathered from governmental and non-governmental organizations. From January to December 2015, data and interview transcripts were analyzed, which provided some understanding of the utilization of climate science in land use practices of Quy Nhon City. But evaluation of utilization could not be achieved with available data.

The third trip to Quy Nhon City was from December 2015 to January 2016 to organize community meetings and conduct more interviews with different government offices in the city. The two villages of Nhon Binh Ward (KVs 8 and 9) and one village of Nhon Phu Ward (KV 6) were included during this visit to organize community meetings and interviews. Household survey contents of previous visits were converted into an i-Clicker exercise in community meetings. Two community meetings were organized. The i-Clicker has been used to collect community opinion in the past on land management issues (Kim, Burnett, & Ghimire, 2015, 2017). Besides that, community mapping exercises were conducted to understand land use change and flooding issues in villages and wards. When interview transcripts and the community meeting data were analyzed, it became clear that research required the policy documents, including master plans for Quy Nhon City, to analyze utilization of climate science in land use planning.

The fourth visit was organized in July 2016 in order to collect documents on land use planning in Quy Nhon. A windshield tour was conducted in Nhon Phu and Nhon Binh wards to observe land use changes in the area. Construction of Highway 19 that connects Nhon Hoi Industrial Zone and Highway 1A has impacted land use in Nhon Binh Ward of Quy Nhon City. Some local residents were consulted informally about their opinion on flood and new development in the area, and extensive field notes were prepared. Master plans of 2015 and 2004 were collected during the visit. Data collected during four fieldworks are used to answer questions raised in this research.

Mixing two types of data (qualitative and quantitative) can occur in different steps of research execution. It can be at the data collection, interpretation, analysis or in all three steps (Creswell, 2009). In this research, data was collected concurrently because of limitation to access population for survey and interview. Similarly, both interventionalist and non-interventionalist designs (Biesta, 2010) were followed. Interventionalist approaches are those in which rthe esearcher uses certain types of interventions such as experiment, survey, interview, etc. in data collection, whereas non-interventionalists approach is the opposite of that. The interventionalist approach in research was done through surveys and interviews, whereas non-interventionalist approaches were informal conversation with villagers or random city residents about flood problems, the environment, land use change, and government interventions on flood mitigation. It also included observation of development projects and coastlines during visits.

3.4. Justification of Mixed Approach

The hitherto unexplored topic and context of research administration required a mixed approach for this research. Multiple research methods were used to collect and analyze data to understand climate science utilization in plans and implementation. Research administration was controlled and guided in Vietnam. Data collection methods were modified multiple times to match permissions given by national and local governments. As a result, the research required the use of multiple methods to achieve its goals.

Quy Nhon City is in Binh Dinh Province of South Central Vietnam. A research plan had to be proposed to sponsor organizations in Hanoi and in the Binh Dinh. Initially, the research was designed as a sequential mixed method (Creswell, 2009) in which quantitative aspects (surveys and statistical analysis) of research guided the qualitative parts (interview and coding). The method had to be modified because of unexpected situations during fieldwork. It was changed to a concurrent triangulation method (Creswell, 2009) during data collection. The researcher collected both qualitative and quantitative data concurrently and compared two datasets to determine whether there was convergence, differences, or some combination of both (Creswell, 2009).

During fieldwork in 2014, two logistic findings surfaced. First is a unique centralized climate science production process in Vietnam and second is logistics to administer surveys and interviews among government decision makers in Quy Nhon City.

The climate science production process is led by the Ministry of Natural Resources and Environment (MONRE). Although there are some provincial institutions working on climate science, models produced in Ha Noi or Ho Chi Minh City are conducted under the auspices of the authorities. Even though there is a requirement for climate science production at provincial level, the job is done by consultants in Hanoi or Ho Chi Minh City.

Regarding administration of surveys and interviews among selected offices in city and province, the local sponsor mentioned that surveying government officials and planners was not feasible because offices were scattered throughout the province, and all of them were not involved with climate change related projects and programs. As a result, the sponsor selected organizations that were working on climate change in the city and province. Interviews with those organizations were recommended. A similar situation occurred when selecting wards for household surveys.

A combination of concurrent and sequential mixed methods (Creswell, 2009) was used in data collection. Concurrent triangulation strategy (Creswell, 2009) was used in data analysis. Household survey data was used to triangulate the findings of interviews.

Table 3.2: Mixed Research Methods

Research components	Data collection	Data analysis
A household survey in Nhon Binh and Nhon Phu Wards	√	X
Interview with provincial organizations	√	O
Community meetings (mapping and i-Clicker exercises)	O	X
Document reviews and content analysis	√	√
Non-participant observations	√	X

√ = Concurrent method, O = Sequential method, X = Concurrent triangulation strategy

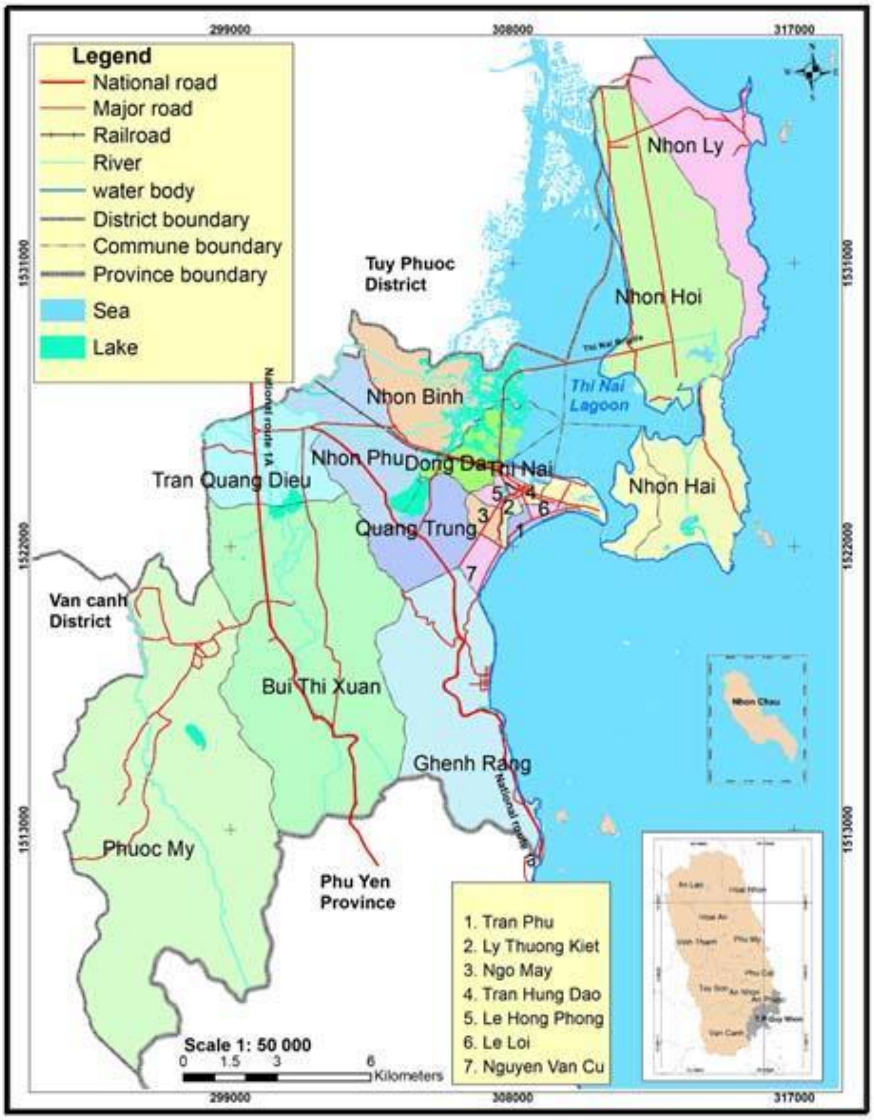
(After Creswell, 2009)

Table 3.2 presents combination of mix approaches in the research. Household surveys, interviews, and observation were conducted concurrently in the first phase of fieldwork. The local sponsor helped to administer the survey and interviews in a 3 months period of the first visit in 2014 (August to December; they had to be administered concurrently). In the second phase, the interviews, community meetings, and observations were conducted in concurrent fashion for the same reason. But analysis of interview transcripts, household survey data, and observation was done with different methods than the first phase. Survey and community meeting data were used to triangulate results from the interviews. Non-participant observation was also used to triangulate claims of government officials in the city and province.

3.5. Study Area: Quy Nhon City

The study was conducted in Quy Nhon City of Central Vietnam. The largest city of Binh Dinh Province and its provincial capital, Quy Nhon City is located on the coast with myriad economic opportunities. The city has an area of 285.53 square kilometers in total, and a population of over 283,000 people (Challenge to Change et al., 2009; Chi et al., 2015; Quy Nhon Sub-office of Statistics, 2013). There are 16 wards (urban administrative body) with 258,010 people and 5 communes (rural administrative body) with 25,430 people. It also has high development potentiality because of its connection with the Central Highlands of the country.

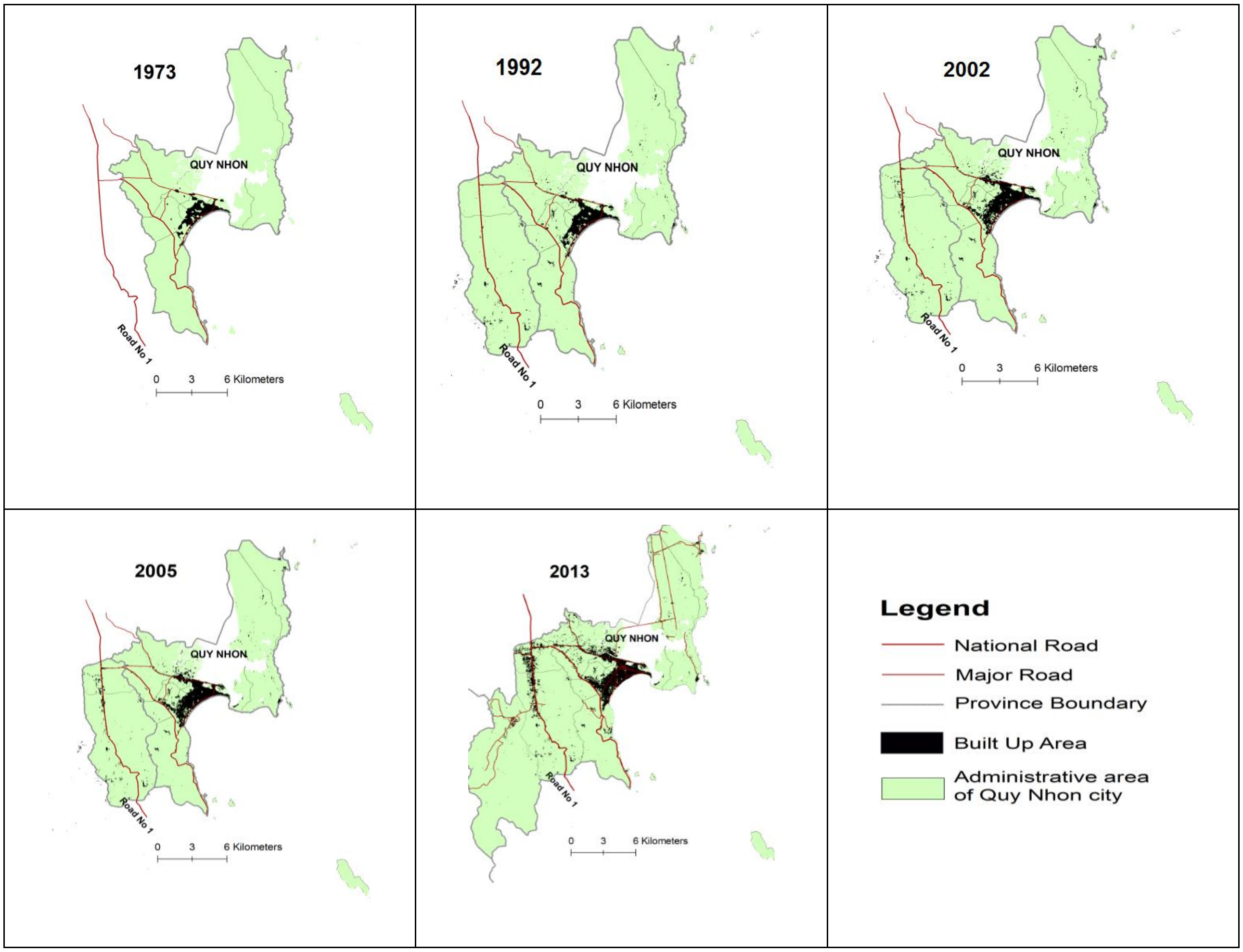
Figure 3.3: Administrative Map of Quy Nhon City



(Ghimire et al., 2018)

The town of Quy Nhon was established in 1898 as a small trading hub. The remarkable development after Doi Moi in 1986 can be described in terms of population growth, administrative changes, and spatial expansion. There were eight wards and six communes with 160,000 inhabitants in the city in 1986. In 1998, several city wards were divided, and Nhon Binh and Nhon Phu communes became city wards. In 2006, the city's administrative boundaries expanded by incorporating the Phuoc My Commune. Figure 3.4 presents the current administrative boundaries of the Quy Nhon City and figure 3.5 shows the city expansion over time (Chi et al. 2017).

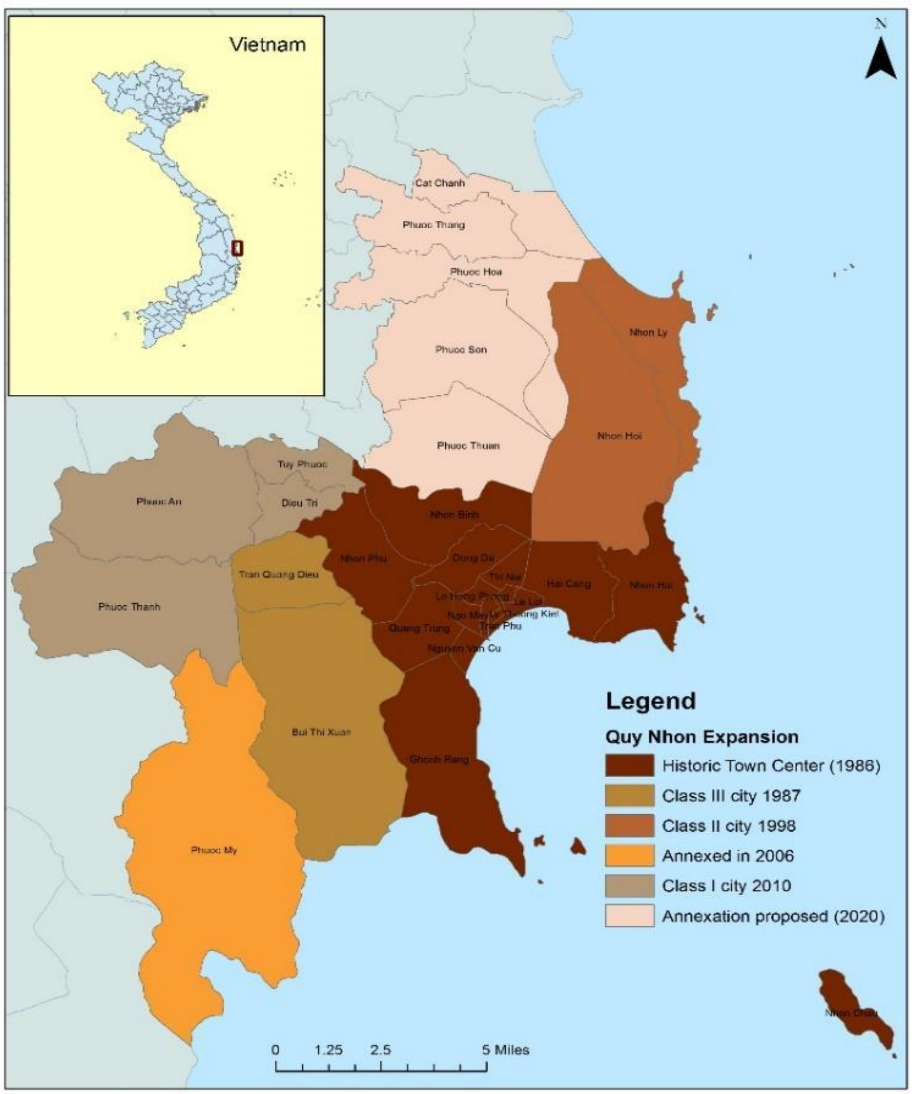
Figure 3.4: Expansion of Administrative and Built-up Areas in Quy Nhon City



(Chi et al., 2015)

Quy Nhon is an appropriate case to assess climate science utilization in land use planning for three reasons: the coastal location of the city; rapid urbanization and industrialization in coastal and delta areas, and greater attention from national, provincial and international organizations on climate change impacts in the city. It faces sea level rise, saltwater intrusion, coastal erosion, flooding, sand drifting, etc. (Dinh et al., 2010). Despite disaster challenges, the city is an economic hub for provincial and national governments. It is continuously growing in geography, population, and economy. Boundaries of the city have changed, incorporating surrounding rural wards to expand its geographic area. The city is under the Binh Dinh provincial administrative jurisdiction. Administratively, the city is divided into 21 wards. Its boundaries have expanded 5 times since 1986, incorporating surrounding communes (Figure 3.6). Many wards are still rural. With population growth and expansion of area, it has been upgraded from a Category III to Category I city by the national government. Categories of cities are created based on the demography, area, and economic importance of a city. The major economic engine of the city is the trade services, which occupy more than 45 percent of the economic stake.

Figure 3.5: Quy Nhon City Expansion



(DiGregorio, 2015; Dinh et al., 2010; Tuan, My, Anh, & Toan, 2014)

The city has been prioritized as an industrial hub for crude oil refinery. The national government has designated the Nhon Hoi Ward as industrial zone for this purpose (this designation is widely discussed in Quy Nhon Master Plan 2015). There are long-term investments in the city, including construction of Highway 19, tourism services along the beachfronts, residential colonies, educational institutions, and sanitation projects. With establishment of the oil refinery, it is expected to add 60 thousand workers in the city (Binh Dinh Department of Construction, 2015). In order to make the city more resilient towards impacts of climate change, it was selected as a member city of the Asian Cities Climate Change Resilience Network (ACCCRN) Initiative. It is expected to evolve as an example of system-wide urban resilience towards climate change impacts and weather-related disasters. The ACCCRN Project was implemented 2008 to 2014. There are some tangible impacts on institutions and policy changes in the city and Binh Dinh Province as it adapts to climate change impacts.

The final reason for selection of the Quy Nhon as the case study for this dissertation is a long-term relationship with the city; the relationship of study advisors and the principal investigator was built over the course of years. It is very important in case study research to build relationships with key personnel before administering the study. Leveraging the relationship during data collection helped to get the trust of provincial government offices to acquire sponsorship and gain permission to administer interviews and surveys.

3.6. Research Questions and Propositions

Research questions are designed around three broad frameworks of knowledge utilization and plan evaluation. The major theme is the utilization of climate science in land use plans and decisions in order to better adapt to impacts. Utilization is assessed using the framework presented at the beginning of this chapter. Research questions are inspired by gaps in the literature presented in Chapter 2 (Literature Review). Every research question does not have a proposition because some of them require description and explanation of phenomena rather than data analysis and explanation of causal relationships among variables of climate science utilization and land use planning.

The overall objective of this research is to explore how scientific knowledge of climate change informs land use planning to design and implement adaptation measures dealing with impacts of climate change in Quy Nhon City of Vietnam. It is narrowed to three researchable questions: the dissemination process, levels of understanding, and practices of implementation of climate science in land use planning. As mentioned in a previous section of the chapter, dissemination is based on the accessibility of the city government of Quy Nhon to climate science. Understanding is the level of knowledge among decision makers and planners concerning climate change and its impact. Implementation is the use of scientific knowledge of climate change into plans, policies, and decisions to inform land use practices on adaptation.

- **How is the climate science produced, disseminated, and utilized in Vietnam?**

This question operationalizes production and dissemination of climate science in Vietnam. The scientific data production process and dissemination mechanisms have a crucial role in determining utilization of science in plans, policies, and decision-making. The question is further broken down into three specific questions.

  - How is scientific knowledge of climate change produced in Vietnam?

Proposition 1.1: Scientists work together to produce scientific knowledge of climate change.

Proposition 1.2: There is a collaboration between scientific organizations in climate science production.

Proposition 1.3: Interaction between scientists and policymakers takes place during climate science production.

  - What are the mechanisms of transferring climate science from national research organizations to cities in Vietnam?

Proposition 1.4: There are institutional mechanisms to disseminate climate science from national research organizations to provinces and cities in Vietnam.

  - What are sources of climate knowledge among planners and decision makers of the Quy Nhon City?

Proposition 1.5: Local planners and decision makers receive scientific information about climate change from the national government through organizational channels.

- **How does the governance of urbanization and land management influence the utilization of climate science in land use planning?**

This question focuses on nexus between existing institutional set-ups in land management and urbanization and climate science utilization. Institutions, governance, and the decision-making process have strong roles in utilization of climate science, and this will be assessed and explained in the contexts of Vietnam and, more specifically, Quy Nhon City. This question is narrowed down into following sub-questions.

  - What are the legal, administrative and institutional setups of land management and urbanization in Vietnam?
  - How do current practices of land management and urbanization influence the utilization of climate science in land use planning in the Quy Nhon City?
  - To what extent does scientific knowledge of climate change inform decision making on land use?

Proposition 2.1: Local land use decisions are informed by climate science.

- How is scientific knowledge of climate change used in Master Plans of Quy Nhon City?

Proposition 2.2: The utilization of climate science is same between Master Plan 2004 and Master Plan 2015.

- **What are the challenges and opportunities of climate science utilization in the land use planning in the context of Vietnam?**

This question explores current conditions and challenges of utilization of climate science in Vietnam. Land use planning in Quy Nhon City offers a unique perspective on the trend of knowledge utilization in planning and decision making. Institutions, priorities, and actors involved in land use planning in Vietnam are different than those in many other developing countries. This question unfolds characteristics of land use, governance, and urban planning in Vietnam and poses utilization of climate science in this context.

  - What are constraints of using scientific knowledge of climate change in land use planning?

Proposition 3.1: There are not any challenges of using scientific knowledge of climate change in land use planning in the Quy Nhon City.

- What are the unique characteristics of climate science utilization in Quy Nhon City that help to contextualize knowledge utilization approaches for developing countries?

Proposition 3.2: The utilization of climate science in land use planning in Quy Nhon City follows the steps prescribed by existing knowledge utilization frameworks.

Analytical responses to research questions and associated propositions are found in Chapters 4 to 7 of this dissertation. A summary of responses to each proposition is presented in Chapter 8.

3.7. Data Sources

Five data sources were used in this research: interviews, household surveys, community meetings, document review, and non-participant observation. Archival research was started in 2013 after selection of Quy Nhon City as a case study for this research. Interviews, surveys, and community meetings were administered in three fieldwork iterations in 2014, 2015, and 2016. Interviews were conducted in Ha Noi, Ho Chi Minh City, and Quy Nhon City over 4 months period in 2014 and a 2 months period in 2015 and 2016. Household surveys were administered over a 4 month period in 2014. Community meetings were organized over a 2 month period in 2015-2016. The proposed method for this research was a sequential mixed method (Creswell, 2009). As it is discussed in the previous subsection, there was a necessary change to a sequential and concurrent triangulation approaches (Creswell, 2009) due to logistic problems during field research. In that proposed method, a survey was designed for planners and decision-makers at provincial levels to understand how they received and utilized climate science in land use planning. Claims made by decision-makers and planners were intended to be validated among households in two wards of the city through a household survey. In-depth interviews with climate scientists intended to focus on how they interacted with decision makers and planners in the course of producing and delivering climate science.

Logistically, it was not possible to administer a survey among government offices in Quy Nhon City. Data collection instruments have to be changed from survey to interview for government offices at provincial and city levels. The number of interviews was also reduced. The provincial sponsor stated that some government offices on the interview list did not have any experience of working on climate change. Interviewing or surveying such offices would not have been useful, and ultimately, 19 offices in Quy Nhon City were interviewed during the first phase of data collection. The household survey size was also adjusted.

Research on land use and management systems is challenging in Vietnam because the complexity and sensitivity of issues related to land management are high (details are discussed in Chapter 4). Barriers range from lack of reliable data to reluctance of key informants to discuss politically sensitive issues and unlawful practices (Labbé & Musil, 2013). Nevertheless, a smaller number of key informants can be helpful to understand gravity of the problem. Similarly, using "off-the-record" interviews with key actors can help to understand issues that cannot be understood through official sources (Labbé & Musil, 2013). Information from multiple sectors was collected during field work for this research.

3.7.1. Interviews

In all, 48 interviews were conducted among climate scientists, government workers, professionals, mass organizations, and non-government organizations in Quy Nhon City, Ha Noi, and Ho Chi Minh City. Interview questions were related to climate knowledge, relevance of knowledge in decision making, relationship with climate scientists and policymakers, and different adaptation measures. 30 interviews were conducted at provincial and city levels, and 18 interviews were conducted at the national level. The majority of interviewees at provincial and city levels were government offices, and the reason for focusing on provincial offices is that Quy Nhon City was still under political and administrative jurisdiction of Binh Dinh Province.

Table 3.3: Representation in Interviews

Interviewees	Provincial level	National level
Climate scientists	1	7
Professionals and consultants	0	6
Government decision makers	23	2
Mass organizations	4	1
Project leaders, donors, and non-government organizations	2	2
Total	30	18

(Author, 2018)

In order to get interviewees prepared for interview, consent forms and interview questions were sent one week in advance in collaboration with the local sponsor, who selected government offices based on the nature of research and functions of offices. In the first phase of fieldwork, 18 interviews were conducted in Ha Noi and Ho Chi Minh City. In Quy Nhon City, a total of 16 interviews and 359 household survey were conducted. The second phase of fieldwork was organized from December 2015 to January 2016. 14 interviews and 3 community meetings were organized during this visit. Based on a snowballing of references of interviewees from first fieldwork and preliminary analysis of interviews, more organizations were identified and interviews were administered in December 2015 and January 2016.

Semi-structured interviews were used to assess utilization of ecosystem-based knowledge in land use planning in Hawaiʻi, Vancouver, and Belize in previous research (McKenzie et al., 2014). Surveys with broader stakeholders was also used to triangulate results from interviews (McKenzie et al., 2014). Household surveys in two wards of the city were used to triangulate interview findings and content analysis of master plans of Quy Nhon City.

Each interview was conducted in a formal setting. Interviews were conducted among climate scientists and policymakers at the national level at the beginning (Ha Noi and Ho Chi Minh City). This provided an overview of climate science production in Vietnam. It also enhanced understanding of institutions on interaction between climate scientists and policy makers. Interviews at the national level were organized with help of national sponsors in Ha Noi. The snowball approach, a process to identify cases in a social network where the respondents may not know each other but they are connected through direct and indirect networks (Neuman, 2004), was followed to identify policymakers and scientists. While conducting interviews at the national level, field visits to Quy Nhon City were arranged in coordination with local sponsors.

Three types of government and semi-government organizations were chosen for interview in the city: government agencies, mass organizations, and scientific agencies. The first category included political leaders in wards, city, and province who were involved in city planning of Quy Nhon. The second category was of mass organizations with networks from national to local levels. The third category included scientific organizations (who were contacted in coordination with national and local sponsors of the research) related to climate change and weather forecast in the city. Sponsors played a strong role in the selection of agencies for interviews. They also reviewed interview questions beforehand and required detailed operation plans of the research. An hourly plan was submitted to a designated officer of the local sponsoring agency (Please see in Appendices 7 and 8). Interviews with provincial offices were conducted in Vietnamese. There was instantaneous translation, allowing the researcher to understand responses and reframe some questions accordingly. Each interview lasted from 1.5 to 2 hours.

Three sets of questions were asked during the interviews, and questions changed slightly, based on the function of an agency. At the national level, questions were focused on interaction between climate science producers (IMHEN) and policymakers. At municipal and provincial levels, interview questions were related to sources of climate science, trust in climate change scenarios, implementation of climate scenarios, challenges of climate science use, and adaptation measures.

Table 3.4: Interview Questions

Steps of climate science utilization	Interview questions
Transmission	- How did you know about climate change and associated impacts in the city/province? - Have you participated in climate change related workshops, training, and conferences? If 'Yes' could you describe the content of these events? - During your work, if you need the information or data of climate change scenarios, sea level rise, temperature change, rainfall change, vulnerability about roads, people in the area, who do you contact? Do you contact climate experts to acquire this information? - When you contact specialists for climate data or scenarios, how do you ask other organization/climate experts? - How does scientific information on climate change come to your office?
Understanding	- Could you describe climate change impacts in Binh Dinh/Quy Nhon City? - Why is climate change important for your office? - Have you read the climate change scenarios report for Vietnam? - To what extent does your office identify vulnerable areas, populations, and infrastructures to climate change impacts?
Implementation	- How do you and your office deal with flooding, typhoon, drought problems in Quy Nhon and Binh Dinh? - What are challenges of using climate change-related information in projects and activities of this office? - Are there projects related to climate change in your office? - Does your office work with IMHEN, DARD, MONRE, DONRE or any other climate change-related organization? What kind of collaboration does your office have? - How has your organization participated in the preparation of a climate action plan of Binh Dinh and Quy Nhon?

	- How is your office contributing to implement recommendations related to climate change in the climate action plan? - Does your organization make decisions and guidelines to address climate change in projects and programs? What are they? - What are the challenges you face when working on issues of climate change? - What are your recommendation to better address the challenges of climate change? - What data and information about climate change do you need to address in your organizational plans, policies, and projects?

(Author, 2018)

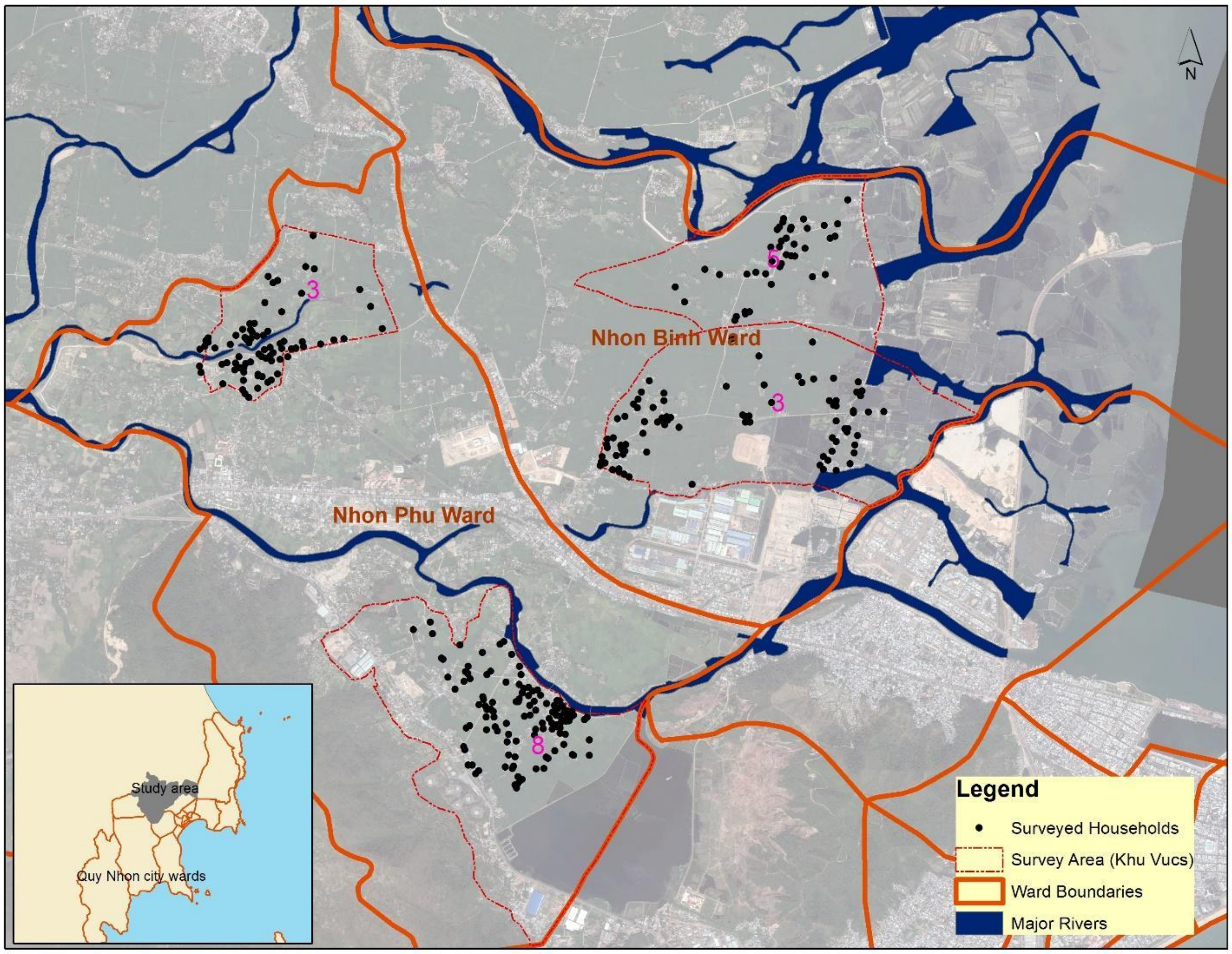
There was a slight difference in questions asked to climate scientists. These included questions related to scientific modeling, involvement in climate research organizations, and interaction between climate scientists and decision makers on institutional and personal levels. For mass organizations such as the Women's Union, Youth Union, Farmers Union, and Vietnam Red Cross, differences in interview questions were based on sources of scientific knowledge and its use in their networks.

3.7.2. Household Surveys

Household surveys were conducted in two wards of Quy Nhon City in October 2014. Hamlets (*Khu Vucs - KV* in Vietnamese) were selected in coordination with local sponsors. From Nhon Binh Ward, KV 3 and 5 were selected, and from Nhon Phu Ward, KV 3 and 8 were selected. These two wards were most impacted by severe flooding of 2009 and 2014 (DiGregorio & Van, 2012). Conducting a household survey in these wards could provide a picture of changes in disaster pattern. Because of the higher occupancy of farmers and fishermen in the selected KVs, these two wards were targeted for different projects related to climate change adaptation, including shelter construction, improvement of early warning systems, and evacuation plans.

The objective of conducting the survey was to understand impacts of climate science utilization on land use planning in practice. It was assumed that government offices in interview would claim the best use of climate science in the decision making. The survey was expected to help the researcher understand how land use changes in these two wards were impacting flood patterns among residents. A map of the survey area is shown in Figure 3.7.

Figure 3.6: Household Survey Locations



(Author, 2018)

The survey had four sections with 61 questions. Sections on physical changes and awareness of climate change were designed to gather data on the impact of land use changes on flooding. The survey was translated into Vietnamese (Both versions are available in Appendices 1 and 2), and it was administered using 6 trained surveyors. Households were selected using simple random sampling method (Neuman, 2004). One condition for respondent selection was age. Since the survey covered the experience of flood and land use changes over 20 years, the cut-off age for respondents was 45 years and older. Surveyors fluent in English and Vietnamese were hired and trained in collaboration with the local sponsor. Before the survey, a pilot test was conducted in the Nhon Binh Ward office among 10 residents. Some wording was adjusted to improve the clarity of questions after the pilot test. During survey administration, informal interaction was conducted with villagers to better understand their perception of new development in wards (details of those observation and anecdotal evidence are discussed in subsequent sub-section of the chapter).

Table 3.5: Household Survey Design

Wards	Area (Khu Vucs)	Total Households (Census 2009)	Surveyed Households
Nhon Binh	KV 3	528	84
	KV 5	265	40
Nhon Phu	KV 3	591	93
	KV 8	934	142
Total		2,318	359

(Author, 2018)

3.7.3. Community Meeting

During the 2009 and 2013 flooding, Nhon Binh and Nhon Phu wards were heavily impacted. 41 communes of Binh Dinh Province and all 10 districts of the city were flooded in November 2013 (The United Nations Vietnam, 2013). Nhon Phu and Nhon Binh were inundated heavily because they are lowest delta areas of the city. Community meetings were organized during first and second weeks of January 2016 that covered three KVs of these wards. Group meetings or focus group discussion were established approach of data gathering. They were group interviews on fairly defined topics with two or more participants a trained facilitator (Bryman, 2004). Descriptive analysis of household survey data was the basis of community meetings. The meeting agenda were focused on physical changes in KVs, awareness of climate change impacts, changes in flooding over time, and flood/typhoon preparedness and mitigation practices. Facilitators were trained on facilitation, meeting agendas, and group exercises. KV leaders were informed a week in advance about the meetings through a formal letter from the local sponsor. Meeting venues were selected by the KV leaders. In case of KV 8 and 9 of Nhon Binh Ward, KV leaders from both KVs coordinated venue and invitations.

Three meetings were organized with the same approach and agenda. Meeting handouts and presentation materials were translated into Vietnamese, and meetings were run in Vietnamese. Each meeting was divided into four parts. After introduction and opening, a mapping exercise was conducted. Participants were divided into 2-3 groups, and each group was facilitated by a trained facilitator. Large KV maps along with different color markers were provided to each group. The facilitator provided an overview of the map by pointing out major landmarks in KV so that participants could become familiar with the map. Participatory mapping exercise, a map-making process that attempts to show association between land and local communities using simple and comprehensible language of cartography (Corbett, 2009), was a strong data collection tool. Participants were asked to draw physical changes in KV and the ward over the last 10-15 years. Drawing included new buildings, road networks, industrial sites, irrigation ditches and dikes, and power lines. Following the mapping exercise, each group was asked to provide an overview of its results. The second exercise was an opinion poll using i-Clicker, which was used to collect community opinion on the previous research (Kim, Burnett, & Ghimire, 2015, 2017). 24 questions on climate change impacts, early warning systems, household responses to typhoons and flooding, and new developments and changes in flooding were asked. The overview of the i-Clicker polling system was provided at the beginning of the exercise, with some demonstration questions to acquaint participants acquainted the system.

3.7.4. Informal Interactions and Observations

Non-participant observation was done throughout the duration of the fieldwork in all of its phases as a means for data collection and recording methods in qualitative research. The major advantage of this technique is its directness. It can complement other data gathering techniques, such as interviews and questionnaires (Robson, 2002). Views, opinions, and feelings of people were not asked in observation; rather, observation was focused on non-linguistic aspects (Robson, 2002).

Field notes are the researcher's written documentation of participant observation, and the subjective interpretation of the phenomenon the researcher encounters during field work (Saldaña, 2015). It offers advantages in verifying and confirming information collected through other sources such as surveys, interviews and focus group discussion. Non-participant observation supplemented other methods of data collection in this research. During fieldwork in 2014, the local villagers around large construction projects were informally consulted. Villagers were telling stories about how flooding got worse over time in the area. The interpreter and researcher talked to people regarding their experience on changes in KVs. While having conversations with them, the researcher took notes and took pictures of the area to supplement and verify information and data provided during surveys and interviews. For example, a farmer who was living behind a newly constructed university structure told the researcher that the building was elevated and built on a floodway which guided flood water in different directions. The result was flooding to his home and surrounding areas.

Informal talks with local key informants were held to help the researcher understand issues related to contention over urbanization and land management. Infrastructure expansion has been a major concern for people living in the hinterlands of the city. Local political and government leaders were working as mediators to defuse tensions between government/private investors and local communities. A large number of complaints were filed in local court, but government workers and political leaders took these complaints as an "unreasonable bargain" to government. This information was collected through anecdotal conversations with locals in coffee shops, over lunch, or in some cases, motorcycle rides around the city. The drivers of the motorcycles were a student and a retired government worker who pointed fingers to both sides of the road while explaining the proposed development and plans.

3.7.5. Document Review

Three types of documents were collected during this research: local land use plans (master plans), legal and procedural documents issued by national and provincial governments, and reports published by projects on climate change in Binh Dinh Province and Quy Nhon City. Legal documents were related to climate change adaptation and land use planning.

In collaboration with the local sponsor, two master plans of Quy Nhon City were acquired from the provincial Department of Construction (DOC). They are Master Plan 2004 and Master Plan 2015. Master Plan 2004 is an update of Master Plan 1998, and Master Plan 2015 is an update of Master Plan 2004. Both master plans were translated to English. Content analysis was done using NVivo (a qualitative analysis software).

There are laws, decrees, and circulars on climate change, urban planning, socioeconomic development, and land management as well as different types of legislative provisions issued by different levels of governments in Vietnam. They are issued by the prime minister, ministries, and departments. They were collected from public sources during this research. The majority of them are available in English. Documents in Vietnamese were translated into English before review. Vietnamese construction standards were reviewed to assess whether there are provisions for adapting to climate change impacts.

Reports on climate change scenarios for Vietnam were collected and reviewed. Climate change impact assessments for Vietnam and Quy Nhon City were also reviewed, including climate change scenario reports published by Institute of Meteorology, Hydrology and Environment (IMHEN) in 2008 and 2016. Numerous publications by Institute for Social and Environmental Transitions (ISET), ACCCRN, and Binh Dinh Climate Change Coordination Office (CCCO) were also collected to assess institutional impacts on climate change adaptation and awareness building in the city.

3.8. Data Analysis and Interpretation

3.8.1. Assessment of the Climate Science Utilization

Assessment of climate science utilization is conducted using Table 3.1 measurement criteria. Each step of utilization is further divided into themes and constructs, which are guided by the conceptual framework presented above.

Table 3.6: Measurement of Climate Science Utilization in Quy Nhon Land Use Planning

Steps of climate science utilization	Utilization themes	Measurement constructs	Measurement levels
Transmission/ dissemination	Production	Collaboration among national scientists, decision makers, and international scientific communities of climate change.	Weak /Fair /Strong
	Communication	Sharing of climate change scenarios, communication of climate science through media, sharing of climate science through circulars and guidelines, circulating climate science through boundary works	Weak /Fair /Strong
	Acquisition	Diversity of sources of climate science among decision-makers and planners, mediums of achieving scientific information on climate change	Weak /Fair /Strong
Understanding	Awareness / cognition	Awareness of climate change, discussion of current and future impacts, and change in worldviews	Weak /Fair /Strong
	Assessments	Awareness of risks and vulnerabilities associated with climate change, citing and referencing climate science, evaluation of climate change scenarios	Weak /Fair /Strong
	Complexities	Identifying cross-cutting nature of climate change, recognizing share of climate change on worsening of existing disasters, identifying nexus between climate change and other anthropogenic environmental changes	Weak /Fair /Strong

Implementation	Legislative changes	Changes in laws, rules, codes, and zoning ordinance to address challenges posed by climate change	Weak /Fair /Strong
	Capacity building	Enhancement of early warning, community preparedness guides, change in community awareness.	Weak /Fair /Strong
	Planning process	Changes in planning processes of city, participation of multiple stakeholders in land use planning, reduction of flood impacts over time, enforcement of climate change adaptation measures in land use plans and decisions	Weak /Fair /Strong

(Author, 2018)

Measurement constructs for each theme are focused on utilization of climate science in land use planning. Besides themes in the dissemination step, others juxtapose with the awareness, assessment, and action framework of plan evaluation (Baynham & Stevens, 2014; Ghimire et al., 2018; Luers & Moser, 2006; Moser & Luers, 2008; Tang et al., 2009; UKCIP, 2003). New measurement concepts related to planning in the context of Quy Nhon were added. That included understanding of the cross-cutting nature of climate change, the planning process of land use plans, and legislative changes related to land use planning.

Measurement for each construct was rated weak, fair, or strong based on the Likert scale (developed in 1932 to understand how much people like or dislike, agree or disagree, or believe in true or false) (Allen & Seaman, 2007). It has been widely used to measure attitudes of people such as opinion, mental disposition, and preferences (Göb, McCollin, & Ramalhoto, 2007). This research relied heavily on qualitative data from interviews, document analysis, and observation. It should be noted that quantitative representation of data was not the intention. As a result, each construct of measurement of climate science utilization was done using weak, fair, and strong levels of certainty. If there were none or few examples in favor of measurement constructs, it was considered weak. If there were more than 3 examples with specific focus on the measurement of construct, it was considered fair. If there were more than 5 examples and specific cases on the measurement of construct, it was considered strong.

3.8.2. Transcription of the Interviews

Interviews were transcribed into text format. Each interview was saved as a separate file after transcription. Confusing sentences spoken by translator during interviews were corrected with help of the translator after each interview. Furthermore, interview transcripts were sent to the translator for further corrections. Another round of proofreading was conducted on transcripts before they were analyzed using NVivo 11.0. (NVivo is a computer software to analyze qualitative data) (Welsh, 2002). Such software-based analysis helps researchers to conduct a multilevel qualitative analysis so that underlying theories and relationships in data can emerge (Leech & Onwuegbuzie, 2011).

3.8.3. Coding

Coding was done for content analysis (Bryman, 2004) of master plans and interview transcripts. For document review, codes were directly geared for analysis of transmission, understanding, and implementation of climate science utilization. Three levels of coding (initial, pattern, and theme) were conducted for interview transcripts (Saldaña, 2015).

Initial coding (Saldaña, 2015) was executed on all contents of transcripts using NVivo. It generated more than 100 codes on different topics, such as administrative duties, climate change impacts, disaster governance, financing climate change, adaptation challenges, climate change-related projects, climate science, adaptation measures, flood problems, city expansion, disaster risks, and planning challenges. This coding was helpful in understanding the overall content of interviews. It was also helpful in assessing why the city was not able to achieve certain measures of climate science utilization.

The second level of coding was to identify patterns. These codes provided explanation, pattern, and emergence of themes (Miles & Huberman, 1994). The simultaneous coding method was used to code patterns. If two or mode codes were applied within a single datum, that was considered as simultaneous coding (Saldaña, 2015). If multiple agencies emphasize a challenge for climate science utilization, that was treated as a pattern code.

The third level of coding was related to identifying themes of climate science utilization. This iteration of coding was pre-determined based on transmission, understanding, and implementation of climate science. Each code from first and second levels of coding was situated within the frame of climate science utilization as presented in Table 3.6.

3.8.4. Regression Analysis

One measurement factor of implementation of climate science in land use planning was a reduction in flood impacts over time. This involved evaluating the role of land use changes on the flood pattern. Household surveys collected data on land use changes and flood patterns in the most flood-prone wards – Nhon Binh and Nhon Phu – of Quy Nhon City. The survey collected data on physical changes in wards and residents' experience of flood over time. Using stratified random sampling (Robson, 2002), household members 40 years and older were asked about physical changes and flood patterns (Table 3.5). They were to compare current situation with the situation of land use change and flooding 20-25 years ago. Questions related to physical change included modification of bodies of water, agricultural areas, vegetation areas, housing, infrastructures, dikes, industries, and irrigation systems (Appendices 1 and 2 have detailed questionnaires). Changes in flood included flood depth, duration, predictability, coverage, and frequency. There were 359 households selected for the survey out of 2,318 total households in four KVs of Nhon Binh and Nhon Phu wards. Physical changes in the area were also mapped by other studies (Figure 3.5). The changes in flood patterns were based on perception of respondents.

A linear regression model was formed to evaluate the role of land use changes on flood patterns. The dependent variable was change in the flood pattern and explanatory variables were land use and land cover changes.

The model was as follows:

$$y = a + bx$$

Where,

y = Dependent variable (e. g. the perception of flood increase in the area (1 to 6))

a = Intercept

b = Slope

x = Explanatory variable/s (e.g. land use change in KVs, changes in water bodies, and socioeconomic characteristics)

Regression analysis helped to understand role of physical development and land cover changes on flood patterns in two wards. This also helped to triangulate interview findings.

3.9. Summary of Research Method

This research is guided by pragmatism. It follows a mixed method in the case study of Quy Nhon City. Research evaluated climate science utilization using transmission, understanding, and implementation of climate science in land use planning. Components were crafted based on three frameworks from previous literature. Two of them were from the discipline of knowledge utilization, and one is from land use plan evaluation. Research questions were framed based on transmission, understanding, and implementation of climate science. The overall focus of research is how planners and decision makers use climate science to design adaptation measures in land use planning of Quy Nhon City in Binh Dinh Province. It is one of the most exposed cities to climate change impacts in Vietnam, with tremendous potential for economic development and urbanization. It is also in the spotlight of climate change initiatives nationally and internationally. This makes the city a relevant case study for this research. In order to answer three research questions related to transmission, understanding, and implementation of climate science in land use planning of Quy Nhon City, four major research approaches were followed: interviews, household surveys, focus group discussions, and document reviews. Non-participant observation was also used to verify and supplement data. Using content analysis of city master plans and interviews, and statistical analysis of household surveys, propositions were tested and interpreted in subsequent chapters.

CHAPTER 4. COMPLEXITY OF URBAN PLANNING AND LAND MANAGEMENT IN VIETNAM

Urban planning and land management are based on principles of socialism in Vietnam. Cultural and economic reform (Doi Moi) of 1986 led Vietnam to develop a market economy while the political and administrative system remained socialist. Every land law since 1986 strives to secure private rights on the land. The Land Law of 2013 is the latest source of land management. The land belongs to the people, with the State acting as representative manager (The Social Republic of Vietnam, 2013). The government has the authority to allocate or lease the land for different use. The 2013 Land Law does not mention entitlement or permanent ownership, but it does discuss the transfer of use. As a part of land management, the government provides leases to private citizens, which can be transferred from one user to another. This includes transfer between organizations, interest groups, religious organizations, private households, private businesses, and foreign organizations.

Legal mandates and institutional development for urbanization and land use management evolved with the political and economic advent of the country. The history of urbanization since the establishment of French Indochina (l'Indochine française) in 1858 includes industrialization and establishment of port cities during colonial period, stagnation of urbanization and communal land management during the communist era, and privatization of land management and proliferation of urban growth after Doi Moi. This chapter covers history of land management and urbanization in Vietnam. It answers following two research questions:

- What are the legal, administrative and institutional setups of land management and urbanization in Vietnam?
- How do current practices of land management and urbanization influence the utilization of climate science in land use planning in the Quy Nhon City?

The complexity of land management system has deep implication on the spatial planning of cities. Available data sources include archival reviews and interviews with government officials in 2014, 2015, and 2016 at national and provincial levels. Land management and urbanization in Quy Nhon City are evaluated from a perspective of political economy.

4.1. Urbanization in Vietnam

Urbanization in Vietnam and Southeast Asia became rapid with economic liberalization and increased from 15 percent to 33 percent from 1960 to 1998 (McGee, 2008). Historically, the urbanization of Vietnam evolved along with political and economic drifts in the country. Phases of urbanization in Vietnam can be divided into four categories: colonial era, two nations phase, communist phase, and Doi Moi era.

During the French colonial period, urbanization was contested between the political motives of the French Government and the interests of colonial administrators and business communities. Focus was on the expansion of industries and trade opportunities throughout Vietnam. The French colonized Vietnam from 1859 to 1954, first in Cochin China (South Vietnam) followed by Tonkin (North Vietnam) and Annam (Central Vietnam) in 1885 (Thrift & Forbes, 2006; Wright, 1991). Cambodia and Laos were colonized in 1893, establishing the Indochinese Federation. French architecture and urban design arose in major cities of Vietnam (mainly Ha Noi and Saigon), which included modification of traditional villages, execution of city plans beyond traditional city boundaries, promotion of grid street networks, and the establishment of landmarks (Wright, 1991). Power struggles between the French colonial government and business communities was manifested in spatial plans and designs of cities. One example was the spatial planning of Saigon.

There was a paucity of coordinated efforts for long-term vision of urbanization under colonialism. Urbanization was motivated by replication of Paris plans in smaller size cities of Vietnam. French scholars have described the mismatch between the Vietnamese context and planning interventions. From 1886 to 1926, Paris appointed more than fifty-two governments for Indochina, reflecting the lack of administrative stability in the region. Some results of that instability were inefficient street grids and poor sites for monuments and public buildings (Wright, 1991) that were visible in Saigon during this era. The French colonial period ended in Vietnam in 1954 with division of the country into South Vietnam and North Vietnam, and the separation was prolonged until cessation of hostilities in 1975 after North Vietnam successfully unified the war-torn nations.

Unique political systems of North and South had tremendous impacts on urbanization and land management. From the beginning, urbanization unfolded in a different manner in the South than in the North. The socialist political system in the North focused on urbanization of smaller towns and rural areas. Large city urbanization was not a priority. The government forced large cities to depopulate through migration restrictions and household registration systems. Only 7% of total population was living in the urban centers from 1954 to 1976 (Thrift & Forbes, 2006) in the North. Overall, the time period from 1954 to 1965 is characterized as a slow urban growth period in Vietnam. The war targeted large cities like Ha Noi and Hai Phong, leading people to migrate back to smaller villages (Smith & Scarpaci, 2000) in the North. The opposite scenario prevailed in South, however. Since the end of the French colonial period in 1954, urbanization in large cities was rapid with a strong service sector. City dwellers were a mix of Vietnamese and foreigners in Saigon. Rural areas were deprived of economic opportunities and security during the war. In addition, there were no restrictions on migration, which led to high population growth in large cities like Saigon. Service economy and informal sectors were booming in large cities, resulting in the concentration of economic opportunities in larger cities and higher rural-urban migration in the South.

The two countries were unified as the Socialist Republic of Vietnam in 1975. Slow urbanization continued in the South even after unification. The central government put restrictions in migration to cities and made people move to new economic zones in the South, but more than 30 percent of the population made their way to the cities through different means (Smith & Scarpaci, 2000). A detailed history of urbanization in Vietnam is shown in Table 4.1.

Table 4.1: History of Urbanization in Vietnam

Period	Administration/ political system	Significant changes	Influence on urbanization and land management
200 BC – 939 AD	Chinese empire	Education, civil service, urban architecture	City plan of Hanoi and Hue; Feudal landlord system (Thrift & Forbes, 2006).
1802-1945	Nguyen dynasty	Centralized land management, promotion of trades and growth centers	Development of ports in South and Central Vietnam; feudal landholding; establishment of cities in South of Chinese emporia (The Editors of Encyclopædia Britannica, 2011)
19th -20th Century	French colonial period	Service to colonial administration, trade and resource extraction	Development and expansion of Hanoi and Saigon, establishment of provincial capitals to expand industrialization (Thrift & Forbes, 2006); transportation system expansion
20th Century (until 1954)	Resistance against the colonial power	Higher legitimacy of communist power to represent national interest (Huỳnh, 1986)	Rise of communism with influence of national patriotism and international ideologies, anti-colonial communist movement focusing on urban and rural (Huỳnh, 1986)
1954-1974	Dual systems of planning and development (Communist in the North and market-based in South)	North: socialist development and planning, South: weak government and less control over rural areas	North: rural-urban migration restriction, de-urbanization of large cities South: Rapid expansion of large cities such as Saigon and Da Nang.

1974-1986	Socialists Republic of Vietnam	Socialists approach of planning	De-urbanization of large cities in South Issuance of residential permits to slow urban growth, efforts to develop small towns, population resettlement in designated economic zones
1986 onwards	Innovation (Doi Moi) system	Economic liberalization with socialist government and administrative system	Growth of the private sector and priority to industrialization while maintaining communist political system, attraction to foreign direct investments as essence of economic development (Kirk & Tuan, 2009).

(Author, 2018)

Before adoption of the Doi Moi system in 1986, Vietnamese urbanization followed the Murray-Szelenyi model of socialist urbanization (Smith & Scarpaci, 2000; Thrift & Forbes, 2006), which assumes three stages of urbanization: revolutionary stage, bureaucratic stage, and technocratic stage. In the first stage, urbanization is frozen or de-urbanization begins, which leads to the second stage: policy changes allowing stagnation of urban growth. At the beginning of the third phase, there is another policy change (e.g. initiation of Doi Moi in Vietnam) leading to a spur in urbanization. This model has prevailed in North Vietnam since the 1950s. Urbanization was below 10 percent until 1975. Urbanization increased more than 40 percent in the South during same time period (Smith & Scarpaci, 2000). Unification of the two countries occurred in 1975, triggering another urbanization drift. The Socialist Republic of Vietnam (after integration) followed a planned economy, putting more emphasis on the development of rural areas (The World Bank Vietnam, 2011). Highly populated cities in the southern part were targeted to de-populate. Strategies included forced migration of urban population to small towns and rural areas. Identity of socialist cities was maintained by introducing residential permits systems, higher focus on smaller towns, and government induced resettlements in the industrial zones (McGee, 2008). The five-year plans of 1976-1980 and 1981-1985 organized production facilities of the nation into agricultural cooperatives aiming to optimize the state’s resources, including redistribution of lands and forced collectivization on production (Steinfeld & Thai, 2013). But inflation skyrocketed in absence of a free market. As a result, new economic reform entitled “Economic Renovation” or “Doi Moi” was endorsed by the Communist Party of Vietnam in December 1986 (Steinfeld & Thai, 2013). Major changes under Doi Moi were in land ownership, land management, industrial and business sectors, foreign direct investment, diversification of the economic activities beyond agriculture, etc. Transformation of the economic system in Vietnam was different than other socialist countries (Russia, Poland, Czechoslovakia, Hungary, etc.). Major driving forces behind changes were increasing inflation (100 to 700 percent) during the late 1970s and early 1980s (Thuy, 1993), low efficiency of agricultural cooperatives models, economic stagnation, and decline of production and business sectors. This was not the case for other contemporary communist countries.

Doi Moi brought major changes to economic policies but minor changes to the political system (Turley & Selden, 1993). Urbanization entered into a new phase with Doi Moi. Cities went through functional and spatial transformations (Chi & Hang, 2017), including accommodation of social, economic and industrial priorities of the country. The economic system of the country shifted from agrarian to industrial and service-focused. Laws, decrees, and strategies on land management, urbanization, and economic growth were put in place. With systemic reforms, the importance of cities in development was realized. More organized urban planning and management thrived under the new laws.

Urban areas are defined as areas with dense populations engaged in non-agricultural economic activities; political, administrative, economic, cultural or specialized centers playing a role in promoting the socioeconomic development of a country; and territorial regions consisting of inner city and suburbs (The Social Republic of Vietnam, 2009). Urbanization after Doi Moi has been a complex process. The hinterlands have experienced industrialization, housing expansion, infrastructure development, and subdivisions. After Doi Moi, villages experienced changes from their rural identity as they faced rapid economic growth, urbanization, and spatial modifications. In addition, the hinterlands have experienced a migration from rural areas and promotion of urban features, resulting their new identity as “urban villages” (Bousquet, 2015). Integration with surrounding agrarian communes and villages is a goal of urban growth strategy.

Prior to the reform (Doi Moi), the socialist administration of Vietnam favored uniform urbanization in country by promoting smaller towns and provincial centers. It strongly discouraged growth in metropolitan areas. With the Doi Moi system, migration to cities increased leading geographic expansion of those cities, creating impacts on the peri-urban agricultural lands. It is more rapid in larger cities such as Ha Noi, Ho Chi Minh City, and Da Nang. Although there are designated city boundaries by the administration, those boundaries are not respected in land use conversion for urban use including infrastructure development, industrial growth, and residential development.

Under current urban law, a geographic agglomeration is considered as an urban area at a minimum with 4000 people (with 2500 in mountain areas). At least 65% population should be dependent on non-agricultural activities (The Ministry of Construction, 2008). The current categorization of urban areas are presented in Table 4.2.

Table 4.2: Urban Classifications in Vietnam

	1998		2010		2020 (projected)	
Classes	Cities	% urban population	Cities	% urban population	Cities	% urban population
Special class	2	37	2	39	2	40
Class I (National cities)	3	9	3	10	3	11
Class II (Regional cities)	12	15	12	16	12	17
Class III (Provincial cities)	16	7	18	8	20	9
Class IV (District towns)	58	14	62	13	66	12
Class V (Townlets)	612	18	1172	14	1831	11
Total urban centers	703		1969		1934	

(Coulthart, Quang, & Sharpe, 2006; The World Bank Vietnam, 2011)

4.2. History of Land Management in Vietnam

Land management evolved along with political and economic transitions in Vietnam. Constitutions of 1946 and 1959 have recognized multiplicity of land ownership including state, collective, and private ownerships (Tuyen, 2010). Law on Farm Land Reforms of 1953 has redistributed land from feudal lords to peasants under the slogan of “farms to the cultivators”, which allowed farmers to own the farmland. But it did not last long. In the 1960s, the country implemented a cooperative system, forcing farmers to contribute their land, livestock, and other farming resources to agricultural cooperatives, a practice that was predominant in North Vietnam. The major objective was to establish a socialist base for agricultural production and development of a collective effort. There was no established law for land management in 1960s. Rather, directives and guidelines were issued by the Prime Minister (Tuyen, 2010). The communal land management system lasted until 1988. Primary ownership of land was in the hands of the state. When the country was divided into the Democratic Republic of Vietnam (North) and the Republic of Vietnam (South) in 1954, two land management systems were implemented. In the North, land management was governed by a communist approach that included communal farming and state ownership. Cooperatives were formed in villages to manage farming and agricultural productions. Farmers had very little incentive to enhance productivity of the land because they had to sacrifice all their harvest to the state. In contrast, land in the South was owned by landlords. Landless peasants farmed for large landowners, and harvests were divided between landlords and farmers. Peasants were entitled to the excess production after payback to landlords. After unification in 1974, the cooperative approach was extended to South but the success was scant. The three phases of land management system of the country is shown in Table 4.3.

Table 4.3: History of Land Administration in Vietnam

1950-1975	1975-1986	1986 onwards
• Redistribution of land to peasants, land ownership resulted an increase in agricultural production. • The role of agriculture cooperatives in mobilizing manpower, food, and foodstuffs. • North: Smaller land holdings for farming under cooperatives and centrally planned model (Kirk & Tuan, 2009). A significant drop in the output. • South: Shared cropping between landlords and tenants; export-oriented farming; Land-to-the-tiller program with 20	• Unification with extension of agricultural to South, lower effectiveness compared to North. Some cooperative had 2-3 villages with more than 1000 hectares of land (Kirk & Tuan, 2009). • Agricultural productivity significantly. Farmers preferred to sell their products to an unorganized private market to get higher price than offer by government (Kirk & Tuan, 2009). • Land use rights were transferred toe households in a quota system of production through the Directive No. 100 by Communist Party in 1981 and excessive output was allowed to sell in private or government markets resulting in an increase in agricultural productivity (Kirk & Tuan, 2009).	• Discontinuation of collective ownership. • Introduction of Resolution No. 10 allowing land to be distributed among peasants based on the family size for 15 to 40 years (Kirk & Tuan, 2009). • Removal of foreign trade quantitative restrictions in 1988. Devaluation of exchange rate to free market in 1989 (Kirk & Tuan, 2009), assurance of farmer's rights on agriculture and unitary price of agriculture productions, and establishing monetary policy. • Land Law 1993: Security of tenure, issuing of land use certificate, farmers' right of cultivation and production (Steinfeld & Thai, 2013), right of mortgaging, transfer, exchange, lease, and inheritance (Barker, 1994; Kirk & Tuan, 2009; Sepehri & Akram-Lodhi, 2002). • Land use law reform of 2001: Permission to foreign investors to acquire land use rights. • Land Law of 2003: Allowing to buy and sell land use rights or change the function of land within the overall

acres ceiling of landholding allowing ownership of land among peasants (Kirk & Tuan, 2009).	• Inflation increased by more than 60 percent between 1980 and 1984, price difference between free market and government was more than 10 times. (Kirk & Tuan, 2009).	planning framework, authorization of local communes to have right to change functional classification of land. • Land Law Reform 2004: gender balance on land certificate (adding the name of both husband and wife in certificate) (Kirk & Tuan, 2009). •

(Boothroyd & Phạm, 2000; Do & Iyer, 2008)

4.3. Land Management Laws

Current land management system in Vietnam evolved with three sets of laws: the land laws of 1993, 2003, and 2013. The liberal land management system is young. Most of the land management institutions were established within the last 30 years. Between these three land laws, there are amendments and adjustments to address the needs of national interests and priorities. Before 1993, the Land Law of 1988 (which is also called "Resolution 10") established legal ground for the government to manage land while protecting the rights of land users. But ownership remained with the government (Tuyen, 2010) through agricultural cooperatives (Mellac, Fortunel, & Dan, 2010). The 1988 Law guaranteed the use of land for 15 years for farmers, which incentivized farmers to put extra effort in productivity. Nevertheless, the land management system of the communist system continued to prohibit transaction of land.

The Land Law of 1993 was introduced to assure long-term lease and entitlement to improve agricultural outputs. It incentivized farmers to produce a surplus from their plots because it allowed farmers to sell extra production for income. The 1993 Law extended duration of lease from 15 years to 50 years for families (Mellac et al., 2010) and provided five major rights to farmers in order to boost up agricultural productivity: rights of transfer, exchange, inheritance, lease, and mortgage of land (Vo, 2011) as allocated by government (The Social Republic of Vietnam, 1993). The goal was development and growth of the national agriculture-based economy. The right of transfer of land is mentioned in the Article 1 of the law (Tuyen, 2010), which allowed local people's committees to keep 5% or below of total agricultural lands to meet the social requirements of the city or province (The Social Republic of Vietnam, 1993). But in practice, this 5% could be leased out by the province or commune for income.

The Land Law of 2003 was progressive compared to 1993 in terms of duration of lease and users' rights on land. It extended land lease duration to 70 years for slow returning investments, and up to 99 years in case of diplomatic services. Classification of land uses was also more detailed compared to the 1993 Law. The 2003 Law designated the Ministry of Natural Resources and Environment (MONRE) as the apex administrative body on land management. It is clearly stated that the government could retain land from users under two conditions: promotion of national interests such as public infrastructures, and promotion of economic development and private investments (Dang, Tu, & Burke, 2016). Decentralization of land use decision-making among provincial departments and people's committees dealt with administering laws and decrees from the national government to provincial and local levels.

The 2013 Land Law has inprovised participation of local agencies in land management, including issue of Land Use Right Certificates (LURC) for 50 to 70 years for agricultural use (Dang et al., 2016). Higher prioritization for investors prevails in the 2013 Law, however. The government can play a role of land grabber from small landholders to transfer use to investors with a clause for compulsory eviction in Article 69,

> *If the land users still do not cooperate with the organization in charge of compensation and ground clearance within 10 days after the mobilization and persuasion, the chairperson of the district level People's Committee shall issue a decision on compulsory inventory. The user of recovered land shall comply with a decision on compulsory inventory. In case the land users do not comply with the decision, the chairperson of the district level People's Committee shall issue a decision on enforcement of the decision on compulsory inventory and organize the enforcement in accordance with Article 70 of this Law.*
>
> *(The Social Republic of Vietnam, 2013)*

If a negotiation does not work between land use certificate holders and the local government, the local government can use compulsory eviction. Provisions are flexible enough in the 2013 Law to allow local government and private investors to use it against users of land.

There is also a provision on climate change adaptation. In Article 3, it defines the master plan of a city as a medium for environmental protection and climate change adaptation based on land use potential and demands from all sectors at administrative units (The Social Republic of Vietnam, 2013). Based on current provisions in the 2013 Law, private sectors interested in investment can marginalize farmers from their land. As a result, farmers must use public action, networking, and coalition as strategies to keep their land tenure secure (Dang et al., 2016). On the other hand, the 2013 Law is far more progressive in terms of specifying different types of land use. It has detailed provisions on industrial areas, economic development zones, residential condominium development, rural residential areas, urban residential lands, technological innovation areas (Hi-tech zones), and land area for construction material production as well as are many other categories that were lacking in previous land laws. Comparison of the three land use laws is shown in Table 4.4.

Table 4.4: Major Land Use Laws of Vietnam

Land Law 1993 (The Social Republic of Vietnam, 1993)	Land Law 2003 (The Social Republic of Vietnam, 2003)	Land Law 2013 (The Social Republic of Vietnam, 2013)
<u>Rights of use:</u> transfer, exchange, inherit, lease and mortgage were established (Vo, 2011). Companies needed to pay compensation if land was taken from users. <u>Duration of lease:</u> 20 years for the annual	<u>Rights to use:</u> Besides rights from 1993, right of donation, sub-lease and capital contribution to a legal entity. <u>Duration of lease:</u> 20 years for annual crops and 50 years for perennial crops are kept as Land Law of 1993. For investment projects and non-agricultural activities, leases will not exceed 50 years. For slow return rated investment, can be granted up to	<u>Rights to use:</u> Law recognizes assets on lands such as houses or other attached structures as part of ownership. <u>Duration of lease:</u> Same as Land Law of 2003. <u>Investment:</u> Clause of investment (Article 9) is changed in this Law. It is similar to the Land Law of 2003. <u>Environmental consideration:</u> In Chapter 4 under Master Planning

farming and 50 years for perennial crops. Investment: Leaseholders, especially farmers, are encouraged to invest to improve productivity. Environmental consideration: None Classification of land: The land is classified into six categories – Farming, forestry, residential, urban, special areas, and unused. Control of management: ultimate power resides on National Assembly to exercise about decision and supervision of land administration and use. People's councils at all levels exercised these	70 years. For diplomatic use, it is can be granted for 99 years. Investment: Users are encouraged by State to invest in land for protection, improvement, reclamation from sea, rehabilitation, and development of infrastructure to improve value. Environmental consideration: None Classification of land: There are two types of classification – agricultural and non-agricultural. Agricultural category further categorized as land for annual crops, land for perennial crops, forest land, commercial forestation, specialized forestation, aquaculture, salt production, and others. Non-agricultural land includes residential land, land for offices, national defense, industrial zones, irrigation and road networks, religious establishments, community facilities, cemeteries, water bodies, and others. Control of management: The National Assembly promulgates laws on land, makes decision nationwide on land use planning	process, it has the provision of reasonable exploitation of natural resources and environmental protection, including climate change adaptation. Article 44 also has a provision to include environmental effects of Master Plan implementation. Classification of land: Same as the Land Law of 2003. Control of management: Control of management relies on State and line agencies (People's Committees and line agencies of MONRE). But there are details of surveying, measuring, administrative boundaries, master planning, certification of use, housing, land information systems, public outreach on land laws, etc. They are added in responsibilities of State and line agencies. Cadastral mapping is institutionalized through line agencies and staffing at different levels. Provisions on taking: Same as Land Laws of 1993 and 2003. Decision making in land taking

powers at their jurisdictions on behalf of State. <u>Provisions on taking:</u> State can take the land for the purpose of national defense, security, national or public interest, and natural disasters.	and zoning. MONRE is responsible to govern the land. People's Committees implement legal provisions. Fatherland Front plays role of watchdog on practices of land administration.	is much more decentralized. District-level People's Committee can also decide to recover land from households, individuals and communities. Article 69 (c & d) allows for the forced taking of land for national defense and for socioeconomic development.

(Author, 2018)

There are decrees and circulars to operationalize the latest land law. Some examples of decrees to implement Land Law 2013 are the Decree on the Collection of Land Use Levy 2014; the Decree on Regulations on Land Prices 2014; the Decree on Regulations on Compensation, Support, and Resettlement upon Land Expropriation by the State 2014; and Decree on Detailing a Number of Articles of Land Law 2014. There are a number of circulars from MONRE to further operationalize decrees. There are also joint circulars among ministries on land management. They are changing from time to time and the latest versions can replace or modify previous ones.

At present, conflict between the communist approach of state-led land administration and neoliberal use in cities is clearly visible in Vietnamese land management system (Hansen, 2013). The Land Law 2013 details owners' rights on the land, management systems, and agricultural land ceiling per family. It also includes provisions that allow corporate interests to take lands from farmers and families in the name of socioeconomic development of the province. This results in confrontation between local authorities and farmers and villagers. Conflict occurs more in the hinterlands of cities where land is being converted from agricultural use to commercial and industrial use by investors (Dang et al., 2016). This tug of war is not a new phenomenon in Vietnam. It germinated with the communal land management system of 1970s and early 80s.

4.4. Land Management: Source of Revenue, Corruption, and Conflict

Land management is contested in Vietnam. In practice, it is neoliberal, but management and administration still reinforce the socialist system of the past. As a result, there are number of inconsistencies and problems in overall land management in Vietnam. Increasing economic importance of land in cities and hinterlands results bargaining for benefits from multiple actors. Informality and interest-driven actions are rampant in land management. Recent demonstrations and resistance from communities across the country have reveal this hidden contestation over land. All three land laws and accompanying amendments designate the government as the sole land manager, and that land is owned ultimately by the people. This is socialist orthodox concerning common ownership of public assets.

The government has fixed targets and objectives for the socioeconomic development for country. Every province and centrally-administered city prioritizes socioeconomic development policies and plans based on national targets and objectives. There is competition among provinces and cities to claim more resources based on their prosperity and the growth they achieve. A major contributor of ranking of cities is infrastructure development (DiGregorio, Phong, Garschagen, & Tyler, 2016). Each city wants to maximize its investment in infrastructure development and attract more domestic and foreign investment. As a result, each city is trying to improve the socioeconomic indicators of its development through physical development and urban expansion. Unfortunately, this has created tremendous evictions, land grabbing, gentrifications, and mistrust on government's actions on land use.

4.4.1. Source of Revenue

Land is a source of income for the government in Vietnam. There are two types of government revenues from land: regular and terminal. The annual tax on land use is a regular source of income, whereas transfer and issuing new certificates are terminal. Government finance on local infrastructures such as roads, energy, communication, and water supply requires a significant amount of revenue. Local governments rely on revenue collection through taxation, including land tax and service charges. In terms of investment, real estate was the second largest foreign direct investment (FDI) sector in 2015 at 8.7 percent of the total FDI in country (General

Statistics Office, 2016). In 2016, there were 581 projects throughout the country related to real estate development with FDI (General Statistics Office, 2016). In Binh Dinh Province in 2016, there were 66 ongoing projects and 11 new projects that were licensed for FDI projects. Real estate projects are associated with land acquisition, development, and selling. Provincial and city governments can benefit from these projects in two ways. The first is revenue collection in the form of tax, levy, and service fee from developers. The second is infrastructure and urban characteristics improvement in cities and provinces. These benefits are much worthwhile for government than keeping land as agricultural use or open space (DiGregorio et al., 2016).

Provincial and city government have a separate office to facilitate the investment proposals from developers. In Binh Dinh Province, the Investment Promotion Center under Provincial Department of Planning and Investment (DPI) is one such organization. It is established to help investors to meet all government requirements for investment.

Real estate development has been one of the strongest source of revenue for cities. In Ho Chi Minh City, new registration and ownership transfer of real estates are collectively the second largest source of revenue for the city (McCluskey & Trinh, 2013). They consitute regular income for cities to finance its public infrastructures. Real estate taxes allow financial independence for local administrations from the national government and simultaneously reduce the financial burden of the central government. When land is reserved for agriculture or environmental conservation, such open space deprives city and provincial governments of higher revenue collection. They tend to promote investment on agricultural land for other purposes by supporting investors over farmers and other users. This is reflected in a number of approved projects with FDI in provinces and cities.

4.4.2. Source of Corruption

Beyond being major source of income to local governments, land has been a major source of corruption in Vietnam (Viet Nam News, 2016). There are two types of corruption in land management in Vietnam: bribery from the general public and personal benefits from developers to officials.

Higher risk of corruption lies in issuing of household land registration certificates and land acquisition for investors (National Political Publishing House, 2011). The general public tends to provide bribes to government officials to get land use certificates because of inefficiencies and complexities in the application process (understanding of requirements, filling up the application, etc.) (National Political Publishing House, 2011).

Developers and investors provide personal benefits to government officials for aligning land use plans, providing confidential information of land use, and favoring land acquisition. Corruption occurs when investors influence government officials to align the land use plan to their investment interests. Investors provide a share of their profit to government officials for favored land use plans for their projects (National Political Publishing House, 2011). Developers pay for access to information and approval of projects that are allowed by land use plans (National Political Publishing House, 2011). In terms of land acquisition for development, developers can maximize their profit through low valuation of the lease or land, an increase of the amount of land, and lower compensation to people who hold the land in question (National Political Publishing House, 2011).

Land management-related corruptions are widely documented in Vietnam. A study conducted by National Economics University and United Nations Development Program (UNDP) Vietnam (2017) among five Government Private Partnership (GPP) investment projects concluded that there is no benefit to people from these projects who will be most affected (Nguyen et al., 2017). The study presented stages of project development and monetary corruption for each stage. As an example, the report presented a residential development project from a northern mountain province that had a risk of 10 billion Vietnamese Dong (VND) informal payment just to get approval, then favoring in tender to a particular developer had another 5 billion VND. The tendering and site selection processes were completed without informing or consulting affected communities (Nguyen et al., 2017).

There is missing link between development and local people with projects. In the general practice of development investment in Vietnam, a developer has to pay roughly 5% of the total return from a housing project as bribe, in many cases, government officials themselves are involved in bribery. The cost of corruption in land management is already visible on the ground. There are many demonstrations and confrontations between the affected and excluded public and the government throughout the country.

4.4.3. Source of Dispute

As mentioned above, land management has been a source of conflict in Vietnam, and land-taking from farmers and noncommercial users is the major source of this conflict. Land-taking is rampant throughout the country; especially in peri-urban areas. From 2001 to 2010, a million hectares of land was converted from agricultural to residential and commercial uses (Gillespie, 2013; Hansen, 2013). It was conducted based on Land Law 2013, which has two provisions for land appropriation from farmers or private users. They are appropriation for public projects related to national defense, public security, and common goods (roads, electricity, etc.); and an appropriation for socioeconomic development such as industrial parks, commercial use, and housing projects (Gillespie, 2013; Hansen, 2013). The second category is related to large industrial parks, condominium projects, luxury housing projects, and any large investments in provinces and cities. This is a major source of disputes and corruption in the country (Gillespie, 2013). There are news coverages of farmers and small landowners protesting in Ha Noi and other cities to protect their lands from being seized. One of the most popular cases is from March/April of 2017 because it was such an extreme move by locals. Residents of Dong Tam Village outside of Hanoi kept more than 3 dozen government officials hostage for weeks (Ives, 2017), the result of a government effort to evict farmers from agricultural lands in order to lease to a telecommunication company without compensating the farmers (Lipes & Nguyen, 2017).

Another example is from Duong Hoi Village of Ha Noi. This case is more of a demonstration to protect the land. The village was in Ha Dong, a neighboring province of Ha Noi until 2008. The entire province was merged with Ha Noi in 2008 as one more district in the city. In April 2014, government officials and private investors used physical force (beatings and arrests of locals) to remove people from their land. There were 9 development projects approved in the area that affected more than 300 local families. In March 2014, 2 protestors were arrested; authorities informed their families that they committed suicide, but the bodies were never returned (Vietnam Right Now, 2014). There are incidents of fatal shootings on land disputes. One recent dispute was between farmers of Quang Truc Commune of Dak Nong Province and an agroforestry company. As a result of the conflict, three individuals died on the scene; one farmer was found guilty and suffered capital punishment later (Tuoi Tre News Society, 2018). These are just a few extreme examples of conflict between the farmers and authorities.

Some of land-related conflicts lasted for decades. An example is from Van Giang Village of Hung Yen Province of Northern Vietnam. In this district, more than 4 thousand families fought with local authorities and a developer against Ecopark, an "Eco urban township". Confrontations went for more than 8 years. Villagers occupied the construction sites of the company but were met by government security forces, resulting in the arrest of 20 villagers (The Observers, 2012). Extreme physical force was used to evict people from the construction site.

Media coverage and instances of land disputes can be triangulated with government records of complaints. Based on the government figures, 90 percent of complaints received by government from public are related to land disputes, and 98 percent of them were received by MONRE (Linh, 2015; Wells-Dang, Tu, & Burke, 2015). The MONRE is the apex administrative body of land management. It has the power to review grievances of people on property rights.

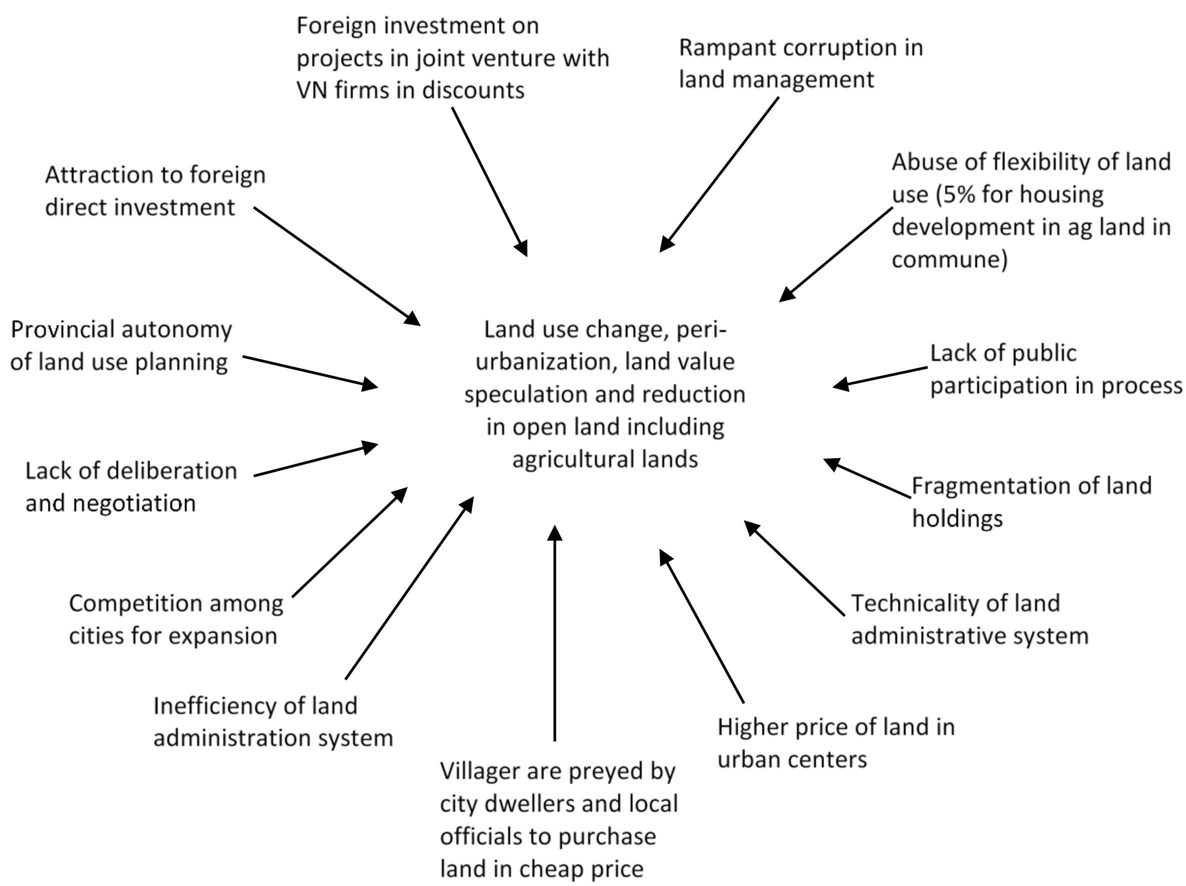
Land grabbing by government and private companies for development is analogous to another foreign invasion for villagers and farmers in peri-urban areas. One of the displaced women from the Ecopark location said the following in an interview,

> *The land grab has been like a foreign invasion. For us country people, the land is our sole means of earning a living and feeding our children. Up until now, we haven't been able to dialogue with investors or the authorities on the project's parameters. It's as if they're stealing our land. In the beginning, they offered to compensate us with 19.5 million dongs [around 700 euros] and 360 square meters [around 0.09 acres] of land. Offended, we contested the sum. The offer then went up to 54 million dongs [close to 2,000 euros]. These days, a rural family with two children spend on average 100 million dongs [3,600 euros] per year; in other words almost twice what was offered. What would we live off for the last six months of the year? The authorities explained to us that they would give us job training in different fields, but I just don't see how that would work for those of us who are already 40 or 50 years old. Besides, there are very few opportunities in the area…*
>
> (RFI's Vietnamese Service quoted by France24, accessed on March 20, 2018)

As mentioned earlier, the government keeps management authority of land in Vietnam. Every land law reinforces this basic principle, which allows the government to allocate land for uses in the name of the people. As a result, the government takes land from farmers and allocates it for socioeconomic development, especially infrastructure and industrial, commercial, and residential development. These land use changes bring investments to provinces and cities, resulting positive externalities to the local economy. But due to lack of transparency and accountability, land taken from farmers and local users created a hostile relationship between them and the government that claimed to represent them.

Low valuation of land is the primary cause. The value of agricultural land is assessed based on its annual production rather than market value or future prospects (Mellac et al., 2010). This creates huge dissatisfaction among farmers on land taken from them and is a source of corruption and land price speculation (Vo, 2011).

Figure 4.1: Complexity of Land Management in Vietnam



(Author, 2018)

As shown in figure 4.1, land use change, peri-urbanization, and land price determination in Vietnam are not simple processes. Three parties have commitments to strong interest maximization, and this leads to conflict. The most disadvantaged group is the farmers and local users who do not have the authority to influence any decisions on land use. The following section on political economy of land management and urbanization illustrates interest mismatch among three actors and its influence on the climate science utilization.

4.5. Political Economy of Land Management and Urbanization

Urbanization and land management are critical for economic growth of Vietnam, but they face multiple challenges, including legal, administrative, and planning-related issues. Laws of urbanization are creating competition among cities in terms of developing infrastructure, extending non-agricultural economy, and increasing population size. As a result, cities are focusing on the development of large infrastructures, industrial parks, cultural venues, residential towns, and tourist service areas, which involves incorporating rural districts and converting agricultural lands into non-agricultural uses (DiGregorio et al., 2016) by moving residents from these lands.

The Vietnamese planning system carries the legacy of socialist planning. Socioeconomic plans are prepared by the Ministry of Planning and Investment (MPI) and its line agencies. The MPI issues national targets and data on socioeconomic indicators. Sectoral and spatial master plans are based on those targets. Master plans also carry the legacy of centralized planning from the socialist era at provincial, city, and district scales (DiGregorio et al., 2016). Private investors have strong influence on spatial plans (master plans and detail area plans) as they endeavor to create planning provisions in their favor by influencing government institutions and officials. This occurs at the level of plan implementation as well. There are examples on land use conversion or development project approved by higher authorities overriding decisions made by city or local governments. Developers with influence at ministerial level can override decisions of provincial and city governments on project approval, even though city master plans do not allow such projects, and city governments implement such decisions without raising questions. As a result, spatial development proposals of master plans are deviated in implementation.

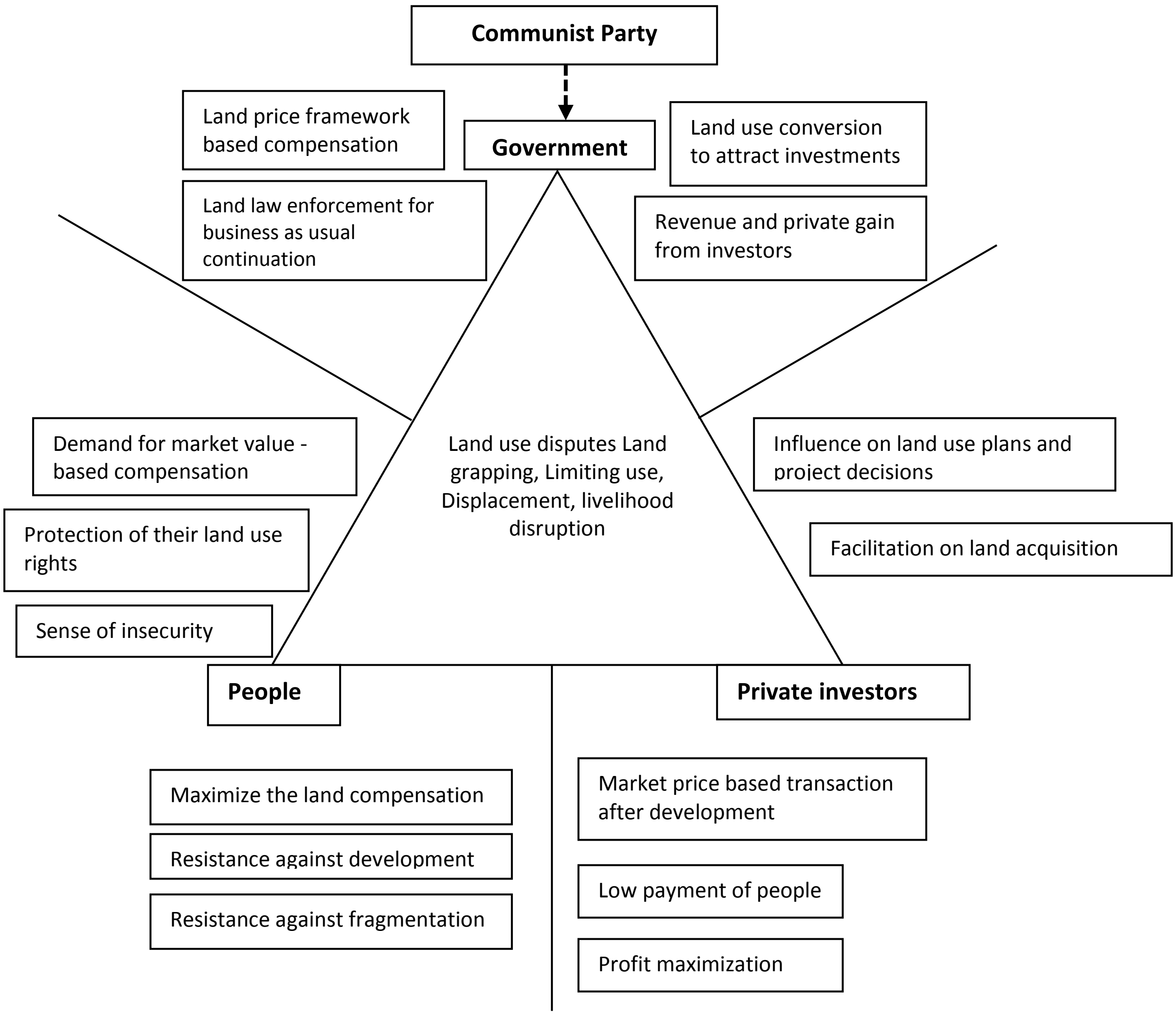
Master plans becomes aspirational rather than real-world guiding documents for city development (DiGregorio et al., 2016).

The Communist Party of Vietnam has strong role to play in city development and land management. It is not directly involved in policy decisions, but its influence remains substantial from national to local levels. Long standing social and political prestige of the party in county tend to endow authority that influences administrations and planning, even though it is considered having little political authority in decision making (Fforde & Homutova, 2017).

Doi Moi reforms in Vietnam has provided an avenue to investment from the outer world, resulting in rapid economic growth. It has also led to higher demand of urban services, putting pressure on land markets (Phuc, Westen, & Zoomers, 2014). Land is not available to the government to address those demands because the best lands are allocated to people for agricultural uses. As result, government practices land-taking for non-agricultural development. Land Law 2013 allows the state to take land from people for the public interest. But practices of taking are often framed by the interests of investors and developers rather than promoting the public good (DiGregorio et al., 2016). The top-down non-participatory process of land grabbing lacks transparency and accountability. Investors' interests overshadow the will of the people. Provincial, city and local government institutions support investors' interests because they need to attract more finance on infrastructures and non-agricultural economic activities. Urbanization has created a privatized real estate market supported by state-led land conversion (DiGregorio, Phong, Garschgen, and Tyler, 2016).

Local land users have been at a disadvantage during land use conversion and urbanization. Farmers are using every means to stop conversions and to get fair compensation from developers and the government for their lands. But success is scant due to marginalization from all sectors, including local and national governments. Along with land users, cross-cutting environmental issues such as climate change are also sidelined in urbanization and land conversions. As a result, urbanization and land management leads to increased risk and vulnerabilities of cities to climate change impacts (DiGregorio, Phong, Garschgen, and Tyler, 2016).

Figure 4.2: Contesting Interests of Government, Investors, and People on Land Management



(Author, 2018)

Figure 4.2 illustrates bipolar conflicts in land management in Vietnam. Conflict between investors and government are not confrontational. Rather, they are focused on maximization of gain. But the conflict between communities and government, or between developers and people, is confrontational. Although communities also strive to maximize their interest during land taking, their voices are rarely heard. Each actor in Figure 4.2 tries to maximize their interests on both sides. For example, people have three interests to government and investors. Regarding investors, people like to maximize compensation and protect their lands from development and fragmentation. With the government, people want market price-based compensation, protection of their land use rights, and resistance against eviction. In the same manner, the government prefers land price framework-based compensation that is less than market value, and seeks to invoke the land law to take land for economic development. The government is backed up by interest of the Communist Party. There are mismatches between interests of people and government and vice versa. The same situation prevails in the case of government and private investors, and people and private investors. The negotiation process is not participatory. Rather, it is top-down. As a result, there are disputes and conflicts on land use conversion in cities.

4.6. Influence of Land Management to Climate Change Adaptation and Knowledge Utilization

Complexity of land management sidelines climate change adaptation efforts. There is enough scientific information of climate change produced for Quy Nhon City by theClimate Action Plan for the city in 2010 under the ACCCRN Project. The Plan contains recommendations related to climate change adaptation in land use planning. Implementation of those recommendations, however, are yet to be done. Provisions on climate change adaptation and mitigation in the action plan are ambitious but concrete. However, the vision of city expansion under Master Plans 2004 and 2015 does not include recommendations of climate action plan. The master plans have sought to expand the city in flood-prone areas without adaptation measures, despite compelling analysis of climate change impacts in the climate action plan. The urban planning system of incentives and competitive growth among cities has led to an increase such planning behaviors (DiGregorio, 2015) (Details of provisions in master plans are discussed in Chapter 6). Despite higher priorities of city expansion and attraction of construction projects, the Climate Action Plan of 2010 has nevertheless established provisions of climate change adaptation in land use planning. Some of the provisions are as follows:

- Restoration of the mangrove forest in the Thai Nai Lagoon,
- Integration of flood risk with planning, urban expansion, and socioeconomic development,
- Improvement of infrastructures in flood-prone areas,
- Afforestation in upstream areas for water retention and landslide preventions,
- Integration of drought risk in urban planning and socioeconomic development,

- Resettlement programs for vulnerable residents of coastal areas,
- Prevention of coastal erosion through integration with planning, and urban development,
- Improvement of reservoirs to reduce the flow downstream,
- Integration of saltwater intrusion policies with planning, socioeconomic development, and urban expansion,
- Integration of sand drifting problem in plans and development strategies.

(Dinh et al., 2010)

Among recommendations for climate change adaptation, the above provisions are related to land use planning in the city. There is a ranking assigned to them based on the urgency. Mainstreaming of flooding, drought, storm, and saltwater intrusion are in the second rank. The first rank is awareness and capacity building. In order to operationalize these recommendations, sectoral master plans should address climate change impacts in plan documents and implementations. The Master Plan of 2015 has incorporated climate change adaptation and mitigation to some extent. Provisions in the plan are more descriptive than action-oriented, however, and it is more progressive in terms of mainstreaming climate science in policies. Other sectoral master plans are not incorporating climate change and disaster risk in planning processes, especially master plans of transportation, water resources, and energy.

Challenges in implementing recommendations of climate action plan include inaccessibility to updated information, lack of resources, conflicts between economic interest and ecological concerns, and urbanization geared by rapid economic growth and investment rather than a more precautionary approach (Dinh et al., 2010). During interviews, government officials responsible for land use planning mentioned challenges of using climate science in decision making. A clear understanding of climate change is lacking among policymakers at national and local levels. In this regard, one interviewee at national level made this statement,

> *….those scientific things about climate change is so complicated, not only for the least educated people to understand but also for very well educated; for those who are working in the, I mean like in scientist, working in the field of climate change, not talking also about the government decision-makers, policymakers and decision-makers to understand it in order to convert it into policy or decision.*
>
> *(Personal interview, 2014)*

Priorities of the Quy Nhon Climate Action Plan and the government concur on awareness building regarding climate change impacts. Government officials and climate experts mentioned that awareness among government planners was limited on climate change impacts. With implementation of the ACCCRN Project in the city, awareness of climate change has increased, but utilization of climate science in land use planning is still lagging. The top-down approach to planning and strict legal mandates add challenges. Government workers with authority of land use decision making at provincial level said the following,

> *Until now, the materials of climate change for the central government is not decided yet. Material spends the standard of the construction. There [we are] waiting for the standard from the central government and to address the climate change. We got handcuffs in our hands [;] we cannot do anything without guidance from the central government.*
> *(Personal interview, 2015)*

Local governments are waiting for clearly defined standards and legal mandates from the national government on climate change adaptation. Simultaneously, they have the obligation to achieve economic and urbanization goals. That puts them in the situation of choosing climate change or economic growth rather than coupling them for resilience building. The complexity of land management and master planning creates an extra layer of challenge in adapting to climate impacts, a challenge faced by land use planners and consultants of Quy Nhon master plans as well. This challenge includes land taking in the peri-urban areas and allocating it to different projects. In order to provide incentives to investors, there are some regulatory easements, which includes loosening environmental considerations in development projects. There was some indication of this by interviewees. One interviewee described challenges in implementing the rules,

> *…. in Vietnam, it is difficult to say no when you have a program, it is also very difficult to ask people to move. They have some technical insurance like dikes, like resolution. Let's say we do not develop here which is dangerous and we develop here. After that like anywhere in the world, we have "money, money, money". If you need money, it is very difficult to say no to project. For instance, in the report, we put the areas saying no development here; all the Vietnamese even 70 years old said that. We said that and they agreed that they will not develop in that area. At the same time, there are some architectural firms working on that [area]. When you go to the site, you will see new expansion of road in the area. It is being filled up. That is quite difficult.*
> *(Personal interview, 2014)*

The interviewee mentioned the receptive nature of provincial and local governments to investments, reflecting a willingness to bypass some provisions in project implementation, which is common in the course of urbanization in Vietnam. As it was reflected in previous sub-section of this chapter, land use changes can bring growth to provinces and can be beneficial to decision makers at individual levels. Provincial and city governments are willing, however, to accept investments, regardless of their negative consequences on people, environment, and overall planning of the city. When scientific research identifies a certain area of a city as sensitive to climate change impacts, the local government still allows investment in the area if developers are willing to take risk. While discussing this tendency, an interviewee said,

> *Practically you know climate change became the priority at the national level but it is not the priority at the provincial level and city level yet. You need to promote for that and you need to see how they react when they know about this. And also the priority always go for the economic development and economic projects.*
>
> *(Personal interview, 2014)*

Another interviewee added,

> *Technical solutions, everybody is okay but to make the proposition that is more like mitigation such as saying, people, that they cannot live in certain location anymore, or to stop the developer by saying that he or she cannot build here. That is more difficult because, for cities, money is coming from developers, not from taxes.*
>
> *(Personal interview, 2014)*

Although there is wide discussion of climate change, planning actions are not changed as a consequence. Land use planning and decision making are complex and contested among multiple interests. The national government has established national target programs on climate change, but actual practice at the provincial and municipal levels does not follow measures designed to adapt to impacts.

At the provincial level, interviewees did not mention the dominance of economic priorities over climate change or other environmental considerations. All government officials who were interviewed for this research claimed that they were addressing climate change in their decision making. As interviewees mentioned above, once it comes to taking action on impacts, the city government reinforces the conventional socialist approach to decision making rather than trying innovative ways to address climate change impacts in land use planning.

4.7. Summary of Urbanization and Land Management in Vietnam

Land management evolved with the political history of Vietnam. Land is owned by people and managed by the state. Doi Moi brought neoliberal practices of land use, yet the prevailing administration and governance system carried the legacy of communist era. Current land management is governed by Land Law 2013 and associated decrees and circulars. MONRE is the apex body for land administration, and line agencies of MONRE and people's committees in provinces and cities have authority to administer land use in their territories.

Land management is highly contested. Interests of government, private investors and communities clash in land use conversion. Lack of people's participation in decision making process, lack of transparency in land use conversion, and dominance of economic interests of government and investors increase corruption, disputes, and malpractices in land management in Vietnam. Newer issues like climate change impacts are mentioned in plan documents, but climate change gets sidelined and the conventional practice of decision making is reinforced.

Local decision makers do not care about climate change, once investors come to the city or province with a proposal. Rather, they are motivated to raise revenue for local government projects and benefit personally from investments. Climate science raised the awareness of government officials in cities and provinces, but its use in decision making to embrace adaptation measures in plans implementations is minimal. Scientific knowledge of climate change can have influence on decision making concerning land use if there are changes in the institutions of land management in Vietnam from national to local levels.

CHAPTER 5. CLIMATE SCIENCE PRODUCTION AND DISSEMINATION IN QUY NHON CITY

Scientific knowledge has a critical role in policy and planning as humanity deals with uncertain but inevitable problems like climate change. The relationship between policy makers and scientists is not linear because there are differences in scope, language, perception of evidence, time frame, and scale between them (Choi et al., 2005). As a result, production and implementation of science do not match.

This chapter explores the production of climate science in Vietnam. The production of climate science is led by scientists, but policy process are governed by bureaucrats and politicians in Vietnam. Climate science is produced at the national level, but implementation occurs at provincial and city levels. The role of boundary agents is critical on the dissemination and understanding of climate science in Vietnam. This chapter tracks institutions of climate science production and mechanisms of dissemination in Quy Nhon City. It strives to answer following research questions presented in Chapter 1:

- How is scientific knowledge of climate change produced in Vietnam?
- What are the mechanisms of transferring climate science from national research organizations to cities and provinces in Vietnam?
- What are the sources of climate knowledge among planners and decision makers of the Quy Nhon City?

Interviews with government scientists, provincial offices, and city agencies are used as source of evidence. Published reports on climate change scenarios are reviewed to assess evolution of climate science production in Vietnam.

5.1. Unbalance of Climate Science Production and Accessibility

Knowledge is a basic factor necessary for successful adaptation to new situations (Sundblad, Biel, & Gärling, 2009). New scientific knowledge and local experience help humanity to deal with uncertain but inevitable climate change. Climate science data has different forms, including evidence, information, and fact (Contandriopoulos et al., 2010). Availability and accessibility of climate knowledge influence its utilization, which is also determined by the qualification of knowledge. This qualification depends on the context and discipline in which the knowledge is obtained. There is a huge disparity in qualification and availability of climate science between developed and developing nations.

Scenarios and experience-based knowledge aid in the analysis of climate change in qualitative and quantitative forms. Climate change models are quantitative and scenario-based, whereas people's knowledge is qualitative and experienced-based. Simulations are the basis of climate change models which are initially based on past data and assumptions. Experienced-based knowledge is localized with limited geographic coverage, but scientific knowledge is broad with wider spatial representations. In case of climate change and its impacts, local knowledge reflects experience of a specific community, but it may not have a sense of causes and trends for the greater region. Local tacit knowledge cannot be put in words and numbers (Polanyi, 1967). A study conducted among farmers in Uttar Pradesh of India on climate change adaptation showed that farmers experience changes in climatic phenomena (rainfall and temperature), but they did not know that it is caused by climate change (Tripathi & Mishra, 2017). Scientific information on climate change can supplement local knowledge by covering broader geographic areas and longer time frames (past and future).

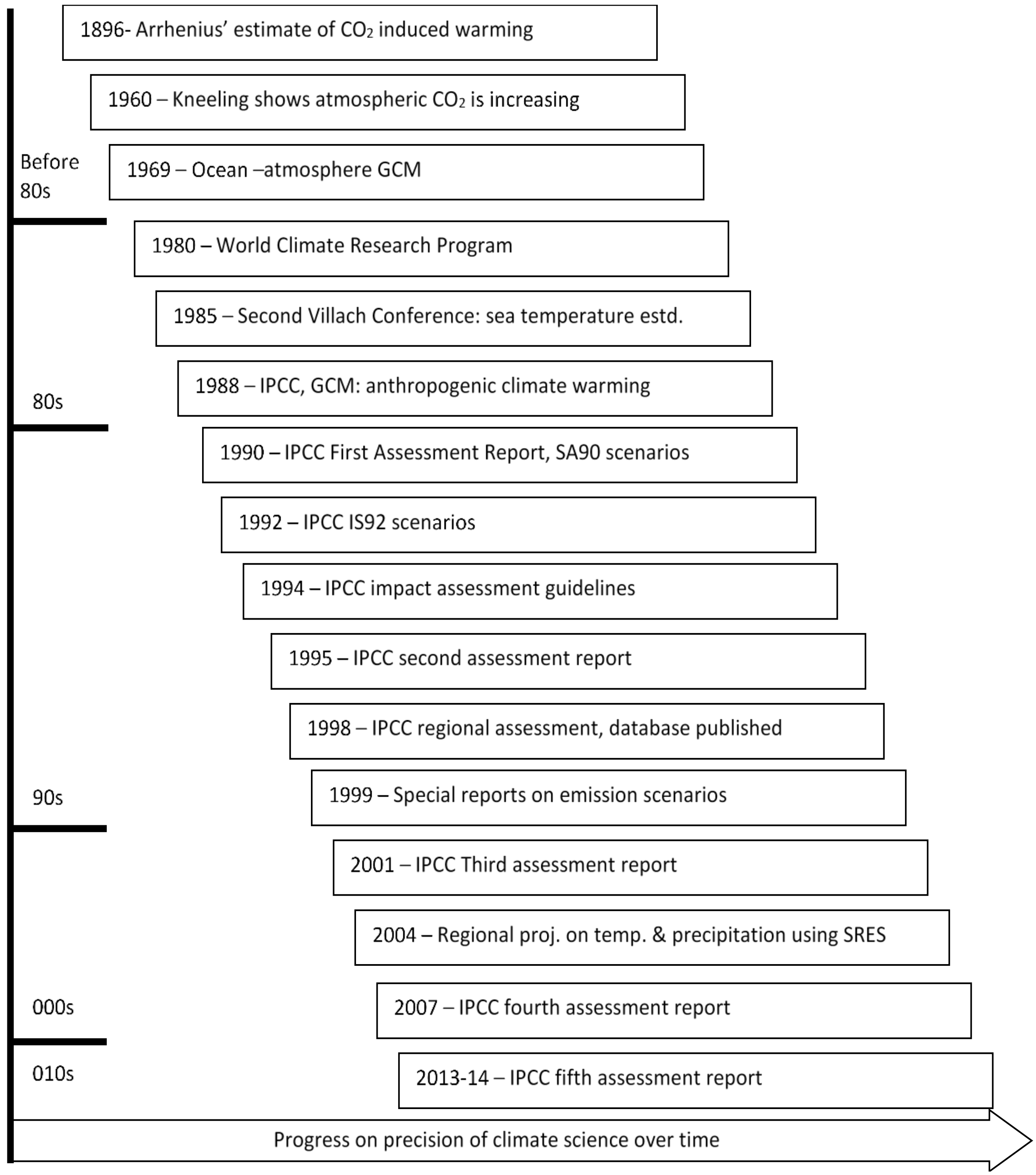
Climate science is dominated by global, regional and local scenarios, whereas lived experiences (Abbott & Wilson, 2014) are led by knowledge and experiences of communities. Lived experiences may not always streamline with scientific evidence. They may contradict the concepts, epistemologies, and strategies for implementation based on scientific data (Abbott & Wilson, 2014). For both types of knowledge, scale is critical. Local impacts and processes are influenced by global climate change and its global existence is built on local processes (Clifford, 2014). Thus, the role of climate science is crucial in local planning. In the case of Vietnam, both types of knowledge are present, but their influences are unique at different levels of planning.

Scenarios are sources of knowledge of climate change. They describe plausible trajectories of climate conditions and aspects of future (Moss et al., 2010) that may be classified into three categories: climate models; integrated assessment models; and assessment of impacts, adaptation, and vulnerability (Moss et al., 2010). Climate models are representations of the response of earth's natural system to changes caused by natural and anthropogenic processes. They are coarser at a global scale and finer at a regional scale. Ocean and atmospheric circulation models are examples. Integrated models include information related to human and natural systems to assess potential impacts. They parse the world into different regions with a time span of a decade, and include emission scenarios, impacts, cost-benefits of the mitigation measures, and evaluation of uncertainties (Moss et al., 2010). Assessment of impacts, adaptation, and vulnerability has a diverse array of methods including observation, modeling, participation, economic evaluation, and decision analysis (Ahmad et al., 2001; Moss et al., 2010). Methods of impact, adaptation, and vulnerability assessments inform decision makers about potential risks and opportunities of climate change and impacts.

Climate change is a new area of research. The organized research tradition of climate change is less than one hundred years old. In this short time, there has been a tremendous improvement in the quality of scientific knowledge. (Evolution of climate change knowledge is presented by Moss et al., 2010). CO_2 was identified by Arrhenius in 1896 as a catalyst that increases worldwide warming. Since then, there has been continuous improvement and refinement. The first General Circulation Model (GCM) of ocean and atmosphere was created by Manabe et al. (1975). The World Climate Research Program was started in 1980. 1985 is considered as a major milestone for climate change research because issues of climate change were brought to the international spotlight solo scientific research in the year (Franz, 1997). Initiatives included an international agreement to protect the ozone layer. Another major moment in climate science research was the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988. The IPCC published a newer version of GCM, concluding that climate was no longer considered a natural process but understood as the result of the Anthropocene Era. Holistic understanding of the earth's climate system proliferated with publication of IPCC first climate assessment report in 1990 (Le Treut et al., 2007). Since then, climate science production has been exponentially improved.

Another major milestone in climate science research has been free availability of models and datasets for researchers since 1998. This has allowed scientists to customize climate change scenarios based on their research interests. An example of such exercise is production of climate change scenarios for Vietnam. 2016 Vietanam climate change scenarios used 16 global and regional models (Ministry of Natural Resources and Environment, 2016b). A Summary of progress on climate science production is shown in Figure 5.1.

Figure 5.1: Evolution of Climate Science Research and Institutions



(Author, 2018)

Production and accessibility of climate science are not equal among different geographies. High-quality scientific scenarios of climate change are not available in developing countries (Haque, Bremer, Aziz, & van der Sluijs, 2017). A higher number of scientific research projects take place in economically well-off regions that have a higher climate footprint (Pasgaard, Dalsgaard, Maruyama, Sandel, & Strange, 2015). Wealthy regions with the same political and economic interests are likely to exchange knowledge. This has been shown by a recent biometric review of climate change related publications from 1980 to 2014 (Haunschild, Bornmann, & Marx, 2016). They are quantitatively dominated by USA, followed by the UK, Germany, and Canada (Haunschild et al., 2016). Imbalances in knowledge production between global north and south have serious implications on appropriate actions to deal with climate change impacts (Blicharska et al., 2017). Although data on GCM and publications on climate change and models are freely available, infrastructures and human resources of developing nations do not have capacity to use them (McSweeney, Lizcano, New, & Lu, 2010).

Greater international access to climate change data and models does not automatically increase participation of developing nations in climate science production because so much depends on political and economic factors. One of the chronic limitations of climate science production in these countries is human and economic resources (Yamineva, 2017). With the example of IPCC, Yamineva (2017) concludes that active participation of developing countries and NGOs in credible, salient, and legitimate knowledge production requires resources and capacity, a conclusion that is further elucidated by Washington et al. with empirical evidence from Africa (2006). They have shown that Africa suffers from two challenges in the production of regional climate science: lack of data and scarcity of scientists. As a result, Africa has the lowest number of scientific publications on climate change (Washington et al., 2006). The situation is no different in other developing countries including many Asian nations. Even though distribution of climate observation stations is good in Asia, challenges of record keeping and mismatch of data is huge (Page et al., 2004). In many countries, weather stations are manual and have limited volunteers to operate. Repair of malfunctioning or broken stations is slow because of the remoteness of many countries of Southeast Asia and Pacific (Page et al., 2004).

Climate science production and utilization in Vietnam suffer from many challenges faced by developing countries. A study conducted by Shaw et al. (2016) assessed utilization of science and technology in disaster risk reduction among 11 countries of Asia, including Vietnam. Variables are as follows: use of science and technology in decision making, investment in science and technology, and link of science and technology to people. An overall science and technology attribution score was calculated for each nation normalized to 100. Vietnam scored 50, which is lower than Japan, Iran, India, Malaysia, Indonesia, and China, but higher than Bangladesh, Myanmar, Pakistan, and the Philippines. It has the second lowest score for investment in science and technology and linkage of science and technology to people (Bangladesh had the lowest score) (Shaw, 2017; Shaw, Izumi, & Shi, 2016).

Lack of investments to carry out research is what drives scientific organizations and individual scientists to look for funding and expertise from other countries and international organizations. The majority of scientific research on disaster and climate modeling occurs at individual levels in Vietnam. Scientists are constantly looking for collaboration with bilateral and multilateral donor agencies, especially from developed countries like Australia, United States, United Kingdom, Germany, and France to fund climate science research. During interviews for this research, climate scientists mentioned one or more collaborative work with scientists or research organizations from other countries as their partner or funder for climate change research. National level scientists mentioned their collaboration with scientists from Australia, Germany, Norway, Japan, and other developed countries to explain their work on climate modeling. Such involvement of bilateral and multilateral scientists improves accuracy and relevance of their research in Vietnam. One scientist presented examples of his collaboration with climate science organizations from abroad,

> *Last two years, from 2012 to 2013, we have a joint project funded by AusAID led by Dr -------- of CSIRO. There are AusAID side, IMHEN and us, three organizations. They are working on this project. CSIRO ran several models, and we also ran several analyses and combined together to get results.*
>
> *(Personal interview, 2014)*

The first climate change-related bilateral project on record was in 1992. The Asian Development Bank (ADB) and Institute of Meteorology, Hydrology and Environment (IMHEN) worked together to develop the first climate change scenarios for the country (Zink, 2013). Since

2006, projects on climate change increased rapidly in the country. In 2008, there were 40 projects related to climate change in Vietnam (Zink, 2013). Before 2006, projects on climate change were focused on developing awareness and key concepts. The majority of them were not related to climate change; rather, they focused on disaster management, energy efficiency, and coastal zone management (Zink, 2013). Spurred by different projects and joining of Vietnam into the Kyoto Protocol, climate science production increased in governmental, non-governmental, and private sectors. As a result, the first government-led scenarios of climate change (sea level rise, temperature change, rainfall change, etc.) were produced in 2009 and updated in 2015.

Global science hubs have been established with the advent of IPCC and other global organizations. Climate scientists around the world are accessing scientific datasets and expertise to generate scenarios. Developing countries are producing climate change scenarios through personal and institutional collaboration with scientists from developed countries. Vietnam has progressed well on this regard. It has a robust institutional setup at the national level to produce climate models, but there are still conflicts and competition in the production process within the country.

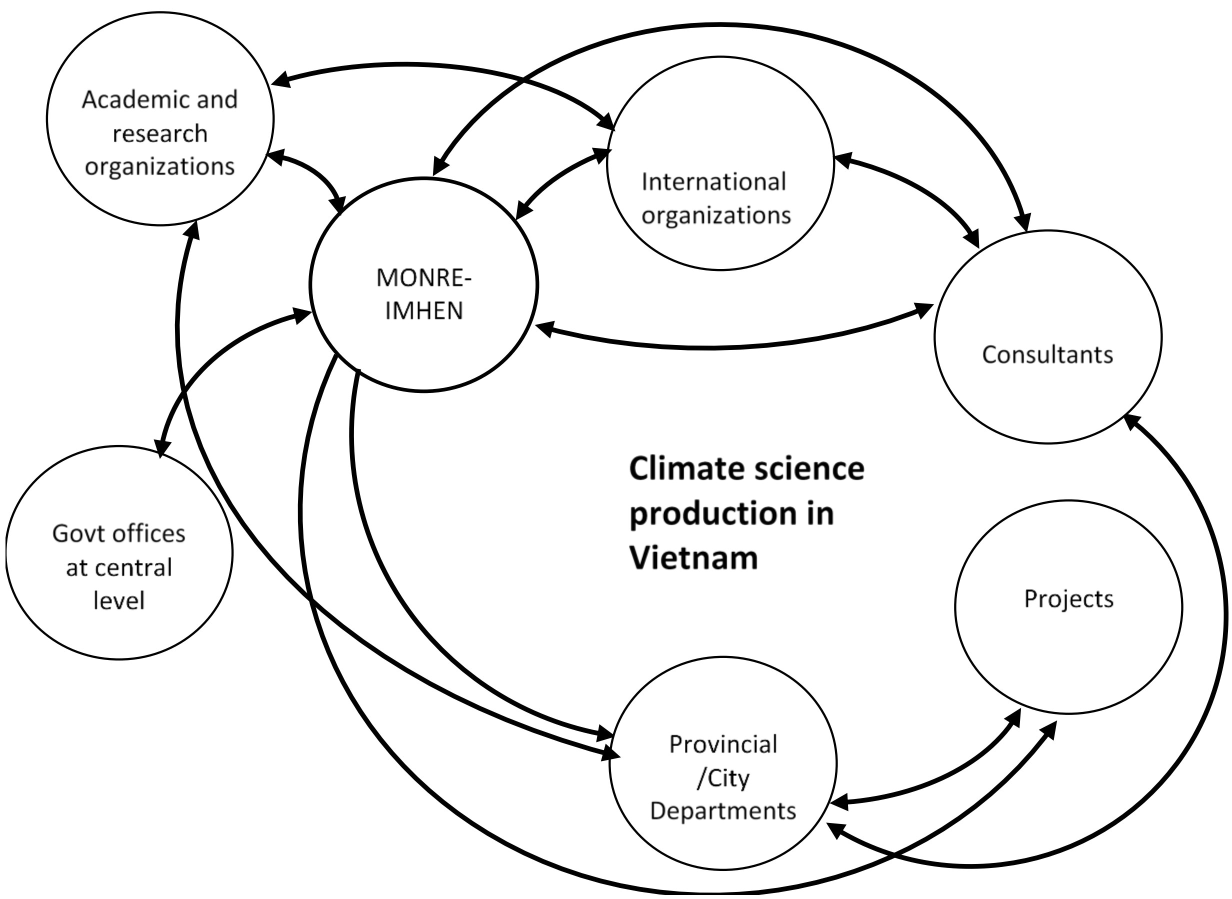
5.2. Climate Science Production in Vietnam: Government or Projects?

Climate science production is related to developing scenarios for different geographies. There are three sources of climate science production in Vietnam: national government, bilateral/multilateral projects, and provinces and cities. The official source of climate science is the Ministry of Natural Resource and Environment (MONRE). IMHEN is a scientific organization under the MONRE for producing climate scenarios.

There are several sectoral projects in collaboration among national, provincial and local governments that produce climate change scenarios for their focused areas. Independent scientists and consulting firms also produce scenarios for their specific interests and tasks. International organizations produce them for their works in Vietnam and these knowledge production streams are not independent of each other.

In practice, climate science production is considered as a linear rational approach led by IPCC (Abbott & Wilson, 2014). It needs long-term data. Future scenarios are constructed based on long-term datasets. Regional and global scenarios from IPCC predict future changes in temperature, sea level, precipitation, and drought. Economic growth is the major determinant of change. Multiple scenarios are constructed to provide future conditions of climate in different regions. Global and regional scenarios are taken to the national governments around the world and downscaled to national and local levels, and this is happening in Vietnam as well. The complexity of process and major actors in the production of climate science in Vietnam is shown in Figure 5.2.

Figure 5.2: Government-led Climate Science Production in Vietnam



(Author, 2018)

In Figure 5.2, arrows show direction of communication and collaboration for production of climate science. The highest numbers are coming to, and departing from, the MONRE-IMHEN cell. IMHEN is a government organization with national authority to produce climate scenarios for the country. It has a relationship with academic organizations, international agencies, consulting firms, and other government agencies at national and provincial levels during scenarios production. It works with different government agencies to acquire data on climate change variables (temperature, rainfall, drought, tidal data, etc.) and socioeconomic changes. The second busiest cell is provincial departments that use climate scenarios in planning and construction projects. They produce climate change scenarios for their jurisdictions and contract consultants to accomplish the task.

5.2.1. Climate Science Production by National Government

The government of Vietnam has been producing climate science since 1994, although there are claims from government scientists that the government is participating in climate change modeling since 1980s. The first climate change scenarios were produced in 1994 with financial assistance from ADB and technical assistance of the Commonwealth Scientific and Industrial Research Organization (CSIRO). CSIRO is the federal government agency of Australia that conducts scientific research. Scenarios forecast change in temperature, monsoon pattern, sea level rise, and rainfall intensity all the way to 2070 (Asian Development Bank, 1994). In the same year, Vietnam rectified the United Nations Framework Convention on Climate Change (UNFCCC). Initial county communication to UNFCCC was delivered in 2003. It also rectified the Kyoto Protocol in 2002, which opened more opportunities for the country to join international initiatives of climate research. The evolution of climate science research in Vietnam is shown in Table 5.1.

Table 5.1: History of Climate Science Production in Vietnam

Year	1994	2003	2009	2010	2016
Publishing Agency	ADB & CSIRO	MONRE	MONRE	MONRE	MONRE
Publication Title	Climate change scenarios for Vietnam UNFCCC rectification	Vietnam: Initial National Communication under UNFCCC	Climate Change, Sea Level Rise Scenarios for Vietnam	Vietnam's Second National Communication under UNFCCC	Climate Change and Sea Level Rise Scenarios for Vietnam

(Author, 2018)

During this research, two climate research organizations (Hanoi University of Science (HUS) and IMHEN) and several scientists were interviewed in order to understand the process of climate science production at the national level. The reason for choosing these two organizations was their leadership in climate science production in the country. Individual scientists were associated with them. IMHEN has strong collaboration with international scientific communities to perform climate change analysis as it works on scenarios and makes recommendations to MONRE. The scenarios are then submitted to prime minister by MONRE where they become official scenarios of the government once the prime minister approves them. When given that status, they should be followed by all levels of government.

The national government has assigned the task of preparing national scenarios of climate change to MONRE, which then delegates assignments to IMHEN, and IMHEN collaborates with academic and research organizations within Vietnam and abroad to prepare climate change scenarios. The HUS under Vietnam National University (VNU) is IMHEN's major collaborator. Donor agencies work with IMHEN on climate change modeling. As a result, IMHEN was able to produce high-resolution scenarios of climate change for Vietnam in 2009 & 2016. The United Nations Development Program (UNDP), CSIRO, Climate Research Center of Norway, Meteorological Agency of United Kingdom, and the Meteorological Research Institute of Japan were technically involved in the production of scenarios in 2016 (Ministry of Natural Resources and Environment, 2016b). Contributions of donors and experts from other countries were highlighted by Vietnamese climate scientists during interviews. One scientist explained the involvements,

> *It [Project on climate change] has enabled the Institute to work with the meteorological services of UK, in particular, to bring models to Vietnam and to run these models and do some technical exchanges and advice. It also brought some hardware, such as you need some computers to run the model, we have been doing that capacity building partly inside the IMHEN itself and they are the core organizations in terms of the science of climate change. So they are not specialized on adaptation or mitigation but the science is what they are, historically what is they good at and they are for it. We help [on] that to some extent. They learn from their exchanges with the Japanese and the British themselves as directed with the other funding with the Australian climatologists and meteorologist and most government organizations, so we are not claiming to be explicit supporter of the IMHEN in that sense but you can say that in the past eight years, we have been building our relationship with them, and project with them at least for six years, probably longer and that has enabled to produce those scenarios that are in the public domain, including downscaling of some of that, including inundation maps and few other climate data.*
>
> *(Personal interview, 2014)*

Donors have a long history of involvement with climate change modeling in Vietnam. This includes exchange of technology, hardware capacities, human resource development, and collaborative learning, which allows climate science to flourish in Vietnam. National scenarios of 2009 is one robust example of donors' support for climate science production. The second version of these scenarios was published in 2016. There were a number of climate change scenarios produced for Vietnam before 2009 as well.

In 2009 scenarios of climate change, average temperature change was 0.5 to 0.7 °C annually between 1958 and 2007 (Ministry of Natural Resources and Environment, 2009). The climate change scenarios were generated by streamlining global scenarios, including the development of national scenarios at low emission (B1), medium emission (B2) and high emission (FIA1) (Ministry of Natural Resources and Environment, 2009). The country is divided into seven climatic zones (North West, North East, North Delta, North Central, South Central, Central Highlands, and South) and prediction of temperature, rainfall, and sea level rise (as applicable) were done under all three scenarios. MONRE recommends the use of medium emission scenario (B2) nationally because it is a plausible scenario internationally as well (Ministry of Natural Resources and Environment, 2009). Winter temperature change is faster than summer ones. With the comparison of 1931-1940 trend with 1991-2000, temperatures rose by 0.8, 0.4 and 0.6 °C in Ha Noi, Da Nang and Ho Chi Minh City, respectively, during 1991 and 2000.

Table 5.2: Climate Change Projections for Vietnam

Trends and Projections	Temperature (°C)	Rainfall (%)	Typhoons	Sea level
2009 (Past trend –mid 20th century to 2007)	0.5-0.7 °C increase	2% decrease	More abnormal typhoons	Average 20 cm rose
2016 (Past trend – mid 20th century to 2014)	Increased by 0.62 °C from 1958 to 2014. It increased by 0.42 °C from 1996 to 2016.	Rainfall decreased in Northern climate zones (5.8 % to 12.5 %) and Southern climate zone (6.9% to 19.8%) between 1958 to 2014	Typhoons became stronger (more in number of events with level 12 or more in Beaufort scale)	13.72 cm rise since 1960s. Annual rate is accelerated since 1993 to 3.34 mm per year.
2009 (Projection until 2100)	North West: 1.7, 2.6, 3.3 °C; North East: 1.7, 2.5, 3.2 °C; North Delta: 1.6, 2.4, 3.1 °C; North Central: 1.9, 2.8, 3.6 °C; South Central: 1.2, 1.9, 2.4 °C; Central	North West: 4.8, 7.4, 9.3; North East: 4.8, 7.3, 9.2; North Delta: 5.2, 7.9, 10.1; North Central: 5.0, 7.7, 9.7; South Central: 2.2, 3.2, 4.1; Central Highlands:	Number of higher intensity typhoons are expected to increase. Number will increase in southern part of the country.	Sea level would rise about 65 to 100 cm relative to baseline of 1980-1999 by 2100. In the case of low (B1), medium (B2) and high (A1FI)

	Highlands: 1.1, 1.6, 2.1 °C; South: 1.4, 2.0, 2.6 °C (°C for B1, B2, and A2 scenarios, respectively)	1.0, 1.4, 1.8; South: 1.0, 1.5, 1.9 (in percentage for B1, B2, and A2 scenarios, respectively)		scenarios, sea level rise expected to be 65, 75 and 100 cm by 2100.
2016 (Projection until 2100)	RCP 4.5 North: 1.9 to 2.4, South: 1.7 to 1.9 °C RCP 8.5 North: 3.3 to 4.0, South: 3.0 to 3.5 °C (RCP 8.5)	5 to 15% increase under RCP 4.5 and 20% increase under RCP 8.5	Number of weak and moderate typhoons are likely to decrease but strong typhoons are likely to increase	RCP 4.5: 55 cm with 33 – 75 cm range. RCP 8.5: 77 cm with 52-106 cm range.

(Ministry of Natural Resources and Environment, 2009, 2016a)

Scenarios were updated in 2016. The update was based on IPCC 2013 global and regional climate change assumptions which are different from 2009 emission scenarios. The assumptions are mentioned as representative concentration pathways (RCP) and included emission scenarios. Each aspect of climate change was projected under different RCPs at a global level. For Vietnam, two concentration pathways were selected: RCP 4.5 and RCP 8.5. They assume CO2 concentration as 650 parts per million (ppm) and 1,370 ppm, respectively. The RCP 4.5 assumes stabilization of emission without overshoot, and RCP 8.5 assumes continuous rising emissions by 2100 (Ministry of Natural Resources and Environment, 2016a). The rationale behind selecting them is to make 2016 scenarios consistent with 2009 versions. The 2016 report divides timeline of projection into three phases: near future (2016-2035), mid-century (2046-2065) and end of the century (2081-2100). Findings of 2009 and 2016 scenarios are symmetrical except some methodological differences. Geographic areas are presented differently (at least for estimation of temperature). Both are output of combine efforts between government, academic and international scientific organizations of climate change.

Donors and Vietnamese scientists have engaged in joint efforts to produce science in Vietnam. Collaboration has included exchange of scientists and capacity building (skills and hardware). Climate scientists have also highlighted the collaborations in their work as credibility of results and their contribution to science production process at the national level.

Climate scientists are happy to discuss their involvement in different climate science projects, and this enthusiasm is reflected during interviews with them. They said that they were working on multiple projects in various locations within the country and abroad.

Collaboration among climate scientists within Vietnam occurs at the personal level. Based on past joint experience or becoming close friends during an academic journey are major motivations of scientists to collaborate for climate modeling. They start with a team from the beginning of a project and work together to execute tasks of climate scenarios. Most of these projects are funded by bilateral and multilateral agencies. During interviews, one scientist explained the collaboration at the personal level,

> *We have the network connection among us. When someone is trying to make a project proposal they think that we can do this kind of component and Prof. [name is hidden] can do that component and we get involved from the beginning of the project proposal building and if the project got accepted then we get the part the project.*
>
> *(Personal interview, 2014)*

Another scientist added,

> *We are working together but before it was not as good as right now. Right now IMHEN has a new scientist in the leadership positions and they are easy to communicate with, particularly they are my friends. Many of them are graduated from the same University. We collaborate well. For example the climate system I built here through my modeling, I got much advice from them and also they can use my model output and my methodology in their projects and, actually I'm also involved in one project of my friend.*
>
> *(Personal interview, 2014)*

Because authority in climate science production is centralized in Vietnam, government scientists claim leadership in climate science production and hold that the government's results are the only valid source of climate scenarios. There is very little opportunity for funding of scientific organizations outside of IMHEN. Donor agencies have to work with IMHEN. A scientist from IMHEN explained the authority of the agency on climate science production,

> *IMHEN is the leading organization in Vietnam working on climate change modeling. It is the only institution working for climate science basis for Vietnam. We have some other agencies working on climate science basis but their work is mainly supporting to IMHEN. More than 30 years ago, IMHEN started to work on climate change. We are more focused on climate change science. We are assigned by the government to construct the climate change simulation scenarios for Vietnam. As you see the climate change simulation scenario for each province, means in Vietnam, is produced by this office. Technically, we work to construct the climate change scenarios and we submit the scenarios to MONRE that is Ministry of Natural Resources and Environment. And then it approves the scenarios and submits to the government for final approval.*
>
> *(Personal interview, 2014)*

Confidence and capacity are high among government scientists, whereas these qualities are not encouraging outside of the government. Academic climate scientists are more concerned about the quality of work, and they feel that they do not have enough opportunities and resources to fully engage in climate research. Even though climate scientists in universities and consultant firms have expertise on climate modeling, their work will not impact on decision making because they do not have the authority to deliver the science to governments. Their models must be accepted by IMHEN to be considered as climate scenarios for Vietnam.

Scientists are not motivated to engage in transmission and mainstreaming of climate science to policies and planning. They believe that once scenarios are published, government agencies at all levels have to follow them in planning and decision-making. They explicitly highlighted this point during interviews for this research. In practice, however, the link between production and utilization of scenarios weakens as bureaucratic and administrative distance between national level and local level increases. Local planners and decision makers tend to perceive climate change scenarios produced by the national government as irrelevant. Details of this disconnection between the national government and provincial/local governments are presented in subsequent sections of this chapter.

5.2.2. Climate Science Production by Projects

Projects are the second most effective venue of climate science production in Vietnam. Scientists are involved in generating climate science at local levels (provinces and cities) through projects related to master planning, disaster risk reduction, and climate change adaptation. They work as consultants, institutionally and personally, and perform the role of boundary agents in these projects by producing finer scale scenarios and disseminating them.

Besides developing national scenarios of climate change, IMHEN works as a consultant at the local level to customize scenarios. During interviews, scientists repeatedly mentioned their involvement in different climate change adaptation projects in provinces and cities. Scientists from IMHEN and HUS work as climate science experts and advisors for different funded projects, NGOs, private consulting firms, provinces, and cities. Their roles under these various entities are diverse. One commonality in their involvement is that they convey climate science to project locations. It could be either a production of climate change scenarios or delivery of climate science through conferences, workshops, and training. They involve in multiple projects simultaneously, and are hired by provinces and cities as consultants in the production of scenarios of individual hazards such as drought, flooding, sea level rise, saltwater intrusion, and rainfall pattern. They are also invited to deliver lectures in training and workshops about potential impacts of climate change on the city or province. Their involvement in projects was highlighted by scientists during the interview. One scientist said,

> *That means we had four projects, sorry. In Quang Nam, we have been asked by the province to build the future projection of climate change for Quang Nam. That project was funded by DANIDA. I'm not directly [in] contact to the Quang Nam province, what I did was a component of the project. The project was contracted to the Quang Nam's people ['s committee]. That is Quang Nam. The second one is for the Highland region of Vietnam. We have a request from the German company. They request us to provide information about the climate change that can impact on the coffee production and cultivation. We just have that project. Another project is the project that is needed by Prof. [name is hidden] in the North Central part of Vietnam for the three provinces that are Ha Tinh, Quang Binh, and Thanh Hoa, we have to provide for future climate projection for this provinces.*
>
> *(Personal interview, 2014)*

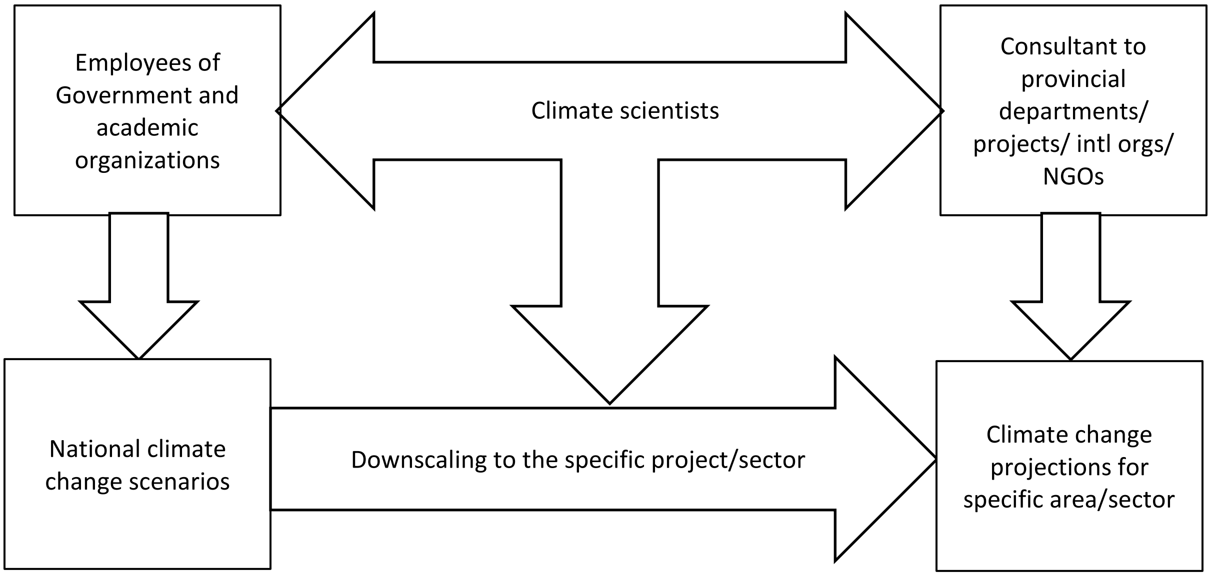
Climate scientists downscale climate change scenarios for their clients through extraction from the national dataset. As boundary agents, their role is to bring scientific knowledge of climate change to decision making so that climate science reaches provincial and local levels.

There is not any province or city that has initiated a climate scenario production process without experts. In case of Quy Nhon, scientists were involved in scenario modeling for the provincial government. Climate change scenarios for the city were prepared under the ACCCRN Project, and information from the scenario was used by different provincial departments, including the Department of Construction (DOC). As a result, Quy Nhon Master Plan 2015 has been progressive in addressing climate change impacts. Details of the master plan are presented in Chapter 6. This involvement is also project-based. One scientist involved on climate change modeling for Quy Nhon City said,

> *. . . at first, I made some flooding maps for the Quy Nhon City, the purpose of that study was to build the awareness among the city people [government officials] that want to extend the sea level rise impacts to the flooding problem in the city. We also did some analysis about the impacts of climate change in the Tuy Phuoc district. That shows the extent of the impact of climate change among the poor people that includes analysis of how the climate change can impact to the irrigation system that may result to a reduction in the productivity of agriculture, it also included the potentiality of the insects that can damage the crops. The second step was that we developed the high scale model. With the model they can calculate the flooding condition, they can calculate the drought condition for the Quy Nhon City. We allowed task for that model for some Departments in Quy Nhon City that includes the [3 departments' names are hidden] so that they can use the model and then calculate the future condition that can happen. ………………… When they are concerned about flooding, they can ask the city government to delegate some budget to ask some consultant to carry out the work for them. It is easier for them rather than doing the same work by themselves because they may not have the capacity. That is the reason why even with us, for the model, we created for them, they could not use that model as we expected.*
>
> *(Personal interview, 2014)*

Climate scientists in Vietnam works as permanent employees of the government and as expert consultants for projects at different levels (national, provincial, city, NGO, consulting firm). This double role of scientists on climate science production is presented in Figure 5.2.

Figure 5.3: Dual Roles of Scientists in Climate Science Production in Vietnam



(Author, 2018)

Figure 5.3 shows that climate scientists are working in government agencies like IMHEN or working in universities and academies of science. That is their permanent appointment. They are involved in production of climate change scenarios at the national level. When they are contacted by the provincial government and other entities (NGOs, INGOs, and projects), they use the same expertise to downscale scenarios for the province, city, or project areas.

Involvement of scientists as consultants carries higher weight in local climate science production. It is believed that climate scientists from the national level have better access to valid information. Scientists also believe that climate change scenarios from the government are the most realistic. One interviewee scientist explained the authority of climate science from government,

> *We do not have a problem to work with the local level. These climate scenarios are signed by President. No one goes against it. This is approved by the Government. Only sometimes, we have some counter front or opposite ideas and opinion about the climate change.*
>
> *(Personal interview, 2014)*

Involvement of a government agency as a consultant to a province or city is common practice in Vietnam. Provinces are seen as lacking the capacity to develop a plan for climate change (Nam et al., 2015). There was a mandatory requirement from the national government that provinces and centrally controlled cities have to prepare climate action plans (CAP) under the National Target Program (NTP) of climate change. CAPs have used scientific projection of climate change as the basis to assess potential impacts. MONRE has prescribed a list of qualified agencies and consultants that could produce climate science and impact assessment for provinces and cities (Nam et al., 2015). Each province received 50 thousand USD to prepare a CAP. Provinces and cities were free to determine methodology and priorities of plans. Financial support from NTP was a major motivation for provinces and cities to prepare climate scenarios. Besides centrally controlled cities, few other cities have produced climate scenarios on their own. Mekong-Building Resilience to Climate Change in Asian Cities (M-BRACE) is a collaborative program managed by ISET-International. Two Vietnamese cities (Hue and Lao Cai) are supported in climate change adaptation and mitigation under this program with funding from the United States Agency for International Development (USAID). Few cities and provinces have direct technical support from international organizations on climate change adaptation and mitigation. For example, Can Tho City, Ben Tre Province, and Quang Nam Province were technically supported by international organizations to prepare scenarios and CAPs. Under ACCCRN, M-BRACE, and NTP, climate change scenarios and CAPs were produced by consultants. Climate scientists were part of a consulting team to produce these CAPs. Besides NTP, ACCCRN, and M-BRACE, there were sectoral projects in cities and provinces that generated climate scenarios. There is a large effort throughout Vietnam to develop adaptation interventions in agriculture and fisheries. This effort has generated climate change scenarios for the agricultural sector.

Quy Nhon CAP was published in 2010 under the ACCCRN Project which contained climate scenarios for the city. Scenarios included sea level rise, change in precipitation, saltwater intrusion, drought pattern, and sand drifting (Dinh et al., 2010). Since Quy Nhon is a provincial city, decisions are made by the provincial government. Besides CAP, scientists have been involved in flood and drought modeling for the city and surrounding areas. Projections of flood, drought, and sea level rise were included in the City Master Plan 2015. Beyond this, scientists developed a decision support tool for provincial departments to assess flood impact in different locations of the city. Climate scientists discussed the tool during interviews for this research.

During interviews, scientists described their trips to provinces and cities to provide lectures and presentations on climate change scenarios and impacts. All of them discussed their presentations in conferences and workshops at national, provincial and city levels. Such activities are more prevalent through sectoral projects on climate change. In the case of Quy Nhon City, involvement of scientists as developers of decision support tools and disseminators of climate science brought science closer to planners and decision makers.

Limitation of project-based science production is a spatial and temporal scope of work. Scientific scenarios of climate change are guided by objectives and scope of projects rather than the needs of communities. As a result, planning for interventions becomes short-term and project-focused. In anecdotal observations and conversations with government offices in Quy Nhon, it became apparent that the Climate Change Coordination Office (CCCO) has fewer activities on climate change in recent years because of termination of ACCCRN Projects. There were not many opportunities to continue funding for climate change related activities in the city through CCCO. This also generates the risk of "project-focused science production" rather than having climate scenarios for government agencies and stakeholders in the city.

5.3. Local Science: Climate Change Experiences in Quy Nhon City

The citizens' knowledge of local weather events (such as drought, rainfall, flooding, and sea level rise) is more trustworthy as a supplement for and source of verification of scenarios in Quy Nhon City. Provincial and municipal government agencies highlighted the importance of citizens' knowledge during interviews.

In general, local knowledge is not presented to policy makers as a source of information in developing countries. They judge scientific knowledge higher over local knowledge. This trend is changing, however. Social scientists are bringing local knowledge as an information source for decision making by highlighting its value in policy processes (Abbott & Wilson, 2014). It is also believed that local communities have a better understanding of the context into which climate change data must be placed (Luu, Von Meding, & Kanjanabootra, 2018), which in turn makes them resilient to local disasters.

Local knowledge was cited as a major source of information in decision making in Quy Nhon. Provincial departments described their discourse with local farmers and villagers regarding flooding, rainfall, drought, and saltwater intrusions when departments had projects for the area. Out of 18 provincial government agencies that participated in interviews, eight mentioned the role of local knowledge in their projects. One representative emphasized that local knowledge allowed him to verify climate scenarios. He further explained,

> *There is a lot of information but the most important is the experience of the people living around that area. Several years ago, these people chose to live in that area, they choose that place because they can understand the weather of the place, they also understand typhoon and flooding, with information in modern life like this to help me to make sure about my decision. Decisions from us usually follow experience of local people. For investors, if they want to come in this area, of course, we study hydro-meteorology of the area but we also ask people living around that area, combining both type of analysis: the [local] experience and the scientific data from hydrology meteorology. We can get a lot of information, especially the experience of the people is most important.*
>
> *(Personal interview, 2016)*

Provincial departments can be divided into two categories on the basis of their use of local climate knowledge. The first group values local knowledge and scientific information equally to get a better understanding of climate change. The second group posits community knowledge above scenarios of climate change. This group first consults locals around their project site to collect information on flooding pattern, water discharge, drought conditions, salt water intrusion, and typhoon impacts, then compare community opinions with scientific scenarios and decides whether to explore further on potential impacts of climate change. One interviewee said,

> *At first, we will talk to local people and find out the best level height of the flooding from the people of the area. We will ask the people in the area. If the design or the height is very abnormal, if the height of the flooding is very high we will need some document [records and scenarios] from other agencies to prove it and to crosscheck it. For example [we ask] from the Department of Agriculture or from the Department of Natural Resources and Environment, readings from the hydro-meteorology plant, etc.*
>
> *(Personal interview, 2014)*

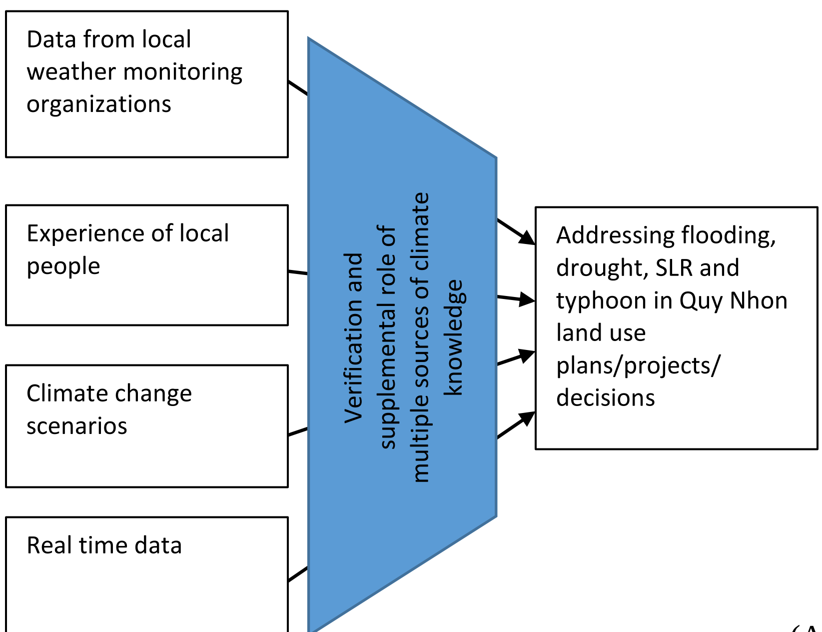
Another interviewee added,

The local citizens are most knowledgeable about the climate change than scenarios. The results of scenarios can be compared with the citizen's input and choose the best alternative scenarios for us.

(Personal interview, 2014)

Many provincial agencies referred to local knowledge as the base for climate change information. They mentioned that climate change is occurring in Quy Nhon and Binh Dinh Province, and referred to the experience of farmers and villagers. Climate change scenarios are not their primary sources; rather, they depend on local experience as a source of climate change data.

Figure 5.4: Interdependency of Knowledge Sources of Climate Change to Inform Provincial and City Agencies



(Author, 2018)

Provincial departments frequently described the local center for hydrology and meteorology as major source of climate data because it provides real-time local climatic data for them. They mentioned that such data is a critical source of climate knowledge.

Sources of climate knowledge are not independent of each other at provincial and municipal levels. Figure 5.4 explains their supplementary role. Provincial offices collect information on climate change from multiple sources to verify and supplement each other. Districts and wards, however, are different. The wards and districts do not look for climate science data. They normally act as administrators of provincial decisions rather than evaluating information from provinces and cities. Ward leaders mentioned that they had participated in several workshops and training on climate change organized by CCCO or other provincial agencies. They did not mention how they perceived the quality of data and information shared in those workshops and training.

5.4. Boundary Works on Climate Science Dissemination in Quy Nhon City

Boundary agents are leading dissemination of climate science among provincial and city departments in Quy Nhon City. Agents are CCCO, consultants, projects, climate scientists, local champions, and local mass organizations. CCCO is the most influential boundary agent to bring climate science to the city. It was established by provincial people's committee to implement ACCCRN and other climate change-related projects in province. Besides Binh Dinh Province, CCCOs of Da Nang and Can Tho were formed to administer the ACCCRN Project. Although approaches are different among three CCCOs, the common objectives were: to serve as a coordination function; collect and interpret data of climate change, climate risk assessment in the city; develop multi-sectoral strategy for climate change; coordinate external funding on climate change; and technical capacity building on climate change planning (Taylor, 2017). This led to a boundary function between science and decision making of climate change in Quy Nhon. The organizational structure of the CCCO in Quy Nhon is comprised of representatives from provincial government agencies as a steering committee. It shares staff with the provincial Department of Natural Resource and Environment (DONRE), and its functions include organizing workshops and training, providing feedback on projects and sectoral plans from the perspective of climate change mitigation and adaptation, and providing technical support to provincial departments on climate risk assessments. During the interview, a department associate explains involvement of CCCO in its projects,

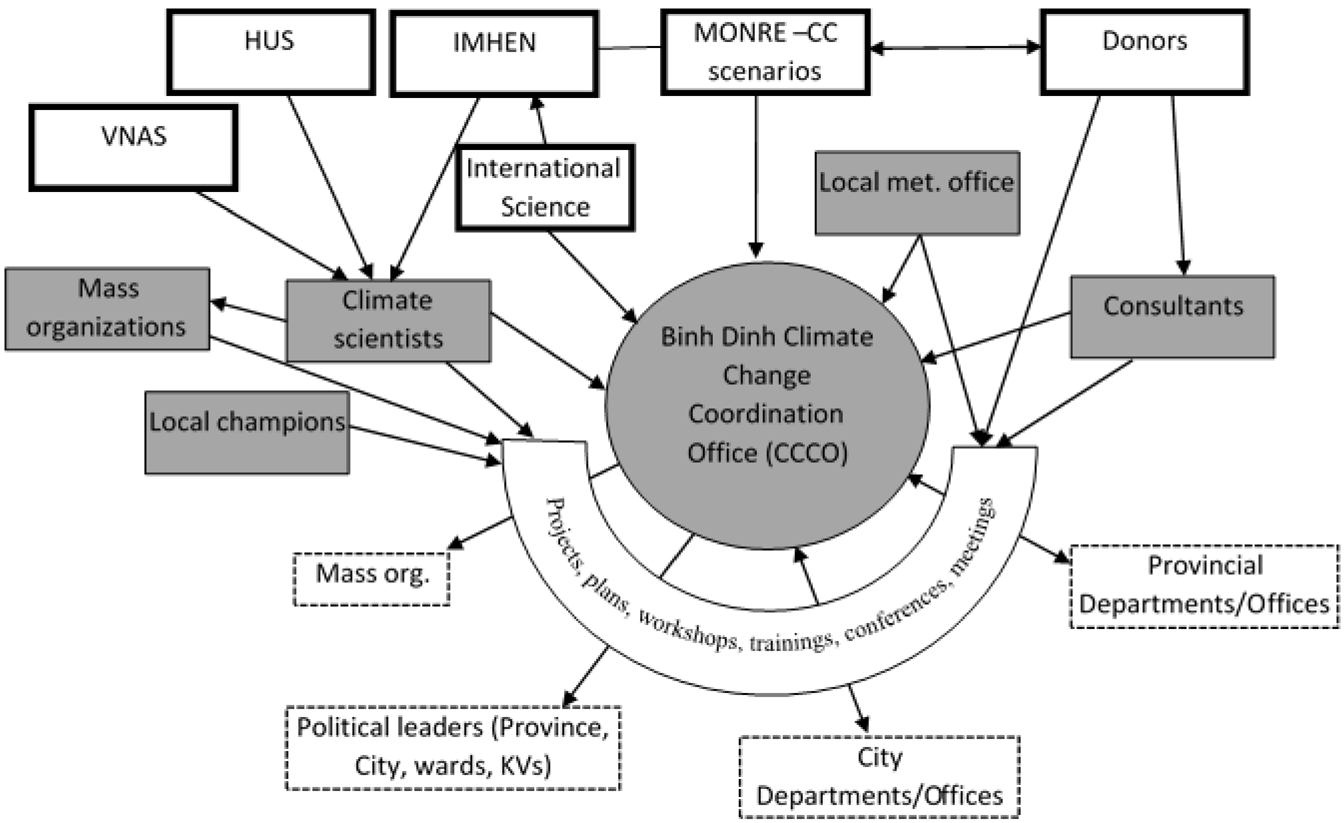
> *When we are conducting some projects, some issues of climate change and the environment in the industrial zone can come up. We normally invite CCCO to come and join the meeting and give us the comments. When they have some question or the issues related to climate change they normally called CCCO.*
>
> *(Personal interview, 2015)*

Second most critical boundary agents are consultants. They include climate scientists, planning contractors, and local experts. They are normally tied up with a project. The ACCCRN Project had multiple shared learning dialogue (SLD) through which climate scientists shared climate science with agencies in Quy Nhon City. The SLD is the platform allowing a range of participatory tools and methods to encourage brainstorming, discussion, and debate among stakeholders on trends, trajectories and key areas of vulnerability to climate change impacts (ISET-International, 2012). Projects invite scientists as short-term consultants in such forums in order to disseminate climate science through presentation, group exercises, and documents. Scientists customize climate science in a simple way so that local departments and community leaders comprehend deliveries. Besides climate change related projects, climate scientists are also involved in sectoral projects that are sensitive to climate change. Agriculture is a sector highly sensitive to changes in weather and climate. Climate scientists aided in developing drought and saltwater resistant rice crops in Quy Nhon City. Other sectors are infrastructures development, waste management, and coastal resource management. The World Bank and the Binh Dinh People's Committee are implementing several projects on drainage management, wastewater collection and treatment, and solid waste management in Quy Nhon. They are considered as sensitive sectors in future impacts of climate change (Binh Dinh People's Committee, 2016). In such projects, there is a discussion of climate scenarios and potential impacts on the sector.

Local experts are the third important boundary agents for spreading climate science among local communities and government agencies in Quy Nhon. They include individual champions or institutions. During interviews, provincial government agencies referred to certain individuals who are influential in climate science dissemination in the city. Multiple interviewees mentioned a government employee in the Department of Agriculture and Rural Development (DARD) as a key figure for mainstreaming flood risks in policies and plans of the province.

While explaining official duties of an organization, the interviewee mentioned the role of mass organizations in disseminating climate science among members and local communities through training sessions and campaigns. For example, the local hydrometeorological office of Binh Dinh Province shares weather related data and models with provincial departments.

Figure 5.5: Boundary Agents and their Role on Climate Science Dissemination in Quy Nhon City



(Author, 2018)

Boundary works performed by different agents are shown in Figure 5.4. Dark shaded boxes in the figure represent agents. Their involvement with provincial and city offices is shown with arrows and lines. CCCO is the major boundary organization in Quy Nhon City. It works with all provincial and city offices on climate change. The direction of arrows shows the flow of climate science. Boxes with thick boundaries represent agencies at the national level. Boxes with dotted boundaries are provincial and city organizations. In interviews with ward leaders, mass organizations, and provincial departments, they pointed to CCCO as a major source of climate science. Climate experts from the CCCO are involved in different projects in Quy Nhon City and Binh Dinh Province to mainstream climate science.

During interviews, donors mentioned that they are involved through projects in capacity building of provincial departments to enable them to withstand climate change impacts. Large donors such as World Bank or UNDP are not directly involved, however. They work through consultants and Vietnamese counterparts to mainstream climate science in project activities. Consultants are normally working on projects. Climate scientists from HUS, IMHEN or the Vietnam National Academy of Sciences (VNAS) provide lectures in training, workshops, and conferences by customizing climate scenarios for Quy Nhon. They also share climate change scenarios with sectoral projects.

Even though CCCO is the strongest knowledge broker in the province, its mandates and functions are undermined by its perceived inferiority and limited administrative structure. One of the major constraints for the CCCO is lack of recognition by the Ministry of Home Affairs, so its status is experimental and only supported by the provincial government (Taylor, 2017). During interviews with provincial departments, one interviewee mentioned that he had a personal relationship with the leader of the CCCO rather than institutional for climate change. Local champions in the organization improved interaction among departments. They became boundary agents to disseminate climate science in the city.

5.5. Summary of Climate Science Production and Dissemination in Quy Nhon City

Climate science production in Vietnam is divided in three sources: national government, projects, and provincial and municipal offices. Complexity arises in production, accessibility, and dissemination. Production of climate science is unbalanced globally. Capacity and accessibility of climate science is skewered toward rich countries. Poor countries are relatively deprived of high quality climate science, and deprivation prevails in climate science production in Vietnam. Vietnamese climate scientists are always seeking collaboration with scientists from developed countries such as Japan, Australia, and the UK to produce climate change scenarios. Institutionally, IMHEN has had collaborative projects with developed countries since early 90s to produce climate change scenarios. It produced two sets of scientific scenarios of climate change for Vietnam since 2000 and holds sole authority to produce climate science for the country.

Climate science production also occurs at provincial and city levels through funded projects. Government-employed scientists from IMHEN, HUS, and VNAS are consultants in projects to downscale climate change scenarios for provinces, cities, and targeted sectors. Besides knowledge production at national, provincial, and municipal levels, experience-based knowledge is equally important in Quy Nhon. Provincial departments and city offices rely on local experiences of flooding, droughts, rainfall, and typhoons to mainstream climate change impacts in plans and projects. They use local knowledge to verify and supplement climate change scenarios and real-time hydro-meteorological data.

Even though IMHEN and MONRE believe that climate scenarios are blueprints for the country, dissemination to provinces and cities is not strong through their line agencies. Boundary agents play critical role in bringing climate science to the province and Quy Nhon City. The Binh Dinh CCCO has been most proactive in customizing and disseminating climate science to provincial departments and lower jurisdictions, including Quy Nhon City agencies. Besides the CCCO; planning consultants, climate scientists, local champions, and mass organizations are key boundary agents in disseminating climate science in Quy Nhon City.

CHAPTER 6. UTILIZATION OF CLIMATE SCIENCE IN QUY NHON MASTER PLANS

This chapter covers how climate science is utilized in land use plans of Quy Nhon City. Two master plans of the city from different time periods are evaluated to assess how the climate change is addressed in them: Master Plan 2004 (an update of Master Plan 1998) and Master Plan 2015 (an update of Master Plan 2004). They are most recent master plans of the city. Evaluation of the master plans followed framework of transmission, understanding, and implementation of climate science. Details of the framework are described in Chapter 3.

Climate change is a fairly new topic in Vietnam. Between 2004 and 2015, many projects, programs, and institutions have been established in Quy Nhon City. The Asian Cities Climate Change Resilience Network (ACCCRN) Project from the Institute for Social and Environmental Transition (ISET) and the Ministry of Natural Resource and Environment (MONRE) is the major booster of climate change awareness and interventions in the city. It was implemented from 2008 to 2014 in Quy Nhon. The Climate Change Coordination Office (CCCO) was established by the provincial government to implement the ACCCRN Project. ACCCRN and other funded projects in the city improved transmission and understanding of climate science among planners and decision makers. As a result, topics of climate change were incorporated into the Quy Nhon Master Plan 2015. Understanding has been stronger than transmission and implementation, however. Implementation has a long way to go in the planning process. There are a number of challenges when implementing climate science in projects and programs designed for climate change impacts. Based on interviews and informal communication with local decision makers and planners, institutional and personal incentives have been a major driving factor for implementing climate science in Quy Nhon City.

Analysis and conclusion of the chapter will respond to the following research question. The analysis does not cover the actual implementation of master plans, rather it covers the contents of the plan documents.

- How is scientific knowledge of climate change used in master plans of Quy Nhon City?

Content analysis of master plans was conducted using qualitative software discussed in Chapter 3. Organized document reviews were conducted with scientific publications on climate change. Interviews with provincial and municipal agencies, and informal communication with local residents and government officials in the city clarified challenges associated with climate science utilization in master plans.

6.1. Climate Science Utilization in the Quy Nhon Master Plans (2004 and 2015)

Master Plan 2004 has 5 chapters. It is an update of Master Plan 1998. Master Plan 1998 could not be included in this analysis because it was not publicly available, and mainstreaming of environmental issues in plans and policies was more significant after 2000. This trend was highlighted by climate scientists and decision makers during interviews for this research.

Master Plan 2015 is an update of the 2004 Plan. It sets a new direction for master planning of the city. It is a 296-pages long document with 10 chapters and 3 appendices. As in Master Plan 2004, this plan also starts with the rationale behind the establishment of an update of the previous master plan.

Master plans differ on how best to outline and implement climate change adaptation. Scientific knowledge of climate-related disasters such as flooding, typhoons, droughts, and sea level rise are discussed rigorously in Master Plan 2015 compared to Master Plan 2004. Master Plan 2015 quotes climate change scenarios in Vietnam in multiple chapters, and proposes adaptation and mitigation measures for land use planning. Flooding is extensively discussed in the plan as well. In contrast, Master Plan 2004 has no coverage of climate change and associated impacts. It only briefly mentions flooding in Quy Nhon while discussing the need for drainage improvements. The overall impression of climate change is limited because it focuses on economic growth and infrastructure development.

The plan evaluation framework (discussed in detail in Chapter 3) hovers around utilization of climate science to inform adaptation measures in the plans. The three components of climate science utilization are knowledge transmission, understanding, and implementation. Content analysis of the master plans and associated publications were conducted.

The planning process in Quy Nhon City is prescriptive and top-down. There is very little flexibility for provincial and city agencies to influence the process. Provisions of plan preparation come from the national government, and the law prescribes administrative steps, starting from contract to consultants to approval of a plan. There are provisions for the process, but discretion in preparation is on consultants in terms of process, data, and use of science. That is why it is hard to assess how climate change science has influenced adaptation and mitigation strategies. Plan preparation meeting minutes from municipal, provincial, and national levels were not accessible. In such a situation, content analysis become a more relevant method of obtaining relevant data (Krippendorff, 2004) because it allows the researcher to draw meaning from narratives based on context.

The planning context of Quy Nhon City has changed between 2004 and 2015. New institutions on climate change have been established. There are bilateral and multilateral projects, including ACCCRN. Government agencies, leaders, mass organizations, and communities are more empowered to face impacts of extreme temperature, flood, typhoon, drought and sea level rise. Two major floods occurred in 2009 and in 2014. The first flood caused US$280 million worth of economic damage and claimed 122 lives in Central Vietnam (DiGregorio & Van, 2012). Before 2004, perceptions of flood, typhoons, and other local disasters were different. They were defined based on natural science, which assumed that they were unavoidable by residents of the city (Cardona, 2013). Awareness of climate change at national, provincial and local levels was limited. Previously, the intensity of flood impact in Quy Nhon City was not as bad as 2009 or 2014 floods. There was limited bilateral and multilateral funding on disaster risk reduction and climate change adaptation, and Quy Nhon City was smaller in size. The landscape was relatively unaltered. Some of these contextual changes have been considered during content analysis of the master plans of the city.

6.1.1. Master Plan 2004

There is no discussion about how scientific information on climate change is utilized in the plan. This includes a disclosure of impacts on flood, typhoons, droughts, and sea level rise. There is no discussion about the plan making process. In fact, it is challenging to trace a planning process of any master plan in cities of Vietnam. The only documentation available on plan preparation is decisions of provincial people's committees and the Department of Construction (DOC) for contracting consultants. Besides this, planning process is governed and guided by consultants. As a result, it is challenging to trace in written form how master plans of the city were prepared. In order to understand the use of climate science in the plan, it would be relevant to assess the situation of climate science production in Vietnam before 2004.

Scientific literature on climate change published before 2004 was reviewed to assess the status of climate science production in Vietnam. Based on the review, there were three publications before 2004 which discussed climate change scenarios for Vietnam. First was an Asian Development Bank (ADB) publication on impacts of climate change in Vietnam that was published in 1994. One major difference between this report and recent reports on climate change scenarios for Vietnam is that the 1994 report was led and published by the ADB. There was no active involvement of government agencies in the research for the report. Scenarios presented were produced by the Commonwealth Scientific and Industrial Research Organization (CSIRO). Temperature was expected to increase between 1.2 and 4.5 degrees °C by 2070 in the North and 0.5 to 3.0 degree °C in the South (Asian Development Bank, 1994). The report also predicted an increase in typhoon activities, decrease in rainfall during dry seasons, and increase in rainfall in monsoon seasons. Sectoral impacts of climate change were identified in agriculture, water resources, coastal areas, forestry, human health, energy system, and transportation. The report also discussed policy options to cope with these impacts.

Before this report, there was another briefing document published by the University of East Anglia entitled "Global Warming and Vietnam". It contained data, impacts, and Vietnam's policy responses to global warming. Climate change has been observed in the region since late 19th century. Regional average temperature remained constant from 1895 to 1980. Since the 1980s, however, temperature and rainfall patterns started to change in Vietnam (Granich, Kelly, & Ninh, 1993). Tropical cyclone activity has increased since the 1950s. The briefing document includes sea level rise scenarios and presented impacts of climate change on public health, agriculture, biodiversity, water resources, and mangrove ecosystems. The final section of the document presented policy responses and challenges to address climate change in a Vietnamese context. It mentioned that the Vietnam Climate Action Plan prepared by the Hydro-Meteorological Office would guide the socioeconomic development strategy of the country and strengthen international cooperation.

The third milestone in climate science production was Vietnam’s initial national communication under the United Nations Framework Convention on Climate Change (UNFCCC) in 2003. Besides greenhouse gas inventory and reduction strategies, the report included climate change scenarios for Vietnam. It included a temperature change forecast for regions of the country. On average, it was expected that the temperature in South Central and South would increase by 1.5 °C by 2070 (Vietnam Ministry of Natural Resources and Environment, 2003). It also predicted a half a meter sea level rise on average by 2070.

Transmission of climate science was limited in Master Plan 2004. None of the information discussed in three reports was transmitted to the Plan of Quy Nhon City. As result, the utilization of climate science in the Master Plan 2004 was none. The plan did not mention the words “climate change”. It focused on socioeconomic development and land management in the city, and mentioned that the population growth rate of the city was 1.62% in 2004. Total population in 16 wards was 223,305 people in 2000, out of which about 57% was active labor force. Total area of the city was 21,644 hectors including 14,531 hectors of inner city and 7,113 hectors of rural areas (hinterlands). Information in the Plan was related to economic performance, especially industrial development in the city, and its contribution to overall economy of province and the status of the city at the national level. For example, Quy Nhon was one of three tourist centers in Central Vietnam; the Phu Tai Economic Zone of the city provided employment to 8,846 people, and its area has been enlarged to 140 hectares from 101.7 hectares. The trade sector contributed 47.8% of total GDP of the city in 2000, which was equivalent to 716.9 million Vietnamese Dong (VND).

Planning and administrative context showed a lack of mainstreaming cross-cutting issues like climate change in the master plan. Absence of institutions that could play the role of connector among line agencies was the main reason. Vietnamese administration operates through line agencies from national to local levels. During interviews, non-governmental agencies and mass organizations mentioned that sectoral agencies are reluctant to exchange and supplement responsibilities and duties across sectors. An interviewee said that his national agency was first in the country to introduce climate change programs. Another interviewee said that he relied on his national agency to get information and materials on climate change. They did not reach out each other to share and request climate change related materials. In the absence of coordinating organizations at national and local levels, government agencies just followed their own line agencies. Their boundaries of duties and responsibilities wer rigid and focused in respective sectors.

Master Plan 2004 was coordinated and prepared by the DOC, reviewed by the Ministry of Construction (MOC) and approved by the prime minister. There was not any interaction with other agencies during preparation except asking for data, and feedback and comment on the final draft of the plan. As a result, transmission of climate science from the contemporary Hydro-Meteorological Office did not reach the DOC and MOC. Climate change was considered as a part of science and environmental management only, so its cross-cutting nature was not realized. This limited the transmission of climate science from three reports in the Master Plan 2004. Common hydro-meteorological disasters such as flooding and typhoons are discussed in the plan and are presented as a part of suitability analysis of an area development. There is not, however, any discussion on future scenarios of sea level rise, temperature change, rainfall change, flooding, and drought.

As background information for land use planning, industrialization, environmental management, and urban boundary expansion, the plan discusses environmental factors. Considerations are not specific to impacts of climate change or potential risks from disasters. Rather they are taken into account for projects on housing development, water supply expansion, waste management, industrial park establishment, and energy supply expansion. Transmission of knowledge is not presented as a part of Table 6.1 because nothing was found that described how scientific information of flood, typhoons, and drought was received during the plan preparation.

Table 6.1: Understanding and Implementation of Climate Science in Quy Nhon Master Plan 2004

Understanding	Implementation
- Quy Nhon city is located in moderate climatic zone under which winter is not cold and humidity is relatively low with average rainfall. - Low lying areas will be elevated by filling before using for development to avoid flooding and erosion. - Construction in the Phuong Mai Peninsula will not have flooding because it has high sand dunes. - Intense rainy season is from September to November and most storms occur in October in Quy Nhon City. - Wastewater and waste oil from ships will be managed properly to avoid environmental pollution. - Information on emission and noise levels from factories will be collected to help meet the national standard QCVN 26:2010/BTNMT. - Quy Nhon has an average rainfall of 1600 mm – 1700 mm. - Temperature exceeds more than 28 °C on average during four summer months.	- Construction in both sides of river is prohibited; planting trees is allowed. - Some reservoirs (Phu Hoa, Phu Tai, and Bong Hong Lake) will be dredged to regulate water in the reservoirs and make them appropriate for local climate conditions. - There is a lack of a sewer system in the city. Inner city sewer system is not integrated with drainage system even though there is some sporadic construction. - In next few years, the drainage system in central areas and a new drainage system on roads will be constructed in the first phase. That includes construction of culverts in residential areas and in industrial areas in Basin 1, 2, 3, and 5.

(Author, 2018)

Flood was most recognized hydro-meteorological disaster in the plan. There was a discussion in the plan on suitability of land for development. In Chapter 3, lands were categorized in terms of gradation based on flood inundation. Categories are: not favorable, less favorable, and most favorable. The most favorable lands were those without inundation and less than 10 percent slope, whereas unfavorable lands had more than 25 percent slope with high flood potential. The amount of land was also presented for each category. The result is a good understanding of flood potential in land use planning. Industrial development, infrastructure expansion and improvements, and land use provisions were most widely discussed topics in the plan. Lack of sewage and drainage systems was reviewed. While describing the topography of the old city area, the plan explained,

> *Old city areas are built up areas; structures are located on the ground level including roads with a 1% flood. The city is expected to expand into the North towards Phu Hoa Lake, Bui Thi Xuan Ward, and Tran Quang Dieu where construction is less. Some areas with a low elevation of <2.0 m flooded regularly.*
>
> *(The Quy Nhon Master Plan, 2004)*

Although there is not any discussion on climate change in the plan, there is recognition of local hydro-meteorological disasters and associated environmental problems as well as discussion of local climatic factors. There are measures for dealing with flood and the regulation of water in reservoirs. Setback from the riverbank is an example of adaption with floods. Similarly, widening drainage system and dredging reservoirs reduce flood problems in the city. The major objective of using data of rainfall, temperature, floods, and typhoons is to attract economic activities such as tourism, real estate, industries and infrastructure development. Even though the plan did not mention the term “climate change”, there were instances of using scientific knowledge of flood, typhoons, temperature, and rainfall in the plan. Overall utilization of scientific knowledge of climate change in the plan is presented in Table 6.2.

Table 6.2: Overall Utilization of Climate Science in the Quy Nhon Master Plan 2004

Climate science utilization	Status	Justification
Transmission - Communication of climate science - Relationship between scientists and policymakers/planners - Sources of climate science	Weak	There are a number of reports on climate change scenarios published before 2004. But none of them has any influence on Master Plan 2004 of the city. The plan does not refer any information on climate change.
Understanding - Reference to climate change scenarios for the city including floods, typhoons, droughts, rainfall change, etc. - Awareness of climate change – citation and discussion on terms and concepts - Identifying risk and vulnerabilities to climate change impacts	Weak	There is a discussion of local weather phenomena in the plan. It talks about hurricane, flood, and temperature in summer. There is not any specific citation on changes in those phenomena. They are presented as parts of local environment.
Implementation - Efforts to use climate science in plans and decisions - Use of science in policy processes - Use of climate science to inform decision on zoning, construction standards, building codes, permits, and land use changes - Changes in impacts of hydro-meteorological disasters	Weak	The plan mentions river bank setback. It mentions reservoir dredging to regulate water in the city. It also mentions improvement and expansion of drainage networks in the city. But none of these are informed by climate science. Rather they are done to protect local environment and reduce loss from reoccurring floods and typhoons.
Overall	Weak	Three steps of climate science utilization are not noticeable in Master Plan 2004.

(Author, 2018)

6.1.2. Master Plan 2015

Climate change scenarios and impacts were widely discussed in Master Plan 2015. Specific projection of sea level rise, temperature, drought, rainfall, flooding and typhoons were cited in several chapters. A major challenge for Master Plan 2004 implementation was a restriction of urban expansion posed by terrain and flooding issues. The banks of Ha Thanh and Kon rivers became unfavorable for urban development because the old areas on river banks were heavily affected by flooding (Chapter 1, pp. 6). In addition, there were uncertainties created by the climate change which were not addressed by Master Plan 2004. A lack of consideration of climate change in the course of urban expansion was a weakness of Master Plan 2004,

> *According to the Quy Nhon city's construction master plan up to 2020 approved by the Prime Minister in 2004, minimum construction height is H ≥ 2.5m and the maximum ground slope is 0.4%. Up to now, detailed plans have been approved and some of them have been implemented, most of which are basically built to comply with approved QHC standards. However, the 2004 blueprint does not address the issue of global climate change due to sea level rise as the QHC plan of Quy Nhon City and its vicinity is until 2030 and vision to 2050.*
>
> *(Quy Nhon Master Plan, 2015)*

The Master Plan 2015 discusses climate change rigorously. Except in Chapters 3 and 7, all chapters include some level of discussion on climate change impacts in the city such as sea level rise and temperature changes under different climate change scenarios (Chapter 2), impact of climate change on the flood pattern or drought (Chapters 1 & 2), challenge of climate change to urbanization (Chapter 1), and adaptation measures to potential impacts of climate change (Chapters 2, 5 and 8). Chapter two mentions climate change impacts fourteen times. Chapters 2, 4, 5, 7 and 8 discuss flood problem in Quy Nhon City. Improvement of the East Dike located in Nhon Binh Ward and planting mangrove forest in Thai Nai Lagoon are identified as adaptation measures to deal with future impacts of climate change (Chapter 2). Current dikes along the Thai Nai Lagoon do not meet standards issued by Ministry of Agriculture and Rural Development (MARD). They needed to be an upgrade to level V in first phase (capacity to adapt with 5% probability of flood). This strengthening would also be able to stop saltwater intrusion from the sea level rise scenario created for a 2050 projection plus a 5% rise in tides. Chapter 2 also discusses a provision to improve overall drainage system of the city to channel rainwater during monsoon while improving water bodies in order to deal with potential impacts. Chapter 8 contains extensive discussion on climate change impacts and adaptation measures. It proposes design standards for residential housing construction and agricultural expansion in the city as an adaptation and mitigation measure.

Transmission of climate science in the master plan can be traced through two sources: the master plan itself, and interviews with consultants and the provincial DOC (a provincial agency with authority to prepare and implement the plan).

Chapter 2 of the plan describes sources of climate change scenarios that are presented in discussions of sea level rise projections for Central Coast of Vietnam. It mentioned the Institute of Meteorology, Hydrology and Environment (IMHEN) under MONRE as the source of sea level rise scenarios, and observed that recommended emission scenario for Vietnam is B2. It specifies that the sea level rise would be 75 cm along coast of the Quy Nhon City by 2100. The chapter also discusses a projection on changes in temperature and rainfall. Based on citations of the IMHEN and the MONRE, there was some level of interaction between consultants and the IMHEN/MONRE during plan preparation. The consultants reached out to the IMHEN or MONRE to access reports and data on climate change scenarios. During interviews, they also explained their interactions with MONRE and IMHEN. One of the consultants mentioned that she had someone in her organization who helpd her get scientific data on climate change. She also mentioned that they had a certain unit in their organization that compiles data during consulting tasks. Another consultant was also asked how data and scenarios of climate change were acquired in the course of plan preparation. He said that their interaction with scientists was informal and ad-hoc. He emphasized that if they needed scientific data during their consulting job, they leveraged all connections and sources to acquire them. He further explained,

> *It [Sharing of scientific findings of the climate change results by scientific communities] happens very rarely. For that, the consultants, [when they] do the plan, if they need a certain type of information, then they just keep seeking the information, through the internet or through a personal relationship; they explore all the channels together seeking the information they needed. We don't have the formal channels so that the scientific information automatically coming to us as showing us the result.*
>
> *(Personal interview, 2014)*

Transmission of climate science between consultants of Master Plan 2015 and scientists is not institutional. The consultants said that they used all means to acquire data related to climate change, including formal, informal, personal and institutional channels. They also searched for data on websites and in reports.

Based on interviews with consultants and review of Master Plan 2015, scientific information on climate change comes to the master plan from IMHEN and MONRE. The consultants also mentioned a role of the Center for Hydrology and Meteorological Forecasting at national and provincial levels. The plan mentions these centers in multiple chapters.

Citations of the IMHEN and MONRE in the plan and discussions with interviewees about mediums of data acquisition demostrate that transmission of climate science from IMHEN and MONRE occurs during the plan preparation.

Understanding climate science in Master Plan 2015 is strong. The plan cites specific data on climate change impacts, including changes in rainfall, temperature, flood, sea level, and drought. It cites the role of climate change in exacerbating flood problem in the city. Chapter 2 discussed forecast of flooded area in the city with reference to different scenarios of sea level rise,

> *……… 1.4 km^2 by 2020; 1.48 km^2 by 2050; 2.81 km^2 by 2070 and 8.4 km^2 by 2100. The flooded area is the lowland terrain of Tuy Phuoc District, Quy Nhon City (Nhon Binh, Nhon Phu, Quang Trung, and Phuong Mai Peninsula). The flooded areas are affected by the tidal regime of Quy Nhon Bay.*
>
> *(Quy Nhon Master Plan 2015, pp. 87)*

Coverage areas of flood from sea level rise and tidal changes were based on a medium emission scenario (B2). It is projected to be 8.4 square kilometers by 2100.

Implementation of climate science in Master Plan 2015 is strong. In this case, it is not actual utilization of climate science in projects and development activities on the ground that are prescribed by the master plan. Rather, there are specific provisions in the Plan on building codes, zoning, construction standards, etc. There are numerous examples that explain how land use activities (housing, infrastructure) and emergency response systems will be improved to deal with flooding, typhoons, and droughts. The following excerpt is one example of adapting to flash floods, *The residential areas in downstream of Con River are areas affected by the Con River floods, grading and encouraging the construction of houses of 2 to 3 stories or more, the first floor should be left empty to respond when there are floods.*

(Quy Nhon Master Plan 2015, pp. 222)

In Chapter 8 of the plan, there are provisions to adapt and mitigate flood impacts. Measures include river dredging, strengthening existing dikes, limiting city expansion against hydrology of the area, moving settlements from river banks to safer areas, and limiting expansion of road networks in north-south directions in the city. Understanding and the implementation of climate science in Master Plan 2015 is presented in Table 6.3.

Table 6.3: Understanding and Implementation of Climate Science in Master Plan 2015

Understanding	Implementation
- <u>Overall climate change</u> Except Chapters 3 and 7, others have used term "climate change". Chapter 8 used the term 28 times and Chapter 2 used 14 times. Chapter 6 used only 2 times. Specific impacts of climate change in are mentioned as sea level rise, exacerbation of existing hydro-meteorological disasters in Chapter 8. Geographic areas and a segment of population that are most vulnerable to climatic phenomena are also identified. Damage to livelihood is also discussed (pp. 260-261). - <u>Sea level rise and emission scenarios</u> Emission scenarios and sea level rise projections are discussed in Chapter 2. In page 86, it discusses low (B1), medium (B2) and high emission (A1FI) scenarios and associated sea level rise in coastal areas of the city. It	- <u>Urban agriculture and open space preservation</u> Chapter 5 proposed a strategy to promote urban agriculture in Tuy Phuoc District to deal with flooding problem caused by climate change (pp. 140). The Chapter highlights that promotion of urban agriculture would increase greenery in the city and reduces risks of climate change (pp. 131, 157). Ecological area along Thai Nai Lagoon would have overlay zones to limit urban growth and promote agriculture allowing flood drainage corridor to minimize impacts of climate change (pp. 138). - <u>Construction codes to adapt to flood</u> Construction heights requirements are discussed in Chapter 8 based on flood probabilities and urban center classification. For Quy Nhon, it is required to have a capacity

mentioned that in case of low emission, sea level rise would be 65 cm in coastal areas of Quy Nhon. But in the case of high emission scenario, it would be 1 meter. The ideal scenario is medium (B2) in which sea level rise is expected to be 75 cm by 2100. Details also include a map of inundation areas in the city. Low lying areas of Nhon Binh Ward and northern parts would be impacted. Projection of sea level rise is presented in 10 years interval until 2100 (pp. 87). - Rainfall and flooding There are more than 30 instances of discussion on flooding problem across five chapters of the plan. Chapter 2 mentioned that current flood management based on capacity of reservoirs to slow flood is capable to mitigate 10% probability flood but capacity should increase to deal with the 1% probability flood (pp. 65). The chapter identified 14.27 % of area of the city is less favorable for any development because of flood problem. Expansion of urbanization in old areas of the city along Ha Thanh River is challenging because of recurring flooding and potential impacts of climate change (pp. 6). Master Plan 2004 proposed expanding urbanization in the Nhon Phu and Nhon Binh wards without considering the potential	of dealing 1% probability flood for residential areas, business districts, industrial parks, and warehouses whereas 10% probability flood for sports complexes, public parks, and other areas. Minimum construction height of foundation is required to be 2.76 m from ground level for residential areas. This provision is applicable to areas that are not affected by ocean tides. But for residential areas that are potentially affected by ocean tides, it would be 3.56 m (pp. 224). With addition of sea level rise to 2050, another 0.3 m would be added. This is under medium emission scenario (B2). High-rises are not allowed to be constructed in the Nhon Binh and Nhon Phu wards because they are an outlet of Ha Thanh River. Development in those two wards would follow green urban model (pp. 156). Housing in rural areas of the city will be encouraged to adapt to climate change impacts (pp. 157). Specific recommendation for houses in flood-prone areas of Con and Ha Thanh rivers are 2 to 3 stories high with the first floor open to allow flood water to pass through (pp. 222). Viaducts would be constructed in areas with high flood frequencies ensuring flood drainage (pp. 220-221). Dikes in Nhon Binh and Nhon Phu wards would be improved to resist flood with a

impacts of climate change on flooding and sea level rise. (pp.7) Chapter 2 mentions that rainfall and associated flood is becoming serious in the city (pp. 85). Historic flood events in Quy Nhon are discussed. Chapter 2 also mentions that rainfall will change in average by 2.3 and 3.9% by 2100 under medium (B2) and high (A2) emission scenarios (pp. 87), respectively. Vulnerability assessment to flooding is discussed in Chapter 8 (pp. 260-261). It mentions that climate change will have a disproportionate impact on poor households, fishermen, farmers, and houses near shore through exacerbation of flood. Rainfall, flood, and typhoon are discussed under natural conditions of the city in Chapter 2 as well (pp. 15-16) without their connection to climate change. - <u>Drought</u> Chapter 2 (pp. 70) mentioned that the city has to prepare for drought as a result of climate change. The chapter discusses drought history and saltwater intrusion without relating it to climate change (pp. 95-96). Chapter 8 mentioned drought as an extreme event in Binh Dinh Province that would be exacerbated by climate change (pp. 260). It also mentioned	probability of 5%. They would be improved along river systems to resist 10% probability floods (pp. 222). Dredging, embankments, and cleanup of rivers will be done before the rainy seasons arrives (pp. 222). Flood level and required drainage for 5 basins are also discussed and recommended in Chapter 8 (pp. 227-230) - <u>Construction standards to adapt to saltwater intrusion and sea level rise</u> East Dike would be upgraded to cope with saltwater intrusion. It would be strengthened to adapt to 5% probable events for urban areas of the Quy Nhon City. Similar measures would be implemented for Tuy Phuoc and Phy Cat dikes to adapt with 10% probable flood events. Height of these dikes would be 2.4 meters to 4.33 meters (pp. 221-222). Construction height for residential structures, recreational and park areas are recommended with flood water, tide, and sea level rise. Chapter 8 presented height of foundation for Nhon Hoi Economic Zone, Quy Nhon City, Uran Dieu Tri, Tuy Phuoc, and rural residential areas (pp. 222-223). Recommended heights varies from 2.5 meters to 13.0 meters. - <u>Retreat, setbacks, and resettlements</u> Urbanization and residential development in north-south directions along roads is prohibited

other associated disasters to drought such as forest fire. - <u>Temperature change</u> Chapter 2 of the plan mentions that temperature will increase by 2.0 and 3.0 degree °C by end of century compared to 1980-1999 period under the medium (B2) and high (A2) scenario emisson scenarios, respectively (pp. 87). Chapter 8 mentions sand movement and drought as a result of prolonging temperature increase (pp. 261), adding that the sand erosion due to a temperature increase in Nhon Hoi will be coupled with physical development in the area. As a result, more sand movement will take place.	and east-west direction is promoted in order to align urbanization with hydrology (pp.222). New development along dikes are prohibited and existing residential areas along dikes would be resettled in safer areas. New development along river banks is discouraged (pp. 222). Road expansion would be in east-west direction. Provincial route 640 would be upgraded with viable flood management measures. The narrow bridge (Tranh River) on Highway 19 is a bottleneck for flood water flow, impacting Huynh Mai and Phuoc Son villages. That would be widened to allow more drainage capacity (pp. 222).

(Author, 2018)

Understanding of climate change is explicit in the plan. Chapter 2 talks about sea level rise and emission scenarios for Central Vietnam. A medium emission scenario (B2) is used to calculate sea level rise, temperature change, and rainfall change for Quy Nhon City. The chapter also discusses all three scenarios (low, medium and high) before the selection of medium as the basis of analysis. Droughts, rainfall, and temperature changes are influenced by climate change. As a result, there would be a more extreme floods, prolonged droughts, and further saltwater intrusion. These climate change impacts and vulnerability assessments are discussed in Chapter 2 and Chapter 8. Social vulnerabilities as a result of worsening drought, flood, and sea level rise are discussed in Chapter 8. On implementation of scientific information concerning climate change, Chapter 8 gives construction requirements for different types of land use in flood-prone districts and wards. Enhanced requirements for dikes are presented to deal with future floods in the city. In same manner, there are proposals for resettlement, coastal set back, and limiting developments. There are specific requirements for residential house construction in flood-prone areas.

Table 6.4: Overall Utilization of Climate Science in the Quy Nhon Master Plan 2015

Climate science utilization	Status	Justification
Transmission of science - Communication of climate science - The relationship between scientists and policymakers/planners - Sources of climate science - Cases and examples of climate science utilization	Fair	Consultants of the plan mentioned informal interactions between them and climate scientists at the IMHEN, MONRE and Binh Dinh Province. Plan mentions sea level rise and emission scenarios from IMHEN and MONRE. During interviews, the consultants also mention that they explore all possible sources of data and science in the course of plan preparation.
Understanding of climate science - Reference to climate change scenarios including the flood, typhoon, drought, and rainfall change projections. - Awareness of climate change – citation and discussion on terms and concepts - Identifying risk and vulnerabilities to climate change impacts	Strong	Climate change scenarios (sea level rise and emission) are discussed. Low (B1) medium (B2) and high (A1F1) emission scenarios are mentioned. The medium emission scenario is presented as most realistic for Quy Nhon City. It is adapted in national plans, policies, and programs as well. Projection of changes in rainfall, temperature, and sea level rise are mentioned to 2050 and 2100 under B2 scenario. Numerical data of changes are presented. Concepts of emission scenarios and climate change are discussed throughout the plan. Flood, sea level rise, sand drifting, saltwater intrusion, rainfall, and drought are discussed in different chapters.

		Vulnerability assessment of residents is presented. Impact of drought, saltwater intrusion and flood would be worst for farmers and low-income fishermen in Nhon Binh and Nhon Phu wards.
Implementation of climate science - Efforts to use climate science in plans and decisions - Use of science in policy processes - Use of climate science to inform decision related to zoning, building codes, permits, and urban expansion - Changes in impacts of hydro-meteorological disasters	Strong	Awareness of climate change impacts in the Quy Nhon City is solid. Plan referred to emission scenarios and associated changes in sea level, rainfall, and temperature. The impacts from flood, typhoons, and drought are also discussed as well as adaptation and mitigation measures. In sum, discussion of impacts of hydro-meteorological disasters is widely discussed in the plan. Climate science has been effectively utilized throughout the plan to craft construction standards and codes. The plan presents a recommended height of construction for residential structures and other types of structures in different districts of the city based on flood impact levels in district. Similarly, there are also recommended measures for roads and dikes to adapt to increasing flood impacts. Existing vulnerable residents are planned to be resettled in safer areas of the city. There is no discussion on how these recommendations on construction codes and standards influence development projects, however. The plan also does not mention how recommendations would be synchronized with other sectoral master plans of the city.
Overall	Strong	There are some examples of interaction between planning consultants and scientists from IMHEN

		and MONRE during plan preparation. Climate data and modeling results were transmitted to consultants through informal mechanisms. Climate change scenarios, associated impacts, and vulnerabilities are discussed. Chapters 2 and 8 contain many examples of climate change impacts in terms of local hydro-meteorological disasters. There are construction height requirements to deal with floods in different wards and districts of the city.

(Author, 2018)

Although there are differences between scientists and policymakers on how and when projects, programs, and national prioritization were started on climate change, evaluation of master plans (2004 & 2015) illustrates that government-led policies and programs were started after 2004. It has been mentioned by some interviewees,

> *Because climate change is a very new topic in Vietnam you said that it is 20 years but I say that it is not actually 20 years. It was started from 2005 until now, they have to conduct a lot of training for activities in this area in this field even they do not have enough basic information about the climate change, they misunderstand about disaster and climate change.*
>
> *(Personal interview, 2015)*

Master Plan 2015 shows strong awareness of climate change impacts in Quy Nhon City. It has clearly outlined impacts on drought, flooding, and typhoon patterns. In every section about the common disasters, there is some discussion on the potential role of climate change. Impacts of flooding are mentioned in almost all chapters as well as discussion of standards for Type I cities to adapt to erratic rainfall, sea level rise, and floods. Cities in Vietnam are classified into five classes (I to V; lower number represents the higher class of cities) based on socioeconomic development, population size, population density, non-agricultural labor proportion, and infrastructure development (The Social Republic of Vietnam, 2009).

The major reason for higher utilization of climate science in the Master Plan 2015 is implementation of different projects in the city between 2004 and 2015. The main initiative in

Quy Nhon and other two cities (Da Nang and Can Tho) during that time was the ACCCRN Project which has changed understanding and perception of government agencies and general public on climate change, natural disaster, and resilience building.

6.2. Influence of ACCCRN Project on Utilization of Climate Science in Quy Nhon Master Plans

Implementation of the ACCCRN Project in Quy Nhon has a strong role in creating institutional changes in the city for climate change adaptation and mitigation. The project facilitated establishing the CCCO at the provincial level to oversee projects and programs on climate change in the city. Due to the ACCCRN Project, general awareness of climate change increased among government organizations, community groups, and the general public in Quy Nhon. Government agencies became involved in the ACCCRN Project through technical working groups and steering council for CCCO. As a result, they are more eager to mainstream climate change in the plans, policies, and projects in different sectors. It has been the bedrock to promote climate science utilization in master plans.

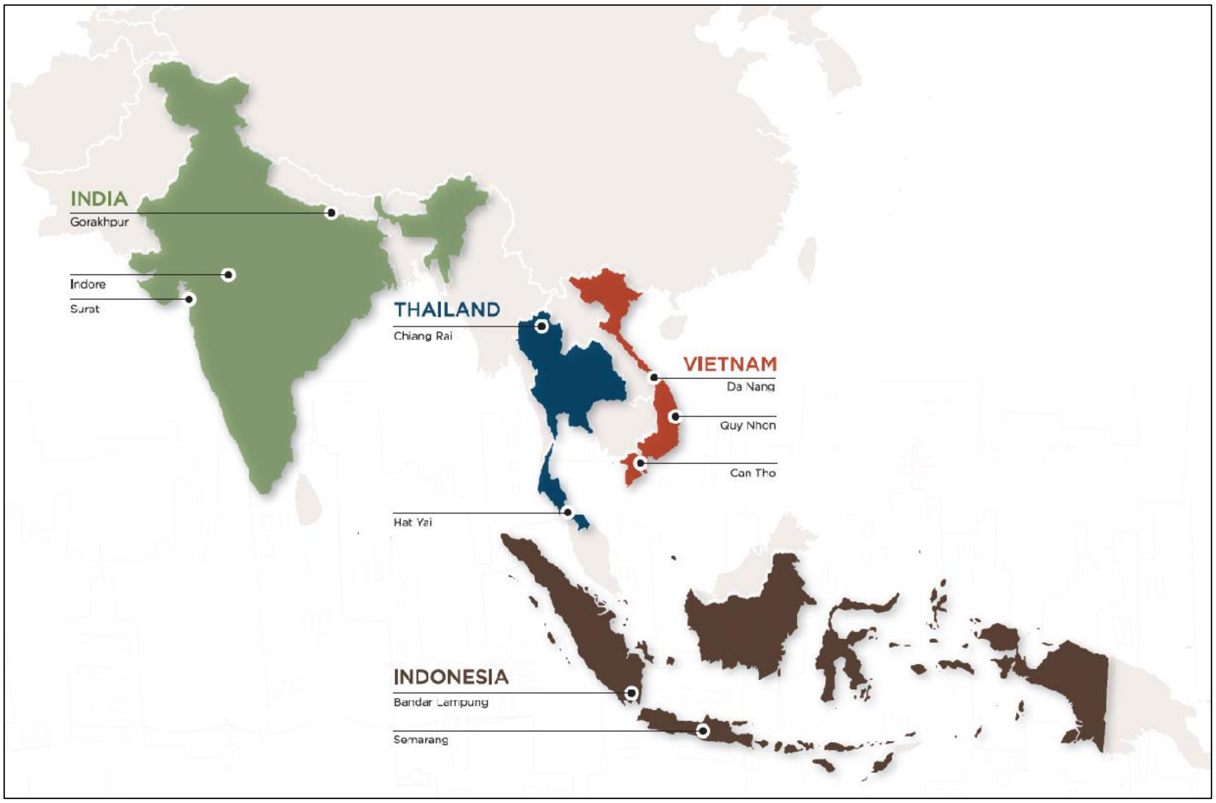
The Rockefeller Foundation launched the ACCCRN Initiative among 10 cities in Asia to improve their resilience to present and future challenges of climate change. It was launched in 2007 with US$ 59 million for 9 years, and all activities were expected to conclude by 2016. The major impetus behind launching this initiative is the importance of urban resilience in addressing impacts of climate change. It is believed that impacts in cities were rarely discussed, even though more than 50% of the global population was living in cities at that time and Asian cities were becoming economic powerhouses (The Asian Cities Climate Change Resilience Network, 2014). In that context, The Rockefeller Foundation has launched this initiative in small and medium-sized cities of Asia. The primary goal of this initiative is "…to measurably enhance the resilience of ACCCRN cities' institutions, systems, and structures to current and future climate risks, and through this, measurable [to] improve lives of poor and vulnerable people" (Bahadur & Tanner, 2014). All member cities had access to six different models of resilience building:

1. Community empowerment neighborhood/ward focused approach
2. Technocratic project approach

3. Multi-stakeholder engagement approach
4. City climate cell – CCCO
5. Choice of entry point – climate specific or problem identification/governance
6. Light touch city facilitation

(The Rockefeller Foundation & Verulam Associates Ltd, 2014)

Figure 6.1: 10 Asian Cities under ACCCRN Initiative



(The Asian Cities Climate Change Resilience Network, 2014)

The Initiative has four expected outcomes:

1. Improving partner cities capacity to plan, finance, coordinate and implement climate change resilience.
2. Sharing the experience and practical knowledge among the participant cities and other stakeholders to deepen the awareness, engagement, demand, and application.

3. Expansion of the urban climate change resilience to new cities through scaling-up and networking. It is also expected to attract new donors.
4. Operation of the ACCCRN in an efficient manner in the context it operates while providing leadership and contribution to the Rockefeller Foundation's strategy and mission.

(The Rockefeller Foundation & Verulam Associates Ltd, 2014)

Expected outcomes are noticeable in Quy Nhon City. Establishment of the CCCO, organization of Shared Learning Dialogues (SLD) in a regular fashion, organizing training and workshop among government agencies and communities, establishment of a city climate action plan, mainstreaming climate change in Master Plan 2015, and evaluation of sectoral master plans by the CCCO from a perspective of climate change adaptation and mitigation are some of the achievements made in Quy Nhon.

By 2014, the ACCCRN model was extended to more than 30 cities in Bangladesh, India, Vietnam, Indonesia, and Thailand (The Asian Cities Climate Change Resilience Network, 2014). It has created a movement on climate change adaptation in Asian cities. The City Climate Cell or CCCO approach is the Vietnamese method of implementation of the ACCCRN. Two cities (Can Tho and Da Nang) in Vietnam established the CCCO under city administration, and Quy Nhon city has the CCCO under provincial administration. CCCOs are intended to play the role of coordination, interpretation, and collection of climate change related data for risk assessment; developing strategies of city resilience; building technical capacities on resilience planning; and coordinate external funding and climate change projects at local levels (Taylor, 2017).

There is common ownership of the project among government and non-government agencies in Quy Nhon. During interview, planners, scientists and international experts mentioned the ACCCRN Project and its activities as their own effort to adapt to climate change. Project implementation was coordinated among many provincial departments and city offices. Establishment of the CCCO under provincial government has improvised new duties and responsibilities among provincial and city offices to deal with climate change impacts. As a part of the ACCCRN Project, an urban resilience framework is developed in which the role of scientific knowledge and boundary agents are realized as crucial aspects in urban resilience (Tran, 2017).

A total 22 out of 28 offices that were interviewed in Quy Nhon City mentioned their consultation with CCCO on climate change related issues. Many of them said that they got climate change related data, scenarios, and information from the CCCO, which has been in the administrative culture of Binh Dinh Province and the Quy Nhon City. In the planning process, the government organization that is responsible for plan preparation circulates the draft of the master plan among all provincial agencies to get their feedback and comments on it. The CCCO also participates in those reviews and provides feedback on contents from the perspective of climate change impacts. While discussing the role of CCCO on climate change adaptation and mitigation, one interviewee said,

> *When we are conducting some projects, some issues of climate change and the environment in the industrial zone can come up. We normally invite CCCO to come and join the meeting and give us the comments. When we have some question or the issues related to climate change we normally call CCCO.*
>
> *(Personal interview, 2016)*

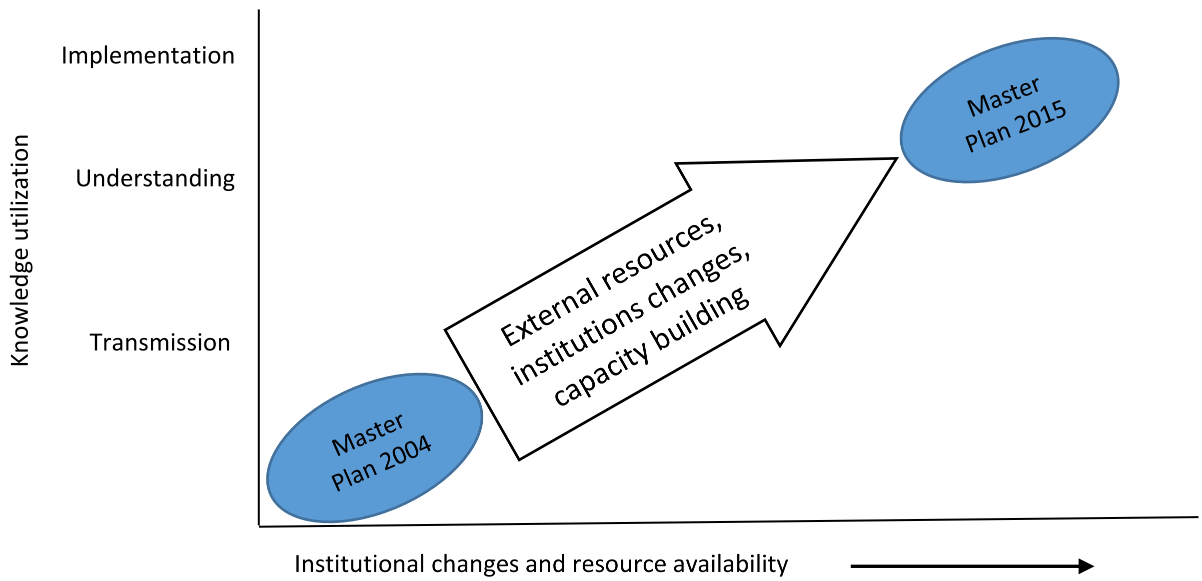
In the case of Quy Nhon Master Plan 2015, MOC and DOC organized an assessment conference in Quy Nhon City after a draft was submitted by consultants. During interviews with representatives of the provincial DOC, they mentioned that they invited the CCCO, ACCCRN representatives, and city experts on climate change to give feedback on the draft. They also claimed that Master Plan 2015 addressed climate change impact especially flooding.

Establishment of the CCCO is a major milestone of institutionalization of climate change related issues in Binh Dinh Province and Quy Nhon City. It was established with a legal mandate and administrative budget from provincial government. It will function in the province with or without external funding. Interviewees in Quy Nhon City also brought up sustainability of the CCCO after completion of the ACCCRN Project. One interviewee said,

> *With the help of the Rockefeller Foundation, they established the CCCO. But when they built the CCCO, there are two roles assigned to it. One is to work for the Rockefeller Foundation Project and the second role is to work for the local government to implement different activities on climate change. After they finished the Rockefeller Project they have a lot of reports and documents to finish. Upon the finish of the project, they still continue to work for purpose of climate change in the Province. That is their duty for the climate change in the Province. The Province must have to pay for some projects for them to continue to work.*
>
> *(Personal interview, 2014)*

The majority of interviewees emphasized that major challenges for them in addressing climate change in plans, programs and projects are financial and institutional at national, provincial and local levels. Realization of climate change as a serious planning problem in Master Plan 2015 compared to Master Plan 2004 is result of the availability of financial resources on climate change and the establishment of the CCCO. Such external funding increases the capacity of provincial and city-level stakeholders to assess, understand, and act on climate change impacts as illustrated in Figure 6.2.

Figure 6.2: Role of ACCCRN Project to Enhance Climate Science Utilization in the Master Plans



(Author, 2018)

Progression is gradual from transmission, understanding to implementation. In the case of master plans for Quy Nhon City, utilization of climate science in Plan 2015 is determined by available resources, institutional development, and capacity of stakeholders (provincial departments, mass organizations, city offices, consultants, political leaders, and communities). In the case of Master Plan 2004, there was no funding available to Quy Nhon City to work on climate change. Climate change was not in the national program before 2004, although there was some discussion on climate change impacts in the country. Awareness and capacity of provincial and municipal organizations were low. National communication of Vietnam to the UNFCCC and rectification of the Kyoto Protocol were some milestones that triggered national policies on climate change adaptation and mitigation.

At the municipal level, introduction of the ACCCRN Project was a major step in boosting climate change adaptation in policies, programs, and projects. Available funding from the ACCCRN Project allowed the establishment of the CCCO, ability to conduct regular SLDs, establishment of an interagency steering committee, and organization of workshops and training. The CCCO also organized many awareness campaigns in vulnerable wards of the city, including placing sign boards on flooding (discussed in Chapter 7), providing evacuation boats to the ward offices (discussed in Chapter 7), organizing campaigns among youth on innovative climate change adaptation project ideas (with the Provincial Youth Union), and construction of evacuation shelters. These activities created a flow of climate change scenarios, data, models, and information from the national level to provincial and municipal levels. Similarly, establishing the CCCO also allowed customization of climate change scenarios for the city that led a realization of climate change as a serious issue in plans and policies. As a result, Master Plan 2015 emerged as a progressive step in climate science utilization compared to Master Plan 2004.

6.3. Summary of Climate Science Utilization in Master Plans of Quy Nhon City

Climate science utilization is stronger in Master Plan 2015 than in Master Plan 2004. Master Plan 2004 does not have single provisions on climate change despite publication of three reports on climate change scenarios for Vietnam before 2004. Master Plan 2015 has details about climate change scenarios; future projection of rainfall and temperature change; and exacerbation of floods, droughts, and typhoons with increased influence of climate change. Consultants of this plan acquired climate science from multiple sources using multiple mediums (formal and informal) during the plan making process. Quy Nhon City and Binh Dinh Province were also in favor to address climate change in the master plan. Concrete adaptation measures were proposed to deal with increasing flood, drought, and sea level. Residential and communal building construction standards were proposed for different areas of the city, based on expected flood impacts from inland and ocean. Elevation of structures is presented as a major approach in adapting to flooding. The plan proposed to expand road networks and urbanization in east-west directions, matching with local hydrology, as well as setback for coastal areas and river banks.

The reason behind such a shift in utilization of climate science in Master Plan 2015 was the availability of external resources and expertise to the city and Binh Dinh Province. The ACCCRN Project brought financial and technical resources to the city. As a result, the provincial government established CCCO as the designated organization to work on climate change-related projects. Uniqueness of CCCO's organizational structure is that it is governed by a steering council with representation from all departments of the province. SLDs, workshops, training, media awareness campaigns (loudspeaker programs, television programs, and radio programs) and many other activities related to climate change led to strong awareness on climate change impacts. As a result, when a draft of Master Plan 2015 was circulated among departments and city agencies, there was a demand to address climate change. Availability of extra financial and technical resources, new institutional setup, and improved capacity of provincial and city agencies were causes of strong utilization of climate science in the Master Plan 2015.

CHAPTER 7. UNLEASHING CLIMATE SCIENCE IN LAND USE PLANNING OF QUY NHON CITY

The research translation to public policy follows a non-linear approach. Process is uniquely complex in developing countries because existing institutional setups lack provisions for smooth transference of science to policy making. This also aplies to climate science utilization in urban land use planning of these countries.

Utilization of climate science includes transmission, understanding, and implementation. Transmission is production and dissemination of climate science to decision makers and planners. It is interaction between climate scientists and policymakers/planners from national, provincial, and local levels. Understanding is the awareness and cognition of climate science among decision makers, planners, and communities. Implementation is the use of climate science in decision making and planning choices. This also includes plan implementation to minimize impacts identified in the understanding phase. Ideal transmission leads to comprehensive understanding of climate science, and understanding leads to optimal implementation. The best utilization of climate science results in mainstreaming of adaptation measures in plans, policies, and implementation. Details of variables and measurements are discussed in Chapter 3.

This chapter assesses transmission, understanding, and implementation of climate science in the land use practices of Quy Nhon City. It strives to answer three research questions posed in Chapter one:

- To what extent climate science informs decision making on land use?
- What are the constraints of using scientific knowledge of climate change in land use planning?
- What are the unique characteristics of climate science utilization in the Quy Nhon City that help to facilitate knowledge utilization approaches for the developing countries?

Interviews among government agencies, a household survey in two flood-prone wards of Quy Nhon, and non-participant observation are sources of data. A total of 49 interviews were conducted among climate scientists, policy makers, and community leaders. Scientists were interviewed at the national level. Policy makers and planners were from provincial and city levels. Leaders of Nhon Binh and Nhon Phu wards were interviewed to evaluate implementation of climate science at local levels. Household surveys were conducted among 359 households of Nhon Binh and Nhon Phu wards to understand land use changes and patterns of flooding, drought, and typhoons over time. Interview transcripts were analyzed using qualitative data analysis software, NVivo. A linear regression model was created based on household survey data to assess the role of land use changes on flood patterns in Nhon Phu and Nhon Binh wards. This chapter is organized into transmission, understanding, and implementation of climate science in land use practices in Quy Nhon.

7.1. Transmission of Climate Science

Transmission includes production, dissemination, and accessibility of knowledge. Interaction between producers and users can lead to better utilization and builds trust among users. This applies to the production of climate science in Vietnam. Climate science is trusted more by decision makers and planners if they have personal rapport with the scientists providing the data. Dissemination is a process through which science reaches to the users. This includes both supply and demand of knowledge. Accessibility focuses on the demand-side of climate science. Decision makers and planners access climate science through multiple sources. Better accessibility improves the transmission.

7.1.1. Production of Climate Science

The knowledge production process has a crucial role in utilization. Interaction between knowledge producers and users boosts utilization (Mitchell et al., 2010). There are three mechanisms of science production in Vietnam: collaboration among Vietnamese climate scientists, collaboration of Vietnamese scientists with international climate experts, and collaboration of climate scientists with policymakers and planners. The interaction between planners and scientists is the weakest among the three.

Strong centralized authority prevails in the production of climate science in Vietnam. The Institute of Meteorology, Hydrology and Environment (IMHEN) is the leading research organization for climate science production in the country. Even though Hanoi University of

Science (HUS) is a partner in the process, authority of production remains with IMHEN. In this regard, a scientist outside of IMHEN explained the institute's role during an interview,

> *He (pointing at a climate scientist in the room) does not participate to create climate change scenarios. This is the responsibility of the IMHEN. …….MONRE has the sole and bigger responsibility to produce those scenarios, so other Institute does not build up scenarios because it is their responsibility and duty. …..there are numerous scenarios of climate change by MONRE, and other Departments and ministries will consult with them in the process of policymaking.*
>
> *(Personal interview, 2014)*

Scientists also mentioned that the Ministry of Natural Resources and Environment (MONRE) has sole responsibility to offer suggestions on national policies formed by other ministries. If a ministry asks for an opinion, scientists from outside of MONRE will have an opportunity to provide recommendations and suggestions. But this is a rare case.

IMHEN collaborates with national and international partners to conduct scientific research on climate change. Within the organization, units related to climate change research are the Climate Change Research Center, Center for Meteorology and Climatology, and Center for Hydrology and Water Resources. The Climate Change Research Center is the leader in climate science research and was cited repeatedly by scientists during interviews.

In-country collaboration among climate scientists depends on formal and informal relationships among them. Leading climate scientists have typically graduated from Vietnam National University ((VNU). As a result, there is stronger collaboration between VNU and IMHEN in climate scenario modeling.

Use of personal relationships was reflected during snowball sampling of scientists for interviews. The first interview was administered to a scientist in IMHEN. At the conclusion, he was asked to recommend two climate scientists. He provided two names who were alumni of VNU from where he graduated.

International collaboration on climate modeling is led by IMHEN. During an interview, a scientist from IMHEN mentioned that IMHEN collaborated with climate research centers from Australia, European Union, Japan, and the United Kingdom. He explained the rationale for collaboration, *In order to construct scenarios, we have to work with other countries. For example, we work with CSIRO Australia in the last two years. We are also working with [a] climate center in England. We also work with Japan to build climate change scenarios.*

(Personal interview, 2014)

Involvement of scientists from other countries provides technical and financial support for modeling. The Commonwealth Scientific and Industrial Research Organization (CISIRO) has a long relationship with Vietnam on climate scenario modeling. It was involved in producing the first climate scenarios for the country in 1994 (funded by ADB).

Besides IMHEN, international funding for climate change research has led to the proliferation of projects in other organizations. Government agencies under the Ministry of Science and Technology and the Ministry of Agriculture and Rural Development have bilateral and multilateral projects on climate change that are focused on impacts. Parts of the projects have been on climate science production. Non-government sectors (I/NGOs and consultants) are equally active in conducting scientific research of climate change. They normally take national scenarios from MONRE and downscale them to the area of interest.

7.1.2. Communication of Climate Science

Despite the strong top-down administrative system, climate science communication from national to local levels is not institutional in Vietnam. During an interview, a scientist at the national level claimed that provincial and local governments have to follow climate change scenarios in decision making because they are published by the national government. As mentioned in the two communities theory of knowledge utilization (Caplan, 1979), climate scientists do not pay attention to the use of climate scenarios in decision making. Rather, they believe that it is a task of planners and decision makers. They claim that scientists are not responsible for communication of climate scenarios. Except for boundary functions (as consultants), scientists are not involved in communication at provincial and local levels. Climate science dissemination occurs through workshops, training, conferences, and boundary works. As a part of the interview process, each scientist was asked how they communicated climate scenarios and modeling results. The motive of that question was to understand whether climate research organization has a branch or unit to communicate climate science to planners and decision makers. All interviewed scientists mentioned that they lack a unit within their organization to communicate climate science.

There is a disconnect between the authority of climate science and needs of affected communities in Vietnam. It is believed at national level that provincial and local governments have to use scenarios from MONRE in planning and decision making because these scenarios are approved by the prime minister and bear legal authority. But provincial and local governments do not use them in practice. Interviewees at the national level named IMHEN as the only authority on climate science production. A climate scientist clarified this authority following way,

> *IMHEN is the leading organization in Vietnam working on climate change modeling. It is the only institution working for climate science basis for Vietnam. We have some other agencies working on climate science basis but their work is mainly supporting to IMHEN. More than 30 years ago, IMHEN started to work on climate change. We are more focused on climate change science. We are assigned by the government to construct the climate change simulation scenarios for Vietnam. As you see the climate change simulation scenario for each province, means in Vietnam, is produced by this office.*
>
> *(Personal Interview, 2014)*

Even though VNU plays an active role in the production of climate change scenarios, it does not have the authority to deliver results to government offices. Scientists from VNU explained that they must have government approval to share new scientific findings with other offices. A scientist mentioned about the role of VNU on dissemination of climate scenarios,

> *...for such kind of policymakers level workshop, IMHEN is more in charge of that. Because we are just [our] research unit and maybe our result is not authoritative enough for the country.*
>
> *(Personal interview, 2014)*

Lack of authority concerning communication makes scientists outside of IMHEN less interactive with decision makers at the national level. This reflects the systemic control and limitation of dissemination of climate science.

Based on interview analysis, there was a knowledge gap among cities and provinces on climate change. Vietnam Urban Development and Planning Association (VUDPA) has administered a need assessment survey for training on climate change among planners and decision makers. It concluded that there is a lack of basic knowledge among them. An interviewee elaborated the knowledge deficiency,

> *The first reason is people lacks knowledge about the science of climate change. In our country, [the] we have some scenarios about climate change, [he has the report of the 2012 national scenarios], this one is 2012. When we make the survey [in] many cities, they do not know about these scenarios, they do not know about the scenarios of climate change, even in many universities. They study architecture and planning but they do not have any subject about climate change or disaster management.*
>
> *(Personal interview, 2014).*

However, Quy Nhon City has a high level of awareness of climate change and its impacts. Offices had a clear understanding of climate change scenarios and impacts in the city and Binh Dinh Province. Establishment of the Climate Change Coordination Office (CCCO) by the provincial government to coordinate and implement climate change-related projects led to more workshops, training, and conferences in the city, raising awareness among government planners and decision makers. The Asian Cities Climate Change Resilience Network (ACCCRN) Project had funding for 5 years which led government offices and the Communist Party of Vietnam to get involved in climate change. The involvement was more active from offices that were directly associated with land management, weather forecasting, water management, infrastructure construction, disaster management, agricultural planning, community mobilization, and coastal management.

Provincial departments worked with CCCO through steering council and technical committees to address different issues of climate change in the city. This provided an opportunity for provincial offices to educate themselves about climate science and impacts in the city. CCCO organized capacity building training and workshops at different levels (province, city, ward, and commune).

It is a general administrative practice in Vietnam to have a designated unit in an office as an official representative on a certain topic. An employee in the unit who represents the office in every climate change related meeting, workshop, training, and conferences. Other units of the office, however, may not be aware of participation. During interview, respondents mentioned that their offices might have another unit to work on climate change. Such practice was observed by the principal investigator in two workshops.

The first was organized in 2012 by the Globalization Research Center and Department of Urban and Regional Planning of University of Hawaii and second was organized in 2016 by the United States Navy. Both events were organized in Da Nang City. In both events, there were many common participants representing city and provincial agencies. They were more empowered in 2016 compared to 2012. Participants in 2012 were not able to communicate or ask questions, but in the 2016 workshop, participants were more vocal and participated in discussions and group exercises. The principal investigator of this research was one of the resource persons for both workshops. Active participation of staff members made them capable of critically reviewing climate information provided during workshops. This pattern is also visible in the case of CCCO and technical working committees in Quy Nhon City. During interviews, certain provincial offices got multiple recommendations for interviews because leaders of those offices had been working on climate change for a long time.

Communication comprises a mix of government and non-government efforts. The Climate Change Research Center within IMHEN is actively collaborating with international donors to produce climate change scenarios for the country. As a dissemination effort of climate science, MONRE publishes scenarios. These reports are not sent to provinces and cities, but they are uploaded to agency’s website, expecting provinces and cities access them from website. NGOs, INGOs, and mass organizations are working on climate change in different provinces and cities, including Quy Nhon. They produce climate scenarios (temperature change, sea level rise, and rainfall change), and they share these scenarios with local government collaborators.

7.1.3. Accessibility of Climate Science

Accessibility plays a critical role on knowledge utilization. If planners and decision makers have easy access to knowledge, they understand the mportance of an issue and makes them think whether it should be included in plans. Otherwise, they may not be aware of associated challenges.

Use of climate science depends on context of use, process of production, and iteration of the relationship between producers and users (Dilling & Lemos, 2011). Iterative relationships between producers and users establish trust and understanding between them. Regular meetings, conferences, and workshops on climate change improves the use of scenarios in plans and policies. In many examples of knowledge utilization, social capital is highlighted as an effective means to improve utilization (Mushkolaj, 2013). The social interaction theory of knowledge diffusion also highlights personal relationships as an effective media for diffusion of new knowledge (Dilling & Lemos, 2011; PARKER, 1981). This is true for climate science as well.

Accessibility to climate science in Vietnam is based on informal connections and communication. Compared to production, accessibility is more challenging because climate science has economic and political value. One of the interview questions for climate scientists was how they were contacted for data and scenarios of climate change. They mentioned that they were contacted based on their pre-existing personal relationships with policy makers and planners. One scientist explained,

> *Sometimes [I get] invited. Some people [from proving support] from the government, they do not know about climate change impacts or a certain aspect of climate science, did call me and they asked me to go somewhere in the in the coffee shop and talk together. It is kind of informal.*
>
> *(Personal interview, 2014)*

Scientists considered fostering informal relationships as a critical mechanism to get connected with decision makers and other users of climate science. They mentioned in interviews that they get invited to present the science or ask for information more frequently if users are their colleague or friend or person who knew them, which they considered a normal practice in Vietnam. Such practice can also be at the institutional level. Personal relationships among government employees establish relationships between their institutions. This also applies to consultants and non-governmental organizations. The system of informality was explained by two scientists,

> *I'll tell you that informal is normal in Vietnam. People from [climate science modeling national organization] IMHEN, if they want to know about this, they can call me.*
>
> *(Personal Interview, 2014)*

Another interviewee added,

> *For another kind of in-depth, we engage through the personal relationship as we work with the Vietnam Urban and Development Planning Association.*
>
> *(Personal Interview, 2014)*

Accessibility to climate science is linked to political and economic power. The exchange of knowledge is a challenging task because it is strongly bound with people (Von Krogh, 1998). Organizational care of individual inventors plays a crucial role in sharing knowledge. In a competitive environment, however, sharing knowledge is considered a means of losing power and influence (Von Krogh, 1998) because knowledge is power (both social and economic). During interviews with scientists and decision makers at the national level, they explained that many organizations and individuals did not share reports and data because knowledge is power and has economic value for individuals and institutions. This challenged the accessibility of climate science among planners and decision makers. A planning consultant at the national level explained this during an interview,

> *In Vietnam the process is not really proactive to come and share, normally information is power and information is money, so like we have the project if we want to get further information on downscaling to the certain provinces and if we approach IMHEN they said yes, we can provide service you need, service means is money, they don't provide freely.*
>
> *(Personal interview, 2014)*

Production and accessibility of knowledge in Vietnam is competitive rather than collaborative. Previous research has shown that an individual feels a loss of power and influence in an organization when he or she shares knowledge with others in a competitive environment (Von Krogh, 1998). At the provincial level, there is a certain legal mandate for the provincial institute of hydrology and meteorology to share climate data with other agencies. If there is a need beyond the legal mandate, the requester has to purchase the data. Provincial agencies mentioned this trend multiple times during interviews.

Accessibility to climate science is guaranteed by funded projects in Quy Nhon City. Local agencies gets scale-relevant information on climate change from projects because they have funding to produce scenarios. Interviewees spent a good amount of time in all interviews describing their involvement in different projects. Scientists emphasized their involvement in provincial and municipal levels through science production beyond their legal duties of scientific modeling at national level. They engaged in those projects personally and earn income through consulting fees as boundary agents in the projects. While explaining his involvement in projects, a scientist said,

> *For those provinces, I said I signed the contract with USAID. They have branch [of the] company such as Win Rock International and they have the contact with those provinces already. For USAID, they don't have only one project for those provinces. They had previously many projects with the provinces already. So they already knew the people there and people there ask them to provide support for climate change. The USAID people can ask the provincial government and people to organize those activities. So for myself, I do not have to directly contact them. The provincial people come to USAID and USAID would contact me. So as I doing teaching and research as well, I prefer that system. I don't like to deal with provincial people because I do not have enough time to work on. It can become very complicated if you go there by yourself.*
>
> *(Personal interview, 2014)*

Interviews revealed a mismatch between local demands and IMHEN's assumptions concerning accessibility. IMHEN scientists claimed in interviews that climate was available to provincial and local levels through its website and by request. However, existing climate scenarios were still not sufficient at provincial and municipal levels. Local agencies, consultants, and planners needed detailed information of climate change impacts that was lacking in national scenarios.

Accessibility of scenarios is not sufficient to inform decision making. It is imperative to have decision support tools (Jacobs, Garfin, & Buizer, 2009). In Vietnam, the major challenge to addressing climate change in planning is lack of planning tools. Government offices at Quy Nhon mentioned a lack of legal standards from the national level.

Interviewees highlighted informality in climate science sharing and accessibility. Scientists and government officials at the national level would discuss the topic of personal connections and accessibility. But provincial and municipality offices were not comfortable bringing it up. They claimed that the knowledge sharing among organizations occurs in a formal way. However, it was visible in their behaviors that there were problems. Examples of informal relationships among officials to access information were presented during informal conversation with project staffs, translators and retired officials. They mentioned that reciprocity among offices based on favoritism at provincial and city levels prevails. A government official shares information to another official in expectation of future favors.

Higher educational levels, international exposure, and national decision making authority were reasons for informality among government officials and scientists at the national level. Since they considered each other as members of similar elite group, they were open to discuss problems and challenges of their system among themselves. However, provincial and municipal officials were trained and hesitated to criticize their system since they were merely administrators with clear duties and responsibilities and not among those with higher political and economic status. They believed that criticizing the administration could degrade their relationship with national and provincial offices.

Decision makers and planners of Quy Nhon City and Binh Dinh Province access climate science through multiple sources despite higher national importance of scenarios produced by the national government. During interviews, they said that they did not rely on a single source. Television programs on climate change are the main source of climate science for them. All interviewees at provincial and municipal levels mentioned television as an important source of climate science. Projects funded these television programs for regular broadcast on climate change and its impacts.

Overall dissemination of climate science from scientific institutions to planners and decision makers is presented in Table 7.1. It covers production, communication, and acquisition of climate science.

Table 7.1: Overall Production and Dissemination of Climate Science in Vietnam

Components of Transmission	Sub-components of evaluation	Measurement
Production	Collaboration among scientists	Fair
	Collaboration between scientists and policymakers	Weak
	Collaboration of experts (national and international)	Fair
Communication	Sharing of climate scenarios to provinces spontaneously	Weak
	Communicating climate science from scientists through media (from producers to the users)	Weak
	Sharing of scenarios through the circulars and guidelines	Weak
	Dissemination of climate science through boundary mechanisms (chapter 6 has detail analysis)	Strong
Acquisition	Source of climate science to the city	Strong
	Mechanisms to achieve climate science	Weak

(Author, 2018)

7.2. Understanding of Climate Science

Understanding of climate science includes awareness and assessment of scenarios and simulation results. It also includes understanding the cross-cutting nature of climate change with other planning problems. Awareness covers a basic knowledge of potential impacts of climate change. Assessment includes an evaluation of relevance of climate science to a local setting and assessment of scenarios. Knowledge of the interdisciplinary nature of climate change and its nexus to planning problems are also part of understanding, which also includes change in worldviews of climate change among decision makers. Planners and decision makers make decisions based on available information, but they are unable to determine consequences (Knott & Wildavsky, 1980b). Leaders and government officials in Quy Nhon City get information about climate change that influences their decision choices in the city. They are not sure of how these decisions impact the future resilience of the city, however. This section focuses on understanding of climate science as awareness, assessment, and knowledge of complexities. Analysis is generated using data from interview, household surveys, and community meetings.

7.2.1. Awareness of Climate Change

Awareness of climate change is high in Quy Nhon. Government offices, party leaders, mass organizations, non-governmental organizations, and communities are aware of climate change and its impacts. Interviewees, survey respondents, and community meeting participants mentioned that they knew about it.

Three groups of organizations were interviewed in the province and city: government agencies, mass organizations, and non-governmental organizations. In total, 29 organizations were interviewed: 10 were political and mass organizations, 18 were government agencies, and 1 was a non-government agency.

21 interviewees mentioned that they knew about climate change scenarios and were aware of climate change impacts in the city. The majority of them had the capacity to critically assess them. As part of climate change related projects in the province, local and national governments have regular broadcasts on climate change. One interviewee mentioned that television programs were an awareness building component of a project in Binh Dinh Province. The program included the experience of local people, documentary footage, and reports about local climate change. Out of 29 interviewees in Quy Nhon City, 52% mentioned television as a source of information about climate change. Interviewees explained the impacts as follows,

> *The impact of climate change here is very clear, even we can feel the sea level rise. Here, a lot of people works for farming and fishery, so they need to pay attention to the tide calendar. It is usually that the tide calendar [usually] tells sea level will be 2 m at the high tide, but now they find out that the upper level of the tide in the high tide is 2.2 m.*
> *(Personal interview, 2016)*

We know about the climate change scenarios for Vietnam. We include the information about the scenarios in our TOT training. We include the information from scenarios in our training modules. Scenarios are not only for the regional level, but we also customize them fitting our local context.

(Personal Interview, 2014)

Awareness of climate change is strong among residents of the Quy Nhon City. Out of 359 respondents of a household survey, 72 percent replied that they heard about climate change. Questions were focused on impacts of climate change as a factor in hydro-meteorological disasters such as flooding, drought, saltwater intrusion, and typhoons. There were five questions in the survey focusing on climate change and its impacts. Out of 359 respondents, 73 percent responded affirmative about their knowledge of climate change impacts in the city. Details of the responses are presented in Table 7.2.

Table 7.2: Awareness of Climate Change Impacts on Existing Disasters (Multiple choice question)

Impacts	Frequency	Percentage
Stronger typhoons	23	6%
Increase temperature	221	62%
Sea level rise	37	10%
Increase rainfall	143	40%
Increase flooding	153	43%
Others	33	9%

(Author, 2014)

The same questions were also asked during an i-Clicker exercises in community meetings. The details of the use of the i-Clicker technique in planning and research are presented in Chapter 3. Five questions on climate change awareness and impacts were asked in those meetings. Out of 42 respondents of i-Clicker exercises, 67 percent replied affirmative about their knowledge of climate change. The question was asked using example of changes in local weather and flooding (Table 7.3).

Table 7.3: Awareness of Climate Change among i-Clicker Exercise Participants

Meaning of climate change	Frequency	Percentage
Change in industrial production	5	12%
Change in longer-term weather and change in flooding and typhoon	28	67%
Change in pollution in the river	6	14%
I don’t know	3	7%
Total	42	100%

(Author, 2016)

Regarding climate change impacts, 83% of i-Clicker exercise participants responded that they are changes in typhoon frequency and severity, sea level rise, and increase in temperature.

Awareness of climate change among government agencies, mass organizations, political leadership, community leadership, and general public is high in Quy Nhon City. They may not be aware of a particular climate change scenario for the country, but they know about current and future impacts in their city.

7.2.2. Assessment of Climate Science and Impacts

Assessment of climate science is divided into three parts: identification of specific impacts, risk and vulnerability assessment, and assessment of relevance of climate science in a geographic and administrative context. A mixed result on assessment in Quy Nhon City was evaluated among policymakers, mass organizations, political leaders and the general public through interviews, household surveys, and community meetings.

Interview questions focused on impacts of climate change, climate change scenarios, and organizational capacity to conduct risk and vulnerability assessments. While explaining the local impacts in the city, one government official explained,

> *We noticed a change in rainfall and temperature in Binh Dinh. The temperature has increased in the last 10 years, and rainfall is also increasing in that period. The rainfall has increased during the rainy seasons but during the drought season, the rainfall has decreased. The frequency and intensity of the typhoon have also increased. In 2013, we had excessive rainfall and severe flooding but we did not have enough rainfall in 2014 during the rainy season.*
>
> *(Personal Interview, 2014)*

Change in temperature and rainfall has been a major concern to government officials. They mentioned that they have noticed changes in temperature and flood and believed that the trend will continue in the future. They referred to climate change scenarios to explain changes. A government official quoted climate change scenarios on prediction of temperature changes,

> *The major impact of climate change is the change in temperature for Binh Dinh. The scenario of 2011 predicts the climate change pattern until 2080. It predicts 0.4 degree Celsius increase in the temperature. The implication of temperature change will be for the drought.*
>
> *(Personal Interview, 2014)*

Residents of Nhon Phu and Nhon Binh wards were aware of impacts of climate change. In a household survey, they were asked whether climate change was dangerous to them. Out of 352 respondents for this question, 72 percent replied affirmatively. Those who gave an affirmative response were asked again how climate change could be dangerous to their households.

Table 7.4: Awareness of Climate Change Impacts among Survey Respondents (Multiple choice question)

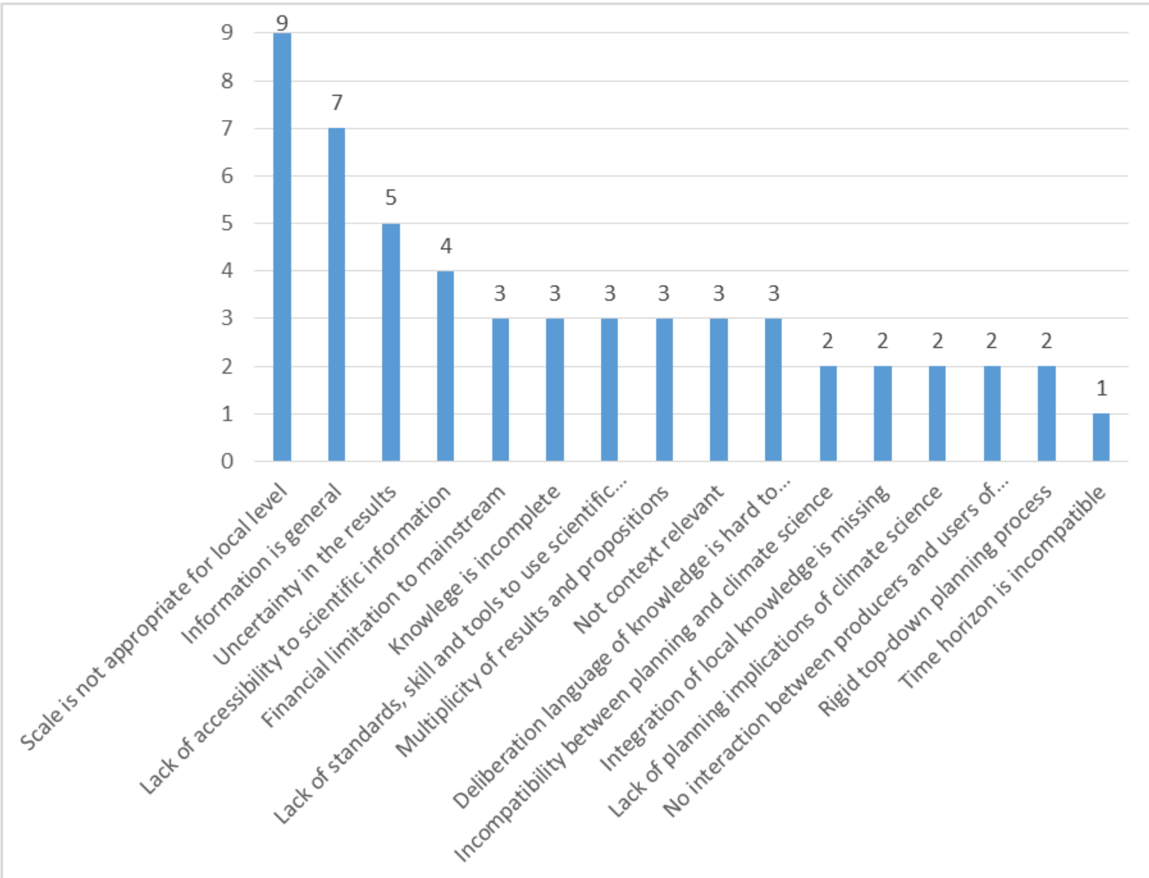
Perceived impacts	Frequency	Percentage
It increases flooding in our house	172	68%
It reduces our agricultural production	45	18%
We will have a shortage of drinking water	75	30%
We will have longer duration without rainfall	162	64%
We will have a risk of diseases	23	9%
Our irrigation system will not have water	12	5%
We will not have enough food	26	10%

(Author, 2014)

The same questions were asked in three community meetings. Consistently, participants in community meetings were also well aware of impacts of climate change in their localities.

Questions on awareness and assessment of climate change scenarios were only asked of government agencies because decision makers and planners are more likely to use them in planning and decision makings than the general public. On top, literature indicates that scientific knowledge helps decision makers select relevant policy alternatives. The quality of national climate scenarios for provincial and local governments was measured by the relevance of the scenarios to city planning. Out of 19 interviewees who discussed the quality of climate change scenarios and their relevance to decision making, 9 mentioned that their scale was not relevant to the city. 7 interviewees said that information presented by climate scenarios was too general. Uncertainty of results and lack of accessibility to information were mentioned as challenges of using climate change scenarios at provincial and municipal levels.

Figure 7.1: Relevance of Climate Change Scenarios to the Quy Nhon City



(Author, 2014, 2016)

While discussing the quality of climate change scenarios, a government official explained,

> *We have heard about climate change scenarios. But incidents of disaster are very sudden. The information predicted by scenarios are not enough to predict the impacts of climate change. I also read and know about the climate change scenarios of MONRE.*
> *(Personal Interview, 2014)*

Risk and vulnerability assessment is part of understanding climate science. During interviews, respondents were asked whether their office conducts risk and vulnerability assessments to climate change impacts. 34% responded affirmative out of 29. It was not conclusive whether assessments were specific to the climate change impacts. An interviewee from transportation sector of the province said,

> *We are also conducting vulnerability analysis of roads to the flooding. The areas that are prone to flooding will have asphalt replacement with concrete. We also use the concrete in the new road constructions where there is a high possibility of flooding.*
>
> *(Personal Interview, 2016).*

Provincial and municipal offices prioritized local knowledge over climate change scenarios to assess risks and vulnerabilities. They mentioned that climate change scenarios were not sufficient to design and administer a vulnerability assessment. Priority of local knowledge was higher among mass organizations. For example, the Farmers Union gave priority to farmers' knowledge for a vulnerability assessment to agricultural sectors. The Union explained the role of local knowledge in following way,

> *We conduct the risk and vulnerability assessment to the flooding and drought. We use the experience-based data to deal with flooding and drought. We visit districts and villages to conduct a vulnerability assessment of agricultural sector based on the experience of farmers. We collect the data of farmers' loss and the problem with farming and we get that information to determine the vulnerable areas of the flooding (especially for farmers) and develop the adaptation strategies to deal with those impacts of flooding and drought.*
>
> *(Personal Interview, 2014)*

One major challenge of local knowledge-based vulnerability assessment is that it only reflects past experiences and trends. Future trends come from climate change scenarios. In case of Quy Nhon, government agencies said that they administered risk and vulnerability assessments. However, their assessments were mainly business as usual. They were not specific to climate change impacts.

7.2.3. Understanding Complexities of Climate Change Impacts

Climate change is complex in two ways: its association with existing hydro-meteorological disasters and its cross-cutting nature among multiple sectors. Planners and decision-makers should understand these complex characteristics in order to develop more relevant policies, programs, and projects to adapt to impacts.

There is a lack of understanding about the cross-cutting nature of climate change in Quy Nhon. During interviews, few leaders and government officials elaborated on this nature. Each position and agency in a provincial department has fixed duties and responsibilities. Lack of flexibility of their roles and responsibilities does not allow these agencies to work on new problems like climate change. When interviewees were asked about roles and responsibilities of the organization (even though they were asked in general), they cited the legal document issued by government for their position and the organization. When a provincial official was asked about the role of her organization, she explained,

> *The role of this organization is specified in the Decision number 302 of the provincial government. The major duty of this organization is to manage the infrastructure in the province related to transportation. Regarding the Quy Nhon city, the city is managed by the Department of Construction but the transportation infrastructures of the city are managed by this Department. The inner city streets are though managed by the Department of Construction itself.*
>
> *(Personal Interview, 2016)*

Among the few interviewees who were aware of nexus between climate change, natural disasters, and socioeconomic problems, they mentioned that increasing devastation from flooding and typhoons was not only caused by climate change impacts, but also exacerbated by deforestation, urbanization, and hydropower development. Upstream hydropower development has been pointed out by interviewees as a leading reason for flash floods in Ha Thanh and Kon rivers. Respondents to household surveys, participants in community meetings, and the interviewees referred to a flood in 2009. However, they did not mention the complexity that was created by a mix of climate change impacts, infrastructure development, city expansion, and the deforestation in upstream areas. They just mentioned that there was increased flooding in the city.

This is a relevant example of wicked problem (Innes & Booher, 2010; Newman & Head, 2017; Rittel & Webber, 1973). The impact of increasing flood was felt by people and decision makers, but the source and solution of the problem were not certain, and it was not fathomable for the general public to understand or to define. Short-term and longer-term solutions for flooding are not possible because the problem is connected to issues such as compromising environmental protection for economic growth and development deficiencies.

Few interviewees in Quy Nhon explained the complexity associated with flooding problem in the city. One interviewee explained the issue,

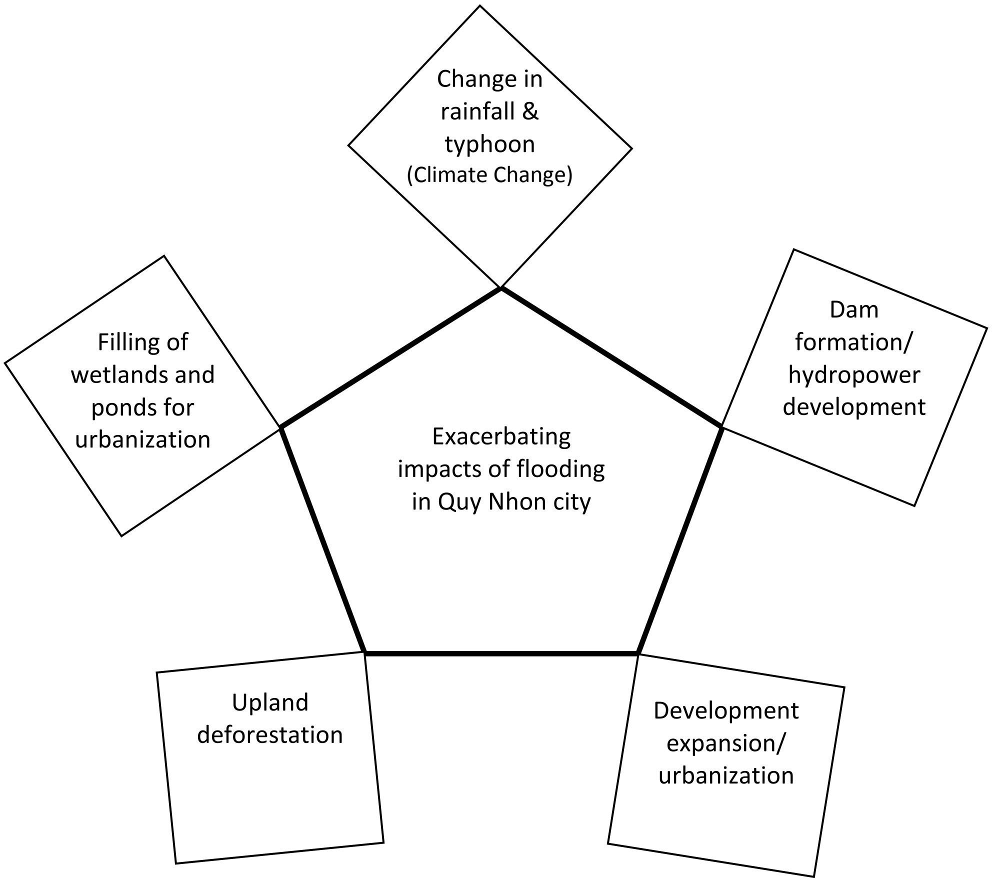
> *When there was flooding in this area, after one or two days of flooding, it used to become normal around the house and around the surrounding areas but now when the rainfall happens, it runs to our area really fast from the mountains because there are no trees in the mountains. Therefore the water runs to the downstream really fast.*
>
> *(Personal Interview, 2016)*

Decision makers are aware of the role of new development and large projects in flooding problems. They mentioned that flood water retention ponds and reservoirs were being filled in for urbanization, which led to more flooding in the city. One interview participant explained this in following way,

> *The population of the province has increased. There used to be different ponds to retain the flood water but they are being filled now for the development. This is one cause of increased flooding in the province. The Phu Hoa reservoir is being filled. The Suoi Trau reservoir has been filled. These water bodies are the retention pond of the flood water.*
>
> *(Personal Interview, 2016)*

Understanding of problems formed in the nexus of climate change impacts, land use change, and altercation of the ecology is useful in developing relevant adaptation measures to flooding. Such understanding was low among decision makers and planners in Quy Nhon. Government officials who worked in flood management for a long time have a better grasp of the complexities. Based on explanations in interviews, household surveys, and community meetings, the connection of flooding with other socioeconomic and environmental issues is shown in Figure 7.2.

Figure 7.2: Connection of Flooding Problem with Other Issues in Quy Nhon City



(Author, 2018)

The relationship between climate change and flooding was understood in Quy Nhon, as was demonstrated during interviews, household surveys, and community meetings. Decision makers, political leaders, community leaders, and households were aware of the association between changes in rainfall and flooding. Figure 7.2 shows that climate change is not the leading cause of the flood problem in the city. Urban expansion, deforestation, change in physical landscape, filling of water bodies, and hydropower development as well as changes in rainfall exacerbate flooding.

Activities of the ACCCRN Project led to higher understanding of flooding in Quy Nhon. The project had activities on awareness building (television and radio programs), empowerment (training, early warning, emergency response, and evacuation), and environmental protection that were implemented by the CCCO. These activities raised awareness of climate change and its impacts among residents and government offices in Quy Nhon. The overall understanding of climate science in Quy Nhon is presented in Table 7.5.

Table 7.5: Overall Understanding of Climate Science in Quy Nhon City

Components of understanding	Sub-components of evaluation	Measurement
Awareness/cognition	Awareness of climate change	Strong
	Discussion of future impacts	Strong
	Identification of current impacts	Strong
	Change in worldview	Fair
Assessment	Risk and vulnerability awareness	Fair
	Risk and vulnerability assessment	Fair
	Reference to the climate science	Fair
	Evaluating relevance of climate scenarios	Strong
Complexities	Discussion of nexus between climate change and other socioeconomic, physical environmental changes	Weak
	Identifying share of different factors on worsening situations of disaster (e.g. flood)	Weak

(Author, 2018)

7.3. Implementation of Climate Science in Land Management Practices

Climate science implementation in land management includes its use in development projects and land use decisions to adapt to current and future impacts. In Quy Nhon City, this involves improvement in capacity of agencies and communities to deal with impacts (flood, drought, salt water intrusion, and typhoons), changes in legislations, changes in the land use planning processes, and reducing damage from reoccurring floods, droughts, and typhoons. Climate science implementation, however, is not smooth or straightforward. A major challenge is a lack of legislation, standards, guidelines, and resources to address impacts in land use planning despite strong awareness of the issue among provincial and city-level agencies.

7.3.1. Capacity Building

Capacity building in Quy Nhon includes enhancement of early warning systems, households' preparedness and response to flooding, improvement of awareness of climate change impacts, and enhancement of codes and decision tools (building codes, zoning ordinance, etc.) among government offices to enhance adaptation.

There was not any discussion on early warning systems in interviews with government officials during this research. There were four questions in the household survey about the early warning system in the city. Observation and informal communication with ward and hamlet *(Khu Vucs or KVs in short)* leaders in the Nhon Binh and Nhon Phu wards helped illustrate the situation of early warning systems. One major finding is that the early warning system depended on cellphone network. Each KV leader in Nhon Binh and Nhon Phu wards were provided a designated cell phone to communicate with upstream KV leaders and Committee on Flood and Storm Control (CFSC). They could communicate with each other to get information on water levels in rivers after a rainfall event. Based on this communication, KVs could decide to evacuate if necessary. There were manual and automatic communication systems between water gauges/rainfall measurement stations and the Hydro-Meteorology Forecasting Center of the province. After receiving data from measurement stations, the Center provides warning to CFSC and KV leaders simultaneously (ISET-International & CCCO Binh Dinh, 2016). In coordination with ward committees and KV response committees, a message would be aired to residents about an upcoming flood, evacuation details, and preparedness measures. One of KV leaders in Nhon Phu Ward said during a conversation that he goes around his KV with a handheld loudspeaker and announces a warning of an upcoming flood. CCCO has identified floodways in two wards and put warning signs and pillars with historic flood markers in multiple places to inform residents.

Figure 7.3: Warning Signs in Flooded Streets in Nhon Binh and Nhon Phu wards

Translation: “Caution: Do not cross if the flood water is fast and strong”

(Author, 2016)

Pillars contain water depth measurement scales and marks of historical floods in the area. 2009 and 2013 floods were marked because they were most devastating floods in recent history of Nhon Binh and Nhon Phu wards. These signs were administered by CCCO under the ACCCRN Project. They enhanced the capacity of local communities and local governments (municipal, ward, and KVs) on flood management.

Figure 7.4: Pillar to Measure Flood Depth with Historical Flood Level Marks

(Author, 2016)

Households have capacity to deal with flooding. In household surveys and i-Clicker exercises, they were asked about their reactions to the possibility of a flood. In household survey, 70% of households mentioned that they protect their houses from flooding. When they were asked how, the majority of them said that they created a barrier around the house to stop flood water from entering.

During i-Clicker exercises, participants were asked how they protected their house from flood. 56 percent responded that they used sandbags, elevated the structure, and dug canals to release the standing water quickly.

In the same manner, households living in a flood zone have a personal boat to get out from their area in case of flooding. Wards and KV offices also have boats to rescue people from homes. Boats were provided by multilateral and bilateral projects. Boats for Nhon Phu and Nhon Binh wards were provided by the ACCCRN Project and CCCO.

The overall capacity for dealing with a flood in Quy Nhon City has been enhanced. Government agencies at the province, city, wards, and KVs were aware of the flood problem. The warning system has been improved with support from projects and programs from donors and the government. Nhon Binh and Nhon Phu wards established a number of evacuation shelters with support from the ACCCRN Project. The chain of communication in flood warnings was well established. Households were aware of changes in flooding in recent years due to climate change and physical changes in the area. They also knew about basic flood protection measures for their homes. In total, the capacity of flood management in the city has been improved in recent years.

7.3.2. Changes in Legislations and Building Codes

Utilization of climate science includes its role in risk reduction. It involves mainstreaming of science in legislation, policies, projects, and decisions. As a result, it mitigates vulnerabilities and losses from flooding, drought, typhoon, and other disasters related to climate change in all levels of administration (cities, communities, and households). Some examples are addressing climate change impacts in zoning, building codes, construction standards, building permits, and infrastructure developments.

Building codes in Vietnam evolved from Soviet Union systems. After Doi Moi, the influx of foreign investments fostered opportunities to modify Soviet-based standards. Newer versions were more harmonized with international standards (Nguyen, 2006). These codes and standards are issued by different national ministries to comply with their subordinate agencies. Each ministry has designated a branch to oversee standards. The Ministry of Science and Technology (MOST) issues standards related to the quality of goods and products. The Ministry of

Construction (MOC), Ministry of Transportation (MOT), and Ministry of Agriculture and Rural Development (MARD) have standards related to developments under their institutional jurisdictions. Each ministry has a department of science and technology to oversee its standards and quality of work (Nguyen, 2006). The MOC has building standards that specify climate stress factors in construction, but they do not specifically mention rare flood, heat, and sea level rise. They only mentioned that, with certain dynamics of heat and water, construction material may shorten its lifespan. For example, Concrete and Reinforcement Concrete Design Standards of 2005 stated,

> *For structure working in condition atmosphere humidity below 40%, stress loss should increase 25%. In the case structure made from heavy concrete, small particle concrete, working in hot climate zone and not protected from solar radiation, stress loss should increase 50%.*
>
> *(Ministry of Construction, 2005)*

The Concrete and Reinforcement Concrete Design Standard was updated in 2012. In newer versions as well, there is not any specific example of addressing climate change impacts and disaster risks.

Interview participants from Quy Nhon City were asked about consideration of climate change impacts and disaster risks in existing construction standards and building codes. Opinions were divided for this question.

Half of respondents claimed that the existing construction standards on infrastructures and building codes address climate change impacts and disaster risks. They argued that climatic factors are considered in design standards. Government officials who were involved in construction decisions in the city mentioned that current construction standards were flexible enough to address climate change impacts. Government officials claimed that ministries and line agencies were already addressing climate change in plans, policies and decision making. While providing the example of a bridge construction, one government official mentioned, *We have a different level of standards for the bridges. For the normal flooding, it is the normal level we leave while building the bridge. The national standard is the maximum of 5% more of the normal flooding to be left to adapt with some large-scale flooding. We have different extra elevation for the bridge. For example, we leave the delta one for the wood and logs to be passed through the bridge, delta two is the elevation that should be left from the water level to allow boats to be passed under the bridge and the delta 3 is the larger scale flood because of the climate change. Delta three is the extra level of flooding to adapt to the climate change for the bridge.*

(Personal Interview, 2016)

The other half of interviewees said that current building codes and design standards were not sufficient to address climate change and obscured disasters. Current building codes and standards were not inclusive of climate change impacts. The latest climate science was not used to inform construction standards and building codes. Government officials explained that their hands were tied with the status quo of standards, and they could not act, even though they were aware of impacts.

Interviews with nongovernmental personnel (community leaders and consultants) were more vocal about issues. While explaining construction of roads and highways, one interviewee described the following,

… talking about new highway reconstruction in Nhon Binh ward. ---- Of course, there are some standards for the construction in order to adapt with the weather, but those are for normal weathers, but not for the extreme futures, such as climate change. ……. if we use the normal standard, they can build some of the flyovers and bridge in here to allow the water to go out quickly. If they follow only normal standard they want to follow 5% threshold, it is 50 years flooding, but in order to make sure that the water will go out from this area, they have raised the standard to adapt with hundred year flooding and of course the 5% and 1% are very different. It can bear to the strong typhoon, higher water for example. For this issue the Ministry of Construction, they do not have any standard to adopt the climate change. They have some guidelines and some issued paper to tell them to adapt with the climate change but there is not any standard until now.

(Personal Interview, 2014)

Except for a few guidelines and circulars produced by ministries, there were not any legislative updates on standards and codes addressing climate change impacts. Provincial government agencies are looking up to national ministries and departments to provide updates on building codes and standards to address the climate change impacts. In this regard, one government official illustrated the situation,

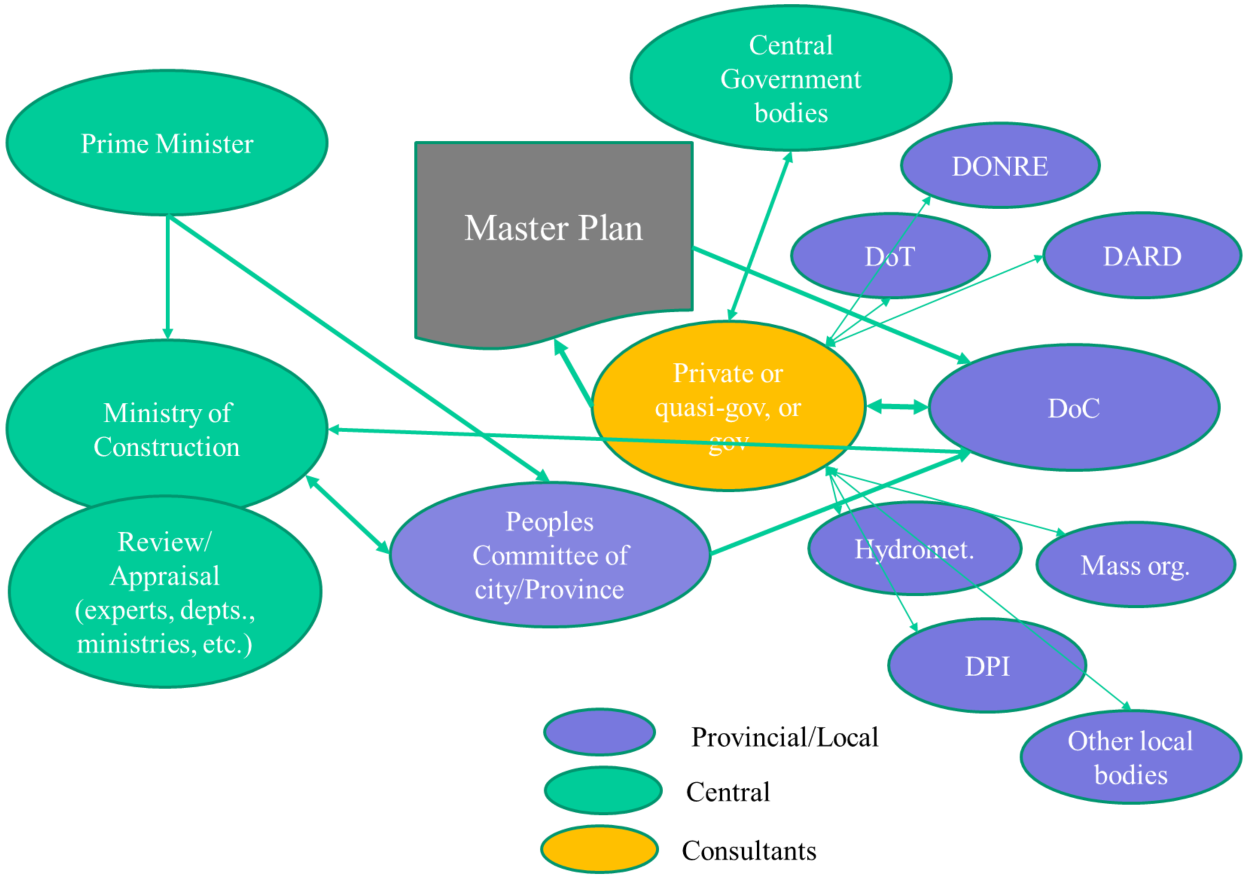
> *Until now the materials of climate change from the central government is not decided yet. Material related to the standard of the construction. We are waiting for the standard from the central government and to address the climate change. We got handcuffs in our hands; we cannot do nothing without guidance from the central government.*
>
> (Personal Interview, 2016)

Accessibility to climate science and higher awareness of impacts (flood, typhoons, drought, sea level rise, and others) are not sufficient to transform knowledge into action. There are institutional setups that can challenge utilization of such knowledge in decision making and planning.

7.3.3. Change in Planning Processes

Urban planning in Vietnam is predominantly rational. Cities contract consultants to prepare plans. The Binh Dinh Province hired the Vietnam Institute of Architecture and Urban and Rural Planning (VIAP) and a France-based planning firm, AREP, to prepare Master Plan 2015 of the city. Both companies were interviewed about the master plan. Despite advocacy of communicative planning approach by consultants, the plan was prepared through a top-down rational approach. Based on informal communication with government officials, retired employees of provincial departments, and consultants, the approach of Master Plan 2015 is illustrated in Figure 7.5.

Figure 7.5: Quy Nhon City Master Planning Process



(Author, 2018)

In Figure 7.10, there are three colors of oval shapes. Purple-colored shapes represents provincial and local agencies, orange is planning consultants and green is national organizations. The leading organizations for the master plan are the Binh Dinh Department of Construction (DOC) and Department of Planning and Investment (DPI) which identified consultants to prepare the Plan of 2015. Consultants were in constant communication with the DOC in the plan-making process. They interacted in data gathering, requirements and deliverables. The DOC works with other provincial and city agencies to deliver data, organizing meetings with consultants, gathering feedback on drafts and circulating the final plan. Once the review process is completed, the DOC submits the plan to the provincial people's committee for review and comments. Concurrently, they also submit it to MOC. The ministry normally asks an external organization to evaluate the plan. In case of master plans of the city, the Vietnam Urban

Development and Planning Association (VUDPA) was assigned for plan evaluation. If there are any changes to be made, the ministry returns the plan to the DOC. Once the plan is approved by the ministry and the people's committee, it is ready for implementation. In Figure 7.10, the thickness of lines represents an iteration and gravity of relationship between organizations. Arrow direction represents the direction of interaction or information flow. This is a process of spatial planning for cities under the provincial government. If a city is under the national government (e.g. Ho Chi Minh City or Ha Noi or Da Nang), final plan approval should be done by the prime minister. In master planning, national priorities and guidelines of planning need to be followed.

Participation and deliberation have been strong aspects of planning in the communicative era. They include context-specific and issue-specific approaches. In Vietnam, people's participation is minimal. Residents of Nhon Binh and Nhon Phu wards were unaware of any master plans of the city. During i-Clicker exercises, participants were asked whether they knew about a master plan of the city and more than 80 percent replied negatively.

Opinion on people's participation in Quy Nhon Master Plan 2015 was divided among consultants. Pro-government consultants argued that planning approach was participatory and incorporated voices from different sectors and communities. Consultants outside of the government claimed that the hierarchical planning system has challenges in terms of coordination and participation in plans and projects. Differences in opinion on urban planning system are shown in the following two contrasting quotes,

Government and quasi-government consultants	Professional, international and private consultants
At first we do research, surveys, observation of every local area of the city, each ward, each village, each province around the city; after that we have to collect information from every department in the city and in the province; after that we have to collect information from central government agencies and every department at the central level. After that soon prepared this successive plan of the area so we have to ask for the responses, feedbacks, and suggestions from all of them, from wards, cities and provinces; every department at the local level and every department in the central level government, and ask for the opinions from the citizens in the area, after that if there are no changes, it will be conducted and submitted to the government.	*These big projects directly are coming through the ministry, which means that the decisions, even from the members of the peoples committee from city, even DOC cannot say no. ……. Just one month after the master plan was finished, we read the news from a newspaper that there is a company coming from Saudi Arabia to invest there. We did not even know about it. … Big projects like big industries like mining, they directly come from the ministry. They even do not consult with the local authorities. There is no relationship among them in terms of big economic projects like that. There is no communication relationship between the foreign investors and local authorities, the decisions are made at the ministry level and implement the project at the local level. ……. There is no relationship at the local level of this.*

(Personal interview, 2014)

As observed during informal conversation with them, government officials in Quy Nhon expressed dissatisfaction with the planning process of Master Plan 2015. They wanted to follow a more participatory approach of planning. These organizations had practiced collaborative planning through the Quy Nhon Climate Action Plan under the ACCCRN Project. Due to existing planning requirements based on the rational and socialist approaches, Master Plan 2015 followed the standard Vietnamese model. It was heavily depended on data and reports published by government line agencies at ministerial, provincial, and local levels.

7.3.4. Flood Impacts in Nhon Binh and Nhon Phu Wards

Implementation of climate science can be measured through impacts of land use decisions on disaster patterns. In Nhon Binh and Nhon Phu wards, the impacts of land use changes were assessed through household experience on flooding pattern and land use changes. Residents of the wards were asked about physical changes in their locality and their experience of floods during household survey. They were asked to compare current flood damage with their experience of 20 years ago. For perception of physical change, they were given multiple choice questions with 10 variables of physical changes. 8 options were related to contextual physical changes (new houses, industries, roads, tourism facilities, irrigation systems, dykes, etc.). The perception of increased flooding was from 0 to 6, with 6 being the highest severity and 0 referring to no change. Changes in agricultural area was a binary variable where respondents were asked whether they noticed a change in the agricultural area. Negative changes in water bodies included changes in size and number of reservoirs, area of wetland, and number and flow of small streams. A detailed survey is available in Appendices 1 and 2.

A linear regression model was created in order to assess flood impacts in the Nhon Binh and Nhon wards. The wards are adjacent to the urban center of Quy Nhon and are relatively undeveloped. Based on characteristics, they are considered as perfect examples of an urban village (Bousquet, 2015). A dependent variable was the impact of flood and determinant variables were land use changes in the wards. The model is as follows:

$$y = a + bx$$

y = Dependent variable (e. g. Perception of flood increase in the area (1 to 6))

a = Intercept, b = Slope

x = Explanatory variable/s (e.g. land use change in the Nhon Binh and Nhon Phu wards, changes in water bodies, and socioeconomic characteristics)

Table 7.6: Role of Land Use Change on Flood Pattern in Nhon Binh and Nhon Phu wards (Regression Models)

Variables	Model 1	Model 2	Model 3	Model 4
Physical changes	0.06696 (0.18)	0.09726*** (0.05)	0.1044*** (0.04)	0.1124*** (0.03)
Decrease of water bodies		-0.108*** (0.04)	-0.09686** (0.09)	-0.09265 (0.11)
Reduction in ag. area			0.30062*** (0.01)	0.28509*** (0.02)
Reduction in area of vegetation			-0.01291 (0.93)	-0.00308 (0.98)
Wards (dummy variable)				0.10851 (0.44)
Age				0.00204 (0.72)
Education				0.05591 (0.70)
Intercept	2.82	2.87	2.49	2.27
R^2	0.0050	0.0173	0.0364	0.0387
Adjusted R^2	0.0022	0.0117	0.0281	0.0191

*** Significant at $p < 0.05$, ** Significant at $p < 0.1$

(Author, 2018)

Table 7.7 shows four iterations of regression models predicting perception of flood increase in Nhon Binh and Nhon Phu wards. The highest adjusted R-square is in Model 3 where three explanatory variables are significant. Across all models except Model 1, changes in landscape or physical changes have a significant role in explaining increment of flooding in the wards. Once demographic characteristics are controlled in Model 4, the slope for physical changes increases slightly more than Model 3. The best model to explain the role of physical changes in flooding is Model 3. It explains the 3.64 percent variation of increase in floods in two wards. Among explanatory variables, reduction in agricultural lands is the highest significant contribution, at 0.30062. Interestingly, reduction in the water bodies in these two wards has a negative value at 90 percent confidence level. Reduction in vegetation area does not have a significant role in increasing floods.

Regression models reinforce arguments from residents during informal interactions for this research. It also matches with the historical pattern of flood in two wards, and with outcomes of community meetings. Although Model 3 only explains 3.64% of change in flood, physical changes and reduction of agricultural areas have positive values at 95% significance level. This means a unit change in physical characteristics in the area increases floods with the factor of 0.1044. Similarly, a one unit reduction in agricultural lands in the area increases floods with factor of 0.30062. This is a weak model in terms of an explanation of flooding, but it illustrates the significant role of agricultural land reduction and physical development expansion to exacerbate flooding problems in cities.

This model also matches with the historical and current situation of Quy Nhon City. Historically, Nhon Binh and Nhon Phu wards were agricultural lands. They are deltas of Ha Thanh and Kon rivers. They are also two major growth areas of the city. Both wards have faced a lot of physical changes in the last 20 years. Houses, roads, industries, residential areas, highways, gated communities, roads, and wastewater treatment plants were built, resulting in loss of agricultural lands. Agricultural terraces were absorbent of flood water in the past, so with the conversion of agricultural lands, flood waters became irregular and stronger in remaining open areas where farmers are living at present.

The opposite argument was presented during interviews by government interviewees in the province. They were asked whether they were addressing climate change in construction projects in these two wards. Government officials claimed that they were addressing climate change and argued that they were implementing climate science in Master Plan 2015 and decisions related to land use. Perceptions and experience of locals, however, showed that flooding was becoming stronger every year in terms of damage, duration, and extent.

Implementation of climate science is weak in Quy Nhon. It has a strong impact on capacity building among local agencies and communities to prepare and respond to flood and typhoons but its utilization on legislative changes of land use planning is weak. As a result, climate science was not utilized in plan implementation. Due to the rigid top-down rational master planning model, Quy Nhon does not follow a collaborative approach to planning. This hinders appropriate use of climate science in planning processes and implementation. Flooding impact has increased in the city due to reduction of agricultural lands and physical development in Nhon Phu and Nhon Binh wards. This means changes are not taking account of local hydrology and environment. Overall implementation of climate science is shown in Table 7.8.

Table 7.7: Overall Implementation of Climate Science in Quy Nhon City

Components of Implementation	Sub-components of evaluation	Measurement
Legislative changes	Change in building codes to adapt to potential changes	Weak
	Establishment of no-build zones	Weak
	Following and enforcing zoning related to adaptation (overlay-zone, transfer of development rights, etc.)	Weak
Capacity building	Enhancement of early warning systems	Strong
	Clear guideline to households on actions related to disasters and other impacts	Strong
	Improved awareness among communities	Strong
Planning process changes	Collaborative/communicative planning	Weak
	Participation of multiple actors in the planning process (collaborative rationality)	Weak
Impact reduction	Reduction of flood impacts among households and wards	Weak
	Felt a responsibility to enforce and practice legislative measures by communities.	Weak

(Author, 2018)

7.4. Overall Utilization of Climate Science in Quy Nhon Land Use Planning

Utilization of climate science is divided into three steps: dissemination, understanding, and implementation. In land use planning of Quy Nhon City, understanding of climate science is the strongest. The second strongest is transmission. Implementation is the weakest.

Understanding of climate science is broken down into cognition/awareness, assessment, and knowledge of complexity. Government officials, leaders, and residents of the city have a high awareness about climate change. They described current and future impacts during interviews, surveys and community meetings. Participants were aware of impacts on local temperature, rainfall, and flooding. The majority of government offices had knowledge about climate change scenarios for Vietnam. Some of them mentioned details of those scenarios. Assessment was associated with identifying specific vulnerabilities or assessing future impacts of sea level rise, flooding, drought, and typhoons. It also included the capacity of interviewees to assess the relevance of climate science in their decisions. Government agencies and mass organizations with funded projects were involved in risk and vulnerability assessment including offices that were related to climate change, flood management, dike construction, and rural road construction. They noticed current impacts of climate change, such as an increase in flooding, sea level, and drought.

Understanding the complex relationship between climate change and physical changes was not strong in Quy Nhon. Some interviewees in the province discussed the role of deforestation and landscape changes as a reason for increasing flooding in the city. They mentioned that an increase in floods is a result of upstream deforestation and change in the landscape along both sides of Ha Thanh and Kon rivers.

Transmission includes production, communication, and acquisition of climate science. Production process is isolated from policymakers. Climate scientists are less concerned about needs of policymakers during production of climate science. There is some interaction but their relationship for information sharing is demand-driven. Communication is not proactive in scientific communities. Scientists publish reports of climate change research to fulfill grant requirements. There is not any institutional setup for communication of climate science. As mentioned by decision makers, information is power and bears a monetary value. Sharing of data is not common. If there is monetary and political benefit to share climate science, there will be more frequent interactions between decision-makers and scientists. Funded projects on climate change provide that opportunity.

Implementation of climate science was evaluated based on changes in legislation, capacity building, changes in planning processes, and changes on flood impacts in the city. Legislative changes to address climate change impacts are not in place. Although establishment of the CCCO by provincial government is a huge milestone, it was not spontaneously generated by the government. It was established as an administrative agency for the ACCCRN Project. Availability of resources from the project was the driving factor. Provincial departments look up to the national government for legislation to address climate change impacts in land use planning. Without those legislative changes, the provincial departments cannot enforce any new measures in urbanization to adapt climate change impacts.

Existing measures for adaptation to climate change impacts are weakly enforced. Government officials mentioned that they have legislation on river bank setback, but enforcement is weak. Slow and gradual encroachment of river banks is common in Quy Nhon which is another factor in the complexity of land management in Vietnam.

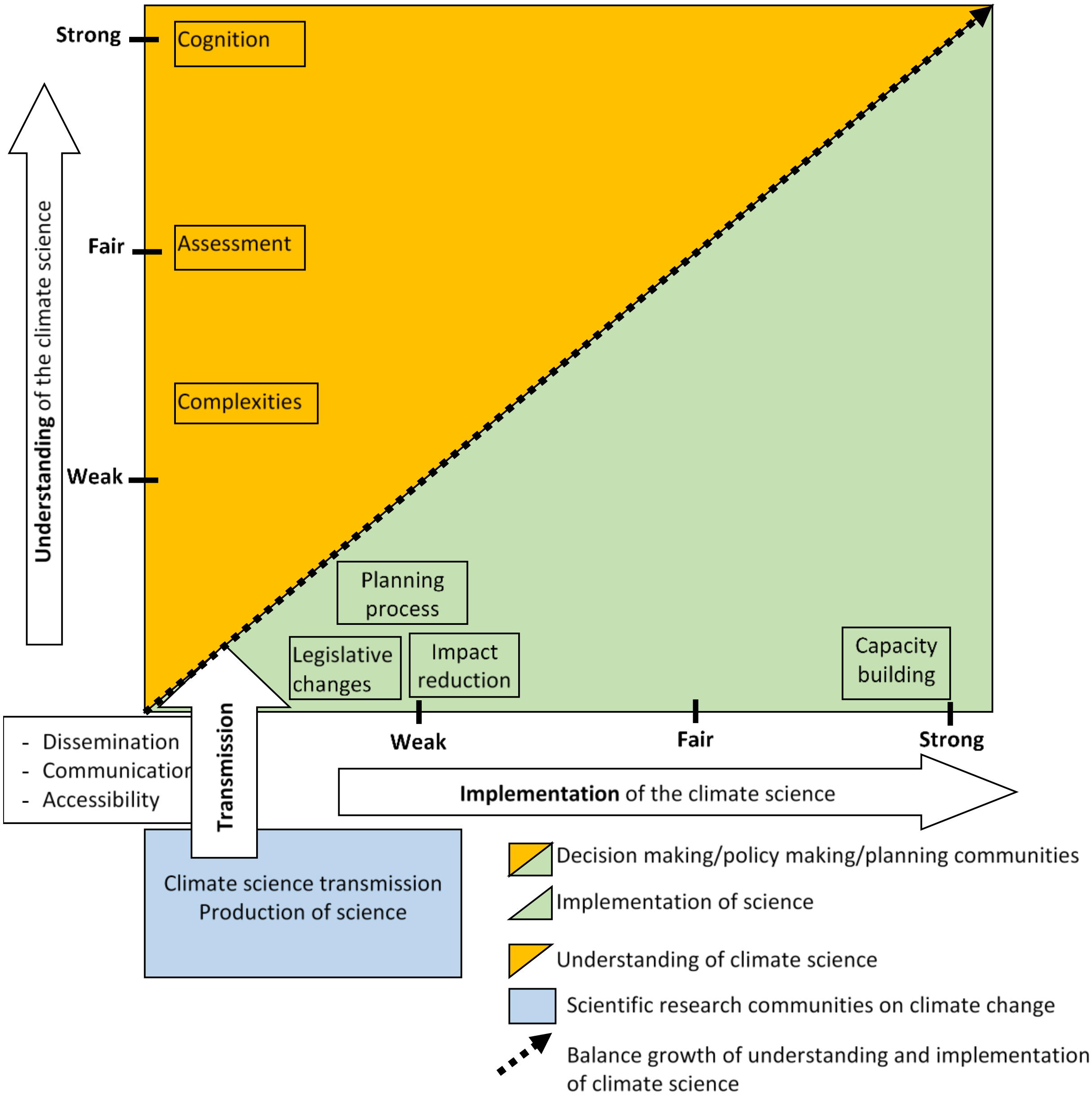
Utilization of climate science is strong in capacity building. It includes areas that do not need any legislative changes from government, such as improving awareness of climate change impacts, enhancement of the early warning system, and household preparedness to floods and typhoons. They were focus areas of the ACCCRN Project. Besides ACCCRN, other bilateral and multilateral donors are also working on flood warning, drainage enhancement, and livelihood resilience in the city. KV leaders, ward leaders, and residents are aware of climate change impacts. They believe that climate change alters flooding, typhoon, drought, temperature and sea level in their locality.

The technocratic and rational planning process of the city has not changed. It is led by consultants; local communities and stakeholders are not consulted in course of plan preparation. As a result, local communities are not aware of the master plan and planning processes. This allows less flexibility to utilize multiple sources of knowledge, including climate science from different sources.

Flood impact in the city is increasing. With implementation of new projects and land use conversion, it is getting worst. If climate science is used as foundation for development projects, this should not be the case. Long-term perception of residents shows changes of agricultural use to others and physical development increased the impacts of flood.

Overall progress of climate science utilization in land use planning in Quy Nhon City is shown in Figure 7.6.

Figure 7.6: Climate Science Utilization in Land Use Planning in Quy Nhon City



(Author, 2018)

In Figure 7.6, the bottom blue rectangle represents scientific communities of climate change where climate science is produced. The two-colored large rectangle above is the domain of decision making, policy formation, and planning. The lower triangle of the rectangle represents implementation, and the upper rectangle represents understanding of climate science. The middle diagonal dotted line represents the optimum balance between understanding and implementation of climate science in planning. X-axis represents a progress of implementation (weak, fair, and strong) and y-axis shows a progress of understanding (weak, fair and strong). In an ideal scenario, higher understanding leads to higher implementation of climate science among in policy, plans, and programs. In an ideal scenario, understanding and implementation of climate science grow in the same proportion, once knowledge is transmitted to decision making.

Scientific research reaches the domain of policy, planning, and decision making through three mechanisms: dissemination, communication, and accessibility. They occur between scientists and decision-makers at institutional and personal levels. Interaction between policymakers and climate scientists can also take place during production of science. An example of this would be a consulting service of climate scientists for different ministries or provincial departments. Based on policy and project requirements, ministries and provincial departments ask for certain climate change data and scientists provide the service. It can be demand-driven or more interactive. For Quy Nhon City, the CCCO and boundary agents play a strong role in customizing and delivering climate science to provincial and local agencies. Besides this, interaction between national climate research organization and provincial planning agencies does not take place for production and dissemination of climate science.

Understanding of climate science in Quy Nhon is strong. It is further divided into awareness and cognition, assessment of impacts, and recognition of complexities of climate change and other existing problems. Provincial agencies, political leaders, and the general public are well aware of climate change and its impacts. Based on evidence, it ranked highest in the city. But the assessment capacity of impacts is relatively low. These agencies have some knowledge about risk and vulnerabilities of flood, drought, and typhoon in the city, yet few provincial offices conduct a vulnerability assessment to floods, droughts, and typhoons.

Understanding of the complex relationship of floods with deforestation, land use change, and alteration of hydrology is very limited among provincial agencies and city departments.

During interviews, only 2 interviewees discussed the role of deforestation in changing flood impact.

Implementation of climate science is weak in Quy Nhon. Strong understanding of climate science should lead robust implementation in the master plans, policies, and projects in the city. But this is not the case. Except for a few guidelines and circulars from ministries and national departments, there is no change in construction standards, building codes, and zoning laws in the city to address climate change impact. Climate science is used to inform these components of implementation. Bilateral and multilateral projects on climate change create incentive for utilizing climate science. Another component of implementation is planning which is less flexible and follows a rational model. As a result, it allows less room for incorporating climate science in formation and implementation. Land use change projects in the city are exacerbating flood problems. They are part of the master plan implementation. The provincial department that is responsible for land use decisions claims that their plans, programs, and projects are adapting to flood, drought, and typhoon-induced problems. But the experience of residents in flood-prone wards shows that land use changes and reduction of agricultural lands are causing more flooding.

7.5. Factors Affecting Utilization of Climate Science in Land Use Planning in Quy Nhon City

There are seven factors that challenged optimum utilization of climate science in land use planning in Quy Nhon: institutional setup, climate science production and dissemination, resource availability, political economy of the land management, and governance mechanisms of land use planning.

- **Resource limitation:** Application of knowledge requires resources. Resource limitation is one leading constraint of the utilization of knowledge (Knott & Wildavsky, 1980b). Decision makers with limited resources may not make the best decisions on knowledge utilization. There is also failure of dissemination because what decision makers receive, they may not be able to use (Knott & Wildavsky, 1980b). Resources include both human and financial. Capacity of staff is crucial. Government agencies in Quy Nhon identified limitation of resources as major challenge in using climate science in decisions. More than nine interviewees mentioned that they could not address climate change in their office because of budget constraints. They were aware of climate change and its impacts on flooding, typhoons, and drought but addressing it in planning required extra resources. They gave an example of elevating a highway bridge to address extra flooding. They could ask consultant to raise the bridge to a certain height to accommodate extra flood water, but it required extra finance which is not accessible to the agency. They also do not have technological and human resources. A branch agency of the Provincial Department of Natural Resources and Environment (DONRE) was ready to conduct flood mapping for Nhon Binh and Nhon wards but it did not have a mapping software.

- **Contestation of interests over land:** Land management in Vietnam is contested, which has an implication on utilization of climate science in land use practices. The government, private sectors, and communities impose their interests over land. Private investors want to maximize profit from their investments. The government wants to collect more revenue on land through lease, transfers, and taxes. Citizens want to hold on land to protect their tenure, maximize benefits, and get compensation equal to market value. As it was discussed in Chapter 4, the three actors in land management are always conflicting with each other. The government leans towards private investors to get more economic benefits from land. The one-sided decision is normally made in negotiation and consultation between the government and private investors in formal and informal settings rather than with the people living on the land. The Communist Party of Vietnam has an influence on deals. Local political leaders are asked to convince users to accept offers and are mobilized to enforce land use decisions of the government. Compensation to users is normally below the market value of the land. As a result, conflict between authorities and locals escalates and sometimes results in tragic accidents, including physical harm and fatalities. Maximum economic return for the government and private sector has been the main focus of land use planning and projects. This has overshadowed issues like equity, environmental justice, and climate change. As a result, land use conversion keeps happening in environmentally sensitive areas such as wetlands, banks of rivers, lakes, and coastal areas. This scenario prevails in Quy Nhon city as well. Although there is a requirement of environmental impact statement for development projects, the focus is on economic gain. Even though locals are facing increasing impacts of flooding, drought and sea level rise, land use planning lacks implementation of climate change regulations in process and decisions.

- **Centralization of building codes, construction standards, and large-scale projects:** In a centralized government system like the one in Vietnam, provincial and local planning operate based on decisions and delegated authority of the national government. Having broader awareness and assessment capacity among government officials is not sufficient to use new climate change knowledge in plans and policies. They need to have mandates and standards from the national government in order to use climate science. For example, one interviewee mentioned that he wanted to establish flood zones as construction prohibited areas but his office did not have an authority to do so. Even though he was aware of future impacts of flooding in case of construction in certain areas of Quy Nhon City, his agency could not enforce a prohibition on construction. The same situation prevails for reducing coastal retreat and buffering streams. The Office of Storm Control and Flood Prevention under the Department of Agriculture and Rural Development (DARD) has a duty to provide information on potential flood impacts for construction projects and plans. But the input is not mandatory for the proposer to follow; it is just a suggestion. As a result, feedback from the Office of Storm Control and Flood Prevention under the DARD may not be included in plans and projects. This problem applies to utilization of climate science as well. In the centralized administrative system, provincial and local government agencies work as protectors of interests of national government and claim that standards from the national government are best options to deal with local challenges. This is vividly apparent in Binh Dinh Province and in Quy Nhon City. A group of offices that are involved in infrastructure development and land use planning argued during interviews that current Vietnamese standards on construction are flexible enough to address climatic disasters such as extreme flooding, typhoons, sea level rise, and higher temperatures.

  Having good scientific scenarios of climate change is not be sufficient to limit development in certain areas of the city. Large-scale projects such as highways, bridges, and economic zones are normally approved by the national government with no inputs from provincial and municipal governments in the process of decision making. Local governments are unaware until the projects are approved. Even though a city master plan prohibits development in a certain area of the city, the national government can approve projects for the area without consultation with provincial and municipal governments.

- **Compatibility of climate science with local planning needs:** Scientific knowledge of climate change in Quy Nhon comes from both national and international scenarios. Provincial departments and mass organizations mentioned that the national scenarios are not good enough to use in plans and projects. Eight interviewees mentioned that demand and supply of climate science did not match. They highlighted scale differences, longer time frame, and differences in results as reasons to limit utilization of climate science in Quy Nhon City. Lack of interaction between decision-makers and scientists in science production, limited understanding of local scientific needs, and uncertainty in thresholds are some other challenges for decision makers and planners to utilize climate science in land use planning.
- **Dominance of traditional top-down approach of planning:** The city planning process is data-driven in Quy Nhon City and starts at the provincial DOC. Direction for master plan preparation comes from the prime minister. The provincial people's committee mandates the DOC for an update of the existing master plan of the city. The DOC contracts the task to consultants through a bidding process. In case of the Quy Nhon City Master Plan 2015, consultants were AREP and VIAP. They followed a data-driven rational approach. Master Plan 2015 has good coverage on climate change impacts but implementation is scant. Provincial departments and mass organizations mentioned that national climate change scenarios are too general to implement. If the master planning process allows participation of provincial departments in the planning process, it will allow ownership of the plan which leads to implementation and enforcement. In the same manner, data analysis and contents should be constantly communicated to stakeholders during preparation so that they understand recommended actions for land use planning. People's participation in the plan can diversify knowledge sources, allowing better adaptation measures. Local information on disasters can supplement climate scenarios. But this was not the case in Quy Nhon. The master lan is not public knowledge. Consultants approached provincial departments for data collection and sharing of draft plan for comments. A workshop was organized to brief about contents. The time window for review was short for stakeholders. The plan making process

was not flexible enough to incorporate multiple-source knowledge. In such cases, climate science may not result in mitigation and adaptation during implementation.

- **Competing priorities:** Development deficiency is pertinent in Vietnam. Basic services such as transportation, communication, employment, quality health service, and education are not equally accessible to all. Provinces and cities have to focus to make basic services available to all citizens. In order to achieve them, they need to generate more revenue internally and from outer sources. There is competition to attract more investments among cities and provinces. It includes creation of favorable social and economic environment to attract foreign direct investments for industries, infrastructure, and urbanization. One major strategy is making land available for industries and housing projects at lower cost to investors. Another strategy is making legal and environmental requirements easier for developers. Higher investments in infrastructure, urban development (housing, hotels, landmarks, etc.), and industries help cities upgrade their ranks. Higher urban rank provides privilege for resources from the national government. Although each project is mandated to conduct an environmental impact statement, it would be for safety and security of the project itself rather than protecting the environment. During an interview, one government official mentioned that if an investor is ready to bear risk of flooding by investing in a flood-prone area that would be his /her problem; the government office only provides a caution about susceptibility to flood. Environmental issues are low in priority where basic needs are not met. Provincial and municipal officials are aware of climate change and its impact on local environmental disasters such as floods, droughts, and typhoon, but they do not address them in projects and investments. As a result, social vulnerabilities worsen. Farmers, fishermen, and poor people are disproportionately affected by disasters.
- **Capacity and nature of government offices:** Government offices that participated in this research were engaged in ACCCRN and other projects on climate change and disaster risk reduction. They were selected from a list of provincial offices. The local sponsor suggested them and mentioned that they had the best knowledge on climate change in the province. These offices lack capacity to implement climate science in projects and decisions of land use planning or conduct risk and vulnerability assessments. This raise a question on the broader capacity of climate science utilization among provincial and city agencies. On top

of this, the rigid top-down planning system allows little flexibility in policies and implementation. It reinforces a “one model fits all” approach to climate change adaptation among cities and provinces. Impacts and associated problems of climate change are context specific. A successful project in one organizational setting cannot be replicated in other organizational settings (Knott & Wildavsky, 1980b).

Political will, specialized skills, leadership quality, and organizational capabilities often have a strong influence on climate science utilization, regardless of dissemination efforts.Top-down planning mechanisms have influenced the flow of climate science in Quy Nhon City which became apparent during interviews as well. Interviewees mentioned that they did not receive any information on climate change documents circulated by CCCO because there is a different unit within the organization to follow up and review those documents. If a unit within an organization does not share information, or if the head of the organization does not initiate a dissemination of climate change related communications from other organizations, only the designated unit of the organization would know about them. This practice prevents dissemination of scientific information of climate change within an organization.

7.6. Summary of Utilization of Climate Science in Land Management in Quy Nhon City

Climate science does not inform land use planning decisions in Quy Nhon City. Complexity of utilization starts from knowledge production process. Lack of communication between climate scientists and policymakers at the national level creates distance between climate scientists and policymakers. There is a lack of institutional setup to disseminate climate scenarios. Planning agencies also lack dedicated units on research and knowledge management which could reach out to scientists to acquire knowledge of climate change. The Quy Nhon Master Plan 2015 has discussion of climate scenarios and impacts on hydro-meteorological disasters. But the land management practices in the city lack any consideration of climate change. Land management in Vietnam suffers from political and economic problems, including higher priority given by all levels of government to private investments over environmental and climate change-related issues. As a result, mainstreaming climate change impacts is just a formality. There is a lack of standards and codes from the national government to address impacts in land use planning at the provincial and municipal levels. As a result, new development projects are exacerbating flood impacts in Quy Nhon.

There are two potential opportunities of climate science utilization in Quy Nhon. They are the emergence of CCCO and other boundary agents, and strong awareness of climate change impacts among government agencies. Boundary agents are bringing climate science to provincial and municipal agencies. They are scientists, consultants, local experts, and non-government organizations. The role of the ACCCRN Project is significant in raising awareness of climate change among government offices and residents. The project motivated the provincial government to establish CCCO which has a crucial role to build awareness among agencies. Strong awareness of climate change impacts among government agencies can be used as an opportunity to implement science in land use projects in Quy Nhon City.

Major challenges for climate science utilization in Quy Nhon are limitation of resources, lack of institutions, higher priorities for urbanization and industrialization over environmental issues, and absence of a communicative approach of city planning. Without institutional changes and legislation, climate science implementation in land management will not be possible.

CHAPTER 8. DISCUSSION, CONCLUSION AND FUTURE RESEARCH

This research sheds light on the utilization of science in planning to deal with a new but complex problem, climate change. This chapter summarizes major findings from an assessment of climate science utilization in land use planning for Quy Nhon City. My major conclusion is that transmission and understanding of climate science are strong in the city, but implementation efforts are weak. Boundary agents play a critical role in transmission and developing societal understanding of climate science at all levels of society. Implementation in land use planning requires institutional changes from national to local levels, including addressing climate change impacts in existing land use laws, permit systems, construction standards, and building codes. Incremental changes in institutions have to be done along with administrative and financial decentralizations of climate science production and land use planning. Concurrently, development deficiencies of the country have to be achieved. Existing knowledge utilization models fall short to explain contextual challenges of developing countries. A case study of Quy Nhon land use planning presents challenges for climate science utilization that may be found in developing countries where formal agencies on knowledge management do not exist. This chapter discusses evaluation of propositions, overall findings, contribution of the case study to broader scholarship of knowledge utilization, and directions for future research.

8.1. Discussion of Propositions

Propositions are presented in Chapter 3. Each research question is broken down into specific sub-questions. Propositions are formed based on those questions. All research questions do not have propositions because some of the questions are explorative and descriptive. Based on analysis in Chapters 4, 5, 6, and 7, conclusions on propositions are presented in Table 8.1.

Table 8.1: Evaluation of Research Propositions

Research Questions and Propositions	Findings
1. How is the climate science produced, disseminated and utilized in Vietnam?	
1.1. Scientists work together to produce scientific knowledge of climate change.	This research supports this proposition. Vietnamese climate scientists work together through their networks to produce scientific knowledge of climate change. Detailed discussion on collaboration is in Chapter 5.
1.2. There is a collaboration between scientific organizations in climate science production	This research supports this proposition. Vietnamese climate research organizations are constantly looking for collaboration with national and international research organizations. Details are presented in Chapter 5.
1.3. Interaction between scientists and policymakers takes place during climate science production.	Cases of Vietnam and Quy Nhon City do not support this proposition. Interaction between climate scientists and policymakers do not take place during climate science production about information needs of policymakers. Detailed evidence is presented in Chapters 5 and 7.
1.4. There are institutional mechanisms to disseminate climate science from national research organizations to provinces and cities in Vietnam.	Current climate science dissemination in Vietnam does not support this proposition. There are no institutional mechanisms to disseminate climate science from national organizations to provincial and city levels. Detailed evidence is presented in Chapters 5 and 7.
1.5. Local planners and decision makers receive scientific information about climate change from the national government through organizational channels.	In the context of Quy Nhon City, this proposition is partially true. Climate Change Coordination Office (CCCO) gets climate change scenarios from the Ministry of Natural Resources and Environment (MONRE) and redistribute them among provincial and city agencies in the city. Except for the CCCO, there is not any organizational channel to get climate science to the city. Detailed mechanism is discussed in Chapter 5.

2. How the governance of urbanization and land management influences the utilization of climate science in land use planning?	
2.1. Local land use decisions are informed by climate science.	This proposition is not true in Quy Nhon City. Land use decisions are based on socioeconomic interests of the government. Climate change impacts and other environmental issues get lower priority in land use decisions. Chapter 7 has detailed discussion.
2.2. The utilization of climate science is same between Master Plan 2004 and Master Plan 2015.	This proposition in not true. There is a huge difference in utilization of climate science between the Quy Nhon Master Plan 2004 and the Master Plan 2015. Detailed discussion on climate science utilization in master plans is in Chapter 6.
3. What are the challenges and opportunities of the climate science utilization in land use planning in the context of Vietnam?	
3.1. There are not any challenges facing the use of scientific knowledge of climate change in land use planning in Quy Nhon City.	This proposition is not true. There are myriad challenges for climate science utilization in land use planning, especially in implementation. They include limitation of resources, lack of institutional support, and development deficiencies. Details of challenges are discussed in Chapter 7.
3.2. The utilization of climate science in land use planning in Quy Nhon City follows the steps prescribed by existing knowledge utilization frameworks.	This is partially true in Quy Nhon. Climate science utilization follows standard steps prescribed by existing models of knowledge utilization, but there are many contextual factors that influence utilization. They are context specific to cities of Vietnam and developing countries, and are discussed in Chapter 5, 6, and 7.

(Author, 2018)

8.2. Summary of Findings

Based on the discussion and analysis in previous chapters, following eight conclusions can be drawn.

- **Higher frequency of interaction between climate scientists and provincial agencies increased utilization of climate science in Quy Nhon City.** An iterative relationship between scientists and decision makers improves utilization of the science. This is also highlighted by social interaction theory (Estabrooks et al., 2006; Havelock, 1975; Landry et al., 2001b; National Research Council, 2012). Climate science utilization in the land use planning of Quy Nhon City demonstrated that the interaction between producers and users of science can improve utilization. Planning consultants and provincial departments interacted with climate scientists for data and scenarios. As a result, the utilization of climate science increased in Quy Nhon Master Plan 2015. Provincial and city offices were not familiar with the climate change scenarios production process. It led to less trust in national scenarios over local data and experience-based information.
- **The role of boundary agents is most effective in promoting science dissemination in countries where formal institutions are not yet set up.** In Quy Nhon City, the boundary functions of scientists, local experts, consultants, CCCO, and NGOs are most effective in bringing climate science to Binh Dinh Province and Quy Nhon City. CCCO is the most effective agent to disseminate climate science. Government scientists worked as consultants to different projects in Quy Nhon and bring climate science, but there is not any institutional setup to bring climate science from national research organizations to Quy Nhon City. These boundary agents are key players to fill this void.
- **Institutional change is imperative in achieving implementation of climate science in land use decisions in Quy Nhon**. The importance of institutional changes is highlighted for climate change adaptation (Ayers & Huq, 2009). Dissemination and understanding of climate science can be achieved through the work of boundary agents, but its implementation in decision making and planning requires bigger but incremental institutional changes in a centralized planning system like Vietnam. Strong and rigid government infrastructure from the national level to local levels has the potential to create

opportunities to enforce legal, organizational, and administrative changes for science implementation. Understanding climate change is ubiquitous as a result of boundary works, but implementation is lacking. Many interviewees from provincial agencies and city offices said that they could not mainstream climate change in their daily decision making because they did not have legal mandates to aid them in their duties. They also highlighted financial and human resource limitations as a barrier to utilize climate science in land use planning.

- **Regardless of institutional capacity and quality, climate science produced closer to agencies in Quy Nhon are more trusted than produced by national agencies.** Distance between organizations includes institutional and legal barriers. In Quy Nhon City, national government-produced climate change scenarios are perceived as less relevant to the city. Data from the local hydro-meteorological center in the province and the experience of locals are considered more trustworthy by provincial and municipal agencies than scenarios from MONRE. Provincial and municipal offices are far from MONRE and the Institute of Meteorology Hydrology and Environment (IMHEN) in the administrative hierarchy.
- **Complexity of land management plays a critical role in implementation of climate science in land use practices in Vietnam.** Scientific knowledge is not sufficient to induce adaptation action in land use practices in rapidly transforming cities like Quy Nhon. Land management is a complex process in Vietnam. Administrative and legal mechanisms of land takings, leasing, and protection are skewed to reflect the interests of the government and private investors rather than the general public. There are many underlying and unseen factors that influence land use conversion, including corruption and profit maximization. In such a context, scientific knowledge is relegated to providing only a fraction of influence in the decision-making process. Vested interests of government, private sectors, decision-makers, and current users are much stronger in land management. Institutional development with resource and legal mandates would help to improve the implementation of climate science in land use decisions in this scenario.
- **Financial limitation is a major impediment to implement climate science in practice in cities of developing countries including Quy Nhon.** Quy Nhon City progressed in transmission and understanding of climate science in land use planning because of availability of funding from the Asian Cities Climate Change Resilience Network

(ACCCRN) Project and other funded projects. Transmission and understanding of the climate science culminated through project activities in the city. These funds allowed for flexibility of spending to government offices, which benefited government employees at the personal level through extra income. They also had the independence to design and implement ward and *Khu Vuc*-level projects using project funds. Even though activities were led by CCCO, other provincial departments were part of them. As a result, climate change became major agenda for provincial and municipal agencies.

- **The top-down data-driven approach is typically used to deal with complex problems like climate change in the planning process, but a combination of rational and communicative models are more appropriate in order to deal with it**. Climate change is a new cross-cutting challenge for all disciplines of planning (transportation, housing, land use, energy, environmental services, and disaster management). Impacts of climate change are in two forms: association with existing hydro-meteorological disasters such as flood, typhoon, drought, sea level rise, and temperature change; and association with existing socio-economic problems such as deforestation, land use conversion, etc. This includes a disproportionate impact on the poor, marginalized population, low lying areas, and weak infrastructures of a city. The impact of the 2009 and 2013 floods in Quy Nhon City had proven this. Utilization of climate science in Quy Nhon City is not robust, and implementation is weak. The master planning of the city is dominated by a rational model, so science does not reach all stakeholders for discussion in the course of plan making. Climate change impacts are not discussed in planning process among provincial and municipal agencies. Local experience and perception were not part of climate knowledge. If the city's master plan would combine both data-driven and experience-based methods, utilization of climate science during plan implementation could be trusted and used.

- **Existing models of knowledge utilization fall short in explaining the use of climate science in rapidly transforming cities of developing countries including Vietnam.** Social interaction theory, a supply-driven approach, and a demand-led approach of knowledge utilization describe certain steps of knowledge utilization. There is a paucity of discussion on challenges in transition from one step to another in knowledge utilization. In the case study of Quy Nhon City, it is easier to accomplish transmission and understanding of climate science in developing countries where these two steps are transparent and straightforward. Transition from transmission to understanding is clear and smooth and can be completed by boundary agents in the absence of formal organizational setups. They can be easily achieved through climate finance and other decentralized projects. But implementation is a complex process. It has to be endorsed by the government at different levels through institutional changes. Boundary agents helped to disseminate climate science to the city and built a good understanding of climate science among government agencies and city residents. Despite dissemination and understanding of climate science, impacts of flooding, drought, saltwater intrusion, and sand movement are getting worse in the city because implementation of the science is limited. There is a reluctance among government agencies to implement it in land use practices because they lack institutional mandates and resources (financial and human). Such a challenge to implementation is not highlighted by existing models of knowledge utilization. They are unique to the context of developing countries and the discipline of planning. In Quy Nhon City, lack of institutional mandates is the major challenge for the implementation of climate science.

8.3. Contribution of Research on Knowledge Utilization in Land Use Planning

The major contribution of this dissertation is on climate science utilization in planning to adapt with potential impacts. Besides the gaps in literature of knowledge utilization discussed in Chapter 2, the contribution of this research is a climate science utilization model relevant to rapidly transforming cities in developing countries.

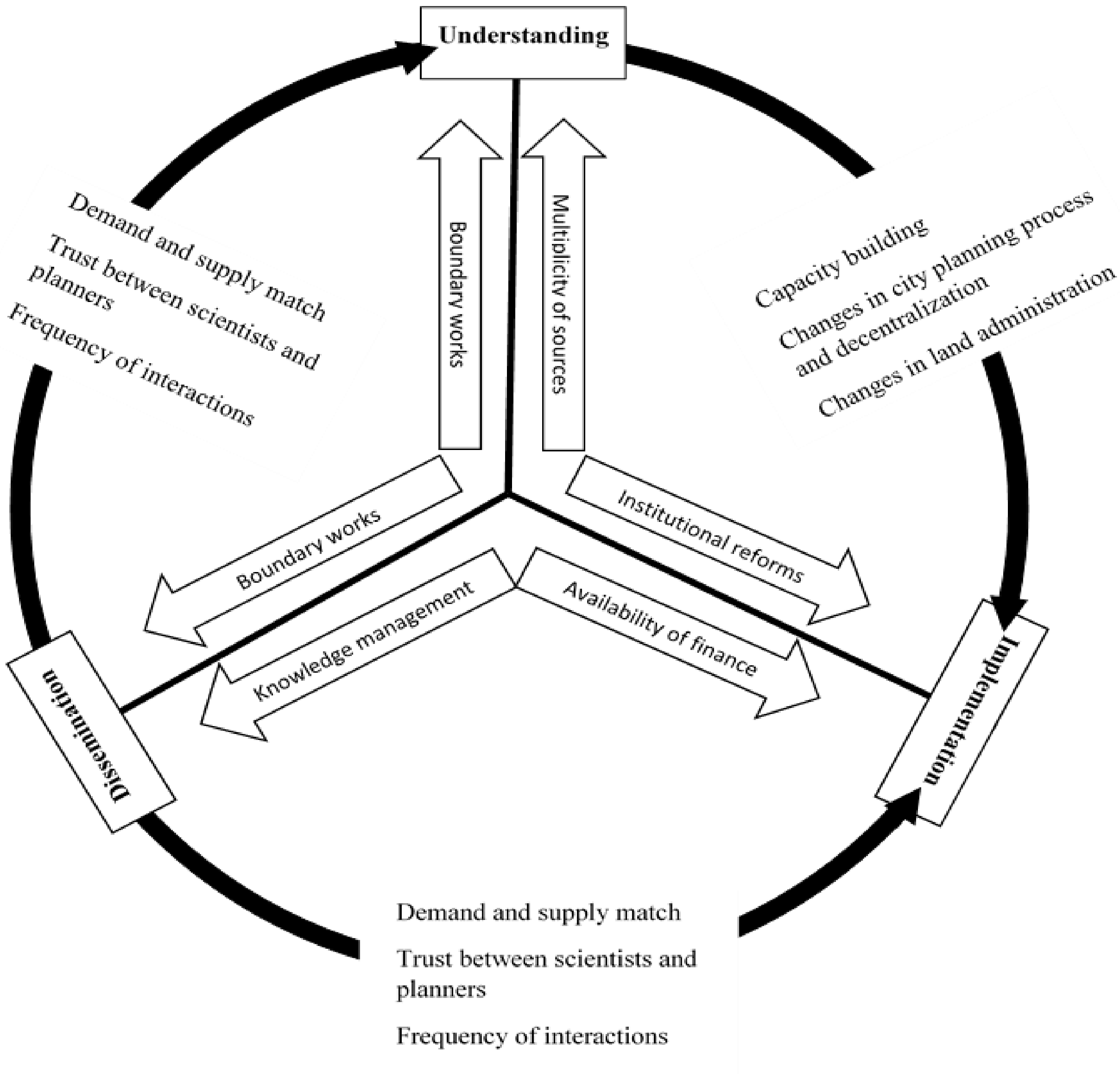
The first gap in literature is that there is a paucity of empirical research on utilization of climate science in land use planning in cities of developing countries. This research presents a unique case of Quy Nhon City of Vietnam. The role of boundary agents and availability of external resources fosters transmission and understanding of the climate science. But the implementation has to come from governments at different levels in a rigid top-down administrative system like in Vietnam. Decision makers in the city look to the national and provincial governments for new mandatory laws and standards to enforce climate science in land use practices of the city.

The second gap in literature is limited empirical research on the role of climate science in land management. This study demonstrates the complexity of addressing climate change in land use planning in developing countries where the land management system is still in a limbo between traditional and modern systems. As discussed in Chapter 4, the Vietnamese land management system suffers from a triangular conflict of interests: government, private investors, and general public. Systemic problems with land management are reinforced by the government in practice. Land became a commodity for the market after Doi Moi, but management mechanisms carried the legacy of communist administration before Doi Moi by making government in-charge of land. People and market forces, however, strive for decentralization. As a result, malpractice in many forms (corruption, lack of transparency and accountability, favoritism in decisions, etc.) emerged in land transactions. Negotiation between local users (mainly farmers) and private investors is neither transparent nor participatory. Local users are disadvantaged significantly during land use changes. As a result of existing challenges in land administration, problems of climate change impacts and disaster risks do not get the attention they deserve. Implementation of climate science in land use decisions (approval of projects, granting permits for development, land use conversion, etc.) is minimal.

The third contribution of this research is related to evaluation of climate science utilization in Vietnam. It is proven in literature that a sustained interaction between scientists and policymakers can improve utilization of the science. In the case of developed countries, data and science are normally in the public domain and are accessible to planners and decision makers. The context of developing countries, however, is different. From this study, it has been shown that boundary agents have a strong role in the transfer of climate science from research arena to the realm of decision making and planning. In such a process, external financial and technical support is imperative. Such work of boundary agents and projects only help to galvanize transmission and understanding of science. Implementation requires institutional reforms from the governments at national, provincial, and local levels.

This research shows the relevance of existing models of knowledge utilization in use of climate science in a rapidly transforming city of a developing country. General steps of knowledge utilization aid climate science use in Quy Nhon City. Steps prescribed by the ladder of knowledge utilization (Cherney & McGee, 2011; Cherney et al., 2012; Landry et al., 2001a), knowledge utilization in practice (Beyer & Trice, 1982; Estabrooks, 1999; Estabrooks & Wallin, 2004; McKenzie et al., 2014; Nutley et al., 2007; Pelz, 1978; Waylen & Young, 2014), and AAA (Awareness, assessment and action) framework of land use plan evaluation (Baynham & Stevens, 2014; Luers & Moser, 2006; Moser & Luers, 2008; Tang et al., 2009; UKCIP, 2003) are categorized into dissemination, understanding, and implementation of climate science for this research, and are in practice in land use planning of Quy Nhon City. However, there are other contextual factors that play critical role in strengthening dissemination, understanding, and implementation of climate science that are relevant to cities in Vietnam, including Quy Nhon. Figure 8.1 below shows how different contextual factors of cities can play role to improve climate science utilization in terms of dissemination, understanding and implementation.

Figure 8.1: Climate Science Utilization in Land Use Planning in Cities of Developing Countries



(Author, 2018)

In Figure 8.1, arrows show the direction of influence. Large arrows are coming out from the center of diagram to each components of climate science utilization. They represents requirements and conditions for each component. These conditions are based on land use planning of Quy Nhon City but are applicable to other cities of developing countries. For example, dissemination and understanding of climate science can be improved through boundary works (large arrows with text ‘Boundary works’) in these cities. The understanding among government agencies can be improved through promotion of multiple sources of climate science (large arrow with text ‘Multiplicity of sources’). Dissemination can be improved with establishment of knowledge management units within municipal governments (large arrow with text ‘Knowledge management’) in cities of developing countries. Such units are crucial for communication with scientists and for gathering scientific knowledge on climate change. Similarly, implementation of climate science in land use planning can be boosted with institutional changes and availability of financial resources.

The best use of climate science is its implementation in planning. Both dissemination and understanding lead to implementation in Figure 8.1. Good dissemination can result in robust understanding of climate science, but trust between scientists and decision makers, frequency of interaction between them, and match between supply and demand of climate science are determinants. Based on the experience of Quy Nhon City, provincial and municipal agencies do not interact with national climate research agencies, and national scenarios of climate do not meet their scientific data needs for decision making. As a result, they focus on local experience as the basis of their work. These factors also influence the implementation of climate science in land use practices. Understanding results in implementation of climate science, but it would be necessary to improve local capacity on risk and vulnerability assessment, change in planning process from rational to collaborative, improve land administration, and promote local champions of climate change. These improvements can lead to better implementation of climate science in land use decisions.

8.4. Limitations and Future Directions

This dissertation portrays climate science utilization in land use planning in Quy Nhon City. The case of Vietnam is unique because it has a strong central government in charge of land administration. All land belongs to the people, and the government is manager in the name of the people. However, government practices have created tremendous dissatisfaction among the people. The government can unilaterally make a decision on land acquisition and distribution. Land management issues of Vietnam, however, are not identical across the developing countries. The findings of this study may not be relevant to other cities in developing countries where private ownership of land is institutionalized and the government does not have authority to evict users without negotiation and market-based compensations.

The case of Quy Nhon City is unique concerning climate science utilization because it is one of 10 cities selected under the ACCCRN Project. There are many training sessions, workshops, and skill development events organized under the project in the city at different administrative levels (from *Khu Vucs* to provincial levels). There are also smaller projects related to infrastructure improvements (dike improvement, mangrove afforestation, and evacuation shelter construction) under the ACCCRN. Other donors have invested in the city to mitigate and adapt with impacts of climate change. The German Corporation for International Cooperation (GIZ) has given support to the development of a drainage plan that would be adaptive to future climate change impacts. The city attracted attention from donors, scientists, consultants, and local climate change experts following the ACCCRN Project. Financial and technical supports facilitated the establishment of CCCO in the province. These activities improved the transmission and understanding of climate science in the city. But other cities in Vietnam or in developing countries may not have the same privilege and support. Therefore, findings from the case study of the Quy Nhon City may not be applicable to other cities of Vietnam and beyond.

Future research should focus on three directions of climate science utilization in developing countries. The first is the evaluation of the transmission, understanding, and implementation framework presented in Figure 3.1 and Figure 8.1 in cities of Vietnam where the external funding is not available. Transmission and understanding are strong in Quy Nhon because it received more than a million US dollars in funding from the ACCCRN Project to carry out climate change related projects. Sensitization and awareness of climate change expanded among government agencies and residents in the city. However, climate science implementation is negligible in land use planning. But how climate science reaches cities without an external project, and what unique drivers are necessary to develop transmission, understanding, and implementation of climate science in them. This is future direction of this research.

The second area of future research would be evaluation of the frameworks in a decentralized democratic context. Many cities in developing countries operate under a decentralized governance system. They are far more autonomous and have administrative power concerning land management, planning, and finance. Assessment of the frameworks in cities outside of a socialist political system help to enhance the scope of frameworks in developing countries.

The third area of future research is evaluation of frameworks to assess utilization of science other than climate change, which is unique because it is new (many communities have not experienced yet) and still not comprehensively outlined in terms of location and magnitude. This creates an extra challenge for utilization in planning and decision making. Evaluation of frameworks in other sciences such as medicine, engineering, animal science, and agriculture can enhance the scope in other disciplines of knowledge utilization.

APPENDICES

Appendix 1: Household Survey (English version)

Use of Climate Knowledge in Planning and Decision Making

<u>Household Survey 2014</u>

Survey Identification #: Date:

Surveyor's Name: Start Time:………… ☐ AM ☐ PM

Section 1: Basic Information

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1. Name:
2. Gender (observe): 1☐Male 2☐Female
3. Age: Years
4. Residential address:

   1☐ Nhon Phu Ward 2☐Nhon Binh Ward

   Address (Area and street):

5. Education:
   (Please select ONE)

   1☐ Elementary (1-5 grade) 2☐ Lower secondary (6-9 grades) 3☐ Secondary (10-12 grades)

   4☐ Bachelors Degree 5☐ Masters Degree 6☐ Doctorate Degree (PhD)

   7☐ Vocational Education 8☐ Literate (Can read and write) 9☐ Other *(Please specify)*: ……………………………

6. Are you the head of household?
   (Please select ONE answer)

   1☐ Yes 2☐ No

7. What is your primary occupation?
(Please select ONE answer)
1 ☐ Farmer

2 ☐ Fishery

3 ☐ Government workers

4 ☐ Business owner

5 ☐ Industry worker

6 ☐ School or college teacher

7 ☐ Engineer or doctor or other technical skilled worker

8 ☐ Self-employed

9 ☐ Salaried employee (e.g. shop asst, restaurant worker, hotel help, manager, etc.)

10 ☐ Retired

11 ☐ Student

12 ☐ Unemployed

13 ☐ Other (Please specify):…………………………………………………

8. What is your secondary occupation?
(Please select AS MANY AS it applies)
0 ☐ I do not have secondary occupation

2 ☐ Farmer

3 ☐ Fisherman

4 ☐ Government workers

5 ☐ Business owner

6 ☐ Industry worker

7 ☐ School or college teacher

8 ☐ Engineer or doctor or other technical skilled worker

9 ☐ Self-employed

10 ☐ Salary employee (e.g. shop asst, hotel help, restaurant worker, manager, etc.)

11 ☐ Retired

12 ☐ Student

13☐ Unemployed

14☐ Other *(Please specify)*:…………………………………………………

9. Are you part any of following organizations?
(Please select AS MANY AS it applies)

1☐ People's Committee | 2☐ Flood Control Committee

3☐ Farmer's Union | 4☐ Women's Union

5☐ Local Club | 6☐ Non-governmental organization

7☐ Khác (*nêu rõ): ……… …………* | 0☐ I am not part of any organization

10. How many persons are in your household?

Ans:

1☐ 15 years and younger: | 2☐ 60 years and older:

3☐16-59 years old:

11. What is your tentative annual household income (in VND)?

Ans: 1☐ Per Month 2☐ Per Year

3☐ Enough earning for the family

12. How long have you been living in Quy Nhon?
Ans: Year

13. Where did you live before you move to Quy Nhon?

0☐ I don't know

Village/block/street name and number: …………………………..

Commune/ward name: …………………………..

Commune/Ward number: …………………………..

District/town name: …………………………..

District/town number: …………………………..

Province name(s): …………………………..

City name(s): …………………………..

Province number: ………………………….

14. What were occupations of your household 20-25 years ago?

(Please select AS MANY AS it applies)

0 ☐ I do not know

1 ☐ Farming

2 ☐ Aquaculture

3 ☐ Government workers

4 ☐ Business owner

5 ☐ Industry worker

6 ☐ School or college teacher

7 ☐ Engineer or doctor or other technical skilled worker

8 ☐ Self-employed

9 ☐ Salaried employee (e.g. shop asst, restaurant worker, hotel help, manager, etc.)

10 ☐ Other *(Please specify):*………………………………………………

15. What are occupation of family members at present *(List only persons that are working)*?

Name of the household member	Occupation
1.	
2.	
3.	
4.	
5.	
6.	

Section 2: Physical change

---

16. What kind of changes you see in your village in last 20-25 years?

(Please select AS MANY AS it applies)

1☐ New houses are built
2☐ New industries are built
3☐ New roads are constructed
4☐ New drainage is installed
5☐ New hotels, resorts are constructed
6☐ New dykes are built
7☐ New irrigation systems are built
8☐ New ponds are built
9☐ Other *(Please specify)*:……………………………
0☐ No Changes in my village.

17. When did your family build the current house?
(Please select ONE answer)

1☐ 1-2 years ago
2☐ 3 Years ago
3☐ 5 Years ago
4☐ 10 Years ago
5☐ 15 Years ago
6☐ Other *(Please Specify):* ……………..

18. How high is first floor of your current house from the rice bed (tentative)?
(Please select ONE answer)

1☐ Less than half meter
2☐ Half meter
3☐ 1 meter
4☐ 2 Meters
5☐ Other (*please specify): ……………….*

19. If your family had previous house in this village, could you describe it?

0☐ This is our first house (Please go to Question #21)

Description of previous house (Material used for wall, roof, doors and windows, height, etc.):

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

………

20. How high was first floor of your previous house from the rice bed (tentative)?
(Please select ONE answer)

1☐ Less than half meter 2☐ Half meter

3☐ 1 meter 4☐ 2 Meters 5☐ Other (*please specify): ……………*

21. When was electricity supplied to your village?
(Please select ONE answer)

1☐ 1-2 years ago 2☐ 3 Years ago

3☐ 5 Years ago 4☐ 10 Years ago

5☐ 15 Years ago 6☐ Other *(Please Specify): ……………..*

22. What changes happened to following water bodies in your village in last 20-25 years?

Water bodies	No change	Decreased	Increased	I don't know
• Number of ponds and reservoirs	1☐	2☐	3☐	0☐
• Size of ponds and reservoirs	1☐	2☐	3☐	0☐
• Area of wetlands	1☐	2☐	3☐	0☐
• Number of small streams	1☐	2☐	3☐	0☐
• Water flow in small streams	1☐	2☐	3☐	0☐
• Mangrove forest area	1☐	2☐	3☐	0☐

23. What changes happened to vegetation (Trees, bushes, forest area, etc.) in your village in last 20-25 years?

Vegetation (Trees, forest, etc.)	No change	Decreased	Increased	I don't know
• Area of vegetation	1☐	2☐	3☐	0☐
• Types of trees in village	1☐	2☐	3☐	0☐

24. Do you think the agricultural land area is reduced now compare to 20-25 years ago?

1☐ Yes 2☐ No 0☐ I don't know

25. What is your major fresh water source?

1☐ Private tab 4☐ Ground well

2☐ Public tab 5☐ River/stream

₃☐ Tube well ₆☐ Pond

₇☐ Other *(Please specify)* ……………………………………………

26. Do you have any challenge to get fresh water (in last 10 years)?

1☐ Yes 2☐ No

If 'Yes' what are the challenges?
(Please select AS MANY AS it applies)

1☐ The is limited number of public tabs

2☐ Tube wells or ground wells need to be dipper than before

3☐ Rivers/streams/ponds are contaminated

4☐ Ponds/streams are drying out

5☐ Erratic supply of water in tab

6☐ Other1 *(Please specify)* ……………………………………………

7☐ Other2 *(Please specify)* ……………………………………………

27. Where and what types of new development occurred in your village (in last 10 years) (from 2000 to now)?

Use the attached map (Draw/write location of development on the map using following codes)

1 = houses/ tall buildings	2 = roads	3 = industry	4 = school/college
5 = bridge/culvert/diversion	6 = health clinics	7 = irrigation canal	8 = residential colony
9 = government buildings/ monuments	10 = community buildings	11= shopping center	12 = Hotels and resort
13 = Port facilities	14= security related structures	15= other (specify)…………………………	

28. Could you provide us approximate location of your house in the map?
(Directly draw following symbol with red color on attached Map)

●

29. What area of your city/village is being impacted regularly by the flooding now? *(Draw in the attached map with blue marker)*

30. When you were young (20-25 years ago), what areas of your city/village were regularly impacted by the flooding? *(Draw in the attached map with red marker)*

Section 3: Flooding/Typhoon pattern

---

31. What are changes in flooding pattern in recent years compare to 20-25 years ago?

(Please select AS MANY AS it applies)

0☐ I don't know
1☐ There is no change
2☐ Flood depth is higher
3☐ Duration of flooding is longer
4☐ Flooding is unpredictable
5☐ Coverage of flooding is wider
6☐ Flood depth is lower
7☐ Duration of flooding is shorter
8☐ Coverage of flooding is narrower
9☐ Flooding is more frequent
10☐ Flooding is less frequent
11☐ Other *(Please specify)*
………………………………………………

32. Does flood water come inside your house during the flooding?

1☐ Yes 2☐ No

If 'Yes', how long the flood water stays inside your house?
(Please select ONE answer)

1☐ Less than 2 hours
2☐ 4-6 hours
3☐ 1-2 days
4☐ 2-4 hours
5☐ 1 day
6☐ Others (Please specify): ……

33. Did flood water use to come inside your house 20-25 years ago?

1☐ Yes 2☐ No 0☐ I don't remember

If 'Yes', how long the flood water used to stay inside your house 20-25 years ago?

(Please select ONE answer)

- 1☐ Less than 2 hours
- 4☐ 2-4 hours
- 2☐ 4-6 hours
- 5☐ 1 day
- 3☐ 1-2 days
- 6☐ Others (Please specify): ……

34. What do you do when the flood comes?
(Please select AS MANY AS it applies)

- 1☐ Do nothing
- 5☐ Move to roof and wave for help
- 2☐ Move to second floor of house
- 6☐ Go to dry areas of the village
- 3☐ Ask help from neighbors
- 7☐ Listen to radio and watch television to know more about it
- 4☐ Wait for instruction from government
- 8☐ Other *(Please specify):* ……………………………………

35. Do you protect your house from flooding?

1☐ Yes 2☐ No (Skip Question 36)

If 'Yes', what do you do to protect?
(Please select AS MANY AS it applies)

- 1☐ I elevate the house
- 2☐ I create a barrier around the house (Wall, pile of soil and stones, etc.)
- 3☐ I plant more natural barriers (such as bamboo) around house
- 4☐ I make the first floor of house open
- 5☐ I dig ditches to make channel for water to flow quickly
- 6☐ Other1 *(Please specify)* ………………………………………………
- 7☐ Other2 *(Please specify)* ………………………………………………

36. Do you feel that the flood protection techniques are enough to make your house secure from flooding in recent years compare to when you were young (20-25 years ago)?

1☐ Yes 2☐ No 0☐ I don't know

If 'No' what are the challenges to manage flood now?

(Please select AS MANY AS it applies)

1☐ Flood depth is higher

2☐ The flow of flood is stronger

3☐ Floods are longer in duration

4☐ Floods are more frequent

5☐ Coverage of flood is wider

6☐ Less help from other people to develop protections and barriers

7☐ Less help from government to control flood

8☐ Other *(Please specify):* ……………………………………………………

37. Do you protect your house from typhoon?

1☐ Yes 2☐ No *(Skip Question 38)*

If 'Yes', what do you do to protect?
(Please select AS MANY AS it applies)

1☐ I plant plants (e.g. bamboo) around the house as natural barrier

2☐ I reinforce pillars and walls of house with concrete

3☐ I reinforce the roof with pillars

4☐ I install the typhoon resistant doors and windows

5☐ I built with local light materials, once it is blown I will rebuild again

6☐ Other1 *(Please specify)* ……………………………………………………

7☐ Other2 *(Please specify)* ……………………………………………………

38. Do you feel that the typhoon protection techniques are enough to make your house secure from typhoon in recent years compare to when you were young (25 years ago)?

1☐ Yes 2☐ No 0☐ I don't know

If 'No' what are the challenges to deal with typhoon now?

(Please select AS MANY AS it applies)

1☐ The wind speed is higher

2☐ The amount of rainfall is higher

3☐ The typhoon duration is longer

4☐ Typhoons are more frequent

5☐ The typhoon warnings are not enough in advance

6☐ Less help from government to deal with typhoons

7☐ Other *(Please specify)* ……………………………………………

39. Do you feel that the new development (houses, residential colonies, roads, universities, clinics, industries, canals, etc.) has increase flooding impact around your house?

1☐ Yes 2☐ No 0☐ I don't know

If 'Yes' how new development increase the flooding?
(Please select AS MANY AS it applies)

1☐ New development filled the wetlands where flood water goes

2☐ New development block the flow of flood water

3☐ There is not canals to divert the flood water

4☐ The rainfall became erratic and increase flooding

5☐ New developments are elevated higher than surrounding residential areas

6☐ No drainage system to absorb the flood water

7☐ Other *(Please specify)* ……………………………………………

40. Based on your experience on flood, if you want to protect your village from flooding, what will you recommend?
(Please select AS MANY AS it applies)

0☐ I do not know

2☐ Develop drainage system

3☐ Increase the height and strength of dykes

4☐ Plant more plants (bamboo, other trees, on both sides of the river)

5☐ Elevate all houses

6☐ Move village to higher ground

7☐ Other *(Please specify)* ……………………………………………

41. Based on your experience on typhoon, if you want to protect your village from typhoon, what will you recommend?
(Please select AS MANY AS it applies)

0☐ I do not know

2☐ Plant more bamboo and other trees around the houses

3☐ Construct a typhoon shelter

4☐ Improve houses with stronger windows, doors and roofs

5☐ Develop forecasting system of typhoon

6☐ Have community group for rescue people after typhoon

7☐ Other *(Please specify)* ……………………………………………

42. If you are crop farmer, do you think your crop yield per acres of land is same as 20-25 years ago?

1☐ Yes 2☐ No

If 'No' what are the causes of yield reduction?
(Please select AS MANY AS it applies)

1☐ Lack of rainfall on time

2☐ The irrigation is not sufficient as in the past

3☐ The crops are destroyed by typhoons

4☐ The disease outbreaks among crops

5☐ The fertility of soil has been gone down

6☐ Other1 *(Please specify):* ……………………………………………

7☐ Other2 *(Please specify):* ……………………………………………

43. If you are aquaculture farmer, do you think your fish yield per pond or water area is same as 20-25 years ago?

1☐ Yes 2☐ No

If 'No' what are the causes of yield reduction?
(Please select AS MANY AS it applies)

1☐ Lack of rainfall on time

2☐ Ponds do not have enough water

3☐ The flood water destroys ponds

4☐ The temperature of water in pond has been increased

6☐ Other1 *(Please specify)* ……………………………………………

7☐ Other2 *(Please specify)* ……………………………………………

Section 4: Climate/Disaster awareness

---

44. What are disasters in your village?
(Please select AS MANY AS it applies)
(Rank them based on their impacts, 1=major, 2=moderate, 3=minor and 4=No impact)

Disasters	Rank
1☐ Flooding	☐
2☐ Typhoons	☐
3☐ Drought	☐
4☐ Salt water intrusion	☐
5☐ Fire	☐
6☐ Earthquake	☐
7☐ Heat waves	☐
8☐ Other *(Please specify)*……………………………	☐

45. Compare to your young age (20-25 years ago), what type of changes you have noticed in the following phenomena in your village?

Phenomena	No change	Decreased	Increased	I don't know
• Number of flood events per year	1☐	2☐	3☐	0☐

• Death and property damage from flooding per year	1☐	2☐	3☐	0☐
• Number of typhoons per year	1☐	2☐	3☐	0☐
• Death and property damage by typhoons per year	1☐	2☐	3☐	0☐
• Length of drought per year	1☐	2☐	3☐	0☐
• Loss (ag. Productivity and fresh water source) from drought per year	1☐	2☐	3☐	0☐
• Number of fire events per year	1☐	2☐	3☐	0☐
• Death and property damage from fire events per year	1☐	2☐	3☐	0☐
• Length of hot weather per year	1☐	2☐	3☐	0☐
• Hotness during the summer	1☐	2☐	3☐	0☐
• Length of cold weather per year	1☐	2☐	3☐	0☐
• Cold during winter	1☐	2☐	3☐	0☐
• Number of outbreak of diseases per year	1☐	2☐	3☐	0☐
• Death from outbreak of communicable diseases	1☐	2☐	3☐	0☐
• Shortage of drinking water per year	1☐	2☐	3☐	0☐
• Air pollution	1☐	2☐	3☐	0☐
• Size of the rivers	1☐	2☐	3☐	0☐

46. Do you think that you are getting warning of typhoon and flooding before they occur?

1☐ Yes 2☐ No 0☐ I don't know

47. How do get information about upcoming typhoon now?
(Please select AS MANY AS it applies)

1☐ From neighbors
2☐ From phone call/text from friends
3☐ From television
4☐ From Radio
6☐ From village leaders
7☐ From laud speaker in village
8☐ From newspapers
9☐ Own observation

5☐ Printed notice in public places
10☐ Other *(Please specify):* ……………

48. When you were young (20-25 Years ago), how did get information about upcoming typhoon? *(Please select AS MANY AS it applies)*

1☐ From neighbors
2☐ From phone call/text from friends
3☐ From television
4☐ From Radio
5☐ Printed notice in public places
6☐ From village leaders
7☐ From laud speaker in village
8☐ From newspapers
9☐ Own observation
10☐ Other *(Please specify):* ……………

49. What are the months in which majority of typhoons occur annually? *(Please select AS MANY AS it applies IN LUNAR CALANDER)*

1☐ January
2☐ February
3☐ March
4☐ April
5☐ May
6☐ June
7☐ July
8☐ August
9☐ September
10☐ October
11☐ November
12☐ December

50. When you were young (20-25 years ago), what were the months in which majority of typhoons occurred annually? *(Please select AS MANY AS it applies IN LUNAR CALANDER)*

1☐ January
2☐ February
3☐ March
4☐ April
5☐ May
6☐ June
7☐ July
8☐ August
9☐ September
10☐ October
11☐ November
12☐ December

51. Do you think the typhoons are occurring during wrong seasons now?

1☐ Yes 2☐ No 0☐ I don't know

52. Do you get warning of upcoming flooding and rainfall?

1☐ Yes 2☐ No

If 'Yes' how do you get the warning?
(Please select AS MANY AS it applies)

1☐ From neighbors
2☐ From phone call/text from friends
3☐ From television
4☐ From Radio
5☐ Printed notice in public places
6☐ From village leaders
7☐ From laud speaker in village
8☐ From newspapers
9☐ Own observation
10☐ Other *(Please specify):*
……………………………………

53. Compare to 20-25 years ago, do you think the rainfall is less in your village per year?

1☐ Yes 2☐ No 0☐ I don't know

54. Compare to 20-25 years ago, do you think the rainfall has increased in certain months of the year?

1☐ Yes 2☐ No 0☐ I don't know

55. Compare to 20-25 years ago, do you think the hotness during summer has increased in your villager?

1☐ Yes 2☐ No 0☐ I don't know

56. Have you participated any training or workshop on typhoon and flood management?
1☐ Yes 2☐ No

57. Have you heard about climate change?

1☐ Yes 2☐ No

If 'Yes' what is it?
(Select as many as it applies)

- 0☐ I don't know
- 1☐ Long term pattern of weather
- 2☐ Global greenhouse effect
- 3☐ Other *(Please Specify)*……………………………………………………

58. Do you know the impacts of climate change in your locality?

1☐ Yes 2☐ No 0☐ I don't know

If Yes, what are the effects of climate change?
(Please select AS MANY AS it applies)

- 1☐ Stronger typhoons
- 2☐ Increase temperature
- 3☐ Sea level rise
- 4☐ Increase flooding
- 5☐ Increase in rainfall
- 6☐ Others *(Please Specify)*…………………………………….....

59. How do you know about climate change related impacts in your village?
(Please select AS MANY AS it applies)

- 1☐ From training/workshops
- 2☐ From families and friends
- 3☐ From television
- 4☐ From Radio
- 4☐ From NGOs and projects
- 5☐ Printed notice in public places
- 6☐ From village leaders
- 7☐ From government offices
- 8☐ From newspapers
- 9☐ From Own observation
- 4 ☐ From reports and publication
- 10☐ Other *(Please specify):* ……………………………………
- 0☐ I don't know

60. Do you think climate change is dangerous to you and to your household?

1☐ Yes 2☐ No 0☐ I don't know

If ‘Yes’ how can it be dangerous?
(Please select AS MANY AS it applies)

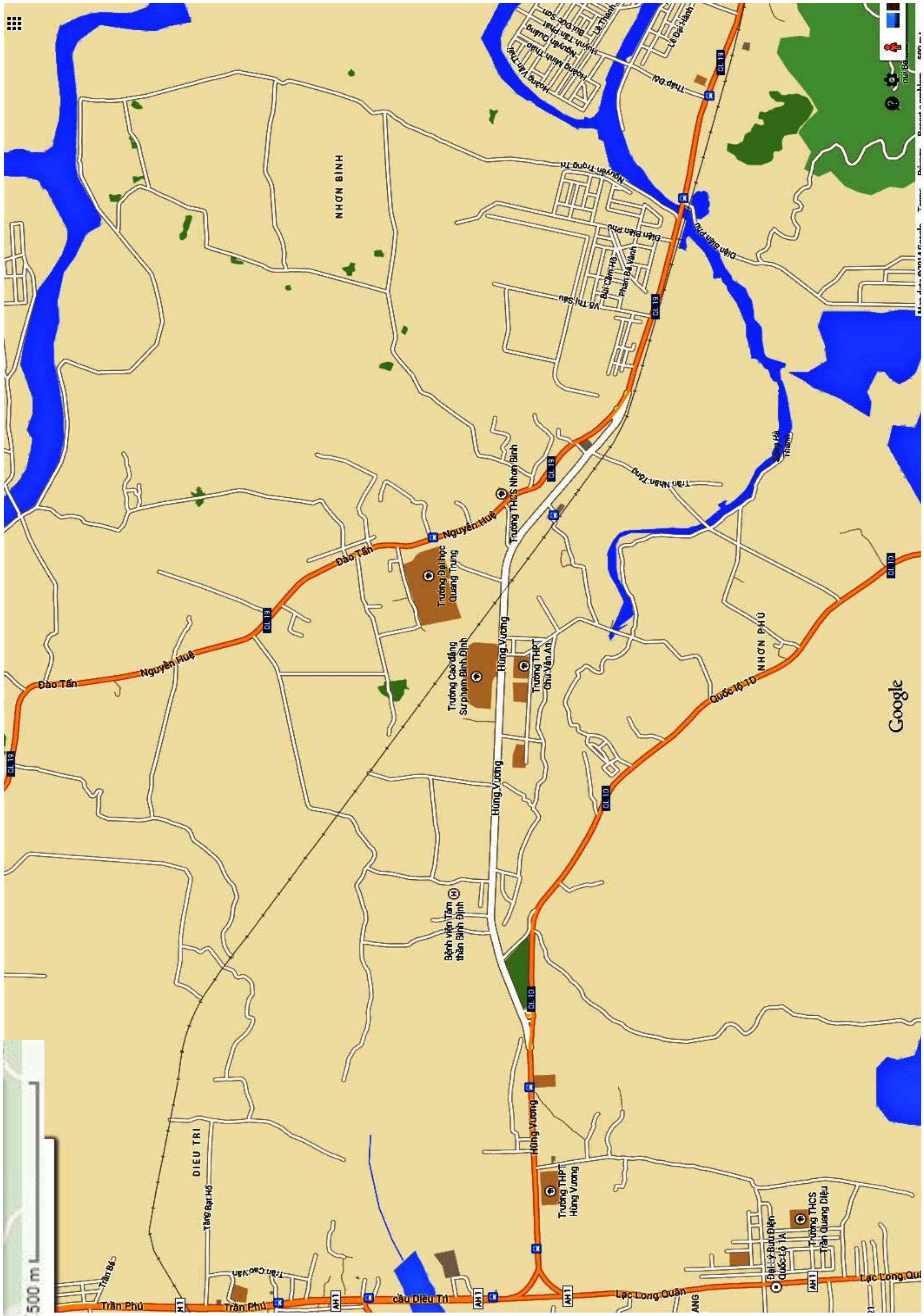
1☐ It increases the flooding in our house
2☐ It reduces our agricultural production
3☐ We will have shortage of drinking water
4☐ We will have longer duration without rainfall
5☐ We will have more risk of diseases
6☐ Our irrigation system will not have water
7☐ We will not have enough food
8☐ Other *(Please specify)*
……………………………………………………

61. Do you think the impacts of climate change are happening in you village?

1☐ Yes   2☐ No   0☐ I don’t know

Thank you very much. We will provide the findings of this research to you through presentation and public meeting when the analysis will be completed.

Survey end time:………… ☐ AM ☐ PM



NHƠN BÌNH
NHƠN PHÚ
DIÊU TRÌ
Nguyễn Huệ
Đào Tấn
Hùng Vương
Quốc lộ 1D
Trường THCS Nhơn Bình
Trường Đại học Quang Trung
Trường Cao đẳng Sư phạm Bình Định
Trường THPT Chu Văn An
Bệnh viện Tâm thần Bình Định
Trường THPT Hùng Vương
Trường THCS Trần Quang Diệu
Trần Phú
cầu Diêu Trì
Lạc Long Quân
Google
500 m

Appendix 2: Household Survey (Vietnamese version)

Ứng Dụng Kiến Thức về Biến Đổi Khí Hậu vào Việc Lập Kế Hoạch và Ra Quyết Định Quy Hoạch Đô Thị

Phiếu Khảo Sát Dành Cho Hộ Gia Đình - Năm 2014

Phiếu khảo sát số: …………………………….. Ngày khảo sát:………….....

Họ và Tên điều tra viên:………………………. Thời gian bắt đầu:………… ☐ AM ☐ PM

Phần 1: Thông tin chung

---

1. Họ và tên:………………………………………..

2. Giới tính: 1☐ Nam 2☐ Nữ

3. Tuổi:…………………..

4. Địa chỉ nơi ở:

   1☐ Phường Nhơn Phú 2☐Phường Nhơn Bình

   Địa chỉ nhà bạn (Khu vực, đường):……………………………………………………

5. Học vấn:
   (*Xin vui lòng chọn câu trả lời phù hợp với ông/bà/anh/chị*)

   1☐ Lớp 1 đến lớp 5 2☐ Lớp 6 đến lớp 9 3☐ Lớp 10 đến lớp 12

   4☐ Cử nhân 5☐ Thạc sĩ 6☐ Tiến sĩ

   7☐ Giáo dục hướng nghiệp (*nêu rõ):* 8☐ Biết đọc và biết viết 9☐ Khác (*nêu rõ):*

   …………………………. ………………………….

6. Ông/bà/anh/chị có phải là lao động chính trong gia đình không?

   1☐ Có 2☐ Không

7. Nghề nghiệp chính của ông/bà/anh/chị là gì?
(Xin vui lòng chọn 1 trong những gợi ý sau)

1 ☐ Nông dân

2 ☐ Ngư dân

3 ☐ Viên chức nhà nước

4 ☐ Doanh nhân

5 ☐ Công nhân

6 ☐ Giáo viên

7 ☐ Kỹ sư, bác sĩ, hoặc công nhân kỹ thuật

8 ☐ Làm cho chính mình

9 ☐ Các nghề khác có được trả lương, ví dụ: nhân viên bán hàng, nhân viên làm việc trong nhà hàng, phục vụ khách sạn, quản đốc, v.v.

10 ☐ Nghỉ hưu

11 ☐ Sinh viên

12 ☐ Thất nghiệp

13 ☐ Khác (*nêu rõ):* ………………………

8. Nghề nghiệp phụ của ông/bà/anh/chị là gì?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

0 ☐ Tôi không làm thêm

1 ☐ Nông dân

2 ☐ Ngư dân

3 ☐ Viên chức nhà nước

4 ☐ Doanh nhân

5 ☐ Công nhân

6 ☐ Giáo viên

7 ☐ Kỹ sư, bác sĩ, hoặc công nhân kỹ thuật

8 ☐ Làm cho chính mình

9 ☐ Các nghề khác có được trả lương, ví dụ: nhân viên bán hàng, nhân viên làm việc trong nhà hàng, phục vụ khách sạn, quản đốc, v.v.

10 ☐ Nghỉ hưu

11☐ Sinh viên

12☐ Thất nghiệp

13☐ Khác (*nêu rõ):*………………………………………

9. Bạn có tham gia những tổ chức nào sau đây không?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1☐ Ủy ban nhân dân

2☐ Ủy ban phòng chống lũ lụt

3☐ Hội khuyến Nông

4☐ Hội Phụ Nữ

5☐ Các Câu Lạc Bộ ở địa phương

6☐ Tổ chức phi chính phủ

7☐ Khác (*nêu rõ):* ……… …………

0☐ Tôi không tham gia tổ chức nà

10. Hộ gia đình ông/bà/anh/chị có bao nhiêu người?

Câu trả lời:………….

1☐ Dưới 15 tuổi:..……

2☐ Trên 60 tuổi: ……….

3☐ 16 – 59 tuổi:………

11. Thu nhập hàng năm của hộ gia đình ông/bà/anh/chị ước tính được khoảng bao nhiêu tiền (VNĐ)?

Câu trả lời: ………….

1☐ Một tháng

2☐ Một năm

3☐ Thu nhập đủ trang trải cho cả năm

12. Ông/bà/anh/chị sống tại Quy Nhơn được bao lâu rồi?

Câu trả lời: …………………Năm

13. Trước khi đến Quy Nhơn, ông/bà/anh/chị sống ở đâu?

1☐ Tôi không rõ

Tên làng/khu phố/đường số nhà: …………………………..

Tên xã/ phường: …………………………..

Số xã/phường: …………………………..

Tên quận/thị trấn: …………………………..

Số quận/thị trấn: …………………………..

Tên (các) tỉnh: …………………………..

Tên (các) thành phố: …………………………..

Số tỉnh: …………………………...

14. 20 - 25 năm, gia đình bạn làm nghề gì?

(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

0 ☐ Tôi không rõ

1 ☐ Nghề Nông

2 ☐ Ngư dân

3 ☐ Công chức nhà nước

4 ☐ Chủ doanh nghiệp

5 ☐ Công nhân

6 ☐ Giáo viên

7 ☐ Kỹ sư, bác sĩ hoặc công nhân máy móc

8 ☐ Làm cho chính mình

9 ☐ Làm thuê (nhân viên bán hàng, nhân viên khách sạn, quản lý…)

10 ☐ Khác (*nêu rõ): ……… …………….*

15. Công việc hiện tại của thành viên trong gia đình bạn là gì?

(Họ và tên của một thành viên đang đi làm trong gia đình bạn)

Họ và tên	Công việc
7.	
8.	
9.	
10.	
11.	
12.	

Phần 2: Thay đổi trên diện rộng
----

16. 20 – 25 năm gần đây, có những thay đổi gì ở nơi bạn sống?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1☐ Nhiều ngôi nhà mới được xây
2☐ Nhiều khu công nghiệp được mở
3☐ Nhiều con đường mới được mở
4☐ Nhiều cống rãnh được xây
5☐ Nhiều khách sạn, nhà nghỉ được xây
6☐ Nhiều hệ thống đê điều được xây
7☐ Nhiều kênh mương được mở
8☐ Nhiều ao hồ được xây
9☐ Khác (*nêu rõ): ……… …………….*
0☐ Tôi không thấy sự thay đổi nào

17. Bạn xây nhà được bao lâu rồi?
(Xin vui lòng chọn 1 trong những gợi ý sau)

1☐ 1 – 2 năm trước
2☐ 3 năm trước
3☐ 5 năm trước
4☐ 10 năm trước
5☐ 15 năm trước
6☐ Khác (*nêu rõ): ……… ...*

18. So với đồng ruộng, nhà của ông/bà/anh/chị có cao hơn không và cao hơn bao nhiêu (Ước lượng)? *(Xin vui lòng chọn 1 trong những gợi ý sau)*

1☐ Dưới nửa mét
2☐ Nửa mét
3☐ 1 mét
4☐ 2 mét
5☐ Khác (*nêu rõ): ……… …………….*

19. Miêu tả về ngôi nhà trước kia của bạn?

0☐ Đó là ngôi nhà đầu tiên của bạn *(Làm tiếp câu 21)*

Miêu tả ngôi nhà trước kia của bạn (Chất liệu, mái nhà, cửa sổ, cửa, chiều cao…):

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

20. Tầng 1, ngôi nhà của bạn cách mặt đất bao nhiêu (Ước lượng)?
(Xin vui lòng chọn 1 trong những gợi ý sau)

1☐ Dưới nửa mét   2☐ Nửa mét

3☐ 1 mét   4☐ 2 mét   5☐ Khác (*nêu rõ):* ……… …………….

21. Ở xã bạn, điện có từ khi nào?
(Xin vui lòng chọn 1 trong những gợi ý sau)

1☐ 1 – 2 năm trước   2☐ 3 năm trước
3☐ 5 năm trước   4☐ 10 năm trước
5☐ 15 năm trước   6☐ Khác (*nêu rõ):* ……… …………….

22. 20 – 25 năm gần đây, hệ thống đê điều, kênh mương ở xã bạn có thay đổi gì không?

Hệ thống đê điều:	Không có thay đổi	Suy giảm	Gia tăng	Tôi không biết
• Số lượng ao hồ	1☐	2☐	3☐	0☐
• Kích thước của bờ ao, hồ	1☐	2☐	3☐	0☐
• Diện tích đất ẩm ướt	1☐	2☐	3☐	0☐
• Số lượng các dòng suối nhỏ	1☐	2☐	3☐	0☐
• Lượng nước trong các dòng suối	1☐	2☐	3☐	0☐
• Số lượng cây đước trồng	1☐	2☐	3☐	0☐
• Khác (*nêu rõ):* ……… …………….	1☐	2☐	3☐	0☐

23. 20 – 25 năm gần đây, ở xã bạn, các loài thực vật có thay đổi gì không?

Thực vật (cây, rừng)	Không có thay đổi	Suy giảm	Gia tăng	Tôi không biết
• Diện tích	1☐	2☐	3☐	0☐
• Các loại cây	1☐	2☐	3☐	0☐
• Khác (*nêu rõ):* ……… …………….	1☐	2☐	3☐	0☐

24. Bạn có nghĩ rằng diện tích đất canh tác bị thu hẹp so với 20 – 25 năm trước không?

1☐ Có 2☐ Không 0☐ Tôi không biết

25. Nguồn nước sạch của ông/bà/anh/chị được lấy từ đâu? Nguồn nước sạch chính ở đâu?
(Xin vui lòng chọn 1 trong những gợi ý sau)

1☐ Bồn nước tư nhân

2☐ Bồn nước công cộng

3☐ Giếng khoan

4☐ Giếng đất

5☐ Sông/suối

6☐ Ao hồ

7☐ Ý kiến khác (*nêu rõ):* …………………………………….

26. Ông/bà/anh/chị có khó khăn nào để lấy nước uống (trong 10 năm gần đây)? Có khó khăn gì trong việc lấy nước sạch không (Trong 10 năm gần đây)?

1☐ Có 2☐ Không

Nếu ông/bà/anh/chị trả lời "Có" xin hãy nêu ra những khó khăn/thử thách đó là gì?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1☐ Ít bồn nước công cộng

2☐ Giếng khoan hoặc giếng đất đất cần phải đào/khoan sâu hơn so với trước đây

3☐ Sông ngòi/dòng suối/ao hồ bị nhiễm độc

4☐ Ao hồ/dòng suối ngày càng khô cạn dần

5☐ Nguồn nước máy được cung cấp thất thường

6☐ Ý kiến khác (*nêu rõ):* ………………………………………........

7☐ Ý kiến khác (*nêu rõ):* ……………………………………………..

27. Trong 20 – 25 năm trở lại đây, có gì thay đổi, phát triển ở làng không? Ở đâu?

Sử dụng bản đồ đính kèm. Hãy sử dụng bản đồ số và dùng những con số sau để đánh dấu vị trí những nơi có sự phát triển mới mà ông/bà/anh/chị biết:

1= nhà ở/toà nhà cao tầng	2= đường xá	3= ngành công nghiệp	4= trường học
5= cầu đường/cống nước hoặc ống điện ngầm/khu giải trí	6 = bệnh viện	7=kênh thuỷ lợi	8=khu dân cư

9=trụ sở hành chính/công trình tưởng niệm	10=toà nhà cộng cộng	11= trung tâm mua sắm	12=khách sạn và khu du lịch/nghỉ dưỡng
13= các cụm cảng	14= các công trình xây dựng liên quan đến vấn đề an ninh	15 = ý kiến khác (*nêu rõ):* …………………………	

28. Ông/bà/anh/chị có thể vẽ vị trí tương đối của nhà mình trên bản đồ không?
(Vẽ biểu tượng sau đây trên bản đồ đính kèm bằng cách sử dụng đánh dấu màu đỏ)

●

29. Khu vực nào trong thành phố/trong làng hiện thường xuyên chịu ảnh hưởng lũ lụt?
(Vẽ vào bản đồ kèm theo bằng bút xanh)

30. Khoảng 20 – 25 năm về trước, theo ông/bà/anh/chị thì khu vực nào thường bị nạn lụt tác động?
(Vẽ vào bản đồ kèm theo bằng bút đỏ)

Phần 3: Kiểu lũ lụt/Bão

---

31. Kiểu lũ lụt gần đây thay đổi ra sao so với 20 – 25 năm về trước?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1☐ Tôi không rõ
2☐ Không có sự thay đổi nào
3☐ Nước lụt cao hơn
4☐ Trận lụt kéo dài lâu hơn
5☐ Lũ lụt không thể đoán trước được
6☐ Phạm vi lũ lụt rộng hơn
7☐ Nước lũ thấp hơn
8☐ Trận lũ lut kéo dài ngắn hơn
9☐ Phạm vi lũ lụt thu hẹp hơn
10☐ Lũ lụt diễn ra thường xuyên hơn
11☐ Lũ lụt diễn ra ít thường xuyên hơn
12☐ Ý kiến khác (*nêu rõ):* ……………………

32. Có bao giờ nước lũ chảy vào nhà của bạn trong suốt mùa lũ lụt không?

1☐ Có 2☐ Không

Nếu "Có", bao lâu sau nước rút?
(Xin vui lòng chọn 1 trong những gợi ý sau)

1☐ ít hơn 2 giờ
4☐ 2-4 giờ
2☐ 4-6 giờ
5☐ 1 ngày
3☐ 1-2 ngày
6☐ Khác (*nêu rõ): ……… …………….*

33. 20 – 25 năm về trước, nhà bạn có hay bị nước lũ ngập vào không?

1☐ Có 2☐ Không 0☐ Tôi không nhớ

Nếu nhà bạn bị nước ngập, bao lâu sau nước sẽ rút?
(Xin vui lòng chọn 1 trong những gợi ý sau)

1☐ ít hơn 2 giờ
4☐ 2-4 giờ
2☐ 4-6 giờ
5☐ 1 ngày
3☐ 1-2 ngày
6☐ Khác (*nêu rõ): ……… …………….*

34. Ông/bà/anh/chị làm gì khi lũ đến?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1☐ Không làm gì
2☐ Chuyển lên tầng 2
3☐ Nhờ hàng xóm giúp đỡ
4☐ Đợi hướng dẫn của cơ quan nhà nước
5☐ Leo lên mái nhà và gọi giúp đỡ
6☐ Đến khu vực khô ráo của làng
7☐ Theo dõi báo đài để biết thêm thông tin
8☐ Khác (*nêu rõ):*
……………………………………

35. Ông/bà/anh/chị có tìm cách bảo vệ ngôi nhà của mình khỏi lũ lụt không?

1☐ Có 2☐ Không *(Nếu "Không" thì xin bỏ qua câu hỏi số 36)*

Nếu "Có," xin chỉ ra rõ ông/bà/anh/chị là gì để bảo vệ nhà của mình.

(Hãy đánh dấu vào những ô vuông có những gợi ý phù hợp)

1☐ Tôi nâng nền nhà tôi lên cao hơn và gia cố nhà chắc hơn

2☐ Tôi tạo rào chắn xung quanh nhà bằng các bức tường, đống cát đá, v.v.

3☐ Tôi trồng nhiều cây hơn làm rào chắn xung quanh nhà, ví dụ như: cây tre

4☐ Tôi để tầng 1 của căn nhà trống

5☐ Tôi đào mấy cái mương để tạo thành rãnh, nước sẽ thoát nhanh hơn.

6☐ Ý kiến khác (*nêu rõ):* ……………………

7☐ Ý kiến khác (*nêu rõ):* ……………………..

36. Ông/bà/anh/chị có thấy rằng những kỹ thuật bảo vệ nhà cửa khỏi lũ lụt có đủ thích ứng với tình hình lũ lụt hiện nay; với 20-25 năm thì sao, có đủ không?

1☐ Có 2☐ Không 0☐ Tôi không biết

Nếu Ông/bà/anh/chị trả lời "Không", xin vui lòng ghi ra những thử thách/khó khăn trong hiện tại
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1☐ Nước lụt dâng cao hơn

2☐ Dòng chảy của nước lụt mạnh hơn

3☐ Các trận lũ kéo dài hơn

4☐ Lũ lụt xảy ra thường xuyên hơn

5☐ Lũ lụt trên diện rộng

6☐ Nhận được ít sự giúp đỡ từ những người khác để phát triển các biện pháp bảo vệ và rào chắn

7☐ Nhận được ít sự giúp đỡ hơn từ chính phủ trong việc kiểm soát các trận lũ lụt.

8☐ Ý kiến khác (*nêu rõ):* …………………………

37. Ông/bà/anh/chị có bảo vệ nhà mình khỏi bão không?

1☐ Có 2☐ Không *(Bỏ câu 38)*

Nếu “Có”, ông/bà/anh/chị làm gì để bảo vệ nó?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1☐ Tôi trồng cây (ví dụ như cây tre) xung quanh nhà để làm rào chắn tự nhiên

2☐ Tôi gia cố cột và tường cho căn nhà bằng bê-tông

3☐ Tôi tăng cường cột để chống đỡ mái nhà

4☐ Tôi gắn các cửa ra vào và cửa sổ có khả năng chịu bão

5☐ Tôi đã xây nhà mình bằng vật liệu nhẹ có sẵn tại địa phương. Một khi nó bị bão thổi đi, tôi sẽ làm lại cái khác.

6☐ Ý kiến khác (*nêu rõ):* ………………………

7☐ Ý kiến khác (*nêu rõ):* ………………………

38. Ông/bà/anh/chị có thấy rằng những kỹ thuật bảo vệ nhà cửa khỏi bão có đủ khả năng chống chọi với tình hình lũ lụt hiện nay, so với 20-25 năm thì sao?

1☐ Có 2☐ Không 0☐ Tôi không biết

Nếu “Không”, xin ông/bà/anh/chị vui lòng cho biết khó khăn/thử thách khi ứng phó với bão ngày nay?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1☐ Tốc độ gió cao hơn

2☐ Lượng mưa nhiều hơn

3☐ Bão kéo dài hơn

4☐ Các cơn bão diễn ra thường xuyên hơn

5☐ Các cảnh báo bão chưa kịp thời

6☐ Nhận được ít sự giúp đỡ từ chính quyền

7☐ Ý kiến khác (*nêu rõ):* ………………………………

39. Theo ông/bà/anh/chị, sự phát triển mới, ví dụ như: về nhà cửa, khu dân cư, đường xá, trường học, bệnh xá, các khu công nghiệp, kênh đào, v.v. có làm tăng ảnh hưởng của lũ lụt xung quanh nhà mình không?

1☐ Có 2☐ Không 0☐ Tôi không rõ

Nếu "Có", sự phát triển đó làm tăng lũ lụt quanh nhà ông/bà/anh/chị như thế nào?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1☐ Sự phát triển của các khu đô thị, làm cho diện tích các đầm lầy bị thu hẹp làm cho nước lũ không còn nơi thoát.

2☐ Sự phát triển của các khu nhà cao tầng, làm chặn đường thoát của dòng nước lũ

3☐ Không có các kênh đào để chuyển hướng dòng nước lũ

4☐ Lượng mưa trở nên thất thường và làm tăng lũ lụt

5☐ Các công trình phát triển mới được nâng lên cao hơn so với mặt bằng của các khu dân lân cận

6☐ Không có hệ thống thoát nước để làm thoát nước lũ

7☐ Ý kiến khác (*nêu rõ):* ……………………………..

40. Dự vào kinh nghiệm về lũ lụt, nếu ông/bà/anh/chị muốn bảo vệ làng xóm khỏi lũ lụt, ông/bà/anh/chị có ý kiến đóng góp gì không?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1☐ Không biết/Không ý kiến

2☐ Phát triển hệ thống thoát nước

3☐ Tăng độ cao và chiều dài các con kênh, mương

4☐ Trồng thêm cây (Tre, cây cối, bụi cây nhỏ hai bên bờ sông)

5☐ Nâng cao nền các nhà

6☐ Chuyển làng đến nơi ở mới cao hơn và khô ráo hơn

7☐ Khác (*nêu rõ):* ………………………………………………

41. Dựa vào kinh nghiệm về bão, nếu ông/bà/anh/chị muốn bảo vệ làng xóm khỏi bão, ông/bà/anh/chị có ý kiến đóng góp gì không?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1☐ Không biết/Không ý kiến

2☐ Trồng thêm cây/cây tre xung quanh nhà

3☐ Xây dựng nơi tránh bão

4☐ Gia cố nhà cửa với cửa sổ, cửa ra vào, mái nhà

5☐ Phát triển hệ thống dự báo bão

6☐ Có nhóm cộng đồng cứu nạn sau bão

7☐ Khác *(nêu rõ):* ……………………………

42. Nếu bạn là một người nông dân, theo ông/bà/anh/chị thì vụ mùa thu hoạch được có nhiều như cách đây 20-25 năm không?

1☐ Có 2☐ Không

Nếu câu trả lời là "Không", xin ông/bà/anh/chị vui lòng chỉ ra nguyên nhân cụ thể gây ra sự suy giảm sản lượng này
(Ông/bà/anh/chị có thể chọn nhiều hơn 1 lựa chọn sau)

1☐ Thiếu mưa vào vụ mùa

2☐ Hệ thống tưới tiêu cho đất không đủ như trước

3☐ Các cơn bão phá huỷ các vụ mùa

4☐ Dịch bệnh bùng nổ vào những vụ mùa thu hoạch

5☐ Sự màu mỡ của đất đai suy giảm

6☐ Ý kiến khác (*nêu rõ):* ……………………

7☐ Ý kiến khác (*nêu rõ):* ……………………

43. Nếu bạn là một người nuôi trồng thủy sản, bạn có nghĩ rằng sản lượng cá trong ao, hồ thu được so với 20 – 25 năm về trước có bằng nhau không?

1☐ Có 2☐ Không

Nếu câu trả lời là "Không", xin ông/bà/anh/chị vui lòng chỉ ra nguyên nhân cụ thể gây ra sự suy giảm sản lượng này.
(Ông/bà/anh/chị có thể chọn nhiều hơn 1 lựa chọn sau)

1☐ Thiếu mưa vào vụ mùa

2☐ Thiếu nước trong ao hồ

3☐ Lũ lụt phá hủy ao hồ

4☐ Nhiệt độ của nước trong ao hồ tăng

5☐ Ý kiến khác (*nêu rõ):* ……………………………

6☐ Ý kiến khác (*nêu rõ):* …………………………......

Phần 4: Nhận thức về sự biến đổi khí hậu/thiên tai

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44. Những thiên tai tự nhiên nào diễn ra trong làng/xã của ông/bà/anh/chị?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

*(Xếp theo thứ tự những thảm hoạ sau đây theo mức độ ảnh hưởng của chúng:
1 = Lớn, 2 = Trung bình, 3 = nhỏ, 4 = không ảnh hưởng)*

Thiên tai:	Mức độ
1☐ Lũ lụt	☐
2☐ Bão	☐
3☐ Hạn hán	☐
4☐ Xâm nhập mặn	☐
5☐ Hoả hoạn	☐
6☐ Động đất	☐
7☐ Những đợt nắng nóng	☐
8☐ Ý kiến khác (*nêu rõ):*……………………….	☐

45. 20-25 năm về trước, ông/bà/anh/chị có thấy những thay đổi nào trong những hiện tượng sau đây xảy ra ở trong làng/nơi ông bà sinh sống:

Hiện tượng	Không có thay đổi	Suy giảm	Gia tăng	Tôi không biết
• Số trận lụt mỗi năm	1☐	2☐	3☐	0☐
• Thiệt hại về người và tài sản do lũ lụt mỗi năm	1☐	2☐	3☐	0☐
• Số lượng cơn bão mỗi năm	1☐	2☐	3☐	0☐

Hiện tượng	Không có thay đổi	Suy giảm	Gia tăng	Tôi không biết
• Thiệt hại về người và tài sản do bão gây ra mỗi năm	1☐	2☐	3☐	0☐
• Số lượng tháng hạn hán mỗi năm	1☐	2☐	3☐	0☐
• Sụt giảm (sản lượng nông nghiệp và nguồn nước ngọt) do hạn hán mỗi năm	1☐	2☐	3☐	0☐
• Số lượng các đám cháy mỗi năm	1☐	2☐	3☐	0☐
• Thiệt hại về người và tài sản do hoả hoạn mỗi năm	1☐	2☐	3☐	0☐
• Thời gian nắng nóng mỗi năm	1☐	2☐	3☐	0☐
• Nắng nóng trong suốt mùa hè	1☐	2☐	3☐	0☐
• Thời gian trời trở lạnh mỗi năng	1☐	2☐	3☐	0☐
• Số đợt bùng nổ dịch bệnh mỗi năm	1☐	2☐	3☐	0☐
• Tử vong do bùng nổ dịch bệnh	1☐	2☐	3☐	0☐
• Thiếu nước uống mỗi năm	1☐	2☐	3☐	0☐
• Không khí ô nhiễm	1☐	2☐	3☐	0☐
• Kích cỡ dòng sông	1☐	2☐	3☐	0☐

46. Ông/bà/anh/chị có nhận được thông tin về bão trước khi nó xảy ra hay không?

1☐ Có 2☐ Không 3☐ Tôi không biết

47. Ông/bà/anh/chị nhận được thông tin về bão từ nguồn nào?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1☐ Từ hàng xóm 6 ☐ Từ trưởng làng

2 ☐ Bạn bè thông báo
3 ☐ Tivi
4 ☐ Đài Radio
5 ☐ Thông báo, áp phích ngoài đường
7 ☐ Thông báo từ đài phát thanh làng
8 ☐ Báo chí
9 ☐ Quan sát cá nhân
10 ☐ Khác (*nêu rõ*):………………………

48. Cách đây 20-25 năm, ông/bà/anh/chị nhận được thông tin về bão từ nguồn nào?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1 ☐ Từ hàng xóm
2 ☐ Bạn bè thông báo
3 ☐ Tivi
4 ☐ Đài Radio
5 ☐ Thông báo, áp phích ngoài đường
6 ☐ Từ trưởng làng
7 ☐ Thông báo từ đài phát thanh làng
8 ☐ Báo chí
9 ☐ Quan sát cá nhân
10 ☐ Khác (*nêu rõ*):………………………

49. Hàng năm, những tháng nào trong năm có nhiều cơn bão xuất hiện?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau, tính theo âm lịch)

1 ☐ Tháng giêng
2 ☐ Tháng hai
3 ☐ Tháng ba
4 ☐ Tháng tư
5 ☐ Tháng năm
6 ☐ Tháng sáu
7 ☐ Tháng bảy
8 ☐ Tháng tám
9 ☐ Tháng chín
10 ☐ Tháng mười
11 ☐ Tháng mười một
12 ☐ Tháng mười hai

50. Cách đây 20-25 năm, ông/bà/anh/chị thấy những tháng nào có nhiều cơn bão xuất hiện hàng năm?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau, tính theo âm lịch)

1 ☐ Tháng giêng
2 ☐ Tháng hai
3 ☐ Tháng ba
4 ☐ Tháng tư
5 ☐ Tháng năm
6 ☐ Tháng sáu
7 ☐ Tháng bảy
8 ☐ Tháng tám
9 ☐ Tháng chín
10 ☐ Tháng mười
11 ☐ Tháng mười một
12 ☐ Tháng mười hai

51. Theo ông/bà/anh/chị, các cơn bão ngày nay xuất hiện có trái mùa không?

1☐ Có 2☐ Không 0☐ Tôi không biết

52. Bạn có nhận được thông tin gì trước khi lũ lụt và mưa xảy ra không?

1☐ Có 2☐ Không

Nếu "Có", làm thế nào mà bạn biết?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau.)

1☐ Từ hàng xóm
2☐ Bạn bè thông báo
3☐ Tivi
4☐ Đài Radio
5☐ Thông báo, áp phích ngoài đường
6☐ Từ trưởng làng
7☐ Thông báo từ đài phát thanh làng
8☐ Báo chí
9☐ Quan sát cá nhân
10☐ Khác (*nêu rõ):*………………………

53. Bạn có nghĩ rằng lượng mưa những năm gần đây ít hơn so với 20 – 25 năm về trước không?
1☐ Có 2☐ Không 0☐ Tôi không biết

54. Bạn có nghĩ rằng lượng mưa mấy tháng gần đây nhiều hơn so với 20 – 25 năm về trước không?

1☐ Có 2☐ Không 0☐ Tôi không biết

55. Bạn có nghĩ rằng, những năm gần đây, nhiệt độ vào mùa hè nóng hơn so với 20 – 25 năm về trước không?

1☐ Có 2☐ Không 0☐ Tôi không biết

56. Ông/bà/anh/chị đã từng tham gia tập huấn hoặc hội nghị về phòng chống lụt bão nào chưa?

1☐ Có 2☐ Không

57. Ông/bà/anh/chị đã từng nghe nói về Biến đổi khí hậu chưa?

1☐ Có 2☐ Không

Nếu "Có," xin vui lòng ghi rõ biến đổi khí hậu là gì
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1☐ Tôi không biết/không rõ

2☐ Quy luật dài hạn của thời tiết

3☐ Hiệu ứng nhà kính toàn cầu

4☐ Thay đổi nhiệt độ

5☐ Khác (*nêu rõ): ………………………………………………………*

58. Ông/bà/anh/chị có biết tác động của biến đổi khí hậu lên khu vực mình sinh sống không?

1☐ Có 2☐ Không 3☐ Tôi không biết

Nếu "Có," xin vui lòng chỉ ra hậu quả của biến đổi khí hậu bằng cách đánh dấu vào các ô vuông mà ông/bà/anh/chị cho là đúng.
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1☐ Làm tăng nhiệt độ

2☐ Lũ lụt gia tăng

3☐ Làm tăng lượng mưa

4☐ Các cơn bão mạnh hơn

5☐ Mực nước biển dâng cao

6☐ Ý kiến khác (*nêu rõ):*
…………………………..

59. Ông/bà/anh/chị biết về biến đổi khí hậu qua những nguồn nào?
(Ông/bà/anh/chị có thể chọn nhiều hơn một trong những gợi ý sau)

1☐ Từ tập huấn, hội nghị

2☐ Gia đình và bạn bè

3☐ Tivi

4☐ Đài Radio

5☐ Tổ chức Phi chính phủ và các dự án.

6☐ Áp phích, băng rôn cổ động ngoài đường

0☐ Tôi không biết

7☐ Trưởng thôn/làng

8☐ Văn phòng chính phủ

9☐ Báo giấy/ báo trên mạng internet

10☐ Quan sát cá nhân

11☐ Các báo cáo, sách vở.

12☐ Khác (*nêu rõ): ……………………*

60. Theo ông/bà/anh/chị, sự biến đổi khí hậu có nguy hiểm đến bản thân ông/bà/anh/chị và hộ gia đình của mình không?

1☐ Có 2☐ Không 0☐ Tôi không biết

Nếu "Có", xin vui lòng chỉ ra những tác hại của biến đổi khí hậu bằng cách đánh dấu chọn các ô vuông phù hợp sau đây:

1☐ Làm gia tăng nạn lụt
2☐ Sản lượng nông nghiệp suy giảm
3☐ Thiếu hụt nước uống
4☐ Mùa khô kéo dài hơn
5☐ Có nhiều nguy cơ bệnh tật hơn
6☐ Hệ thống thuỷ lợi không có nước
7☐ Thiếu lương thực
8☐ Ý kiến khác (*nêu rõ):*
………………………

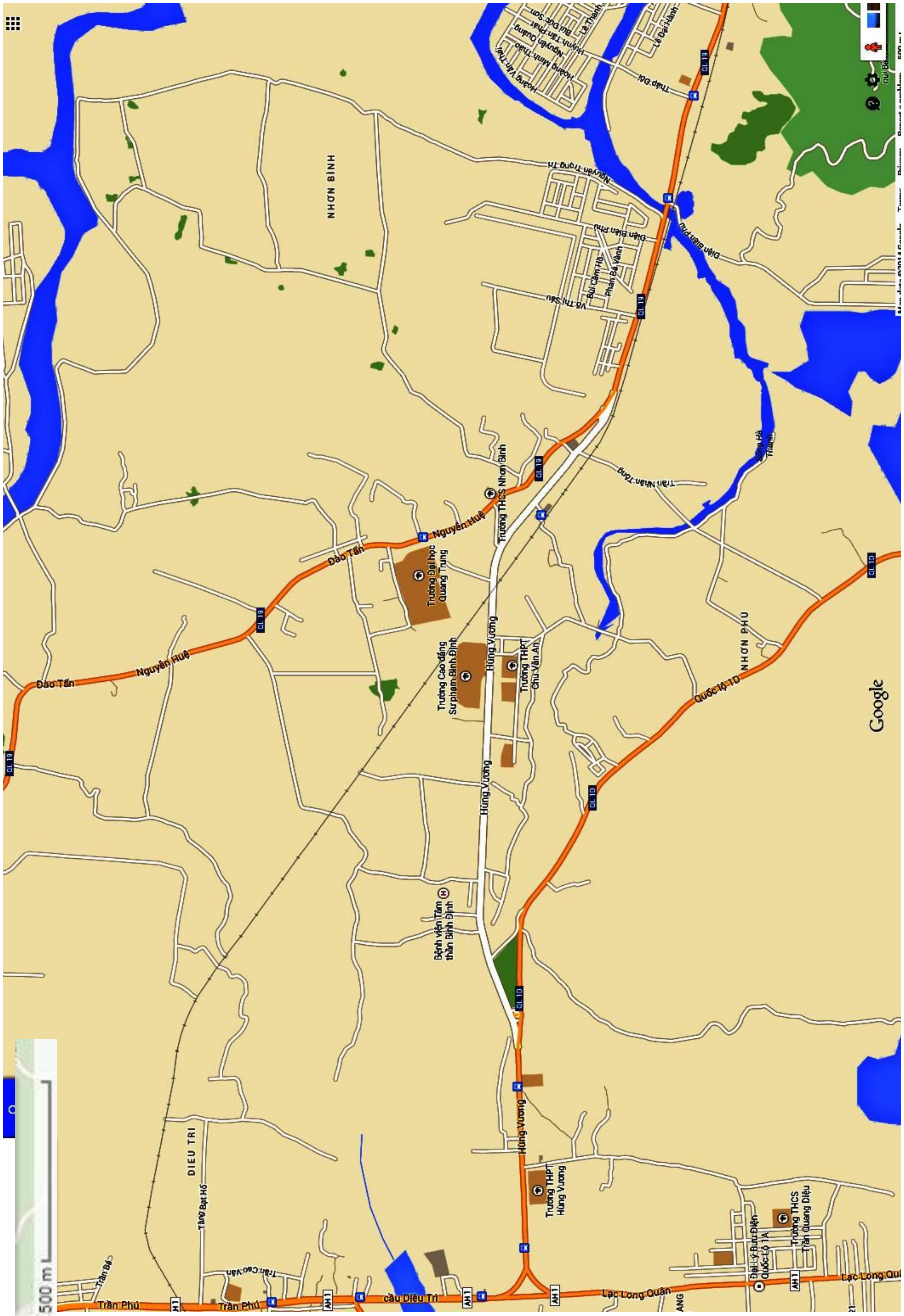
61. Bạn có nghĩ rằng biến đổi khí hậu đang ảnh hưởng tới nơi bạn sống không?
1☐ Có 2☐ Không 0☐ Tôi không biết

Cảm ơn ông/bà/anh/chị nhiều. Khi dự án nghiên cứu hoàn thành, chúng tôi sẽ có một buổi trình bày rộng rãi về kết quả mà chúng tôi thu thập được.

Thời gian kết thúc buổi khảo sát::………… ☐ AM ☐ PM

Số hiệu của Điều tra viên:………………………

Chữ ký của Điều tra viên:………………………



NHƠN BÌNH
NHƠN PHÚ
ĐIÊU TRÌ
Nguyễn Huệ
Đào Tấn
Hùng Vương
Quốc lộ 1D
Trường THCS Nhơn Bình
Trường Đại học Quang Trung
Trường Cao đẳng Sư phạm Bình Định
Trường THPT Chu Văn An
Bệnh viện Tâm thần Bình Định
Trường THPT Hùng Vương
Trường THCS Trần Quang Diệu
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Appendix 3: Approval from University of Hawaii Human Studies Program

Office of Research Compliance
Human Studies Program

UNIVERSITY of HAWAI'I®
MĀNOA

August 5, 2014

TO: Jiwnath Ghimire
Principal Investigator
Urban & Regional Planning

FROM: Denise A. Lin-DeShetler, MPH, MA
Director

SUBJECT: CHS #22340- "Translating Climate Science Knowledge to Collective Adaptation in Saptial Planning and Practice in Binh Dinh Province and Quy Nhon City of Vietnam"

This letter is your record of the Human Studies Program approval of this study as exempt.

On August 5, 2014, the University of Hawai'i (UH) Human Studies Program approved this study as exempt from federal regulations pertaining to the protection of human research participants. The authority for the exemption applicable to your study is documented in the Code of Federal Regulations at 45CFR 46.101(b)(Exempt Category 2).

Exempt studies are subject to the ethical principles articulated in The Belmont Report, found at http://www.hawaii.edu/irb/html/manual/appendices/A/belmont.html.

Exempt studies do not require regular continuing review by the Human Studies Program. However, if you propose to modify your study, you must receive approval from the Human Studies Program prior to implementing any changes. You can submit your proposed changes via email at uhirb@hawaii.edu. (The subject line should read: Exempt Study Modification,) The Human Studies Program may review the exempt status at that time and request an application for approval as non-exempt research.

In order to protect the confidentiality of research participants, we encourage you to destroy private information which can be linked to the identities of individuals as soon as it is reasonable to do so. Signed consent forms, as applicable to your study, should be maintained for at least the duration of your project.

This approval does not expire. However, please notify the Human Studies Program when your study is complete. Upon notification, we will close our files pertaining to your study.

If you have any questions relating to the protection of human research participants, please contact the Human Studies Program at 956-5007 or uhirb@hawaii.edu. We wish you success in carrying out your research project.

1960 East-West Road
Biomedical Sciences Building B104
Honolulu, Hawai'i 96822
Telephone: (808) 956-5007
Fax: (808) 956-8683

Appendix 4: Community Meeting Agenda

Use of Climate Knowledge in Planning and Decision Making

Agenda for community meetings

Serial number	Agenda	Responsible	Time allocation
1	Introduction of research and objectives of the meeting	Jiwnath and Mr Van	10 minutes
2	Physical change in village exercise A large map of the KV will be provided to each group. Different color markers are provided. Stakeholders will be divided into 2-3 groups. They will be asked what type of changes occurred in the village. Their house: Pink color, new buildings: red color, new road: black, new industry: purple color, new dykes/irrigation ditches: blue color. Stakeholders will be asked to write on maps directly.	Jiwnath, Mr Van, facilitators	30 minutes
3	Sharing the result of the exercise Each group will provide opportunity to talk for 2 minutes about their physical change group exercise	Mr Van	10 minutes
4	i-clicker exercise on worst disaster, climate change awareness, disaster management strategies, etc. Each participants will be provided remote of i-Clicker. A question is asked in each slide and five answers will be provided in the screen. Participants will press a remote button to select an answer (A or B or C or D or E).	Jiwnath, Mr Van and participants	30 minutes
5	Closing		

Required preparation

1. Preparation of attendance sheet
2. Preparation of projector and extension curds
3. Supplies for group exercise: large size sheets, tape, different color markers
4. 3 volunteers.

Appendix 5: i-Clicker Exercise (English version)

How do you deal with flooding and typhoons?

Why your opinion is important

- There was worst flooding in 2009 and 2013 in Nhon Binh and Nhon Phu wards.
- We all had challenges of dealing with flooding in both years.
- This type of exercise will help us to understand your experience of flooding and typhoon.
- We will share the finding of this exercise with others including government so that other people will understand how you deal with flooding and typhoons in the future.

How we will work today on group exercise and voting

- Group exercise - 30 minutes
- Reporting of each group - 10 minutes
- Voting exercise - 30 minutes

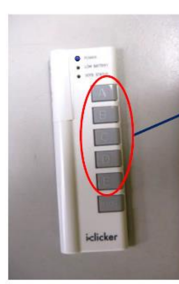
Group mapping exercise (30 minutes)

- Break into three groups (6-7 persons per group)
- Please directly write and draw on the map
- Each group will have one facilitator to help the discussion and mapping
- Please draw six features on the map using color markers (New features are built within last 20 years):
  - Your house: Pink color
  - New buildings: Red color
  - New roads: Black color
  - New industry: Yellow color
  - New dykes irrigation ditches: Green
  - Regularly flooded area in your village: Blue color

Reporting of your group exercise (10 minutes)

- Choose one group leader
- Group leader will share the information on map for 3-4 minutes.
  - Group leader describes location of houses of group members.
  - Location of new development in the Khu Vuc.
  - Flooding areas of the village.

How to use remote to give your vote



With the "POWER" blue light on, press A, B, C, D, or E button to cast your vote.

What is biggest city in Binh Dinh?

A. Phu Cat
B. Quy Nhon
C. Nhon Ly
D. Nhon Hoi
E. I don't know

The right answer is

A. Phu Cat
B. Phu My
C. Nhon Ly
D. Quy Nhon
E. I don't know

Are you member of any of following organization?

A. **Farmers Union.**
B. **Flood and Storm Control Committee.**
C. **Womens Uniont.**
D. **I am not part of any organizaiton.**
E. **Other.**

What are major disasters in Quy Nhon based on damage?

A. **Flooding and typhoons.**
B. **Drought.**
C. **Fire.**
D. **Earthquake.**
E. **I don't know.**

How is the pattern of flooding in your village in recent years compare to 20-25 years ago?

A. **Flooding has become deeper.**
B. **Flooding became wider and longer.**
C. **Both A and B.**
D. **There is no change in flooding.**
E. **Flooding has decreased.**

How long flooding stays in your house when flooding happens?

A. **My house never gets flooding.**
B. **1-2 hours.**
C. **2-6 hours.**
D. **1 day.**
E. **More than 1 day.**

What do you do when flooding happens in your village?

A. Move to mezzanine.
B. Go to relatives house to stay until flood goes away.
C. Listen to radio and TV for instruction what to do.
D. All of above (A, B and C).
E. My house never got flooding.

How do your protect your house from flooding?

A. Put sand bags around house.
B. I elevated the house when I constructed.
C. I dig canal to release the water quickly.
D. All of above (A, B, and C).
E. My house never got flooding.

Why flood management techniques are not enough now compare to 20-25 years ago?

A. The flood is deeper, stronger, wider and unpredictable.
B. There is lack of warnings at advance.
C. Not enough support from government to deal with flooding.
D. All of above (A, B, and C).
E. Current flood management techniques are enough.

How do you protect your house from typhoon?

A. I reinforce roof, pillars and walls with extra ties and nails.
B. I plant bamboos around my house as natural barrier.
C. Not enough support from government to deal with flooding.
D. All of above (A, B and C).
E. Current flood management techniques are enough.

Why typhoon protection techniques are not enough compare to 20-25 yrs ago?

A. Typhoon has higher wind speed now.
B. Duration of typhoon is longer now.
C. There is higher rainfall during typhoon now.
D. All of above (A, B and C).
E. Current typhoon management techniques are enough.

How new constructions around your village increased the flooding?

A. New construction blocks the flow of flood water.
B. New development fills the ponds and reservoirs where flood water used to go.
C. New construction is elevated than surrounding areas, that leads flood water to surrounding areas.
D. All of above (A, B and C).
E. New construction did not increase the flooding.

What you recommend to reduce flooding impacts in your village?

A. **Establish higher capacity drainage network.**
B. **Plant more bamboos and trees.**
C. **Elevate houses.**
D. **All of above (A, B and C).**
E. **Do not require to do anything.**

What you recommend to reduce typhoons impacts in your village?

A. **Plant more bamboos and trees.**
B. **Reinforce windows, doors and roof with extra ties and nails.**
C. **Improve forecast system and construct typhoon shelter.**
D. **All of above (A, B and C).**
E. **Do not require to do anything.**

How do you get information about upcoming flooding and typhoons?

A. **From neighbors and phone calls from friends.**
B. **Radio, television and loud speaker.**
C. **Village leaders and commune leaders.**
D. **All of above (A, B and C).**
E. **From my own observation.**

When you were young (20-25 years ago), how did you get information about upcoming flooding and typhoons?

A. **From neighbors.**
B. **Village leaders and commune leaders.**
C. **Own observation and guess.**
D. **All of above (A, B and C).**
E. **I did not get information about upcoming flooding and typhoons.**

Compare to 20-25 years ago, does rainfall decrease or increase in your area?

A. **Decrease.**
B. **Increase.**
C. **I don't know.**

Compare to 20-25 years ago, does hot weather decrease or increase in Quy Nhon?

A. **Decrease.**
B. **Increase.**
C. **I don't know.**

Have you ever participated on training, workshops or meeting related to climate change?

A. Yes
B. No

What do you mean by climate change?

A. Change in industrial production.
B. Change in longer term weather and change in flooding and typhoon.
C. Change in pollution in river.
D. I don't know.

What are impacts of climate change in your locality?

A. Change in flooding and typhoons.
B. Increase in sea level.
C. Increase in temperature.
D. All of above (A, B and C).
E. I don't know.

How do you know about climate change?

A. Newspaper, TV, radio, leaflet.
B. Village leaders and loud speaker.
C. Workshops, trainings, meetings.
D. All of above (A, B and C).
E. I don't know about climate change.

How climate change is dangerous?

A. I don't know.
B. It reduces the rainfall and productivity of agriculture and fishery.
C. It creates bigger flooding and stronger typhoons.
D. It reduces the water supply for drinking and agriculture.
E. All B, C and D

How climate change is impacting to your village?

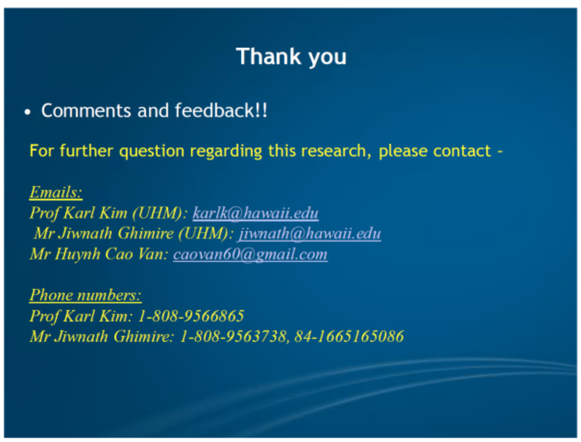
A. My village does not have climate change impact.
B. We have longer drought.
C. We have stronger flooding and typhoons.
D. Both B and C.
E. I don't know.

Have you heard about Quy Nhon Master Plan?

A. Yes
B. No

Have you heard about Climate Change Action Plan?

A. Yes
B. No



Appendix 6: i-Clicker Exercise (Vietnamese version)

Cách bà con ứng phó với lũ lụt và bão

Vì sao ý kiến của bà con lại quan trọng với chúng tôi?

- Năm 2009 và 2013, đã có những đợt lũ nghiêm trọng xảy ra ở hai phường Nhơn Bình và Nhơn Phú.
- Tất cả mọi người đã gặp khó khăn trong việc ứng phó với các đợt lũ trong hai năm đó.
- Hoạt động sắp được tiến hành sau đây sẽ giúp chúng tôi hiểu được những gì bà con đã trải qua trong các trận lũ lụt và bão.
- Chúng tôi sẽ chia sẻ kết quả này cho nhiều người/tổ chức khác bao gồm chính quyền. Điều này sẽ giúp họ hiểu được cách thức mà bà con dùng để ứng phó với bão lũ trong tương lai.

Cách thức làm việc trong hoạt động nhóm và chọn đáp án

- Làm nhóm - 30 phút
- Đại diện các nhóm trình bày - 10 phút
- Trả lời câu hỏi (chọn đáp án) - 30 phút

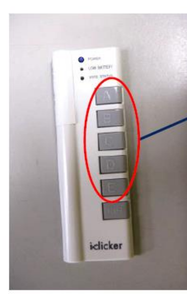
Hoạt động đánh dấu trên bản đồ theo nhóm (30 phút)

- Bà con được chia thành ba nhóm (6-7 người/ nhóm).
- Bà con viết hoặc vẽ trực tiếp lên bản đồ.
- Mỗi nhóm sẽ có sự trợ giúp của một cộng tác viên trong quá trình thảo luận và ghi chú trên bản đồ.
- Dùng bút màu đánh dấu sáu vị trí của sáu nơi lên bản đồ (Những nơi được xây trong 20 năm qua)
  - Nhà riêng: Hồng
  - Các tòa nhà mới: Đỏ
  - Các con đường mới: Đen
  - Xí nghiệp mới: Vàng
  - Đê điều thủy lợi mới: Bạc
  - Nơi thường xuyên bị lụt trong khu vực: Cam

Đại diện các nhóm trình bày (10 phút)

- Chọn nhóm trưởng
- Nhóm trưởng mỗi nhóm sẽ trình bày thông tin ghi trên bản đồ của nhóm mình cho những nhóm khác.
  - Vị trí nhà của thành viên trong nhóm.
  - Vị trí của công trình xây dựng mới trong Khu Vực.
  - Những vùng bị lũ trong Khu Vực.

Cách sử dụng thiết bị để trả lời câu hỏi



Bấm nút ON/OFF. Khi thấy đèn xanh "POWER" bật sáng, nhấn nút A, B, C, D, hoặc E để chọn đáp án.

Thành phố nào lớn nhất ở Bình Định?

A. Phù Cát
B. Phù Mỹ
C. Nhơn Lý
D. Quy Nhơn
E. Tôi không biết

Đáp án

A. Phù Cát
B. Phù Mỹ
C. Nhơn Lý
D. Quy Nhơn
E. Tôi không biết

Bà con có tham gia những tổ chức nào sau đây không?

A. Hội Khuyến Nông.
B. Ủy Ban Phòng Chống Lũ Lụt.
C. Hội Phụ Nữ.
D. Tôi không tham gia tổ chức nào.
E. Khác.

Thảm họa nào gây thiệt hại nghiêm trọng ở Quy Nhơn?

A. Lũ lụt và bão
B. Hạn hán
C. Hỏa hoạn
D. Động đất
E. Tôi không biết

Tình trạng lũ lụt trong khu vực vào những năm gần đây so với 20-25 năm trước?

A. Trở nên nghiêm trọng hơn.
B. Trở nên lan rộng hơn và kéo dài hơn.
C. Cả A và B.
D. Không có nguy cơ bị lũ lụt.
E. Ít xảy ra hơn.

Nhà bà con bị ngập lụt trong bao lâu khi lũ lụt xảy ra?

A. Nhà tôi chưa bao giờ bị ngập lụt.
B. 1-2 tiếng.
C. 2-6 tiếng.
D. 1 ngày.
E. Hơn 1 ngày.

20 đến 25 năm trước, nhà bà con bị từng ngập lụt trong bao lâu?

A. Nhà tôi chưa bao giờ bị ngập lụt.
B. 1-2 tiếng.
C. 2-6 tiếng.
D. 1 ngày.
E. Hơn 1 ngày.

Khi lũ lụt xảy ra trong khu vực, bà con làm gì?

A. Di chuyển lên gác lửng.
B. Trú tạm nhà người thân đến khi nước lũ rút.
C. Nghe hướng dẫn từ radio và ti vi.
D. Cả ba phương án trên (A, B và C).
E. Nhà tôi chưa bao giờ bị ngập.

Bà con bảo vệ nhà cửa như thế nào khi có lũ lụt?

A. Tôi đặt các túi cát quanh nhà.
B. Tôi xây nền nhà cao lên.
C. Tôi đào mương để thoát nước nhanh hơn.
D. Cả ba phương án trên (A, B, và C).
E. Nhà tôi chưa bao giờ bị ngập.

Vì sao các biện pháp chống lũ lụt hiện tại lại không đủ hiệu quả?

A. Lũ nghiêm trọng hơn, mạnh hơn, và khó lường.
B. Tôi xây nền nhà cao lên.
C. Tôi đào mương để thoát nước nhanh hơn.
D. Cả ba phương án trên (A, B, và C).
E. Có đủ khả năng đối phó với lũ lụt.

Tại sao các hình thức đối phó với lũ lụt hiện tại không hiệu quả như với 20- 25 năm trước?

A. Lũ lụt nguy hiểm hơn, mạnh hơn, lan rộng hơn và khó lường hơn.
B. Thiếu biện pháp cảnh báo trước.
C. Không đủ sự hỗ trợ từ chính phủ.
D. Cả ba phương án trên (A, B, và C).
E. Có đủ hình thức hiệu quả đối phó với lũ lụt.

Bà con bảo vệ nhà cửa như thế nào khi có bão?

A. Tôi gia cố mái nhà, cột nhà và tường bằng đinh và dây buộc.
B. Tôi trồng tre quanh nhà để tạo hàng rào tự nhiên.
C. Tôi gia cố các cửa sổ và cửa chính.
D. Cả ba phương án trên (A, B và C).
E. Các biện pháp chống bão hiện tại không đủ hiệu quả.

Tại sao các biện pháp chống bão
không đủ hiệu quả như với 20-25 năm trước?

A. Bão bây giờ có tốc độ gió cao hơn.
B. Bão bây giờ kéo dài hơn.
C. Bão bây giờ kèm theo lượng mưa lớn hơn.
D. Cả ba phương án trên (A, B và C).
E. Có đủ các hình thức đối phó với bão.

Các công trình xây dựng mới quanh khu vực
làm tăng tình trạng lũ lụt như thế nào?

A. Chặn dòng lũ thoát lũ.
B. Lấp các ao và các hồ chứa nước làm nước lũ không chỗ thoát.
C. Được xây cao hơn các khu vực lân cận khiến nước lũ chảy ra các vùng thấp hơn.
D. Cả ba phương án trên (A, B và C).
E. Không gây gia tăng lũ lụt.

Bà con có đề xuất gì để giảm thiểu tác động
của lũ lụt trong khu vực?

A. Nâng cấp hệ thống thoát nước.
B. Trồng thêm cây xanh và tre.
C. Nâng cao nền nhà.
D. Cả ba phương án trên (A, B và C).
E. Không có đề xuất gì .

Bà con tiếp cận thông tin về những trận bão
lũ sắp xảy ra như thế nào?

A. Từ hàng xóm và các cuộc gọi của bạn bè
B. Từ radio, ti vi và loa phóng thanh
C. Từ những người đứng đầu của thôn và xã
D. Cả ba phương án trên (A, B và C)
E. Từ quan sát của tôi

Nhiều năm trước (20-25 năm), bà con
tiếp cận thông tin về những trận bão lũ sắp
xảy ra như thế nào?

A. Từ hàng xóm
B. Từ những người đứng đầu của thôn và xã.
C. Từ tự quan sát và phỏng đoán.
D. Cả ba phương án trên (A, B và C).
E. Tôi đã không có được thông tin về những trận bão lũ sắp xảy ra.

So với 20-25 năm trước, lượng mưa trong
khu vực này tăng hay giảm?

A. Giảm.
B. Tăng.
C. Tôi không biết.

So với 20-25 năm trước mức độ nắng nóng ở Quy Nhơn tăng hay giảm?

A. Giảm.
B. Tăng.
C. Tôi không biết.

Bà con đã từng tham gia vào cuộc tập huấn, buổi hội thảo hay buổi gặp gỡ nào liên quan đến biến đổi khí hậu chưa?

A. Rồi
B. Chưa

Bà con hiểu gì về biến đổi khí hậu?

A. Thay đổi trong sản xuất công nghiệp.
B. Thay đổi về thời tiết về lâu về dài và biến đổi trong tình trạng bão lũ
C. Thay đổi về mức độ ô nhiễm của sông hồ.
D. Tôi không biết.

Biến đổi khí hậu có tác động gì lên địa phương của bà con?

A. Thay đổi trong lũ lụt và bão.
B. Tăng mực nước biển.
C. Tăng nhiệt độ.
D. Cả ba phương án trên (A, B và C).
E. Tôi không biết.

Từ đâu bà con biết đến biến đổi khí hậu?

A. Qua báo chí, ti vi, radio, tờ rơi.
B. Qua khu vực trưởng và loa phóng thanh.
C. Qua hội thảo, tập huấn và các buổi gặp gỡ.
D. Cả ba phương án trên (A, B và C).
E. Tôi không biết gì về biến đổi khí hậu.

Biến đổi khí hậu nguy hiểm như thế nào?

A. Tôi không biết.
B. Làm giảm lượng mưa và năng suất của nông nghiệp và ngư nghiệp.
C. Gây ra lũ lớn và bão mạnh.
D. Giảm nguồn cung cấp nước uống và nước cho nông nghiệp.
E. Cả ba phương án trên (A, B và C).

Biến đổi khí hậu có ảnh hưởng gì lên địa phương của bà con?

A. Khu vực chúng tôi không bị ảnh hưởng của biến đổi khí hậu.
B. Chúng tôi phải chịu hạn hán dài hơn.
C. Chúng tôi phải chịu những trận lũ và đợt bão mạnh hơn.
D. Cả B và C.
E. Tôi không biết.

Bà con đã bao giờ nghe về Kế hoạch Tổng thể của thành phố Quy Nhơn chưa?

A. Rồi
B. Chưa

Bà con đã bao giờ nghe về Kế hoạch Ứng phó với Biến đổi Khí hậu của thành phố Quy Nhơn chưa?

A. Rồi
B. Chưa

Lời cảm ơn

- Xin hãy gửi cho chúng tôi ý kiến và phản hồi của bạn!

Nếu muốn biết thêm về bài nghiên cứu này, xin hãy liên lạc:

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Số điện thoại:
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Jiwnath Ghimire: 1-808-9563738, 84-1665165086

Appendix 7: Detail Interview Schedule in Quy Nhon City (English version)

INTERVIEW WORK PLAN FOR DEPARTMENTS, ORGANIZATIONS AND UNIONS TO ASSESS THE RESPONSE AT LOCAL LEVEL, 2014

Date	Time	Place	Content
Friday 10/10/2014		Arrive to Quy Nhon	Check in Ngọc Ánh 11 Trần Văn Ơn, Tp. Quy Nhơn
Monday 13/10/2014	8:00 - 11:30	Meeting with CCCO on work plan 05 Nguyễn Văn Trỗi, Tp. Quy Nhơn	This presentation is necessary to improve the methodology
Tuesday 14/10/2014	8:00 - 9:00	Pilot Survey in Nhơn Phú, Tp. Quy Nhơn	In order to make the survey comfortable to households to respond, it is important to do some pilot test and improve the survey. Thereffore, we want to run the pilot test of survey and improve it.
	9:30 - 11:30	Pilot survey Nhơn Bình, Tp. Quy Nhơn	In order to make the survey comfortable to households to respond, it is important to do some pilot test and improve the survey. Thereffore, we want to run the pilot test of survey and improve it.
	14:00 - 17:00	Meeting with surveyors and research assistants CCCO Bình Định 05 Nguyễn Văn Trỗi, Tp. Quy Nhơn	- Meeting with local investigator to brief them about the survey. - Meeting with the interpreter to discuss about the content of the interview and meetings.
Wednesday 15/10/2014	8:00 - 9:30	Department of Natural Resources and Environment 08 Hai Bà Trưng, Tp. Quy Nhơn	Interview with the Department of Natural Resources - Hydrometeorology Department of Natural Resources and Environment
	9:45 - 11:30	Environmental Protection Agency 387 Trần Hưng Đạo, Tp. Quy Nhơn	Interview with the representative of the Environmental Protection Agency

	14:00 - 15:30	Center for Information Technology 03 Nguyễn Trung Trực, Tp. Quy Nhơn	Interview with the representative of the Center for Information Technology
	15:45 - 17:00	CCCO Bình Định 05 Nguyễn Văn Trỗi, Tp. Quy Nhơn	Interview with the representative of CCCO Binh Dinh
Thursday 16/10/2014	8:00 - 9:30	Binh Dinh Provincial Department of Construction 32 Lý Thường Kiệt, Tp. Quy Nhơn	Interview with representatives of the Management Division of the Department of Construction
	9:45 - 11:30	Binh Dinh Provincial Department of Construction 32 Lý Thường Kiệt, TP Quy Nhơn	Interview of the representative of the Infrastructure Division of Department of Construction
	14:00 - 15:30	Department of Planning and Investment 35 Lê Lợi, Tp. Quy Nhơn	Interview with the Economic Planning Division of Department o Planning and Investment
	15:45 - 17:00	Binh Dinh Investment Promotion Center 35 Lê Lợi, Tp. Quy Nhơn	Interview with the Investment Promotion Center of Binh Dinh Province
Friday 17/10/2014	8:00 - 9:30	Irrigation-Dykes and Flood Control Department 04 Thi Sách, Tp. Quy Nhơn	Interview with the representative of the Irrigation - Dykes and Flood Control Department
	9:45 - 11:30	Center for Agriculture and Rural Planning 450 Nguyễn Thị Minh Khai	Interview with the representative of Center for Agriculture and Rural Planning
	14:00 - 15:30	Department of Transportation 14 Nguyễn Huệ, Tp Quy Nhơn	Interview with the representative of Department of Transportation
	15:45 - 17:00	Meteorological Center of Province 34 Hải Thượng Lãng Ông, Tp Quy Nhơn	Interview with the representative of Meteorological Center of Province

Monday 20/10/2014	8:00 - 9:30	Binh Dinh Department of Fiance 181 Lê Hồng Phong, Tp. Quy Nhơn	Interview with the representative of Binh Dinh Department of Finance
	9:45 – 11:30	Binh Dinh Red Cross 374 Trần Hưng Đạo, Tp. Quy Nhơn	Interview with the representative of Binh Dinh Red Cross
	14:00 - 15:30	Union of Science and Technology 472 Trần Hưng Đạo, Tp. Quy Nhơn	Interview with the representative of the Union of Science and Technology
	15:45 - 17:00	Binh Dinh Farmers Union 241 Lê Hồng Phong, Tp. Quy Nhơn	Interview with the representative of the Binh Dinh Farmers Union
Tuesday 21/10/2014	Morning	Binh Dinh Peoples Committee	Interview with the representative of the Binh Dinh Peoples Committee
	14:00 - 15:30	Quy Nhon Peoples Committee	Interview with the represenatative of the Quy Nhon Peoples Committee
	15:45 - 17:00	Binh Dinh Women's Union 21 Mai Xuân Thưởng, Tp. Quy Nhơn	Interview with the representative of the Binh Dinh Women's Union
Wednesday 22/10/2014	Whole day	Nhơn Bình, Tp. Quy Nhơn	Household survey at the area 3 of Nhon Binh Ward, Quy Nhơn
Thursday 23/10/2014	Whole day	Nhơn Bình, Tp. Quy Nhơn	Household survey at the area 3 of Nhon Binh Ward, Quy Nhơn
Friday 24/10/2014	Whole day	Nhơn Bình, Tp. Quy Nhơn	Household survey at the area 3 of Nhon Binh Ward, Quy Nhơn
Monday 27/10/2014	Whole day	Nhơn Bình, Tp. Quy Nhơn	Household survey at the area 5 of Nhon Binh Ward, Quy Nhơn
Tuesday 28/10/2014	Whole day	Nhơn Bình, Tp. Quy Nhơn	Household survey at the area 5 of Nhon Binh Ward, Quy Nhơn
Wednesday 29/10/2014	Whole day	Nhơn Phú, Tp. Quy Nhơn	Household survey at the area 3 of Nhon Phu Ward, Quy Nhơn
Thursday 30/10/2014	Whole day	Nhơn Phú, Tp. Quy Nhơn	Household survey at the area 3 of Nhon Phu Ward, Quy Nhơn
Friday 31/10/2014	Whole day	Nhơn Phú, Tp. Quy Nhơn	Household survey at the area 8 of Nhon Phu Ward, Quy Nhơn
Monday 03/11/2014	Whole day	Nhơn Phú, Tp. Quy Nhơn	Household survey at the area 8 of Nhon Phu Ward, Quy Nhơn
Tuesday 04/11/2014	Whole day	Nhơn Phú, Tp. Quy Nhơn	Household survey at the area 8 of Nhon Phu Ward, Quy Nhơn

Wednesday 05/11/2014	8:00 - 10:00	CCCO Bình Định 05 Nguyễn Văn Trỗi, Tp. Quy Nhơn	Report to CCCO Binh Dinh experience and preliminary observations and future plans
Thursday 06/11/2014	8:00	Return from Quy Nhon to Hanoi	

Vietnam Union of Science and Technology (2015-2016)

To: - Binh Dinh Department o Foreign Affair
- Union of Science and Technology of Binh Dinh

Work Plan
Jiwnath Ghimire in Quy Nhơn, 2015

Ngày tháng	Thời gian	Địa điểm	Hoạt động
30/12/2015	09:00	Binh Dinh Youth Union (Quang Trung, Quy Nhon City)	Meeting and interview
	14:00	Institute of Envrionmental Resources (08 Hai Bà Trưng, Tp. Quy Nhơn)	Interview on the land use and urbanization
31/12/2015	09:00 – 17h00	Department of Construction 32 Lý Thường Kiệt, Tp. Quy Nhơn	Interview on the urban planning, housing and infrastructure
04/01/2016	09:00	Department of Agriculture and Rural Development 135 Le Hồng Phong, Tp. Quy Nhon	Interview on the condition of agriculture, rural development and impact of urbanization
	14:00	Provincial Industrial Development Authority 65 Tây Sơn, Tp. Quy Nhon	Interview about the industrial zones development and urbanization
05/01/2016	09:00	Department of Finance 181 Lê Hồng Phong - Thành phố Quy Nhơn	Interview on the urban budge of Quy Nhon and economy
	14:00	Department of Transportation 08 Lê Thánh Tôn - Quy Nhơn	Interview on the status and planning of transportation in Binh Dinh and Quy Nhon
06/01/2016	09:00	Sở Công thương 198 Phan Bội Châu, Quy Nhơn	Interview on the local industrial development and trade promotion
	14:00	Department of Health 756 Trần Hưng Đạo, Thành phố Quy Nhơn	Interview on the health infrastructure development in Quy Nhon and Binh Dinh
07/01/2016	09:00 – 17h00	Peoples Committee of Nhơn Bình Ward	Interview and discussion on the urban characteristics, cultural

			development, and residential development in the Quy Nhon
08/01/2016	09:00 – 17h00	- Meeting with the leaders of KVs on Nhon Binh Wards to introduce by Peoples' Committee	Interview and discussion on the urban characteristics, cultural development, and residential development in the Quy Nhon
11/01/2015	09:00 – 17h00	Peoples Committee of Nhơn Phu Ward	Interview and discussion on the urban characteristics, cultural development, and residential development in the Quy Nhon
12/01/2016	09:00 – 17h00	- Meeting with the leaders of KVs on Nhon Phu Wards to introduce by Peoples' Committee	Interview and discussion on the urban characteristics, cultural development, and residential development in the Quy Nhon

Appendix 8: Detail Interview Schedule in Quy Nhon (Vietnamese version)

KẾ HOẠCH LÀM VIỆC VỚI CÁC SỞ, BAN, NGÀNH VÀ ĐỊA PHƯƠNG ĐỂ TÌM HIỂU CÔNG TÁC ỨNG PHÓ VỚI BIẾN ĐỔI KHÍ HẬU TẠI ĐỊA PHƯƠNG, 2014

(kèm theo Công văn số: 40\CCCO ngày 07 tháng 10 năm 2014 của Văn phòng Điều phối về biến đổi khí hậu tỉnh Bình Định)

Ngày	**Thời gian**	**Địa điểm**	**Nội dung**
Thứ Sáu 10/10/2014		Bay từ Hà Nội vào Quy Nhơn	Ở tại Khách sạn Ngọc Ánh số 11 Trần Văn Ơn, Tp. Quy Nhơn
Thứ Hai 13/10/2014	8:00 - 11:30	Văn phòng Điều phối về BĐKH (CCCO) tỉnh Bình Định 05 Nguyễn Văn Trỗi, Tp. Quy Nhơn	Gặp mặt CCCO để chia sẻ kế hoạch làm việc
Thứ Ba 14/10/2014	8:00 - 9:00	Phường Nhơn Phú, Tp. Quy Nhơn	Thử nghiệm trước bộ câu hỏi để chuẩn bị nội dung điều tra hộ dân
	9:30 - 11:30	Phường Nhơn Bình, Tp. Quy Nhơn	Thử nghiệm trước bộ câu hỏi để chuẩn bị nội dung điều tra hộ dân
	14:00 - 17:00	CCCO Bình Định 05 Nguyễn Văn Trỗi, Tp. Quy Nhơn	- Gặp mặt điều tra viên địa phương để hướng dẫn về công tác điều tra - Gặp mặt phiên dịch viên giúp hiểu ý nghĩa và mục đích của buổi trao đổi và điều tra
Thứ Tư 15/10/2014	8:00 - 9:30	Sở Tài Nguyên và Môi Trường 08 Hai Bà Trưng, Tp. Quy Nhơn	Trao đổi với người đại diện của phòng Tài nguyên nước - Khí tượng thủy văn thuộc Sở Tài Nguyên và Môi trường
	9:45 - 11:30	Chi cục Bảo vệ Môi trường 387 Trần Hưng Đạo, Tp. Quy Nhơn	Trao đổi với người đại diện của Chi cục Bảo vệ Môi trường
	14:00 - 15:30	Trung tâm Công nghệ Thông tin 03 Nguyễn Trung Trực, Tp. Quy Nhơn	Trao đổi với người đại diện của Trung tâm Công nghệ Thông tin

	15:45 - 17:00	CCCO Bình Định 05 Nguyễn Văn Trỗi, Tp. Quy Nhơn	Trao đổi với người đại diện của CCCO Bình Định
Thứ Năm 16/10/2014	8:00 - 9:30	Sở Xây dựng tỉnh Bình Định 32 Lý Thường Kiệt, Tp. Quy Nhơn	Trao đổi với người đại diện của phòng Quản lý xây dựng thuộc Sở Xây dựng
	9:45 - 11:30	Sở Xây dựng tỉnh Bình Định 32 Lý Thường Kiệt, TP Quy Nhơn	Trao đổi với người đại diện của phòng Quản lý Hạ tầng kỹ thuật thuộc Sở Xây dựng
	14:00 - 15:30	Sở Kế hoạch và Đầu tư 35 Lê Lợi, Tp. Quy Nhơn	Trao đổi với người đại diện của phòng Kế hoạch Kinh tế ngành thuộc Sở kế hoạch và đầu tư
	15:45 - 17:00	Trung tâm Xúc tiến đầu tư tỉnh Bình Định 35 Lê Lợi, Tp. Quy Nhơn	Trao đổi với người đại diện của Trung tâm Xúc tiến đầu tư tỉnh Bình Định
Thứ Sáu 17/10/2014	8:00 - 9:30	Chi cục Thủy lợi - Đê điều và Phòng chống lụt bão 04 Thi Sách, Tp. Quy Nhơn	Trao đổi với người đại diện của Chi cục Thủy lợi - Đê điều và Phòng chống lụt bão
	9:45 - 11:30	Trung tâm Quy hoạch Nông nghiệp và Nông thôn 450 Nguyễn Thị Minh Khai	Trao đổi với người đại diện của Trung tâm Quy hoạch Nông nghiệp và Nông thôn
	14:00 - 15:30	Sở Giao Thông và Vận tải 14 Nguyễn Huệ, Tp Quy Nhơn	Trao đổi với người đại diện của Sở Giao Thông và Vận tải
	15:45 - 17:00	Trung tâm Khí tượng thủy văn tỉnh 34 Hải Thượng Lãng Ông, Tp Quy Nhơn	Trao đổi với người đại diện của Trung tâm Khí tượng thủy văn tỉnh
Thứ Hai 20/10/2014	8:00 - 9:30	Sở Tài chính tỉnh Bình Định 181 Lê Hồng Phong, Tp. Quy Nhơn	Trao đổi với người đại diện của Sở Tài chính tỉnh Bình Định
	9:45 - 11h30	Hội Chữ Thập đỏ tỉnh 374 Trần Hưng Đạo, Tp. Quy Nhơn	Trao đổi với người đại diện của Hội Chữ Thập đỏ tỉnh
	14:00 - 15:30	Liên hiệp các Hội Khoa học và Kỹ thuật tỉnh 472 Trần Hưng Đạo, Tp. Quy Nhơn	Trao đổi với người đại diện của Liên hiệp các Hội Khoa học và Kỹ thuật tỉnh
	15:45 - 17:00	Hội Nông dân tỉnh 241 Lê Hồng Phong, Tp. Quy Nhơn	Trao đổi với người đại diện của Hội Nông dân tỉnh

Thứ Ba 21/10/2014	Sáng	UBND tỉnh Bình Định	Trao đổi với người đại diện của UBND tỉnh Bình Định
	14:00 - 15:30	UBND TP. Quy Nhơn	Trao đổi với người đại diện của UBND TP. Quy Nhơn
	15:45 - 17:00	Hội Liên hiệp Phụ nữ tỉnh 21 Mai Xuân Thưởng, Tp. Quy Nhơn	Trao đổi với người đại diện của Hội Liên hiệp Phụ nữ tỉnh
Thứ Tư 22/10/2014	Cả ngày	Phường Nhơn Bình, Tp. Quy Nhơn	Điều tra hộ dân khu vực 3, phường Nhơn Bình, Tp. Quy Nhơn
Thứ Năm 23/10/2014	Cả ngày	Phường Nhơn Bình, Tp. Quy Nhơn	Điều tra hộ dân khu vực 3, phường Nhơn Bình, Tp. Quy Nhơn
Thứ Sáu 24/10/2014	Cả ngày	Phường Nhơn Bình, Tp. Quy Nhơn	Điều tra hộ dân khu vực 3, phường Nhơn Bình, Tp. Quy Nhơn
Thứ Hai 27/10/2014	Cả ngày	Phường Nhơn Bình, Tp. Quy Nhơn	Điều tra hộ dân khu vực 5, phường Nhơn Bình, Tp. Quy Nhơn
Thứ Ba 28/10/2014	Cả ngày	Phường Nhơn Bình, Tp. Quy Nhơn	Điều tra hộ dân khu vực 5, phường Nhơn Bình, Tp. Quy Nhơn
Thứ Tư 29/10/2014	Cả ngày	Phường Nhơn Phú, Tp. Quy Nhơn	Điều tra hộ dân khu vực 3, phường Nhơn Phú, Tp. Quy Nhơn
Thứ Năm 30/10/2014	Cả ngày	Phường Nhơn Phú, Tp. Quy Nhơn	Điều tra hộ dân khu vực 3, phường Nhơn Phú, Tp. Quy Nhơn
Thứ Sáu 31/10/2014	Cả ngày	Phường Nhơn Phú, Tp. Quy Nhơn	Điều tra hộ dân khu vực 8, phường Nhơn Phú, Tp. Quy Nhơn
Thứ Hai 03/11/2014	Cả ngày	Phường Nhơn Phú, Tp. Quy Nhơn	Điều tra hộ dân khu vực 8, phường Nhơn Phú, Tp. Quy Nhơn
Thứ Ba 04/11/2014	Cả ngày	Phường Nhơn Phú, Tp. Quy Nhơn	Điều tra hộ dân khu vực 8, phường Nhơn Phú, Tp. Quy Nhơn
Thứ Tư 05/11/2014	8:00 - 10:00	CCCO Bình Định 05 Nguyễn Văn Trỗi, Tp. Quy Nhơn	Báo cáo CCCO Bình Định để chia sẻ về kết quả sơ bộ của cuộc trao đổi, điều tra về kế hoạch trong tương lai

Thứ Năm 06/11/2014	8:00	Bay từ Quy Nhơn về Hà Nội	

VIỆN VIỆT NAM HỌC VÀ KHOA HỌC PHÁT TRIỂN (2015-2016)

Kính gửi: - Sở Ngoại vụ tỉnh Bình Định;
- Liên hiệp Các Hội KHKT tỉnh Bình Định.

KẾ HOẠCH LÀM VIỆC
Của NCS. Jiwnath Ghimire tại Quy Nhơn, 2015

Ngày tháng	**Thời gian**	**Địa điểm**	**Hoạt động**
30/12/2015	09:00	Đoàn Thanh niên Bình Định (Quang Trung, Tp. Quy Nhơn)	Gặp gỡ, trao đổi
	14:00	Sở Tài nguyên Môi trường (08 Hai Bà Trưng, Tp. Quy Nhơn)	Trao đổi, tìm hiểu về qũy đất, hiện trạng sử dụng đất đô thị
31/12/2015	09:00 – 17h00	Sở Xây dựng, 32 Lý Thường Kiệt, Tp. Quy Nhơn	Trao đổi, tìm hiểu về tình hình quy hoạch và quản lý nhà ở, hạ tầng đô thị
04/01/2016	09:00	Sở Nông nghiệp và phát triển nông thôn 135 Le Hồng Phong, Tp. Quy Nhon	Trao đổi, tìm hiểu về tình hình nông nghiệp, phát triển nông thôn và tác động từ đô thị hóa
	14:00	Ban Quản lý Khu Công nghiệp tỉnh 65 Tây Sơn, Tp. Quy Nhon	Trao đổi, tìm hiểu về tình hình phát triển khu công nghiệp và tác động phát triển đô thị hóa
05/01/2016	09:00	Sở Tài chính 181 Lê Hồng Phong - Thành phố Quy Nhơn	Trao đổi, tìm hiểu về kinh tế đô thị tại Bình Định
	14:00	Sở Giao thông- Vận tải, 08 Lê Thánh Tôn - Quy Nhơn	Trao đổi, tìm hiểu về thực trạng và quy hoạch phát triển giao thông tỉnh Bình Định
06/01/2016	09:00	Sở Công thương 198 Phan Bội Châu, Quy Nhơn	Trao đổi, tìm hiểu về các thành tựu và khó khăn của phát triển công thương nghiệp địa phương
	14:00	Sở Y tế 756 Trần Hưng Đạo, Thành phố Quy Nhơn	Trao đổi, tìm hiểu về kế hoạch phát triển hạ tầng y tế tại Quy Nhơn và tỉnh Bình Định

07/01/2016	09:00 – 17h00	- UBND phường Nhơn Bình - Gặp gỡ Ban lãnh đạo các khu dân cư phường Nhơn Bình theo giới thiệu của UBND Phường	Trao đổi, tìm hiểu về kinh nghiệm, đặc thù quản lý đô thị; văn hóa đô thị của cư dân đô thị Quy Nhơn
08/01/2016	09:00 – 17h00	- Gặp gỡ Ban lãnh đạo các khu dân cư phường Nhơn Bình theo giới thiệu của UBND Phường	Trao đổi, tìm hiểu về kinh nghiệm, đặc thù quản lý đô thị; văn hóa đô thị của cư dân đô thị Quy Nhơn
11/01/2015	09:00 – 17h00	- UBND phường Nhơn Phú - Gặp gỡ Ban lãnh đạo các khu dân cư phường Nhơn Phú theo giới thiệu của UBND Phường	Trao đổi, tìm hiểu về kinh nghiệm, đặc thù quản lý đô thị; văn hóa đô thị của cư dân đô thị Quy Nhơn
12/01/2016	09:00 – 17h00	- UBND phường Nhơn Phú - Gặp gỡ Ban lãnh đạo các khu dân cư phường Nhơn Phú theo giới thiệu của UBND Phường	Trao đổi, tìm hiểu về kinh nghiệm, đặc thù quản lý đô thị; văn hóa đô thị của cư dân đô thị Quy Nhơn

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