

**ASSESSMENT OF
GEO-INFORMATION
DISCLOSURE SYSTEMS:
A CASE ON SEA-LEVEL RISE
IN THE NETHERLANDS**

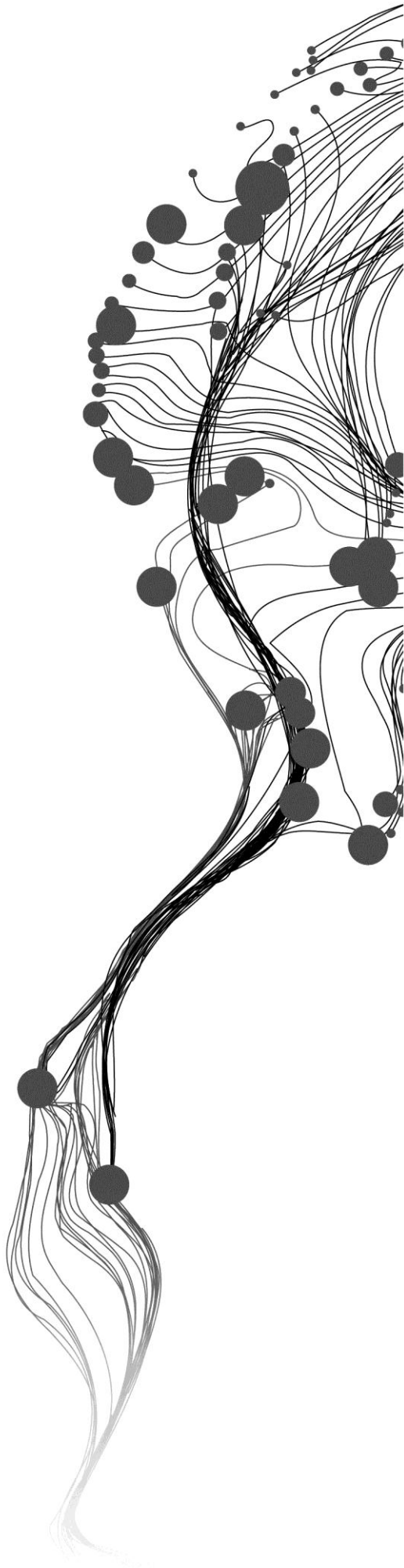
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February, 2013

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ASSESSMENT OF GEO-INFORMATION DISCLOSURE SYSTEMS: A CASE ON SEA-LEVEL RISE IN THE NETHERLANDS

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Enschede, the Netherlands, February, 2013

Thesis submitted to the Faculty of Geo-Information Science and Earth Observation of the University of Twente in partial fulfilment of the requirements for the degree of Master of Science in Geo-information Science and Earth Observation.

Specialization: Governance and Spatial Information Management

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ABSTRACT

Sea-level rise; a consequence of climate change is a major concern for researchers, politicians and sessions of the civil society in recent times. Low-lying delta countries like Netherlands tend to have high probability to flood risk as the sea-level rises (Botzen, Aerts, & van den Bergh, 2009). This concern requires rigour policy measures that leave room for one to ask; what does this mean to ordinary citizens; are they well informed about the anticipated flood risk that may result from sea-level rises? The research focused on finding answers on how and why sea-level rise geo-information is disclosed specifically a case study in the Netherlands. The research contributes conditions necessary for Geo-information Disclosure Systems (Geo-IDS) to be effective to inform citizens in a transparent manner.

The main objective is to assess what would make Geo-IDS effective by identifying the elements behind sea-level rise (SLR) geo-information disclosure by dwelling on “what are the elements behind disclosure of geo-information on sea-level rise that would make Geo-IDS effective”; the research question? The assumption was that Geo-IDS is effective when there are indications of transparency elements such as active communication, responsibility, targeted policy, rules and regulations; and participation. Geo-IDS is the study conceptual framework: the action and the connection between disclosers (information providers) and information provided (aggregated information) inside a transparency cycle of Fung, Gilman, and Shkabatur (2010).

To investigate SLR disclosure empirically, the study derived indicators (concept-variable matrix) from a multidisciplinary environment. SLR Disclosure in the Netherlands can best be studied empirically through an open, qualitative mixed methods approach, relying on data collection through unstructured interviews and documentary evidence. This is followed by a qualitative analysis which searches for and classifies underlying perceptions, views and beliefs on both disclosure and transparency; and the urgency or relevance of the issue of SLR.

Results obtained indicates the interactions of actors (i.e. disclosers, profesional users and regulators) inside the discloser box of the transparency clyce. In the course of the interactions, each actor makes choices of which SLR information to disclose via their websites. Information mostly disclosed are the climate scenarios and water levels. Interested audiences in the users disclosure box can access the SLR information via the internet. Conversely, users interactions were not investigated as that was beyond the scope of the study.

Geo-IDS were seen to be effective among the disclosers and the professional users. Nevertheless, the citizens are left out in active communication on SLR. Contrarily, Geo-IDS were ineffective between the disclosers and the citizens. As a result, four factors have been recommended that can help make Geo-IDS effective between the disclosers and the citizens. These factors are;

1. Legalise or institute an organisation (an act (law) or legislation)
2. Formulate a targeted transparency policy on SLR geo-information disclosure
3. Enhance expert skills and techniques
4. Provide funding

With these factors in place, transparency elements such as active communication with citizens, responsibility, targeted policy, rules and regulations; and participation can be groomed that would make Geo-IDS effective.

Keywords: Geo-information Disclosure Systems, Geo-IDS, Sea-level rise, Transparency

ACKNOWLEDGEMENTS

As challenging as it was, God's grace was sufficient to have strengthened me through the whole process of study and the successful completion of this thesis document. I am humbly indebted to God Almighty. Next, were many more who in their own diverse ways contributed immensely to the success story I am about to tell.

To begin with, my heart felt gratitude goes to my principled supervisors; Ir. W.T. de Vries and Drs. J.J. Verplanke, for their well thought of critics, guidance and patience during the course of the study and preparation of the thesis document. Not forgetting my lecturers at ITC whose knowledge impacts have built up into the many concepts learnt within the eighteen months of acquiring new knowledge. Especially to Prof. dr. in. P.Y. Georgiadou, who steered the affairs of the GSIM students and is been an inspiration to me.

I like to also appreciate the many supports I received from the Netherlands Government through NUFFIC. The fellowship granted me by NUFFIC provided sufficient funds to finish my study at the Faculty of ITC, University of Twente and also to explore most of the beautiful cities in Europe. I shall always be grateful for these kind gestures.

What would have happened if the Government of Ghana had not granted me paid study leave that enabled me to acquire the new knowledge? I am really indebted to the Ministry of Lands and Natural Resources and my department; the Geological Survey to have granted me the opportunity to study for this long period in spite of the inadequate human resources at the moment.

Again, I am immensely grateful to the experts at KNMI, Rijkswaterstaat, Delta Programme, Deltares, City of Rotterdam and many individuals who shared their knowledge and expressed their opinions during the interviews hence giving me the empirical data to analyse and contribute to the new direction on disclosure.

To my colleagues at ITC, I am also grateful to you all. Especially my GSIM family; Chris Adebola Odeyemi, Rory Patrick Nealon and Muhammad Kurniawan for all the support and fun we shared together. Not forgetting my Ghanaian family in Enschede, many thanks to you all.

Not all, I would like to thank the International Christian Fellowship in Enschede for the inspirations that renewed my strength day by day.

I am grateful to my friends at home especially Mrs Regina Brown- Mensah, Mr Ernest Brakohiapa and all whose names were not mentioned but I shall always be thankful to you. Also many thanks to my friends abroad especially to Tsitsi Muparari who always calls and say "Yvonne, let's go out for fresh air" no matter the amount of work load we have. I am most grateful for all that.

Lastly but not the least, I would like to humbly thank my families both home and abroad for their support and prayers.

I say, God richly bless you all.

Yvonne M. Anokwa

February, 2013.

DEDICATION

As lovely children, you deserve the tender love and care from a mother at all times. Nana Yaw Marfo Don, Diana Owusu and Gifty Owusu; you missed these for eighteen months! Bravo for understanding me to do this work and for that reason, I humbly dedicate this thesis to you.

With love!

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GLOSSARY

Disclosure	encompasses information policies that require firms to provide information about their product on labels and, where appropriate, to report government grades about certain attributes of their product (e.g., vehicle rollover safety) and service (e.g., restaurant hygiene)(Winston, 2008)
Geo-information discloser	refer to an individual or an organisation that discloses geo-information either voluntarily or mandatorily to the public
Geo-information Disclosure Systems	can be seen as a regulatory tool that integrates policies, technologies and organizational arrangements to release relevant, user-centred, clear, understandable and timely information that are linked to specific point on the Earth's surface to the public to help make decisions within a transparency system.
Geo-information	geo-information, or geographical information, is the term applied to any information which can be linked to a specific point on the Earth's surface.
Policy	is a set of principles and plans of action that are designed to achieve an associated set of goals(Bellamy & Taylor, 1998).
Targeted transparency	represents a distinctive category of public policies that, at their most basic level, mandate disclosure (emphasis added) by corporations or other actors of standardized, comparable, and disaggregated information regarding specific products or practices to a broad audience in order to achieve a specific public policy purpose(Winston, 2008).
Transparency systems	refer to government mandates requiring corporations or other organizations to provide the public with factual information about their products and practices. (Fung, Graham, Weil, & Fagotto, 2004).
Transparency	defined as an obligation to willingly provide to shareholders the information needed to make decisions (DiPiazza(2002) quoted in (Vaccaro & Madsen, 2009))

ABBREVIATIONS AND ACRONYMS

CO-OPS	Center for Operational Oceanographic Products and Services
CReSIS	Center for Remote Sensing of Ice Sheets
DEM	Digital Elevation Model
ESRI	Environmental Systems Research Institute
Geo-IDS	Geo-information Disclosure Systems
GIS	Geographic Information Systems
GLOBE	Global Land One-km Base Elevation
GPS	Global Positioning System
HSW	Human Sensor Web
I6 (9)	Interviewee number (question number)
ICT	Information Communications and Technology
IDS	Information Disclosure Systems
INSPIRE	Infrastructure for Spatial Information in the European Community
IOOS	Integrated Sustained Ocean Observing System
IPCC	Intergovernmental Panel on Climate Change
KClimate	Knowledge for Climate
KML	Keyhole Markup Language
KNMI	Koninklijk Nederlands Meteorologisch Instituut
NGO	Non-Governmental Organization
NOAA	The National Oceanic and Atmospheric Administration
NWLON	National Water Level Observation Network
NWLP	National Water Level Program
SDI	Spatial Data Infrastructure
SEMA	Sensors, Empowerment and Accountability
SLR	Sea-level rise
SRTM	Shuttle Radar Topography Mission
Uni.	Universities

1. INTRODUCTION

1.1. General Introduction

The chapter sets a background of the research. It starts with a brief discussion on issues concerning sea-level rise (SLR) as a global phenomenon and its implication in the Netherlands. Next, justification for research is highlighted in the second section followed by an initial literature review on Geo-information Disclosure Systems (Geo-IDS) with the problem definition in section four. Yet section five focuses on the research objectives whilst section six presents the research questions set for the study. Much more, an overview of research methods is given in section seven followed on is the thesis structure and conclusion for chapter. First of all, let's begin to explore the context of SLR.

1.2. Background

Progressively, ice caps in Greenland and Arctic ice sheets are melting as a result of global warming and climate change causing the sea level to rise. Low-lying deltas tend to have high probability to flood risk (Botzen, et al., 2009) as the sea-level rises. In the Netherlands, most areas lie below the sea level making them vulnerable to flooding. The flood risks of deltaic areas (de Moel, et al., 2011; Kellens, Vanneuville, Ooms, & De Maeyer, 2009) tend to increase due to human activities and urban growth. Nevertheless, major cities in the Netherlands like Amsterdam and Rotterdam lie below the sea level but host enormous economic activities and infrastructures that stand at a risk from flooding. Therefore life and properties need to be protected through proper flood risk management than ever before. An example is in the work of Bouwer, Bubeck, and Aerts (2010) looked into the future of flood risk in the Netherlands. The authors stated that, *“If no additional measures are taken to reduce flood probabilities or consequences, climate change may lead to an increase in expected losses of between 46 and 201%, a combination of climate and socioeconomic change may increase expected losses between 96 and 719%”*(Bouwer, et al., 2010) in the 21st century. Thus leading to the question, *“what does this mean to ordinary citizens?”* Are they well informed about the anticipated flood risk?

Flood risks of deltaic urban areas in the Netherlands have increased because of their proximity to rivers and the sea. Scientists have shown that the total amount of urban area potentially liable to floods has increased six- fold during the 20th century and may double up in the 21st century (de Moel, et al., 2011). Yet again, de Moel, et al. (2011) stated that *“potential flood damage has increased exponentially over the 20th century (16 times) and is expected to continue to increase exponentially (approximately ten-fold by 2100 with respect to 2000) assuming a high economic growth scenario. Flood damages increase more moderately (two- to three-fold by 2100 with respect to 2000) assuming a low growth scenario”*. Thus these scenarios call for measures that may include spatial planning that prevent citizens to build houses at risk areas, setting rules and regulations(Meijer, 2005) to be followed whilst building infrastructure at such locations. Above all, there is the need to provide adequate information to citizens (Dunbar, 2007; Meijer, 2005) living in flood risks areas. After all, the citizens have the right to know all the dangers that are bound to affect their lives.

Are dangers of sea-level rise (SLR) normally communicated to citizens in the form of flood risk maps? Active communication to citizens using flood rise maps by organizations with the mandate to collect data on SLR would be necessary to carry the right message in a simple form. In this way, they would be seen as being accountable if they disclosed geo-information on the web in the form of risk maps to citizens and other users. The risk maps on SLR disclose via the web can help citizens become aware of the danger or risk that is bound to affect their lives. But, according to Meijer (2005) risk maps intended to communicate to citizens are mostly not used. Meijer (2005) argued that only a small group is informed of the risk maps

but do not use it to put pressure on the government to be more accountable. Regarding this, Meijer (2005) concluded that risk maps are not the appropriate medium to communicate dangers. Likewise, would communication of SLR using risk maps to citizens be adequate to alter their behaviour? This may depend on how the risk maps is framed that would or cease to communicate the right messages to citizens. Thus, the framing of risk maps on SLR is important. If not done properly, the framing becomes a communication barrier between the discloser and the user.

Communication on SLR to citizens would be effective only when the intended purpose of the communication is achieved. Communication of SLR as flood risk maps serving a certain policy interest or purpose that may be risk management (Kellens, et al., 2009) of the organization is in the right direction. Risk maps on the web serving as geospatial frames would show the transparency on the part of discloser that communicates dangers to citizens and other users. The risk maps or geospatial frames have colours, symbols, text, and the like that tell stories or messages based on the medium of communication and the purpose or interest they would achieve. "A picture speaks a thousand words" and in this case, the risk map is a picture or a geospatial frame that communicate thousand words to citizens. This is to increase their understanding of the risk due to flooding as may result from SLR. The choices of symbols, colours, texts, and legend-all these being cartographic representations, carry messages that bear the purpose or intent that the risk maps are to serve. A good risk map can help citizens to make sound decisions (Kellens, et al., 2009; Meijer, 2009) which would then alter their behaviour to act. Kellens, et al. (2009) argued that a good risk map should be the one which is understandable, clearly arranged with clear and simple explanations. The risk maps or geo-spatial frames disclosed on the web to alter citizens behaviour do not work (Meijer, 2005) and why they do not work is unknown from literature (Georgiadou, 2008; Georgiadou, Miscione, Lance, & de Vries, 2009). It can be argued that, they do not work due to the choices of cartographic representations made in coming up with the geospatial frames or risk maps. Not only that, it is a lack of communication of the part of the discloser to make citizens aware of such information on the web. Hence this study will find out what kind of information is publicly disclosed on SLR, why they make choices of which information to disclose, which tools do they use in disclosing the information and see if there is an active communication on this information disclosure. The assumption here is that, if information is disclosed publicly, it is an indication of transparency but active communication on SLR shall indicate commitment or accountability on the part of the discloser. With this study, a lot of contribution is made to transparency policy goals.

1.3. Justification of the research

The study strives to contribute to the development initiative with a vision to support targeted transparency policy (Fung, Graham, & Weil, 2007) goals. This vision was spoken by U.S. Vice-President Al Gore in 1998. It seeks to help policy makers, decision makers, academia, ordinary citizens, etc. to understand the planet and also become aware of impacts of societal activities on the environment (Craglia et al., 2008; Grossner, Goodchild, & Clarke, 2008). In addition, it creates the possibility to explore for information that is vital to make right decisions. On the other hand, Grossner, et al. (2008) pointed out the challenge to identify a case specific requirement to develop user application software which will suit a client transparency need. It was however supported by Craglia, et al. (2008) who stressed on the need for researchers to carry out the vision of Digital Earth to promote transparency. For transparency to reach its highest height, they highlighted on various issues including connecting infrastructures to address needs of society as a whole, with all stakeholders contributing their own observations into the system and making information accessible to all (OECD, 2008). Thus developing a 'Human Sensor Web (HSW) application with the right social and technical capability, seeks to empower citizens to enact accountability from government officials and again contribute to the Digital Earth vision.

The HSW is a participatory platform which is contributing to the Digital Earth vision. It was initiated in Africa as Sensors, Empowerment and Accountability (SEMA) project. SEMA is an integrated research programme that focuses on empowering ordinary citizens through the use of the HSW to compel water and health officials to be accountable. This research programme has collaborators from University of Dar es Salaam and University of Twente with support from other Non-Governmental Organizations. Fortunately, the programme which started in 2012 till 2016 is funded by Netherlands Organisation for Scientific Research (Verplanke, 2012). Nevertheless, the programme has several research themes in which “Information and Public Accountability” is one of them. Intently, it is an opportunity to assess how information on SLR is being disclosed in the Netherlands under this project theme.

In assessing how and why information is disclosed on SLR, the polis lens perspective is adopted to conduct the research. This resulted from Georgiadou, et al. (2009) argument that “with a polis lens we stand a chance to understand and explain in different ways how authentic human actors, groups and communities with different values, interests and motivations use geo-information and how the use reflects in societal benefits”. Coenen and Lulofs (2008) also stressed that, investigating effects require a researcher to use policy as central focus of study to measure the degree of goal achievement backed by feedback from the organisation. In this regard, polis lens can help to fetch out the policy interest or intent hidden in information disclosure. Also, it can help make an inventory of social and technical capabilities necessary for disclosing geo-information on SLR effectively. Hence, the research on how and why SLR information is disclosed shall contribute some conditions necessary for Geo-information Disclosure Systems (Geo-IDS) to be effective that are also needed for the development of the HSW.

1.4. Initial literature review

Geo-IDS can be seen as a regulatory tool (Fung, et al., 2004) that integrates policies, technologies (Winston, 2008) and organizational arrangements to release relevant, user-centred, clear, understandable and timely information (Meijer, 2005) that are linked to specific point on the Earth’s surface to the public which facilitate decision making within a transparency system. This is to say that Geo-IDS are human-computer systems guided by policies and regulations in the disclosing of geospatial information.

SLR risk maps are geospatial information that would depict the technical side of Geo-IDS. This is because; the risk maps result from a combination of spatial data, technologies, policies, and cartographic choices of organisations. Accordingly, making it important to assess whether risk maps are being used as a communicating tool to disclose information on SLR as visually through experience are seen as relevant, clear, understandable, user-centred and timely. Not only that attributes, but the choices of datasets, technology, and cartographic presentations used are equally important that can allow one to understand the motives behind those choices. Therefore, risk maps are used as geospatial frames in communicating spatial risk to citizens and other users is seen here as essential.

Geospatial frames are deliberate mode of presenting spatial data with the purpose to guide the societal debate into a particular policy direction. On the other hand, geospatial frames of same datasets but different cartographical representations (symbols, legend, colour, text, labels, etc.) may carry dissimilar messages that give different meanings to the users (Kellens, et al., 2009). Georgiadou (2008) and Georgiadou, et al. (2009) presented and analysed few examples of maps used as frames. Yet little is known about which geospatial frames work or how and why they would work to effectively disclose geo-information on SLR to alter behaviour of citizens to act. In this sense, this study fills the gap by taking a specific look at whether information on SLR in the Netherlands is framed in risk maps or what exist to know which ones work and why. Nevertheless, assessing of Geo-IDS can be deduced to fit into Fung, et al. (2010) transparency cycle as it has a transparency, information, disclosure and discloser components.

Fung, et al. (2010)'s transparency cycle represents a conceptual frame to investigate transparency systems. Fung, et al. (2004) defined transparency systems as “*government mandates that require corporations or other organizations to provide the public with factual information about their products and practices*” thus to change behaviour of the two primary actors within the transparency cycle. According to the authors(2010) the cycle is an intent to capture how information users and intervention targets connect theoretically. The transparency cycle begins with the collection and provision of information by a technology that increases transparency which the authors called technological intervention. Accordingly, this cycle is a framework of their study that seek to know how new information is used to promote objectives which depend on the integration of understanding, action and response(Fung, et al., 2010). The cycle has seven elements called disclosure boxes.

Disclosure boxes of the transparency cycle are “Technological transparency intervention” connecting to “Aggregated information” which help “User’s perception and calculation” to change “User’s behaviour and actions” through “Efficacious agents action” to enact for “Targets of intervention” that put pressure on “Information providers” to improve on “Aggregated information (Fung, et al., 2010). The cycle is the conceptual framework shown in figure 1. However, this study focuses on the action which is the connection between the disclosers(information providers) and the information provided (aggregated information) in a transparency system (Fung, et al., 2004). This transparency system in this study is referred to as Geo-IDS. The Geo-IDS relates to how and why geo-information disclosers frame geospatial information or risk maps on SLR in the Netherlands to portray the policy intent based on the choices of graphical representations, technology and data available at the time of disclosure.

Geo-IDS is a targeted transparency system serving as a monitoring tool (Fung, et al., 2004). It is used here to assess geo-information disclosers through their information disclosure on SLR that seek to support transparency initiative(Technology for Transparency, 2010). Nevertheless, Geo-IDS requires an action that involves an actor with set of tools to disclose geo-information in a form like risk maps to communicate effectively with diverse audiences(Fung, et al., 2007). In this regard, a geo-information discloser targets the citizens and other users to achieve its objectives within a transparency system (Fung, et al., 2004). Geo-IDS in its nature is designed as a system of disclosing geo-information that is vital to inform citizens (Fenster, 2006) on environmental products and services that are bound to affect their lives. Fenster (2006) argued that, this is necessary as informed citizens can hold government officials in a democratic state accountable. However, such a targeted transparency system does not work if efforts are not made to create varying degrees of success though continuing advocacy (Fenster, 2011). Also, Fung, et al. (2007) concluded in their work that “little is known on how people make choices so as to design systems to communicate effectively with diverse audiences” probing for further studies. Hence, study of Geo-IDS to know how organizations make their choices to disclose geo-information.

Geo-IDS are effective with the required social and technical capabilities in place that aim at making geo-information easily accessible to diverse audiences. These empower (Fung, et al., 2007; Georgiadou et al., 2011) the users to actively enact for transparency in services within government institutions. Even though, some social and technical capabilities making transparency systems effective were highlighted in (Fung, et al., 2007), a detail description of them is not yet known. Consequently, it can be argued that the social and technical capabilities are referred to as policy interest and geospatial frames respectively in this research. These make Geo-IDS effective but are not known from literature but can be seen in the how and why geospatial disclosers disclose information on SLR. Therefore, this study investigates to find what leads to the underlying geo-information, which geospatial tools the geospatial disclosers use to disclose and which policy intent is hidden in the disclosure.

Information disclosures show the inherent choices or decisions that organisations make on which information to disclose. For example, the choice results from procedures, plans, rules and regulations that an organisation follows to place geo-information in the public domain (Hood & Heald, 2006). These can

be seen as targeted policies (Fung, et al., 2007) that empowers a geo-information discloser to disclose information in a desired manner. Targeted policy is the greatest social capability that allows an organisation to dynamically present a comprehensible and user-centred geo-information to users with ease accessibility. Indeed, understandable geo-information can alter users behaviour (Fung, et al., 2007) for them to act and give their feedback (Meijer, 2005). Although some researchers (Dunbar, 2007; Fung, et al., 2010; 2007) mentioned technical capabilities that contribute to efficiency and effectiveness of the targeted transparency policy, but little is known on which ones would lead to effective Geo-IDS. Also, the kind of technology such as ICT, Internet, Web 2.0, and the like were stated by the researchers that is used worldwide, knowledge on what is used by a SLR geo-information discloser is limited and so is the kind of targeted policies it uses. Henceforth, it is important to investigate into how a geo-information discloser makes choices, which technology it uses, the kind of targeted transparency being used in coming up with the geo-information on SLR disclosed on the web as indication of transparency and accountability.

1.5. Research problem

Transparency and accountability are the main components of information disclosure. Information disclosure on SLR is equally important to empower citizens. But little is known on how information is disclosed on SLR. If information is disclosed via risk maps plus an active communication with users, one can be assured that information can be embedded in decisions of users. Risk maps can be framed or presented differently although with the same datasets to achieve an outcome based on policy intent. However, little attention is given to the process of information disclosure on SLR and the policy intent hidden in geo-information if via maps which can be called geospatial frames. Also, little is known about what kinds of elements coming into play in disclosing information on SLR, whether disclosers use geospatial frames to communicate to citizens and the underlying reasons behind the disclosure. In this sense, the study fills the gap by taking a specific look at the process of information disclosure on SLR in the Netherlands that fit into Fung, et al. (2010) transparency cycle.

This study focuses on the action or process that is the connection between the disclosers (information providers) and the information provided (aggregated information) in the transparency cycle (as in figure 1) within a transparency system (Fung, et al., 2004). The transparency system in this sense can be referred to as Geo-IDS. This relates to how organisations disclose geospatial information on SLR specifically in the Netherlands to portray transparency and accountability based on the underlying elements of information disclosure.

Underlying elements of Geo-IDS are not defined in literature and it is difficult for one to measure its effectiveness. Meanwhile; there is limited knowledge on what makes Geo-IDS effective so as to foster campaign among geo-information disclosers. In fact, a study into what makes Geo-IDS effective is important for the scientific community. Ultimately, this study will investigate to find what leads to the underlying information disclosure on SLR that is the elements that come into play to successfully disclose information on SLR.

Even though, much of the elements of disclosure were mentioned by researchers on what kind of technology (ICT, Internet, Web 2.0, etc.) been used worldwide, knowledge on what is used by a geo-information discloser is limited and so is the kind of reasoning behind the disclosure. Relatively, it is important to investigate into how a geo-information discloser makes choices on disclosure from expert interviews and geospatial frames on the web. What is most significant is taking a critical look on the kind of risk maps it discloses to users by using the interviews and content analysis of choices to predict the policy intent at the time of disclosure through keen direct observations (Molnar, 2008).

1.6. Research objective

The research objective is to investigate into what makes Geo-IDS effective by assessing what leads to the underlying information disclosure on SLR in the Netherlands. Thus, investigate the reasoning behind the disclosure of information on sea-level rise. This is done by taking a critical look in the entire process of geo-information disclosure by identifying the elements that come into play for successful communication of SLR to users. Specifically, communicating risk of SLR with citizens that shall empower them to enact for accountability from government officials.

1.6.1. Main research objective

To assess what would make Geo-IDS effective by identifying the elements behind disclosure of geo-information on sea-level rise.

1.6.2. Specific research objectives

- 1 To conceptualize Geo-IDS
- 2 To make an inventory of examples of Geo-IDS risk maps relating to SLR
- 3 To present methods to collect data about actual SLR geo-information disclosure
- 4 To determine the extent of transparency on SLR disclosure in the Netherlands
- 5 To make a recommendation towards an effective Geo-IDS of SLR in the Netherlands

1.7. Research question

In order to conduct this research, a question is formulated from the main research objective with a number of questions from the sub-research objectives.

1.7.1. Main research question

What are the elements behind disclosure of geo-information on sea-level rise that would make Geo-IDS effective?

1.7.2. Specific research questions

1. *To conceptualize Geo-IDS*
 - 1 How can Geo-IDS be conceptualized?
 - 2 What are the underlying forces of Geo-IDS on SLR in the Netherlands?
2. *To make an inventory of examples of Geo-IDS risk maps relating to SLR*
 - 3 Which maps exist that relate to disclosure on SLR?
 - 4 Which risk maps shows effects of SLR in the Netherlands?
3. *To present methods to collect data about actual SLR geo-information disclosure*
 - 5 What methods can be used to collect data on SLR disclosure?
 - 6 How to collect data about actual SLR disclosure in the Netherlands?
4. *To determine the extent of transparency on SLR disclosure*
 - 7 Which organisations are responsible to disclose information on SLR?
 - 8 Which way do they disclose geo-information on SLR?
 - 9 To what extent do they abide by the rules specified?
 - 10 Who checks this information disclosure on SLR?
5. *To make a recommendation towards an effective Geo-IDS of SLR in the Netherlands*
 - 11 What kinds of technology, cartographic choices and datasets should be used at the time of disclosure?
 - 12 What factors determines transparency in the disclosure of SLR geo-information?

1.8. Assumption of Geo-IDS

From the early readings and with understanding of the investigations made, the research assumption is established

- Geo-IDS is effective when there are indications of transparency elements such as active communication with citizens, responsibility, targeted policy, rules and regulations; and participation

1.9. Conceptual framework

Figure 1 illustrates the general idea behind the study with a focus on the Geo-IDS. In the Geo-IDS, is the action and the connection between the disclosers (information providers) and the information provided (aggregated information) in a transparency cycle (Fung, et al., 2010). The Geo-IDS contain specific geospatial frames (GF) that are visually powerful relating to a choice that a government geo-information discloser (GGD) makes in terms of what kind of information to present and how to present it. This choice is by nature political, i.e. it contains a political interest aiming to achieve a political result or policy intent. Thus, finding the elements of the Geo-IDS, the methodology employed is briefly presented in section 1.10.

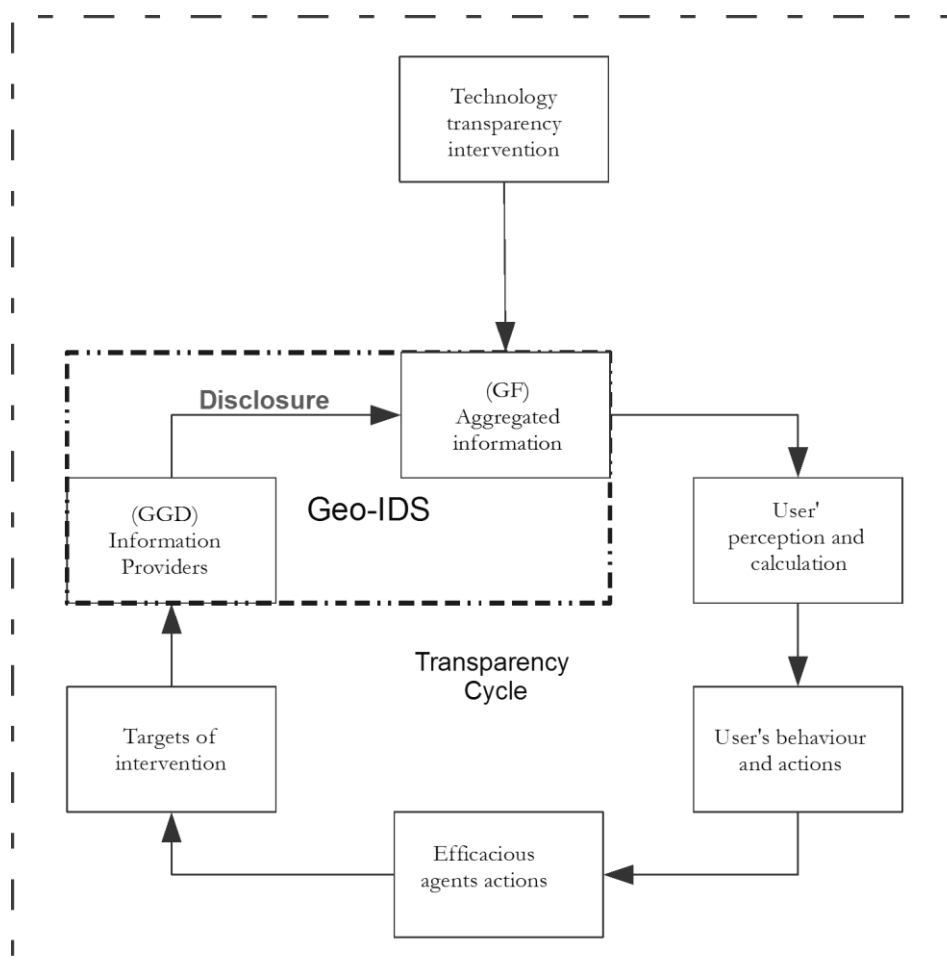


Figure 1 Conceptual framework of the study based on Fung, et al. (2010) transparency action cycle.

1.10. Overview of research methodology

Having given the conceptual framework for the study, with a specific focus on the discourse of SLR in the Netherlands in the previous section, the methodology used is given here. The investigation includes the collection set of risk maps called geo-spatial frames believed to be a powerful communication tool. The geospatial investigation emphasizes on Geo-IDS and the elements that come into play for it to be effective. Critical direct observations (Molnar, 2008) is made on the kind of geo-information (GF) in relation to disclosure on sea-level rise with document content analysis (Brinkerhoff, 2004) of elements in government geo-information discloser (GGD). The relation of GGD and GF is seen as geo-information disclosure establishes to highlight the policy intent in the GF elements to that of policy interest in GGD elements. Nevertheless, a desk research method is adopted to analyse literature to describe the concepts of Geo-IDS and underlying forces of disclosure. This helps to obtain enough information on transparency systems and policy issues on disclosure. This research is also based on a case study in the Netherlands to assess how disclosure on SLR is done by government geo-information disclosers to communicate risk to the citizens and experts. Table 1 is a matrix showing a presentation of methods to answer research questions. It outlines the way in which the research objectives and questions with respective methods are used to collect data for analysis in order to attain the expected results.

1.10.1. Data collection

The research depends mostly on secondary data from the Netherlands publications on SLR. These include resources from Rijkswaterstaat (Netherlands Water Agency), KNMI (Royal Dutch Meteorological Institute), PBL (Netherlands Environment Assessment Agency) and Nature Science/ Climate Change. Thereafter, primary data is obtained from the internet based risk maps to make an inventory of geospatial frames and an interview is conducted with key experts from the above mentioned agencies and institutions to verify the relation of policy interest in GGD to policy intent in GF.

1.10.2. Research matrix

It outlines the way in which the research objectives and questions with respective methods are used to collect data for analysis to attain the results. These are as shown in table 1. It has columns with headings; research objectives, research questions, data sources, methods and techniques, data analysis and expected results. Hence the research matrix was a guide followed in the research process. Hence, the research process is described in the next section.

Table 1 Research matrix showing a summary of research objectives, questions and method

Research Objectives	Research Questions	Data Sources	Method and Techniques	Data Analysis	Results
To assess what would make Geo-IDS effective by identifying the elements behind disclosure of geo-information on sea-level rise.	What are the elements behind disclosure of geo-information on sea-level rise that would make Geo-IDS effective?	Secondary data (SD) from Agencies (which disclose information on climate change in the Netherlands) on Websites, Documents, Reports, Artefacts, Risk maps that are available through the internet. Primary data(PD) from interviews with key experts	Internet searches <ul style="list-style-type: none"> Using ITC library databases Using search engines e.g. Google Systematic Observations 	Text analysis-Using coding <ul style="list-style-type: none"> interpreting words, content analysis, observations 	Geo-IDS is effective when there are indications of transparency elements such as active communication, with citizens, responsibility, targeted policy, rules and regulations; and participation
<u>Specific Objective 1</u> To conceptualize Geo-IDS	<u>Specific Question 1</u> How can Geo-IDS be conceptualised? <u>Specific Question 2</u> What are the underlying forces of Geo-IDS on SLR in the Netherlands?	SD Literature Review of documents, articles, journals, books, webpage references	Snow ball internet searches		Geo-IDS conceptualised
<u>Specific Objective 2</u> To make an inventory of examples of Geo-IDS risk maps relating to SLR	<u>Specific Question 3</u> Which maps exist that relate to disclosure on SLR?	SD: Literature Review of documents, articles, journals, books, webpage references	Snowball internet search	Classifying observations , Context analysis and Coding	methods that can be used to collect data on SLR disclosure
	<u>Specific Question 4</u> Which risk maps shows effects of SLR in the Netherlands?				Selected methods for collecting data on SLR disclosure
<u>Specific Objective 3</u> To present methods to collect data about actual SLR disclosure	<u>Specific Question 5</u> What methods can be used to collect data on SLR disclosure?	SD: NL publications on SLR with resources(policy documents, reports, strategic plans) from Rijkswaterstaat, KNMI, PBL and Nature/ Science /Climate Change	Direct observations of context and content of documents	Context and text analysis; Coding	Inventory of examples of Geo-IDS
	<u>Specific Question 6</u> How to collect data about actual SLR disclosure in the Netherlands?				Classification of Risk Maps that show effects related to SLR in the Netherlands
<u>Specific Objective 4</u> To determine the extent of transparency on SLR disclosure	<u>Specific Question 7</u> Which organisations are responsible to disclose information on SLR?	PD: Survey and Personal Interviews	Interactive method using unstructured interviews, Sending survey key informants	Coding and analysis	List of organisations responsible to provide risk maps
	<u>Specific Question 8</u> Which way do they disclose geo-information on SLR?				Present, laws, policies, guidelines and standards used in the disclosing information on SLR
	<u>Specific Question 9</u> To what extent do they abide by the rules specified?				Present the degree to which information disclosure conforms with what the rules say (effectiveness)
	<u>Specific Question 10</u> Who checks this information disclosure on SLR				List of organization tha monitors the disclosure process
<u>Specific Objective 5</u> To make a recommendation towards an effective Geo-IDS of SLR in the Netherlands	<u>Specific Question 11</u> What kinds of technology, cartographic choices and datasets should be used at the time of disclosure?	SD: Policy documents Plans, reports from NL agencies	Direct observations and matching elements to form patterns	Text analysis, interpreting	Present kinds of technology, cartographic choices and datasets to be used in disclosure
	<u>Specific Question 12</u> What factors would make Geo-IDS on SLR effective in the Netherlands?	SD: Policy documents Plans, reports from NL agencies	Direct observations	Pattern coding and interpreting	Suggest factors that would make Geo-IDS effective
		PD: Interviews of key informants at NL Agencies	Interactive method using unstructured interviews	Transcribing, coding and interpreting	

1.10.4. Research process

The research process is a step by step approach adapted to strategically conduct the research to a successful end. The process consists of four phases as shown in figure 1.2. These phases are named as follows: Phase 1 is the problem development phase, Phase 2 is the literature review phase, Phase 3 methodology phase and Phase 4 is the solution development phase. Each phase contains series of steps as shown in detail in figure 2 to tackle the set objectives. Thus the thesis structure is described in detail in the next section.

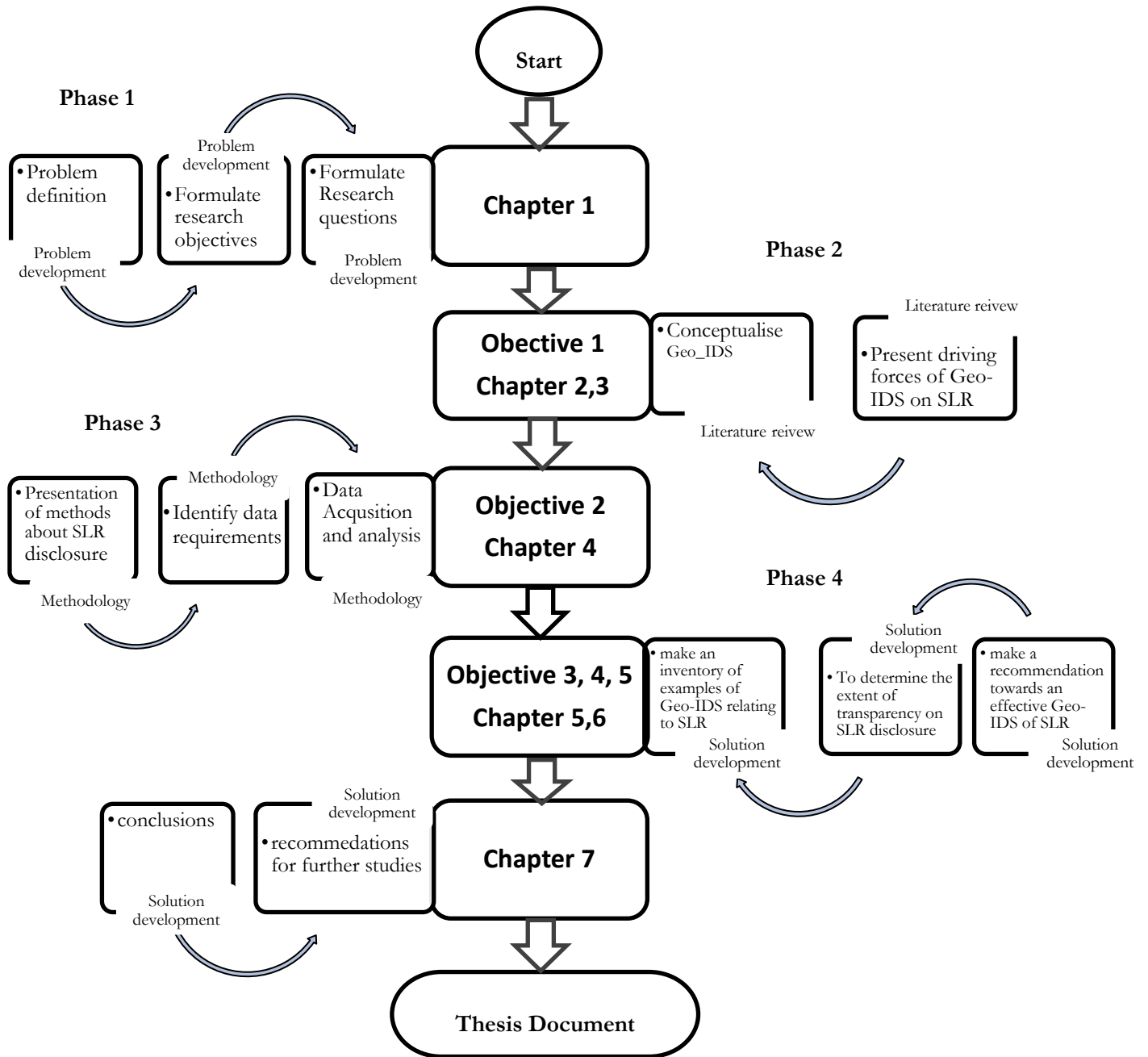


Figure 2 The Research Process

1.11. Thesis structure

This is a section that gives the detail description of the thesis structure. The thesis is presented in seven chapters. These are briefly summarized as follows.

Chapter One: *Introduction*

The aim of this chapter is to set the background of the research. It starts with a brief discussion on issues concerning sea level rise in general and in the Netherlands. The justification of the research is highlighted in the second section followed by an initial literature review on Geo-information Disclosure Systems (Geo-IDS) with a problem definition of the study in section four. Section five focuses on the research objectives whilst section six presents the research questions of this study. Much more, an overview of the research methods is given in section seven followed by the thesis structure and conclusion of the chapter.

Chapter Two: *Disclosure of SLR Geo-Information*

In this chapter, an attempt is made to review issues and concepts on disclosure systems specifically that of Geo-information. It begins with a definition of Geo-IDS as derived from debates in literature on multidisciplinary disclosure systems studied in the past two decades. Also, the key underlying values of Geo-IDS are presented with arguments from literature on the concept of transparency in the disclosure of geo-information. In section two, discussion on government intervention in transparency of organizations is given whilst section three laments on the information disclosers, users and medium of geo-information disclosure and the ethical issues in the disclosure of geo-information are also brought forth. Further, the conceptual framework adopted for the study been targeted transparency called transparency action cycle by Fung et al is also described in detail. The section four of the chapter presents and explains the elements of the disclosure boxes in the transparency action cycle whilst section five sets the boundary or focus of this study. In this study however, much attention is given to the two of the disclosure boxes namely the information providers and aggregated information in the transparency action cycle. Thus, the process of geo-information disclosure is critically looked at in section six considering the main components of disclosure by government institutions. Finally, the main points highlighted in the chapter are specified in section seven as a conclusion thus answering how Geo-IDS can be conceptualised.

Chapter Three: *Underlying forces of Geo-IDS on SLR in the Netherlands*

The aim of this chapter is to present the rules and regulations on SLR geo-information disclosure from literature termed in this study as Geo-IDS. Beforehand, global debates on SLR are highlighted. It continues with sections namely concept of Geo-IDS and SLR followed by policy context of SLR in Netherlands. Also, discussion on the responsible agencies for both the disclosure and monitoring of SLR are Netherlands brought forward. It climaxes with the disclosing of SLR geo-information inter (national) laws that force or empower agencies to collect and distribute data on SLR globally and in the Netherlands. Examples of products of SLR are also given.

Chapter Four: *Methods to Investigate Disclosure of SLR*

The aim of this chapter is to present methods used in achieving the research objectives learnt through the literature review done in chapter two. Appropriate methods to answer research questions for example, to answer question “how to collect data about actual SLR disclosure in the Netherlands” and so forth. The idea is to bring forth a detailed description of the research design and methods requirements in achieving the objectives of this study. It comprises of nine sub-sections starting with an indication of type of research the study is about and the mixed method approach adopted followed by a research matrix. The research matrix contains the summary of all the methods and data sources that seeks to answer the research questions posed in chapter one. Section four describes the instruments and tools used in collecting data on the disclosure of SLR. Further, the section discusses the data collection techniques,

mechanisms. Data processing and analysis are described in section seven as the research process is presented in section eight. Lastly, section nine gives a conclusion that ends the chapter with key issues discussed in previous sections

Chapter Five: *Status of Geo-IDS on SLR in the Netherlands: Results*

The status of Geo-IDS on SLR in the Netherlands is presented in this chapter to meet objective four. Objective four is to determine the extent of transparency on SLR disclosure. Thus the aim of this chapter is to provide answers to the research questions set under the objective. These questions are: “which organisations are responsible to disclose information on SLR”, “which way do they disclose geo-information on SLR”; “To what extent do they abide by the rules specified” and “who checks this information disclosure on SLR” as stated in chapter one chronologically. The answers are results obtained using the mixed methods discussed in chapter three. Specifically, the empirical data from the expert interviews based on the conceptual framework discussed in chapter two are used in answering the questions. The chapter is grouped into three main sections. The first section talks about what one need to look at when determining the extent of transparency on SLR disclosure. It is preceded by three sub-sections which presents results for the type of SLR information disclosure with the dimensions defined in chapter four section 4.4 (the concept-variable matrix). Secondly, the actors influencing SLR disclosure are highlighted. Further in sub-section three, the rules and regulations on SLR disclosure is brought forth pointing out the formal and informal practices involved. Finally, a summary of the results or findings in the study that seek to contribute to effectiveness of Geo-IDS are presented in section three. However, the main purpose here is to know the extent of transparency on SLR disclosure in the Netherlands.

Chapter Six: *Factors that would make Geo-IDS Effective: Discussions*

The purpose here is to examine the factors that make Geo-IDS effective by assessing what leads to the underlying SLR information disclosure in the Netherlands. This is done by critically discussing the current situation to predicting the policy intent thus make recommendations to shape it. The chapter seeks to answer the main objective of the research which is “to assess what would make Geo-IDS effective by identifying the elements behind disclosure of geo-information on sea-level rise”. The argument put forward follows the pros and cons of disclosure on SLR via the transparency system Geo-IDS to acknowledge those that can become embedded in users’ decisions due to policy and regulations.

Chapter Seven: *Conclusions and Recommendations*

The Chapter presents a summary of the major findings and conclusions of the study. It gives an overview of the research objectives, conceptual framework and methods used in arriving at the findings that answers the research questions posed in chapter one. In particular, this chapter takes account of all the summaries of the chapter one to chapter six. Thereafter is a reflection on the outcomes of the entire research conducted and the mixed method approach adopted. Intently, recommendations on SLR geo-information disclosure and further directions into Geo-IDS research are also given at end of the chapter.

1.12. Conclusion

The study focus is on the discourse of SLR in the Netherlands; investigating the underlying values of the geospatial frames (risk map) that leads to what makes Geo-IDS effective. The methods and resource outlined for the research were appropriate to find the solution to the research problem. Also, the work plan was a guide followed in achieving the research objectives which are: 1). to conceptualize Geo-IDS, 2). to present methods to collect data about actual SLR disclosure, 3). to make an inventory of examples of Geo-IDS relating to SLR?, 4). to determine the extent of transparency on SLR disclosure and 5). to make a recommendation towards an effective Geo-IDS of SLR in the Netherlands.

2. DISCLOSURE OF SEA LEVEL RISE GEO-INFORMATION

2.1. Introduction

In order to address the first research question on the nature and fundamentals of disclosure, sea level rise and disclosure through geo-information systems, this chapter reviews the concepts on disclosure systems with specific focus on disclosure of geo-information. It begins conceptualizing Geo-IDs from debates on multidisciplinary disclosure systems in the past two decades. Also, the key underlying values of Geo-IDS are presented with arguments from the concept of transparency in the disclosure of geo-information. In section two, discussion on government intervention in transparency of organizations is given whilst section three laments on the information disclosers, users and medium of geo-information disclosure and the ethical issues in the disclosure of geo-information are also brought forth. Further, the conceptual framework adopted for the study been targeted transparency called transparency action cycle by Fung et al is also described in detail. The section four of the chapter presents and explains the elements of the disclosure boxes in the transparency action cycle whilst section five sets the boundary or focus of this study. In this study however, much attention is given to the two of the disclosure boxes namely the information providers and aggregated information in the transparency action cycle. Thus, the process of geo-information disclosure is critically looked at in section six considering the main components of disclosure by government institutions. Finally, the main points highlighted in the chapter are specified in the concluding section seven.

2.2. Definitions of concepts

The study uses broad concepts which have been challenging for researchers to define. The concepts are:

- 1) Disclosure and components associated with disclosure (e.g. transparency, accountability, responsibility)
- 2) Disclosure of geo-information (alternatively: disclosure through geo-information systems), deriving Geo-IDs
- 3) Transparency action cycle (in which Geo-IDs play a role)
- 4) Sea level rise (information) – the choice of geo-information disclosure this in thesis studies

Each of these concepts is further discussed hereunder. To start with, disclosure is used by many authors in multidisciplinary fields of study. It has always been seen in close relations with transparency, accountability and responsibility as in (Fung, et al., 2007; Koppell, 2005; Molnar, 2008). Thus, it is impossible to discuss disclosure without the essence of the components associated with it. Hence the section is devoted in defining disclosure, transparency, accountability and responsibility in order to shape the main theme of this study on Geo-IDS.

2.2.1. Debates on defining disclosure

Defining the term disclosure starts with the advanced learner's dictionary in which two definitions were cited. Firstly, disclosure is "the act of making something known or public that was previously secret or private"(OALD, 2011). The second definition is given as "information or a fact that is made known or public that was previously secret or private"(OALD, 2011). Thus, disclosure of information is considered a crucial spectacle of transparency in all processes affecting lives and properties. Some of these processes

can be financial, environmental, political, health, etc. just to mention a few. As a matter of the different processes, there exist also different typologies of information disclosures. For example, financial information disclosure (Gelb & Strawser, 2001; Holder-Webb, Cohen, Nath, & Wood, 2008; Jorgensen & Kirschenheiter, 2003), environmental information disclosure (Gallego-Álvarez, 2012; Gallego-Álvarez & Vicente-Villardón, 2012; Moroney, Windsor, & Aw, 2012; Owen, Videras, & Wu, 2012; Zeng, Xu, Yin, & Tam, 2012) and health information disclosure (Bugge, Entwistle, & Watt, 2006; Schneider & Lieberman, 2001) are more prominent in literature on disclosure. Consequently, disclosure, especially that on SLR is missing, probably because it has not attracted the attention of researchers in the past. Therefore, there is need for new knowledge on how the information disclosure on SLR works as a contribution to what is already known on disclosures.

Information disclosure can either be voluntary or mandatory. Mandatory information disclosure is a regulatory transparency guided by policies and laws (Weil, Fung, Graham, & Fagotto, 2006). For instance, Weil et al pointed out that, it is an obligation by law for private and public companies to disclose information on their products and services. Further, there are some companies who feel it is a social responsibility to disclose information voluntarily as in the works of Gelb et al (2001) and Zeng et al. (2012).

Voluntarily or mandatorily disclosure is vital to increase accessibility to information necessary for the society to make informed choices and right decisions. Readily access to data and information reduces extreme risk for example the impacts of natural disasters (Dunbar, 2007). Dunbar (2007) argues that access to information improves public awareness on natural hazards as well as enables researchers to improve upon their findings thus increasing prevention on the consequences of the risk. In this situation, disclosure of information on sea-level rise would increase public awareness, provide data for researchers to improve research on risk associated with sea-level rise and thus show the transparency of the organizations entrusted to disclose such information. Disclosure, in other words, is strongly connected to the concept of transparency. Therefore, the role that transparency plays in disclosure must be further elaborated.

2.2.2. Transparency

Transparency is a broad concept that researchers in this 21st century define to suit the purpose of their study. For example, Fenster (2006) argued in his article titled "Opacity of Transparency", that the concept of transparency creates frustrations for activists in an attempt of advocating for openness in governments. He therefore referred to transparency as "*the openness of the federal and state executive branches to the public*". Hood and Heald (2006) referred to transparency as "*the availability of information to the general public and clarity about government rules, regulations and decisions*". But Koppell (2005) also states that transparency is a foundation or lateral value of accountability where by organizations give accounts of their actions liable to scrutiny by regulators and the public at large. For instance, organizations are obliged to communicate truthful information (Chen, 2012) about their operations and performances in order to fulfil the requirement of transparency. On the contrary, Hood and Heald (2006) argued that although transparency mandates organizations to disclose and disseminate information but often the effective communication is often ignored. Thus, transparency is seen by researchers to be the most important instrument to assess an organization's performance and also a key requirement for measuring all the dimensions of accountability (Koppell, 2005). However, Harrison et. al (2012) are of the view that, transparency is not achieved through only downloading of datasets, but rather be reliable and useful for citizens to act on the organizations accountability through a two-way communication thus to connect vision and voice (Meijer, Curtin, & Hillebrandt, 2012). The importance of transparency for disclosure is thus openness, availability of information and two-way communication that are all attributes of accountability.

2.2.3. Accountability

Another issue that is closely tied to disclosure is accountability. The concept of accountability in public administration is thoroughly discussed in the work of Koppell(2005). The author presented five distinct dimensions of accountability namely transparency, liability, controllability, responsibility and responsiveness. Koppell(2005) argued that, although the true meaning of accountability is indefinable yet it is desired by all who seek openness within government organizations. Further, the author stressed the difficulty for organizations to be accountable in multiple senses in a bid to satisfy everybody often ends up in not satisfying anyone owing to the ambiguous definitions of accountability. As Meijer(2005) in work on risk maps, stressed that government and companies anticipate they will be called to account therefore act in line with accountability principles even if they are not watched by anyone. Because the government institutions are in anticipation of media attention, they often comply to recommendations and make plans to prevent disasters(Meijer, 2005) thus to signify how accountable they are on their responsibility to do so as mandated by laws and regulations; a government intervention(Fung, et al., 2007).

2.2.4. Responsibility

Finally, the concept of responsibility is closely tied to disclosure. Government organizations are guarded by laws, rules and norms (Koppell, 2005) that define the boundary of their mandates or responsibilities. Legal requirements shape an organizations behaviour that demands them to implement policies and program objectives in conformity with the legislation or regulations(Koppell, 2005). Thus, an organization's responsibility or obligation is to follow rules posed by the government in providing public services. For instance, after the 2004 explosions that occurred in Enschede, the Dutch government intervened mandating all provinces to provide the public with risk maps(Meijer, 2005). Following this intervention, it became the responsibility of the Dutch provinces to account to the public by providing risk maps on their websites(Meijer, 2005). These risk maps serve as spatial information mitigation techniques to create awareness on risks from natural and artificial hazards alike(Dunbar, 2007) . In addition, spatial information helps communities to take steps to reduce potential losses that may pose by risk such as flooding; help research scientists to assess risk, calibrate and validate models to ensure safe navigation and monitor climate impacts(Dunbar, 2007). Thus, spatial information or geo-information disclosure on natural hazards such as flooding is a consequence of sea-level rise is essential and for all sections of the civil society to make informed decisions on how to prevent disasters. Hence, a study on how geo-information disclosure systems on sea-level rise work is important to establish to help citizens become aware and therefore hold government officials accountable on disaster prevention and management as anticipation for sea-level rising in recent times.

This disclosure can be defined as “the act of making something known or public that was previously secret or private”(OALD, 2011). Crucial components of disclosure are transparency, accountability and responsibility. Specifically, when disclosing geo-information or disclosing through geo-information systems the term or concept specific about disclosure through geo-information systems is called Geo-IDS. Hence, the components of disclosure for example transparency also play a role in disclosing geo-information.

2.3. Decision making and transparency action cycle

The conventional planning (rationalistic) paradigm is that every decision making process requires and depends on relevant and timely information. Within this view information is assumed to become more accessible as a result of open government initiatives such as targeted transparency policy (Fung(2007). Their work describes how information used in decision making changes behaviour of the actors involved within a transparency system (Fung, et al., 2004). These changes of behaviour occur in a cycle as Fung et al (2010; 2007) presented as a framework to study transparency within an open government and named it as

transparency action cycle. Their prediction was that new information does not necessarily reduce risk but the manner in which new information is crafted in targeted policies to increase its effectiveness. In other words, the authors examined and compared targeted transparency policies to see which ones were effective and which one was a failure. Hence Fung et al concluded that only policies that succeeded in embedding new information in both user's and disclosers decisions routinely were effective.

The deliberations of Fung et al centre on seven disclosure boxes representing the stages of disclosure processes of the transparency action cycle as shown in figure 1. The disclosure boxes are "Technological transparency intervention" connecting to "Aggregated information" which help "User's perception and calculation" to change "User's behaviour and actions" through "Efficacious agents action" to enact for "Targets of intervention" that put pressure on "Information providers" to improve on "Aggregated information" (Fung, et al., 2010). The cycle is shown in the conceptual framework in figure of this study as an integral part of it. Fung et al (2007) argued that , transparency is effective only when the actions within the transparency cycle are fulfilled. The authors stressed that the transparency action cycle are chains of actions and responses by two primary actors(Fung, et al., 2010; Fung, et al., 2007). These actors are disclosers; whose behaviours a targeted transparency policy seeks to change and the users; whose choices policy makers desire to improve(Fung, et al., 2010; Fung, et al., 2007). These actions within the disclosure boxes of the transparency cycle are as described in the subsections below starting from the technology transparency intervention disclosure box.

2.3.1. Technology transparency intervention

Technology transparency intervention is a mechanism in place to foster the use of Information and Communications Technology (ICT) to disclose information. This present information age is attributed to the use of ICT worldwide(Bellamy & Taylor, 1998). A number of researchers have studied and shown the benefits of ICT to facilitate citizens' participation in decision making process. To begin with, Fung, et al. (2010) stress the importance of technological intervention that relies on effective ICT platform to provide valuable, accessible and actionable information to users for them to understand. In this way, the authors pointed out the use of the information that helps the audience to make informed choices thus pressurise the information providers to also change their behaviour. A considerable number of ICT aided platforms such as crowd-sourced or wiki platforms(Fung, et al., 2010), Google Earth(Gouveia & Fonseca, 2008) known to support citizen participation to generate Voluntary Geographical Information (VGI) in environmental monitoring, etc. have been discussed by the mentioned authors. Further, these ICT platforms are supported by the internet, Global Positioning Systems (GPS), web 2.0, Geographic Information Systems (GIS) and other mobile communication tools(Gouveia & Fonseca, 2008) in a bid to explore, capture, store, manage, analyse and disclose information in a multimedia platforms. With these ICT tools, citizens are empowered to enact for accountability from government officials to improve upon their products and services (Fung, et al., 2010; Fung & Weil, 2010; Gouveia & Fonseca, 2008; Meijer, et al., 2012).

One major technology transparency intervention is an ICT infrastructure to allow public access to government open data. Such an infrastructure often requires targeted transparency policy for example, INSPIRE directive(Gouveia & Fonseca, 2008) with the objective to establish Spatial Data Infrastructure(SDI) in Europe and beyond to ease accessibility to environmental data by the public at large. However, simply placing data openly is mostly used by few which the citizens themselves do not use(Fung, et al., 2010; Fung, et al., 2007; Fung & Weil, 2010; Meijer, 2005; Meijer, et al., 2012).

To solve this problem of citizens not using government information placed publicly, many researchers are of the opinion that organizations should use the social media platforms to rather communicate in a dialogue form. For example, the social media platforms such as Twitter, Facebook, YouTube, Blogger and Google+(Briones, Kuch, Liu, & Jin, 2011) have a major role to play in communicating risk to young

people especially. The authors are of the view that audiences of such nature cannot be ignored as those social platforms are where the public share their opinions and debate on issues affecting them (Briones, et al., 2011). The social media increases stakeholder interactions consequently building stronger relationships. They create the atmosphere for healthier communication between an organization and wider audiences as seen in the work of (Briones, et al., 2011; Lovejoy & Saxton, 2012; Saxton & Guo, 2009, 2011). Briones, et al. (2011) established the increasing importance of the social media to build relationships as (Lovejoy & Saxton, 2012; Saxton & Guo, 2009, 2011) emphasized on the use of Twitter as a dialogic communication tool suggesting that organizations need to follow the use of this if they want to interact effectively with their audiences. Furthermore, to build relationships for a two-way communication, organization need to update strategies and tactics to include the social media tools suggested by Briones, et al. (2011) in the disclosure of information to wider audiences. In other words, disclosed information within a transparency cycle is termed as aggregated information which is discussed in the next sub-section.

2.3.2. Aggregated information

Aggregated information is seen as information disclosed in the public domain within a transparency system. It is a result of information collected and disclosed through a technological transparency platform or intervention (Fung, et al., 2010). Fung, et al. (2010) claimed users draw on this aggregated information disclosure to make decisions on products and services from organisations only when they find them relevant. Accordingly, information embedding in users decisions changes their perceptions and behaviour to act in a desired manner (Fung, et al., 2010; Fung, et al., 2007). The authors (2007) further stressed on the need for targeted transparency policy if the policy makers wants this change of behaviour and actions of users to be a reality. They argued that for such policy to be effective, information disclosures guidelines proposed by the policy should be technologically inclined. As a result of their study (2007), they found that some targeted policies were effective and *“what made them effective was when information disclosures provided facts that people wanted in times, places and ways that enabled them to act”*. Hood and Heald (2006) support this idea by stating that *“reliable information is essential for accountability and also it is essential to test the efficiency and effectiveness of government policies and programmes. Access to information enhances legitimacy as secrecy may be necessary but it has to be justified. Justification is a part of transparency”* they said. Needless to say that aggregated information is the kind which is guided by targeted transparency policy to make user’s perception and calculation possible in order to change behaviours and actions.

2.3.3. User’s perception and calculation

Information user’s perception and calculation is an important stage in the decision making process. For example, information disclosed voluntarily or mandatorily by organisations in a simple, clear and understandable manner using ICT enables users to make informed choices based on their intentions (Fung, et al., 2007). This way the public is able to use the information for their own needs and make right decisions on things which affects their lives (Meijer, 2005). As a consequence of this perception and calculation, users of information then change their behaviours and actions (Fung, et al., 2010).

2.3.4. User’s behaviour and actions

The sub-section shows deliberations on how information changes the behaviour of users for them to make the right decisions. To begin with, Fung, et al. (2007) points out information embedded in decisions make users to change their behaviour and actions. Likewise, the users no more do things they used to do but rather take new actions. For example, Meijer (2005) argues that as citizens become aware on the basis of using information, they tend to put *“pressure on government agencies and private companies to improve their risk management”*. The author further stressed that the citizens do this by protesting against decisions or actions when it directly affects their lives (Meijer, 2005). In addition, availability of disclosed data or information enables researchers to improve upon their hazard research that accordingly reduces impacts on natural

disasters(Dunbar, 2007). This happens as they take the necessary measures to prevent or respond appropriately based on new findings from their research. Also the media also take the opportunity of available information to inform others that are not yet aware of situations. Hence, the users become efficacious agents who take action within the transparency cycle of Fung, et al. (2010) discussed in the next sub-section.

2.3.5. Efficacious agents action

Efficacious agents may refer to as actors who have the power to affect government interventions (Fung, et al., 2010). Fung, et al. (2010) indicated those agents can be the citizens themselves or organizations who work on behalf of citizens. In other words, the efficacious agents who act to empower citizens to change behaviour are called intermediaries. For instance, the media play a role as intermediaries or efficacious agents whose actions empower citizens and the like with information to change behaviour(Fung, et al., 2010). They are seen in information disclosure systems as effective agents in empowering citizens to make right decisions within a transparency system. The fact that they use ICT platforms on the web to disseminate information to wider audiences, they are therefore termed to be effective. Consequently, the actions of these agents manifest in targets of intervention as seen in the transparency cycle of Fung, et al. (2010) as deliberated below.

2.3.6. Targets of intervention

Targets of intervention is a type of intervention that *“alters behaviour to increase accountability, responsiveness, etc. of information disclosers or providers”* as Fung, et al. (2010) stated. This altering behaviour of information disclosers happens through advocates by the efficacious agents in the transparency system. In this regard, Meijer (2005) states that *“accountability arrangements often work through anticipation: governments and companies are not actually called to account, but still act as if they will be called to account”*. The author argued that they do so to avoid media attention therefore put mechanisms in place to improve products and services. Thus the actions of agents creates incentives for organisation to improve their performances(Meijer, 2009). If organisations improve services and products it means they are been accountable due to the effects of targets of intervention for them to have provided information to the public.

2.3.7. Information providers

Information providers are the main pillars of a transparency system(Fung, et al., 2004). Here, organisations that provide or disclose information are characterized as information providers or disclosers in the transparency cycle of Fung, et al. (2010). Information providers are obliged by right-to know policies and laws to disclose information about their products and services(Meijer, 2009). Thus, targeted transparency polices are government intervention being a basis of democratic governance(Fung, et al., 2007) articulating openness within government. Further, (Fung, et al., 2007) deliberated on the importance of organisations disclosing information openly. They gave countless examples which some of them are: 1) In order to hold officials accountable for their actions, 2) Reduce needless economic losses to investors from corporate deception; 3) To prevent deaths and injuries; 4)To improve the quality of public services; 5) To fight corruption. Dunbar (2007) adds to that by saying *“To ensure safe navigation and monitor possible climatic impact”*. Nevertheless, these shows the reasons why information provision is necessary when disclosed openly. Openly disclosure of information by organisations is critical to increase availability of information to enhance decision making.

Enhanced decision making relies on timely and relevant information as information availability also depends on transparency in government that institute interventions which oblige organisations to disclose information to the public to use. This information disclosure must be technologically inclined so as to provide the timely, accurate and relevant information for users to access wherever they maybe in the globe. In other words, organisations should be mandated to provide information by means of targeted

transparency policy with laws that legitimise them to do so. Henceforth, it is therefore necessary to find out answers to questions beginning with “how”, “why”, “when” and “what” information is being disclosed by organisations. This implies the underlying forces behind disclosure which this study seeks to find out with a specific case on sea-level rise in the Netherlands. Accordingly, the study focus is an integral part of the transparency cycle of Fung, et al. (2010), shown in figure 1 of chapter one.

2.3.8. How transparency action cycle works: an example

Technology transparency intervention, for example, the social media platforms such as Twitter, Facebook, YouTube, Blogger and Google+(Briones, et al., 2011) have a major role to play in communicating risk to young people especially. They are new web technologies that make possible interactive searches via the internet(Bellamy & Taylor, 1998; Fung, et al., 2007; Fung, et al., 2004; Meijer, 2005, 2007, 2009; Raman, 2012; Technology for Transparency, 2010) for digital information disclosed thanks to right –to –know policies and laws(such as Freedom of Information act); a government intervention.

A government intervention as (Fung, et al., 2007) state transparency policies must be accurate to make information disclosure effective. The authors further argued that for information disclose to be effective, transparency policies *“must be ahead of discloser’s efforts to find loopholes; must focus on the needs of ordinary citizens-user centred, must be sustainable-use, accuracy and scope over time”*(Fung, et al., 2007). Hence, should be targeted transparency policies instead for disclosure to produce the desired aggregated information. Thus, this aggregated information which is technologically oriented, can be interactively searched for with retrieval capabilities used to simply access databases (Dunbar, 2007), files and maps of government organisations for instance. If the information retrieved by users is accurate, timely, simple, clear and understandable enough, then users can make calculations with the information using their perception to make right decisions and then act. For instance citizens become empowered to put pressure on government officials to improve products and services bound to affect their lives.

Nevertheless, if the government officials see that the users have taken action because their behaviours have changed, they then change theirs. In that manner, the regulators or the policy makers become happy because, the policies which were instituted have been effective by achieving the desired outcome that was to change behaviours of both actors (information providers and users) within the transparency cycle.

2.3.9. Transparency action cycle and the study focus

Transparency action cycle contains a chain of actions shown in figure 1. Each action is described in the proceeding sub-sections. As disclosure is the most important action before any other actions can take place, the study focuses only on that. This implies that, the action which is the connection between the disclosers(information providers) and the information provided (aggregated information) in a transparency system (Fung, et al., 2004) is our focus due to time limitation for this study. A specific case on sea-level rise is studied that has a geospatial component called geo making it different from other types of information disclosures already studied by other researchers. This transparency system in this study is referred to as Geo-IDS shown in figure 3. The Geo-IDS relates to how geo-information disclosers frame geospatial information (risk maps) on SLR in the Netherlands to portray the policy intent based on the choices of cartographic representations, technology and data available at the time of disclosure.

Disclosure of information and decision making is related through a transparency system. Transparency cycle can help determine the actions behind information disclosed by information provider to users for them to act. However, there should be policy interventions in decision making cycles based on relevant, reliable and timely information. To investigate how this works in real situations, a case study (Yin, 2002) is employed. Yin (2002) contends on why a case study is a specific strategy for an investigator who has little or no control over “ a how or why question being asked about contemporary sets of events” and stressed on that it has a distinct advantage.

In other words, it is a distinct advantage here to employ a case study to find how geo-information on SLR is disclosed. The case study on SLR is to assess how government information disclosers disclose geo-information and which underlying forces compel them to do what they do using the conceptual framework termed Geo-IDS with the transparency cycle of Fung, et al. (2010). But first of all, let us see what researchers debate is on disclosure to use as a basis to conceptualise Geo-IDS in the next section.

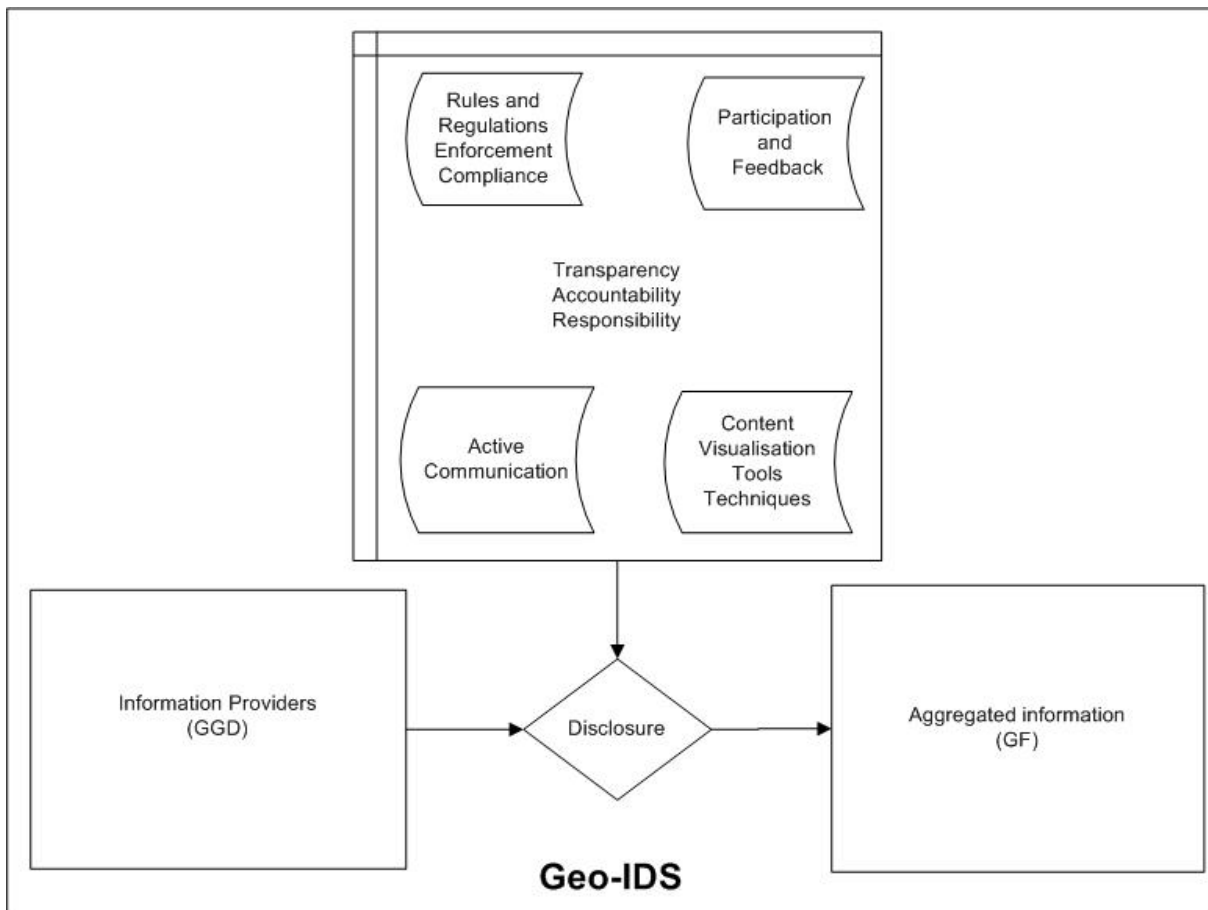


Figure 3 Geo-IDS: The research conceptual framework

2.4. Conceptualizing Geo-IDS

Disclosure of geo-information must satisfy the main components of disclosure which are transparency, accountability and responsibility. There is special kind of disclosure with all the three components in place is termed or come into broad concept and known in this study as Geo-information Disclosure Systems.

2.4.1. Geo-Information Disclosure Systems

Geo-information Disclosure Systems (Geo-IDS) can be seen as a regulatory tool that integrates policies(Fung, et al., 2007; Fung & Weil, 2010), technologies(Winston, 2008) and organizational arrangements to release relevant, user-centred, clear, understandable and timely information(Meijer, 2005) that are linked to specific points on the Earth’s surface to the public which facilitate decision making within a transparency system. This is to say that Geo-IDS are a human-computer system guided by policies and regulations in the disclosing of geospatial information.

Freedom of Information (FOI) act has set governments to open up their data for the public to use. For instance, in the year 2009, the US government under President Obama’s administration drew out three fundamental goals for an open government that were, collaboration, participation and transparency

(Dawes & Helbig, 2010; Harrison, et al., 2012). FOI increases transparency in governments with accountability in certain situations as seen in the work of Worthy(2010). Worthy(2010) studied the effects of FOI of the United Kingdom and measured the extent to which the six objectives of the FOI were attained. These six objectives were to increase transparency, increase accountability, improve decision making, improve public understanding, increase participation and build trust in government. The author concluded that only the objective of increased transparency was achieved with increased accountability in some cases but the other objectives were not met. However, Ganapati and Reddick(2012) examined the three fundamental goals; collaboration, transparency and participation; adopted by the U.S State government. The authors argued that most of the government institutions have plans to implement open government yet legislative instruments and government guidelines are crucial in reaching great height of success in open government implementation. Dawes and Helbig(2010) studied the use of land records to determine the complexities of government information use by the public. In their study, the authors used a case study with mixed methods. In their (2010) conclusion, they stressed that, even though there is large useful information within the government data system in the U.S, yet they are rarely user-centred beyond their own needs. They(2010) therefore emphasized on the need for government agencies to take up the new responsibility to make such information usable for the public. This requires investments in skills, tools and policies that changes the manner in which they practically process information to disclose to wide audience.

Concerns on information disclosure are increasing since 1990. This is a result of the U.S. Emergency Planning and Community Right-to-Know act passed in 1986 (L. Zhang, Mol, He, & Lu, 2010). The Laws and regulations are instituted to obligate individuals and organizations to disclose information on their products and services to the public. This further saw the commencement of transparency initiatives noted in the work of Zhang et al. (2010) and the birth of such initiatives as in (Fung, et al., 2007). These initiatives are to promote democracy and accountability through participation(Meijer, et al., 2012). In this way, activists believe disclosure enhances accessibility to information by all stakeholders thus encouraging participation in decision making process. Especially, citizens can make informed choices(Fung, et al., 2007) in their decisions on which product to go for or which organization is not rendering their services to the standards set by the regulations. More so, Fung, et. al (2007) termed this as information embedded in user daily routines that changes the behaviour of citizens to pressurize organizations to improve products and services. This information embedment is an important factor to necessitate participation by all stakeholders in decision making (Gouldson, 2004) thus promote democracy.

Participatory democracy relates to targeted transparency polices as seen as government inventions. The importance of targeted transparency policies are crafted by government as an intervention requiring organizations to disclose information on risks to citizens for them to make informed choices(Fung, et al., 2007). Fund et al further gave three reasons why government is in position to intervene. Firstly, government compels both private and public institutions to disclosure information; secondly bring legislation on transparency and thirdly legitimize the democratic process through transparency. They argued that these targeted transparency policies are on specific products or practices(Fung, et al., 2007) mandating public disclosure on risks that affect lives. Also, these policies are to achieve a specific public purpose or interest which is mostly achieved by following a certain sequence or action cycle to be discussed in section three; to provide useful information for the public.

Useful information from an open government creates an opportunity for the public to understand issues at stake leading to participation. This way, the public can give feedback on the information that allows the government discloser to improve upon. To do this, Dawes and Helbig (2010) suggested that, the government professionals need to learn new skills such as communication skills that can serve the needs of wider information audiences with useful information. Further, a communicator takes into account the diverse interest of target audiences(Hood & Heald, 2006) not ignoring their capacities to use the

information. Thus, an open government should have a policy in place that allows professionals to enhance their communication skills as well as have tools that can process information for wide audiences especially citizens to understand. However, the need for new communication methods that effectively inform the public to help them take active roles in decision making has been emphasized by Jude ((2008) cited from Sorensen,2007; King,1999, Defra,2002; Defra,2005)). The author identified visualization techniques as a key component in communicating risk to the public to earn their participation. Jude(2008) stressed on the need for visualization techniques that allow GIS data to be displayed in a manner that would be more innovative, interesting, informative and appealing to the users for them to understand. This helps them to make informed decisions to participate in the issue at stake.

Issues at stake are visualized with various software packages. The software packages can either be an open source or commercial software. For instance, ESRI desktop GIS; a commercial software package with different extensions such as the 3D analyst to aid in the communication on sea-level rise were mentioned in the work of Jude (2008). The author acknowledged open source softwares where he cited examples developed by Stock & Bishop(2006). Again, Jude (2008) argued that with these software packages, experts can use to create products static, animated and interactive visualizations as in maps at different scales from GIS datasets to help in decision making.

Geo-IDS consist of GIS maps that become disclosure tools. What makes Geo-IDS different from other information Disclosure Systems (IDS) is due to the specific of geo-information. This specific is mostly GIS created maps that is visualised with state of art technology. Thus, the crucial issues in Geo-IDS are technology; software; licenses to software, whether open or closed access. Again Geo-IDS are part of decision making process within a transparency action cycle.

2.4.2. Concept of sea -level rise

A decision on sea-level rise is a major concern in recent times. Se-level rise is the increasing of mean levels of the sea. Sea-level rise is attributed to the dynamic melting of ice sheets of Greenland and Antarctic (Butzengeiger & Horstmann, 2004; Deschamps et al., 2012). It is also attributed to the expansion of the sea water due to increasing atmospheric temperature(Butzengeiger & Horstmann, 2004). Sea-level rises have different spatial distributions in geo-graphical regions (Butzengeiger & Horstmann, 2004). As noted, because of the geo-graphical aspect i.e. spatial distributions of sea-level rise, it is seen to have a close link to Geo-IDS. Hence, been chosen case on the study of Geo-IDS as the sea-level rise is seen to have many consequences (Butzengeiger & Horstmann, 2004). Issues on sea-level rise are discussed in Chapter 3 but now the next section gives the summary of this Chapter.

2.5. Conclusion

Conceptualisation of Geo-IDS was deliberated in detail in this chapter through a literature review. It seeks to answer the research question “*How can Geo-IDS be conceptualized?*” of objective number one. Thus, Geo-IDS was conceptualised and a summary is presented here from the literature review.

Geo-IDS consist of main concepts such as disclosure. This disclosure can be defined as “the act of making something known or public that was previously secret or private”(OALD, 2011). Crucial components of disclosure are transparency, accountability and responsibility. Specifically, when disclosing geo-information or disclosing through geo-information systems the term or concept specific about disclosure through geo-information systems is called Geo-IDS. Hence, the components of disclosure for example transparency also play a role in disclosing geo-information. This role is to make the public become aware of the products and services that is bound to affect their lives through active communication. More so on geo-information about sea level rise is essential to inform citizens to make informed choices and decisions. Nevertheless specific geo-information on sea level rise is risk maps

guided by rules and regulations. This is so because, risk maps presents facts which is easily understood than text and numbers. From these components of information disclosure specific on SLR is termed as concept called Geo-IDS.

Geo-IDS is defined in this study as a regulatory tool that integrates policies(Fung, et al., 2007; Fung & Weil, 2010), technologies(Winston, 2008) and organizational arrangements to release relevant, user-centred, clear, understandable and timely information(Meijer, 2005) that are linked to specific point on the Earth's surface to the public which facilitate decision making within a transparency system. This implies that, Geo-IDS are human-computer systems guided by policies and regulations in the disclosing of geospatial information. So therefore leads to the second question which is: *What are the underlying forces of Geo-IDS on SLR in the Netherlands?* An answer to this question is deliberated on in detail in the next chapter titled 'Underlying forces of Geo-IDS on SLR in the Netherlands'.

3. UNDERLYING FORCES OF GEO-IDS ON SLR IN THE NETHERLANDS

3.1. Introduction

The aim of this chapter is to present the rules and regulations on SLR geo-information disclosure from literature termed in this study as Geo-IDS. Beforehand, global debates on SLR are highlighted. It continues with sections namely concept of Geo-IDS and SLR followed by policy context of SLR in Netherlands. Also, discussion on the responsible agencies for both the disclosure and monitoring of SLR in Netherlands brought forward. It climaxes with the disclosing of SLR geo-information inter (national) laws that force or empower agencies to collect and distribute data on SLR globally and in the Netherlands. Examples of global products of SLR are also given.

3.2. The concept Geo-IDS and relevance of sea level rise

Progressively, ice caps in Greenland and Arctic ice sheets are melting as a result of global warming and climate change causing the SLR. Low-lying deltas tend to have high probability to flood risk (Botzen, et al., 2009) as the sea-level rises. Because of this rises, it is necessary to monitor the trends and impacts of SLR to come up with measures to mitigate or adapt to this changes (Harvatt, Petts, & Chilvers, 2011). Measures for this unstructured problem (Hoppe, 2011) cannot be dealt with unless all stakeholders agree to share this common goal. Lonsdale et al. (2008) was quick to add that “*addressing our role in the problem means examining our behaviour and addressing those activities that increase risks or prevent transformations to more sustainable lifestyles*”. Indeed, one can also imagine the complexities of such a problem without information for originally citizens to become aware of situations surrounding them. Therefore the need for effective Geo-IDS on Sea-level rises to prove transparency in government and accountability on the part of agencies to help all to participate to nurture good governance. But, the challenges are disputable in many parts of the globe as seen in the debates of researchers in modern times.

3.3. Global sea-level rise prediction challenges

In recent times, researchers have turned their attention on climate change and its consequence of SLR. SLR researchers have shown significant increase in SLR. For example, Deschamps, et al. (2012) stated “*Our results, based on corals drilled offshore from Tahiti during Integrated Ocean Drilling Project Expedition 310, reveal that the increase in sea level at Tahiti was between 12 and 22 metres, with a most probable value between 14 and 18 metres, establishing a significant meltwater contribution from the Southern Hemisphere. This implies that the rate of eustatic sea-level rise exceeded 40 millimetres per year during MWP-1A*”. In this note, literature on SLR is seen to gear towards trends, impacts, responses, policy implications, use of maps and the like. To begin with SLR trends, the next sub-section discussed different studies on trends of SLR.

3.3.1. Sea-level rise trends

Probability distribution of SLR estimated by Titus and Narayanan (1996) proves with a projection models that show the extent of climate change possibly increasing the rate of SLR.. However, they were of the view that new probabilistic projections should make use of opinions and views of all stakeholders, for and against the notion of SLR in coming out with useful models. For example, in the work of Church, White, Coleman, Lambeck, and Mitrovica (2004), they estimated the regional distribution of SLR over the 1950-2000 period. Their main goals were to “*estimate any pattern in regional variation of SLR and compare the*

reconstructed trends with the TOPEX/Poseidon trends over the global oceans". The authors (Church, et al., 2004) studied and conclude that uncertainty exist as a result of insufficient geographical distribution of tide gauges specially in the Southern hemisphere. In addition, Albrecht and Weisse (2012) studied German Bight sea-level trends specifying that regional sea-level rise and variability is influenced significantly by North East Atlantic pressure effects and mean sea-level and that future work should consider new developments in scenarios calculations to offer better estimates.

3.3.2. Sea-level rise exposure and impacts

Assessment of coastal exposure to SLR in the developing countries was done by Dasgupta, Laplante, Murray, and Wheeler (2011) using GIS and indicated that there was a major surge in exposure of developing countries to SLR. Specifically, Boateng (2012) did assessment of SLR impacts using a case study and GIS at the eastern coast of Ghana. The author argued that it was necessary to come up with recommendations necessary for adaptation policy formulation and strategies by evaluating policy documents and taken field investigations. Also, GIS models estimating potential impacts of SLR in the Caribbean are seen in the work of Fish et al. (2005). They used beach profile measurements to ascertain the relation of the beach physical characteristics vulnerability to flooding as may result from SLR. "*Vulnerability varied with landuse adjacent to the beach*" Fish, et al. (2005) stated. Adding, GIS-based case study to estimate quantitatively the exposure of Mombasa coast in Kenya to effects of SLR was initiated by Kebede, Nicholls, Hanson, and Mokrech (2012). To support what Fish, et al. (2005) stated, the authors (2012) also found significant exposure of SLR to socio-economic activities in Mombasa recommending new developments to be stationed at less SLR prone areas.

In other words, in 2009, Dasgupta, Laplante, Meisner, Wheeler, and Yan (2009) did a similar work and found out that due to sea-level rise , millions of people in the developing world are bound to be displaced in the near future thus the need to account for SLR in new developments. Not only in developing countries but also in developed world without an adaptation plans. Hallegatte et al. (2011) support the idea of adaptation planning with their results from a case study in Copenhagen. The authors (2011) illustrated a methodology to be used in the assessment of SLR; a consequence of climate change, specifying the paybacks of investing in sea defences. Sea-defence is a critical human response to treat of SLR impact (Neumann, Hudgens, Herter, & Martinich, 2010). In Neumann, et al. (2010) work, spatial GIS modelling approach were used in estimating SLR risks or impacts in New Jersey. They provided geo-information which could be helpful for decision makers involved in adaption to SLR. Also, Adaptation measures are needed in Florida Keys because 95% land areas in Florida Keys has a potential impacts of SLR (Zhang, Dittmar, Ross, & Bergh, 2011). Zhang, et al. (2011) used remote sensing and GIS techniques in their estimation of SLR impacts in human population. Accordingly, Curtis and Schneider (2011) stated on wider note that "*substantial rates of population growth and migration are serious considerations for developing mitigation, adaptation, and planning strategies and for future research on the social, demographic, and political dimensions of climate change*". They found that about 20 million people in the United States are likely to be affected by SLR by 2030(Curtis & Schneider, 2011).

3.3.3. Sea-level rise responses and policy implications

Different dimensions of climate change consequences like SLR is addressed by policy responses. Like in the studies of Nicholls and Mimura (1998), assessment of the dimensions were looked at in four regions namely Europe; West Africa; South, South-East and Asia; and the Pacific Small Islands. They found strong regional co-operation to nurture mitigation approaches which they said requires information to address the challenging issues. To add to this, only policy responses are needed to tackle this pressing issues as Fussel (2007) lamented in his work. With this, author(2007) developed a conceptual framework to help in the assessment of impacts, vulnerability and adaptation to climate change to formulate policy in response. Thus, policy and decision makers in Bangladesh were provided with information through the

study of Karim and Mimura (2008) on predicted SLR in areas which are prone to help future development plans and designs. However, Paskoff (2004) stressed on that existing laws and regulations meant to govern coastal management to address impacts of SLR in France were adequate. Needless to say that developed countries have mechanisms in place to mitigate and adapt to impacts of SLR than developing countries.

3.3.4. Sea-level rise database and maps creation

Globally, SLR is a challenging issue that need adequate information to monitor trends and impacts to develop response plans to mitigate or adapt to it. Likewise, a database containing information on SLR shared through SDI is a distinctive advantage for all stakeholders at large. For instance, through the DINAS-COAST project (Vafeidis et al., 2008), a global database was developed containing information on 80 physical, ecological and socio-economic parameters of the coastal zone. Vafeidis, et al. (2008) argued that *“the database provides the base data for the Dynamic Interactive Vulnerability Assessment modelling tool”* developed by the project. They stressed that the database comply with the required standards of geographic features geo-referenced, stored and modelled to serve impact and vulnerability analysis to SLR. This, they argued it to be structurally consistent, user-friendly and worthy of information to support prospective varied uses (Vafeidis, et al., 2008). Thus maps can be created from the datasets within the database to create awareness among the public. Such maps were illustrated by Titus and Richman (2001) using overlays of elevation models of shoreline erosion, wetland accretion and other coastal processes information. Their maps were to show an area of approximately 58000km² of US Atlantic and Gulf coasts below 1.5m contour which were susceptible to SLR. The authors stipulated that, maps help to comprehend in a broad-scale increasing SLR. This broad-scale increasing of SLR globally has made it possible to institute a scientific body in charge of assessing the climate change and its consequences like SLR.

3.3.5. Intergovernmental Panel on Climate Change and sea-level rise

Consequences of climate changes such as SLR are assessed globally by the Intergovernmental Panel on Climate Change (IPCC). IPCC is an international scientific body established in 1988 by the United Nations Environmental Programme (UNEP) and the World Meteorological Organization (WMO) (IPCC, 2010) to provide information on impacts of climate change thus inclusion of SLR. It works within the framework of climate change drivers, impacts and responses as shown in figure 29 (in Annex I). The figure illustrates how human systems interact with the earth systems causing unstructured problems needing rigour policies with sea-level rise position indicated in red. These policies are normally formulated based on projections from IPCC. An example of such projection is shown in figure 28 (in Annex I) and figure 4 as adopted from Pachauri and Reisinger (2008) and IPCC (2010). In figure 28 (in Annex I), six scenarios of IPCC namely B1, A1T, B2, A1B, A2 and A1F1 scenarios; are given in numbers with footnotes. Whilst in figure 4, the six scenarios are represented graphically so one can easily see the differences in the SLR from the year 2000 till 2100. The scenarios were created from several models (Pachauri & Reisinger, 2008) from different working groups within IPCC.

IPCC working groups make projections on impacts of climate change specially SLR. Each group is tasked differently yet come together to publish an assessment report on which other researchers dwell to translate that into their local situations. As can be seen in table 9 (in Annex I), extracted statements from the current IPCC climate change 2007 assessment report. A comparative to the statements from the researchers as discussed in previous sections clearly shows the correlation with the IPCC statements. Hence, SLR has causes, effects, projections and uncertainties which governments develop strategies for mitigation and adaption not comprising on scientific knowledge (specifically geo-information) from all sections of the society. Here, Geo-IDS is seen as a main item in SLR to make available geo-information necessary for decision making among all stakeholders for them to change behaviour as seen in the transparency cycle discussed in chapter two. From here on, let us take a specific case on SLR in the Netherlands to know how information is disclosed and which underlying forces drives the disclosure.

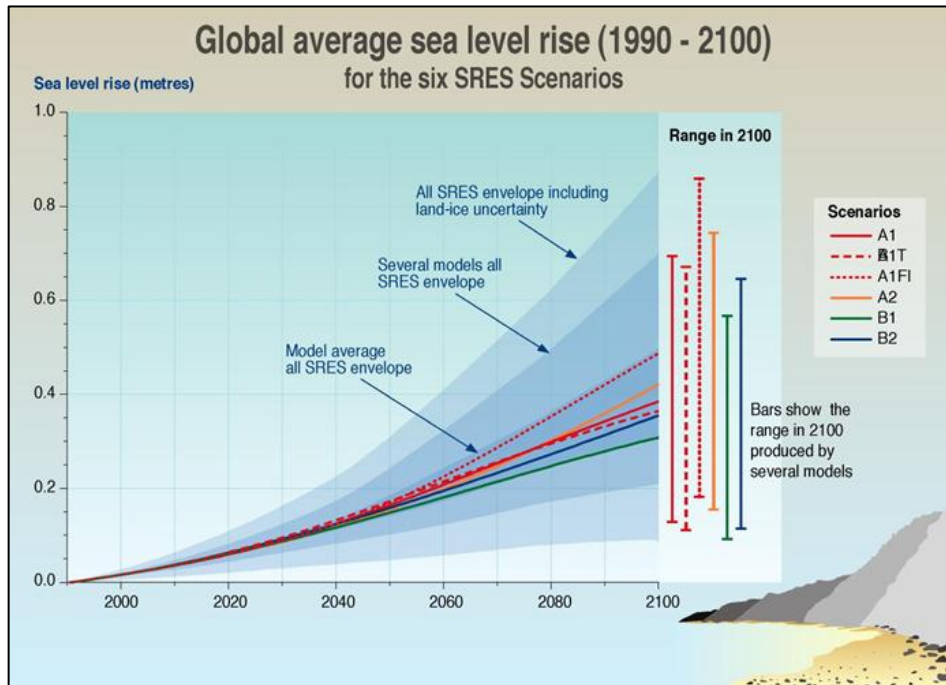


Figure 4 Global average sea-level rise (Source: IPCC (2010))

3.4. How sea-level rise is perceived in the Netherlands

The Netherlands had a population of 16.5 million in 2010 (de Moel, et al., 2011) and most areas lie below the sea level. The country is situated at the mouths of big rivers like the Rhine and Meuse making them vulnerable to flooding as shown in figure 5. The flood risks of deltaic areas (de Moel, et al., 2011; Kellens, et al., 2009) tend to increase due to human activities and urban growth. Major cities in the Netherlands like Amsterdam and Rotterdam lie below the sea level but host enormous economic activities and infrastructures that stand at a risk from flooding. Nevertheless, in Netherlands, 55% of the total surface area is covered by safety dike rings which houses 67% of the Dutch population with urban area of 62% (de Moel, et al., 2011). Because of the historical dike rings; a flood defence system, it is highly unlikely that a single flood event can cause much damage as stressed by the authors (2011). Yet, with increasing sea-level rises new flood management strategies need to be updated (Katsman et al., 2011). Katsman, et al. (2011) developed a SLR high-end scenarios for Netherlands based on IPCC fourth assessment report and lamented on the uncertainties in predictions calling for a thorough monitoring to improve the climate models.

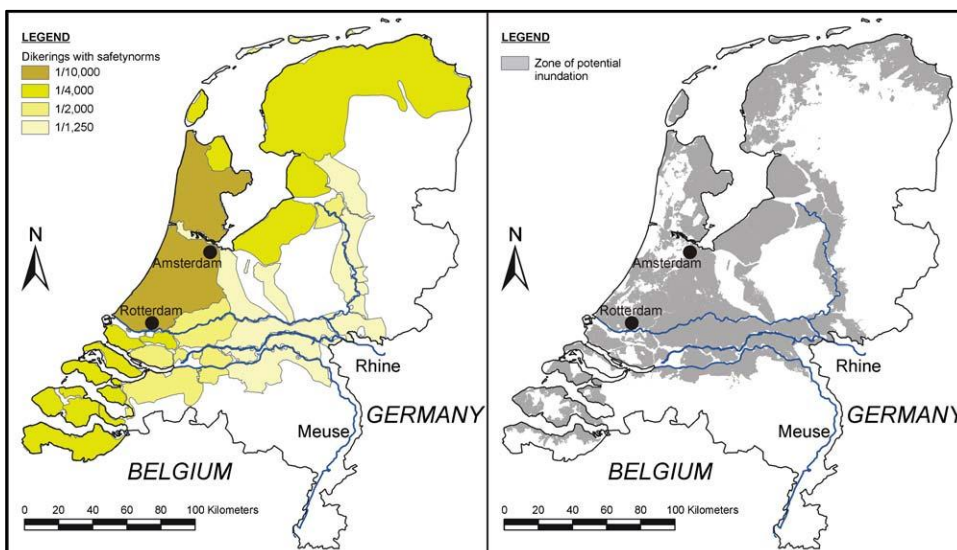


Figure 5 Map of the Netherlands displaying major rivers, the dike ring areas with their corresponding protection level (left panel), and the flood-prone zone (right panel).

Source: de Moel, Aerts, and Koomen (2011)

3.5. Inter (national) Policy and legislation context of sea-level rise

Monitoring and assessment of flood risk and related issues alike are governed by policies, rules and regulations in the Netherlands. A known phenomena as the whole country is flood prone to river discharges and water from the North Sea (van Alphen, et al., 2010). That is why the Dutch have the water system. “*The Water Management Centre the Netherlands (WMCN) is the information centre for the Dutch water system. The Water Management Centre bundles all products and services concerning information about water. By doing so, the Water Management Centre makes an important contribution to optimal management of the water system in the Netherlands*” (Rijkswaterstaat, 2011a). How the Water System works is as shown in figure 7.

As a matter of fact, one can say that the rising sea-levels are an additional burden to existing floods in the Netherlands. Floods risk management and planning has been classified into five. These are prevention, protection and, preparation, response and recovery as shown in figure 6 adopted from the work of van Alphen, et al. (2010). Figure 6 illustrates flood risk management instrument in the Netherlands as categorised into administrative levels and policy levels. The National Water Plan as indicated in red in figure 6 covers all the flood risk management classes in Netherlands. The authors (2010) explained that different authorities exist in managing flood risk as shown geographical by figure 8. As sea-level rise consequences are floods, therefore it can be inferred that its governing body should follow the same as administrative levels as in figure 6. The governing bodies exist at the national, regional and the local levels with respective plans according to the legislation (van Alphen, et al., 2010).

Aside the respective plans in the Netherlands, EU Flood Directive also guides how flood risk should be mapped. “*An EU directive that ensures that the risk of flooding is mapped out at a European level and that Member States cooperate better to manage and control flooding*” (Rijksoverheid, 2008). Such that, one can say that flood risk maps relating to SLR should exist in Netherlands that can inform citizens of the impacts of SLR.

3.6. Sea-level rise as main item of Geo-IDS

As specifically mentioned in the previous section; describes the current inter (national) regulations that obligate government institutions in Netherlands to collect data on flood risk thus also on SLR, one expects that the regulations should also govern the SLR geo-information disclosure to the public at large. In this manner, one can see the transparency in disclosure of SLR geo-information in the Netherlands.

Contrarily to this, in the Netherlands, governments are of the opinion that citizens should not be actively informed on risks that would affect directly their mediate environment (Meijer, 2005). This is to avoid unnecessary panics and fear within communities but rather develop plans as measures to protect citizens against risks instead (Meijer, 2005). However, after the Enschede factory explosions in 2000, the Dutch government intervened letting the provinces to provide risk maps to inform the public and also develop adequate plans for dealing with risks (Meijer, 2005) that may be due to artificial and natural hazards (Dunbar, 2007). So, transparency on risks increased in Netherlands due to the unprecedented crisis of the Enschede explosion but risk maps should be improved not to compromise security against terrorism as Meijer (2005) argued. Hence, geo-information disclosure is tailored based on organizational goals, interest and values (Fung, et al., 2007).

Depending on the goals and values of organisations, information disclosure would be different. Also, the type of SLR information that the government of the Netherlands need to have should be based on the rules and regulations highlighted above thus leading to the research question;

Which risk maps shows effects of SLR in the Netherlands?

	Prevention	Protection	Preparation	Response	Recovery
Legislation	Spatial Planning Act (SPA)	Water Act (WA)	Safety Regions Act (SRA)		
Administrative level					
State	National Water Plan, TPW&WM– accent on protection (WA), also zoning scheme (SPA)				
	National Spatial Strategy, HSPE (SPA)				
		National Flood protection programme, TPW&WM (WA)			
			National floods crisis plan and large-scale evacuations, IKR (SRA)		
Province (12)	Provincial Water Plan (WA), also zoning scheme (SPA)				
Waterboard (26)	Water Management Plan (WA)		Flood Disaster Management Plan (WA)		
Safety region (25)	Crisis Coordination Plan (SRA), Disaster Management plan (SRA)				
Municipality (450)	Land use plan (SPA)				

Figure 6 Flood risk management instruments in the Netherlands

(Source : van Alphen, et al. (2010))

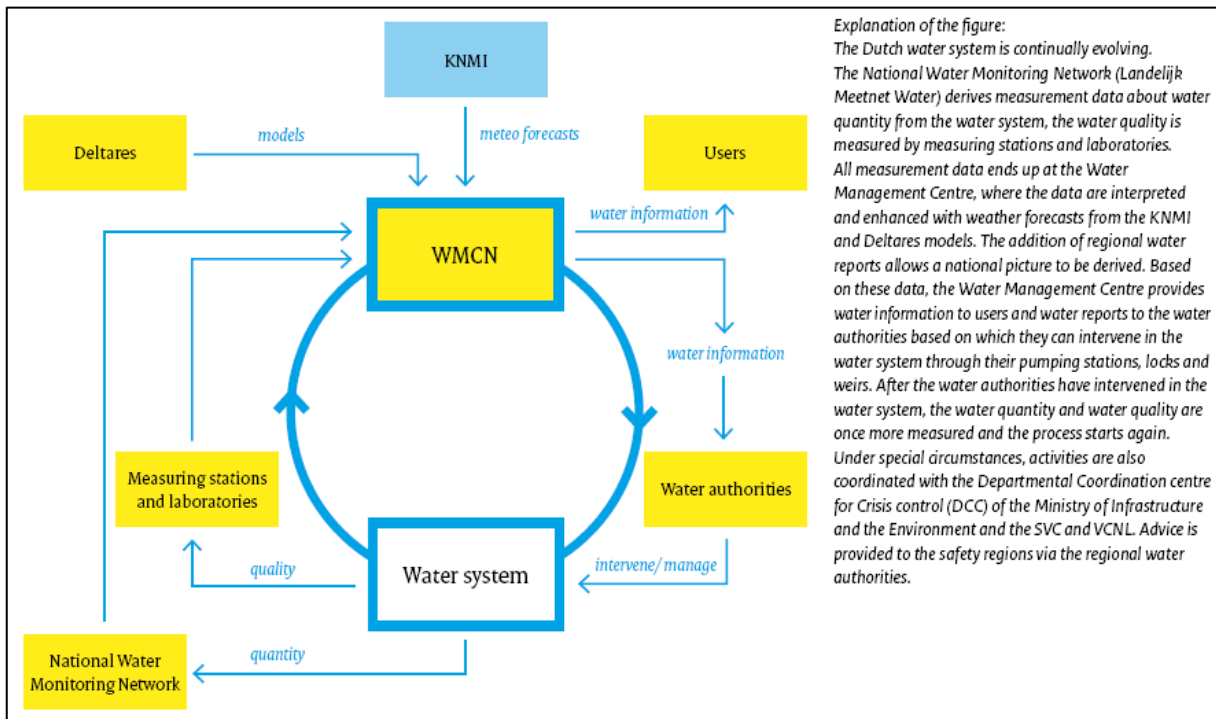
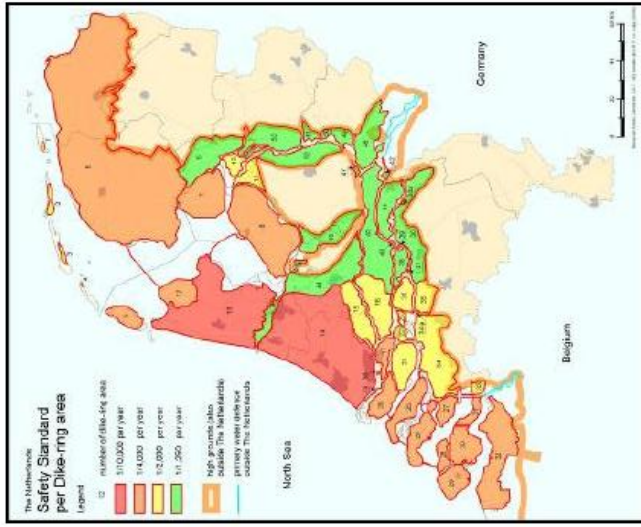
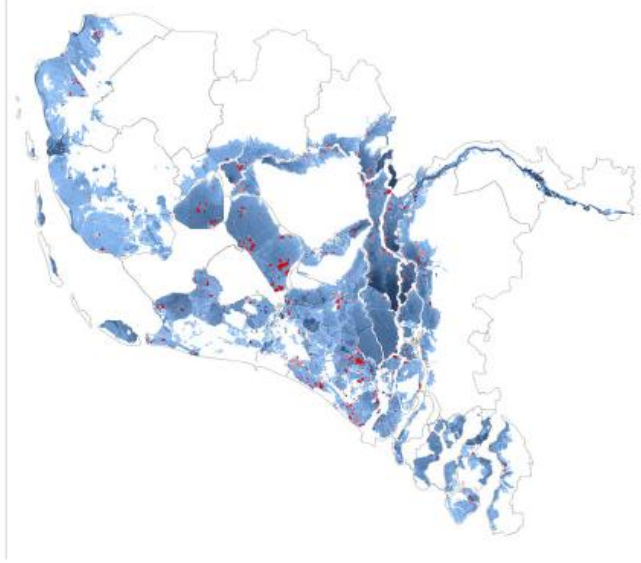


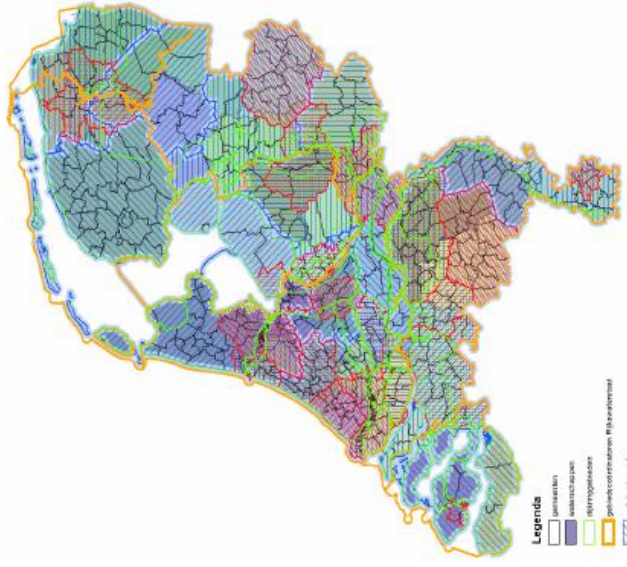
Figure 7 The Dutch Water System (source : Rijkswaterstaat (2011a))



Legal level of flood protection
(Flood Defence Act, 1996; Water Act, 2008).



Flood hazard map, presenting
maximum depth of flooding of dike rings.
New urban developments are red.



overview of territorial boundaries of
provinces, waterboards, municipalities and safety
regions (Deltareas)

Figure 8 Maps of Netherlands showing flood prone areas and defence mechanisms
(Source: van Alphen, Hoornstra, Knijff, and van Duijn (2010))

3.7. Maps showing effects of SLR in the Netherlands

In Netherlands, risk maps showing effects of SLR is given as an inventory in table 11 (in Annex III). There again, examples of such maps is shown in figure 10, 11, 12 and 13. But figure 9 presents a graph drawn to show sea-level along the Dutch coast. These, figures (9, 10, 11, 12 and 13) are the kinds of information available for the public use. Also in figure 9, the data associated with the graph can be downloaded as indicated in red. These types of information the government of the Netherlands have that is to disclosed to diverse audiences show SLR as in figure 9 and impacts of SLR as in figures 10, 11, 12 and 13. However, the kind information disclosed cannot be explained unless the underlying forces are known. Similarly, one needs to know the role of policy in the disclosure of SLR in the Netherlands as can be seen in the examples of Geo-IDS that were found via the Google search engine with the key words “sea level rise maps”.

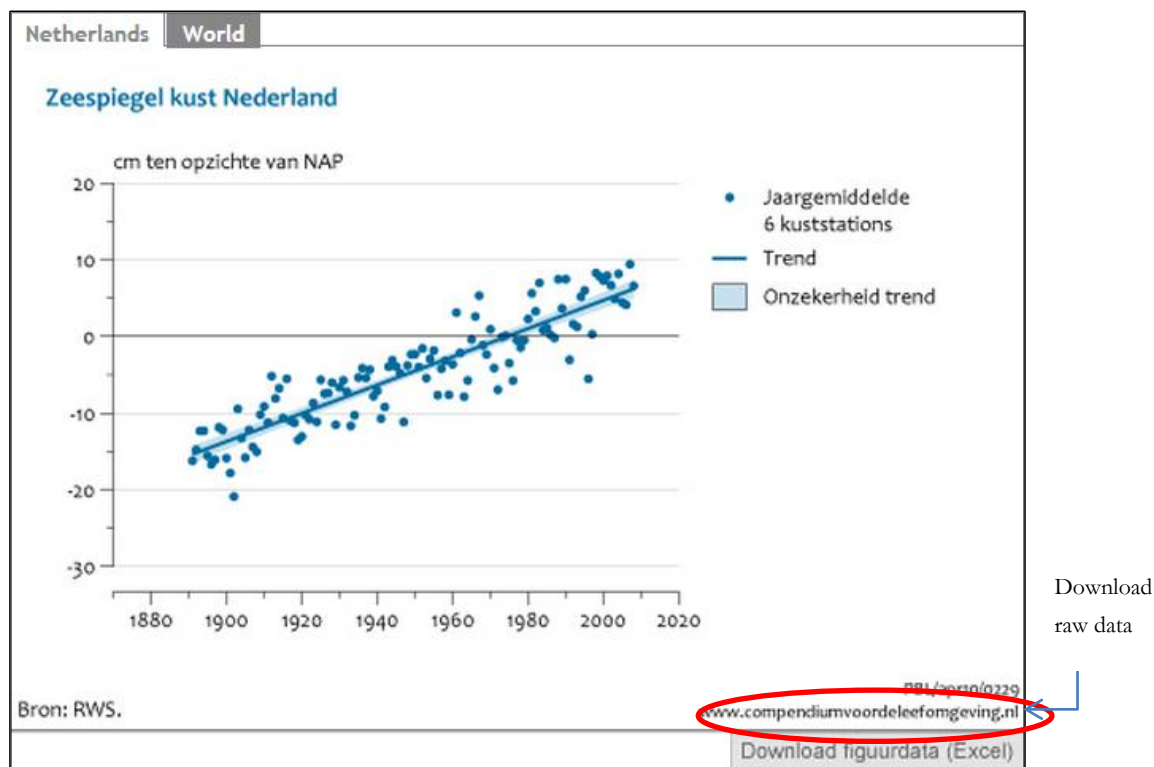


Figure 9 Sea-level along the Dutch coast by about 18 cm higher in the 20 e century
(Source:(CBS, PBL, & Wageningen, 2011))

3.8. Examples of Geo-IDS relating to SLR

The main purpose of this section is to present examples of Geo-IDS relating to SLR. This seeks to meet objective 3 of this study which is to make an inventory of examples of Geo-IDS relating to SLR. Examples of Geo-IDS are based on searches using Google as the search engine with the key words “sea-level rise maps”. The examples of the Geo-IDS is given as an inventory as shown in table 10(in Annex II). This is to answer the research question;

Which maps exist that relate to disclosure on SLR?

Maps existing that relate to disclosure on SLR considered being Geo-IDS are given by the inventory in table 10 (in Annex II). In the columns of the table gives the characteristics of each map which are named by its name and year; responsible organisation and mission statement; rules and regulations that govern the map making; the tools and datasets; brief description and the link to the webpages are provided. The rows show the different maps that were found through the searches. Whilst snaps shots of one of the Geo-IDS is shown in figure 30 and figure 31 all in Annex II. The figures illustrate an interactive map by surging seas where one sees major changes that show increasing affected areas with corresponding affected persons' with a SLR of 10 feet as indicated in red circles. Likewise, one sees immediately that the actual number of person who would be affected should it increases. The main features are the responsible organization, the mission statement, description of the maps and a link to it is also provided.

3.9. Conclusion

The Chapter looked at the underlying forces of geo-information disclosure on sea-level rise in the Netherlands. Firstly, it was found out that, most debates on sea-level rise is targeted at trends, exposure, impacts and responses, at the local, regional and global level. At the global level, we have the scientific body IPCC of which all literature on sea-level rise revolves around their findings. Secondly, how sea-level rise is perceived in Netherlands was discussed. The rules and regulations on SLR geo-information disclosure and the responsible agencies for both the disclosure and monitoring were also revealed. Thirdly, examples of risk make relating to SLR in Netherlands were also given. Lastly, examples of risk maps of SLR believed to be Geo-IDS were highlighted.

The disclosing of SLR geo-information inter (national) laws that force or empower agencies to collect and distribute data on SLR globally is embodied in IPCC framework. But in Netherlands, the major rules and regulations should be govern by the National Water Plan whereby the Dutch Water System is in charge of its implementation. Examples of products of SLR are also given and also in Annex III. Again, products of Geo-IDS can be found in Annex II. However, the aim of the Chapter was to answer the reach question:

What are the underlying forces of Geo-IDS on SLR in the Netherlands?

The next Chapter presents the methods to collect actual data about SLR disclosure.



Figure 10 The Netherlands above and below sea-level
(Source: Unknown)



Figure 11 A map showing effect of SLR: the Netherlands becoming brackish
(Source: Unknown)



Figure 13 Map of Netherlands showing risk of breaches faced by dike zones
(Source: Unknown)

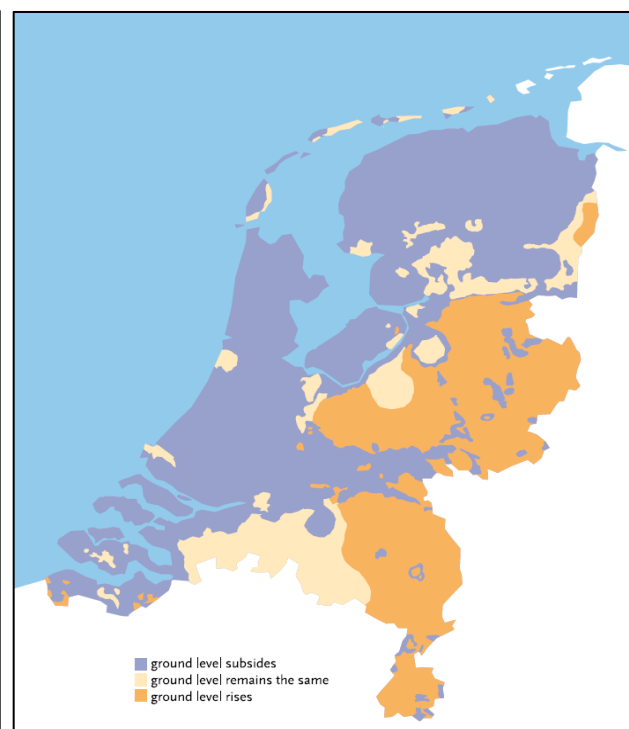


Figure 12 The expected subsidence and rise of ground level up to 2050.
Source: Rijkswaterstaat (2011b)

4. METHODS TO INVESTIGATE DISCLOSURE OF SLR

4.1. Introduction

The aim of this chapter is to present methods used in achieving the research objectives learnt through the literature review done in chapter two. Appropriate methods to answer research questions for example, to answer question “how to collect data about actual SLR disclosure in the Netherlands” and so forth. The idea is to bring forth a detailed description of the research design and methods requirements in achieving the objectives of this study. It comprises of nine sub-sections starting with an indication of type of research the study is about and the mixed method approach adopted followed by a research matrix. The research matrix contains the summary of all the methods and data sources that seeks to answer the research questions posed in chapter one. Section four describes the instruments and tools used in collecting data on the disclosure of SLR. Further, the section discusses the data collection techniques, mechanisms. Data processing and analysis are described in section seven as the research process is presented in section eight. Lastly, section nine gives a conclusion that ends the chapter with key issues discussed in previous sections. However, let us begin with the type of research this study adopted.

4.2. Type of research

The type of research undertaken is a case study research to investigate disclosure of SLR information in the Netherlands. A case study is defined by Yin (2002) as “ an empirical inquiry that investigates a contemporary phenomenon within its real-life context especially when the boundaries between phenomenon and context are not clearly evident”. Further, Yin (2002) contends on why a case study is a specific strategy for an investigator who has little or no control over “ a how or why question being asked about contemporary sets of events” and stressed on that it has a distinct advantage. Thus, this type of research is employed here to help us understand how organizations involved in issues on SLR disclose information to the public. In other words, it aids in explaining the reasoning behind disclosure on SLR thus giving us a broader concept termed in this study as Geo-IDS. In the field of the case study, mixed methods approach is adhered to achieve the research objectives.

4.3. Mixed methods approach

A mixed method approach is adopted in this study to help answer adequately the research questions posed in chapter one. This approach combines different research methods in within a single study in order to achieve research objectives from a multidisciplinary perspective. It is a fundamental choice to apply mixed methods of data collection and data analysis as has been used by other researchers to successfully answer questions on hidden values of individuals and organizations. For example, this approach was used by Meijer (2007). This approach is needed and appropriate in this study for the following reasons.

Firstly, there are always hidden values in policy making and policy debates. Secondly, these values are not often written down in policy documents or scientific reports. Thus, one would need however a description of these values in order to understand the drivers, choices and motivations of politicians, bureaucrats and scientists alike to ultimately understand how the issue of sea level rise is contested more specifically in the Netherlands. Thirdly, any policy on disclosing of information on sea level rise is contested, therefore in order to get a better view on the contest and the viewpoints, an open approach is needed thus the mixed methods approach. Lastly but not the least, documentation on sea level rise and its disclosure is not

consistent in literature. Given this choice of mixed method approach, the next section discusses the methods used in the study.

4.4. Methods and techniques for data collection

The methods and techniques employed in this research are discussed concisely in this section. Firstly, the methods were figured out from the literature reviewed in chapter two. However, the methods selected for this case study includes a survey, unstructured interviews, content analysis of publications, direct observations and structured web pages analysis shown in figure 14. The next section presents the reasons for the selection of the methods used in this study.

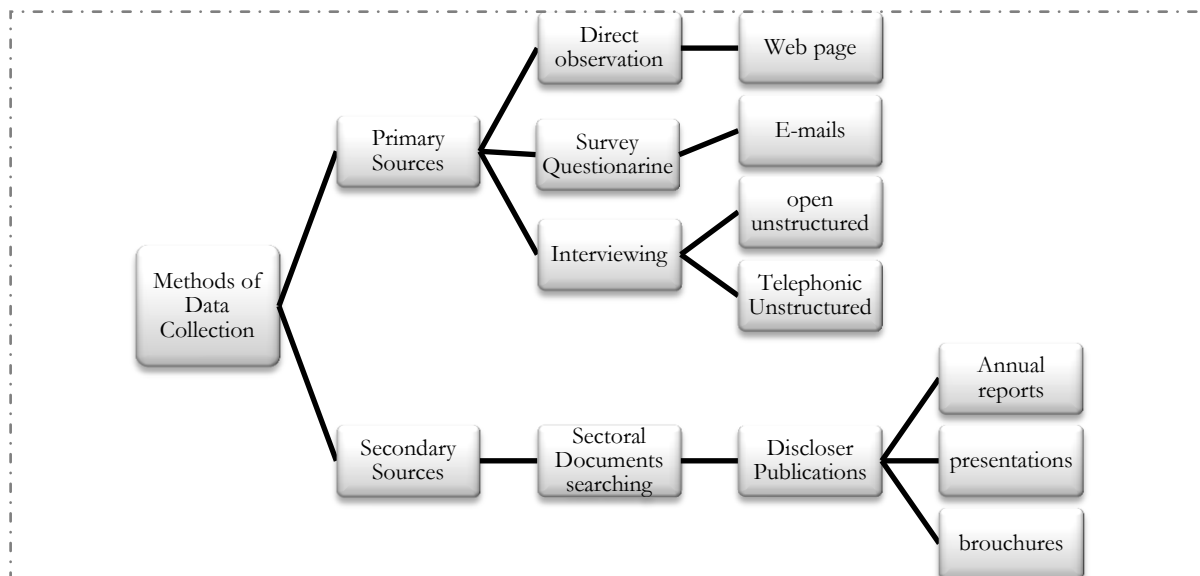


Figure 14

Diagram illustrating the research methods of data collection and data sources

4.5. Goals for the collection of data

The main goals and methods chosen for data collection depend very much on the conclusions highlighted in chapter two. These goals are:

1. To check for the validity of the definition of Geo-IDS and how this is shared among the scientific and professional community involved in issues on SLR. This is to ascertain which issues they think is more or less important.
2. To determine whether usually disclosure on SLR is guided by rules and regulations as concluded in chapter two. Thus, to evaluate the kind of regulations which exist and which one the experts on issues on SLR know about and the degree to which these regulations are been complied to.
3. To check whether disclosure depends very much on political or policy influence or not.

From these goals therefore, there was the need to look up for examples of Geo-IDS on SLR globally and identify their characteristics to see if they match the definition of Geo-IDS. In this way, the characteristics can allow us to compare with examples of SLR effects maps in the Netherlands and see the differences. Thus, the data collection aims to investigate the causal relation of the Geo-IDS on SLR in the Netherlands. As a result of this causal relations needed to established, various instruments are needed for data collection from both primary and secondary sources as has already been demonstrated in figure 11. From here on the instruments for the data collection are described in detail.

4.6. Instruments for data collection

In this study, mixed method approach is adopted requiring different instruments to collect data from secondary sources and primary sources. Literature searches to define concepts were done using the internet. The internet made it possible to use digital library resources. The library resources has database listed on the ITC library webpage. In other words, journals and articles used in the literature review were obtained from library online databases specifically the web of science database. Snow ball (Miles & Huberman, 1994:28) mechanism was used in searching the Web of Science database for relevant literature to the topic. Snow ball or chain “*identifies cases of interest from people who know people what cases are information-rich*”(Miles & Huberman, 1994:28). In this case however, Snowballing is not about seeking cases from people but rather seeking references from one journal or article to another in order to obtain rich information in a multidisciplinary environment. The snowball was necessary here as the topic has not been given much attention in literature. The literature searched for were from different perspectives to define the concepts for this study. As a consequence, instruments thought of for the data collection is as described below.

4.6.1. Internet searches

First and foremost, internet searches were employed to search for examples of risk maps on SLR believed to match the concept definition of Geo-IDS.

4.6.1.1. Internet searches of Geo-IDS examples

The key word used in the Google search engine was sea-level rise maps. Many hits were obtained but only few were looked at for their characteristics and the result was entered into a table. The completed list became the inventory of examples of Geo-IDS as seen table 10 (in Annex II). Further, one example of the Geo-IDS as an interactive map has been included in the Annex II (figure 30 and figure 31). These Geo-IDS searches were followed by SLR discloser webpages search in the Netherlands.

4.6.1.2. Discloser organizations web pages searches

Webpages of organizations and how they were searched for are presented here in this sub-section. In Web of Science database, the key word used was “sea-level rise Netherlands”. Journals were searched through to which organisations the authors were coming from. From this, organisations believed to disclose information on SLR webpages were obtained using Google search engine. The webpages were entered into Microsoft excel sheets as an inventory which helped in analysing content for publications on SLR to obtain maps which has effects of SLR. An inventory of the maps relating to SLR in Netherlands was made as given in Annex III. The displays of such maps are shown in figures 10, 11, 12 and 13.

4.6.2. Direct observations and content analysis of publications

Following the webpages searches, SLR publications within the sites were searched for noting potential expert to contact. This was done through direct observations and content analysis of which person is a key person to contact within the organisation. In all, 35 contacts were listed which forms the basis to explore for more information about disclosure on SLR. Thus, the 35 experts from different organisations believed to be disclosers of information on SLR were contacted through e-mails.

4.6.3. Survey questionnaires

On the 28th of October 2012, e-mails were sent to the mentioned 35 experts on SLR and that contained survey questionnaires. In that, a brief introduction was given on the topic with the amount of time it shall take to complete the questions and stating categorically that the survey would be followed up with an interview. The purpose was to establish the fact that organisations exist in Netherlands who disclose information on SLR, what their main responsibilities were, the rules and regulations they abide by in the

SLR disclosure, etc. A total of five (5) questions were asked but only five (5) experts sent their feedback by answering the survey questionnaires. In this regard, there was the need to conduct interviews to obtain empirical data to answer the set objective for the research questions. Once the responses were not too encouraging, it was decided that the follow-up interviews should be unstructured so as to get rich information to answer the research questions appropriately.

4.6.4. Interviews

Succeeding the survey responses, an interview was planned for as described in the next sub-sections. The aim was to collect empirical data to answer to the extent of transparency on SLR disclosure in the Netherlands.

4.6.4.1. Concept-variable data collection matrix

In order to prepare the interview questionnaires, it was necessary to contextualize the questions in relation to the research objectives. This can be visualised best through a concept-variable data collection matrix presented in table 2. In table 2, three (3) main concepts were looked at. Further, concepts were dimensioned to contain indicators which were measurable. However, a decision column to the indicators was made in to determine which answers correspond to which dimension of each concept. These became guidelines in analysing the key expert interviews discussed in the next segment.

4.6.4.2. Key expert interviews

In obtaining an empirical evidence to address the research problem, open and telephonic interviews were conducted. In both cases, the data collection was through unstructured interviews with key informants from organizations believed to be partially or actively disclosing information on sea-level rise. The purpose of the unstructured interviews was to obtain an in-depth knowledge on how sea-level rise information is mostly disclosed in the Netherlands. Experts believed to have a sufficient knowledge on the subject of sea-level rise information disclosure are here referred to as the key informants.

The key informants were chosen using the snow ball method. Thorough searches on disclosers of sea-level rise information publications on their website unveil these key informants. This depended most on the kind of project they are involved in within the organization. These publications also provided their e-mails which made it easier to contact them to seek their consent beforehand. In all, thirty-five (35) potential respondents were identified from ten potential discloser organizations. This made it possible to send e-mails to them on the 15th of November given a brief introduction about the project being carried out. Also, the duration of the interview was stated as 30 minutes and they were made to choose the date, time and venue which would be most convenient for them. With this e-mails sent, eleven (11) out of 35 consented to be interviewed. The others either recommend their colleagues within the same organization, some were not available due to illness and others did not respond at all although reminders were sent. The interviews took place from 20th November 2012 to 7th January 2013 based on the indication by the respondents. Some preferred being interviewed openly whilst others chose to be interviewed through the telephone. The interviews conducted are as described below starting with open interviews.

Open interviews

Open interviews here refer to having a face-to face contact with the respondents. This means that, interviews were conducted in the office of the respondents within their own organizations. In all, five (5) out of eleven (11) were interviewed with nearly the same unstructured interview questions. Fourteen (14) questions were asked given the opportunity for every respondent to give a remark on the issue on disclosure of information on sea-level rise. The interviews conducted in this manner were all recorded using the voice recorder but not without seeking first the consents of the respondents. The remaining six (6) respondents were interviewed through their telephones named here as telephonic interviews.

Table 2 Concept-variable-data collection matrix

Main Concept	Dimension	Indicator/Characteristics	Interview question	Data analysis Possible (range of) answers	Decision: Relation of answers to indicators / concepts/
Type of sea-level rise information disclosure	Content	Kind of map layers or facts	1. How are citizens informed on sea-level rise currently?	Interpretation through coding and reassembling and aggregating the codes In responses indicates communication with citizens on SLR using maps	If responses indicates certain information kind, I consider as relevant If maps shows no conflicting colours and symbols then consider readable If indications shows website, internet consider available everywhere and public If an indication of information updates I consider relevant
	Visualization	Type of colours, symbols, text, legend	2. What do you think is the best way to inform the public on sea-level rise?		
	Technology	Medium of disclosure	3. Do you think sea-level rise maps can inform citizens as desired?		
	Techniques	Frequency of disclosure	4. What kinds of tools and techniques are used in communicating risk of SLR? 5. What kinds of information are mostly disclosed on sea-level rise and why? 6. How often are the contents of information updated?		
Actors influencing sea-level discloser	Disclosers	Number of disclosers	7. Is your organization involved in issues on sea-level rise and in which way?	Interpretation through coding and reassembling and aggregating the codes	If responses indicates an organization, I consider as a discloser If responses indicates a user, I consider as a user of information If responses indicates organization who checks disclosure, I consider as relevant If responses indicates organization who responsible for of SLR disclosure, I consider as relevant If responses indicates information updates, I consider as relevant
	Users	Number of users	8. Who are the main actors in providing the information on sea-level rise to the public?		
	Regulators	Number of regulators	9. Do they do this by themselves or it is their duty to do so and who checks these?		
	Responsibility	Kinds of task	10. Are there differences between what needs to be done and what is actually done?		
	Accountability	Number of Information updates	11. Which ways are concerns of users of the information sorted and how do they reflect in information updates?		
	Participation and feedback	Number of meetings, workshops with all stakeholders	12. What is the main purpose of informing citizens on the issue of sea-level rise? 13. What are the challenges in presenting facts on sea-level rise for all users to understand? 14. How are these challenges being addressed?		
	Enforcement	Number of reports on monitoring			
Compliance	Differences in actual and desired outputs				
Rules and regulations on SLR disclosure	Laws, Policy, Acts	Formal rules and laws		Query for indications of sea-level disclosure	If interview responses matches the section of the official regulation I consider it a relevant section
		Informal rules and practices		Interpretation through coding and reassembling and aggregating the codes	If codes points consistently to a certain practice, I will consider this a relevant practice and give it a label or name

Telephonic interviews

Telephonic interviews may refer to as interviews conducted through the telephone without any physical encounter with the respondents. With the use of internet VoIP, specifically Skype application software; free software for calling on the internet but charges applies as one calls a phone respondent’s phones were reached to make the interview a reality. The Skype was preferred here because it had an extension called Amolto Call Recorder for Skype which was more convenient to use to record the voice of the respondents for transcribing. However, the consent of the respondents was first sought for before making the recording. These resources were most convenient in terms of time saving and cost effectiveness. However, that flare of physical encounter to observe facial expressions and emotions or the respondents were not present. But the duration of the interviews and the type of questions were the same as that of the open interviews. With these conducted interviews in audio formats, they were then processed and analysed given the details in the next section.

4.6.4.3. Data processing and analysis

This section aims to describe in detail the data processing and analysis of the data collected through the key expert interviews. This helps to present the results to answer the research questions posed in this study. To begin with, the interviews conducted were transcribed as in the following sub-section.

Transcribing

Transcribing is the act of “putting thoughts, speech, or data into written or printed form”(OALD, 2011). Transcribing was necessary here because, the interviews were recorded and saved in formats that can easily be played by almost all application softwares that support mp3, wmv, etc. files. These recordings were then transcribed using a transcribing application software called FTW transcriber; a free software on the internet. The interface of the transcriber is shown in figure 15. This transcribe software makes it possible to reduce the speed of the voice to make the transcribing much .easier. The transcribed word documents were sent to the respondents for correction and for any additions they may want to add. Thus this transcribing of the interviews and sending them to the respondents for correction was a way to ensure the accuracy and validity of the data through the interviews. The interview data as transcripts; a total of eleven (11) were then coded as described in the next sub-section.

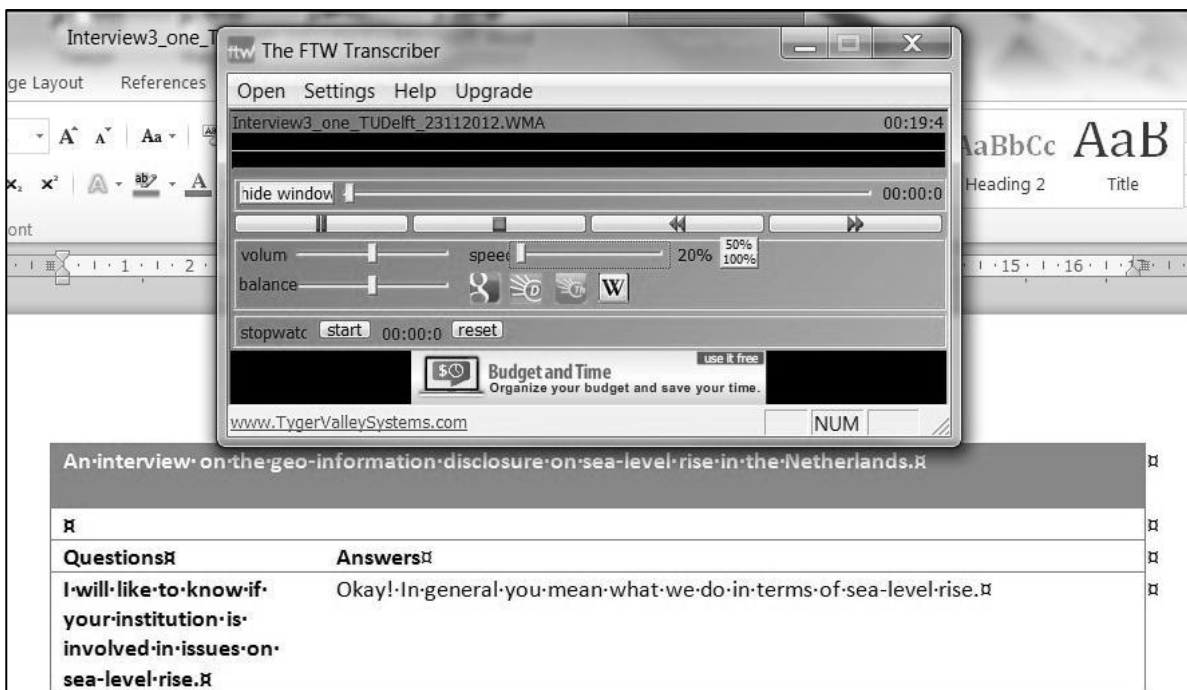


Figure 15 Interface of transcriber software for transcribing audio recorded interviews

Coding of interview data

Interview data in the form of transcripts were coded manually. Saldaña (2009) offers the definition of a code as “*A code in qualitative inquiry is most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data*”. Need to say that, the method of analysis here is to pick up important words and phrases to draw up a picture or form patterns of events occurring from responses of experts. (Saldaña, 2009) characterises patterns in six ways as shown in table 3 with a description what he termed a kind of pattern. In that manner as seen from the table, phases and words from the transcripts were grouped based on similarity, difference, frequency, sequence, correspondence and causation in conformity to the concept-variable matrix in table 2. Also the experts were anonymously coded as I with a number to identify each of them. For example, an expert who was interviewed second had a code of I2. Additional if an expert answers a question, that question’s number is attached to the expert in the coding process to determine from which question he or she responded in that manner. Therefore, an expert who was interviewed second and answered question 4 had a code of I2(4) as a unique identity in coding process. The resulting coding were resembled and aggregated to see the various patterns in the empirical data. This empirical data is shown in Annex VII. The whole research process is illustrated by a flowchart in

Table 3 Characterisation of pattern in coding qualitative data adopted from Saldaña (2009)

Pattern	Description
Similarity	things happen the same way
Difference	they happen in predictably different ways
Frequency	they happen often or seldom
Sequence	they happen in a certain order
Correspondence	they happen in relation to other activities or events
Causation	one appears to cause another

4.7. Research methodology process

In this section, a flowchart is presented to demonstrate how the research was conducted. This is shown a research process (research steps and methods) in figure 16. It starts with internet searches for literature and ends with thesis document.

4.8. Conclusion

In response to the research questions on how to investigate disclosure of sea-level research empirically, the chapter has derived concept-variable matrix based on concepts defined in chapter two. Disclosure of sea level rise in the Netherlands can best be studied empirically through an open, qualitative mixed methods approach, relying on data collection through unstructured interviews and documentary evidence. This was followed by a qualitative analysis which searches for and classifies underlying perceptions, views and beliefs on both disclosure and transparency; and the urgency or relevance of the issue of sea level rise.

The next chapter presents the results using the above mentioned research strategies applied for SLR disclosure in the Netherlands

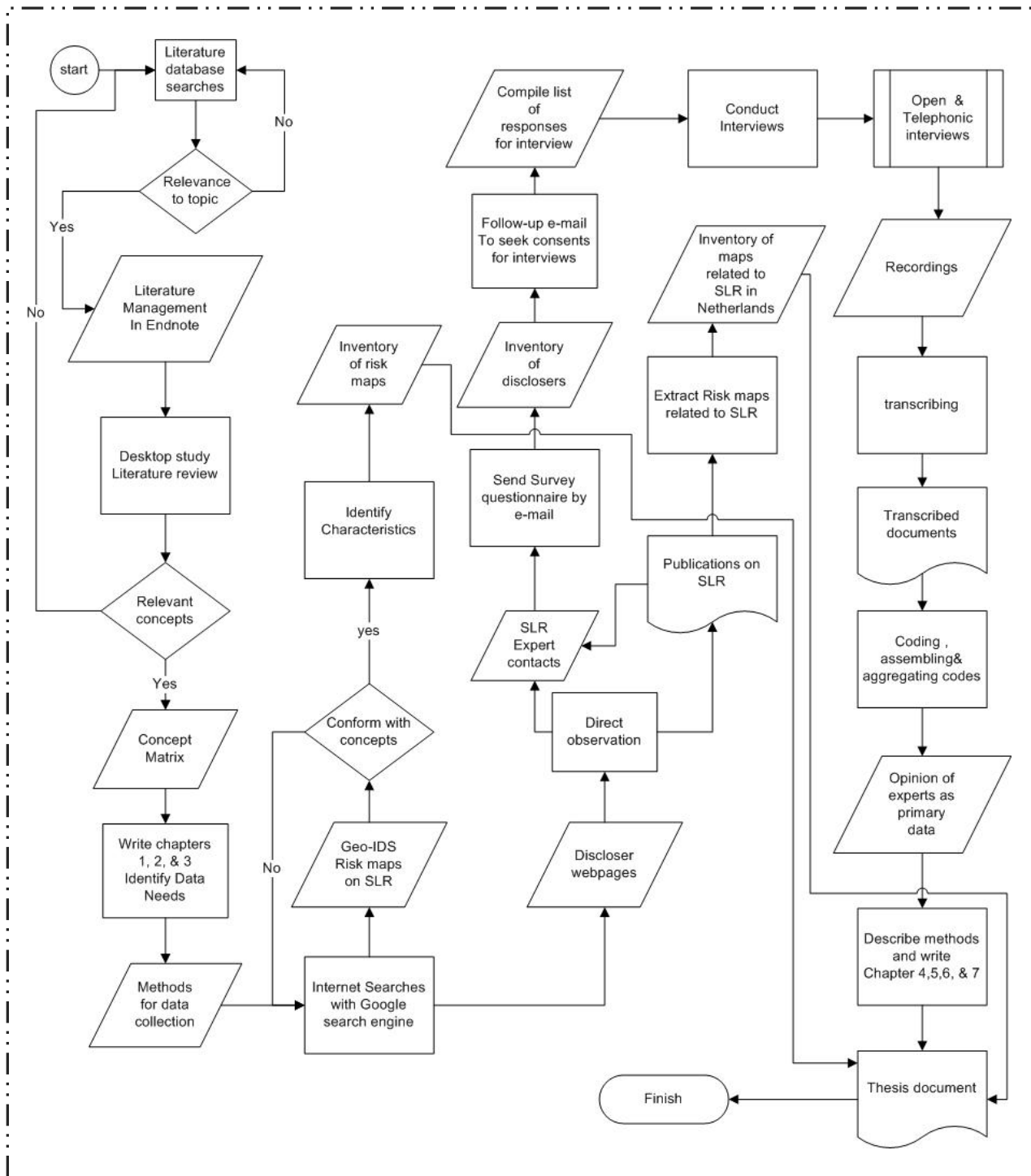


Figure 16 Flowchart of research steps and methods used

5. STATUS OF GEO - IDS ON SEA-LEVEL RISE IN THE NETHERLANDS: RESULTS

5.1. Introduction

The status of Geo-IDS on SLR in the Netherlands is presented in this chapter to meet objective four. Objective four is to determine the extent of transparency on SLR disclosure. Thus the aim of this chapter is to provide answers to the research questions set under the objective. These questions are: “which organisations are responsible to disclose information on SLR”, “which way do they disclose geo-information on SLR”; “To what extent do they abide by the rules specified” and “who checks this information disclosure on SLR” as stated in chapter one chronologically. The answers are results obtained using the mixed methods discussed in chapter three. Specifically, the empirical data from the expert interviews based on the conceptual framework discussed in chapter two are used in answering the questions.

The chapter is grouped into three main sections. The first section talks about what one need to look at when determining the extent of transparency on SLR disclosure. It is proceeded by three sub-sections which presents results for the type of SLR information disclosure with the dimensions defined in chapter four section 4.4 (the concept-variable matrix). Secondly, the actors influencing SLR disclosure are highlighted. Further in sub-section three, the rules and regulations on SLR disclosure is brought forth pointing out the formal and informal practices involved. Finally, a summary of the results or findings in the study that seek to contribute to effectiveness of Geo-IDS are presented in section three. However, the main purpose here is to know the extent of transparency on SLR disclosure in the Netherlands.

5.2. The extent of transparency on SLR disclosure

The aim of this sub-section is to present the results for the extent of transparency on the SLR disclosure. This is possible from the empirical data collected through the expert interviews. The main concepts of the objective were seen in the concept –variable matrix in table 4. Thus, the presentation of the results is done in the manner of the questions asked during the interviews to answers the research questions of objective four. Firstly, the results for the type of SLR information disclosure are offered.

5.2.1. Type of sea-level rise information disclosure

Information of SLR is seen to have four main dimensions. These dimensions are the content, visualisation, technology and techniques which is critical in disclosure of information. From the empirical data obtained and analysed through coding, assembling and aggregating, the results for the four dimensions are presented as follows:

5.2.1.1. Content of information

Content characteristics are kind of map layers or facts mostly disclosed on SLR. Thirteen (13) different content types were identified. Out of these, KNMI climate scenarios (updated every six years) has the highest score of sixteen (16) followed by Rijkswaterstaat original 10 minutes interval water data (updated every day) with a score of 12. Further, time series or a trend in SLR has a score of 7 whilst full description of methods, input data and model assumptions has a score of 7. The rest of the content types can be seen in table 4 with details in Annex VII. However expert I1 quickly added that

“In general, the information on the ministry’s website is basically just a little bit of information. But there are much more documents which are not always on the websites” I1 (9).

Table 4 Content of information disclosed on SLR

Content	
Type	Score
Climate scenarios (every six years)	16
Time series /trends	7
Original 10mins interval water levels data (every day)	12
Aggregated data of yearly averages of high and low water values i.e. Water levels above NAP (yearly)	4
10year averages in books	1
Optimist values and pessimistic values scenarios	1
Full description of methods, input data and model assumptions	6
Basic information	1
Velocity, mm per year SLR up to an absolute sand or relative to dikes	3
Displacement velocity be the parameter to communicate with quality description	2
Observational datasets	3
Elevation models	1
Satellite observations	2

5.2.1.2. Visualisation of SLR information

The results on visualisation as stressed on are as shown in table 5. In table 5, interactive map got the highest score of 4, but that is quite new or it being suggested by experts. As they are now learning by doing as statement form an expert I4 shows *“SLR visualization as maps is a difficult one what we do in terms of adaptation in general if we talk about certain areas we use all kinds of maps..... that is a consortia also for the knowledge of climate my programme that has one of the sub-programme is visualization of these kinds of things”* I4 (4). Details can also be seen in Annex VII. Further, the various kinds of tools were indicated by experts as seen shortly.

Table 5 Visualization characteristics of Information on SLR

Visualization of Information on SLR	
Characteristics	Score
Networked Computer-controlled room	2
Relevant on a small scale (global)	2
Two dimensional best to present with graphs	3
Spatial difference in combination with graphs	2
Colours are very important	2
Red relates to danger or warmer	1
Bluer more days and wet	1
Red and yellow for dry days	1
Drier and wetter, yellow to red	1
Red, yellow and blue are used for climate scenarios	1
Interactive Maps with zip codes and legend	4
3D models	1

5.2.1.3. Tools for SLR information disclosure

32 kinds of tools were identified as medium for disclosure. These are as shown in figure 17. The results of expert opinions show that geo-information disclosure is mostly done via the website of organisations with a score of 15. However, the experts acknowledge the fact that risks maps can be a useful communication tool given it a score of 13. Nevertheless, SLR information disclosure is contained in scientific papers with a score of 11. But the techniques mostly employed or can be adopted in disclosing information on SLR follows this section.

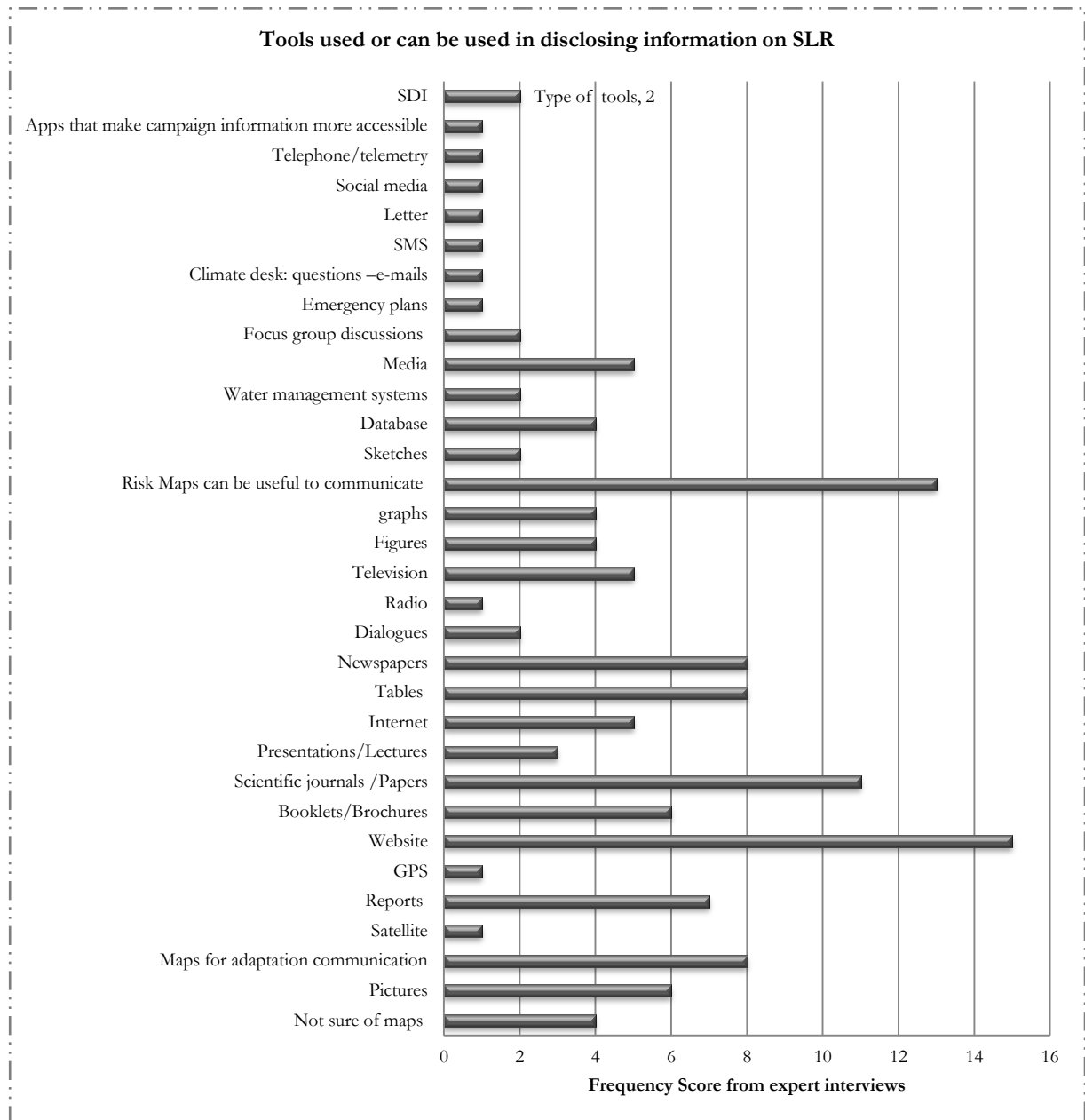


Figure 17 Tools for SLR information disclosure

5.2.1.4. Techniques for SLR information disclosure

In disclosing information on SLR, 23 kinds of techniques are used or can be used depending on one’s situation. The commonly used technique is to update scenarios when new IPCC information comes and that has a score of 9. Presentations to professional users, two-way communication with professional and informing people that have risk of flooding is more critical as they are have a score of 5. In fact, it is also important to know beforehand which kind of message you want to give and campaign that have a score of 4. The rest of the techniques can be seen in figure 18. Also, Annex VII has details of these techniques.

These techniques were highlighted by experts who are involved in issues on SLR. Consequently, from here on, let’s take a look at the actors influencing SLR disclosure in the Netherlands as can be seen in the next sub-section.

5.2.2. Actors influencing sea-level disclosure

An overview of actors influencing SLR disclosure is illustrated in figure 19.

In figure 19, the main actors are categorised into disclosers, users and regulators. These came as a result of the frequency with which the experts were referring to them. These actors are presented below starting with the disclosers.

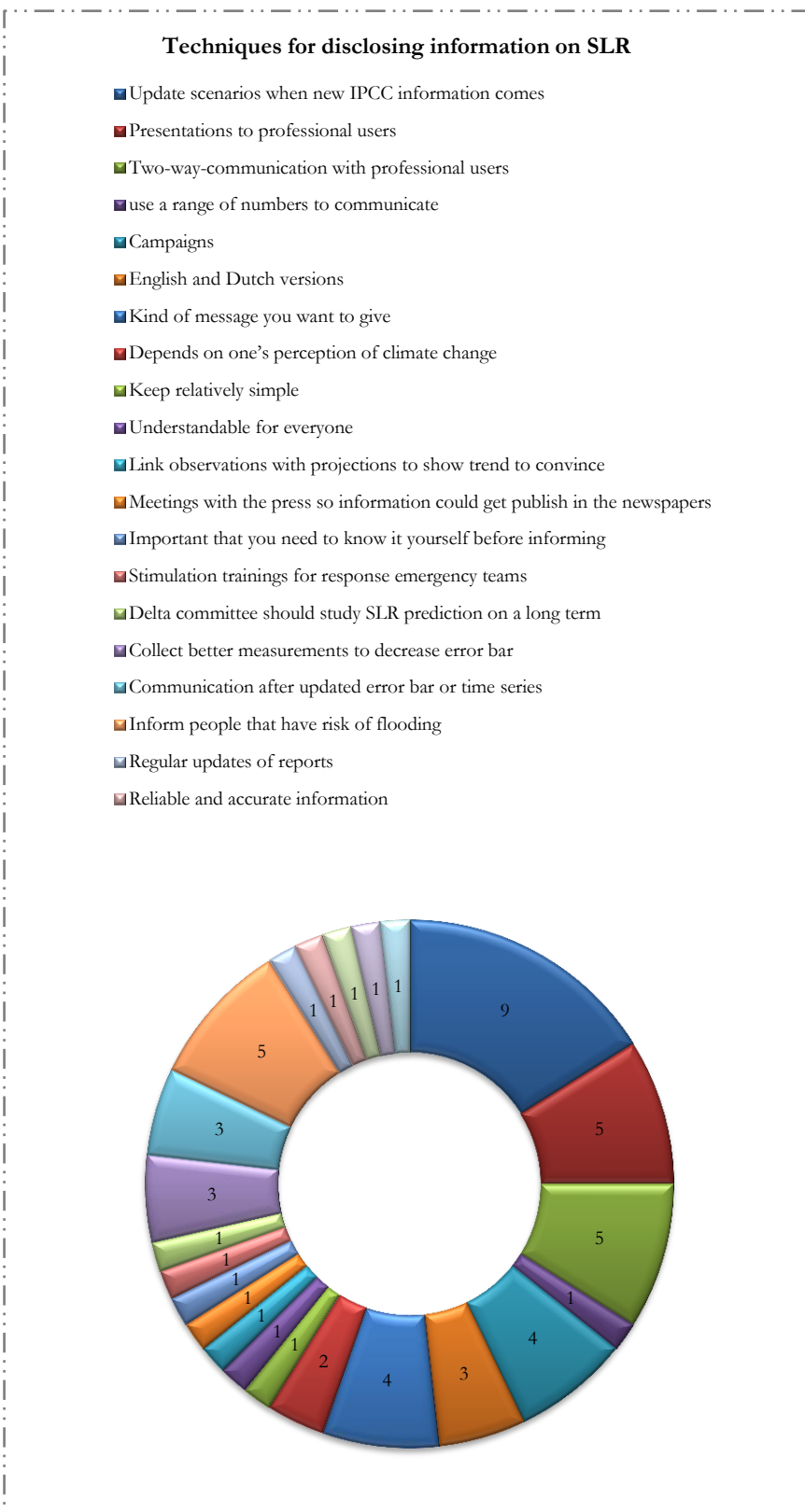


Figure 18 Techniques for disclosing information on SLR

5.2.2.2. Users

Figure 21 exhibits the frequency with which experts named organisations to be users of geo-information on SLR. Deltares has the highest score of 20 and is seen as the main user of geo-information on SLR. Also, the layers of government are users with a score of 15 whilst the Delta programme with a score of 15 is equally important user of the information on

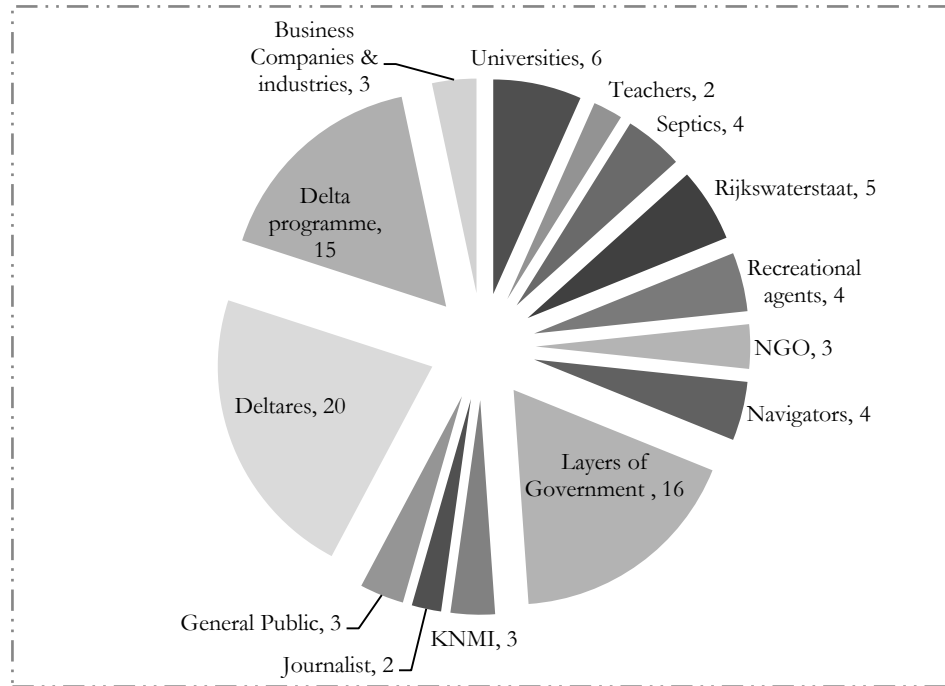


Figure 21

Main users of geo-information on SLR in the Netherlands

SLR. Further, demonstration of the relationship with each other is shown in figure 26 as the data behind it is also given in Annex VII. Following this, some experts also mentioned regulators as given in the section below.

5.2.2.3. Regulators

The layers of government which consists of the national, regional and local governments were given a score of only 3. At the national level, there is the Ministry, at the regional level we have the provinces and the water management boards whilst at the local level, and there are the municipalities. Each one of these regulators, users and disclosers has their own responsibilities shown in detail at Annex VII. For now, the next section presents a brief description of the main responsibilities of organisations that were mentioned the experts to be disclosers, users and regulators.

5.2.2.4. Responsibility

Responsibility of each organisation is given in table 6. These responsibilities are either governed by rules and regulations or by informal rules and practices like the case of KNMI. Details of these responsibilities can be seen in Annex VII. Yet, how the organisations account on their responsibilities follows shortly.

5.2.2.5. Accountability

Various accountability measures were identified in the empirical data. These are as shown in figure 22. Adaptation communication for support and commitment from the Dutch people is very important as that got the highest score of 15. Nevertheless, there are indications of general information on websites of organisations for the public to read if interested as it scored 7. There again, analyses of user requirements is also essential as indicated with a score of 5 together with information updates from user suggestions of a score of 5. Details of the results can be seen in Annex VII. Also, participation and feedback have been indicated there but a brief overview is as given in the next section.

5.2.2.6. Participation and feedback

The mechanisms for participation have been indicated through the expert interviews. The results in figure 23 show that regular contacts with professional users is a practice which is being adhered to in normal disclosure of information on SLR as it got a significant score of 11. In other words, enforcement and compliance to certain rules to communicate to citizens are shown in figures 25 and 24 respectively.

Table 6 Main responsibilities of organisations as named by experts

Organisation	Responsibility
KNMI	Focuses on analyse of SLR
Rijkswaterstaat	Measures, collects, stores, maintain observation water levels data, tide gauges in databases Water Management
Deltares	Impact researcher Design of dikes using hydraulic boundary conditions Flood defence calculations Real time series for Rijkswaterstaat
Policymakers; Delta programme	Develop policy , Strategies Plans Political commission for water safety risk for coastal flooding Adaptive approach Determine short, medium, long range SLR monitoring Beach nourishment for short term Strengthen of dikes for medium term; Make room for the rivers for long term Puts climate change on political agenda
NGOs	Put climate change on political agenda
Sceptics	Do not believe climate change
Navigators	Navigation purposes for ships
Teachers	Teaching purposes
Journalist	Carry messages in media
Recreational agents	Breach sports
Universities	Researches
Technical University in Delft	Research from space using Radar satellite images
University of Utrecht	Research on glaciers
Government (National, regional, local) Ministry, Water boards, Provinces, Regional Disaster Management Institute, Municipalities	Managing water discharges, National report on the safety of dikes, Communicate effects to public,
Knowledge for climate	Researches on adaptation
IPCC (External force)	Global partners in calculating scenarios
Opendata agencies	Act like intermediary between government and public
Department of environmental affairs	Should bear the responsibility of SLR disclosure
General Public	
Industry, Business, companies	

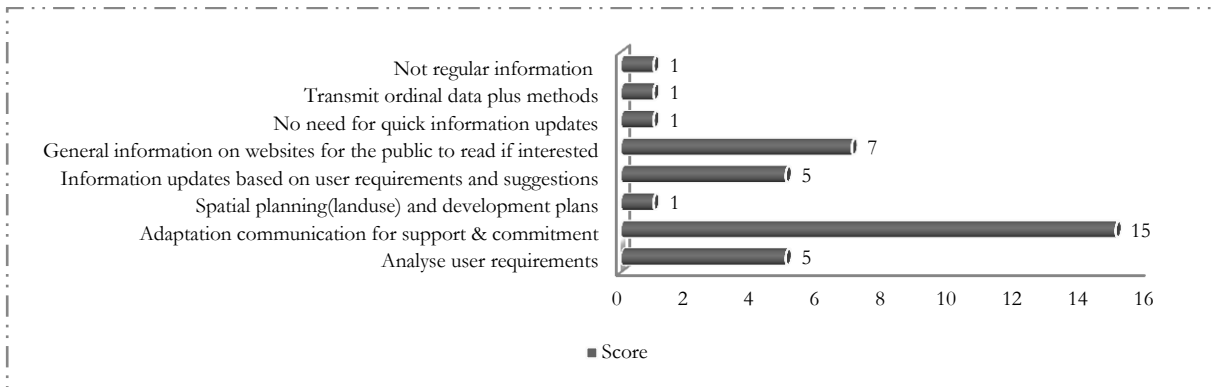


Figure 22 Accountability measures in the disclosure on SLR

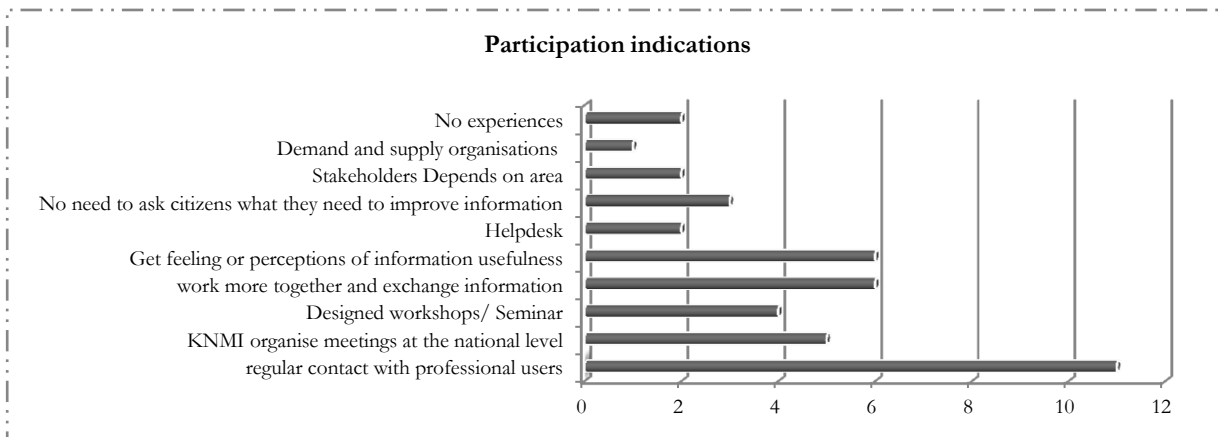


Figure 23 Participation indications in SLR information disclosure

5.2.2.7. Enforcement and compliance

The experts involved in SLR issues in the Netherlands have indicated that the organisations disclosing information on SLR do not adhere to any enforcement (in figure 21) nor do they follow any compliance (in figure 22). As stated by one expert that *“if there is nobody to produce the results then of course there is nothing to be checked eb”* I3(9) and an expert I4 was quick to add that *“not so much on laws and regulations but more on what the Ministry thinks it is good to tell the public”* I4(9). In other words, there are no rules and regulations in Netherlands to specify clearly on how disclosure of SLR information should be done.

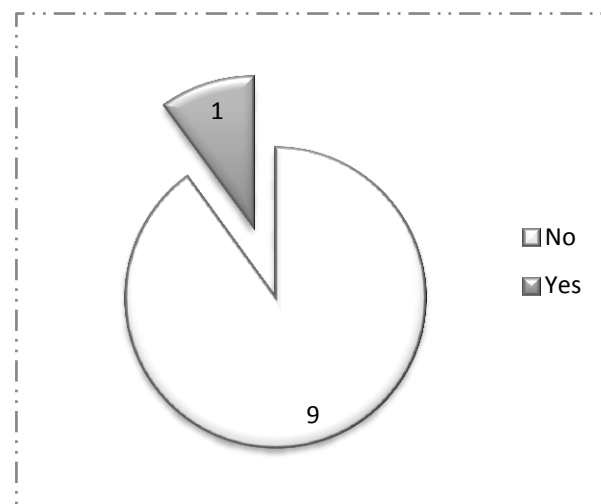


Figure 25 Enforcement of law on SLR disclosure

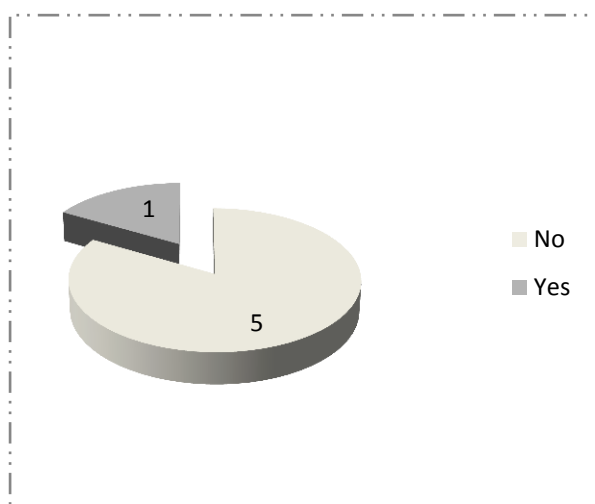


Figure 24 Compliance to rules and regulations on SLR disclosure

5.2.3. Rules and regulations on SLR disclosure

In Netherlands, the National Water Plan (2009 to 2015) presents the rules and regulations on how the water management in the Netherlands should be carried out. For example, I1(9) stated that the plan “describe what things they want to do with the water management in the Netherlands” I1(9). The water management consists of safety of the dikes (score 17), flood defence assessment (score 14) and hydraulic boundary conditions for flood water defences (score 15) which are mainly the significant practices governed by formal rules and regulations. Informally, predictions of SLR with the climate scenarios for the Netherlands (score 15) is also significant. The formal and informal rules are shown in table 7 and Annex VII.

Table 7 Summary of rules and regulations on water management

Legislation	Responsibility	Organisation	Expert agreement	Score
Formal rules and laws				
Coastal protection and river discharges National Water Plan (2009 to 2015) “describe what things they want to do with the water management in the Netherlands” I1(9) Dutch guidelines and technical reports for the design of the dikes I10(10)	Safety of dikes	Delta programme	I1(9), I9(9), I1(12), I6(12), I7(12), I8(12), I10(12), I6(14), I4(1), I9(2), I10(3), I10(4), I9(5), I10(6), I7(7), I9(7), I10(7)	17
	Flood defences assessment (six years)	Deltares Delta programme	I10(9), I5(12), I6(12), I8(12), I9(12), I10(12), I6(14), I4(1), I10(1), I10(3), I7(6), I10(6), I7(7), I10(7)	14
	Beach nourishment	Delta programme	I1(9), I6(12), I8(12), I4(1), I9(2), I7(7), I9(7)	7
	Room for the river and landscape changing	Delta programme	I1(9), I6(12), I8(12), I4(1), I7(7)	5
	Water levels measurements	Rijkswaterstaat	I1(8), I2(8), I3(8), I5(8), I6(8), I7(8), I9(8), I3(9), I9(12)	9
Voorschrift Toetsen op Veiligheid, or VTV2006 HR2006 (hydraulic boundary conditions)	Flood water defences hydraulic boundary conditions (5 to 10 years)	Rijkswaterstaat Water Management Boards	I5(9), I5(12), I6(12), I8(12), I9(12), I6(14), I6(1), I10(3), I9(5), I10(5), I7(6), I10(6), I5(7), I7(7), I9(7)	15
	Spatial development	Province	I6(12), I8(12), I10(7)	3
	Budgeting	Politicians Ministry	I3(12), I7(12), I8(12), I11(13), I2(14), I10(7)	6
EU flood directive	Flood risk maps	Waterdienst of Rijkswaterstaat	I6(14)	1
	Risk maps	Provinces	I7(15), I10(4), I10(5)	3
Freedom of information legislation I11(9)	inform the citizens and people about certain risk	Government	I8(9), I11(9), I3(12)	3
Informal rules and practices				
Not co-ordinated	Climate scenarios for the Netherlands	KNMI	I2(9), I1(8), I2(8), I3(8), I4(8), I5(8), I6(8), I7(8), I9(8), I3(9), I9(9), I0(9), I1(12), I7(13), I3(1)	15
	tidal predictions	Rijkswaterstaat	I5(9), I7(9), I7(13), I6(14), I5(1), I6(1), I6(3), I6(7)	8
	Organisation changing every five years		I5(14)	1
	Confidential information		I9(14), I10(1), I6(3)	3
	Good information for right choices		I3(12), I11(12), I1(14)	3
	Political awareness flood prone areas, prevention of damage and responses	Policy makers	I3(12), I2(12), I1(12), I4(12), I6(12), I7(12), I8(12), I11(12), I11(5)	9
	reluctant to provide that kind of information under certain conditions	Politicians	I11(13), I4(9), I1(9), I2(10), I3(1), I10(1),	6

5.3. Conclusion: SLR Geo-IDS in the Netherlands

The rules and regulations whether formal or informal together with the actors and their interactions using the various media in disclosing information on SLR can be seen as Geo-IDS, a transparency system where participation, enforcement, compliance and accountability is essential. This type of Geo-IDS on SLR in the Netherlands is demonstrated diagrammatically in figure 26. In figure 26, the actors (disclosers, professional users and regulators) cooperate very much with each other in the discloser box of the transparency cycle. After the interactions, each of these actors filters or makes choices of which information on SLR to disclose in public via their websites. The information mostly disclosed are climate scenarios and water levels which the main users in the user’s disclosure box can read and download from the websites if they are interested. However, the interactions of the users within the box are not known as this was beyond the scope of this study to find out. Conversely, Geo-IDS have a lot of challenges which would be discussed in the next chapter in order to come up with solutions that are factors to make it effective.

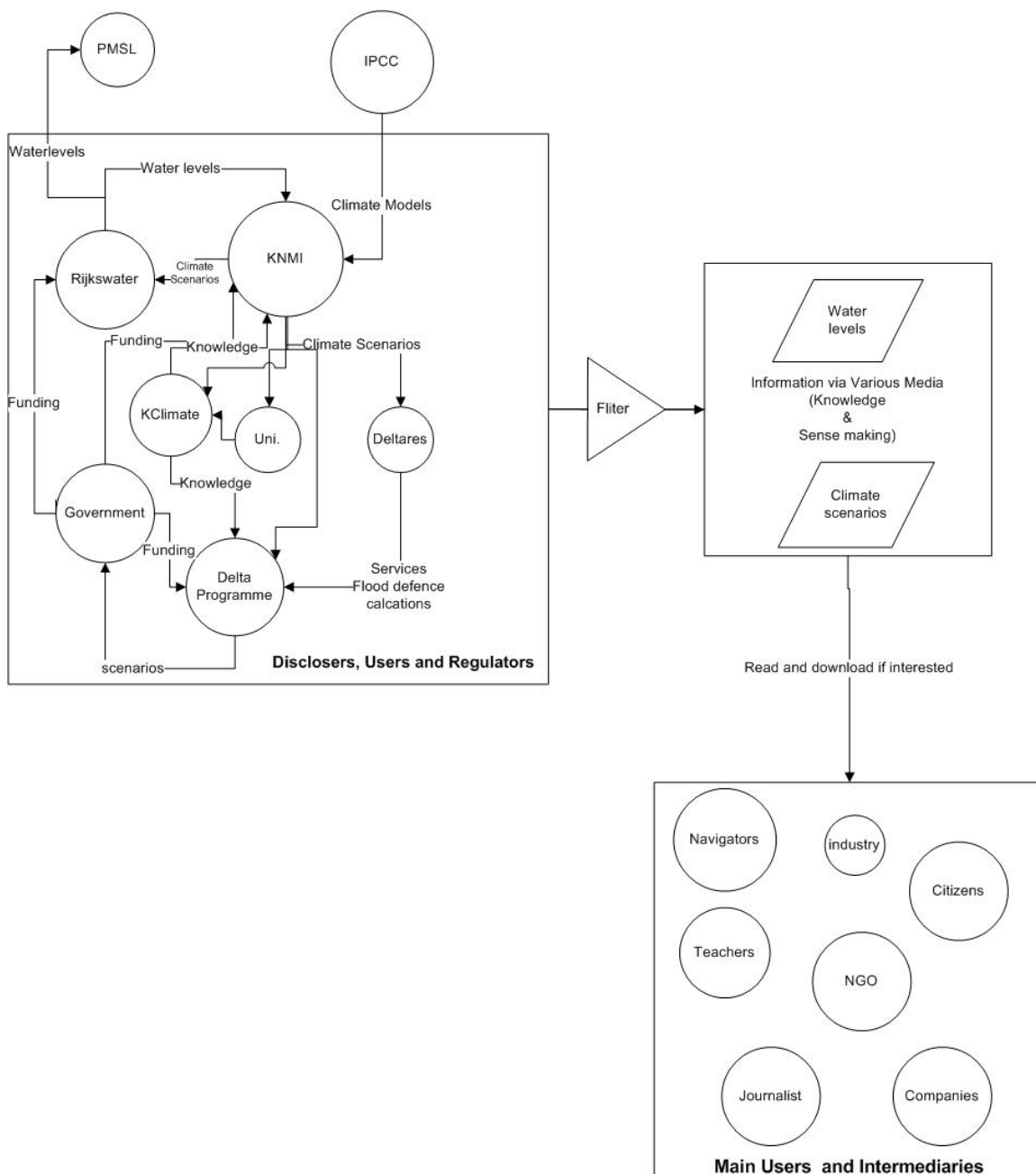


Figure 26 Interactions of disclosers, users, regulators and intermediaries with Geo-IDS

6. FACTORS THAT WOULD MAKE GEO-IDS EFFECTIVE: DISCUSSIONS

6.1. Introduction

The purpose here is to examine the factors that make Geo-IDS effective by assessing what leads to the underlying SLR information disclosure in the Netherlands. This is done by critically discussing the current situation to predict the policy intent thus make recommendations to shape it. The chapter seeks to answer the main objective of the research which is “to assess what would make Geo-IDS effective by identifying the elements behind disclosure of geo-information on sea-level rise”. The argument put forward follows the pros and cons of disclosure on SLR via the transparency system Geo-IDS to acknowledge those that can become embedded in users’ decisions due to policy and regulations.

6.2. Discussion on the status of Geo-IDS of SLR in Netherlands

From, the literature reviewed, it became evident that user’s decisions or perceptions on SLR would change if the Geo-IDS are effective. The effectiveness of Geo-IDS relies critically on elements or indicators which are transparency, responsibility and accountability through active communication. Empirically, data were obtained to analyse the truthfulness of this assumption made on Geo-IDS. Geo-IDS consist of disclosers, aggregated information and the link between the two. The link is seen as disclosure that has inherent policy intent. The disclosure is measured to determine the extent of transparency in geo-information disclosure on sea-level rise. The main concepts used in determining the extent of transparency are as described in the subsequent sub-sections. If each of these has indication of citizens centeredness, it is seen as effective thus attracts a positive score. However, if it is negative, is attracts a negative score. The total scores of all the dimensions of transparency determine the extent of transparency in SLR geo-information disclosure to citizens; as SLR is a product that would affect their lives. After all, the citizens have the right to know what situation they are in (Meijer, 2005).

6.2.1. Discussion on the type of SLR information disclosure

Type of SLR information disclosure was used as concept to determine transparency. The dimensions used were the content of information, visualisation, tools and techniques. Results (table 4) obtained show scientific content which ordinary citizens cannot make sense of unless the climate scenarios are demonstrated in a manner that would make them to understand. Water levels normally disclosed via the website of Rijkswaterstaat is not useful to citizens that would alter their behaviour. Otherwise, the main targets of the information disclosure on sea-level rise are the professional users like Deltares. Hence the manner in which these professional users translate the information into forms that would reach the citizens is essentially important. For the professional user, information content is acceptable as they can handle the complexities. On the other side of the coin, the content effectiveness is negative. This is because it will fail to convey meaningful message that will alter or empower citizens to change behaviour. Hence, transparency on content based on the citizen as user gets a score of -1.

Not only the content of information but how the information is presented or visualized is equally important. The results (table 5) demonstrate the usefulness of interactive maps with zip codes and legend as seen in the examples of Geo-IDS inventory (in Annex II). However this is not used at the moment. It is new and professionals are learning how to make them. What is mostly used for the disclosure is the two dimensional graphs and others. Experts are of the opinion that, they cannot visualise the current

information into interactive maps. Simply because important information is missing that they cannot do without. That important information is the land subsidence that is not taken account of. Such information is missing because there is no organisation that has the responsibility to provide such information. The experts stressed that; maps can scare people if background information is not provided to explain what the maps mean. In Netherlands, people should not be made to panic as they are protected by the dikes. The dikes are flood defence systems that the Dutch are accustomed to right from history. The problem is the missing information on land subsidence. This information can help to decrease the error bars the experts mentioned. Thus interactive maps produce through visualisation to communicate with citizens that would be easier for them to apprehend is not there. Henceforth, as there are no such easy and simple maps to communicate to citizens, visualisation gets a score of -1.

Indeed, experts highlighted on various tools necessary for information disclosure. Results in figure 14 show SLR information disclosure via organisations websites. Hence accessibility to SLR information is easy to obtain anywhere one may be. Risk maps are seen as useful tool to communicate. But they are not used to disclose SLR information. Information is mostly disclosed in scientific reports. In other words, if citizens are able to assess information anywhere and are not able to understand the messages been communicated, then their behaviour will not change. Meijer (2007) shown that simply putting information on websites does not mean that the information would be used that can change behaviours. Although, information disclosure favours the professional users, it does not help citizens to change behaviour to enact for accountability. In that sense, tools now used in communicating or disclosing SLR information in Netherlands get a score of -1.

Similarly, kinds of techniques to disclose information are essential. Result shown in figure 15 demonstrates how climate scenarios information updates are important. One's perception on climate change, keep relatively simple, and meetings with the press so information could get published in newspapers followed. Yet, the experts agreed that citizens are not actively informed on SLR. In other words, how do experts get to know the citizens perceptions on climate change to relatively keep the message simple and easy to understand? Perceptions, views and feelings about issues can only be known through active communication with citizens as seen in the work of Terpstra (2010). That way, citizens can be informed and experts can get the feedback as they need. In this sense, the techniques for disclosing SLR information to reach citizens need to improve. Thus techniques get a score of -1 of effectiveness.

To conclude, the type of SLR information disclosure (scored -4 of effectiveness) is not effective considering the plight of citizens in a democratic environment. Contrarily, the professional users are the advantaged ones as they can assess information in a form that is convenient for them to act.

6.2.2. Discussion on actors influencing sea-level rise information disclosure

The main actors identified in the empirical data were of three kinds shown in figure 16. Out of this, disclosers had the highest score as shown in figure 17. The responsibilities of these disclosers were shown in table 6. From these, one can immediately see that KNMI has a leading role in disclosing of information on SLR. But then in terms of accountability measure (figure 19) adaptation communication for support and commitment had the highest score. This means that, although KNMI discloses information on SLR but does not involve itself so much in adaptation measures. This is inferred from their responsibilities. This explains their inability to account to citizens on SLR. Also in figure 20, KNMI is in regular contact with the professionals but not the citizens. Nevertheless, there are no enforcement (figure 21) of law neither is there any compliance (figure 22) of rules and regulations. Henceforth, as KNMI is not able to reach out to citizens for them to act on SLR, one can confidently give a score of -1 for effectiveness of actor to influence SLR disclosure positively to reach the citizens.

6.2.3. Rules and regulations on SLR disclosure

Rule and regulations in Geo-IDS is considered very important. But from the results in table 7, it is seen clearly that geo-information disclosure on SLR is not co-ordinated. That is to say that, although KNMI is the main discloser of SLR information, it does not follow any formal rules and regulations but rather an informal practice. Consequently, it is not surprising that information reaching the public is main geared towards the professionals but not the citizens. In effect of that, it gets a score of -1. From theses dimensions measured, and the results obtained, one can conclude on the effectiveness of Geo-IDS if target is citizens.

6.3. Transparency in SLR geo-information disclosure

Transparency is the core component of disclosure as seen in the works of these researchers (Fenster, 2011; Fung, et al., 2010; Fung, et al., 2007; Fung, et al., 2004; Weil, et al., 2006). In the empirical studies conducted, results obtained show to a large extent the transparency SLR geo-information disclosure to professional users for them to act but then the Geo-IDS is ineffective as the target of information are not citizens centred also. This is therefore necessary to make a recommendation to effectively disclose information on SLR to reach the citizens for them to act. First of all, the challenges to why experts involved in SLR information disclosure are not able to effectively communicate SLR to citizens are presented in the next section.

6.4. Challenges in SLR geo-information disclosure

The main challenges making Geo-IDS ineffective were highlighted by the experts that were interviewed themselves. These challenges are as shown in figure 24 and in Annex VII. The main challenge is that citizens are not actively informed on SLR in the Netherlands. The underlying reasons are part of the challenges displayed in figure 24. However, the experts also proposed solutions to address these challenges as can be seen in the next section

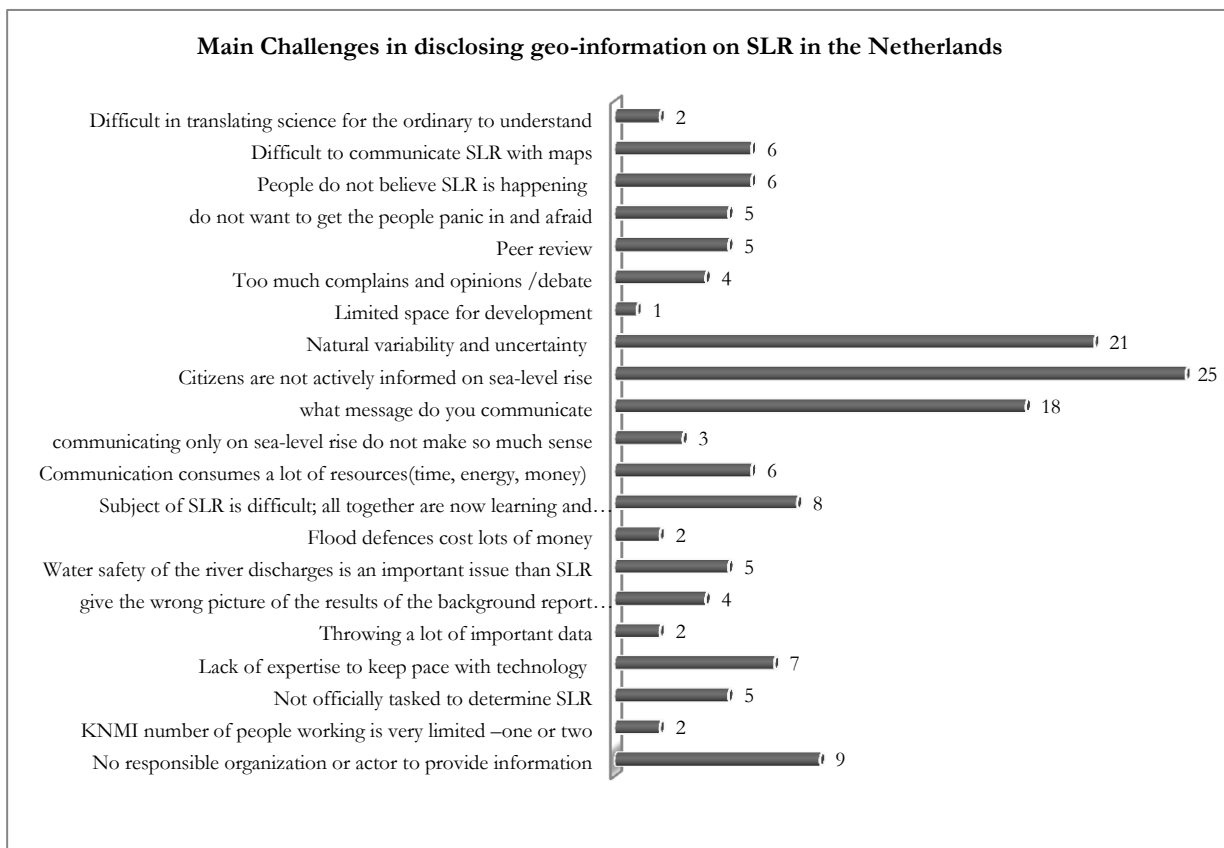


Figure 27

Challenges in SLR geo-information disclosure

6.5. Proposed recommendations from experts

Table 8 shows the recommendations proposed by expert to address the challenges they are facing in disclosing SLR geo-information in the Netherlands. The main challenges are shown in column 1 whilst the recommendations are in column 2.

Table 8 Proposed recommendations from experts

Main Challenge	Proposed solution by experts
No responsible organization or actor to provide information	I9(15)it is very important that one institution in the Netherlands is becoming responsible for the processing of the data on sea-level rise or just sea-level rise role measurements I11(2) Supervise information products to citizens
KNMI number of people working is very limited –one or two	I1(10) need maybe at least ten persons I2(14) interesting hiring somebody new I11(2) Organizations can act as intermediaries
Not officially tasked to determine SLR	I11(2) Create incentives for other organizations to use the information; Complete website with all information about SLR for interested persons to access; Start information availability campaigns
Lack of expertise to keep pace with technology	I2(13) now we have been thinking about the communication and really have to hired professionals to do such things like that for us because now it just takes too much time and we do not just have the skills to do it and how to present it I7(13) need other techniques
Subject of SLR is difficult; all together are now learning and finding out how to do it	I3(10)activities maybe research or on this simply engineers would be deploy to get better estimate, better quality to control small error bars, better estimates
Communication consumes a lot of resources(time, energy, money)	I3(14)That requires funding so the researchers like me and other people should write proposals to get funding to do what they want to do but also from the society or the government and the should ask the scientists say please do a research on this topic because it is very important for this kind of societal relevance
Communicating only on sea-level rise do not make so much sense	I4(10) link the sea-level rise with situations in which people live
What message do you communicate	I8(10)you need to give more specific information about the specific location of the people I8(13), I1(14)be sure about the quality of the information you give, you have to be sure about if you tell them the possibilities to for example to evacuate, when during high sea-levels that this information is correct I9(13)if you want people to understand the data then you have to be very clear and not complex..... really have to make it easily accessible for the people I4 (14) explain with different tools or sometimes you do not explain it, because it is complicated to the mass. I5(14) depends on what we see at that moment
Citizens are not actively informed on sea-level rise	I10(11) But sometimes there are organizations that are operating on behalf of the citizens I11 (15) It could also be relevant to sort of making information accessible to different groups of citizens, so that to make a distinction between different user groups.
Natural variability and uncertainty	I3 (12) decreasing the error bars, decreasing the uncertainty in the predictions. If the predictions are crystal clear, If there is no doubt then it is clear so to do something right. I3 (14) The second thing is that doing the right research to decrease the error bars to understand better what is happening.
Peer review	I3 (14) What they should do with it, put it on the internet so that everybody can use it. In the digital form, the original data, publish their methods and they give the original data, the other methods and reproduce it and then check it.
Do not want to get the people panic in and afraid	I8(2)Good communication but take care not to make people panic because no reason for that No need for panic in Holland , Because companies will face consequences should the sea-level rises, Inform them to have idea on what to do for themselves and that is where the complications starts
People do not believe SLR is happening	I10(13)use a range of numbers to communicate..... make it visible on the map and then make it visible in the results of the calculation
Difficult to communicate SLR with maps	I11(3) Maps certainly play a role; accessible information on SLR makes sense through maps; citizens living near area of SLR impact certainly would be interested in specific kind of information; map is much easier to obtain information about what SLR means for you.

6.6. Factors that would make Geo-IDS effective

The factors that would make Geo-IDS effective were based on the research assumption. This was: “Geo-IDS is effective when there are indications of transparency elements such as active communication with citizens, responsibility, targeted policy, rules and regulations; and participation”. To pick on all the elements needed for Geo-IDS to be effective, all scored -1 as seen in the previous sections. This is because; the citizens were not the central focus of information disclosure. Geo-IDS effectiveness is based on the indicators used for the empirical data collection (concept-variable matrix in table 2). Not only that but also main challenges the experts stressed on and the recommendations they gave forms the basis for the factors that are been given here.

6.6.1. Factor 1: Legalise or institute an organisation (an act (law) or legislation)

An Act that can mandate an organisation to be in charge of data processing and provision of geo-information of SLR to wider audiences. This should include an organisation that can collect data on the land especially a geological survey to provide information on the subsidence in Netherlands. This can help decrease the error bar or the uncertainties in predictions. This way, the information on SLR can be trustworthy that can be communicated to wider audiences specifically to the citizens.

6.6.2. Factor 2: Formulate a targeted transparency policy on SLR geo-information disclosure

A policy is needed to give guidelines on the type of SLR information disclosure. The policy should state it clearly what the content, tools, visualization and techniques should be used in disclosing information to wider audiences especially to the citizens. In this case, the EU Flood Risk Directive would be an added advantage.

6.6.3. Factor 3: Enhance expert skills and techniques

New skills and techniques are needed in disclosing of geo-information on SLR. This can help visualize the information in a manner that can easily be communicated to citizens. Interactive maps require specialities in the field of GIS. Good communicators are critically important in this case. They can interact at regular intervals with users emphasizes on the citizens. This is to communicate with them and then to seek their perceptions on information disclosed.

6.6.4. Factor 3: Provide funding

The government should provide sufficient funds for SLR geo-information disclosure. This is essential as disclosure also requires a lot of resources (labour intensive) for communication.

6.7. Conclusions

Geo-IDS were seen to be effective among the disclosers and the professional users. Nevertheless, the citizens are left out in active communication on SLR. Contrarily, Geo-IDS were ineffective between the disclosers and the citizens. As a result, four factors have been recommended that can help make Geo-IDS effective between the disclosers and the citizens. These factors are;

1. Legalise or institute an organisation (an act (law) or legislation)
2. Formulate a targeted transparency policy on SLR geo-information disclosure
3. Enhance expert skills and techniques
4. Provide funding

With these factors in place, transparency elements such as active communication with citizens, responsibility, targeted policy, rules and regulations; and participation can be groomed that would make Geo-IDS effective.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Introduction

This Chapter presents a summary of the major findings and conclusions of the study. It gives an overview of the research objectives, conceptual framework and methods used in arriving at the findings that answers the research questions posed in chapter one. In particular, this chapter takes account of all the summaries of the chapter one to chapter six. Thereafter is a reflection on the outcomes of the entire research conducted and the mixed method approach adopted. Intently, recommendations on SLR geo-information disclosure and further directions into Geo-IDS research are also given at end of the chapter.

7.2. Conclusions background

Transparency and accountability are the main components of information disclosure. Information disclosure on SLR is equally important to empower citizens. But little was known on how information was disclosed on SLR. The assumption was that “if information is disclosed via risk maps plus an active communication with users, one can be assured that information can be embedded in decisions of users”.

With this in mind, the study focused on the debates of SLR in the Netherlands and investigated the underlying values of geo-information disclosure on SLR that lead to what makes Geo-IDS effective. What was most significant was the critical look taken on the kind of elements behind disclosure on SLR by using empirical data from interviews of experts on information disclosure on SLR to know their choices to predict the policy intent at the time of disclosure through keen direct observations (Molnar, 2008).

In addressing the problem outlined, an objective was set which was ‘to assess what would make Geo-IDS effective by identifying the elements behind disclosure of geo-information on sea-level rise’ with sub research objectives which were: 1). to conceptualize Geo-IDS, 2). to present methods to collect data about actual SLR disclosure, 3). to make an inventory of examples of Geo-IDS relating to SLR?, 4). to determine the extent of transparency on SLR disclosure and 5). to make a recommendation towards an effective Geo-IDS of SLR in the Netherlands.

The research objective gave rise to a reach question which was “what are the elements behind disclosure of geo-information on sea-level rise that would make Geo-IDS effective”? In others words, an assumption was made from the literature reviewed. The assumption was: “Geo-IDS is effective when there are indications of transparency elements such as active communication with citizens, responsibility, targeted policy, rules and regulations; and participation”. Hence the study focused on Geo-IDS, a conceptual framework for the study. Geo-IDS is the action and the connection between the disclosers (information providers) and the information provided (aggregated information) in a transparency cycle (Fung, et al., 2010) . The Geo-IDS contains specific geospatial frames (GF) that are visually powerful relating to a choice that a government geo-information discloser (GGD) makes in terms of what kind of information to present and how to present it.

The research depended most on secondary data from the Netherlands publications on SLR. These included resources from Rijkswaterstaat (Netherlands Water Agency), KNMI (Royal Dutch Meteorological Institute), PBL (Netherlands Environment Assessment Agency) and Nature Science/Climate Change and many more. Thereafter, primary data was obtained from the internet based risk maps to make an inventory of geospatial frames and interviews were conducted with key experts from the above

mentioned agencies and institutions. The aim was to verify the relation of policy interest in GGD to policy intent in GF in which the link was disclosure.

7.3. Conclusions

Conclusions on geo-information disclosure systems on sea-level rise are presented based on the order of the research sub-objectives with the respective sub-questions of the research. To begin with:

7.3.1. Conceptualization of Geo-IDS

Question 1: How can Geo-IDS be conceptualized?

This question was answered in Chapter 2. Geo-IDS consist of main concepts such as disclosure. This disclosure can be defined as “the act of making something known or public that was previously secret or private”(OALD, 2011). Crucial components of disclosure are transparency, accountability and responsibility. Specifically, when disclosing geo-information or disclosing through geo-information systems the term or concept specific about geographical aspect is called Geo-IDS. Hence, the components of disclosure for example transparency also play a role in disclosing geo-information. This role is to make the public become aware of the products and services that is bound to affect their lives through active communication. More so on geo-information about sea level rise is essential to inform citizens to make informed choices and decisions. Nevertheless specific geo-information on sea level rise is risk maps guided by rules and regulations. This is so because, risk maps presents facts which is easily understood than text and numbers. From these components of information disclosure specific on SLR is termed as concept and called Geo-IDS.

Geo-IDS was defined in this study as a regulatory tool that integrates policies(Fung, et al., 2007; Fung & Weil, 2010), technologies(Winston, 2008) and organizational arrangements to release relevant, user-centred, clear, understandable and timely information(Meijer, 2005) that are linked to specific point on the Earth’s surface to the public which facilitate decision making within a transparency system. This implies that, Geo-IDS are human-computer systems guided by policies and regulations in the disclosing of geospatial information. With this concept in mind, a specific case was chosen describe next in question 2.

Question 2: What are the underlying forces of Geo-IDS on SLR in the Netherlands?

This question was answered in Chapter 3. The underlying forces of geo-information disclosure on sea-level rise in the Netherlands were looked at. Firstly, it was found out that, most debates on sea-level rise are targeted at trends, exposure, impacts and responses, at the local, regional and global levels. At the global level, we have the scientific research body IPCC of which all literature on sea-level rise revolves around their findings. Secondly, how sea-level rise is perceived in Netherlands was discussed. The rules and regulations on SLR geo-information disclosure and the responsible agencies for both the disclosure and monitoring were also revealed. Thirdly, examples of risk maps relating to SLR in Netherlands were also given. Lastly, examples of risk maps of SLR believed to be Geo-IDS were highlighted.

The SLR geo-information disclosure has inter(national) laws that force or empower agencies to collect and distribute data on SLR. Globally, this is embodied in IPCC framework. But in Netherlands, the major rules and regulations should be govern by the National Water Plan whereby the Dutch Water System is in charge of its implementation. Examples of products of SLR are given in Annex III. Again, products of Geo-IDS can be found in Annex II. However, the aim of the inventory of maps was to answer the reach question:

7.3.2. Examples of Geo-IDS risk maps relating to SLR

Question 3: Which maps exist that relate to disclosure on SLR?

This question was answered in Chapter 3 section 3.5. Examples of Geo-IDS were based on searches using Google as the search engine with the key words “sea-level rise maps”. The examples of the Geo-IDS is given as an inventory as shown in table 10 in Annex II.

Question 4: Which risk maps shows effects of SLR in the Netherlands?

This question was answered in Chapter 3 section 3.5. Examples of products of SLR effects in Netherlands are given in Annex III

7.3.3. Methods to collect data about actual SLR geo-information disclosure

Question 5: What methods can be used to collect data on SLR disclosure?

This question was answered in Chapter 4. A mixed method approach was adopted that required different instruments to collect data from secondary sources and primary sources. Literature searches to define concepts were done using the internet. The internet made it possible to use digital library resources. The library resources have their database listed on the ITC library webpage. In other words, journals and articles used in the literature review were obtained from online library databases specifically the web of science database. Snow ball (Miles & Huberman, 1994:28) mechanism was used in searching the Web of Science database for relevant literature to the topic. Snow ball or chain “*identifies cases of interest from people who know people what cases are information-rich*”(Miles & Huberman, 1994:28). In this case however, Snowballing is not about seeking cases from people but rather seeking references from one journal or article to another in order to obtain rich information in a multidisciplinary environment. The snowball was necessary here as the topic has not been given much attention in literature. The literature searched for were from different perspectives to define the concepts for this study.

Question 6: How to collect data about actual SLR disclosure in the Netherlands?

This question was answered in Chapter 4. Methods to investigate information disclosure of sea-level rise empirically, is first derive concept-variable matrix based on concepts defined in chapter 2. Disclosure of SLR in the Netherlands can best be studied empirically through an open, qualitative mixed methods approach, relying on data collection through unstructured interviews and documentary evidence. This was followed by a qualitative analysis which searches for and classifies underlying perceptions, views and beliefs on both disclosure and transparency; and the urgency or relevance of the issue of sea level rise.

7.3.4. The extent of transparency on SLR disclosure

Question 7: Which organisations are responsible to disclose information on SLR?

This question was answered in Chapter 5. In Netherlands, KNMI with a score of 37 is the main actor as a discloser of SLR information followed by Rijkswaterstaart (score 23) and IPCC (score 14) as an external force behind the climate scenarios. Yet the layers of government comprising of governments at the national, regional and local levels have an important role to play in disclosing of information on SLR as they have a significant score of 11 likewise the Delta programme. The disclosers are as shown in figure 20 of Chapter 5. Details about these disclosers can also be seen in Annex VII

Question 8: Which way do they disclose geo-information on SLR?

This question was answered in Chapter 5. The actors (disclosers, professional users and regulators) cooperate very much with each other in the discloser box of the transparency cycle. After the interactions, each of these actors filters or makes choices of which information on SLR to disclose in public via their

websites. The information mostly disclosed are climate scenarios and water levels which the main users in the user's disclosure box can read and download from the websites if they are interested.

Question 9: To what extent do they abide by the rules specified?

This question was answered in Chapter 5 and Chapter 6. The rules and regulations whether formal or informal together with the actors and their interactions using the various media in disclosing information on SLR can be seen as Geo-IDS, a transparency system where participation, enforcement, compliance and accountability are essential. But from the results in table 7 of Chapter 5 indicates clearly that geo-information disclosure on SLR is not co-ordinated. That is to say that KNMI been the main discloser do not follow any formal rules and regulations but rather it is an informal practice. In this sense, it is not surprising that information reaching the public is mainly geared towards the professionals but not the citizens. In effect of that, it got a score of -1. From these dimension's measured with the results obtained one can conclude on the effectiveness of Geo-IDS if the target is citizens.

Question 10: Who checks this information disclosure on SLR?

This question was answered in Chapter 6: Transparency is the core component of disclosure as seen in the work of these researchers (Fenster, 2011; Fung, et al., 2010; Fung, et al., 2007; Fung, et al., 2004; Weil, et al., 2006). In the empirical studies conducted, the results obtained show to a large extent the transparency in the disclosure of geo-information to professional users for them to act but then the Geo-IDS is ineffective as the targets of information are not citizens centred. This is therefore necessary to make a recommendation to effectively disclose information on SLR to reach citizens for them to act. Firstly, the challenges to why experts of disclosure of SLR information were not able to effectively communicate SLR to citizens were presented in Chapter 6 and a detail of that is in Annex VII.

7.3.5. A recommendation towards an effective Geo-IDS of SLR in the Netherlands

Question 11: What kinds of technology, cartographic choices and datasets should be used at the time of disclosure?

This question was answered in Chapter 6. Type of sea-level rise information disclosure was seen in Chapter 5. The content of information, visualization, tools and techniques were highlighted by experts. These can be seen section 5.21. Not only the content of information but how the information is presented or visualized is equally important. The results (table 5) demonstrate the usefulness of interactive maps with zip codes and legend as seen in the examples of Geo-IDS inventory (in Annex II).

Question 12: What factors determines transparency in the disclosure of SLR geo-information?

This question was answered in Chapter 6. The factors to determine transparency in disclosure of SLR geo-information are:

Factor 1: Legalise or institute an organisation (an act (law) or legislation)

An Act that can mandate an organisation to be in charge of data processing and provision of geo-information of SLR to wider audiences. This should include an organisation that can collect data on the land especially a geological survey to provide information on the subsidence in Netherlands. This can help decrease the error bar or the uncertainties in predictions. This way, the information on SLR can be trustworthy that can be communicated to wider audiences specifically to the citizens.

Factor 2: Formulate a targeted transparency policy on SLR geo-information disclosure

A policy is needed to give guidelines on the type of SLR information disclosure. The policy should state it clearly what the content, tools, visualization and techniques should be used in disclosing information to wider audiences especially to the citizens. In this case, the EU Flood Risk Directive would be an added advantage.

Factor 3: Enhance expert skills and techniques

New skills and techniques are needed in disclosing of geo-information on SLR. This can help visualize the information in a manner that can easily be communicated to citizens. Interactive maps require specialities in the field of GIS. Good communicators are critically important in this case. They can interact at regular intervals with users emphasizes on the citizens. This is to communicate with them and then to seek their perceptions on information disclosed.

Factor 3: Provide funding

The government should provide sufficient funds for SLR geo-information disclosure. This is essential as disclosure also requires a lot of resources (labour intensive) for communication.

7.4. Contribution to literature

Geo-IDS were seen to be effective among the disclosers and the professional users. Nevertheless, the citizens are left out in active communication on SLR. Contrarily, Geo-IDS were ineffective between the disclosers and the citizens. As a result, four factors have been recommended that can help make Geo-IDS effective between the disclosers and the citizens. These factors are;

1. Legalise or institute an organisation (an act (law) or legislation)
2. Formulate a targeted transparency policy on SLR geo-information disclosure
3. Enhance expert skills and techniques
4. Provide funding

With these factors in place, transparency elements such as active communication with citizens, responsibility, targeted policy, rules and regulations; and participation can be groomed that would make Geo-IDS effective.

7.5. Recommendations for further studies

Users interactions were not investigated as that was beyond the scope of the study. Hence is is necessary to investigate how the interact with each other so that they can be empowered to act for accountability on sea-level rise products and services.

Again, the study focused on Geo-IDS within the transparency cylce. However, further studies can be conducted to investigate what goes on within each of the seven disclosure boxes mentioned by Fung, et al. (2010).

Further, the study could not assess how the risk maps on SLR can be visualised that can be intective enough to inform citizens to make decision. There, a study in that is need.

7.6. Conclusion

The Chapter presented a summary of the major findings and conclusions of the study. It gave an overview of the research objectives, conceptual framework and methods used in arriving at the findings that answered the research questions posed in chapter one. In particular, the chapter took account of all the summaries of the chapters one to six. Thereafter a reflection on the outcomes of the entire research conducted and the mixed method approach adopted were highlighted. Intently, recommendations on SLR geo-information disclosure and further directions into Geo-IDS research were also given at end.

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ANNEXES

ANNEX I IPCC FRAMEWORK AND PROJECTIONS

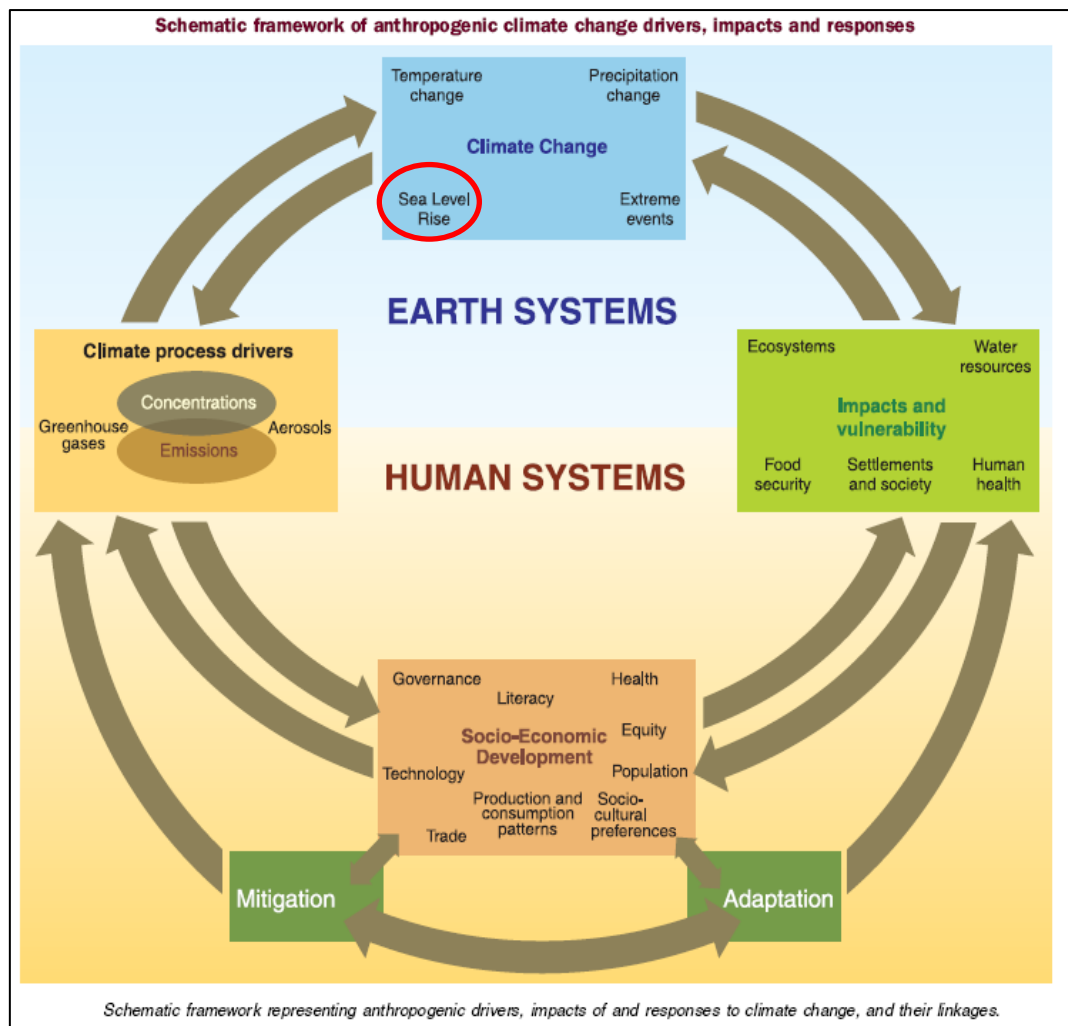


Figure 29 Frame work of IPCC: Climate change drivers, impacts and response e
(Source:Pachauri and Reisinger (2008))

Projected global average surface warming and sea level rise at the end of the 21st century.

Case	Temperature change (°C at 2090-2099 relative to 1980-1999) ^{a, d}		Sea level rise (m at 2090-2099 relative to 1980-1999)
	Best estimate	Likely range	Model-based range excluding future rapid dynamical changes in ice flow
Constant year 2000 concentrations ^b	0.6	0.3 – 0.9	Not available
B1 scenario	1.8	1.1 – 2.9	0.18 – 0.38
A1T scenario	2.4	1.4 – 3.8	0.20 – 0.45
B2 scenario	2.4	1.4 – 3.8	0.20 – 0.43
A1B scenario	2.8	1.7 – 4.4	0.21 – 0.48
A2 scenario	3.4	2.0 – 5.4	0.23 – 0.51
A1FI scenario	4.0	2.4 – 6.4	0.26 – 0.59

Notes:
a) These estimates are assessed from a hierarchy of models that encompass a simple climate model, several Earth Models of Intermediate Complexity, and a large number of Atmosphere-Ocean General Circulation Models (AOGCMs) as well as observational constraints.
b) Year 2000 constant composition is derived from AOGCMs only.
c) All scenarios above are six SRES marker scenarios. Approximate CO₂-eq concentrations corresponding to the computed radiative forcing due to anthropogenic GHGs and aerosols in 2100
d) Temperature changes are expressed as the difference from the period 1980-1999. To express the change relative to the period 1850-1899 add 0.5°C.

Figure 28 IPCC projected global average surface warming and sea-level rise
(Source : Pachauri and Reisinger (2008))

Table 9 Content extraction of full statements on sea-level rise from IPCC Synthesis Report 2007

IPCC Synthesis Report 2007 content extraction of full statements on sea-level rise (Source:Pachauri and Reisinger (2008))				
Method : Search with key words sea level rise – 48 instances found				
Causes	Effects	Scenarios and predictions	Prediction Uncertainty	Adaptation strategy
Partial loss of ice sheets on polar land and/or the thermal expansion of seawater over very long time scales could imply metres of sea level rise, major changes in coastlines and inundation of low-lying areas, with greatest effects in river deltas and low-lying islands	<p>Asian and African megadeltas, due to large populations and high exposure to sea level rise, storm surges and river flooding.</p> <p>Low-lying coastal systems, due to threat of sea level rise and increased risk from extreme weather events</p> <p>Small islands :Sea level rise is expected to exacerbate inundation, storm surge, erosion and other coastal hazards, thus threatening vital infrastructure, settlements and facilities that support the livelihood of island communities</p> <p>Climate change is expected to magnify regional differences in Europe's natural resources and assets. Negative impacts will include increased risk of inland flash floods and more frequent coastal flooding and increased erosion (due to storminess and sea level rise).</p> <p>By 2050, on-going coastal development and population growth in some areas of Australia and New Zealand are projected to Exacerbate risks from sea level rise and increases in the severity and frequency of storms and coastal flooding.</p> <p>Africa Towards the end of the 21st century, projected sea level rise will affect low-lying coastal areas with large populations. The cost of adaptation could amount to at least 5 to 10% of GDP.</p> <p>In coastal areas, sea level rise will exacerbate water resource constraints due to increased salinisation of groundwater supplies.</p> <p>By the 2080s, many millions more people than today are projected to experience floods every year due to sea level rise. The numbers affected will be largest in the densely populated and low-lying megadeltas of Asia and Africa while small islands are especially vulnerable (very high confidence).</p> <p>Sea-level rise and human development are together contributing to losses of coastal wetlands and mangroves and increasing damage from coastal flooding in many areas.</p> <p>Sea level rise and human development are together contributing to losses of coastal wetlands and mangroves and increasing damage from coastal flooding in many areas. However, based on the published literature, the impacts have not yet become established trends.</p>	<p>Altered frequencies and intensities of extreme weather, together with sea level rise, are expected to have mostly adverse effects on natural and human systems</p> <p>Coasts are projected to be exposed to increasing risks, including coastal erosion, due to climate change and sea level rise.</p> <p>The effect will be exacerbated by increasing human-induced pressures on coastal areas (very high confidence).</p> <p>It is very likely that the response to anthropogenic forcing contributed to sea level rise during the latter half of the 20th century.</p> <p>Substantial risks due to sea level rise are projected particularly for Asian megadeltas and for small island communities.</p> <p>There is <i>high confidence</i> that global warming over many centuries would lead to a sea level rise contribution from thermal expansion alone that is projected to be much larger than observed over the 20th century, with loss of coastal area and associated impacts.</p> <p>There is better understanding than in the TAR that the risk of additional contributions to sea level rise from both the Greenland and possibly Antarctic ice sheets may be larger than projected by ice sheet models and could occur on century time scales.</p> <p>Sea level rise from thermal expansion would continue for many centuries at a rate that eventually decreases from that reached before stabilisation, due to on-going heat uptake by oceans.</p> <p>Sea level rise under warming is inevitable. Thermal expansion would continue for many centuries after GHG concentrations have stabilised, for any of the stabilisation levels assessed, causing an eventual sea level rise much larger than projected for the 21st century</p> <p>If GHG and aerosol concentrations had been stabilised at year 2000 levels, thermal expansion alone would be expected to lead to further sea level rise of 0.3 to 0.8m.</p> <p>Anthropogenic warming and sea level rise would continue for centuries even if GHG emissions were to be reduced sufficiently for GHG concentrations to stabilise, due to the time scales associated with climate processes and feedbacks.</p>	<p>Because understanding of some important effects driving sea level rise is too limited, this report does not assess the likelihood, nor provide a best estimate or an upper bound for sea level rise</p> <p>Future changes in the Greenland and Antarctic ice sheet mass, particularly due to changes in ice flow, are a major source of uncertainty that could increase sea level rise projections.</p> <p>The uncertainty in the penetration of the heat into the oceans also contributes to the future sea level rise uncertainty.</p>	<p>Relocation; seawalls and storm surge barriers; dune reinforcement; land acquisition and creation of marshlands/wetlands as buffer against sea level rise and flooding; protection of existing natural barriers</p> <p>Adaptation will be ineffective for some cases such as natural ecosystems (e.g. loss of Arctic sea ice and marine ecosystem viability), the disappearance of mountain glaciers that play vital roles in water storage and supply, or adaptation to sea level rise of several metres²⁷.</p>

ANNEX II EXAMPLES OF GEO-IDS ON SEA-LEVEL RISE

Table 10 An inventory of examples of Geo-IDS on Sea-level Rise

Name Year	Responsible Organization/ Website Type/Location	Mission Statement	Level/ Country	Rules and Regulations It supports	Tools and Datasets	Description	Link
Surging Seas 2012	Climate Central (http://climatecentral.pnet/) NGO Princeton(USA)	Communicate the science and effects of climate change to the public and decision-makers, and inspire Americans to support action to stabilize the climate and prepare for impacts of climate change.	National USA	None	<ol style="list-style-type: none"> 1. Guidelines on how to use the map 2. Open source software 3. Open street map 4. Plans 5. Data downloads 6. Reports 7. Factsheets 8. Widgets <ul style="list-style-type: none"> • digital elevation model (DEM) • Land parcels • Population data • Local mean high water levels • Housing units 	Interactive Map by Stamen(http://stamen.com/) Based on research - http://sealevel.climatecentral.org/research/papers/tidally-adjusted-estimates-of-topographic-vulnerability-to-sea-level-rise-a/ Featured in media cross the United States (appeared more than 900 reports, prints and online publications) http://climate.nextmp.net/what-we-do/pressroom/	http://sealevel.climatecentral.org/su/risingseas/
Sea Levels Online 2010	NOAA- CO-OPS (http://www.noaa.gov) Governmental Washington DC(USA)	CO-OPS is the authoritative source for accurate, reliable, and timely tides, water levels, currents and other oceanographic information. Our data, products and services support safe and efficient navigation, sound ecosystem stewardship, coastal hazards preparedness and response, and the understanding of	National - USA/Global	IOOS-NWLP- NWLON (http://tidesandcurrents.noaa.gov/nwlon.html)	<ol style="list-style-type: none"> 1. Google earth software(KML) 2. Open source software 3. Metadata 4. Fact Tables 5. Historical tide data(http://tidesandcurrents.noaa.gov/station_retrieve.html?type=Historic+Tide+Data) 	Interactive Map Based on data sources from http://tidesandcurrents.noaa.gov/sltrends/mtsparker.html and http://tidesandcurrents.noaa.gov/pub.html#sltrends	http://tidesandcurrents.noaa.gov/sltrends/index.shtml

Sea Level Rise Explorer 2008	Global Warming Art- founded by an individual (http://www.globalwarmingart.com/wiki/Global_Warming_Art:About)	climate change. Global Warming Art is the result of a dream that the public and educators should have easy access to the same data and results that have framed the scientific discussion of global warming and climate change.	Global	None	<ul style="list-style-type: none"> mean sea level (MSL) Google Maps Open source Satellite-based elevation dataset from SRTM 	Interactive Map by CGIAR(http://srtm.csi.cgiar.org/) http://www.globalwarmingart.com/wiki/Special:SeaLevel
Data Products/Sea-level Rise maps 2006	CReSIS (https://www.cresis.ku.edu/)	Developing new technologies and computer models to measure and predict the response of sea level change to the mass balance of ice sheets in Greenland and Antarctica.	Global, regional/ National	Based on IPCC materials (https://www.cresis.ku.edu/policy/timeline)	<ol style="list-style-type: none"> GIS Google earth Sea-level rise calculated from DEM (GLOBE) Population dataset Natural Earth, a global shaded relief map with land cover tints 	https://www.cresis.ku.edu/data/sea-level-rise-maps?quicktabs=3
Impacts of Sea Level Rise on the California Coast 2009	Pacific Institute California	The Pacific Institute works to create a healthier planet and sustainable communities. We conduct interdisciplinary research and partner with stakeholders to produce solutions that advance environmental protection, economic development, and social equity—in California, nationally, and internationally.	Local California	informational purposes only	<ol style="list-style-type: none"> Google Maps GIS data downloads Legend Text Infrastructure datasets Hazard datasets Coastal line dataset 	http://www.pacinst.org/reports/sea_level_rise/transport.pdf with legend and text
Sea level rise maps 2010	Australian Government- Department of Climate Change and Energy Efficiency- OzCoasts (http://www.ozcoasts.gov.au/index.jsp)	OzCoasts is a publicly accessible online database with a web-based interface that provides comprehensive information about Australia's coasts	Regional / Australia	Based on IPCC governmental policies(http://www.ozcoasts.gov.au/climate/sd_fg_aisp#why)	<ol style="list-style-type: none"> FAQ Maps for downloads DEM(LiDAR) Sea level rise value combined with high tide value 	Static maps (jpeg) e.g. (http://www.ozcoasts.gov.au/climate/Map_images/Sydney/16_150_map_4.jpg) by CSIRO where three sea-level rise scenarios of 0.5m, 0.8m and 1.1m relevant for the 2100 period have been prepared

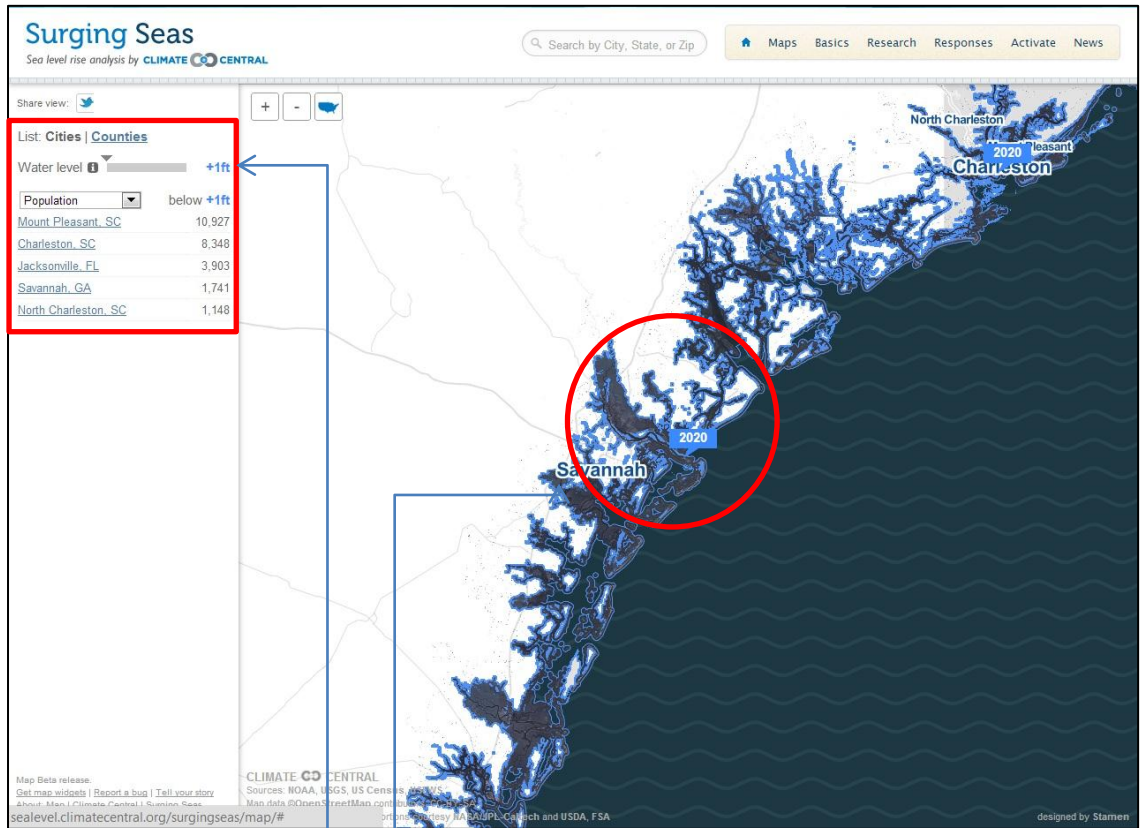


Figure 31 An example of Geo-IDS with 1 feet SLR : from the website of Climate Central

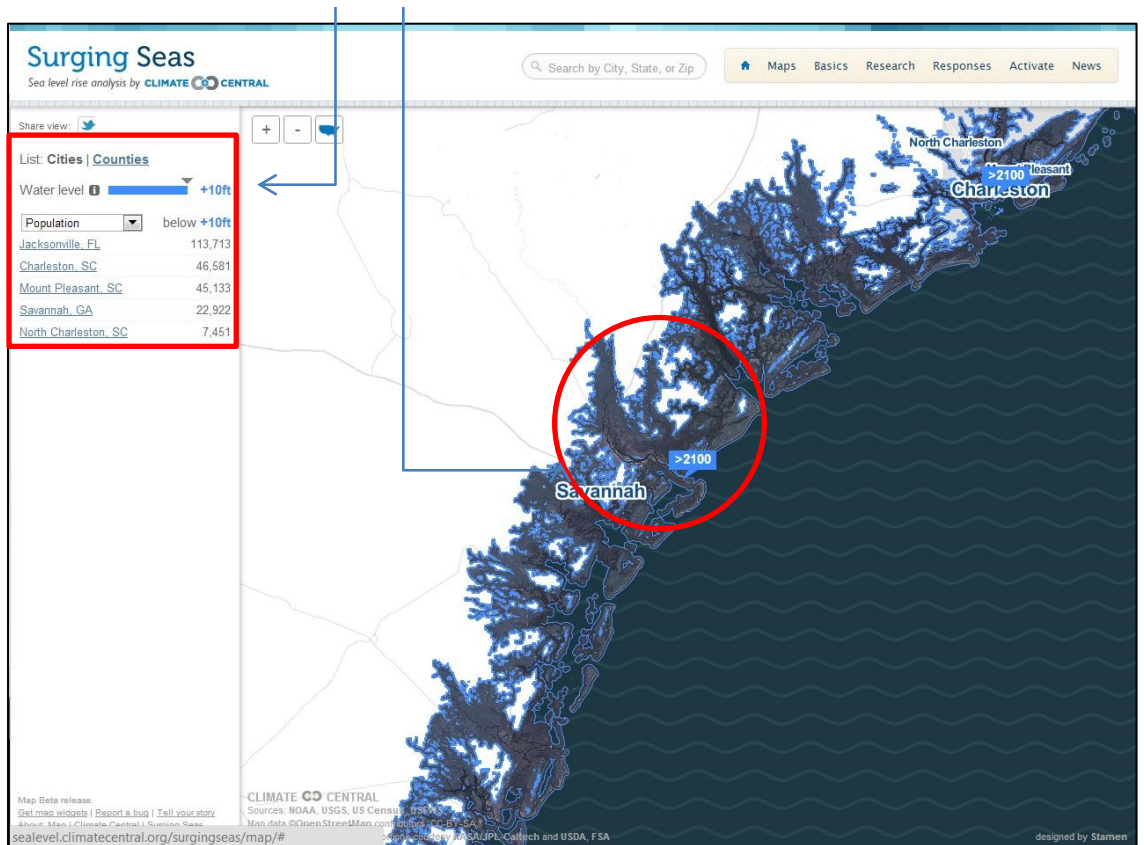


Figure 30 An example of Geo-IDS on SLR of 10 feet from the website of Climate Central

ANNEX III INVENTORY OF MAPS SHOWING EFFECTS OF SLR

Table 11 Inventory of risk maps showing effects of SLR in the Netherlands

Map ID	Name	Scale	Year	Primary Source	Keywords	Description	organization	Document type	Website
<u>M001</u>			2008	Delta Programme	height, grounds, areas, sea, river	Regional divisions used in the Delta Committee's report.	Delta Programme	Report 2008	http://www.safecoast.nl
<u>M002</u>	Safety audit		2006	Rijkswaterstaat	Standards, comply, dikes, safety, flood	Results of the second safety audit of the primary flood defences	Delta Programme	Report 2008	http://www.safecoast.nl
<u>M003</u>	Effects of sea level rise		2008	Delta Programme	discharge, river, sea-level rise, 2050	Effects of sea level rise and changed river discharge rates on the Netherlands drainage system, 2050	Delta Programme	Report 2008	http://www.safecoast.nl
<u>M004</u>				Delta Programme	discharge, river, sea-level rise, 2100	Effects of sea level rise and changed river discharge rates on the Netherlands drainage system, 2100	Delta Programme	Report 2008	http://www.safecoast.nl
<u>M005</u>	Delta Programme		2008	Delta Programme	Delta Programme, enforcement, international, study, co-operation measures, Sea-level rise, adaptation	Measures under the Delta Programme	Delta Programme	Report 2008	http://www.safecoast.nl
M006	Relief map	1000000		Rijkswaterstaat		Relief map of the Netherlands showing height in meters above Dutch Ordnance Datum (NAP)			

ANNEX IV INTERVIEW PLANNING CHECKLIST

A Introduction

Dear

This interview is intended to collect data that will help the researcher to understand the process of geo-information disclosure on sea-level rise in the Netherlands. The information you provide will be used only for academic purpose of the study.

B Biographic Data

1. Sex: Male [], Female []
2. Number of years in the post.....

C Interview questions

Questions				
Interview Planning Checklist Items	Yes	No	Not Required	Comments
1. Is your organization involved in issues on sea-level rise and in which way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2. How are citizens informed on sea-level rise currently?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3. What do you think is the best way to inform the public on sea-level rise?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4. Do you think sea-level rise maps can inform citizens as desired?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5. What is the main purpose of informing citizens on the issue of sea-level rise?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6. What kinds of tools and techniques are used in communicating risk of sea-level rise?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Questions				
Interview Planning Checklist Items	Yes	No	Not Required	Comments
7. What kinds of information are mostly disclose on sea-level rise and why?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
8. How often are the contents of information updated?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9. Who are the main actors in providing the information on sea-level rise to the public?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10. Do they do this by themselves or it is their duty to do so and who checks these?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
11. Are there differences between what needs to be done and what is actually done?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
12. What are the challenges in presenting facts on sea-level rise for all users to understand?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
13. How are these challenges being addressed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
14. Which way are concerns of users of the information sort and how do they reflect in information updates?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
15. Other remarks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
16. Other remarks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

ANNEX V INTERVIEWING SNAPSHOTS



Figure 33 Open (face-to-face) interviewing of an expert in SLR

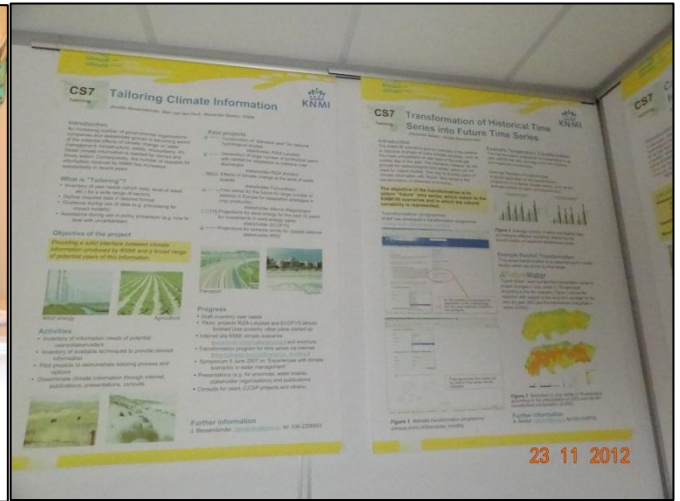
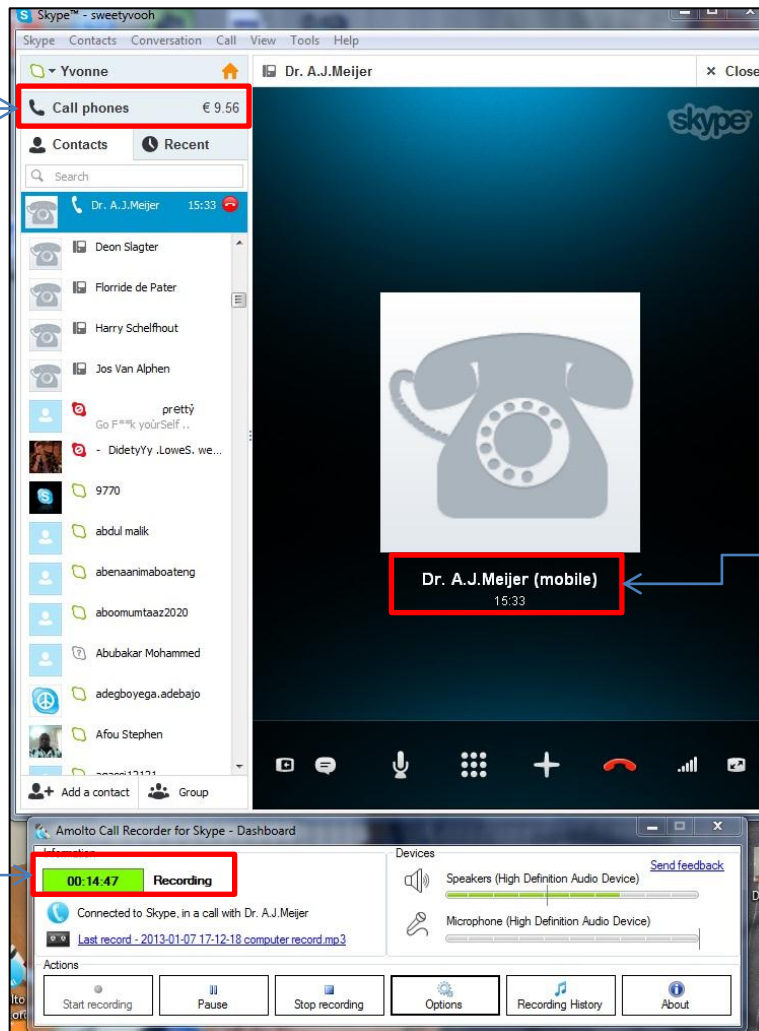


Figure 34 An artefact at KNMI shot during interview with inscription: Tailoring climate information

Skype credit that permits phone calls



Status of recorder: Recording

Interviewee

Figure 32 An example of telephonic interview using Skype software and Amolto Call Recorder

ANNEX VI EXAMPLES OF INTERVIEWS SUMMARY

Table 12 Summary of interviews to show how citizens are informed on SLR currently

Summary of interviews to answer Question 1 How are citizens informed on sea-level rise currently?						
Interviewee	Responsible organization	Who is informed	Kind of information	Tools for disclosure	Specific information	General remarks
I1	KNMI	<ul style="list-style-type: none"> ✓ Delta commission ✓ Professionals ✓ Policy makers ✓ General public 	<ul style="list-style-type: none"> ✓ Climate scenarios of 2006 made from observations and projections on ice sheets and self-gravitation based on global scenarios of IPCC and translated to the regional level which have a lot of uncertainties ✓ Observational time series 	<ul style="list-style-type: none"> ✓ Brochure ✓ Website ✓ Internet ✓ Graphs 	<ul style="list-style-type: none"> ✓ Hybrid information for policy makers or general public in few figures or pictures ✓ Datasets of the climate scenarios for professional users working on sea-level rise impacts together with scientific background documents about the methods used 	<ul style="list-style-type: none"> ✓ Antarctic ice melting has a significant effect on sea-level rise near Netherlands than the Green land ice sheet; ✓ We have measurements for the coast of Netherlands that are used here to calculate the projections for the future. The measurements from the past are combined with the change projections from the climate models. Together they give the projections for sea level in the future
I2	KNMI	<ul style="list-style-type: none"> ✓ Professionals ✓ Local governments ✓ Federal government ✓ Industry ✓ General public 	<ul style="list-style-type: none"> ✓ Projections ✓ Observations ✓ Climate scenarios of 2001 and 2006 ✓ Updates would be ready by 2013 ✓ Explanations on what is happening now and in the future thus what is means for businesses 	<ul style="list-style-type: none"> ✓ Brochure ✓ Tables ✓ Figures ✓ Lectures ✓ Presentations ✓ English and Dutch versions 	<ul style="list-style-type: none"> ✓ Tailored presentations depending on audience ✓ New models stimulations 	<ul style="list-style-type: none"> ✓ Users give suggestions on what they are interested in ✓ Two-way communication mostly with the professionals
I3	KNMI		<ul style="list-style-type: none"> ✓ Some reports on sea-level rise 	<ul style="list-style-type: none"> ✓ Reports 		<ul style="list-style-type: none"> ✓ When asked by government ✓ Not regular information ✓ Publication once in a while ✓ Not co-ordinated
✓ I4	<ul style="list-style-type: none"> ✓ KNMI ✓ Delta Programme 	<ul style="list-style-type: none"> ✓ 	<ul style="list-style-type: none"> ✓ 	<ul style="list-style-type: none"> ✓ 	<ul style="list-style-type: none"> ✓ 	<ul style="list-style-type: none"> ✓ Delta programme is a let's say the National adaptation programme in the Netherlands. Especially focus on the, let's say the coast and rivers and fresh water.; Citizens are informed by KNMI and Delta programme
I5	<ul style="list-style-type: none"> ✓ KNMI ✓ Rijkswaterstaat 		<ul style="list-style-type: none"> ✓ 10minutes interval water levels measurements ✓ Calculated yearly average since 1817 ✓ Trend line and time series of water levels by Rijkswaterstaat ✓ Climate scenarios by KNMI 	<ul style="list-style-type: none"> ✓ Reports by KNMI ✓ Time series 	<ul style="list-style-type: none"> ✓ Basic information 	<ul style="list-style-type: none"> ✓ Basic information; trend line and time series done by Rijkswaterstaat; ✓ KNMI doing kind of scenario studies; ✓ KNMI make reports and publicity about the scenarios

Summary of Interviews to answer Question 1 How are citizens informed on sea-level rise currently?

Interviewee	Responsible organization	Who is informed	Kind of information	Tools for disclosure	Specific information	General remarks
I6	Rijkswaterstaat		<ul style="list-style-type: none"> ✓ Actual water level data on the website of Rijkswaterstaat ✓ Predictions tide tables in the Netherlands since 1895 	<ul style="list-style-type: none"> ✓ Paper publications ✓ Website ✓ Tide tables ✓ Telereket ✓ Newspapers 	<ul style="list-style-type: none"> ✓ Water level data for navigation purposes, Operation of sluices ✓ Planning of events such as sports at the beach ✓ Standard water level values with return periods ranging from 1,250 to 10000years are important for the assessment of the safety of the flood water defences 	<ul style="list-style-type: none"> ✓ Water levels measurements by Rijkswaterstaat; ✓ Collected data sent and Checked each month in networked computer controlled room; ✓ Harmonic analysis of data to correct gaps and outliers ✓
I7	Rijkswaterstaat					<ul style="list-style-type: none"> ✓ Citizens are not actively informed; ✓ Rijkswaterstaat performs the measurement on sea-level rise along the Dutch coast
I8						<ul style="list-style-type: none"> ✓ No communications with the citizens itself; Communication with citizens in Rotterdam will be done in few months; ✓ 40000 citizens living along the river zone have to be informed; But very complicated because what do we communicate? Needs planning; Dordrecht communicating with citizens as the face high water levels from the rivers each year; they are used to it; Through the Media; The citizens role is not worked out yet.
I9	<ul style="list-style-type: none"> ✓ KNMI ✓ Rijkswaterstaat 		<ul style="list-style-type: none"> ✓ Climate scenarios ✓ Rijkswaterstaat publish daily water heights 	<ul style="list-style-type: none"> ✓ Scientific reports 	<ul style="list-style-type: none"> ✓ Information about present and future sea-level rise 	<ul style="list-style-type: none"> ✓ Not sure how the public is informed
I10	<ul style="list-style-type: none"> ✓ KNMI ✓ Delta Programme 		<ul style="list-style-type: none"> ✓ 14 climate scenarios by Delta Programme ✓ Climate scenarios calculations ✓ Information for sea-level rise and river discharges by KNMI 	<ul style="list-style-type: none"> ✓ 	<ul style="list-style-type: none"> ✓ Information within the Delta programme that is confidential information because it is for the studies we do for our politicians 	<ul style="list-style-type: none"> ✓ IPCC studies climate change on a global scale ✓ All Information at KNMI ; make calculations for sea-level rise and river discharges ✓ 14 Climate scenarios by Delta Programme each representing time horizon from now to 100 years ✓ The scenarios are calculation studies for impact dimension of flood defences along the river zones to the coastline. ✓ Inputs from KNMI
I11						<ul style="list-style-type: none"> ✓ No, I am not aware of that

Table 13 Summary of interviews to show the best way to inform the public on SLR

SUMMARY OF INTERVIEWS TO ANSWER QUESTION 2 WHAT DO YOU THINK IS THE BEST WAY TO INFORM THE PUBLIC ON SEA-LEVEL RISE?				
Interviewee	Important elements for communication on SLR	Tools and Techniques	General remarks on informing the public	
✓ I1	<ul style="list-style-type: none"> ✓ Kind of message you want to give ✓ Depends on one's perception of climate change ✓ Keep relatively simple ✓ Understandable for everyone 	<ul style="list-style-type: none"> ✓ Link observations with projections to show trend to convince 		
✓ I2	<ul style="list-style-type: none"> ✓ Meetings with the press so information could get publish in the newspapers 	<ul style="list-style-type: none"> ✓ Public lecture for small group 	<ul style="list-style-type: none"> ✓ Consumes a lot of resources(time and energy) ✓ Big reports (scientific papers) 	
✓ I3	<ul style="list-style-type: none"> ✓ Important that you need to know it yourself before informing ✓ Delta committee should study SLR prediction on a long term ✓ Look at the melting of ice sheets and the consequences for the Netherlands ✓ Think about what you want to communicate, what parameter ✓ Velocity, mm per year SLR up to an absolute sand or relative to dikes ✓ Displacement velocity be the parameter to communicate with quality description 	<ul style="list-style-type: none"> ✓ Collect better measurements to decrease error bar ✓ Update error bar 	<ul style="list-style-type: none"> ✓ Knowledge on rates not good enough ✓ Certain topics were not cover or taken into accounts ✓ It is most important not communicate about it but first of all ask yourself what are we going to communicate? ✓ Numbers also have error bars that means that over hundred years we have hundred times 1mm that is 10cm wrong ✓ Because it does not make sense to work on your infrastructure if you have a big uncertainty 	
✓ I4	<ul style="list-style-type: none"> ✓ Only people prone to dangers like flooding needs to be informed ✓ Direct communication 	<ul style="list-style-type: none"> ✓ Use presentations ✓ Use Dialogues ✓ Use Group discussions 	<ul style="list-style-type: none"> ✓ Actually a difficult one ✓ Inform people that have risk of flooding 	
✓ I5	<ul style="list-style-type: none"> ✓ 1994 Report of time series till 1990 now updating it till 2010 or 2011 ✓ Communication maybe after the updates 		<ul style="list-style-type: none"> ✓ Important fact is a lot of people do not know of SLR ✓ Never seen kinds of time series with trend lines ✓ They do not have to know because they are living there and they do have to worry about SLR ✓ They think that everything in the Netherlands is safe as there is protection against water ✓ They trust the people who are doing the work ✓ A technical person do not worried about communication 	

Summary of Interviews to answer Question 2 What do you think is the best way to inform the public on sea-level rise?			
Interviewee	Important elements for communication on SLR	Tools and Techniques	General remarks on informing the public
✓ I6	<ul style="list-style-type: none"> ✓ Campaigns in recent times to make the public aware of SLR ✓ Each year trainings using large flooding stimulation for medical emergency teams ✓ Response to flooding preparation not only on local scale. ✓ Water management boards inform about the importance of responsibility for the safety of water 	<ul style="list-style-type: none"> ✓ Website called 'Nederland leeft met water' translated 'the Netherlands lives with water' to create aware about flooding, storage of water or pollution of water 	<ul style="list-style-type: none"> ✓ No emergency plans in former times till the event of hurricane Katrina
✓ I7	<ul style="list-style-type: none"> ✓ Pay regular attention to reports that are published 		
✓ I8	<ul style="list-style-type: none"> ✓ Good communication but take care not to make people panic because no reason for that ✓ More specific, communicate with people living in flood zones like Rotterdam 	<ul style="list-style-type: none"> ✓ Possibility through media, television 	<ul style="list-style-type: none"> ✓ No need for panic in Holland ✓ Because companies will face consequences should the sea-level rises ✓ Inform them to have idea on what to do for themselves and that is where the complications starts
✓ I9	<ul style="list-style-type: none"> ✓ New insight in SLR by scientific research ✓ Two worlds exist, scientific world to publish results, another world of policy making to design dikes to be uniform 	<ul style="list-style-type: none"> ✓ National Water Plan states SLR should be used to prepare nourishment or to design new dikes 	<ul style="list-style-type: none"> ✓ Not easy to answer that ✓ Kind of research is not quite sure; always uncertainty ✓ SLR Debates in the scientific world making it difficult for Rijkswaterstaat or water boards on which basic points to take into accounts.
✓ I10	<ul style="list-style-type: none"> ✓ Actual SLR concerns the Ministry of government which do investigations or publications 	<ul style="list-style-type: none"> ✓ We make management reports for studies which are available on the websites ✓ Publications not only on SLR but also on impacts 	<ul style="list-style-type: none"> ✓ That is a difficult one ✓ We do not investigate SLR ourselves but use inputs in our studies to calculate the effects on the dikes and functions behind the dikes
✓ I11	<ul style="list-style-type: none"> ✓ Government should make effort to make citizens aware of the information ✓ Create incentives for other organizations to use the information ✓ Supervise information products to citizens ✓ Organizations can act as intermediaries 	<ul style="list-style-type: none"> ✓ Complete website with all information about SLR for interested persons to access ✓ Start information availability campaigns 	

Table 14 Summary of interviews to show opinions on SLR maps to inform citizens as desired

SUMMARY OF INTERVIEWS TO ANSWER QUESTION 3 DO YOU THINK SEA-LEVEL RISE MAPS CAN INFORM CITIZENS AS DESIRED?			
Interviewee	communication of SLR using maps	Hindrances in presenting SLR information using maps	General remarks on informing the public
I1	<ul style="list-style-type: none"> ✓ Maps is relevant when you have a big country or continent to show spatial differences in combination with graphs ✓ Check interpretation of target audience ✓ Depends on one's situation ✓ People wants to know the situation at where they live ✓ Colours are very important ✓ Red relates to danger or warmer 	<ul style="list-style-type: none"> ✓ Difficult to show trends with maps ✓ You do not see immediately something is increasing just looking at colours and the legend ✓ Easier to transferred message with graphs ✓ Difficult to see colour close to Netherlands 	<ul style="list-style-type: none"> ✓ SLR do not differ so much at the coast of Netherlands thus spatial distribution is not very important ✓ Communication on SLR there is an autumn school on the website to deal with uncertainty in climate change ✓ Partly English and Dutch version climate scenarios
I2	<ul style="list-style-type: none"> ✓ Maps for scientific papers ✓ Maps in paper containing newest data to be part of IPCC series new report ✓ First publish before it can be elsewhere ✓ Maps can be useful as people can easily see where the live ✓ People look at maps and say I have SLR here need to be aware land movement have not been taken into account ✓ Maps have background information to tell which information is in and which is missing. Maps tell a story at only one view 	<ul style="list-style-type: none"> ✓ Projections has only water movement information but no land movement because there no information on that and that makes it a problem ✓ We do not have expertise to do that 	<ul style="list-style-type: none"> ✓ Specifically will not be on the websites ✓ Many parts of Netherlands are below sea-level but there are instruments to keep it dry ✓ There are coastal defence system and Water management system unfair to say the whole country would be flooded if the sea-level rises that is of course when you do nothing
I3	<ul style="list-style-type: none"> ✓ Is about what parameter you want to communicate ✓ What is important is the difference between the point on the dike and the water next to it 	<ul style="list-style-type: none"> ✓ Map is in two dimension role in which description or database is too difficult to show SLR is going to do. ✓ Interesting SLR is along the coast or shore and more like a line or one dimensional graph 	<ul style="list-style-type: none"> ✓ I do not think so ✓ Confusion on what relative SLR maps is
I4	<ul style="list-style-type: none"> ✓ Maps on when a dike breaches and that it used a lot ✓ Dike breach maps are risk maps 	<ul style="list-style-type: none"> ✓ Uses maps but not specifically on SLR 	<ul style="list-style-type: none"> ✓ A bit more difficult
I5	<ul style="list-style-type: none"> ✓ Scenarios are kind of risk maps 	<ul style="list-style-type: none"> ✓ Short interesting message on the internet on own website or webpage for everyone to read 	<ul style="list-style-type: none"> ✓ Short articles in newspapers ✓ Special department on communication ✓ Scientist want to use data
I6	<ul style="list-style-type: none"> ✓ Platforms data which are 10 miles from the coast or even further is very important for large ships and not the public. ✓ Extreme case is the oil platform K13 Alpha far at sea and disclosed only on limited case ✓ Because they are limited to certain professionals not the public ✓ Data concerning coastal and estuarine areas for the public mainly for recreation at the beach, design of buildings 	<ul style="list-style-type: none"> ✓ Linear trend since 19th century ✓ No deviations from the linear trends ✓ Time of high and low water in tide tables given for some purposes but not the levels for those who want to take a walk along the beach 	<ul style="list-style-type: none"> ✓ SLR well known discussion about IPCC and its opponents ✓ Continually watch trends of SLR to see deviation as predicted by IPCC ✓ Data available to everyone ✓ Except raw data which are not quality checked but given on request ✓ Also, raw water level data in tidal reach exist from gauges on platforms far at sea not very interesting for the public

Summary of Interviews to answer Question 3 Do you think sea-level rise maps can inform citizens as desired?

Interviewee	communication of SLR using maps	Hindrance in presenting SLR information using maps	General remarks on informing the public
17	<ul style="list-style-type: none"> ✓ Maps can play additional role ✓ Message of SLR can be beneficial to the public if it includes maps to indicate to what extent the Netherlands can be flooded from the sea additionally to the areas that are prone to flooding at the present conditions 		
18	<ul style="list-style-type: none"> ✓ What do you communicate ✓ In Rotterdam, we want to inform them about the possibilities but also what is being done ✓ An important part of communication will be done through the National Delta Programme based on decisions in 2013 ✓ A lot of people will be informed after that decision ✓ Information about SLR and what is been done by governments ✓ Specifically inform people living close to the sea and rivers 		<ul style="list-style-type: none"> ✓ Difficult because it is uncertain how fast the sea-level will rise and uncertain how the water level will be ✓ Example inform about new constructions to make street higher and build in innovative way
19	<ul style="list-style-type: none"> ✓ Depends on what your message is ✓ SLR Map for Netherland is not quite useful because difference in SLR is not big 	<ul style="list-style-type: none"> ✓ In global scale it is interesting like picture from IPCC, shows much differences in the world that give insight on how SLR actually works and what mechanisms plays a role in SLR 	<ul style="list-style-type: none"> ✓ Showing uncertainties with diagrams is useful with new data ✓ Debates about SLR in newspapers whether is raising or not
110			<ul style="list-style-type: none"> ✓ Flood defences must be tested periodically and that is a legal obligation ✓ When a dike is not safe it must be reinforced ✓ Design documents for the dikes in the Netherlands which formulated how much SLR needs to be taken into account ✓ Planning period is 50years or 100years ✓ Dike loads in terms of river discharges and SLR ✓ Compensate for two parameters SLR and subsidence in soil layers in design of dikes
111	<ul style="list-style-type: none"> ✓ Certainly play a role ✓ Accessible information on SLR makes sense through maps ✓ Citizens living near area of SLR impact certainly would be interested in specific kind of information ✓ Map is much easier to obtain information about what SLR means for you. 		

ANNEX VII EMPIRICAL DATA FROM CODING OF EXPERT INTERVIEWS

Type of sea-level rise information disclosure	
Content	<p>Climate scenarios (every six years) I1(10), I10(14), I2(1), I1(1), I5(1), I1(3), I5(3), I1(4), I1(5), I2(5), I1(5), I1(6), I1(6), I1(7), I2(7), I8(7)</p> <p>Time series /trends I5(13), I5(14), I2(1), I1(1), I5(1), I6(3), I5(5)</p> <p>Original 10mins interval water levels data (every day) I6(13), I3(14), I5(1), I6(1), I5(3), I6(3), I6(5), I8(5), I9(6), I2(7), I5(7), I6(7)</p> <p>Aggregated data of yearly averages of high and low water values i.e. Water levels above NAP (yearly) I6(13), I5(1), I6(1), I6(4)</p> <p>10year averages in books I6(7)</p> <p>optimist values and pessimistic values scenarios I10(13)</p> <p>Full description of methods, input data and model assumptions I3(14), I2(1), I1(1), I2(3), I3(3), I2(5)</p> <p>Basic information I5(1)</p> <p>Velocity, mm per year SLR up to an absolute sand or relative to dikes I3(2), I3(3), I4(3)</p> <p>Displacement velocity be the parameter to communicate with quality description I3(2), I3(5)</p> <p>observational datasets I1(4), I1(5), I2(5)</p> <p>Elevation models I10(4)</p> <p>satellite observations I2(7), I3(7)</p> <p>Networked Computer-controlled room I6(1), I5(7)</p> <p>Relevant on a small scale (global) I1(3), I9(3)</p> <p>Two dimensional best to present with graphs I3(3), I9(3), I4(4)</p> <p>Spatial difference in combination with graphs I1(3), I2(3)</p> <p>Colours are very important I1(3), I1(4)</p> <p>Red relates to danger or warmer I1(3)</p> <p>Bluer more days and wet I1(4)</p> <p>Red and yellow dry days I1(4)</p> <p>Drier and wetter, yellow to red I1(4)</p> <p>Red, yellow and blue are used for climate scenarios I1(4)</p> <p>Interactive Maps with zip codes and legend I4(4), I7(4), I9(4), I11(4)</p> <p>3D models I4(4)</p> <p>Not sure of maps I1(9), I2(12), I9(3), I7(5)</p> <p>Pictures I1(10), I1(11), I1(1), I2(4), I6(4), I9(4)</p> <p>Maps for adaptation communication I4(10), I10(14), I4(3), I8(3), I1(4), I4(4), I8(5), I10(5)</p> <p>Satellite I5(14)</p> <p>Reports I1(9), I9(14), I3(1), I5(1), I10(2), I4(6), I5(6)</p> <p>GPS I5(14)</p>
Visualisation	<p>I1(9): In general, the information on the ministry's website is basically just a little bit of information. But there are much more documents which are not always on the websites.</p>
Tools	

Website	I1(9), I4(10), I1(14), I5(14), I1(1), I6(1), I10(2), I1(3), I2(3), I5(3), I1(4), I2(4), I10(4), I2(7)
Booklets/Brochures	I3(9), I1(14), I1(1), I2(1), I1(4), I2(5)
Scientific journals /Papers	I3(9), I2(10), I9(11), I6(1), I9(1), I2(2), I6(5)I2(3), I1(4), I2(4), I2(6)
Presentations/Lectures	I1(10), I2(1), I4(2)
Internet	I3(14), I1(1), I5(3), I4(4), I5(4)
Tables	I1(10), I2(1), I6(1), I6(3), I4(4), I1(5), I6(5), I6(7)
Newspapers	I4(10) I2(10), I6(1), I2(2), I5(3), I9(3), I3(4), I5(4)
Dialogues	I4(10), I4(2)
Radio	I8(11)
Television	I8(11), I6(1), I8(2), I3(4), I8(4)
Figures	I1(13), I2(13), I1(1), I2(1)
graphs	I1(13), I1(1), I3(3), I6(7)
Risk Maps can be useful to communicate	I1(13), I10(13), I10(14), I7(15), I10(15), I2(3), I4(3), I5(3), I7(3), I11(3), I4(4), I9(4), I10(5)
Sketches	I10(14), I1(4)
Database	I5(15), I6(1), I3(3), I2(7)
Water management systems	I5(15), I2(3)
Media	I8(1), I8(2), I11(2), I1(4), I8(4)
Focus group discussions	I4(2), I2(2)
Emergency plans	I6(3)
Climate desk: questions –e-mails	I1(4)
SMS	I3(4)
Letter	I8(4)
Social media	I8(4)
Telephone/telemetry	I5(7)
Apps that make campaign information more accessible	I11(4)
SDI	I2(7), I5(7)
Techniques	I2(9), I9(9), I4(11), I1(14), I2(1), I2(3), I6(3), I1(6), I11(6)
Update scenarios when new IPCC information comes	I1(10), I3(11), I4(11), I2(1), I2(2)
Presentations to professional users	I2(11), I4(11), I3(11), I1(14), I2(1)
Two-way-communication with professional users	I10(13)
use a range of numbers to communicate	I6(14), I6(2), I11(2), I11(4)
Campaigns	I2(1), I1(3), I2(6)
English and Dutch versions	I1(2), I3(2), I9(3), I3(4)
Kind of message you want to give	I1(2), I1(3)
Depends on one's perception of climate change	I1(2)
Keep relatively simple	I2(1)
	I2(1) Tailored presentations depending on audience
	I6(14) 'Nederland leeft met water'

Understandable for everyone	I1(2)		
Link observations with projections to show trend to convince	I1(2)		
Meetings with the press so information could get publish in the newspapers	I2(2)		
Important that you need to know it yourself before informing	I3(2)		
Stimulation trainings for response emergency teams	I6(2)		
Delta committee should study SLR prediction on a long term	I3(2)		
Collect better measurements to decrease error bar	I3(2), I9(2), I3(4)		
Communication after updated error bar or time series	I3(2), I5(2), I3(4)		
Inform people that have risk of flooding	I4(2), I8(2), I1(3), I7(3), I8(3)		
Regular updates of reports	I7(2)		
Reliable and accurate information	I3(4)		
Communication after Delta programme decision	I8(3)		
Learning by doing	I1(4)		
Good communicators	I4(4)		

Actors influencing sea-level disclosure						
Actor	Task/Responsibility	Type	Interest /Aims	Frequency Score	Interviewee	General Remarks
KNMI	Focuses on analyse of SLR	Discloser	Communication Via climate scenarios	37	H1(8), I2(8), I3(8), I4(8), I5(8), I6(8), I7(8), I9(8), I4(9), I3(9), I1(9), I2(9), I9(9), I10(9), I1(10), I1(13) I10(10), I1(12), I7(14), I4(15), I5(15), I10(15), I1(1), I2(1), I4(1), I3(1), I5(1), I9(1), I10(1), I1(4), I5(5), I9(5), I9(6), I1(7)	I1(8): use of data depends very much on the aim of the different stakeholders how and what the stakeholders communicate determine the kind of information they use I2(8): Rijkswaterstaat Water Dienst collects observations data Operational acts of measuring and storing in databases I3(8): Main actor is Rijkswaterstaat maintain tide gauges, save records , throwing a lot of important data Loosing knowledge rapidly I4(8): In, Netherlands, everybody comes together, all working in a kind of consortia; people work together with each other I5(8): it is a combination with climate change and that is the main topic I6(8) a lot of purposes such as the construction of new water defences and estimation of future sea-level rise these data are used. But measurement of water level is useful for a wide range of purposes I7(8) the provinces which communicates the effects of sea-level rise for their own territory to the public. I8(8) Well, that is a good one. I think in the few places in the National government but again in your research your assumption is that the Netherlands are already actively communicating but that is not really the case. I think that will be done actively again after next year delta programme will be finished in end of 2015 I9(8): Rijkswaterstaat or other partners we use this to build other dikes or to take other measures
		User	Observational time series Water levels data and observations Research knowledge	3	I1(1), I2(1), I1(4) I1(8), I2(8) I4(8)	
Rijkswaterstaat	Measures, collects, stores, maintain observation water levels data, tide gauges in databases	Discloser	Water levels data and observations	23	H1(8), I2(8), I3(8), I5(8), I6(8), I7(8), I9(8), I3(9), I5(9), I10(9), I6(14), I7(14), I9(14), I5(15), I5(1), I6(1), I7(1), I9(1), I5(5), I9(6), I2(7), I5(7), I6(7)	
		User	Scenarios, water levels data	5	I2(8), I5(15), I1(1), I2(1), I9(7)	
Deltares	Impact researcher Design of dikes using hydraulic boundary conditions Flood defence calculations Real time series for Rijkswaterstaat	User	Data/time series Climate Scenarios	20	H1(8), I1(10), I10(10), I10(15), I1(1), I2(1), I1(4), I1(4), I4(4), I9(6) I10(7)	
		User	Upper and lower limits scenarios Research knowledge	15	H1(8), I6(8), I10(9), I10(11), I10(2) I5(14), I9(14), I5(15), I9(15)	
		User	Nice Pictures		I1(1)	
		Discloser	Communication via media	8	I1(9), I1(10), I8(11), I4(5), I10(1), I2(12), I4(15), I4(1),	
NGOs	Put climate change on political agenda	Intermediary	Upper limit scenarios	3	H1(8), I11(12), I1	
		Intermediary	Lower limits Scenarios	4	I1(8), I(9), I3(12), I10(13)	
Sceptics	Do not believe climate change	Intermediary				

Actor	Task/Responsibility	Type	Interest /Aims	Frequency Score	Interviewee	General Remarks
Navigators	Navigation purposes for ships	User	Water level data	4	I6(8), I5(9), I6(1), I6(3)	<p>I11(8): Ministry would bear the responsibility I think but they could ask specific agencies such as the RIVM or other agencies there are opendata agencies to provide this information to the public</p> <p>I1(9) Delta programme have several sub-programmes and one is water safety and the risk for coastal flooding is an important issue and for that you need sea-level rise and storms.</p> <p>I1(10) In water management we do have coastal protection, we have water management of rivers and so low and high discharges, we do have people that are working on water quality, people that are working on groundwater, and that is valid for the provinces, the water boards and the municipalities. Well, in the Netherlands we do have about I think 300 municipalities, we do have 26 water boards, there are several organizations that work on ground water levels, we do have consultancy companies that work on that. And that is only on water management. There are also several organizations that are working on the ecosystems, there are people working on agriculture, working on tourism, entertainment and on health</p>
Teachers	Teaching purposes	Intermediary		2	I1(8), I2(6)	
Journalist	Carry messages in media	Intermediary		2	I1(8), I2(6)	
Recreational agents	Breach sports	User	Water levels	4	I1(10), I6(8), I6(1), I6(3)	
Universities	Researches	User	Research knowledge	6	I4(8), I1(9), I4(9), I4(4), I4(5), I3(7)	
Technical University in Delft	Research from space using Radar satellite images					
University of Utrecht	Research on glaciers					
Government (National, regional, local)	Communicate effects to public	User	Research knowledge	16	I4(8), I8(8)	
Ministry, Water boards, Provinces, Regional Disaster Management Institute, Municipalities	National report on the safety of dikes Managing water discharges	Discloser	Report on safety of dikes	11	I7(8), I1(8), I10(8), I1(10), I2(11), I4(11), I2(12), I1(13), I11(13), I10(14), I4(15), I2(1), I1(4), I2(7)	
Knowledge for climate	Researches on adaptation	Regulator	Flood risk maps Policies	3	I10(8), I11(8), I1(9), I4(9), I10(9), I8(11), I4(15), I10(1), I6(2), I10(2), I8(7) I7(15), I10(4)	
External force IPCC	Global partners in calculating scenarios	Discloser	Research knowledge transfer	3	I8(9), I10(9), I10(1), I4(8), I4(15), I4(7)	
Opendata agencies	Act like intermediary between government and public	Discloser		1	I11	
Department of environmental affairs	Should bear the responsibility of SLR disclosure	Discloser		2	I11(8), I6(6)	
General Public		User	Hybrid information of few figures and pictures	3	I1(1), I2(1), I1(4)	
Industry, Business, companies		User		3	I2(1), I6(3), I1(4)	

Actors influencing sea-level disclosure			
Dimension	Answers	Interviewee	Remarks
Enforcement	No	12(9), 13(9), 15(9), 16(9), 17(9), 19(9), 110(9), 14(9), 13(1)	I4(9) Except the communication of the KNMI that is a little bit checked by the government. But further, everybody can communicate what he or she likes in the Netherlands.
Compliance	Yes	110(9)	I10(9)Rijkswaterstaat to make available the hydraulic boundary conditions for the design and the assessment of the flood defences
	No	12(9), 13(9), 19(9), 110(9), 13(1)	
	Yes	14(9)	I4(9) work with the dataset that are reliable and the KNMI provides them
Regulators	No	12(9), 13(9), 14(9), 17(9), 18(9), 19(9), 110(9), 13(1)	I2(9) We have an external advisory committee who advises on the scientific basis of these things of making the right choices. But that is not on communications but on scientific part I3(9) if there is nobody to produce the results then of course there is nothing to be checked; a scientific journal then it would be peer reviewed, peer reviewed checked. But there is no check by an official organization I4(9) more on what the Ministry thinks it is good to tell the public. KNMI is a under the authority of the Ministry but the other organization like the University of Utrecht or like our organization for the Climate or the Delft Technical University they can publish whatever they want. So it is more the KNMI that has to if it is sensible to sensitive information they normal discuss that with the ministry first. if they publish something and the ministry does not like that, then the ministry gets angry with them I7(9) I do not know
Participation And feedback	Yes	I11(9)	I11(9) I am not sure whether we would need a specific organization I mean I can imagine that the Ministry would just report on these issues and then other civil society organizations or maybe MPs could call the Ministry to account if they could be a problem to provide the information provision. But I am not sure whether we need a separate organizations mean for this
	regular contact with professional users	12(9), 11(10), 11(11), 12(11), 15(11), 11(13), 12(10), 14(15), 12(1), 15(1), 16(3)	I2(10) we try to communicate what we do and show what we are here for and that we are doing useful things. And that is more important.
	KNMI organise meetings at the national level	11(10), 12(11), 14(11), 18(11), 15(1)	
	Designed workshops/ Seminar	10(11), 11(13), 11(4), 14(6)	
	work more together and exchange information	11(10), 14(8), 11(11), 12(11), 110(11), 110(14)	
	Get feeling or perceptions of information usefulness	11(11), 12(11), 14(11), 16(11), 110(11), 12(1)	
	Helpdesk	16(11), 15(3)	I6(11); There is our website, helpdeskwater.nl, a possibility to put a question and there is also a central information number of Rijkswaterstaat (0800-8002). Questions to this central number of Rijkswaterstaat go to the Corporate Dienst of Rijkswaterstaat Utrecht; when they do not know the answer to the question they pass it on to different sections of Rijkswaterstaat. The ServiceDesk Data, where you are now, manages these questions for the Data-ICT-Dienst of Rijkswaterstaat
	No need to ask citizens what they need to improve information	13(11), 14(11), 111(11)	I3(11)This kind of things, governments should take up their own responsibilities because there is no user who is going to be interested in the water level in the year 2100. I4(11) it depends very much on what you mean by the users of the information I11(11) I am not sure although I am a strong proponent of citizen engagement and citizens participation and all kinds of fields but I cannot really imagine when it comes to this type of information how citizens could play a role that they could provide information about I do not know the level of the water level of where they live. But I am not sure how that could be really relevant

	Stakeholders Depends on area	I10(11), I10(14)	I10(11) If we do studies we feel that we cannot do this alone from the perspective of a technological institute. It think if you should have participation, you should sort the participation if you talk about risk, it is not allow a technical component but it is very related to the people who are living in the area. So I think if you do not involve these stakeholders or the people in the area, it will become a theoretical study. I think that people will not be happy because they are not involved and they have to make some decisions I think it will be difficult if there is no bearing support from the stakeholders.	
	Demand and supply organisations	I5(11)		
	No experiences	I7(11), I8(11)	I8(11) communication with our citizens in Rotterdam is still have to be done. Maybe, next year again when this Delta programme is in the phase that they are developing the four Delta Decisions, there will be a more active communication about this.	
Accountability	Analyse user requirements	I1(10), I5(11), I2(1), I1(1), I2(1)		
	Adaptation communication for Supports and commitments	I4(10), I11(11), I2(12), I9(12), I3(12), I4(12), I5(12), I6(12), I7(12), I8(12), I10(12), I11(12), I10(11), I10(15), I4(1)	I10(11) making visible what is happening to the flood system and what is happening to the area I10(15) I do not communicate on sea-level rise but I do communicate on flood defences.	
	Spatial planning(landuse) and development plans	I10(11)	I10(11) try to come forward to the specific stakeholders in the area; try to facilitate the workshop in a way that it fits to the problems or the ambitions in this specific area	
	Information updates based on user requirements and suggestions	I1(11), I2(11), I4(11), I5(11), I2(1)	I5(11) we use their feedback. We make some kind of where have descriptions of all the changes, of all the wishes of the users and all changes. Then we bring it to our managers or high managers and they say this is what we are going to do next year. So that is a real formal system	
	General information on websites for the public to read if interested	I2(11), I6(11), I2(1), I1(1), I5(3), I6(3), I4(4)		
	No need for quick information updates	I3(11),	I3(11) We are talking about very slow processes. So it is not so that very week you should come up with new estimates.	
	Transmit ordinal data plus methods	I3(11)		
	Not regular information	I3(1)		

Challenges or barriers in disclosing information on sea-level rise			
Main Challenge	Interviewee	Remarks	Proposed solution
No responsible organization or actor to provide information	13(8), 13(9), 13(10), 19(10), 15(13), 17(13), 13(14), 19(15), 13(1)	13 (9) to build up a long time series so that we have a long term commitments and the same goes for the deformation of the ground. There is no organization who has that in its portfolio. It is a very big problem. Because all long term predictions are shaky 17(13)two different organizations with different responsibilities and with different methods looking back or looking forward.	I3(10) would be good if there is an organization who is responsible of producing this information, which is not there now but then it would be good if that would be there 19(10) I think that have to be improved, so it would be nice that Deltares or Rijkswaterstaat or whatever organization is made responsible for that. I3(14) government should make responsible organization and should put the responsibility at a certain organization that is the first thing Like a survey department which would produce the data, with quality description, together with geo-physical organization who understands the processes, who could make predictions on what is going to happen in the future. What they should do with it, put it on the internet so that everybody can use it. I9(15) it is very important that one institution in the Netherlands is becoming responsible for the processing of the data on sea-level rise or just sea-level rise role measurements I11(2) Supervise information products to citizens
KNMI number of people working is very limited—one or two	13(8), 11(10),	I1 (10) There are so many people that use our information but we have a very limited group working on this so it is impossible to contact all of them. It is impossible to keep track of everyone who uses the data. It is simple impossible. So many aspects in the society that are affected by climate, climate change and it is impossible to contact everyone.	I1(10) need maybe at least ten persons I2(14) interesting hiring somebody new I11(2) Organizations can act as intermediaries
Not officially tasked to determine SLR	13(8), 12(9), 19(10), 15(14), 13(1)	I2(9) there is a law of what KNMI we have to do but I am not sure on how much there is on climate side. This is a law made in the 1960's that is really due to be updated. So I think they are really discussing and discussing because of how to manage the data and how to provide data because it was written in inside but there was no internet all databases and stuff. The things it says there is like totally out-dated and there is no way you would do it like that. I9(10)processing of that sea-level rise data is done on ad hoc bases, so not regularly I5(14) it is not a very hot topic at this momentbecause it has a little effect	I11(2) Create incentives for other organizations to use the information; Complete website with all information about SLR for interested persons to access; Start information availability campaigns
Lack of expertise to keep pace with technology	13(8), 12(13), 17(13), 11(13), 15(14), 13(2), 12(3)	I3(8) Rijkswaterstaat loosing knowledge rapidly I2(13) I can make figures like this but not like things on the web and making it clickable so you can zoom in that sort of things. No, we do not have such kind of expertise now I5(14) Every five years there is totally a new organization. It is difficult to plan something in here I3(2) Knowledge on rates not good enough	I2(13) now we have been thinking about the communication and really have to hired professionals to do such things like that for us because now it just takes too much time and we do not just have the skills to do it and how to present it I7(13) need other techniques
Throwing a lot of important data	13(8), 16(13)	I6(13) If you see here the data before 1971 are rather scarce for at that time the standard was to process only the times and the heights of high and low waters	
give the wrong picture of the results of the	11(9), 12(10), 11(11), 11(13)	I11(9)It was a very annoying for us because we were not allowed to react directly and they gave the wrong picture	

background report what is really happening or could happen in the future		of the results of the background report gives balanced information I12(10) you should not react to anything that is coming in the newspapers I1(11) some people interpret the picture/figures you give in different ways	
Water safety of the river discharges is an important issue than SLR	I1(9), I3(12), I4(13), I5(14), I7(15)	I1(9) a lot of emphases on what is safety in that programme and it is a very important issue I7(15) a sea-level rise is not very significant addition to the risk of flooding that already exist	
Flood defences cost lots of money	I1(9), I10(11)		
Subject of SLR is difficult; all together are now learning and finding out how to do it	I8(9), I3(10), I4(10), I5(13)I1(13), I8(1), I3(2), I10(2)	I3(2) Certain topics were not cover or taken into accounts	I3(10) activities maybe research or on this simply engineers would be deploy to get better estimate, better quality to control small error bars, better estimates I4(10) when the whole coast was checked, on safeties inside of the sea-level rise and the sound some few places that recur then of course you think about adaptation and then you get into contact with people and then you say okay, this area in which you live nearby is a little bit less safe than other areas and we would like to make them safer then it makes sense to talk to people about it
Communication consumes a lot of resources(time, energy, money)	I1(10), I2(11), I1(13), I11(13), I2(14), I2(2)	I1(10) . What we want to do is to be a reference institute to give information as objective as possible. And that we invest a lot of time in explaining. We never focus on only the upper limits but always we give information about the whole range which is possible I1(13) it is not always easy to find funding. But, there is also something else. As KNMI we are not allowed to do work that could also be done by commercial parties. KNMI is not commercial. So we always have to do what we call pre-competitive research or work. Providing data and information based on scientific research is and our basic task towards the government but outside we is not allowed to do the things that commercial companies can do as well I2(14)I am the only person working on sea-level rise and I have my hands full with the future sea-level rise. And there is no money to hire somebody to do that. So that is a problem that	I2(14)we try to tell these people that they should give us more money to do that I3(14)That requires funding so the researchers like me and other people should write proposals to get funding to do what they want to do but also from the society or the government and the should ask the scientists say please do a research on this topic because it is very important for this kind of societal relevance
communicating only on sea-level rise do not make so much sense	I4(10), I8(13), I9(5)		I4(10) link the sea-level rise with situations in which people live
what message do you communicate	I8(10), I3(12), I1(13), I8(13), I9(13), I10(13), I11(13), I1(14), I4(14), I5(14), I8(1), I4(2), I8(2), I9(2), I3(3), I8(3), I8(4), I2(5)	I8(13) the difficult is the uncertainty and the difficult is what do you tell the people what they can do themselves I13(12) low probability will happen maybe once in two or three hundred years and if it happens, it has high impact; extremely difficult parameters to communicate. Many times, because there are a lot of other important issues in life which simply has a high priority I8(1) But very complicated because what do we	I8(10)you need to give more specific information about the specific location of the people I8(13), I1(14)be sure about the quality of the information you give, you have to be sure about if you tell them the possibilities to for example to evacuate, when during high sea-levels that this information is correct I9(13)if you want people to understand the data then you have to be very clear and not complex..... really have to make it easily accessible for the people I4(14) explain with different tools or sometimes you do not explain it, because it is complicated to the mass.

<p>Citizens are not actively informed on sea-level rise</p>	<p>I11(10), I10(11), I2(11), I8(11), I7(11), I2(13), I4(13), I8(13), I9(13), I10(13), I5(14), I8(14), I9(14), I8(15), I10(15), I7(1), I8(1), I9(1), I11(1), I5(2), I6(4), I8(4), I9(4), I8(6)</p>	<p>communicate? Needs planning; Dordrecht communicating with citizens as the face high water levels from the rivers each year, they are used to it; Through the Media; The citizens role is not worked out yet.</p> <p>I11(10) I do not know what information is actually disclosed at the moment I10(11) we do not invite the whole citizens in that because that is not workable I4(13), I10(13) difficult to explain to people. I9(13) very difficult for people to understand I5(2) Important fact is a lot of people do not know of SLR, Never seen kinds of time series with trend lines, They do not have to know because they are living there and they do have to worry about SLR They think that everything in the Netherlands is safe as there is protection against water, They trust the people who are doing the work, A technical person do not worried about communication</p>	<p>I5(14) depends on what we see at that moment</p> <p>I10(11) But sometimes there are organizations that are operating on behalf of the citizens I3(12) I think it would be more important to communicate things particularly to politicians maybe as a targeted group, try to convince them make, make the arguments so solid that they all believe it. If everybody would believe in climate change it would be much easier to do things. Or you have to focus on the population at large and ask them; educate them, so that they can vote for the right politicians. I3(13) the goal should not be to communicate something which everybody would understand I9(13) if you want people to understand the data then you have to be very clear and not complex..... really have to make it easily accessible for the people I5(14) depends on what we see at that moment. If we see other sea-level rise then what we see before then it is big topic. But if you do not see anything new then it is not any news I8(15) So that would be maybe an advice also to and another one is maybe in the city of Dordrecht. They are I think once a year communicating quite actively with their citizens about how high level but that is not sea-level rise but that is high level of what is in the river. But that will change in the future, but they are already having experience about communication. I11(15) look at the difference between active and passive disclosure. So I can imagine that whether there is a difference between actively making the information available or passively making the information available when it is requested. So that is an important distinction and in your case, I would be in favour of actively disclosure but passive disclosure could be a first step. It could also be relevant to sort of making information accessible to different groups of citizens, so that to make a distinction between different user groups. For example, there is certain groups that are very capable of working with the datasets and they will only need the raw data and then they could work with those themselves. Whilst other less educated citizens may want to not have very flexible maps that we talked about and so, it could be important to make a distinction between different user groups</p>
<p>Natural variability and uncertainty</p>	<p>I1(11), I3(12), I3(13), I5(13), I8(13), I10(13), I11(13), I3(15), I1(1), I3(2), I9(2), I1(3), I2(3), I8(3), I9(3), I10(3), I2(4), I3(4), I4(5), I11(5), I3(7)</p>	<p>I3(12) Then if these error bars are still big then there is still a probability that oooooo maybe it is not so bad. I5(13) land is going down and the water level is coming up I3(15) I think the large part of the error batch is at the landside where we do not have really good estimates on the long term; Because, there is not so many people working on it, and it is ignored or we simply do not know or it is difficult. I do not know</p>	<p>I1(11) Then you get the feeling of the perceptions and how they look at the materials that you produced I3(12) decreasing the error bars, decreasing the uncertainty in the predictions. If the predictions are crystal clear, If there is no doubt then it is clear so to do something right. I3(14) The second thing is that doing the right research to decrease the error bars to understand better what is happening. I5(14) two effects we are interested in because you want to know what is going on, the land is going down and the water is going up you want to know these together. But you would also want to know the two sinks up or what. Because it gives maybe some other information or more information I3(15) There are geologists who would be able to work with these data and interpret it I10(3) Compensate for two parameters SLR and subsidence in soil layers in design of dikes</p>
<p>Limited space for development</p>	<p>I9(12)</p>	<p>I9(2) SLR Debates in the scientific world making it difficult for Rijkswaterstaat or water boards on which basic points to take into accounts.</p>	
<p>Too much complains and opinions /debate</p>	<p>I1(13), I11(13), I9(2), I9(3)</p>	<p>I3(13) Peer review is preventing scientist from making the wrong decisions. So the fact that they would be scrutinized, they would be checked.</p>	<p>I3(14) What they should do with it, put it on the internet so that everybody can use it. In the digital form, the original data, publish their methods and they give the original data, the other methods and reproduce it and then check it.</p>
<p>Peer review</p>	<p>I3(13), I3(9), I9(2), I2(6), I3(6)</p>	<p>I8(13) no reason for this</p>	<p>I8(2) Good communication but take care not to make people panic because no reason for that No</p>
<p>do not want to get the</p>	<p>I8(13), I11(13),</p>		

<p>people panic in and afraid People do not believe SLR is happening</p>	<p>15(2), 18(2), 14(4) 11(8), 1(9), 13(12), 110(13), 111(13), 15(2)</p>	<p>12(3) Many parts of Netherlands are below sea-level but there are instruments to keep it dry</p>	<p>need for panic in Holland , Because companies will face consequences should the sea-level rises, Inform them to have idea on what to do for themselves and that is where the complications starts I10(13) use a range of numbers to communicate..... make it visible on the map and then make it visible in the results of the calculation I11(14) the main thing is to develop a political pressure. So there should be some kind of pressure on the national decision makers to pay more attention to this issue. And I guess the political pressure can either come from inside, form actors here in the civil society in the Netherlands. But it could also be created through inter agreement for example the RS agreements, the European Union countries have agreed to provide information regarding the environment to citizens and the RS agreement has a significant impact on the type of information that is been provided about the environment to their citizens. So I can imagine that though the international agreement they play a role as well. So some kind of pressure is needed and if the pressure is there then I am sure then the barriers would be dealt with.</p>
<p>Difficult to communicate SLR with maps</p>	<p>11(3), 12(3), 13(3), 14(3), 18(3), 14(4)</p>	<p>I1(3) Difficult to show trends with maps; You do not see immediately something is increasing just looking at colours and the legend; Easier to transferred message with graphs; Difficult to see colour close to Netherlands; SLR do not differ so much at the coast of Netherlands thus spatial distribution is not very important I4(4) maps is always a very good tool use but on the other hand, you can make people scared with maps use maps but very clearly what maps means. otherwise you can make people scared and that is not necessary in this country.</p>	<p>I11(3) Maps certainly play a role; accessible information on SLR makes sense through maps; citizens living near area of SLR impact certainly would be interested in specific kind of information; map is much easier to obtain information about what SLR means for you.</p>
<p>Difficult in translating science for the ordinary to understand</p>	<p>14(4), 19(4)</p>		