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Adaptation Experiences in Deltas around the World

An extensive desk-study performed by Wageningen University students on adaptation experiences and trends in eight member countries of the Delta Coalition: Bangladesh, Colombia, Egypt, Mozambique, Myanmar, the Philippines and Vietnam.

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Adaptation Experiences in Deltas throughout the World

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Executive Summary

This desk-study performed by MSC students of Wageningen University & Research identifies trends in climate change adaptation literature and projects over the last 15 years for eight countries of the Delta Coalition: Bangladesh, Colombia, Egypt, Indonesia, Mozambique, Myanmar, The Philippines, and Vietnam.

Literature trends on climate change adaptation since 2002
For this purpose 1) a keyword search was conducted using 16 keywords to identify the relative importance of climate change adaptation topics and identify trends per country and all together. The search was done in the Web of Science (WoS) for its strength in peer-reviewed literature, both for the Core Collection and extended database (WoS All). The other consulted database was the WUR Library, and the WUR Library Peer Reviewed articles (a total of four databases).

Climate change adaptation projects in Delta Coalition countries
Further, 2) climate change adaptation (CCA) projects were collected from 16 applicable CCA databases. Information about the objective, year of establishment, responsible organization of the project were, among other things, recorded. These 259 projects were subsequently classified according to its targeted climate change threat, adaptation element and adaptation sector, following the example of classification in the UNFCCC climate change adaptation database. The specific adaptation implementation options and experiences were then identified. Subsequently, projects within the sectors Infrastructure, Agriculture, Disaster Risk Reduction, Ecosystem-based Adaptation and Water Resources were classified.

Recommendations for adaptation policies and practices
Lastly, 3) a series of recommendations to achieve good practices in climate change adaptation implementation options was developed. This series of recommendations aims to improve the development of adaptation policies (policy process-based) and the actual execution of adaptation practices (practice process-based). These recommendations were mainly derived from the UNFCCC Nairobi Framework (2016) and the UNFCCC (2016) report on best practices from the Least Developed Countries-expert group.

Overall, 259 projects were documented in a searchable long-list for the eight Delta Coalition countries. For 140 of these projects adaptation options were identified, which were then analyzed per country. A table with the synopsis for each country is shown in table 1 at the end of the executive summary.

Overview of main Conclusions

Keyword Search

- The number of scientific publications about climate change adaptation in eight countries of the Delta Coalition shows strong exponential growth (R^2=0.96) over the past 15 years.
- Asian countries exhibit the most scientific publications with exception of Myanmar, which shows the least publications in all four databases.
- Colombia and Mozambique are not well represented in the literature.
- Egypt is well represented in the WUR Library search results, however the reverse is true for the Web of Science. This is probably due to the long-standing collaboration between the Dutch and Egyptian Governments.
- *The most important climate change threat for the eight delta coalition countries in the WoS was flooding, followed by sea level rise and drought.*
- The WUR Peer Library showed another focus for those eight countries: *the most prominent climate change threat was sea level rise, followed by drought and lastly, flooding.*

- The most important adaptation sectors in the WUR Peer Library are in order: Community-based Adaptation, Agriculture, Ecosystem-based Adaptation and Pollution.
- In the WoS, the most important CCA sectors are Agriculture, Community-based Adaptation, Ecological Resilience and Ecosystem-based Adaptation.
- Agriculture is the most important economic sector in developing countries that secures the livelihood of the rural population and the food security of the respective countries. As such, it is not surprising that it is such an important topic for CCA.
- The WUR Peer Library exhibits substantial biases, shown in the number of search results returned and its wide scope of included literature. The Web of Science discriminates more strictly according to the keywords and includes only results were all words of the keyword search are present.
- Based on this bias we conclude, following the results of the WoS, that flooding is the most relevant climate change threat for studied countries. This is supported by the fact that flooding is already a substantial problem in deltas as reported by the 5th IPCC Assessment Report while sea level rise is a slow process that will increase in importance towards the end of the century.

Conclusions from the long-list of Adaptation Projects

- We found an exponential increase of adaptation projects and publication about CCA options in our long list for the period between 2001 to 2016 (R^2=0.66). The correlation is not very strong because there is a peak of adaptation projects from 2008 to 2011. In more recent years the number of projects in our list increased again, but this is mainly attributable to contributions from the Web of Science. We attribute this peak not to a peak of actual adaptation projects in the countries of this review but to the databases (especially Prevention Web) not being kept up-to-date anymore.
- *Most projects were recorded for Bangladesh- followed by Vietnam, Mozambique and Indonesia.*
- Following the trend in the keyword search, Myanmar has the lowest recorded number of projects. However, Egypt only has one more project. The low number of projects in Egypt can likely be explained by the revolts and accompanying struggles that the country faced recently.
- The main climate change threat identified is 'multiple threats', which was attributed close to 50% of all projects. This multiple threats describes a combination of climate change threats within a country. The second most important threat was flood, followed by drought and sea level rise. Our classification gave no opportunity to account for the individual threats that formed the Multiple threats.
- None of the projects in the long list mention ocean acidification as a climate change threat that they are tackling. This is surprising because the fifth IPCC report explicitly refers to ocean acidification as one of the main climate change threats, affecting coral reefs, coastal protection/resilience, fish production, and contributing to soil acidification, depleting agricultural productivity.
- The most important adaptation element with 17% is 'science & research'. Adequate climate change adaptation needs to be informed by science and research to allow for the best possible outcome under uncertain impacts from climate change. Myanmar just recently started with their climate adaptation effort as reflected in the databases.
- Agriculture, as the most important adaptation sector in the long-list and topic in the keyword search, provides food security and sustains livelihoods of most of the population in the studied countries. This makes adaption in this sector vital to the sustainable delta development including the population's well-being and security.
- The second most important adaptation sector after agriculture is water resources followed by disaster risk reduction and governance. The maintenance and protection of water resources is vital in developing countries where groundwater provides affordable means to clean water and is exceedingly required for agriculture and irrigation. This extraction however brings about substantial subsidence in reviewed delta countries,

especially in Asia. Decreasing rainfall during the dry season and the shift of seasons exacerbate the pressure on water resources. Disaster risk reduction is vital in Southeast Asian countries that experience cyclones and storm surges on a regular basis. Governance is crucial, as it provides the framework for adaptation implementation.

- Agriculture and water resources are connected because irrigation becomes increasingly necessary for successful agricultural production in deltas. However, it is also encouraged as a means to increase productivity of the crop to provide a better income for farmers to alleviate poverty and facilitate development.
- Surprisingly, water savings technology is hardly employed except in Egypt. This expertise from Egypt could prove essential for adaptation to droughts in other countries.

Conclusions from Good Practices

- Whatever adaptation measure can be regarded as a 'good' practice is highly dependent on the geographical, political, cultural, and economical context. It is therefore inconceivable to establish a universally applicable list of good adaptation practices. Therefore a series of principles that have the ability to transform an adaptation practice into a good one have been formulated.
- A distinction was made between policy-process and practice process-based guidelines for good practices. The former is mainly concerned with guiding the process of adaptation policy formation, whereas the latter focuses mainly on guiding the execution of the specific measures.
- For policy process-based guidelines for good practices, important principles are stakeholder involvement, risk and vulnerability assessments, authority, baseline establishment, and monitoring and evaluation, amongst others.
- For practice process-based guidelines for good practices, principles are actionable knowledge, priority setting and multisectoral planning.

Conclusions/suggestions for the Delta Coalition

- Based on the conclusions shown above and in the rest of the review, we would like to give the following suggestions for the Delta Coalition.
    - First that it should ensure further focus and exchange on Agriculture, since this is the sector that is most important for the livelihoods of local people and also the sector that is attracting most attention.
    - Secondly, we would like to suggest to improve the dialogue between member countries about their institutional arrangements, both to learn from each other and to ensure that adaptation options that work in one country don't become maladaptation in another.
    - Thirdly, where possible, long standing indigenous knowledge of local adaptation options should be sought out.
    - Fourth, further analysis of the long-list could reveal 'specialities' of specific organizations.
    - Fifth, this database can be used in the starting phase of a project to find organizations that did similar projects.
    - Sixth, it would be valuable to look further into regional adaptation databases such as SEARCA and WISDOM as they are better updated, and to have a someone who speaks the local language to look at local projects.
    - Seventh, this database in combination with the series of recommendations from the literature synthesis, is the perfect base for an analysis of actual use of these recommendations in the field. This analysis can follow the methodology of Gruber et al. (2010).

- Eighth, further analysis into the origins of the money for adaptation projects is an interesting topic for further analysis.
- Ninth, deeper analysis of adaptation initialised by business has promise to reveal some innovative adaptation measures.
- Tenth, the Delta Coalition should promote the sharing of bad experiences, as they are often much more valuable for learning than good practises.

Table 1. Synopsis of the findings for each of the 8 individual countries.

Bangladesh	Drought and flooding are the most studied threats relative to the other countries. Stakeholder involvement, institutional arrangements, and community outreach are elements that are the subject of study more often compared to the other countries, which seem to correlate with the sectors Indigenous & Traditional knowledge and Ecosystem based adaptation. The most important adaptation elements in Bangladesh are science & research, capacity building and implementation. Finally agriculture and water resources seem to be very important sectors for adaptation in Bangladesh.
Colombia	Erratic rainfall is the most studied threat relative to the other countries. The main climate change threats in Colombia are erratic rainfall, floods and storm surges. Colombia does not seem very vulnerable to the impacts of climate change, and most climate change problems that are addressed in Colombia also have a strong human element. The main adaptation elements in Colombia are capacity building, policy development and impact assessment. The main adaptation sectors are governance and human settlements, again reflecting the human element that is present in the climate change problems in Colombia. As a practice, Silvopastoral farming is a topic that is more developed in Colombia.
Egypt	The main climate change threats in Egypt are drought, erratic rainfall, sea level rise and salinization. Especially sea level rise is the most studied threat compared to other countries. Results from literature seemed to comply with findings from our longlist. The main adaptation elements in Egypt are capacity building, science & research, monitoring & evaluation and vulnerability assessments. This can be explained by the fact that Egypt is currently facing many other struggles and adaptation planning is not the country's main priority. The projects that are running are more of inventorying and explorative nature rather than focused on implementing hard measures. The main adaptation sectors are community-based adaptation (which often goes together with capacity building) and water resources. Important adaptation measures are about diminishing leakage of water in agricultural irrigation systems to cope with diminishing water resources.
Indonesia	Indonesia suffers mostly from floods as the main climate change threat, which is also the most studied threat relative to other countries. After floods, sea level rise is the most important climate change threat to Indonesia. The main climate change adaptation elements in Indonesia are capacity building, policy development and implementation. Most strategies to adapt to climate change are related to the sectors of coastal zones/areas, urban resilience and agriculture. The most implementation practices focus on hard measures related to ecosystem-based adaptation. Building dikes, sea wall, and mangrove plantation are the most preferable measures in Indonesia coastal line.
Mozambique	Climate change adaptation projects in Mozambique address a range of sectors

	and climate change threats, and an extensive number of unique measures is employed towards adaption. The main climate change threat (besides 'multiple threats') in Mozambique can be assigned to floods, followed by drought. The main adaptation elements are policy development and implementation, which diverts from the results in the other countries. The main adaptation sectors are disaster risk reduction and governance. A reader interested in innovative measures should take notice of Mozambique, as it has such measures almost every sector, most notably in Agriculture, Infrastructure, Disaster Risk Reduction, and Community-Based adaptation. These measures are mostly geared towards floods and droughts, but other climate change threats are also discussed.
Myanmar	The main climate change threats identified by our longlist for Myanmar are, besides 'multiple threats', increasing temperatures and drought. The main climate change adaptation elements in Myanmar are science & research, policy development and education and training. In a similar fashion as Egypt, this can be explained by the fact that the country is still in the beginning phase of implementing adaptation options and there is still need for identification and exploration of data, as well as a need to train and educate people about climate change adaptation. The main CCA sectors in Myanmar are agriculture and governance.
Philippines	The most important climate change adaptation sectors in the Philippines are Ecosystems, Disaster Risk Reduction and Agriculture. The Philippines are characterized by coral reefs of high ecological value, which are threatened by increasing temperatures. In addition, agriculture is negatively influenced by increasing temperatures, as well as by droughts (lowering the groundwater level) and monsoons that are increasing in intensity. These factors are reflected in the most important climate change adaptation sectors in the Philippines: Ecosystems, Disaster Risk Reduction, and Agriculture. The most common way to solve the problems in these sectors is through implementation of measures, but education/training and policy development are also often used.
Vietnam	The main individual climate change threats to Vietnam are sea level rise, floods, drought and salinization, although 'multiple threats' can be assigned to most projects. The main adaptation elements in Vietnam are science and research and capacity building. Publications about these elements also exceed the mean of the eight countries together. Vietnam's main adaptation sector as identified by our longlist is water resources, followed by urban resilience, services, DRR and coastal areas.

Abbreviations and Acronyms

CC	Climate Change
CbA	Community-based Adaptation
CCA	Climate Change Adaptation
DRR	Disaster Risk Reduction
EbA	Ecosystem based Adaptation
GHGs	Greenhouse Gases
KWS	Keyword Search
LL	Long-list
M&E	Monitoring & Evaluation
S&R	Science & Research
SLR	Sea Level Rise
UNFCCC	United Nations Framework Convention on Climate Change
WoS	Web of Science
WoS-CC	Web of Science Core Collection
WUR Library Peer	Wageningen University & Research Peer-Reviewed Literature
WUR Library All	Wageningen University & Research All Literature

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1. Introduction

Presently, the global climate is changing at an unprecedented rate and global political awareness that decisive action addressing climate change is necessary has risen over the last decades but has often not translated into adaptation action (Noble et al., 2014). Especially the populations of global river deltas and coastal zones are vulnerable to the impacts of climate change by rising sea levels, increased magnitude and frequency of storms, flooding and salinization (Burkett et al. 2014; Wong et al. 2014).

Therefore, the Dutch government initialized a global partnership of 12 countries with major deltas to share knowledge and expertise to adapt to impacts of global projected climate change: The Delta Coalition. The objectives of the Delta coalition are to increase the resilience of deltas, facilitate development and put the sustainable development of urban deltas on the global agenda worldwide. This review examines trends of climate change adaptation, adaptation action and options in eight members of the Delta Coalition: Bangladesh, Colombia, Egypt, Indonesia, Mozambique, Myanmar, the Philippines, and Vietnam.

Global river deltas that are hotspots of both development and climate change vulnerability, especially in Asia and Africa (Wong et al., 2014). The vulnerability of a specific country determines its likelihood to be negatively impacted by climate change. Vulnerability is a combination of exposure to and sensitivity to climate change in combination with the adaptive capacity of the respective country. Deltas are particularly sensitive to three key drivers related to climate change: sea level, ocean temperature, and ocean acidity (Wong et al., 2014). In many non-western countries, societal risks such as poverty and inequality greatly reduce adaptive capacity (Burkett et al., 2014). Additionally, as climate change reduces basic resources such as energy, food and water, existing inequalities may deepen, causing maladaptation and new vulnerabilities (Burkett et al., 2014;). Also, misguided adaptation interventions in one sector or location may even increase vulnerabilities of other sectors, areas or even the targeted population (Noble et al., 2014).

The large and dense populations in rural and urban areas of river deltas of non-western countries are largely dependent on the natural resources provided by agriculture and fisheries (Burkett et al. 2014; Wong et al. 2014, Wassmann et al., 2009), where climate change is exacerbating already existing environmental and societal risks. The anthropogenic pressure on coastal ecosystems will increase significantly in the coming decades due to population growth, economic development, and urbanization (Wong et al., 2014). Groundwater sources, which are an important and cheap source of water supply in cities of non-western countries, are threatened due to over-withdrawals. The extraction of groundwater, floodplain engineering and trapping of sediments by dams causes substantial drops of aquifer water levels in cities such as Manila, Jakarta and many others (Syvitski et al., 2009; UNESCO, 2012). This in turn causes land subsidence which increases exposure to coastal flooding, sea level rise and leads to a decline in water quality especially in river deltas of non-western countries with rapidly growing populations (Nicholls et al., 2008; Nicholls and Cazenave, 2010). River flow is expected to decline in the future during the dry season which increases the magnitude of saltwater intrusion into deltas (Hamilton, 2010) and threatens for instance agricultural productivity of rice in Asia, reducing future food security (Wassmann et al., 2009).

The Mekong River Delta alone covers more than 600,000 km^2 and houses 60 million people (UNEP, 2010). Without adaptation, hundreds of millions of people will be affected by coastal flooding and will be displaced due to land loss by year 2100 (Wong et al, 2014). Some low-lying countries of the Delta Coalition such as Bangladesh and Vietnam are expected to face very high impacts and associated economic damages (Wong et al., 2014). Warming trends and increasing

temperature extremes have been observed and water scarcity is expected to be a major challenge for most of Asia as a result of increased water demand and lack of good management (Hijioka et al., 2014).

The potential for adaptation is large, irrespective of development status, but so far coastal adaptation towards climate resilient and sustainable coasts has progressed more in developed countries (Wong et al., 2014). Engineered and structural options are globally still the most common adaptation actions but the recognition of alternative adaptation options such as ecosystem-based, institutional and community-based adaptation as well as the necessity for safety-nets for vulnerable parts of the population is increasing (Noble et al.,2014). In general, adaptation action is increasing in non-western countries but is mostly short-term oriented (Wong et al.,2014).

The IPCC distinguishes between three strategies of coastal adaptation: retreat, accommodation and protection (Nicholls et al., 2007; Wong et al., 2014):

- Retreat options include allowing wetlands to migrate inland, shoreline setbacks, and managed realignment by, for example, breaching coastal defenses allowing the creation of an intertidal habitat.
- Accommodation is achieved by increasing flexibility, flood proofing, flood-resistant agriculture, flood hazard mapping, the implementation of flood warning systems, or replacing armoured with living shorelines .
- Protection aims at maintaining and expanding existing defence lines by measures such as land claim; beach and dune nourishment; the construction of artificial dunes and hard structures such as seawalls, sea dikes, and storm surge barriers; or removing invasive and restoring native species.

Which adaptation option, or combination of options, is most suitable for a given location is determined by specific threats caused by climate change and anthropogenic pressure and can therefore be very variable depending on the geographical and cultural context. Therefore, policy decisions informed by observations, climate research, and experiences determine how well societies can adapt to expected changes and improve development of low and middle income countries (Burkett et al. 2014).

One of the challenges for global institutions is now to share gained knowledge, experience and expertise about adaptation in order to provide and implement the best possible adaptation measures to ensure human well-being.

The added value of this research

So far, information mostly flows from the Netherlands to other member states of the Delta Coalition. Especially aggregated knowledge about adaptation options of the non-western member states is scarce. Condensed and analysed information however is vital to learn from past experiences and to improve adaptation policy and actions in the future. Therefore, we constructed a long-list of climate change adaptation projects of eight members of the Delta Coalition. This database has a common structure to identify, extract, and synthesize both effective and ineffective climate change adaptation practices, projects, programs, and policies. The database provides not only an overview of adaptation options but also enables the analysis of local and global trends in adaptation. Furthermore, it may be possible to reflect on good practices in climate change adaptation in deltas using this database .

The Research

This review consists of three components: The first component is a keyword search which is based on the Web of Science and WUR library databases in which we noted the number of results that popped up in these databases for pre-defined keywords, followed by an analysis of the main results. The second and main part of the research was the construction of an

adaptation projects database in the eight developing Countries of the Delta Coalition. The third part of the research consisted of the development of a framework for good practice guidelines as proposed by well-regarded institutions. This framework was, in turn, used to evaluate adaptation measures and projects and to construct a series of recommendations for good adaptation practices.

The Report

The report is divided into three sections: 1) a data analysis considering the collected data for all countries together, followed by 2) an in-depth country analysis and 3) the conclusions of the review.

Research Questions

The aim of this review is to answer the following research questions: :

1. What are current trends in climate change adaptation in the eight countries under review?
    a) What is the combined trend?
    b) What are individual trends in each country and how do they differ?
    c) What climate change adaptation action and options are taken to address current and future climate impacts?
    d) What are good practices for climate change adaptation?
2. What lessons can be learned from the experience of these countries?

The method of this review consists of three parts:

1. The Keyword Search

In this part we answer the first basic question by assessing how much scientific attention is given to specific climate change threats and adaptation option in deltas. First we establish the current trend of climate change adaptation in the combined scientific literature of all eight countries in Chapter 2, and then in the country analysis (Chapter 3) we go further into detail as to where each country's "specialization" is.

2. The Long-List

Here we are still answering question one by documenting specific projects and their related main climate change threat, adaptation element and adaptation sector. In Chapter 3 we again establish a baseline, after which we can see in the country analysis what that country's specialization is. But we also are laying the groundwork for question 2, by documenting specific case studies that can be analysed more.

3. Good Practices

At the end of Chapter 2 we provide a synthesis of best practices proposed by well-regarded institutions. We then use this synthesis as a theoretical framework to reflect on projects that we find particularly innovative or well-executed, thereby being able to develop a series of recommendations of good adaptation practices.

2. Global Analysis

This chapter describes the basic methodology and results of the Keyword Search (KWS), Long-List (LL) and Good Practices, providing the reader with general climate change adaptation topics/trends for all countries together. This global analysis is followed by chapter 3 (Country Analysis), which has a country-specific focus.

2.1 Keyword Search

Schematic overview of the Methodology & main Results of the Keyword Search

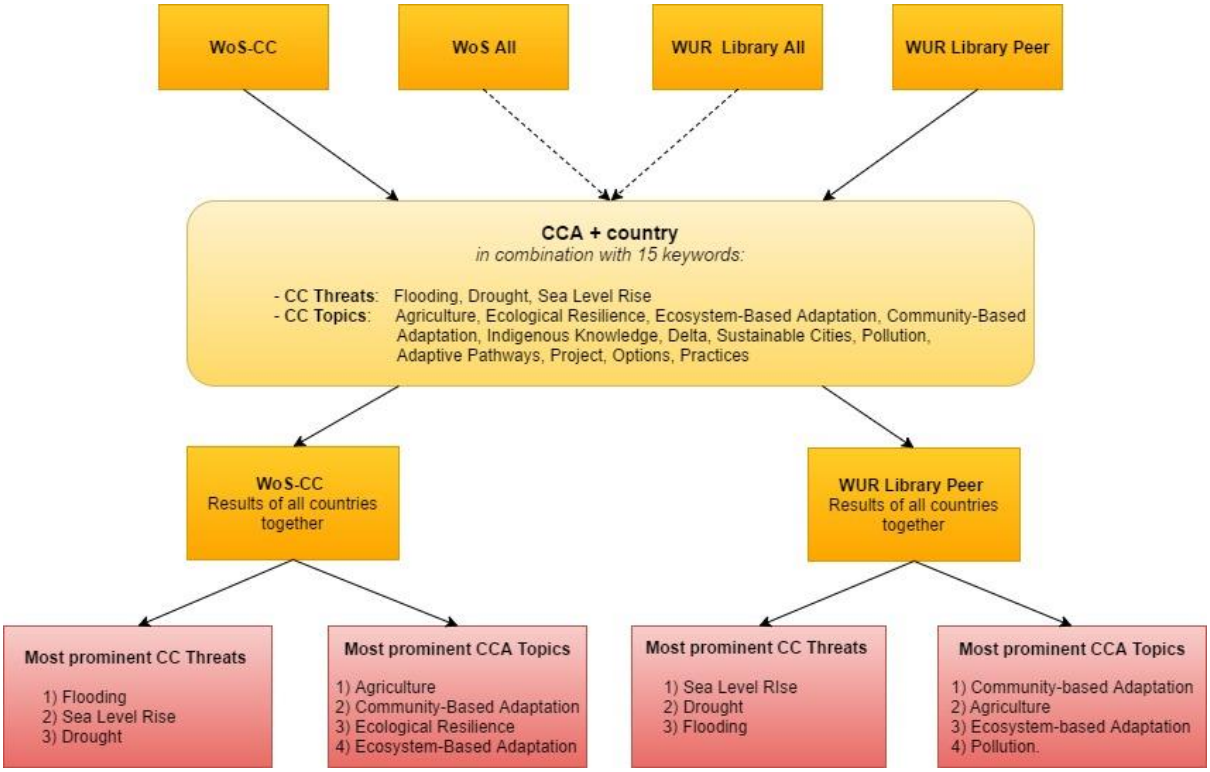

Figure 2.1.1: Schematic overview representing the process of the keyword search and showing the differentiated outcomes of databases WoS-CC and WUR Peer. The exact same process has been conducted for the WoS All and WUR All.

General

In order to find trends of climate change adaptation topics in the eight Delta Coalition countries in the scientific literature, we conducted a keyword search in the Web of Science and the WUR Library databases. In total we used 16 keywords for 8 countries in 4 databases.

The data collection for the keyword search was done on the 5th of May 2017 in the Reuters Web of Science (WoS) and the Wageningen University & Research (WUR) Library search engine. Additionally, we recorded the number of publications per year for the search term "Climate change Adaptation + Country" for all eight countries over a period of 15 years on the 30th of May 2017.

The WoS focusses on peer-reviewed literature in accomplished journals which they call the WoS Core Collection. They also provide the possibility to include a selection of other scientific databases into the search which is called the WoS All databases. The WUR Library search engine has a wider scope than the Web of Science by including books, conference proceedings, among

others, next to peer-reviewed scientific articles. Similar to the WoS, the WUR Library provides an extended search and a search that focuses only peer-reviewed literature.

We could not use Google for the keyword search, as the search engine operators (e.g. the operator 'Allintext:') do not provide the possibility to exclude / include results definitively. This became clear when we found more results instead of less results when we added additional words to the query . This unreliability makes a conclusive data analysis impossible.

Selection of Keywords

We based the keyword search on the search term combination "Climate change Adaptation + Country" which formed the comparative basis for all other adaptation topics. These topics were added to the original search resulting in a format of "Climate change Adaptation + Country + Adaptation Topic".
We chose adaptation topics focussing on adaptation in deltas, the water sector and popular concepts in adaptation such as ecosystem- and community-based adaptation. Furthermore, we added the terms project, options and practices to our search to get an indication of the importance of the terms in the literature in the respective country. The complete list of all 16 search terms and more details of methodology for the keyword search can be found in the Appendix (Appendix A).

Biases in the data search

The numbers generated from the keyword search as detailed above contain several biases and therefore the results should be taken as indications of the abundances of adaptation topics and selected climate change threats in the literature and not as absolute contributions.

The biases are all positive, i.e. they return more results than actually relevant to the search. The magnitude of the bias also differs between the WoS and the WUR library. As the WUR library has a much wider scope including books and conference proceedings also the absolute contributions of irrelevant returns becomes larger. However, it was not possible for us to quantify the bias due to a lack of time and insufficient knowledge about the exact workings of the search algorithm. However, we are quite certain that the numbers are exaggerated in at least one order of magnitude. This becomes apparent when Myanmar (the country with the lowest results in both WoS & WUR Library) is examined more closely in the WUR library. After two pages, articles and books are entering the results that are not connected to the country in question. Therefore, we will compare the results on a relative basis. Also, Wageningen University & Research started out as an agricultural university and is still very active in this field, therefore the results for agriculture are on a continuously high level. Also the overlap of results is much larger than in the WoS.

The bias in the web of science is caused by its built-in function called 'KeyWordsPlus'. This function identifies the search terms in the text of the articles. This potentially increases the number of search results per keyword combination. As an example: When searching for the combination "Climate change adaptation Egypt ecological resilience" in the WoS CC it will return 2 search results. However, one of the search results is not about adaptation in Egypt: it is about adaptation in the Netherlands and it is at first unclear why it was returned for that particular combination. KeyWordPlus had identified Egypt in the text, where, when read, it became clear that Egypt was included because of "controlled drainage" experiences in Egypt from the 80s & 90s. This was cited as lessons learnt for adaptation in the Netherlands (Ritzema et al., 2015).

Data Analysis of the KWS

We used radar- and box plots to visualize the relative contributions of adaptation topics to the overall results of one country for climate change adaptation. Also we made country specific

trend plots visualizing the number of publications per year in each country and as a whole for "Climate change Adaptation + country".

Results of the Keyword Search

The magnitude of results differs greatly between the WoS and the WUR Library but not so much within one database (Fig. 2.2.2).

Indonesia, Bangladesh and the Philippines yield the most search results in the WUR Library All Databases (Fig.2.2.2 a). For the WUR Library Peer this differs slightly. However, this distribution is not repeated by the WoS. Bangladesh, Vietnam and Indonesia exhibit the most publications in the WoS All Databases and the WoS Core Collection (Fig.2.2.2 b). However, also here the WoS Core Collection shows a slight variation in the order of countries. Mozambique and Colombia are both very lowly represented in all four databases.

In general, the Asian delta countries show the most scientific publications in the WoS with the exception of Myanmar. This trend is largely also visible in the WUR Library with the exception of Egypt which returns the second highest search results. The Netherlands have a long standing cooperation with Egypt which brings about a high interest in research & science and resulting publications (also see the KWS bias in this section). We think that the WoS exhibits less biases than the WUR Library (see above). Nevertheless, we did not exclude it from the further analysis because it is interesting as well to see local focal points of Wageningen University & Research. Instead, we will use only the results of the WoS Core Collection and the WUR Library Peer.

For Myanmar, we think the low number of publications in both the WoS and WUR Library may be due to the recent political transformations in the country (see section 3.6).

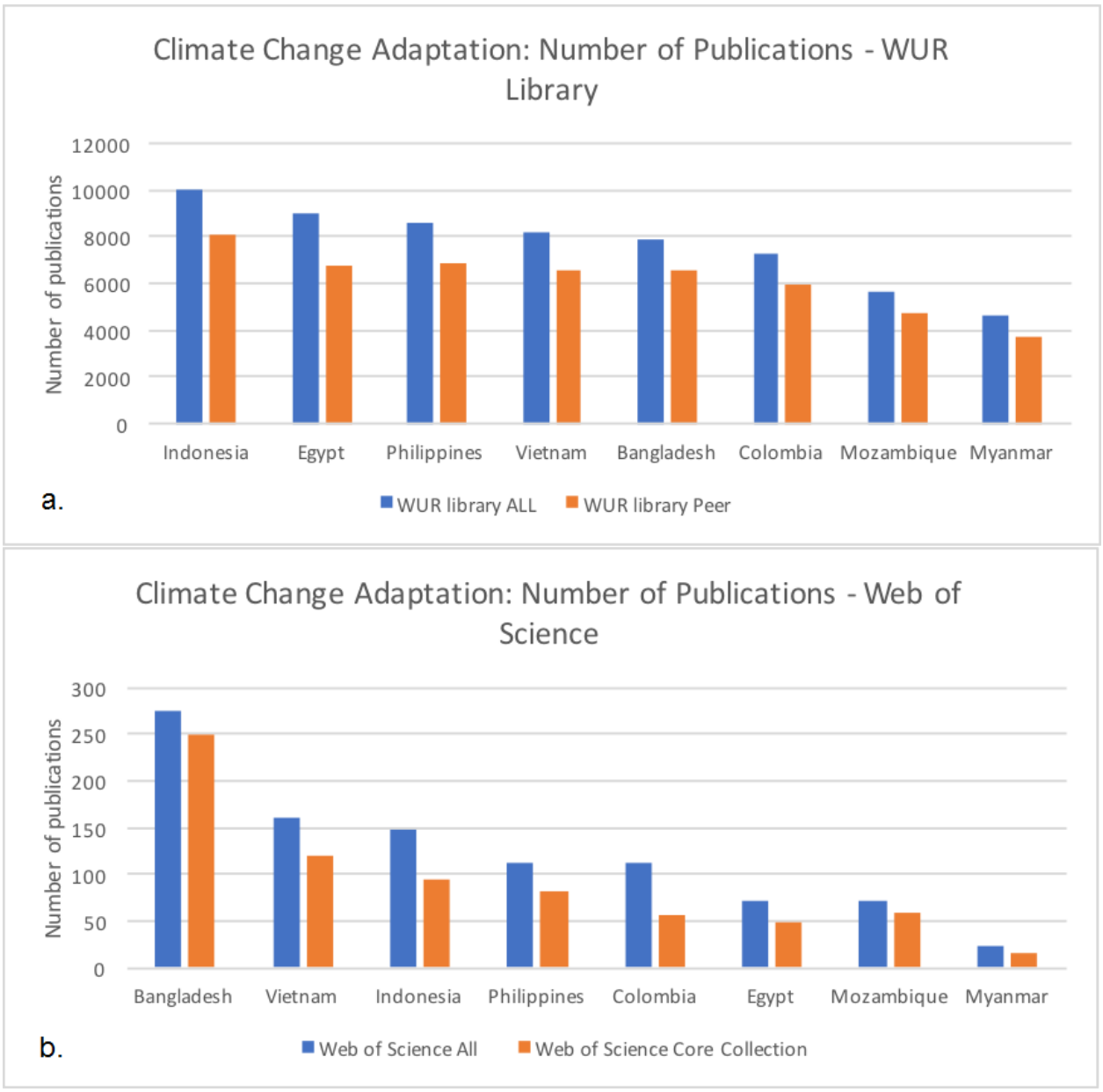

Figure 2.2.2 The graphs show the number of publications for the search term "Climate change Adaptation + Country" for a) the WUR Library Peer and WUR LIbrary All databases and b) the Web of Science Core Collection and the Web of Science All databases. The results are ordered from largest to smallest following the numbers of the WUR Library All and the Web of Science All.

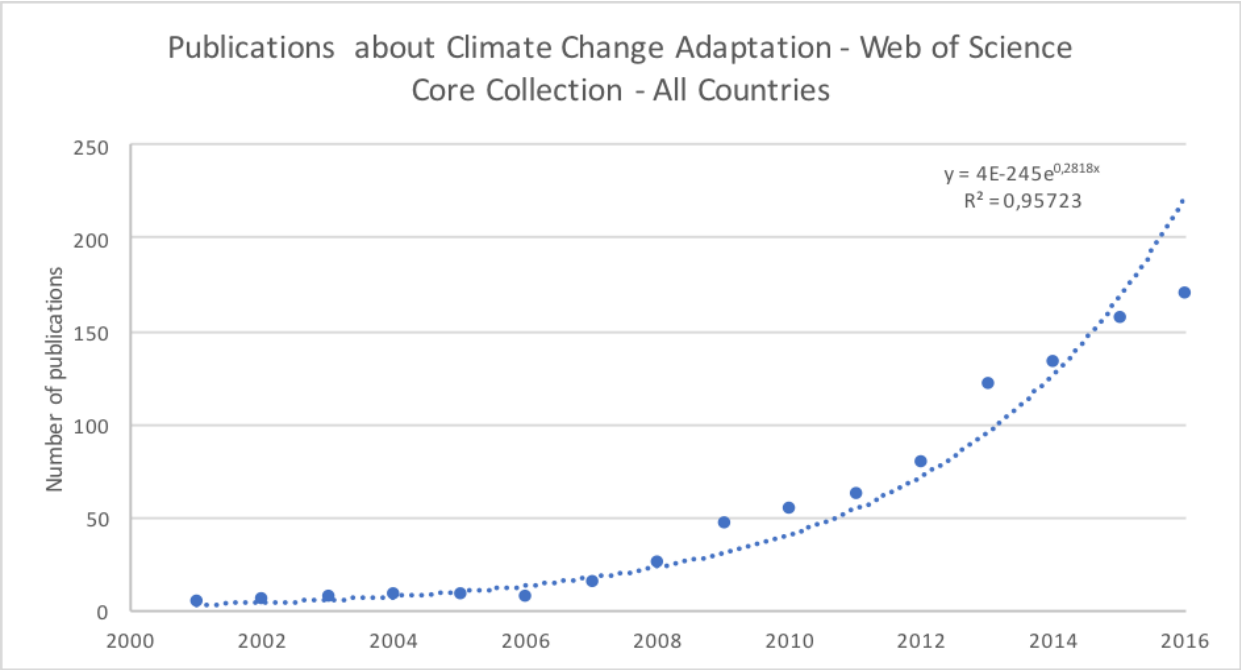

Figure 2.2.3 Cumulative number of publications about climate change adaptation in the WoS Core Collection from 2001 to 2016. Trendline is exponential.

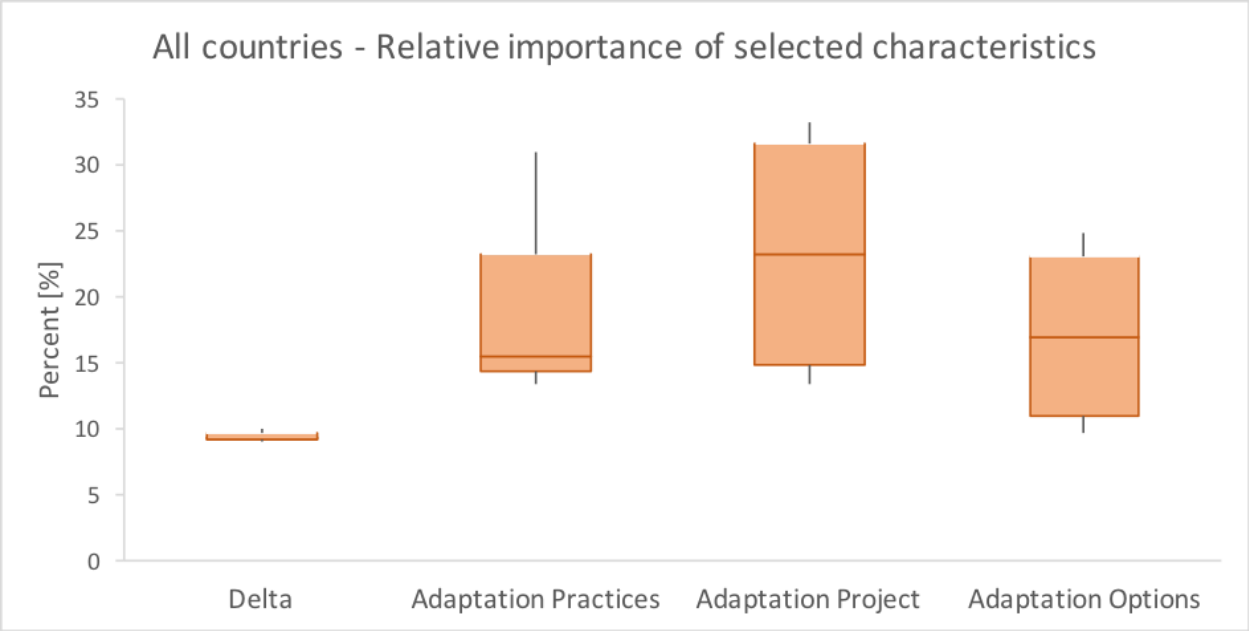

Figure 2.2.4 The boxplot shows the relative importance of keywords about adaptation projects, practices and options. As well as the contribution of Deltas to the overall search over all four databases. The range of the box and deviation is between the minimal and maximal relative contribution to the total number of search results.

The cumulative number of publications has risen exponentially (R^2=0.96) in the WoS Core Collection from 2001 to 2016 (Figure 1.2.2). In the period of 2013 to 2016 shows a linear increase, whether or not this means a slowdown of publication in CCA cannot be answered at this point.

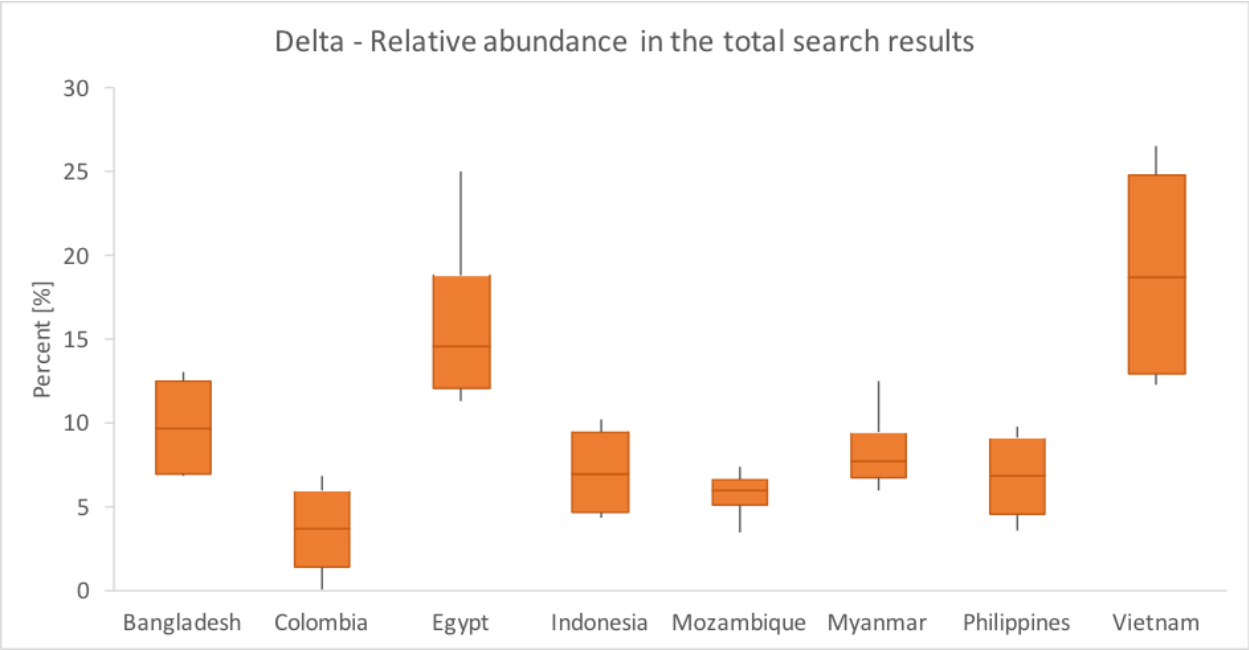

Figure 2.2.5 The box plot shows the relative importance of "Climate Change Adaptation + Country + Delta" for each country over all four databases. The range of the box and deviation is between the minimal and maximal relative contribution to the total number of search results.

Relevance of Deltas, as well as Adaptation Practices, Options and Projects

Climate change adaptation (CCA) in deltas was our main research focus. However, Figure 2.2.4 shows that the deltas account only for about 10% to all search results from all databases for all countries.

However, the importance of deltas for CCA differs a lot among countries (Figure 2.2.5). Deltas contribute most to the CCA literature in Vietnam, Egypt and with some distance Bangladesh. In all other countries the relative contribution of deltas to the scientific literature lies below 10% and is lowest in Colombia. It should however be noted that the higher end of the results for Egypt and Vietnam, come from the results of the WoS Core Collection indicating that in these countries deltas are substantial subject of scientific study. The reverse holds for Colombia, there the WoS Core Collection records zero publications about CCA in deltas. Overall, this indicates that CCA adaptation is not the most prominent research topic except for Vietnam and Egypt and there is need for further study.

Of adaptation projects, practices and options, projects are the most abundant in the search results (Figure 2.2.4). This holds for both databases. However, all three adaptation topics show almost twice the relevance in the WUR Library results than in the WoS (Figure 2.2.7 & Figure 2.2.8 ('supporting graphs') at the end of this chapter). Therefore, practices are more abundant in the CCA literature than options.

Overview of Adaptation Topic Relevance - All countries

We visualized the relative importance of adaptation topics over all countries with a radar graph that includes the results of all four databases (Figure 2.2.6 on the next page).

There are a four things that we can conclude from the radar graph. The first thing that stands out is that the peer reviewed and normal WUR library are almost indistinguishable indicating that the relative distribution of keywords is not significantly different. This is not the case for the WoS Core Collection and WoS All Databases, where the Core Collection emphasizes sea level rise, flooding, and drought, whereas agriculture loses relative importance in the search results.

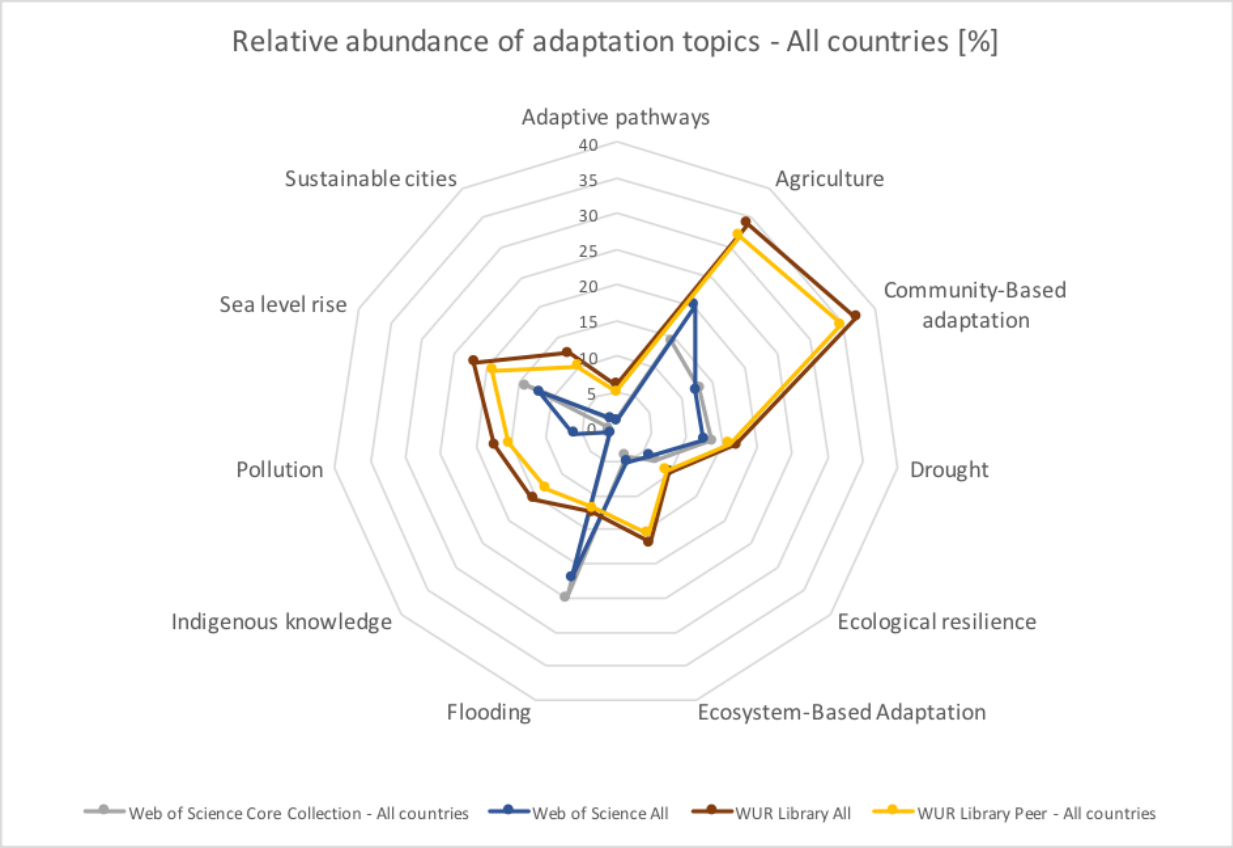

Figure 2.2.6 Radar graph of relative importance of the most important adaptation topics including climate change threats. Order is alphabetical.

The second important thing is that Web of Science emphasizes flooding more by a factor of 2 compared to the WUR Library.

Thirdly, apart from agriculture, the WUR library provides more results in social science related subjects such as Community-Based Adaptation, Ecosystem-Based Adaptation, and Indigenous knowledge, whereas the WoS database focuses more on natural science related subjects such as Sea level rise, Drought and most prominently Flooding. It may be that the social science focus brings about the importance of Community-based Adaptation, making it the most abundant adaptation topic in the WUR Library.

We earlier discussed the bias of the WUR Library and therefore we conclude, following results of the WoS, that flooding is the most relevant threat for deltas at present. This is supported by the fact that flooding is already a substantial problem in deltas as reported by the 5th IPCC Assessment Report while sea level rise is a slow process that will increase in importance towards the end of the century.

Finally it should be noted that on average, Agriculture, Community-Based Adaptation, Drought, Flooding, and Sea level rise contribute most to the overall climate change adaptation literature in these databases for the countries of our review.

It is unclear to us at the present why Community-based Adaptation is the most abundant adaptation topic in the WUR Library.

Databases

After a scoping search on the 5th of May 2017 in the Scopus search engine with two search term combinations that showed that their results are in the same order of magnitude as the WoS results. Additionally, Scopus results are also included in the WUR Library results.

Supporting Graphs

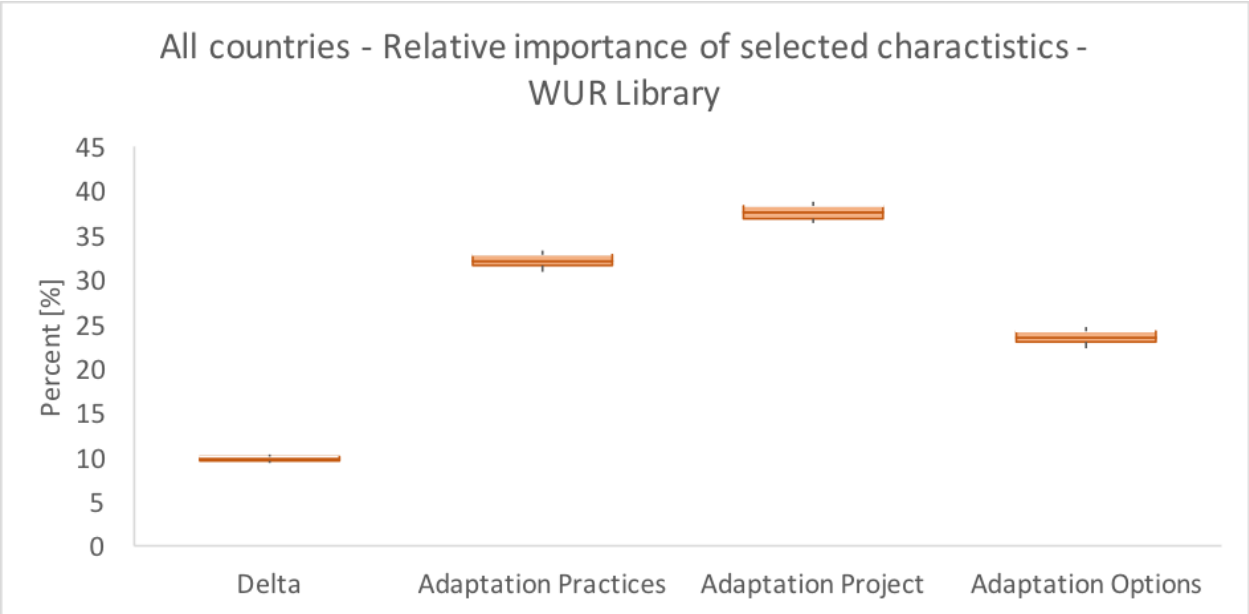

Figure 2.2.7 The box plot shows the relative importance of keywords about adaptation projects, practices and options. As well as the contribution of Deltas to the overall search in the WUR Library Peer and WUR Library All databases. The range of the box and deviation is between the minimal and maximal relative contribution to the total number of search results.

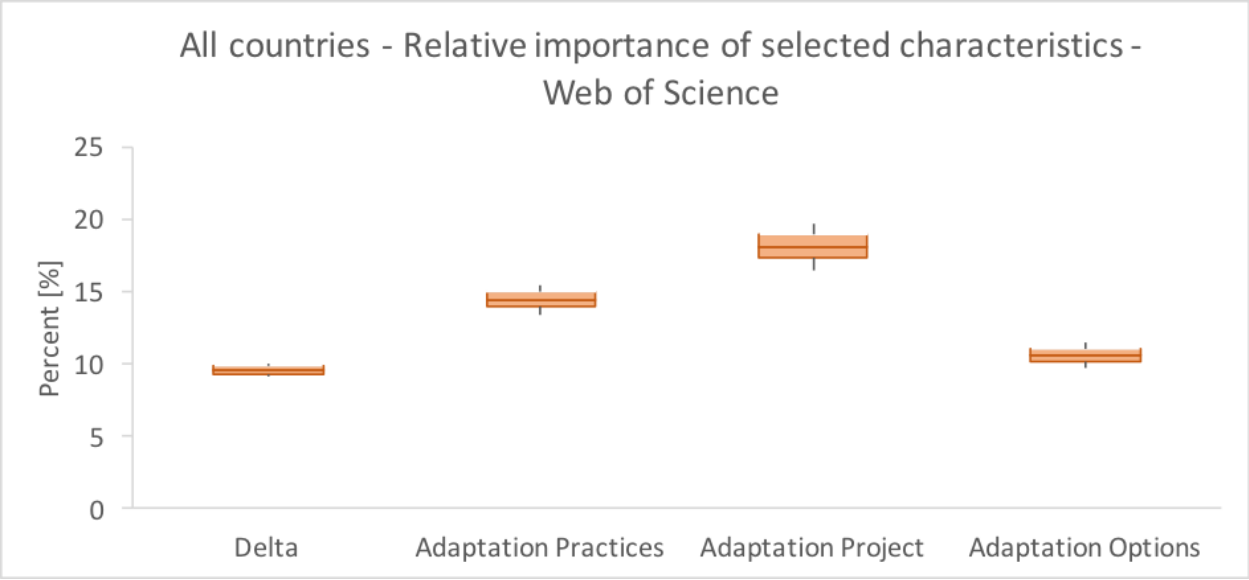

Figure 2.2.8 The box plot shows the relative importance of keywords about adaptation projects, practices and options. As well as the contribution of Deltas to the overall search in the Web of Science Core Collection and WoS All databases. The range of the box and deviation is between the minimal and maximal relative contribution to the total number of search results.

2.2 Long-List

Schematic overview of the Methodology & main Results of the Long-List analysis

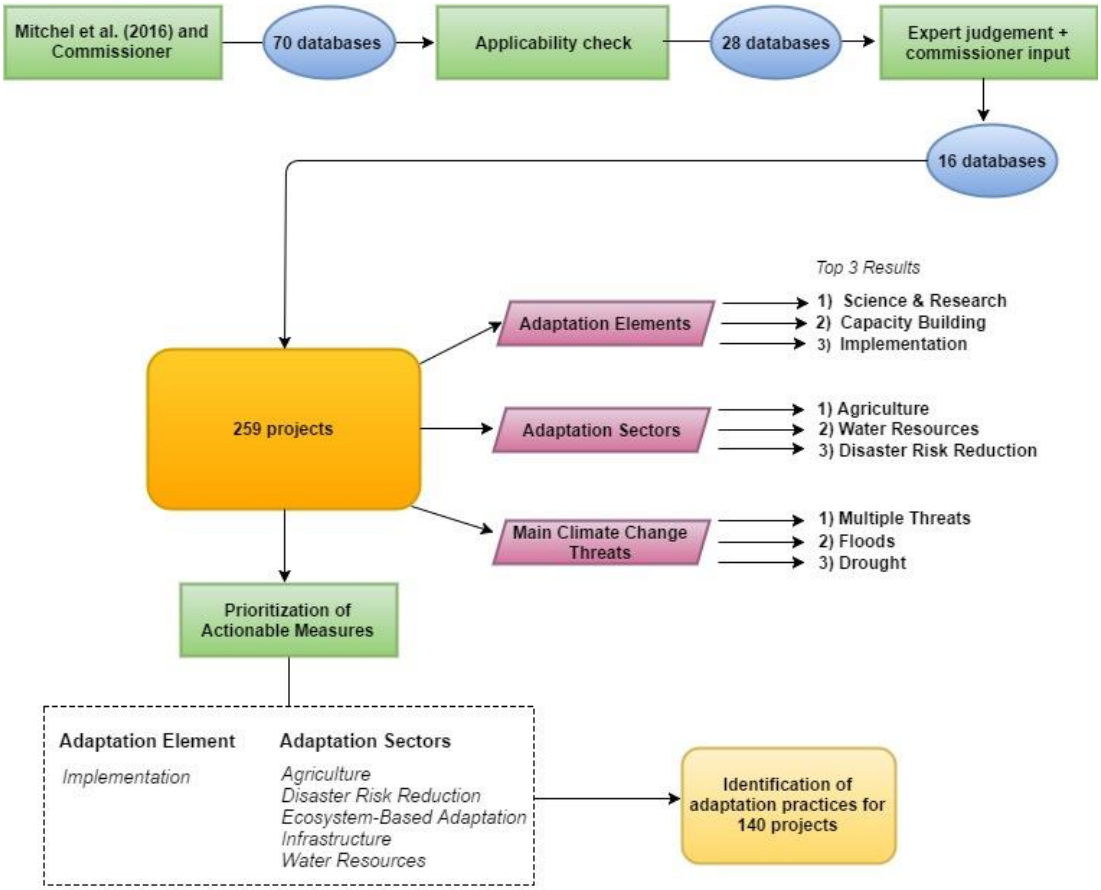

Figure 2.1.1 Schematic overview of the main long-list methodology including the prioritisation of Databases for data collection, the categorization of CCA projects into adaptation elements, adaptation sectors and main CC threats. Categories were adopted from the UNFCCC Adaptation Knowledge Portal. For a subset of 140 from the original 259 projects we identified in detail the underlying adaptation options based on actionable adaptation elements and adaptation sectors.

Note: The long-list is an extensive excel file which can't be added as an appendix to the report. In order to access the long-list, the students or the commissioner can be contacted. For an extended methodology and justification of chosen categories, see appendix B.

Data collection for the Long-List

The long-list is a collection of adaptation projects and publications from the eight countries of the Delta Coalition in this review. To identify adaptation projects, we used the review of adaptation databases of Mitchel et al. (2016) who provided a recent list of 64 established adaptation databases. These 64 databases were complemented by specific websites of interest suggested by the commissioner and three that we found during the research. Together, this amounted to a total of 70 databases. Of these databases, 28 were applicable to our countries of interest. The number of databases was still too large, therefore we prioritized 16 databases in consultation with the commissioner for the collection of adaptation projects and publications (hereafter we will refer to the content of the long-list as projects, which includes publications and studies). See figure 2.1.1.

For each project we recorded the country, the year of establishment or publication, the objective, the name, the size, the organization conducting the project, the donors, the main targeted climate change threats and the type of CCA measure in Microsoft excel (a full list of categories for the data collection can be found in the Appendix II). In this way, we recorded the information for a total of 259 projects (Figure 2.1.1). After this data recording, we introduced three new categories for all CCA projects: adaptation elements, adaptation sectors and main climate change threat. For this classification, we used categories provided by the UNFCCC Adaptation Knowledge Portal (see Appendix II). However, we added the adaptation element "Policy development" and adaptation sector "Governance" due to their abundance in adaptation action because the Portal did not use any equivalent categories. To minimise the individual error and ensure comparability of the categorisation we discussed the projects before assigning them into a category. These three categories facilitated the basis for the data analysis presented in this chapter and part of the individual country analysis.

The identification of individual adaptation options was done for a subset of the total 259 projects. We chose to omit the projects about policy development and governance to focus on the most actionable adaptation options. We prioritized projects with the adaptation element "Implementation" and the adaptation sectors "Agriculture, Disaster Risk Reduction, Ecosystem-based Adaptation, Infrastructure and Water Resources". There were also other relevant categories which we had to avoid due to time constraints. In this way, we identified the adaptation options for 140 projects. The adaptation options do neither represent measures that have all been implemented nor was it possible to provide a quantitative analysis of the implementation of these options, although this was available for a small subset of studies that conducted household surveys.

The Limitations and Bias of the Long-List

The information provided by the databases was in large parts not sufficient to fill the information requirements of our long-list. This made it necessary for us to consult the original documents of the projects. While doing this, we often found that the information provided by the databases contained errors and even false information. Where possible, we took the information from the original project documents and provided the links in the excel file of the long-list. In some cases, it was not possible to identify the starting year of project for example. In these cases, we instead took the earliest available date or the date of publication of the project/scientific article or left it blank where no information was available (25 projects). There are projects that are conducted in more than one of our eight countries, when this was the case we recorded them for each country separately because we were interested in the CCA of these countries and the implementation and measures differed among countries. However, we cannot guarantee that all information in the long-list is correct.

Databases like the UNFCCC Adaptation Knowledge Portal are reliant on people and organizations to submit information about adaptation to the database. Others search for the information themselves like Africa Adapt. In either way, it depends on the activity of the database or submissions which projects and knowledge can be found on the platforms. Most of our projects in the long-list were taken from Prevention web which showed no new projects after 2012.

Another bias in our data collection was brought about by the limitation of the data collection to CCA projects in English. There is, for example, information in Spanish available for Colombia but we could not use these projects for the long-list because we do not speak Spanish. Also, due to the language limitation we were not able to look for more local CCA options and indigenous knowledge. Therefore, we cannot report on this except when it was reported in the CCA databases and scientific publications.

Most of the databases themselves and the projects in them are sponsored by big international organizations like the World Bank and Development Banks. Even scientific publications have usually at least one partner university outside the country of interest. This culminates into a data collection that provides a very "western" look of CCA in the eight countries of the Delta Coalition.

Due to a lack of time, some projects were not noted using a prioritisation process. Towards the end of the data collection we prioritized those projects most clearly relating to the water sector because of the delta and water focus of this review. Therefore, policy and governance related projects may be underrepresented. However, it should also be added that governmental policy development and governance is only present in the databases when they received input from UN bodies or other international organizations.

Additionally, the categorization of the 259 CCA projects into adaptation sectors, elements and main targeted climate change threats is biased by our subjective understanding of the elements and sectors. We did however try to limit this biases by discussing the assignment of categories overall and for critical projects in particular within the group. Furthermore, we needed to select only one element/sector per project even if more would be applicable. We solved this problem by focussing on the core interest of the project. For the main CC threat for example this means that "Floods" often (i.e. in coastal zones) implicates "Salinization" as well. For projects that covered the entire country we assigned "Multiple threats", as the country level is too broad to be assigned one specific main climate change threat.

All the limitations above introduce a bias into our data collection and the results from the long-list. This bias means mainly that the results of the long-list depict a "western view" of CCA in the eight countries of the Delta Coalition. Additionally, this review prioritized projects in the water sector and actionable measures but was not exclusively restricted to these. We included many policy and governance projects. The long-list is not a comprehensive list of CCA projects in the eight countries of the Delta Coalition. Individual countries show relatively small numbers of projects, this will be looked closer at in the individual country section. Nevertheless, we argue that our review still indicates the individual relevance of adaptation elements and adaptation sectors and targeted climate change threats for the countries in this review because of the relatively big sample size of 259 projects and its deliberate focus on the water and deltas.

Trend of recorded projects over time

The long-list shows an increasing trend of established/ published projects over time (Fig 2.2.2). However, the trend is only weakly exponential (R^2=0.66). This is due to a peak of recorded projects in the time period of 2008 to 2011 with the highest number of projects in 2009. After 2009 the number of projects decreases and only shows a new increase in 2016. The peak may be brought about by biases in our data collection most prominently by the high number of projects from Prevention web, which recorded no new projects after 2012 (Figure 2.2.3). The higher number of projects in 2016 is mostly due to scientific publications from the Web of Science. Therefore, this trend should be taken with caution. We know from the KWS that there is a clear increasing exponential trend of scientific publications over the past 15 years. That this is not the case for CCA projects is probably due to the bias in the CCA databases that themselves do not reflect all CCA action in the countries of this review. A comprehensive list of CCA action would also need to include all action from governments on different organisational levels and local initiatives which are only reflected in part in the databases.

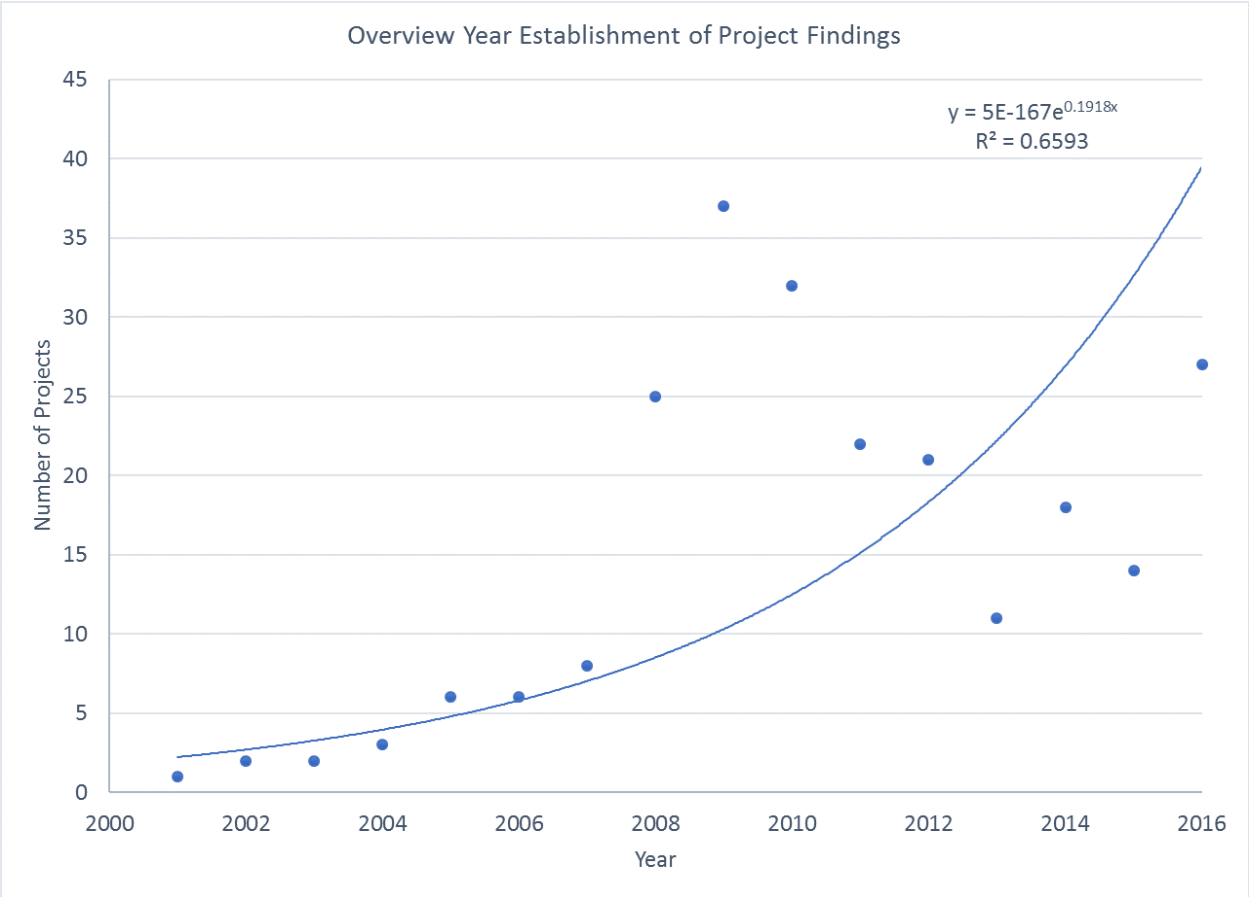

Figure 2.2.2 Cumulative projects for all eight countries in the long-list over time which was recorded as year of project establishment or date of publication of the project/scientific article excluding projects that did not this provide information (25 of the 259 projects). Trend line is exponential.

Source databases of the CCA projects

Prevention Web contributed the most projects to the long-list (32.8%), followed by the Adaptation Learning Mechanism (17.5%) and Web of Science (15.3%). These databases provided projects for all countries in this review while the lower contributing databases are generally either region specific (e.g. Asia-Pacific Adapt, Africa Adapt) or provide information on a specific adaptation topic, e.g. adaptation in cities (100 resilient cities) or adaptation in deltas (Deltares, Delta Alliance). The UNFCCC Adaptation Knowledge Platform as well as the UNEP database also provide information on all countries but the number of contributions in these databases are not high for the UNFCCC Adaptation Knowledge Platform and the information provided in the UNEP database was very poor.

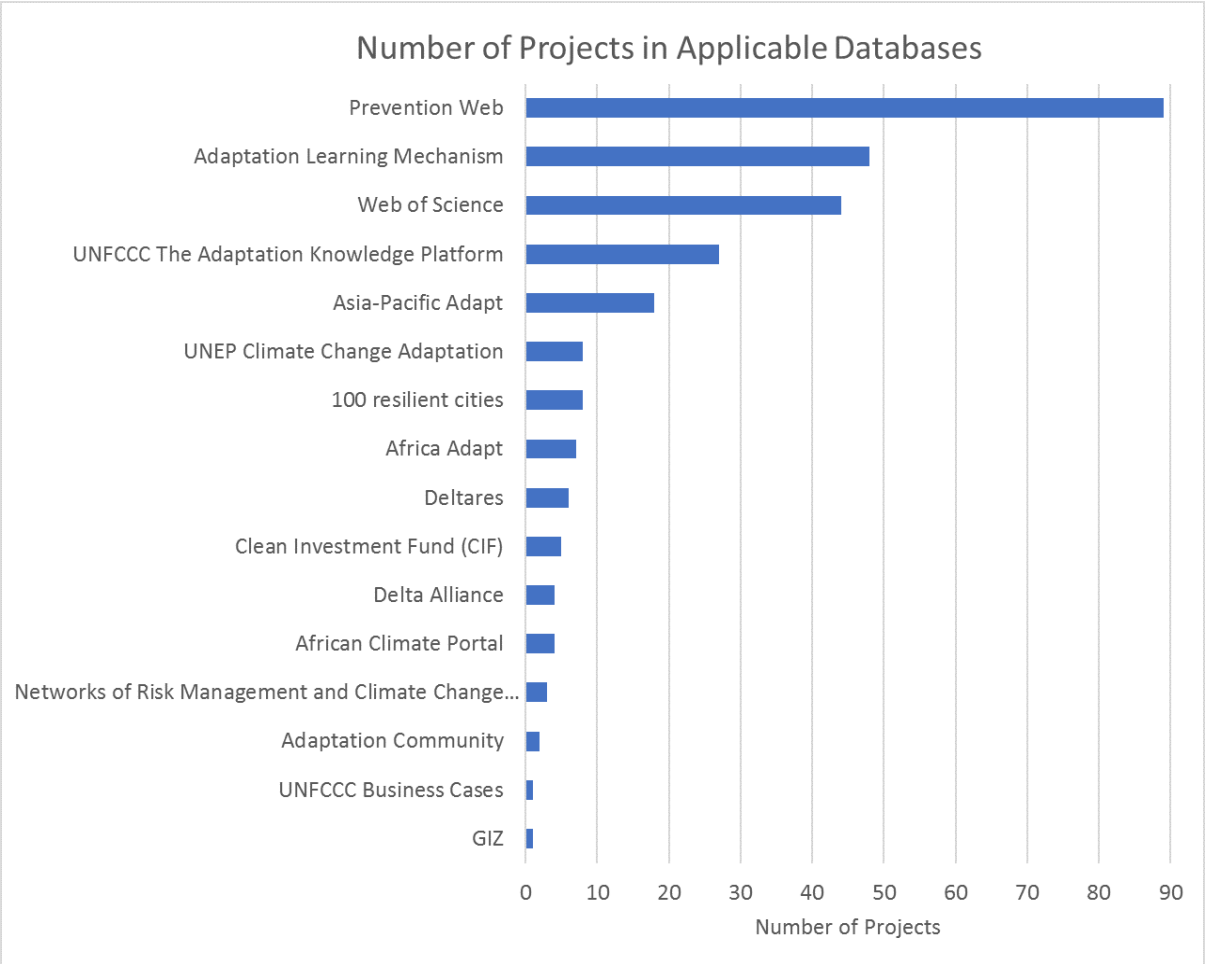

Figure 2.2.3 Contribution of databases to the number of projects in the long-list. 16 projects were found in more than one database. For this figure only the contributions of the databases were counted separately.

Number of projects per country

We found 259 projects which are distributed among the countries as shown in Figure 2.2.4. The distribution of projects among countries is similar to the results of the keyword search. We found the most CCA projects for the Asian countries in our review except for Myanmar which contributed the least projects to the long-list (for more information on this see the Myanmar country section 3.7). The CCA projects of Bangladesh account for 19% of all the projects in the long-list. The reason of this outstanding number for Bangladesh may be that English is widely used by the government, law, business, media and in education. Therefore, it may be easier to find the projects written and published in English for this country than for others where many projects could not be used in the long-list because they were written in the country's native language.

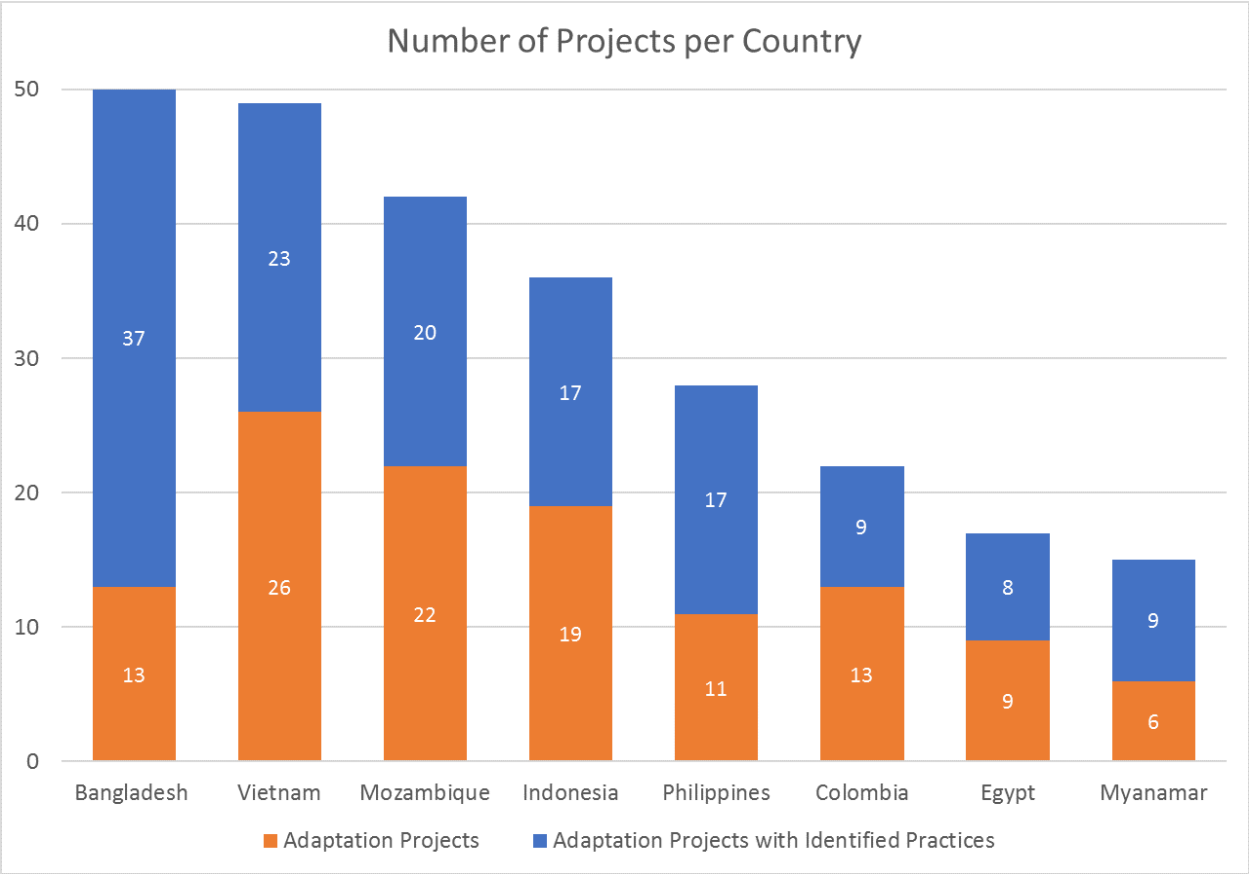

Figure 2.2.4: Number of projects per country ordered from largest to smallest. The number of projects for which we identified the underlying adaptation options in detail are shown in blue (54% of the total 259 projects).

Contrary to the KWS, Mozambique has the third most projects in the long-list. This may be caused by the fact that we used two African specific CCA databases (Africa Adapt and the African Climate Portal) that contributed many projects about Mozambique but less about Egypt. We can at this point not give a clear answer as to why Egypt is lowly represented in African specific CCA adaptation databases but it may be brought about by the revolts in the country during the Arab Spring (this has been elaborated upon in chapter 3.4).

Overview of climate change threats

As can be seen in Figure 2.2.5 on the next page, for almost half of the projects, Multiple Threats was identified as the main climate change threat. Multiple threats was generally used when the targeted climate change threats of a project were rather a combination of different threats without a clear prioritization. This includes projects focused on governance and policy development like the development of a National Adaptation Plan of Action to the UNFCCC in Myanmar and, like stated before, projects that focus on the entire country.

After multiple threats, Drought and Floods are the most common threats that are addressed. Sea level rise and tropical cyclones follow and lastly all the other threats are distributed almost equally low.

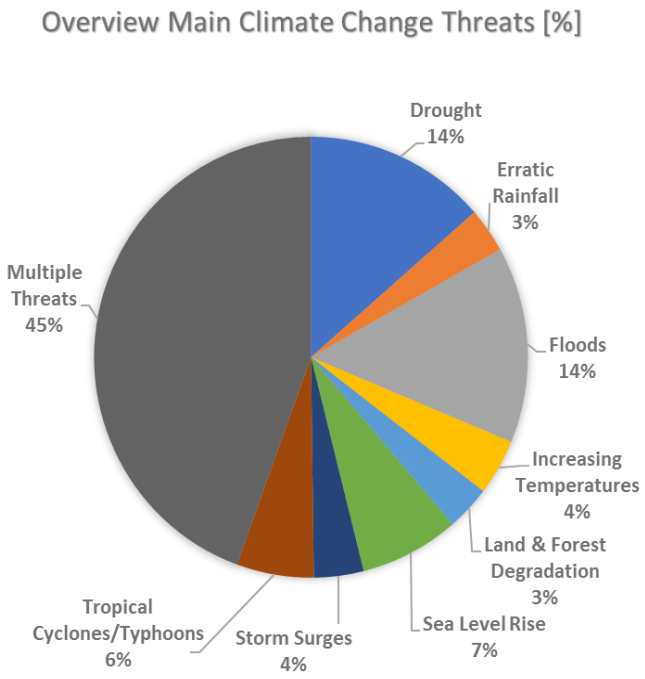

Figure 2.2.5: Main Climate change threats of the projects in the long-list. Multiple threats was generally used when the targeted CC threats of a project were a representative set of threats for that country.

The IPCC report identified three drivers of climate change that deltas and coastal zones are particularly sensitive to: sea level rise, ocean temperature, and ocean acidification (Wong et al. 2009). Of these drivers, only sea level rise was directly targeted as a climate change threat in our review of CCA projects. This is probably due to the fact that ocean temperatures as one of the determinants of the strength of tropical cyclones and typhoons is recognised as a climate change threat in form of the storms itself (Tropical Cyclones/Typhoons, 6%). Additionally, ocean temperatures can also have detrimental effects on coral reefs that protect coastal zones by breaking the waves of storms thereby reducing their destructive potential. Their protection is for example targeted by The Philippines (see section 3.8).

Ocean acidification was not mentioned in any of the projects in the long-list but may however have huge impacts on coastal ecosystems in the future (Wong et al., 2009). This is in addition to salinization by flooding and brought about by the increasing amount of carbon stored in the oceans which decreases the pH of the water. This may have huge impacts on coral reefs but also on the agricultural production in coastal areas. While salinization was mentioned often and is recognized in this review (but often recorded as floods due to the immediate threat to people's lives) ocean acidification was not. Not even by the review of Wassmann et al. (2009), a landmark research paper that studied the effects and possible adaptation of the Asian rice production to climate change (see section 2.3, Box 3).

Adaptation Elements and Adaptation Sectors

Adaptation sectors and elements are linked but describe different parts of the adaptation action. Adaptation Elements is the category that describes what is done in the CCA project and the Adaptation Sectors are a reflection of the societal, economic or environmental domain CCA is implemented in.

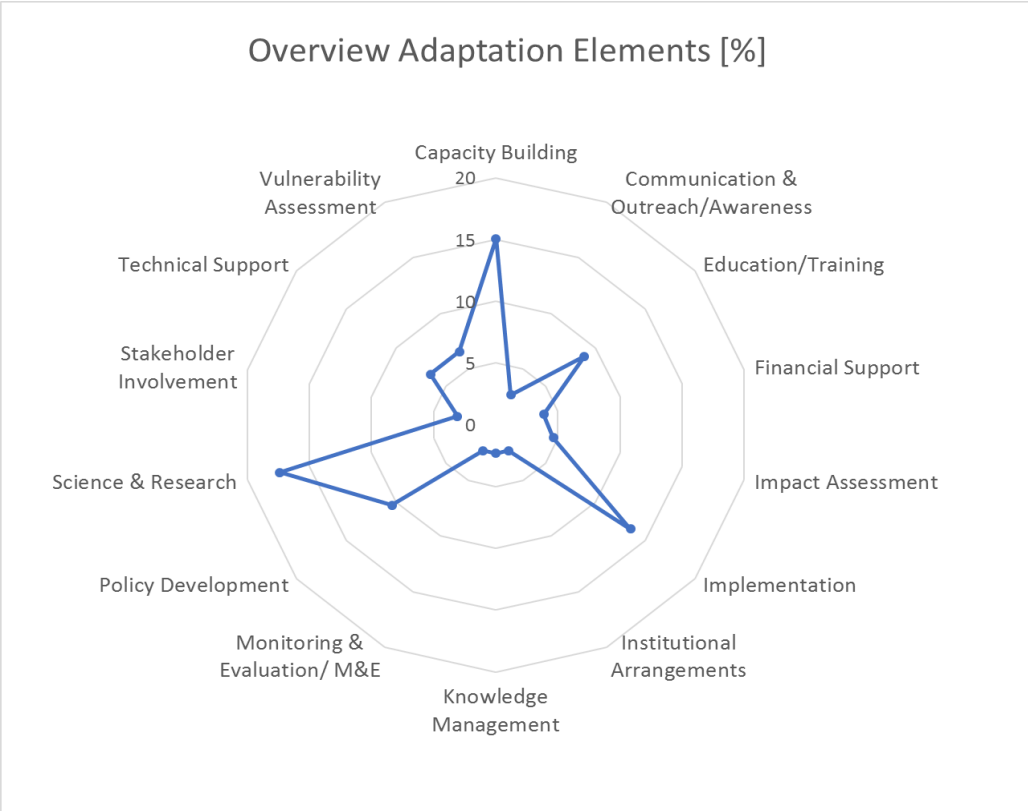

Figure 2.2.6: Radar graphs depicting the relative contribution of individual adaptation elements (top) and sectors (bottom) in percentages.

Science & Research is the most prominent adaptation element (17%) in the long-list, followed by capacity building (15%), implementation (14%), and policy development (10%). The importance of Science & Research in the long-list can be explained by two main factors: 1) the third largest contribution of projects in the long-list stems from the Web of Science (Figure 2.2.3) and 2) the importance of scientific information for successful adaptation planning as advocated by the IPCC (Burkett et al., 2014). We think it is likely to be a combination of both.
Capacity Building is very important for governments and institutions to build the expertise necessary to incorporate CCA into the policy development (see also section 2.3 about good practises in CCA). This goes along with another IPCC recommendation that CCA action should be integrated into existing institutions and plans (Burkett et al., 2014). It should also be noted that Education & Training accounts for about 9% of all projects in the long-list. The dissemination of knowledge is very important to build the adaptive capacity of local farmers and the rural population in general to cope and adapt to climate change.

The most important adaptation sectors are agriculture (12%), water resources (11%), disaster risk reduction (10%), coastal zones (9%), urban resilience (8%), and community-based adaptation (8%).

Agriculture and water resources are very closely connected in the eight countries of our review. This is due to the fact that five of our countries in Asia experience dry and wet seasons in which water is available either in excess or is rare requiring drainage or irrigation/water saving measures (e.g. Wassmann et al., 2009; see also sections 3.7 and 3.9). Most scientific articles in the keyword search about CCA in our set of countries in the WoS and also in the WUR Library deal with agriculture, reaffirming the importance of this sector for livelihoods, food security and development, (Wong et al., 2014; Olsson et al., 2014). The OECD (2016) advocates that the agricultural sector is where modernisation starts that facilitates development in Myanmar (see section 3.7). In Bangladesh the rise of agricultural productivity has increased the number of

people able to afford flood proof housing (see section 3.2). Olsson et al. (2014) also report that agricultural self-employed labourers are the only group that could benefit from rising food prices while all especially the urban poor would be negatively affected by projected rising food prices.

Disaster Risk Reduction (10%) and Coastal zones (9%) are another very important part of CCA in our review. It should however be recognised that the protection and security of livelihoods in the form of agriculture and water resources are only slightly more abundant. This indicates that both the livelihood security, disaster risk reduction and protection of coastal zones are the focus of CCA in the eight Delta Coalition countries in this review. Together these sectors seem to reflect the dualism of adaptation and development that need integration because without the other neither can be successful to increase resilience for people living in poverty (Olsson et al., 2014). If synergies between adaptation action and poverty reduction are not addressed properly the emergence of new poor people in both developed and developing countries is seen as likely, jeopardizing sustainable development especially in urban areas and some rural areas in Africa and Southeast Asia (Olsson et al., 2014).

One possibility to alleviate projected detrimental outcomes of climate change in the future is to integrate poverty reduction into the adaptation action of local governments and the private sectors which have emerged as the one of the most important actors in CCA due to availability of resources (Noble et al. 2014). Other organisations such as NGOs and local initiatives contribute greatly but often lack resources to have greater impacts (Noble et al., 2014). However, we see that in our long-list governance, community-based adaptation, and sustainable cities are together accounting for less than 30% of the recorded adaptation action but this does not mean that these projects are all incorporating poverty alleviation in their planning.

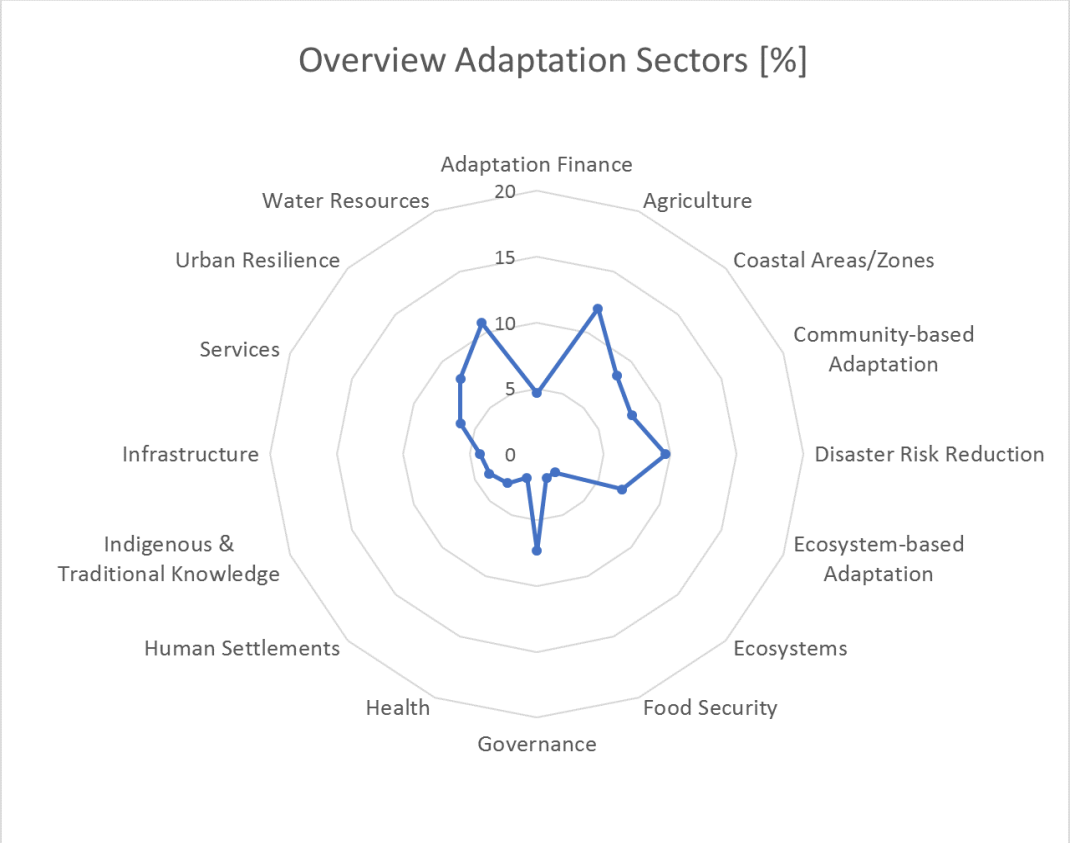

Figure 2.2.6: Radar graphs of relative importance of adaptation elements (top) and sectors (bottom) in percentages.

2.3 Good Practices

A best practice is a "working method or a set of working methods that is officially accepted as being the best to use in a particular business or industry, usually described formally and in detail" (Cambridge Dictionary, 2017). Due to high geographical, political and economic variability amongst countries and regions, it is difficult to establish a list with concrete adaptation options that we can recommend as a 'best practice'. In fact, due to this variation one can question if universal best practice adaptation options exist at all.

Therefore, this section will rather discuss and analyse guidelines that focus on the **process** of designing, implementing and sustaining adaptation options. This analysis will result in a broadly applicable process-based **series of recommendations** that have the potential to transform an adaptation measure into a best practice and are therefore considered good practices. We have decided to use the term 'good' practices over 'best' practices, as constructing a list of good practice principles deemed more realistic than coming up with actual best practices.

Based on the series of recommendations of good practice principles that are provided in this section, the adaptation measures as defined in our longlist will be analysed per country and innovative or promising measures that are most likely to be able to be(come) a good practice in this region will be noted and highlighted.

Synthesis of best practices from literature.

The series of recommendations for good practices outlined in this chapter are derived mainly from the UNFCCC Nairobi Framework and the UNFCCC report on best practices from the Least Developed Countries-expert group. Some are followed by 'Lessons Learned', which are based on experience and aimed at facilitating '*their use* [of adaptation options] *in future areas and applications and actively facilitating learning from experience in order to avoid repeating past mistakes or reinventing the wheel*" (UNFCCC, 2016). Several of the guidelines for good practices are mostly relevant to the least developed countries (LDCs) of our research project - Bangladesh, Mozambique and Myanmar. Those are marked with an asterisk (*).

From the multiple literature sources used, we have compiled all the process-based best practices that are described and recommended. We then divided the best practices into policy process-based and practice process-based groups. Policy process-based best practices are primarily concerned with guiding the process of the formation of adaptation policy, whereas practice process-based best practices focus on guiding the process of executing adaptation practices. Finally we grouped similar best practices into categories, and removed those that we found to be duplicates or irrelevant. These categories are the following for policy process-based and practice process-based respectively (in random order):

Policy process-based:

- Authority
- Stakeholder Involvement
- Road Map
- Knowledge Management
- Baseline Establishment
- Development-first Approach
- Planning Approaches
- Monitoring & Evaluation
- Risk & Vulnerability Assessment

Practice process-based:

- Actionable Knowledge
- Priority Setting
- Multi-sectoral Planning.

In box 2.3.1 an illustration is given of how the policy process-based guidelines could be implemented using the 'Information and Communications Warning System on Wildland Fire in Mozambique (ACCESA)' project. Box 2.3.2 shows lessons learned from the Dutch Delta Programme and the Pilot Program for Climate Resilience, by means of a synthesis. Box 2.3.3 gives some examples from the long-list that in our opinion are examples of good practice

Policy process-based good practice guidelines

(UNFCCC[1] and UNFCCC[5], 2016)

Authority

- To have a lead institution for the process with delegated authority to manage the process, which will enhance coordination, coherence and effectiveness
- Develop a mandate for the process to formulate and implement adaptation plans, increasing engagement among policymakers, communication and facilitate access to resources *****
    - *Lessons Learned:* This may take some time to be developed and approved, therefore in many cases countries start with an interim arrangement.

Knowledge Management

- To undertake gaps and needs assessments in order to identify areas of needed support
- Encouraging a focused dialogue between the scientific community and policymakers/decision makers provides an opportunity to strengthen the science, policy and practice interface for more targeted assessments and more effective and informed adaptation decisions
- Boundary organizations, which exist at the interface between science, policy and practice and facilitate interaction between those communities, can be useful in helping decision makers to make informed decisions
    - Lessons Learned: the ability of decision makers to make informed decisions based on the best available science can be enhanced by:
        - Placing importance on listening to decision makers, understanding their motivation and making use of their existing strengths
        - Promoting peer-to-peer learning
        - Putting more effort into linking science, policy and practice
        - Identifying funding opportunities to establish and sustain boundary organizations in countries and/or regions.

See figure 2.3.1 for an illustration of how science, policy and practice are intermingled and how knowledge can be transferred and exchanged, based on Japan's (also a member of the Delta coalition) adaptation information platform.

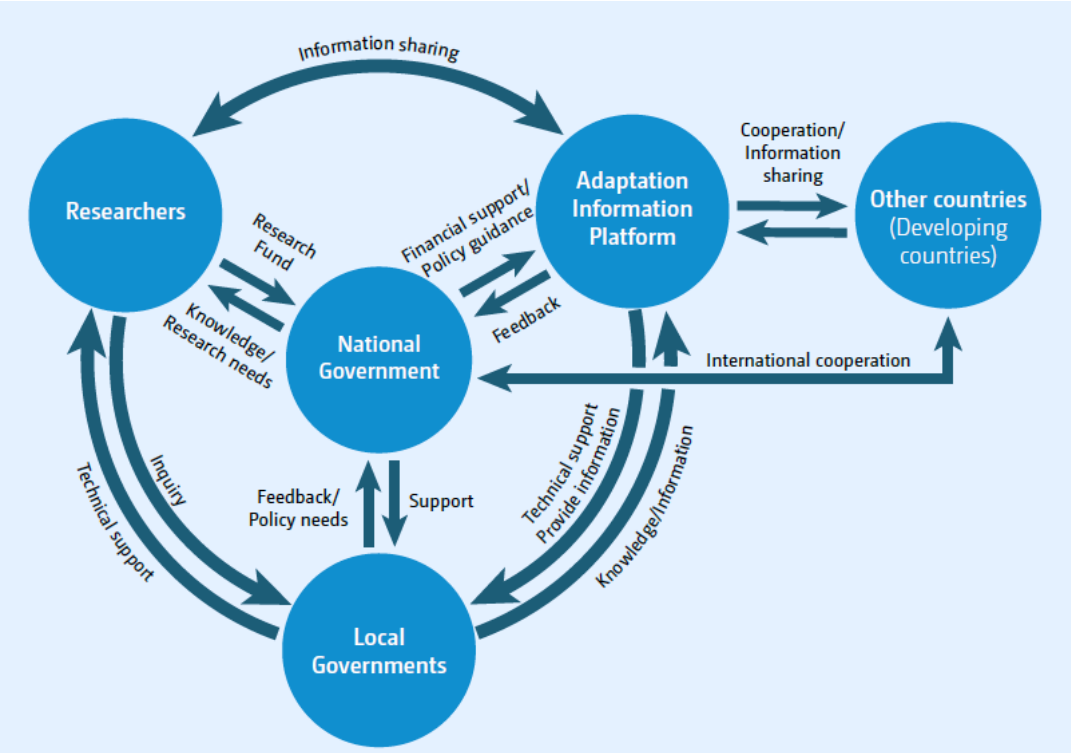

Figure 2.3.1: Japanese adaptation information platform
Source: UNFCCC[5], 2016

Planning approaches

- Complementarity of adaptation planning approaches is beneficial; a careful mix of top-down and bottom-up approaches is often required for successful adaptation planning.
- More importance and attention due to success is recently being granted to the 'nexus approach' integrating interlinked sectors (e.g. water, energy, agriculture, environment), although sectoral approaches to adaptation planning generally prevail
- Integration across adaptation themes such as disaster risk reduction and sustainable development are also needed to implement adaptation successfully
- Efforts to mainstream adaptation into development policies, programmes and funds contribute to a successful and comprehensive adaptation planning and implementation process as they help in prioritizing adaptation (UNFCCC[5], 2016).
- Building resilience may require the diversification from traditional economic activity, particularly in developing countries that are vulnerable to climate change impacts *

Stakeholder Involvement

- To involve all relevant stakeholders continuously throughout the process is essential to ensure a transparent and effective process. Identifying stakeholders and their roles at an early stage of the process is essential to ensure that all interests are met and the process has buy-in from all stakeholders.
    - *Lessons learned:* Stakeholder involvement requires management and clear guidelines to ensure that all stakeholders are represented
- To ensure full understanding of the opportunities and benefits of the process by explaining and promoting the process to all relevant stakeholders in the country
- Inclusion of local communities: the needs and knowledge of local communities also need to be well captured as they are at the frontline of climate change impacts (UNFCCC[5], 2016). Engaging local communities through a participatory process right at the beginning of the adaptation efforts and throughout the planning and adaptation phase is therefore important.*

Baseline Establishment

- To consult current and past adaptation activities in an early stage of policy development to establish a baseline and guide planned activities
    - *Lessons Learned*: requires synthesizing the information to establish a baseline and assess the main adaptation gaps/needs and the effectiveness of past efforts.
- To identify how existing programmes can contribute to the formulation/implementation process, increasing early success and coherent adaptation responses
- To build on existing institutional arrangements which are necessary to ensure a holistic and sustainable adaptation approach, given the medium/long-term nature of adaptation and the involvement of all parts of government.
    - *Lessons Learned*: setting up institutional arrangements at the highest policy level can ensure coordination across different government agencies, that participation of all is encouraged and that required resources are mobilized.

Monitoring and Evaluation

- To set up a monitoring and evaluation system at the beginning of the process, in order to develop a baseline in adaptation needs against which progress can be measured over time.
- A monitoring and evaluation framework should be integral to the adaptation process and be designed at the onset of adaptation plans and initiatives. A portfolio of monitoring and evaluation tools is needed to assess the adequacy, effectiveness and efficiency of adaptation efforts

Road map

- To develop a road map to organize activities towards desired goals and visions
    - *Lessons Learned*: The road map can be a good basis for identifying metrics for monitoring and evaluation.

Development-first Approach

- To take a development-first approach to ensure adaptation efforts contribute directly to resilient development, and explore all opportunities for integrating adaptation into development planning from the onset**,** ensuring coherency between adaptation efforts and broader sustainable development efforts *****
    - *Lessons Learned*: Integration as a process required incremental and iterative steps and benefits from learning-by-doing and experience of other countries
- Linkages between development and disaster risk reduction provide several ways for enhancing societal resilience to natural disasters and climate change, therefore creating opportunities for adaptation *****
    - Lessons Learned: The experience of Pacific island countries in developing a joint national action plan for climate change and disaster risk management can generate replicable good practices in other regions
- Prioritization of adaptation in the broader context of national development planning will help policymakers and relevant stakeholders select the most important adaptation measures to be implemented for a country or region given competing development needs*

Risk and Vulnerability Assessment

- To undertake comprehensive climate risk and vulnerability assessments, which is necessary in order to design adaptation plans for the medium and long term. Ranking risks and vulnerabilities could inform what kind of actions need to be taken. These assessments are most effective when they involve stakeholders and multiple experts.

- *Lessons learned:* systematic observations and monitoring of different variables together with outcomes from different interventions are useful inputs for assessments and require long term investment.
- Climate and impact data need to be interpreted in specific socioeconomic contexts that define vulnerability and help determine adaptation and resilience measures.
- A risk management framework provides a means to enable a systematic analysis of risks and possible interventions to reduce threats

Table 2.3 shows for the ACCESA pilot project in Mozambique in which way it took into account the nine policy-process based guidelines that are described in this chapter.

Box 2.3.1: Illustration of policy process-based guidelines using the 'Information and Communications Warning System on Wildland Fire in Mozambique (ACCESA)' project.

Information and Communications Warning System on Wildland Fire in Mozambique (ACCESA) is the project chosen to illustrate the 'good practice framework' outlined in this report. We found that this project explicitly deals with most guidelines of our good practice framework. The only not very explicit dealt with guideline is the road map. Although there are proposed actions, there is no timeline established. Also, a very extensive terminal evaluation of the overarching program ACCESA has been made available by UNEP (Talafré, 2012). Although this evaluation is critical about some parts of the project, this critique mostly pertains to the use of the results of the pilot to mainstream the policy, and not to the quality of the project.

This project – located in the Buzi district in the Sofala province of Mozambique - aimed to decrease wildfire hazard through Community-Based Fire Management. It resulted in the establishment of a fire early warning system, and a fire danger rating system (Hofmann, 2009. Still it proved too difficult to provide quantities information about the effectiveness. In the terminal evaluation an elaborate reflection on the success criteria is added in which explanations are given for low scores in some areas. This explanation confirmed our belief that this project can still be noted as a good practice.

1. Authority • One institution should be responsible for compilation, analysis, and dissemination of satellite fire information. Recommends Cenacarta (under Min. of Agriculture) • MINAG's Forest Inventory Unit tasked with responsibility to generate end-user friendly information
2. Stakeholder Involvement • Create awareness & knowledge about the use of fire to improve resources income • Enable communities to develop, regulate and enforce village fire regulations. (including basic fire suppression training and equipment) • Stakeholder interviews were held to better understand the current system of wildfire information collection and dissemination
3. Road Map • Long-term steps are recommended to implement recommendations: o Establish File Transfer Protocol

○ Introduce burned area mapping on a quarterly basis ○ Establish a Fire Danger Rating System ○ 2 entry points for community-based fire management activities ○ Pilot 2 CBFiM projects, in Sofala Province, and Buzi District
4. Knowledge Management • Satellite Fire Information System: The data and information should be consistent, reliable, relevant and based on professional interpretation and analysis. It should be delivered on time and communicated by pre-determined and well understood procedures and standards.
5. Baseline Establishment • Fire used to clear land -> can be beneficial but also very harmful • Four administrative levels are responsible for fire management activities (and a extensive analysis of responsible organizations is given) • No formal arrangements between the institutions acting fire prevention. • Analysis of the policy-framework and which law-frameworks are the legal basis for the laws. • The Action Plan for Prevention and Control of Wildfires. Introduced in 2007.
6. Development-first Approach • Create awareness & knowledge about the use of fire to improve resources income
7. Planning Approaches • Community-Based Fire Management should be part of a larger effort to give more control over the environment to the local community.
8. Monitoring & Evaluation • Before the start of the project, clear goals were established, with 3 main desired outcomes of the project. Also indicators to assess the extent to which the desired outcomes were achieved were established.
9. Risk & Vulnerability Assessment • Increase in fire frequency & intensity due to: ○ Population increase and associated demand for land and income ○ Breakdown in traditional land-use management systems over time due to changes in the political context

Table 2.3. Interpretation of the Mozambique ACCESA project in the good practices framework described in the 'Best Practices' chapter of this report.

Practice process-based good practice guidelines

(UNFCCC[2,3,4], 2016) - Nairobi

Actionable Knowledge

- Acquiring "actionable" knowledge: establishing a structured and iterative knowledge co-production that combines multidisciplinary information and traditional knowledge, involving all members of a community (including men, women and indigenous people).*
- Fostering systematic knowledge management to link lessons learned from the local level to the national and international levels, and to convey appropriate information on adaptation priorities.

Priority Setting

- Setting priorities to reduce current and future vulnerabilities across all sectors and increase the climate change adaptive capacity of the most vulnerable people and communities
- Poorest and most vulnerable (including women and youth) should be given particular consideration in decision-making

Multisectoral Planning

- Multisectoral planning at all governance levels: adaptation planning should be integrated into legislation, regulations, existing strategies, standards, planning tools and assessment frameworks.

See figure 2.3.2 below for an illustration of how these good practices/lessons learned translate to good practices for the specific adaptation sectors of Ecosystem-Based Adaptation, Water Resources and Human Settlements/Community-Based Adaptation.

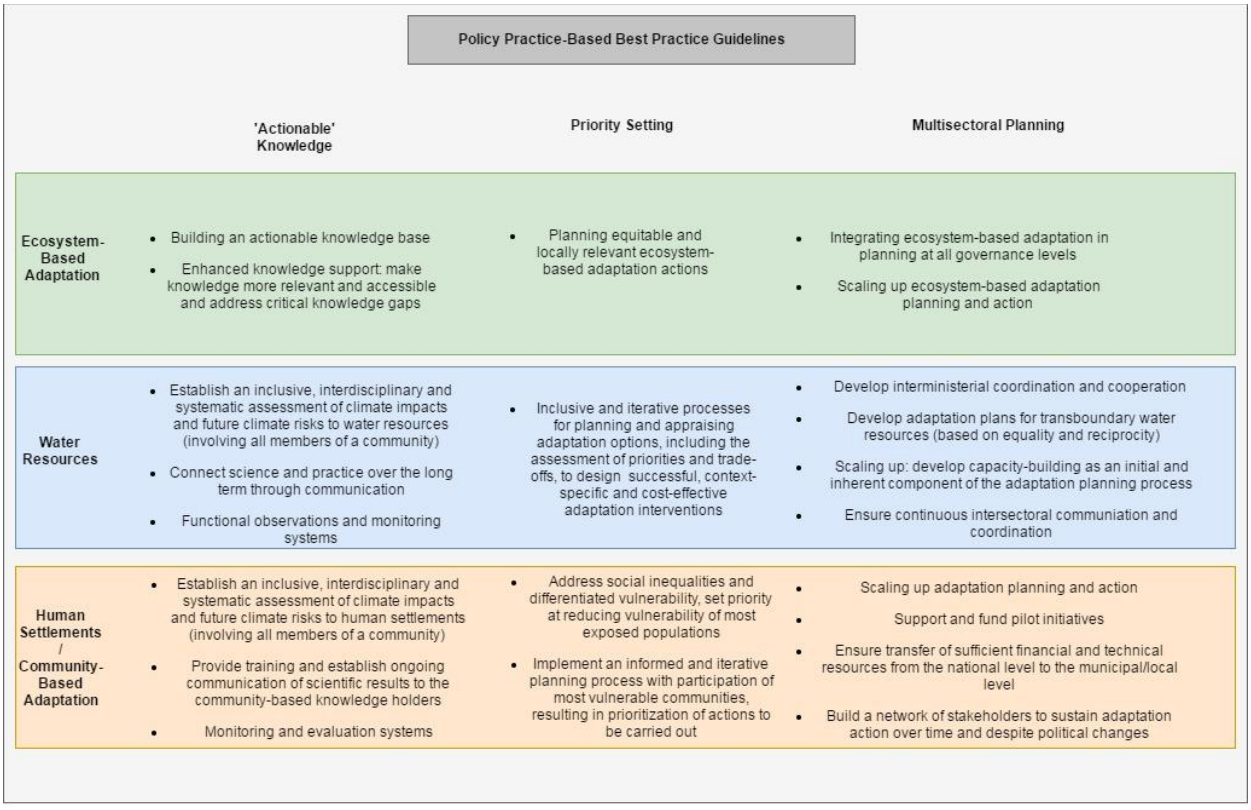

Figure 2.3.2: good practice Guidelines as identified by the UNFCCC Nairobi Work Programme with illustrations from specific adaptation sectors. *(Information derived from UNFCCC, 2016[2,3,4])*

Illustration using the Netherlands Delta Programme

Some key elements common to all adaptation planning approaches support effective adaptation, of which some were defined by the Netherlands experience with the Delta Programme and by lessons learned from the Pilot Program for Climate Resilience (see box 2.3.3 on the next page). Several elements have already been touched upon in the previous section. This box represents a synergy and overview of some of the most important good practice guidelines.

Box 2.3.2: Lessons Learned from the Netherlands Delta Programme and the Pilot Program for Climate Resilience for adaptation guidelines:

- The importance of developing a holistic long-term vision and related policy objectives
- Secure a mandate through a legal Act (help ensure long-term stability and delineation of roles and responsibility)
- Establishment of a dedicated fund
- Anchoring the vision and objectives in national policy frameworks (such as NAP(A)s) combined with regional strategies
- Coordinated decision-making
- Multi-governance stakeholder engagement
- The presence of an institutional arrangement to act as the interface between science and policy (enhancing cooperation and coherence of actions)
- Accountability (providing reports), governance and technological innovations
- Institutional coordination at the highest level is key for successful implementation
- User-oriented customized climate services are necessary for adaptation
- An agreed upfront monitoring and reporting framework enables measurement and management of progress

Source: UNFCCC[5], 2016.

Examples of good and bad practices in our database

In this section we describe some of the projects that we found examples of good practice- were either very innovative or well documented and bad practices.

Box 2.3.3: Good and Bad Practice examples of Adaptation Options which found in long-list (Full references at the end of chapter.

Good Practices
Pakistan, Bangladesh, Myanmar Vietnam, Philippines, Indonesia and China **Title: Regional Vulnerability of Climate Change Impacts on Asian Rice Production and Scope for Adaptation** A very detailed study that assesses the vulnerability to climate change in Asian rice agriculture, taking into account using different species, changing cropping management, resource conservation techniques, crop diversification, and more. The efficiency of these approaches can be increased significantly by geographic analysis of vulnerable regions and developing a policy framework for implementing adaptation programs. Reference: http://www.sciencedirect.com/science/article/pii/S0065211309010037
Bangladesh, Indonesia, Mozambique, Myanmar, Vietnam, Philippines, and 40 more countries **Title: Mangroves as a protection from storm surges in a changing climate** This review study gives an excellent overview and reflection on the use of mangroves as protection from storm surges, taking into account local circumstances. Policy makers and investment planners will benefit considerably on location-specific coastal protection and

other services from mangroves.
Reference: https://link.springer.com/article/10.1007%2Fs13280-016-0838-x#aboutcontent

Mozambique
Title: Integrating Vulnerability and Adaptation to Climate Change into Sustainable Development Policy Planning and Implementation in Southern and Eastern Africa (ACCESA): Information and Communications Warning System on Wildland Fire in Mozambique.
This is an interesting project because it aims to strengthen the national capacity for disaster risk reduction of wildfires, while explicitly dealing with the implications at the local scale and how local people can be engaged. Also it is well-documented.
Refence: http://www.iisd.org/library/information-and-communications-warning-system-wildland-fire-mozambique

Bad Practices

Indonesia
Title: Marunda 3-m height of sea wall (Jakarta)
This practice was part of East Flood Canal projects which built in 2011 but was reported damage in 2015 (short lifetime duration). Currently, the height of sea wall is equal to the height of the sea surface and people suffer from flooding when it is in tidal condition, therefore need to be heightened. The same condition is expected to occur again, since land subsidence in Jakarta is certain to occur in the upcoming years (Abidin et al., 2015). However, the Giant Sea Wall project is not good practice to replace the current sea wall due to societal and environmental issues.
Reference:http://pubs.iclarm.net/resource_centre/WF-2013-32.pdf;
https://rizkynadiahputri.wordpress.com/2017/01/26/giant-sea-wall-jakarta-apakah-sudah-menjadi-solusi-yang-terbaik/

Vietnam
Title: Dike building against flooding (Can Tho City)
This dike built to prevent floods but it turns out delivering negative impacts to livelihood such as:
a. Depletion of fish reserves in the flood protected regions behind the dike therefore many local people who depend on fishing lost their income particularly in the flood season
b. Reduction of free water exchange between areas.
c. Soil fertility (slit volume) is increasingly diminishing in agricultural production areas protected by dike system due to the lack of water exchange between these areas and the canal system during flooding season.
Reference:
http://www.wisdom.caf.dlr.de/sites/wisdom/files/media/pdf/FactSheets/Fact%20Sheet%205_Negative%20Impacts%20of%20the%20Dike%20Systems%20in%20CTC.pdf

3. Country Analysis

This chapter provides an in-depth analysis per country. All countries are introduced shorty first, to be followed up by an overview of the keyword search and the long-list - including general information, climate change threats, main adaptation elements, main adaptation sectors, an overview of specific climate change adaptation options and finally a short country summary.

3.1 Bangladesh

Introduction

Bangladesh lies at the end of the largest delta in the world formed by the rivers Ganges, Brahmaputra, and Meghna. More than two-thirds of the country lies only 5 m above sea level, making the country vulnerable to flooding by rainwater and rivers especially during the monsoon season (The World Bank Group, 2010). Every 3-5 years up to two-thirds of Bangladesh is inundated by floods, damaging infrastructure, agricultural production and livelihoods. Bangladesh rivers have the second highest river discharge on the globe because of the large watershed of its rivers.

In the past 50 years Bangladesh has invested US$ 10 billion on structural (polders, cyclone shelters, cyclone resistant housing) and non-structural (early warning- and awareness raising systems) disaster reduction measures and enhanced its disaster preparedness systems (The World Bank Group, 2010). These measures have reduced the impact of extreme weather events over time. Also agriculture has adapted to the frequent flooding by changing rice varieties from low-yielding deep-water rice to higher productive crops that can withstand the naturally occurring flood events. This has raised agricultural productivity which led to an increasing number of people to live in homes that are able to withstand cyclones, storm surges and floods (The World Bank Group, 2010). Despite this progress, climate change aggravates the naturally challenging conditions in Bangladesh causing economic losses and is slowing the process of reducing poverty and development.

The Ministry of Environment and Forest of Bangladesh (2005) describes in their National Adaptation Plan of Action (NAPA) to the UNFCCC that "*adverse effects of climate stimuli including variability and extreme events in the overall development of Bangladesh would be significant and highly related to changes in the water sector. The most damaging effects of climate change are floods, salinity intrusion, and droughts that are found to drastically affect crop productivity almost every year.*" The IPCC's 5th Assessment Report further identifies the increasing intensity and frequency of cyclones as an additional source of future harm to Southeast Asia, including Bangladesh (Hijioka et al., 2014).

Keyword Search Bangladesh

The keyword search (KWS) in the peer-reviewed literature highlights several topics that are more relevant for Bangladesh than for the mean of all countries (Figure 3.1.1).

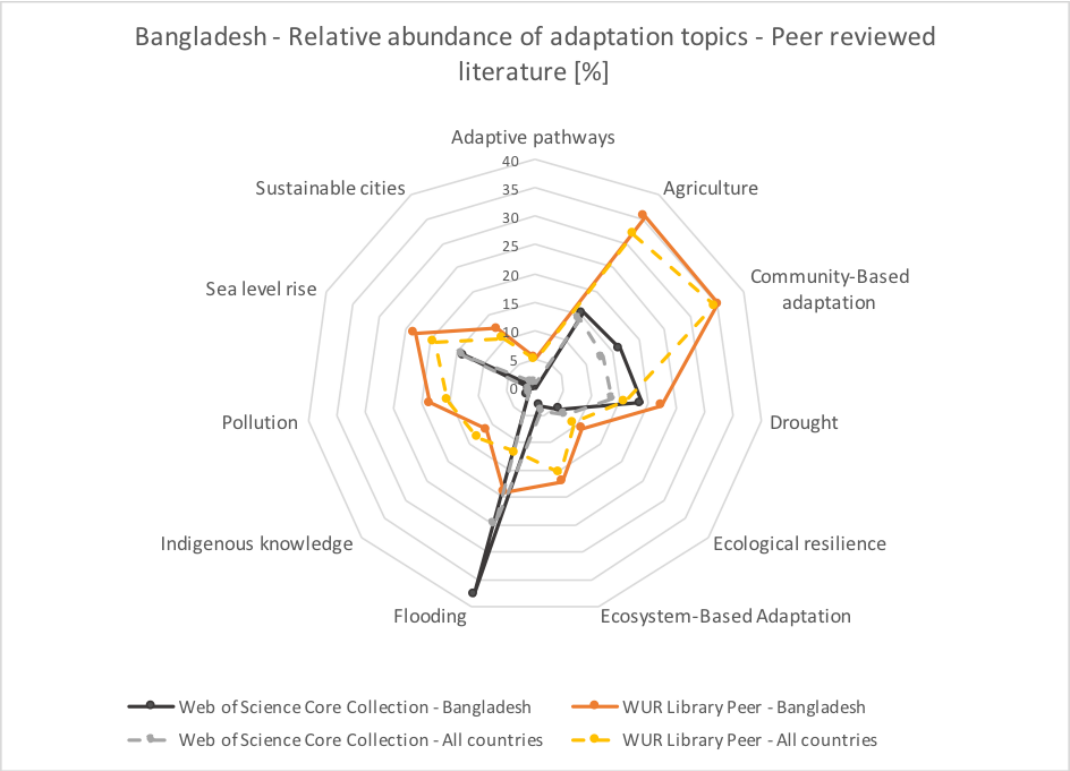

Figure 3.1.1 This radar shows the relative contribution of adaptation topics to the overall keyword search results of "Climate Change Adaptation Bangladesh" in comparison to average values for all countries. Only the results for the WoS Core Collection and WUR Library Peer are shown.

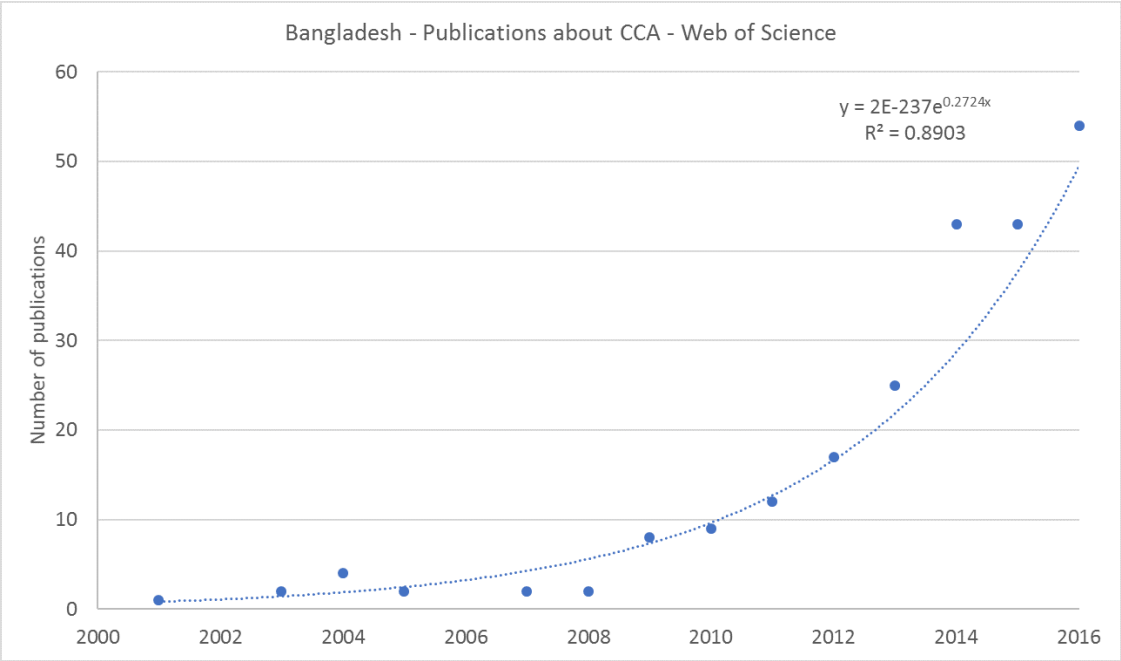

Figure 3.1.2 The graphs shows number of articles about CCA in Bangladesh per year of publication in the Web of Science. The search was done with the keywords "Climate Change Adaptation Bangladesh" on the 30th of May 2017. While 2017 already showed 28 publications about the topic they were left out due to the ongoing year.

The largest difference of Bangladesh compared to the average of all countries can be observed in the climate change threats. Drought and especially flooding contribute more to the climate change adaptation (CCA) literature for both the WoS-CC and WUR Peer database than the average of all countries, while sea level rise is only more abundant in the WUR Peer. While the

keyword search did not include a separate search for tropical cyclones we think it is likely that they are included in the KWS under Floods also explaining its relative importance in the literature.

In the adaptation sectors agriculture (WUR Library and WoS), community-based adaptation (WoS) and pollution (WUR Library) stand out from the mean.

Longlist (LL) analysis

LL Bangladesh - General information

We identified 50 CCA projects for Bangladesh from different databases. Most CCA projects were collected from Prevention Web (29%), Web of Science (25%), the Adaptation Learning Mechanism (14%) and Asia-Pacific-Adapt (7%). For 37 of these projects we identified in detail the underlying adaptation practices.

The year of project establishment in Bangladesh in our database follows the overall trend for all countries. However, when consulting the publication trend for the keywords 'Climate Change Adaptation Bangladesh" in the Web of Science (WoS) (Figure 3.1.2) we find a significant increase of publications over the last 15 years (R^2=0,89). The increasing number of scientific publications about CCA adaptation Bangladesh can be seen as an indicator for the fact that we missed many new projects. This can be due to two reasons 1) the databases are not kept up-to-date anymore or 2) there was a peak-activity of CCA projects in 2008-2011. We think 1) is more likely considering the increasing trend of publications about CCA in Bangladesh in the WoS. Prevention Web only lists projects up until 2012, leading to a bias in our data collection (see section 2.2).

CC threats to Bangladesh

Droughts (28%), Floods (23%), Tropical Cyclones/Typhoons (13%) and Sea Level Rise (10%) make up the largest share of CC threats targeted by the projects in the LL (Fig. 3.1.3). The list overall represents the CC threats identified by the NAPA of Bangladesh and the IPCC for Southeast Asia. However, it was surprising for us that droughts is the most frequent CC threat.

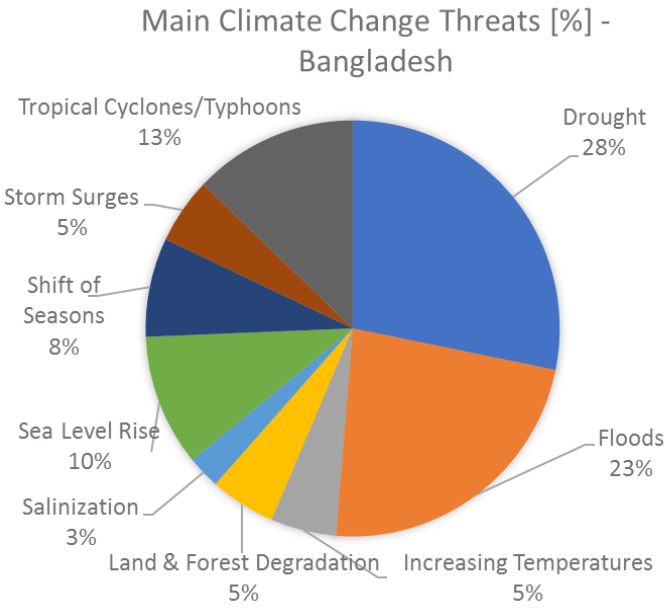

Figure 3.1.3 Main CC threats to Bangladesh targeted by the projects of the LL. Multiple threats describe several CC threats with no clear prioritization and can be understood as a representative mix of the relevant CC threats to Bangladesh.

This may be brought about by the fact that Bangladesh has been investing since the 60ties into its flood defences (The World Bank Group, 2010) and has in doing so, reduced its immediate vulnerability to floods and sea level rise. Hijioka et al. (2014) states that "water scarcity is expected to be a major challenge for most of the [Asian] region as a result of increased water demand and lack of good management". The authors further explain this is due to water resources being highly variable between seasons and different areas exacerbated by a massive population (Hijioka et al., 2014).

Adaptation Elements Bangladesh

The largest amount of projects in Bangladesh are in the field of Science & Research (26%), Capacity Building (14%), Implementation (14%) and Technical Support (10%).

Bangladesh is already experiencing severe impacts of climate change by cyclones, erratic rainfall and extreme temperatures (Hijioka et al., 2014). This could be an explanation why research about adaptation to future climate change and the implementation of options that bring relief to the affected population is so prominent. Capacity building helps the local population build adaptive capacity against CC. At the same time, stakeholder involvement (6%) remains relatively low although it is important for successful adaptation. However, this does not mean that in projects with the adaptation element Science & Research and Implementation no stakeholder involvement takes place.

Financial support (4%) in our database describes two loan programs by the government for those affected by CC. Nevertheless it must be noted that most projects conducted in Bangladesh, including scientific publications, receive funding from international donors such as the World Bank and other development banks.

Adaptation Sectors Bangladesh

Agriculture is the main adaptation sector with 20% of CCA projects followed by Water Resources (12%). Agriculture is one the main income sources of rural Bangladesh residents and is vital to the food security of the entire country (Wassmann et al., 2009). The protection of Water Resources is closely related to agriculture, supporting the necessity of the agricultural sector in Bangladesh for food security. The sector Food Security accounts for 6% of all Bangladesh projects. Together these three sectors account for 38% of all projects.

According to our data this takes precedent before Disaster Risk Reduction (10%) from tropical cyclones, Ecosystem-based Adaptation (10%) and Indigenous & traditional knowledge (10%).

Indigenous & traditional knowledge is significantly more prominent in Bangladesh's CCA compared to the average of all countries (4%). This is interesting, as indigenous knowledge has been described as a vital information source for future adaptation by the IPCC (Hijioka et al., 2014) and other authors. The abundance of Community-based Adaptation (8%) is also higher than in the average of all countries, indicating that stakeholder and community involvement are important features in CCA in Bangladesh.

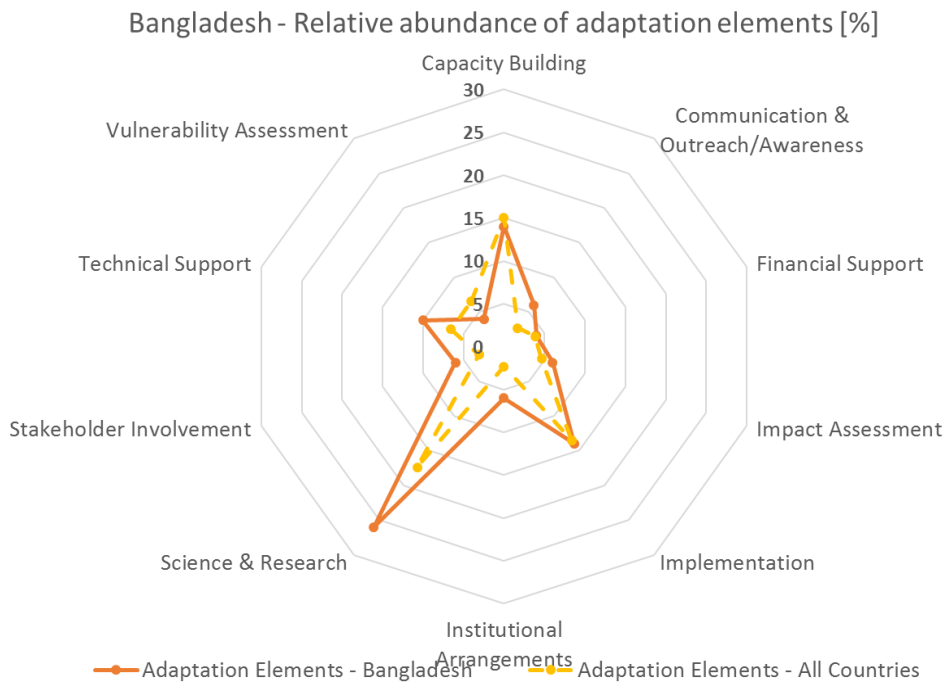

Figure 3.1.4 Relative distribution of Adaptation Elements for CCA projects in Bangladesh in comparison to the average values from all countries. Adaptation Elements with values <3% are not shown in this graph. The full list is included in the Appendix.

Infrastructure accounts for only 4% of all projects which is 0,1% lower than the average of all countries. While the Bangladesh government has been massively investing in flood defences building infrastructure is not done on a CCA project basis which would be detectable in the CCA databases we looked at. Instead CCA projects in Bangladesh tend to focus on Ecosystem-based Adaptation (10%) which is employed more abundant in Bangladesh compared to the average of countries.

The most prominent missing sector is Urban Resilience which accounts for 8% in the overall country results.

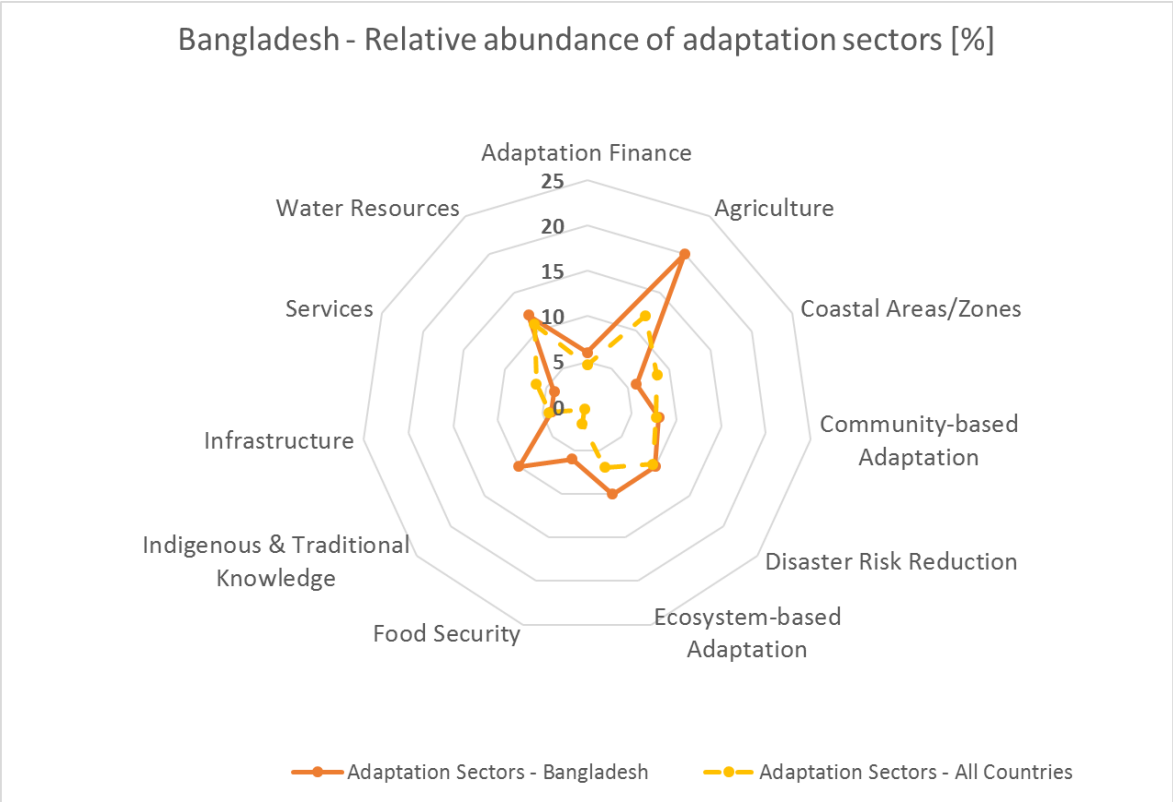

Figure 3.1.5 Relative Distribution of Adaptation sectors in Bangladesh in the LL. Projects that applied to more than one sector were classified with the most relevant sector to the adaptation option pursued in the project. Most projects applied to more than one Adaptation sector.

CCA Options Bangladesh

The following list contains a synthesis of all CCA options in Bangladesh. Many options were implemented more than once, but only unique measures are listed.

Adaptation options according to our data collection for Bangladesh in the LL focus mainly on agriculture and water resources followed by DRR and EbA reflecting the results from the Adaptation Sectors (Figure 3.1.4.). The following list of practices includes indigenous and traditional knowledge but these CCA options are not separately marked.

Agriculture

- Short duration rice varieties
- Replantation of rice for multiple harvests
- Planting of crops during flooding
- Crop diversification
- Cropping patterns: earlier / delayed sowing & harvest of crops
- Floating agriculture / floating gardens
- Flood/ drought/ salt tolerant crop development and use: e.g. dry seedbeds, simultaneous cultivation of rice and of prawn, shrimp cultivation under high salinity
- Integrated farming: combining horticulture, vegetable-growing, agro-forestry, and fruit trees
- More / supplementary irrigation for rice

Water resources

- Rainwater harvesting for irrigation
- Water resource exploitation (deep & shallow tube well)

Disaster Risk Reduction (DRR)

- Cyclone shelter building
- Improved drainage: maintenance of drainage & culverts; excavation of canals
- Training of regional & local officials / institutions in DRR
- Livelihood DRR fund
- Disaster Management Information Center / Early Warning Systems / Community-Based Flood Information Center using mobile phones

Ecosystem-based Adaptation

- Mangrove conservation & afforestation
- Triple F management: fish, fruit & forest)
- Restoration of degraded dry & wetlands

Livelihood Security

- Diversification / change of livelihoods (cash crops, mango cultivation, homestead gardening, jujube cultivation, mulberry intercropping with rice, fodder cultivation, fish cultivation)
- Education & training of farmers
- Securing of roofs against cyclones
- Women empowerment

Science & Research

- CC projections and forecasts (including rainfall)
- Vulnerability / Impact assessments / Irrigation demand assessments
- Financial support for science & research
- Evaluation of flood protective service of coastal mangrove forests under CC scenarios; biggest threat is loss of mangrove forests

Infrastructure

- Building code
- Road / bridge improvements
- Weather resilient boats

Institutions

- Stakeholder involvement including Awareness raising (also in schools)
- Funding for Adaptation
- CCA policy development

Country summary

Drought and flooding are the most studied threats relative to the other countries. Stakeholder involvement, institutional arrangements, and community outreach are elements that are the subject of study more often, which seem to correlate with the sectors Indigenous & Traditional knowledge and Ecosystem based adaptation. Finally Agriculture and Food Security seem to be very important sectors for adaptation in Bangladesh.

3.2 Colombia

Introduction

Colombia is one of the most diverse countries in South-America. Geographically, it ranges from snowy mountain peaks of the Andes to the delta and coast areas on the Caribbean Sea and Pacific Ocean. Socially it ranges from native lifestyle indians to traditional farming and herding to modern cities. It is the most populous Spanish-speaking country in South-America with 47 million inhabitants. Historically the main source of income were mining of precious minerals and agriculture, but since the 1940's the country's' industry has grown significantly and fossil fuel mining and processing has increased as well. (Brittanica, n.d.)

Colombia was among the first countries to sign to the UNFCCC (1992), and ratified it in 1995. After that it ratified the Kyoto Protocol, and published its first and only National Communication to the UNFCCC in 2001. In this National Communication (2001), the Colombian Ministry of Environment notes that there are two possible impacts of climate change on water runoff from the rivers: either the peak flow will become higher or more peak flows will occur.

Keyword Search Colombia

Colombia has 57 results in the WoS core collection – a similar amount of articles in the WoS core collection as Mozambique – however there are a striking amount of articles in the non-core collection, namely 55, whereas this is only 22 for Mozambique for instance. A quick look at the raw data however showed that this amount of articles in the non-core collection does not seem to significantly change the distribution, and thus we can still use the WoS core collection as representative of the WoS in total.

The WUR Library Peer follows the general trend on most topics. The results show that Colombia scores significantly lower on the topics of Sea Level Rise, Pollution, Flooding and Drought as compared to the mean. This is similar in the WoS core collection, however Drought, Flooding, and Sea Level Rise are much more drastically lower than average.

Topics that seem to be of special interest differ per database. In the WoS core collection Agriculture and Community-Based adaptation are relatively more researched than on average, and this is even more pronounced in Ecological resilience and Ecosystem-Based adaptation. The WUR Library Peer on the other hand shows a bigger interest for indigenous knowledge in Colombia.

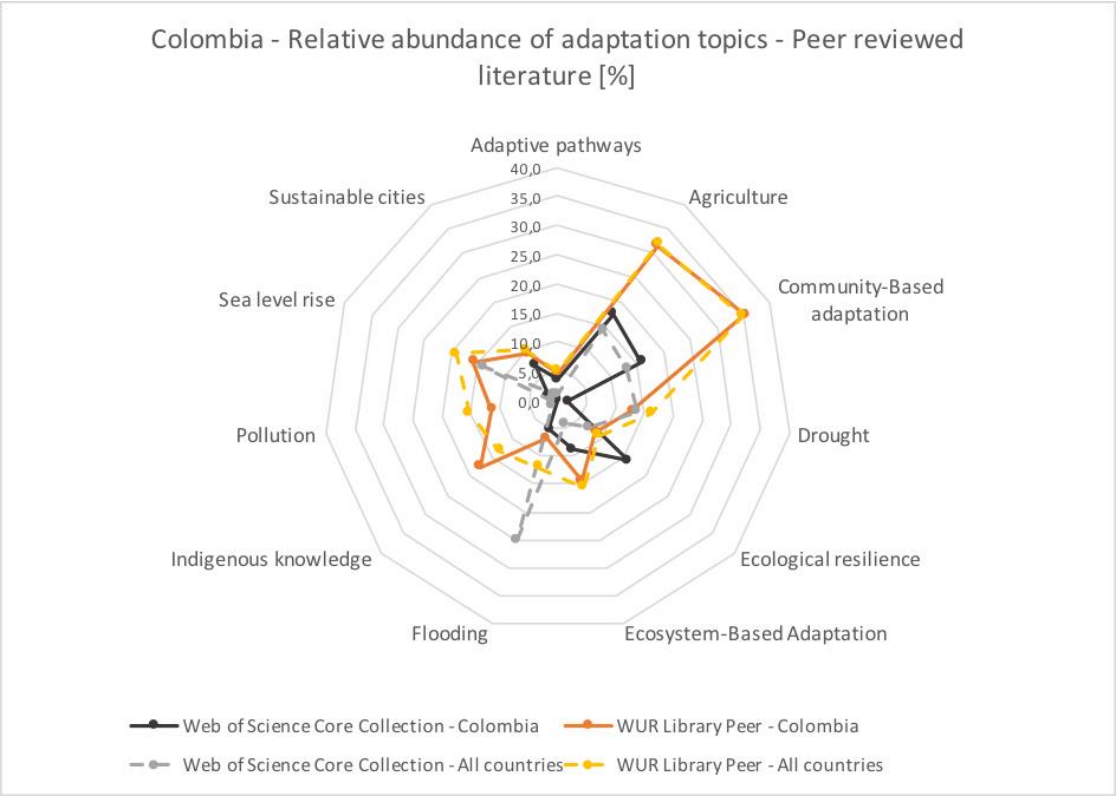

Figure 3.2.1 This radar shows the relative contribution of adaptation topics to the overall keyword search results of "Climate Change Adaptation Colombia" in comparison to average values for all countries. Only the results for the WoS Core Collection and WUR Library Peer are shown.

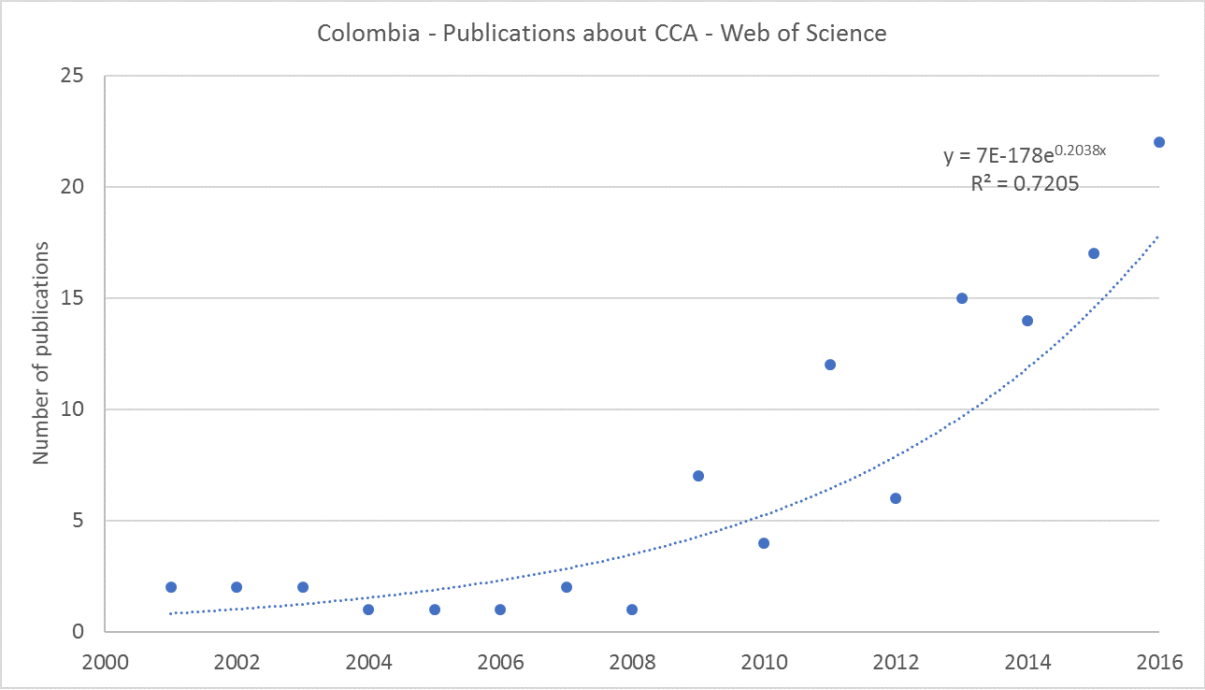

Figure 3.2.2 The graphs shows the number of articles about CCA in Colombia per year of publication in the Web of Science. The search was done with the keywords "Climate Change Adaptation Colombia" on the 30th of May 2017. While 2017 already showed five publications about the topic they were left out due to the ongoing year.

Longlist (LL) analysis

LL Colombia - General information

We identified 22 climate change adaptation (CCA) projects for Colombia from different databases. Most CCA projects were collected from Prevention Web (39%), the Adaptation Learning Mechanism (30%) and Web of Science (13%). For 9 of these projects we identified in detail the underlying adaptation practices.

CC threats to Colombia

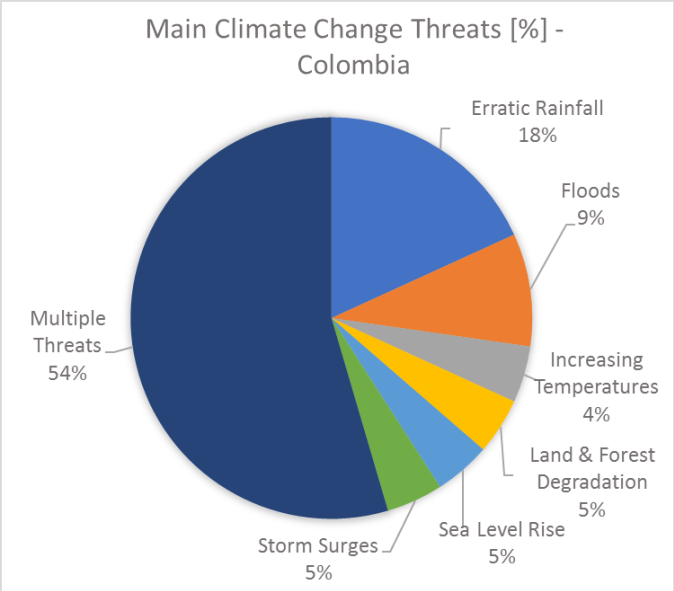

Figure 3.2.3 Main CC threats to Colombia targeted by the projects of the LL. Multiple threats describe several CC threats with no clear prioritization and can be understood as a representative mix of the relevant CC threats to Colombia.

In our own research we often see that multiple threats are combated. Other than that erratic rainfall and floods are most commonly combated in CCA projects, which somewhat reflects the threats identified by the Colombian Ministry of Environment.

LL – Adaptation Elements

The most important adaptation elements in Colombia are Capacity Building (17%) and Policy Development (17%) (see figure 3.2.4). Most of the projects that use these elements have the goal of integrating climate change decision making into policy-making. An exception to this are the two projects from 100 resilient cities. Because we don't focus on policy development in this paper these projects are not examined very deeply, but for a reader interested in policy development these may prove interesting topics.

Impact assessment (13%) is the third most important adaptation element in Colombia, and it is much more important in Colombia than in the other countries. Assessments seem to be used frequently in general in Colombia, since vulnerability assessments (9%) are also used often. The project focusing on agriculture is an interesting project if one is interested in Impact Assessments.

Finally it is worth mentioning that in Colombia, only one project is present whose element is climate observations. This project is focused on the importance of the climate for agriculture,

and uses a two models – AQUACROP and CROPWAT – calibrated to Colombia and specified to specific crops and the needs of the local population.

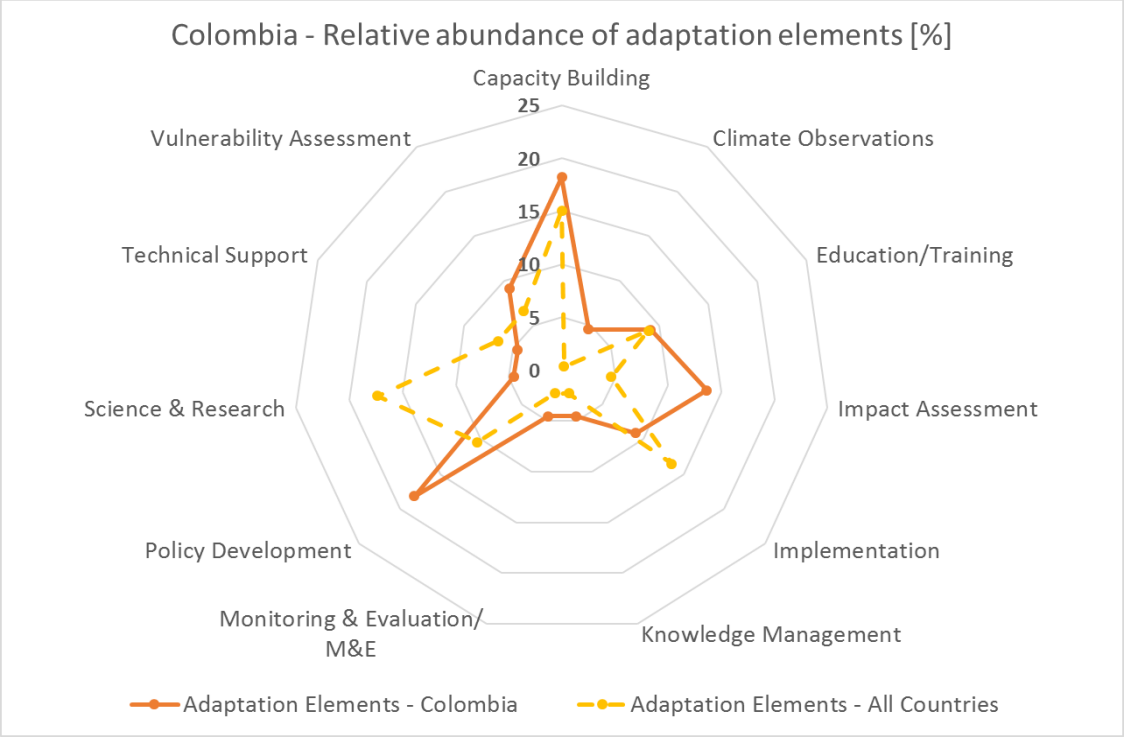

Figure 3.2.4 Relative distribution of Adaptation Elements for CCA projects in Colombia in comparison to the average values from all countries. Adaptation Elements with values >3% are not shown in this graph. The full list is included in the Appendix.

Adaptation Sectors Colombia

The main sector in Colombia is Governance (17%), followed by Human Settlements (13%) and Coastal Areas/Zones (13%). The governance projects in Colombia are mostly about integrating climate change adaptation into the other policy fields, mainly into the development agenda. Human Settlements is in Colombia far bigger than in any other country, so it is good to recap what it exactly entails again.

Human Settlements regards projects that center around the well-being of villages and indigenous people. Since Colombia has many indigenous populations living in the mountains and traditional farming on the high plains and in the delta, this might be a reason why Human Settlements is more important in Colombia. An interesting project in Human Settlements is "Climate Change Vulnerability Evaluation of Coastal and Marine Areas", because it is a comprehensive study that is well documented.

In the sector of Coastal Areas/Zones, "Mangroves as a protection from storm surges in a changing climate" is an interesting project, because it evaluates the effectiveness of a nature based solution and it is a big project.

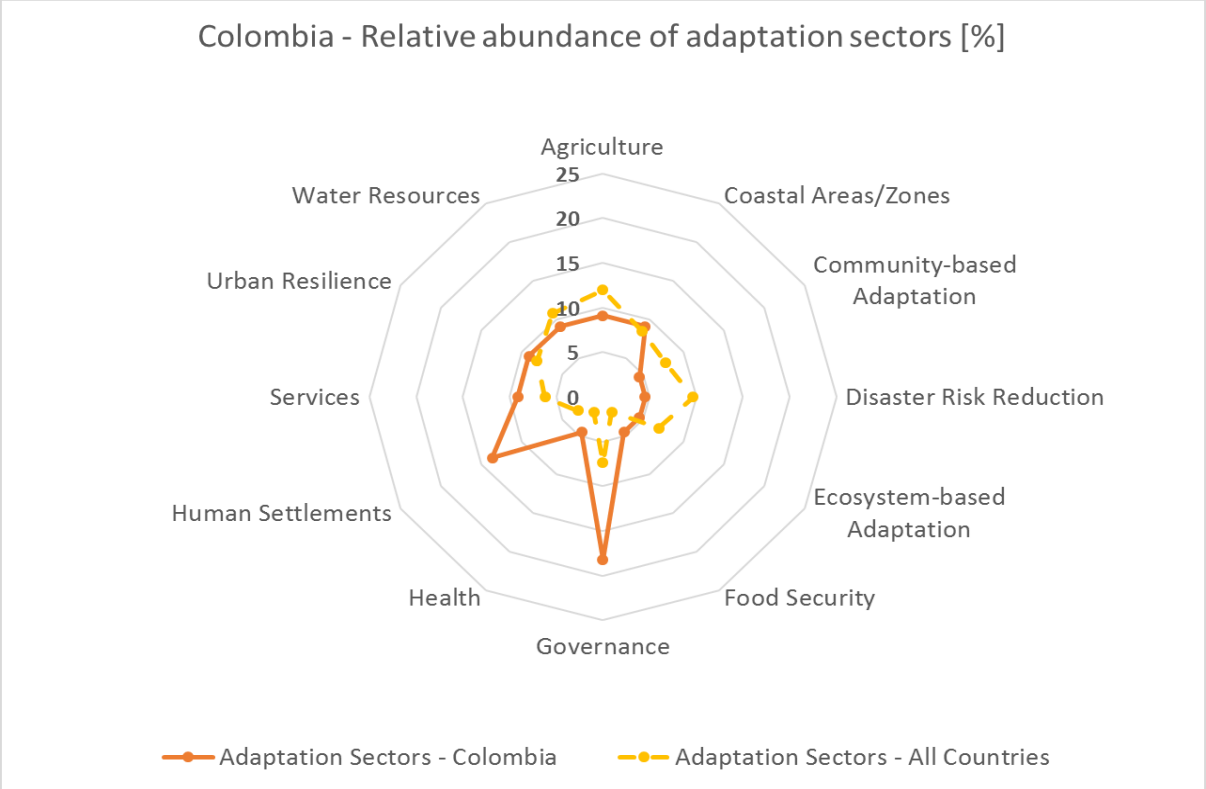

Figure 3.2.5 Relative Distribution of Adaptation sectors in Colombia in the LL. Projects that applied to more than one sector were classified with the most relevant sector to the adaptation option pursued in the project. Most projects applied to more than one Adaptation sector.

CCA Options Colombia

The following list contains a synthesis of all CCA options in Colombia. Many options were implemented more than once, but only unique measures are listed.

CCA options in Colombia mainly have policy development and capacity building as adaptation measures. Because these are not the subjects for which we have identified unique measures, the amount of unique measures in Colombia is lower than in most countries. Many of the CCA options in Colombia have a connection to the training of farmers, for instance to use silvopastoral practices. Missing sectors of CCA in Colombia include Water Resources.

Agriculture

- Growing of CC resilient crops (e.g. cocoa
- Agroforestry practices

Disaster Risk Reduction (DRR)

-

Ecosystem-based Adaptation

- Mangrove & forest conservation
- Restoration of wetlands

Science & Research

- Evaluation of flood protective service of coastal mangrove forests under CC scenarios; biggest threat is loss of mangrove forests
- Early warning systems for Environmental conditions, flash floods, fire & landslides
- CC disaster risk assessment
- Cyclone shelter building

Livelihoods

- Education & training of farmers
- Agricultural insurance system by the government against CC for smallholder farmers
- Participatory learning
- Training in silvopastoral farming (combined use of forest & pasture)

Institutions

- Inventory / Mapping of relevant institutions
- Assessment of institutional strengths and weaknesses for CCA
- Capacity building of aid workers
- National coordination scheme led by the Ministry of Agriculture and Rural Development (MADR) together with international institutions for agricultural adaptation

Country sum*mary*

Erratic rainfall is the most studied threat relative to the other countries. Colombia does not seem remarkably vulnerable to the impacts of climate change, and most climate change problems that are addressed in Colombia also have a strong human element. This may be the reason why governance and human settlements are so high in this country. Silvopastoral farming is a topic that is more developed in Colombia.

3.3 Egypt

Introduction

Egypt is one of the most populous countries of the world. According to data of the Central Agency for Public Mobilization and Statistics in 2012, a population of 82 million people is living just in 5.3% of the country's area (CAPMAS, 2012). This relatively small area is the Nile Valley and Delta.The River Nile is responsible for 98% of Egypt's fresh water supply (MetOffice, 2012) and therefore the expected decreased rainfall and river runoff (UNFCCC, 2016) can have potential disastrous results for the country.

Egypt signed the United Nations Framework Convention on Climate Change (UNFCCC) on the 9th of july 1992, which entered into force on the 5th of march 1995 (UNFCCC, 2014). Egypt also signed the Kyoto Protocol in 1999, which was ratified in 2005.

Egypt is a typical example of a developing country that is eminently vulnerable to the consequences of climate change. Therefore, Egypt faces numerous threats to its economic, social and environmental sustainability, in turn presenting a growing threat to national security. This is fueled by a relatively high population growth: 2.1% annually, as compared to 1.2% as the world's average in 2015 (World Bank, 2017). This population growth is accompanied by rising demand, causing fundamental pressures on Egypt. These pressures include mainly water security, energy security, food security, climate change, unemployment, the poverty gap and the financial crisis (Abouleish et al., n.d.).

In Egypt's first national communication to the UNFCCC the country stated that due to the rapidly growing population, limited fertile land, a large area of desert and the concentration of economic activities in the coastal zones, the potential social and economic impact of climate change could be devastating for the country (UNFCCC, 1999). The most prominent climate change threat identified in this first communication document was therefore sea level rise (UNFCCC, 1999).

In Egypt's second national communication (2010), the country was reported as a lower middle income country with an average yearly economic growth of 4.47% between between 1990 and 2007 (UNFCCC, 2010). The main sectors relevant to climate change as identified by the second national communication are energy, transportation, industry, agriculture and waste. The main climate change threats as identified by this document were erratic rainfall and temperature increase (due to the extreme sensitivity of the Nile river basin) and sea level rise.

The third national communication identified changed weather patterns (reduced rainfall, and therefore reduced river runoff), sea level rise and the accompanying result of salinization of groundwater (negatively impacting agriculture) as main climate change threats.

We identified 17 climate change adaptation (CCA) projects for Egypt from different databases. For 8 of these projects we identified in detail the underlying adaptation practices.

Keyword search Egypt

After Myanmar, Egypt shows the lowest number of publications in the Web of Science Core Collection (WoS-CC) (48) when the database was searched on Climate Change Adaptation options. This might not be surprising as under the adaptation segment of Egypt's second national communication to the UNFCCC it was stated that Egypt is a '*developing country which is struggling to overcome day to day challenges represented by a rocketing population growth and the need to finance several activities [...], issues like climate change which appears like a long term issue is not always a top priority for the successive governments in Egypt*' (UNFCCC, 2010). Moreover, the impact of the Egyptian crisis of 2011-2014 should not be disregarded.

As is shown by figure 3.3.1 (see below), Egypt shows a relatively high peak compared to the other countries for 'sea level rise' as an adaptation topic when being searched for in the WoS-CC. This is not surprising, seen the fact that sea level rise has been identified as a main climate change threat in Egypt in the first, second and third national communication to the UNFCCC and due to the high population density in the delta. Furthermore, as far as the WoS-CC is concerned, Egypt scores significantly lower for the search results of 'Floods' and 'Community-Based Adaptation' as compared to the mean. While the relative shortage of results for community-based adaptation cannot easily be explained, the deficiency of hits for floods seems logical as drought and lack of rainfall are expected problems in Egypt rather than an abundance of water.

For the WUR library, Egypt also scores slightly higher for sea level rise compared to the other countries. Egypt slightly underscores for 'Ecosystem Based Adaptation' and 'Ecological Resilience' compared to the other countries in the WUR library search. For the other adaptation topics, the results for Egypt and the other countries in the WUR library are remarkably similar.

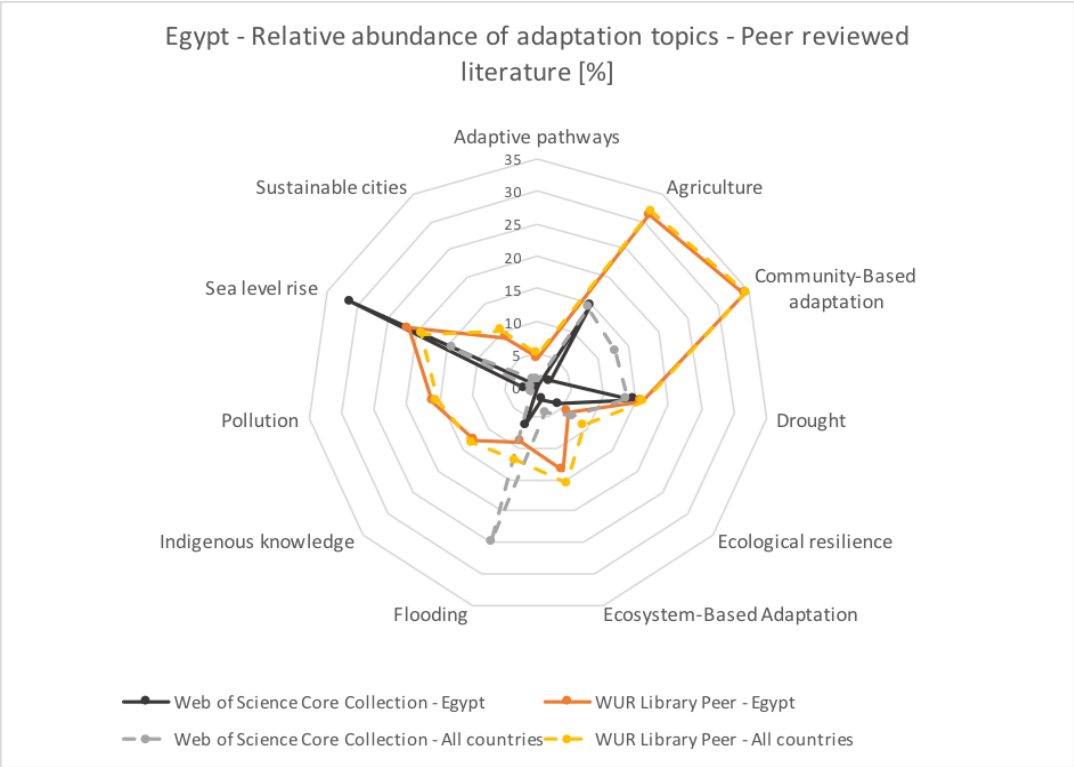

Figure 3.3.1 This radar shows the relative contribution of adaptation topics to the overall keyword search results of "Climate Change Adaptation Egypt" in comparison to average values for all countries. Only the results for the WoS Core Collection and WUR Library Peer are shown.

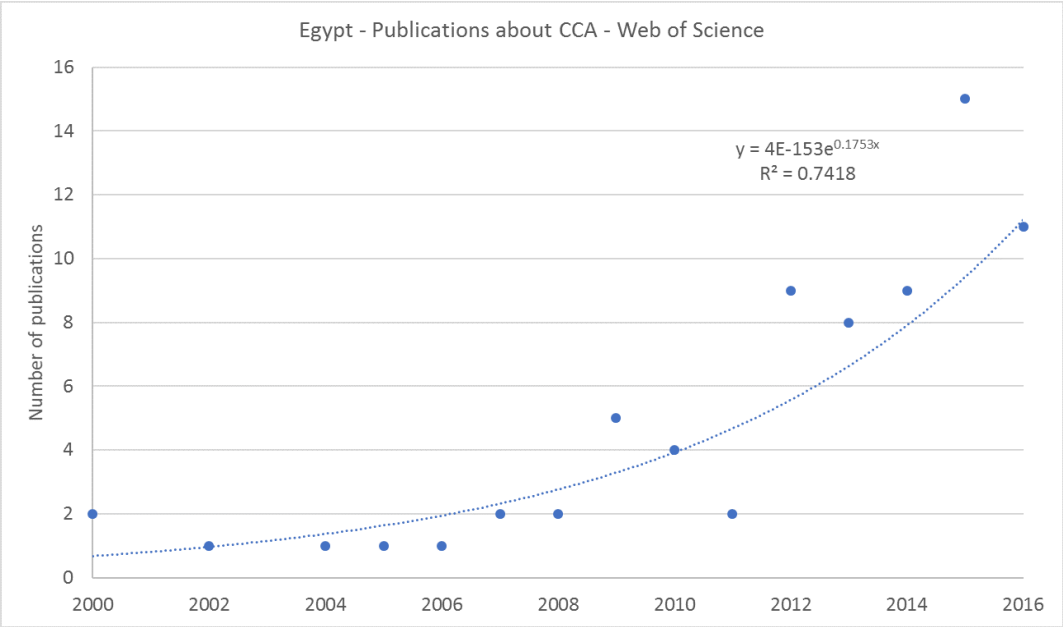

Figure 3.3.2 The graphs shows number of articles about CCA in Egypt per year of publication in the Web of Science. The search was done with the keywords "Climate Change Adaptation Egypt" on the 30th of May 2017. 2017 showed no publications yet for "CCA Egypt".

Longlist (LL) analysis

LL Egypt - General information

We identified 17 climate change adaptation (CCA) projects for Egypt from different databases. This is the second lowest number of projects we found for the developing countries of the Delta coalition, only Myanmar has a lower number of projects (15) in the LL. This can, again, be explained by the economical and political crisis in Egypt and the remark in the second national communication document that Egypt as a developing country not always has room for granting attention to adaptation (UNFCCC, 2010). Most CCA projects were collected from Prevention Web (50%), Adaptation Learning Mechanism (28%), UNFCCC (11%) and Web of Science (6%). For 8 of these projects we identified in detail the underlying adaptation practices.

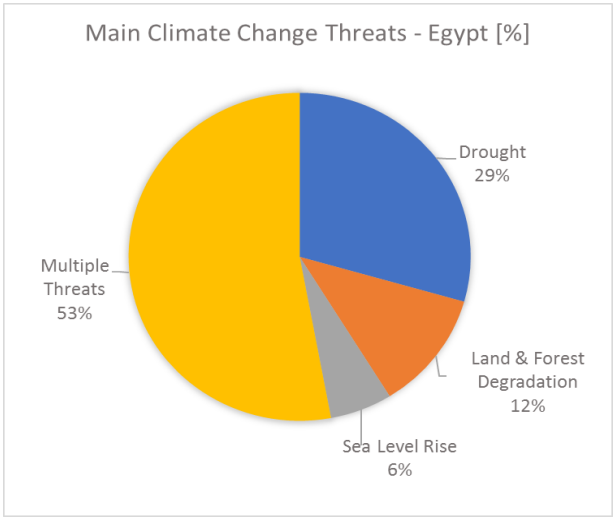

Figure 3.3.3 Main CC threats to Egypt targeted by the projects of the LL. Multiple threats describe several CC threats with no clear prioritization and can be understood as a representative mix of the relevant CC threats to Egypt.

LL CC Threats to Egypt

The main climate change threats to Egypt explicitly defined by the Ministry of State for Environmental Affairs (2016) in the third national communication report were changed weather patterns (less rainfall), drought, desertification, sea level rise, salinization and increased temperatures. In our longlist, we find that 'Multiple threats' accounts for the majority (53%) of main climate change threats in Egypt. This is logical seen the fact that threats such as drought, desertification, increased temperatures etc. often go hand-in-hand. 29% of the adaptation projects that were listed in Egypt were assigned 'Drought' as a main climate change threat. This complies with the findings from literature. Followed by drought, 'Land & Forest Degradation' accounts for most of the projects we identified in Egypt (12%). Only 6% of the projects we identified in the longlist were assigned 'Sea Level Rise' as a main climate threat. This seems crooked, yet can easily be explained by the fact that most projects concerning sea level rise also concern issues such as salinization and are therefore listed as 'Multiple threats'. See the figure below for an overview of main climate change threats as identified in our longlist for Egypt.

Adaptation Elements Egypt

The largest amount of projects in Egypt have been assigned the adaptation elements of Capacity Building (17.6%), Monitoring & Evaluation (17.6%), Science & Research (17.6%) and Vulnerability Assessment (17.6%), followed by Implementation (11.8%) and Education/Training (11.8%) and finally by Policy Development (5.9%). Based on figure 3.3.4 (see next page), several observations stand out.

First of all, Egypt shows a relatively high peak for 'Monitoring & Evaluation' as an adaptation element when being compared to the other countries. A second similarly large deviation from the mean can be found for 'Vulnerability Assessment' as an adaptation sector, which is also more prominent in Egypt than in the other countries. These peaks for Vulnerability Assessment and Monitoring & Evaluation can be explained by the fact that many projects currently running in Egypt are focused on data gathering and adaptation prioritizing, as can be deduced from the project aim of these projects when consulting the longlist, whereas other countries might be further in the process of executing adaptation measures.

Egypt relatively underscores for Implementation and Policy Development as compared to the mean of all countries together. This complies with the previous remark that most projects in Egypt are still in the phase of data gathering and prioritizing, and thus less so focused on policy development and implementation of actual projects.

Egypt scores slightly higher than the mean for Science & Research. The Science & Research projects in Egypt focus mainly on assessing and analysing impacts of climate change on sectors such as agriculture and water resources. One project analyses the value of stakeholder participation in evaluating trade-offs between adaptation options.

For Capacity Building and Education/Training, Egypt also scores slightly higher than the mean. Capacity Building projects in Egypt are mainly focused on building capacity in the poorest and most vulnerable regions through technical, financial and policy interventions and developing the capacity of Egyptian institutions and authorities to facilitate adaptation. The two projects that have Education/Training as their main adaptation element both focus on the education and training of resource managers.

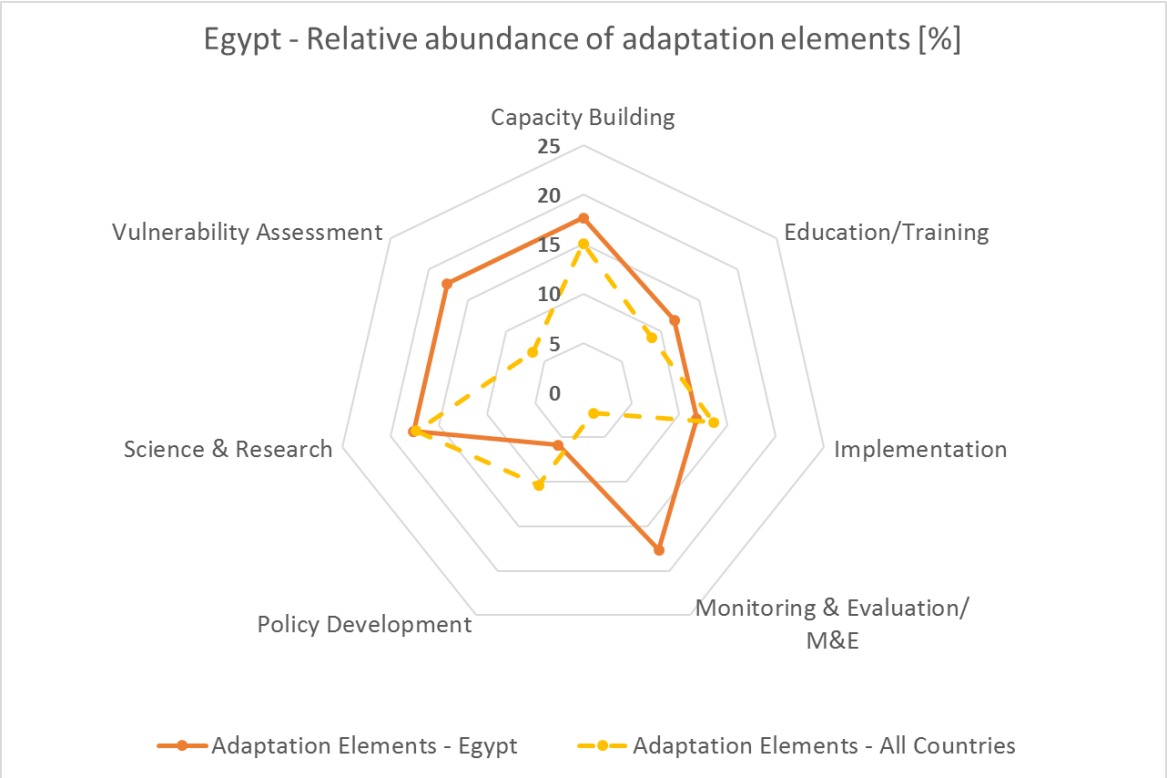

Figure 3.3.4 Relative distribution of Adaptation Elements for CCA projects in Egypt in comparison to the average values from all countries. Adaptation Elements with values <3% are not shown in this graph. The full list is included in the Appendix.

Adaptation sectors Egypt

As far as adaptation sectors are concerned, the main adaptation sectors of CCA projects in Egypt are Community-Based Adaptation (17.6%), Water Resources (17.6%), Agriculture (11.8%), Services (11.8%) and finally Adaptation Finance, Coastal Areas/Zones, Disaster Risk Reduction, Ecosystem Based Adaptation, Energy, Governance and Urban Resilience all with 5.9%.

The largest deviations from the mean of all countries together are represented by Community-Based Adaptation, Water Resources and Services (see figure 3.3.5 on the next page). The relatively large share of projects with water resources as the adaptation sector is hardly surprising regarding the importance of water resources for Egypt as identified by the introduction of this country analysis. Community-based adaptation projects in Egypt are mainly focused on stakeholder participation and livelihood improvement. The service projects focus on strengthening and technically supporting monitoring and reporting systems and helping resource managers to make learned decisions.

Egypt relatively underscores most notably for Disaster Risk Reduction. For the other sectors, Egypt only deviates slightly from the mean, therefore these will not be granted special attention.

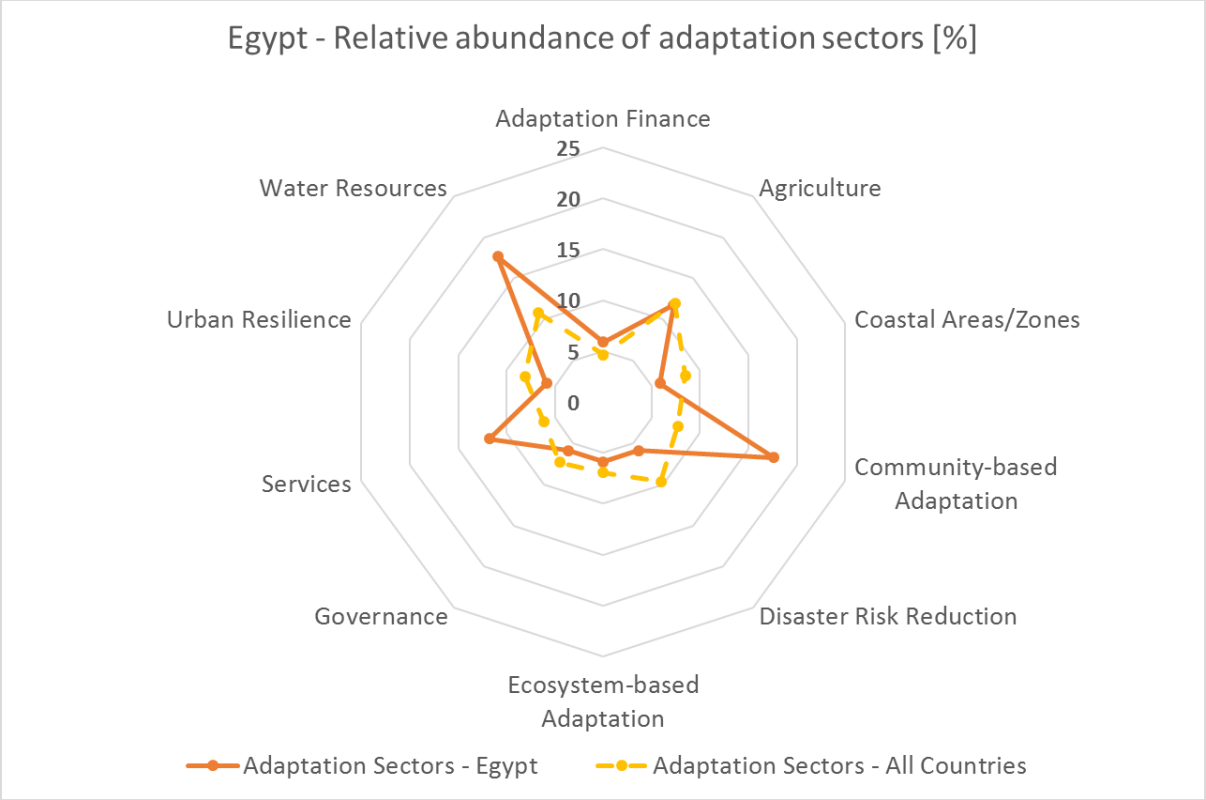

Figure 3.3.5 Relative Distribution of Adaptation sectors in Egypt in the LL. Projects that applied to more than one sector were classified with the most relevant sector to the adaptation option pursued in the project. Most projects applied to more than one Adaptation sector.

CCA options Egypt

The following list contains a synthesis of all CCA options in Egypt. Many options were implemented more than once, but only unique measures are listed.

According to our data collection in the LL for Egypt, the main climate change adaptation options in Egypt are focused on water resources and community based adaptation. Specific adaptation measures are listed below.

Most CCA options are related to agriculture and especially how water is distributed and used in agricultural practices. Something that it is not present in other countries with substantial drought problems (like Bangladesh) is the focus on the effectiveness of water use by reducing the leakage. Notable sectors that are missing in CCA options for Egypt are DRR and EbA.

Agriculture

- Development of the agricultural sector for climate modelling
- Organic agricultural production
- Crop mix: decrease of especially rice cotton & maize and small increase of Berseem (*Trifolium alexandrinum*)to reduce irrigation intensity
- Crop yield technological progress (faster crop yield growth)

Water resources

- Water management with more effective drip irrigation methods

- Vulnerability assessment with SUST model to assess groundwater importance and sensitivity to CC (Turner II et al. 2003)
- Climate modeling for the water sector under CC model to assess groundwater importance and sensitivity to CC (Turner II et al. 2003)
- Climate modeling for the water sector under CC
- Improved field irrigation efficiency (decreasing net losses in agricultural distribution systems. Currently the irrigation efficiency is assumed to be 80 % across most of the country with the upper and middle Egypt regions at 75 % and the Delta at 77 %.)
- Water flow information for the beneficial management of the Aswan High Dam now and in the future
- Equitable & sustainable management & development of the shared water resources in the Nile Basin
- Assessment of the potential changes to the frequency of future drought & flood events

Community-based adaptation

- Farmer field schools
- Stakeholder participation in developing adaptation strategies (workshops, training exercises)
- Allow communities to prioritise risks and make collective decisions on actions

Awareness raising

- Film production "The Future of Climate Change in Egypt"
- Increase awareness on the Water-Energy-Food nexus
- Advocacy of slower population growth (model, not policy).

Science & research

- Downscaling of climate models to the scale of Egypt to project future climate impact
- Research on the Water-Energy-Food nexus
- Assessment of energy & food security using a convergent approach
- Water conflict case studies correlation with climate data

Infrastructure

- Improved municipal and industrial distribution efficiency of water (Current distribution efficiency results in 50 % of the water distributed to municipal and industrial sector being lost through network leakage or other forms of inefficiency.)

Institutions

- Establishment of Clean Development Awareness & Promotion Unit within Environmental Agency
- Capacity building of the government & civil society

Country summary

The main climate change threats in Egypt are drought, erratic rainfall, sea level rise and salinization. Results from literature seemed to comply with findings from our long-list. The main adaptation elements in Egypt are capacity building, science & research, monitoring & evaluation and vulnerability assessments. This can be explained by the fact that Egypt is currently facing many other struggles and adaptation planning is not the country's main priority. The projects that are running are more of inventorying and explorative nature rather than focused on implementing hard measures. The main adaptation sectors are community-based adaptation (which often goes together with capacity building) and water resources. Important adaptation measures are about diminishing leakage of water in agricultural irrigation systems to cope with diminishing water resources.

3.4 Indonesia

Introduction

Indonesia is an archipelagic nation with extensive coastal low-lying areas that are highly vulnerable to climate change impacts. As a country that has the second longest coastline in the world (NATGEO 2013; CIA 2013), most of the cities in Indonesia are located around the coastal zone. This fact forces Indonesia to be more aware to the adverse effects of climate change particularly for hydro-meteorology hazards.

To overcome projected climate change impacts, Indonesia signed the Climate Change Convention of the UNFCCC in 1992 which entered into force in 1994. Indonesia also signed the Kyoto Protocol in July 1998 which was ratified in December 2004 (UNFCCC, n.d).

Indonesia suffered a multitude of hazards between 2004 and 2009 such as Tsunami Aceh (2004) and Mentawai (2005), a big flood in Jakarta (2007), and the Jogja earthquake (2009). The Tsunami Aceh in 2004 had such devastating effects that it marked a break in awareness of climate change adaptation urgency (Banba, 2017). Indonesia started to reform laws and regulations related to disaster management and spatial planning.

In its second national communication (2010), the Indonesian government notes that the most frequent hazards historically have been flooding, followed by landslides and water or vector borne diseases, wind storms, forest fires, drought, and storm surges. They also note that these hazards are likely to increase in the near future, especially because of an expected intensification of El Niño/La Niña (ENSO) climatic impacts.

Indonesia experienced a relative sea level rise of 1 - 8 mm per year (Asian Development Bank, 2009c) and projected rise would reach 0.18 - 0.59 m by 2100 depending on the underlying scenario (Bernstein et al., 2007). The fact that most agricultural areas are located in coastal zones which are directly affected by sea level rise forces the Indonesian Government to issue regulation about climate change. One of them is The Indonesian Climate Change Roadmap of 2009 (ICCR) which recognizes the risk that climate change poses to the agricultural sector and food security. Furthermore, Indonesia also addressed climate change in their National Action Plan (NAP) to the UNFCCC and established the Indonesian Climate Change Trust Fund (ICCTF).

Along with this increase in issued regulations, we found that adaptation projects both for LL and KWS has significantly increased since 2009. While there was an upward trend before in projects and publications the rise accelerated after 2009 visibly.

Keyword Search Indonesia

The number of search results in the KWS are highest for Indonesia in the WUR Library (~8000) and third in Web of Science Core Collection (WoS-CC) after Bangladesh and Vietnam. However, the fact that the WUR Library always shows more results than relevant could have bias this database findings of highest number Indonesian publications of CCA. This bias also relates to the fact that WUR is more focused on 'Agriculture', a topic that Indonesia is also more focused on. In figure. 3.4.2 we can see that in the WoS-CC, which is more 'trusted', CCA publications in Indonesia show a significantly exponential increase from 2001 until 2016 ($R^2 = 0.86$).

The highest score for Community-based Adaptation in the WoS-CC results (figure 3.4.1) highlights the fact that Indonesia is still in the stage where the government is focused on how to build communication between the main government and the lower (regional) levels, which is a

typical problem of decentralization governance. Agriculture scores the second highest when being searched for adaptation options, followed by Ecosystem-based Adaptation.

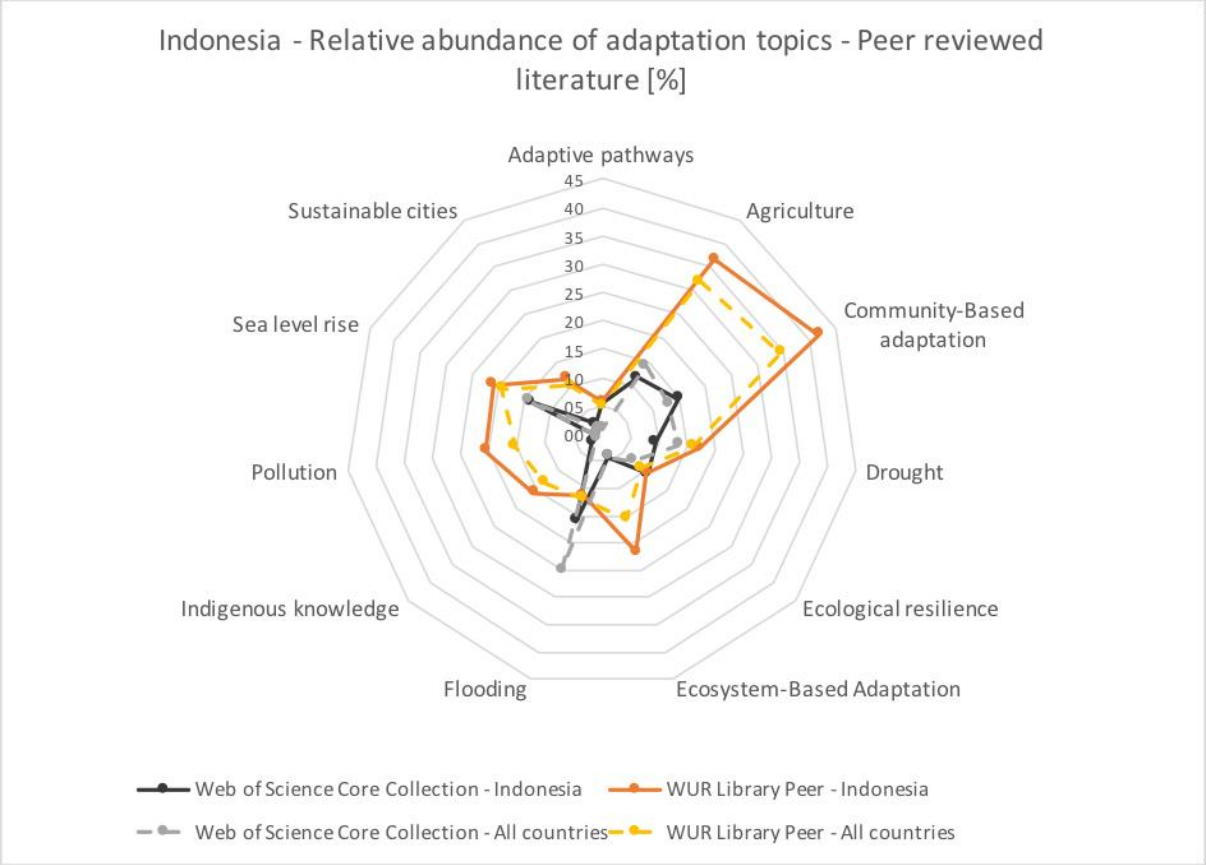

Figure 3.4.1 This radar shows the relative contribution of adaptation topics to the overall keyword search results of "Climate Change Adaptation Indonesia" in comparison to average values for all countries. Only the results for the WoS Core Collection and WUR Library Peer are shown.

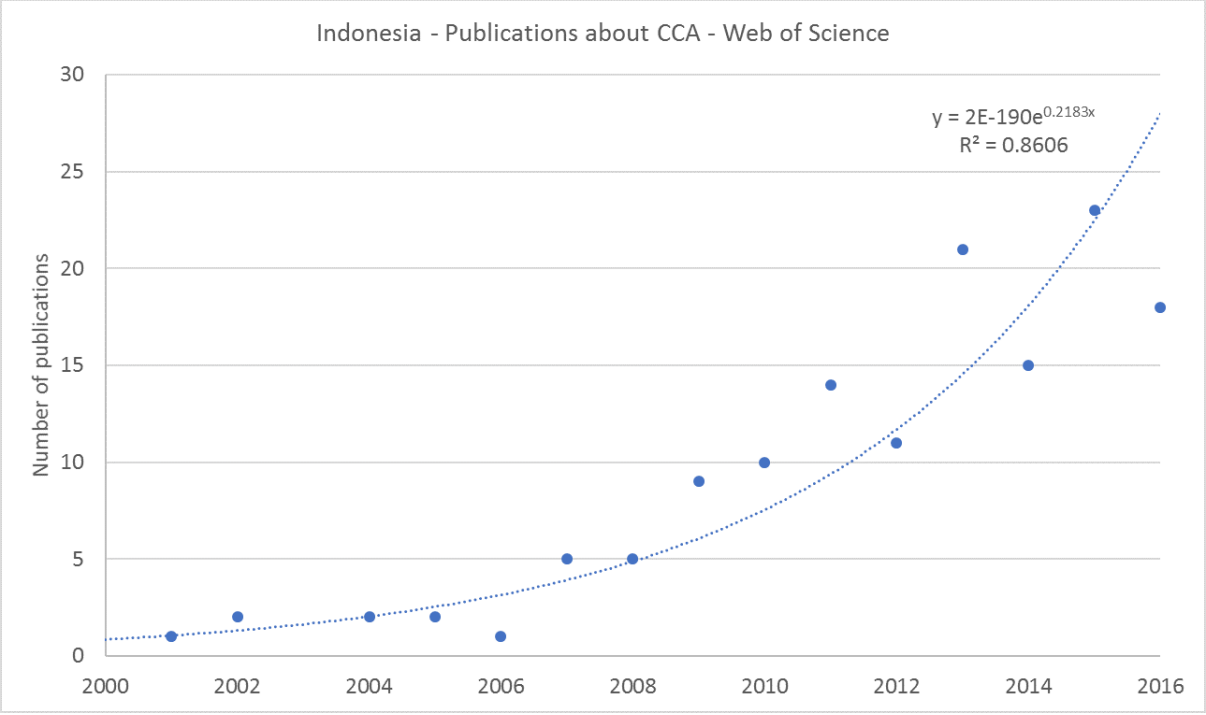

Figure 3.4.2 The graphs shows number of articles about CCA in Indonesia per year of publication in the Web of Science. The search was done with the keywords "Climate Change Adaptation Indonesia" on the

30th of May 2017. While 2017 already showed 8 publications about the topic they were left out due to the ongoing year.

Longlist (LL) analysis

General information

We identified 36 climate change adaptation (CCA) projects for Indonesia from different databases. Most CCA projects were collected from Prevention Web (31%), Adaptation Learning Mechanism (14%), UNFCCC (14%) and Web of Science (14%). For 17 of these projects we identified in detail the underlying adaptation practices.

CC threats to Indonesia

The main climate change threats for Indonesia as identified by The Ministry of National Development Planning (BAPPENAS) (2013) are sea level rise, changed weather patterns, intense rain, floods, and droughts. The projects in our long-list identified Floods (25%) and Sea Level Rise (8%) as the two main climate change threats after Multiple Threats (Fig. 3.4.3).

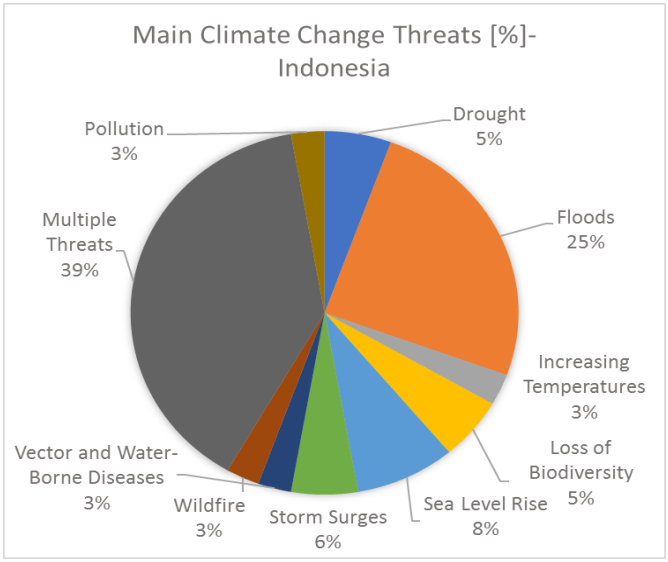

Figure 3.4.3 Main CC threats to Indonesia targeted by the projects of the LL. Multiple threats describe several CC threats with no clear prioritization and can be understood as a representative mix of the relevant CC threats to Indonesia.

Occupying the largest portion of climate change threats, Multiple Threats (39%) refers to a representative mix of threats that Indonesia faces under climate change. Because of this, changes in weather patterns are not shown as a main climate change threat individually in projects. Also, it should be noticed here that Indonesia suffers from more spread climate change threats than other countries of interest, which includes loss of biodiversity, wildfire, and pollution for instance.

Adaptation Elements Indonesia

The Adaptation Elements in Indonesia as identified by our long-list focus mainly on Capacity Building (19%), Implementation (14%), Policy Development (14%), Vulnerability Assessment (11%), and Science & Research (11%) (Fig. 3.4.4).

Related to the National Adaptation Plan, the government of Indonesia plans to strengthen institutional capacity and promulgation of climate change sensitive policies and regulations by 2020 (INDC, 2015). This element is also listed in the Indonesia's strategic development goals, known as *Nawa Cita* (or Nine Agenda Priorities) in which there is a focus on building capacity to provide Dignified and Trustworthy Indonesia.

Here, to reach the long-term goal, Indonesia has implemented capacity building in Disaster Risk Reduction (DRR) in different organization levels (civil society, the government, and the private sector) in densely populated areas. They also issued certain policy in which the focus is on sea level rise and it's effect on the agricultural sector. For example, they have made plans for the adjustment of the irrigation system to regional (sub-national).

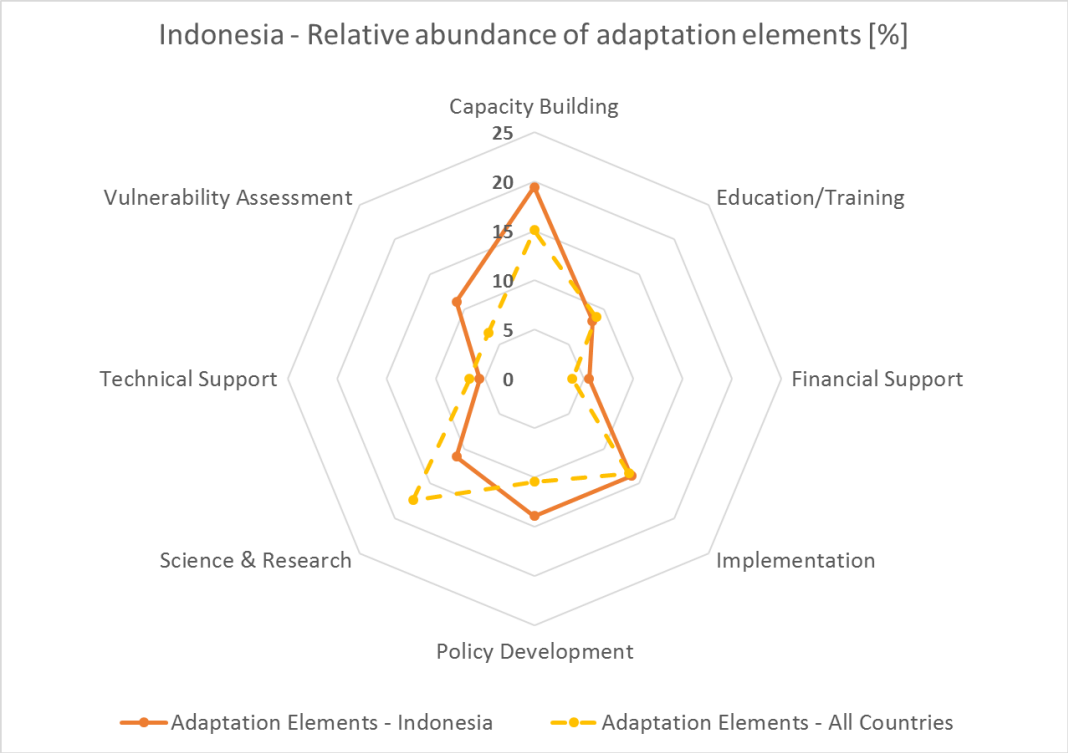

Figure 3.4.4: Relative distribution of Adaptation Elements for CCA projects in Indonesia in comparison to the average values from all countries. Adaptation Elements with values >3% are not shown in this graph. The full list is included in the Appendix.

Adaptation Sectors Indonesia

The two largest Adaptation Sectors in Indonesia are Coastal Areas/Zones and Urban Resilience which share the same contribution of 17% of total projects (see fig. 3.4.5). This result is hardly surprising -most of the Indonesian population is located in coastal areas in which their resilience to climate change impact should be prioritized. When taking a closer look at Adaptation Sectors, there seems to be more bias in the definitions of what these projects focus on. For instance, for the Coastal Zones/Areas sector, the practices which people often do are mangrove reforestation and building sea dams/seawalls which also could be listed under Ecosystem-based Adaptation or Infrastructure. It should be noted here that even though Infrastructure has shown not to be an outstanding sector in our research, it is actually often a (large) part of the projects, e.g. through building breakwater, sea wall, river dredging, or road elevation.

Linked to the KWS findings, here, Agriculture and Community-based Adaptation only share a contribution of 11% and 8% respectively. Agriculture along with water resources are the main focus points to strengthen Indonesian Food Security which support the medium-term goal of Indonesia's climate change adaptation strategy (RPJMN) 2015 -2019 (Ministry of Agriculture, 2015).

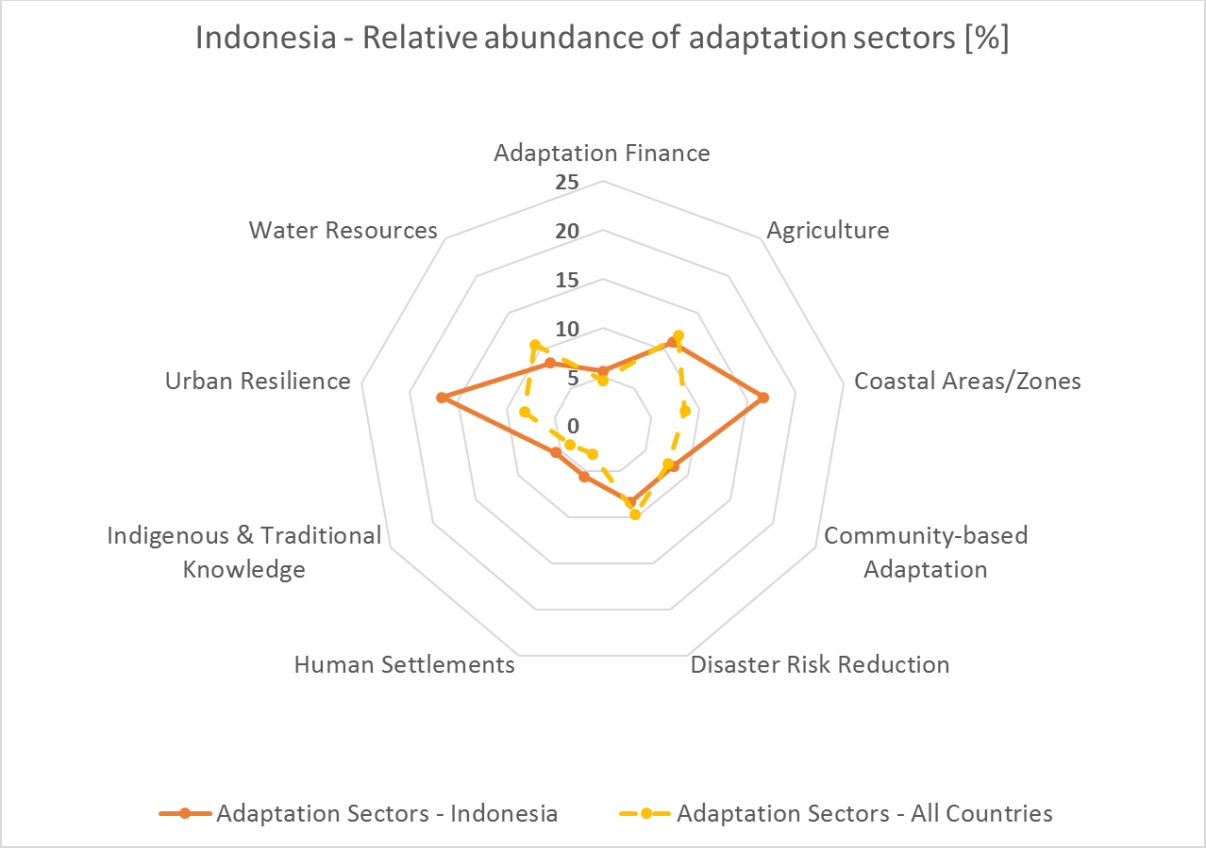

Figure 3.4.5 Relative Distribution of Adaptation sectors in Indonesia in the LL. Projects that applied to more than one sector were classified with the most relevant sector to the adaptation option pursued in the project. Most projects applied to more than one Adaptation sector.

CCA Options Indonesia

The following list contains a synthesis of all CCA options in Indonesia. Similar adaptation options were frequently practiced in multiple projects, yet will only be named once in the following overview.

Although Urban Resilience and Coastal Areas/Zones occupied the largest number of total adaptation sectors, the Indonesian adaptation strategy emphasizes to focus on practices related to agriculture and water resources. The largest adaptation sectors after Urban Resilience and Coastal Areas/Zones are DRR and CbA (Figure 3.4.5.).

One paper from WoS (Förster, 2011), studied that adaptation measures in the agricultural sector should be adjusted to local contexts, e.g., the geographical and institutional circumstances. As CCA options, the authors suggested to establish farm dikes in new areas in South Kalimantan which suffer from land degradation due to sea level rise. The development or application of crop varieties tolerant to extreme conditions such as deepwater and salinity could be another way to adapt. This adaptation option also stated by the National Adaptation PLan of Indonesia (Ministry

of Environment, 2010), which also includes the development of farm risks insurance, the adjustment of cropping patterns, and the development of climate field schools to deal with CC issues. For an example and explanation of a bad adaptation practice in Indonesia as identified by literature, see box 3.4.1 below.

Box 3.4.1: Example of the construction of a sea-wall as a bad practice in Indonesia.

Indonesia

Marunda Permanent Embankment (Jakarta, Indonesia)

North Jakarta has suffered from land subsidence which makes this areas are vulnerable to coastal flood. However, the existing embankment which built in 3-km high along 8 km Marunda coastline is not good practice. In 2015 this sea wall damaged and now the height is same with the sea level in tide condition. Therefore this embankment need to be heightened. The similar condition is expected to occurs again in the upcoming years because land subsidence in Jakarta has typical rates 3 - 10 cm^{-1} $year^{-1}$ (Abidin et al., 2015). However, the planning of Jakarta Giant Sea Wall to prevent floods impact on Jakarta is not good solution to replace Marunda Embankment due to environmental and societal reason (Putri, R.N., 2017).

For more CCA options in Indonesia that we have identified in our long-list, the following list of practices including also indigenous and traditional knowledge (not separately marked) are presented.

Agriculture

- Subsistence farming practices adjustment to more variable and extreme climatic conditions to strengthen food security:
- Use of heat,drought, flood & salt tolerant crop varieties
- Diversification of crops
- Training and assistance in sustainable farming practices for cacao farmers:
  1. Effective pruning of trees,
  2. Fermentation and drying of beans
  3. Improving the quantity and quality of yields by providing more productive plantlets
- Improving pest management
- Competitive sustainable industrial agricultural system ensuring food security and farmer welfare
- Establishment of new agricultural areas
- Farm dikes

Water resources

- Establishment of Fresh Water Supply Facilities
- Continuation of East Flood Canal project
- Strengthen management and maintenance water reservoirs to improve water security on the community level
- Construction of new community/household surface/rain water reservoirs and related essential infrastructure (e.g. canals , pipes, pumps and energy supply)
- Establishment of water user groups who jointly develop and implement management plans for water resources for the community
- Implementation of watershed level conflict resolution mechanism to avoid and reduce conflicts over water use
- Improving water management, irrigation and drainage
- Participatory Irrigation Management
- Development of an integrated water resource management plan

Disaster Risk Reduction (DRR)

- Community based climate risk information system
- Tsunami Early Warning System
- Capacity building in DRR for vulnerable populations, civil society organizations, the government & the private sector

Ecosystem-based Adaptation

- Mangrove conservation & afforestation (Triple F management: fish, fruit & forest)

Livelihood Security

- Diversification / change of livelihoods that are less susceptible to CC
- Education & training of farmers
- Better weather forecasts and crop insurance
- Recognizing & strengthening the role of women in planning & management of farms
- Securing of roofs against cyclones
- Women empowerment
- Rearrangement of the agricultural production system in the context of food security

Science & Research

- Monitoring of water quality fluctuations to identify the causes of quality changes. This is to serve as a basis for better management of agricultural practices to benefit human health.
- Monitoring of flood impacts for future adaptation planning
- Harnessing the indigenous technical knowledge of farmers
- Vulnerability assessment by using probabilistic projections of urban expansion in Java
- Evaluation of flood protective services of coastal mangrove forests under CC scenarios; biggest threat is loss of mangrove forests

Infrastructure

- Construction of river embankments
- Construction of breakwaters
- Construction of sea dams & seawalls
- Road elevation
- River basin management and river infrastructure improvement
- Enhance spatial planning & flood protection; highly effective against flood protection, less for coastal flooding due to rapid urban expansion
- Adjustment of irrigation systems to regional (i.e., sub-national) development anticipating future sea-level rise

Institutions

- Institutional Capacity Building to integrate climate resilience in provincial and district level
- Strengthening the integration & coordination for adaptation policy development
- Establishment of CCA priority areas for action e.g. resilience
- Establishment of a National Water Council
- Financial support by the (local) government for autonomous adaptation action against flooding performed by local inhabitants
- Increase the effectiveness and impact of external financial support for CCA (funding should be based on needs & priorities taking into account long- & mid-term development plans

Country summary

Indonesia suffers mostly from floods as the main climate change threat, which is also the most studied threat relative to other countries. After floods, sea level rise is the most important climate change threat to Indonesia. The main climate change adaptation elements in Indonesia are capacity building, policy development and implementation. Most strategies to adapt to climate change are related to the sectors of coastal zones/areas, urban resilience and agriculture. The most implementation practices focus on hard measures related to ecosystem-based adaptation. Building dikes, sea wall, and mangrove plantation are the most preferable measures in Indonesia coastal line.

3.5 Mozambique

Introduction

Mozambique is a very young state and only declared it's independence from their colonial oppressors in 1975. Then the country was struck by a great drought in 1983, and a civil war between (Soviet-Union backed) FRELIMO and (South-Africa backed) RENAMO. Finally, in 1994 Joaquim Chissano was elected in a fair democratic election. Although Mozambique was hit with some severe natural disasters (drought, earthquake, floods), the economic growth in the region has been remarkable in the 21st century, both due to debt relief and because of foreign interest in the country's' new found coal- and gas reserves. The population however did not benefit very much from this economic growth. (Britannica, n.d).

The biggest and arguably the most important river in Mozambique is the Zambezi river, followed in size by the Rovuma, Lúrio, Save, and Messalo respectively (Britannica, n.d.). These rivers alleviate some of the stress of droughts and infertile soils, but have flooded severely in the past.

Mozambique signed the UNFCCC in 1992 and ratified the Convention in 1995 (UNFCCC, n.d.). After the country ratified the Kyoto Protocol in 2005 (UNFCCC, N.D), it published its' initial National Communication under the UN Framework Convention on Climate Change in 2006 (UNFCCC,n.d.). In this National Communication (2006) Mozambique notes that increasing temperatures together with droughts are two main climate change threats, although inundation of coastal areas and salinization due to sea level rise are important climate change threats too.

Keyword Search Mozambique

The keyword search (KWS) in the peer-reviewed literature highlights several topics that are more relevant for Bangladesh than for the average of all countries (Figure 3.5.1). Most notably, Drought and Ecological Resilience are topics that are relatively often addressed. Agriculture is addressed a bit more in the WoS, but less in the WUR Library. What is interesting to see furthermore is that in the WUR Library most topics seem to be less cited than on average, meaning that the WUR Library is a bit more specific in assigning categories in Mozambique.

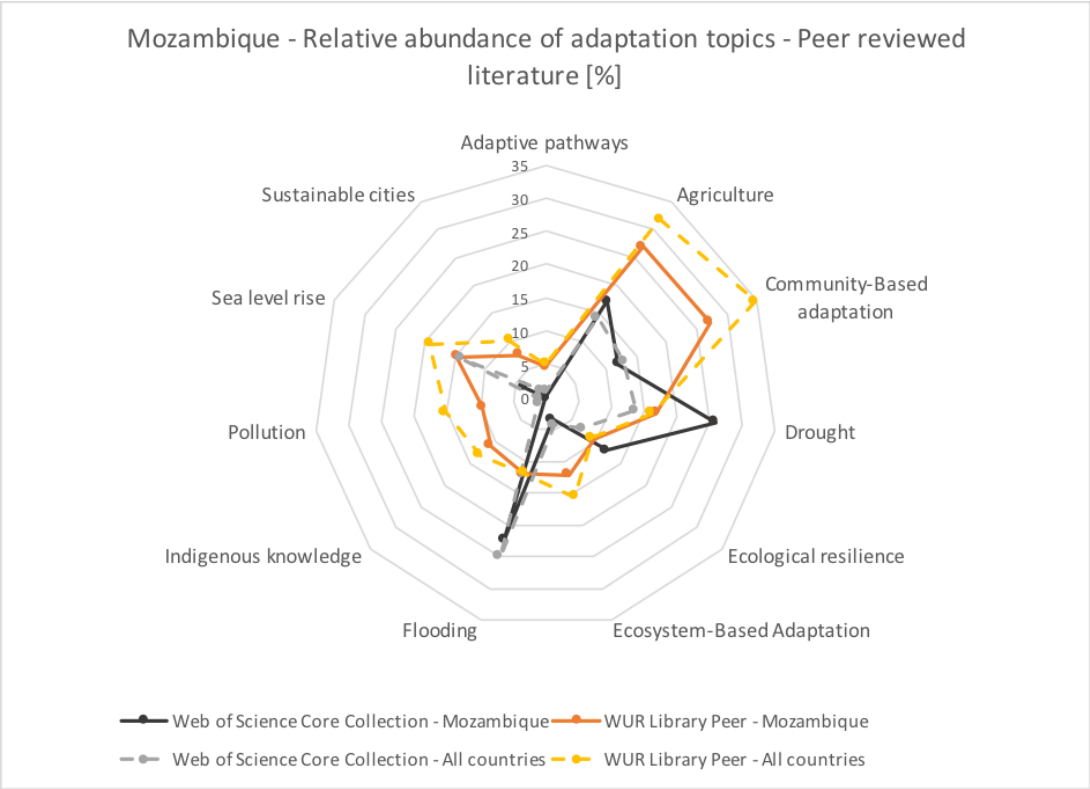

Figure 3.5.1 This radar shows the relative contribution of adaptation topics to the overall keyword search results of "Climate Change Adaptation Mozambique" in comparison to average values for all countries. Only the results for the WoS Core Collection and WUR Library Peer are shown.

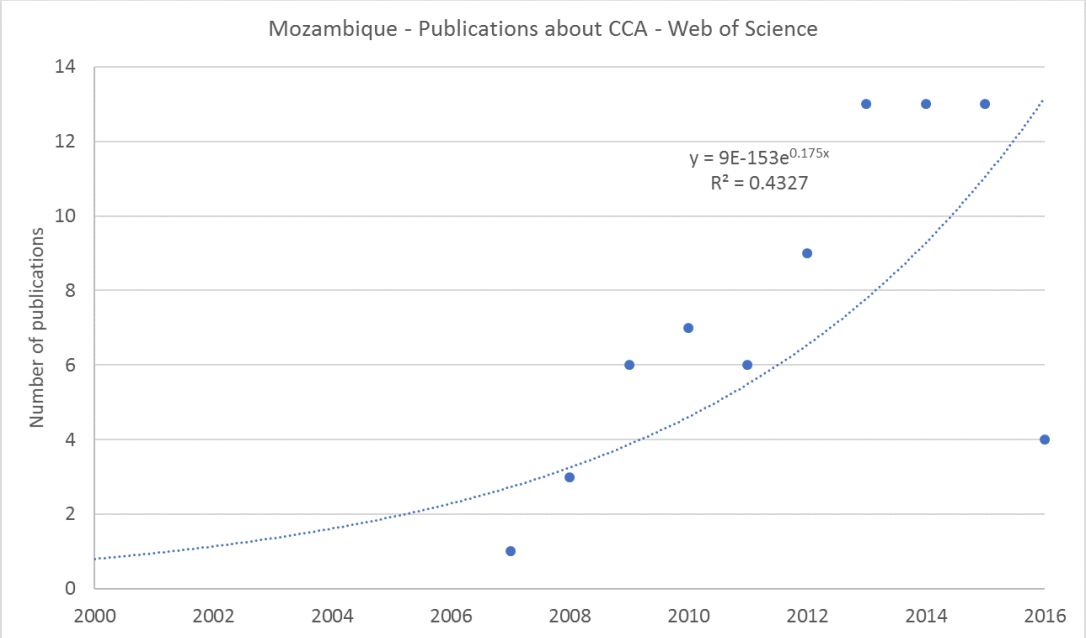

Figure 3.5.2 The graphs shows number of articles about CCA in Mozambique per year of publication in the Web of Science. The search was done with the keywords "Climate Change Adaptation Mozambique" on the 30th of May 2017. 2017 showed no publications yet for "CCA Mozambique".

Longlist (LL) analysis

LL Mozambique - General information

We identified 44 climate change adaptation (CCA) projects for Mozambique from different databases. Most CCA projects were collected from Prevention Web (35%), Africa Adapt (14%),

the Adaptation Learning Mechanism (12%) and Climate Investment Fund (10%). For 20 of these projects we identified in detail the underlying adaptation practices.

LL - CC threats to Mozambique

Broadly speaking, the observations from the National Communication (2006) are reflected in our longlist. Although temperature rise is not represented, the correlated drought is the biggest climate change threat together with floods. Floods do seem to be somewhat overrepresented in our database. The high amount of Multiple Threat projects is mainly due to the high amount of governance or institutional adaptation measures, that target the policy process rather than a specific climate threat.

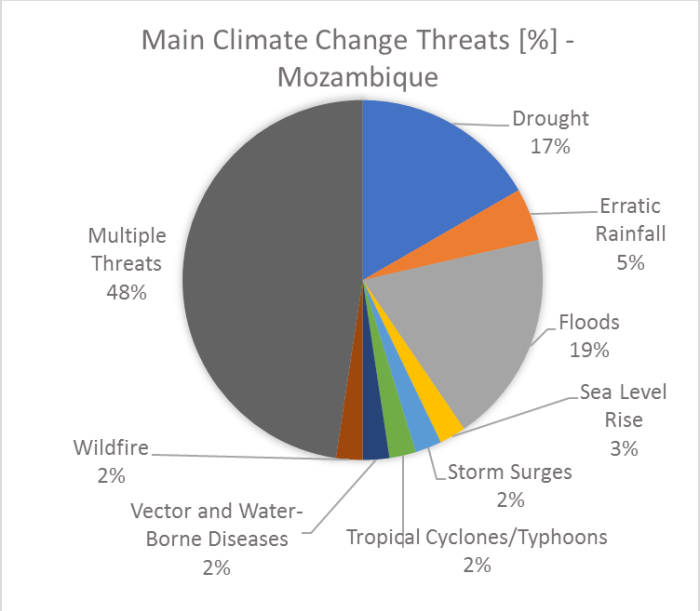

Figure 3.5.3 Main CC threats to Mozambique targeted by the projects of the LL. Multiple threats describe several CC threats with no clear prioritization and can be understood as a representative mix of the relevant CC threats to Mozambique.

Adaptation Elements Mozambique

The largest amount of projects in Mozambique are in the field of Policy Development (18%), Implementation (16%), Education/Training (12%), and Technical Support (12%) (see fig. 3.5.4).

Although Mozambique has most projects in the field of Policy Development, these projects are mostly international projects that try to set-up or improve Sub-Saharan international institutions, rather than innovative policies that are tested in Mozambique.

Implementation on the other hand is a very innovative field in Mozambique. Most implementation projects are quite comprehensive, such as “Sustainable Use and Management of Forests in Mozambique”. But there are also innovative projects, like the “road ponds” or “Early warning in urban areas” which uses snorkel-like devices to serve as an early flood-warning system.

Finally Education/Training and Technical Support have more projects than average, and there are some interesting projects in these areas, such as the training for fish farming.

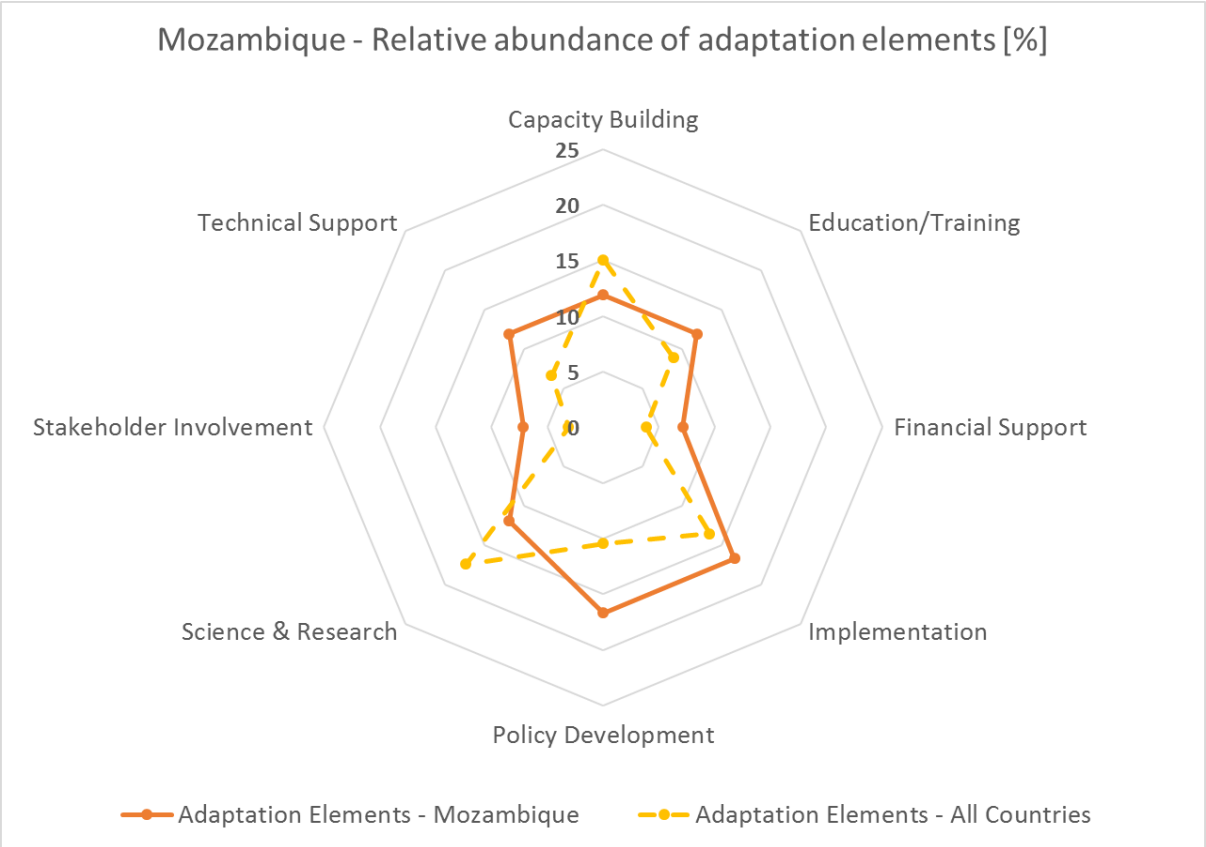

Figure 3.5.4 Relative distribution of Adaptation Elements for CCA projects in Mozambique in comparison to the average values from all countries. Adaptation Elements with values >3% are not shown in this graph. The full list is included in the Appendix.

Adaptation Sectors Mozambique

The biggest adaptation sectors in Mozambique are Governance and Disaster Risk Reduction (fig. 3.5.5). Most governance projects apply to the Policy Development adaptation element, so there is not many interesting innovative projects in Governance. Disaster Risk Reduction on the other hand there are many detailed projects such as for instance ACCESA that aims to combat wildfires by building capacity in local communities through a better organization on national level.

Services and Urban Resilience are two sectors that stand out because they are more prevalent than in general. These are both sectors that can be addressed in a range of ways. In Mozambique in Urban Resilience is mostly addressed using capacity building of the local population and training of staff, and Services are mostly addressed using a technical and research approach.

Finally Ecosystem-based Adaptation (10%) is a hot topic in Mozambique, and there are very interesting projects going on there, most notably in the “Green infrastructure Beira” project, where a whole range of innovative green infrastructure for adaptation is implemented.

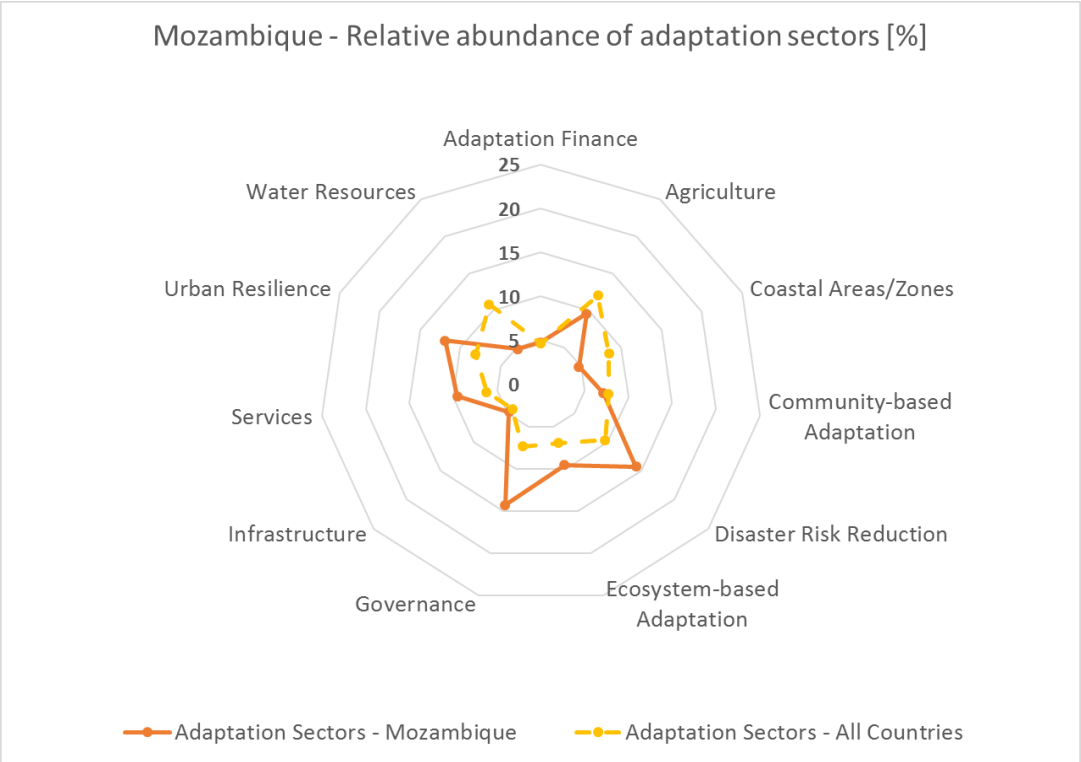

Figure 3.5.5 Relative Distribution of Adaptation sectors in Mozambique in the LL. Projects that applied to more than one sector were classified with the most relevant sector to the adaptation option pursued in the project. Most projects applied to more than one Adaptation sector.

CCA Options Mozambique

The following list contains a synthesis of all CCA options in Mozambique. Many options were implemented more than once, but only unique measures are listed.

Adaptation options according to our data collection for Mozambique in the long-list focus mainly on Governance and Disaster Risk Reduction (Figure 3.5.5.). The following list of practices includes indigenous and traditional knowledge but these CCA options are not separately marked.

Agriculture

- Drought tolerant crop promotion (i.e. sweet potato, cassava or sorghum) and livestock in drought vulnerable areas
- Change timing of sowing/harvesting with shifting seasons (planting crops earlier makes use of residual moisture)
- Promoting of cash crops e.g. rice and vegetables
- Increase of agricultural productivity with mechanised farming techniques and higher yielding crops
- Plant crops with distance to river banks to decrease siltation
- Alternate grazing systems (line 6)
- Change stocking rate of pastures with livestock to reduce stress on the ecosystem
- Changing timing of the grazing period
- Supplementing livestock feed to reduce pressure on pastures
- Sustainable forest management with selective logging
- Increase of productivity of market popular timber species
- Utilize less-known tree species for timber

Water resources

- Improve and protect natural drainage and artificial drainage systems
- Enhancing water storage & reduced use of water storage ponds by farmers
- Training of farmers on irrigation agriculture
- Rainwater harvesting
- Increase civil society's possibilities to influence water governance

Disaster Risk Reduction (DRR)

- Strengthening of early warning systems against floods including those operated by local communities (see box 2.3.1 and 2.3.3 in chapter 2.3)
- Establish and support structures to receive, analyze and disseminate active fire data from the MODIS sensor and Meteosat Second Generation (MSG) at the national level
- Strengthen the fire reporting system at the local level through existing local committees and other communication mechanisms
- Establishment of a Fire Danger Rating System: This is the primary means of determining the daily fire prevention, preparedness and suppression activities of responsible land-management agencies. It provides indices for determining the likelihood of a land fire ignition, its extent and the difficulty in controlling fire activities
- Participatory risk analysis and development of risk maps

Ecosystem-based Adaptation

- Restoration of natural habitats & landscapes
- Planting of trees along rivers to decrease erosion
- Soil conservation

Community-based Adaptation

- Early burning programs with selected communities and members of the local committee responsible for fire management to (re-)introduce traditional knowledge of the use of low intensity fires. "Cold" burning can simultaneously reduce wildfire hazard and improve livelihood opportunities related to grazing, production of thatch grass, etc.
- Trade between communities of different competitive advantages: exchange of resources between those with more land and those with more water resources
- Planting of trees along rivers to increase shade-cover to reduce evaporation
- Create ridges to slow runoff after irrigation
- Enhancing food production on the community level

Awareness raising

- Awareness raising about CC

Livelihood Security

- Vulnerability and Capacity assessment of stakeholders
- Diversification of livelihoods (fish farming & small-scale irrigation as alternative to previous cropping systems as adaptation to unpredictable rainfall
- Increase of access to markets for cash crops and agro-processing facilities
- Capacity building of farmers to cope with CC

Science & Research

- Burned area mapping on a quarterly basis within the Forest Inventory Unit
- Vulnerability & capacity assessments of communities using household surveys to identify vulnerabilities of to impacts of CC; to understand their current coping strategies; the resources important to coping & the constraints to coping (Tools: Climate

Vulnerability and Capacity Analysis (CVCA) and the CRiSTAL (Community Based Risk Screening Tool – Adaptation and Livelihoods)
- Evaluation of flood protective service of coastal mangrove forests under CC scenarios; biggest threat is loss of mangrove forests

Infrastructure

- Improve irrigation infrastructure for food security
- Creation of road ponds
- Permeable pavements
- Green streets and alleys
- Green parking
- Green roofs
- Urban tree canopy
- Downspout disconnection

Institutions

- Establishment of local disaster management committees
- Establishment of an "ecology tax" that passes on the cost forest management on to consumers
- Information sharing
- Implementation of a national CC monitoring system
- Implementation of CCA action into the national development agenda
- Adjustment on national/local levels to increase adaptive capacit

Country summary

Climate change adaptation projects in Mozambique address a range of sectors and climate change threats, and an extensive number of unique measures is employed towards adaption. The main climate change threat (besides 'multiple threats') in Mozambique can be assigned to floods, followed by drought. The main adaptation elements are policy development and implementation, which diverts from the results in the other countries. The main adaptation sectors are disaster risk reduction and governance. A reader interested in innovative measures should take notice of Mozambique, as it has such measures almost every sector, most notably in Agriculture, Infrastructure, Disaster Risk Reduction, and Community-Based adaptation. These measures are mostly geared towards floods and droughts, but other climate change threats are also discussed.

3.6 Myanmar

Introduction

Myanmar signed the Climate Change Convention (UNFCCC) in 1992, the year of its conception. It entered into force in 1995 and it also ratified the Kyoto protocol in 2005 (UNFCCC, n.d).

However, before 2010 Myanmar was an internationally isolated country ruled by the military. In 2010 the government transitioned into a multi-party democracy which held general elections in 2015. These were recognized as free and fair (OECD, 2016). The political change induced what the OECD (2016) calls a "triple transition" process: the political transition (more civil rights), the economic transition (introduction of the market economy) and the transition into peace (Myanmar had many conflicts along its borders and within).

The progress of the country since 2010 has been described by the OECD as "remarkable". Nevertheless, the biggest income generating sector that also employs the most people is still agriculture which is the place where modernisation starts according to the OECD (2016). However, this modernisation is at risk due to CC.

After the political transition Myanmar's send its first national communication to the UNFCCC. The Ministry of Environmental Conservation and Forestry (2012) states that it expects a temperature in increase of 1.4-1.7°C and a precipitation shortfall of up to 80% in the cool months from December to February between 2020 and 2050. Furthermore, cyclones, floods, intense rain, extreme day temperatures and sea level rise are identified as natural hazards that are likely to intensify in frequency and magnitude due to CC.

In the mega-delta of Myanmar, domestic rice production provides the backbone of food security (Wassmann et al., 2009). The rice production has been identified to be at risk by extreme heat during sensitive rice plant-development stages (the month before and the month of the respective harvest). Some parts of Myanmar are already experiencing marginal temperatures for rice production of 36°C during March-June which marks the period before the harvest of the dry-season crop.

The problem is aggravated by the expected increase in droughts which impacts rainfed rice fields. However, in the highly productive delta regions, rice production is impacted most by salinity and flooding. This is worsened by an increasing frequency of storm surges and sea level rise due to CC (Wassmann et al., 2009). The extreme rainfall events in Asian mega-deltas together with often insufficient or missing drainage causes "serious water logging and sometimes complete submergence" of the rice crop (Wassmann et al., 2009).

The expected impacts of CC and Myanmar's dependency on agriculture require urgent action. Nevertheless, we were only able to identify projects for the LL and for the KWS from 2008. The number of projects and publications has been increasing after but it still remains low. The number of projects for the LL and the number of publications in all databases for the KWS are the lowest for all eight Delta Coalition countries.

Keyword Search Myanmar

Of all eight countries in this review of CCA adaptation options, Myanmar shows the lowest number of publications in the Web of Science Core Collection (WoS-CC) (16) and the WUR Library Peer (~4600). However, as stated earlier, the WUR Library always returns many more results than relevant. Therefore, this high number of publications in the WUR Library distracts from the fact that there are not yet many studies on Myanmar and CCA. In fact, publications in the WoS-CC about CCA in Myanmar only start from 2008 (Figure 3.6.2) and has been increasing since but remains on a low level. While an upward trend of publications is visible it is not a significant exponential increase (R^2=0.32).

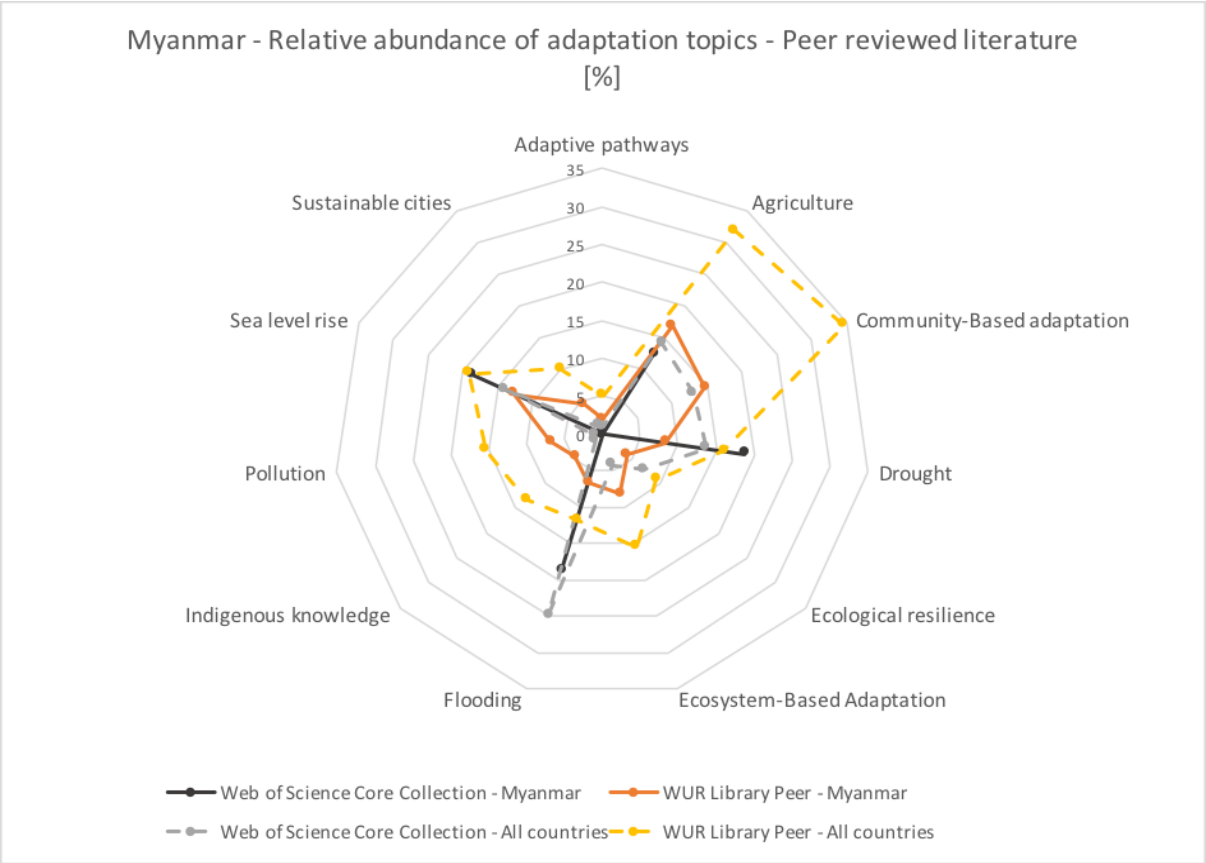

Figure 3.6.1 This radar shows the relative contribution of adaptation topics to the overall keyword search results of "Climate Change Adaptation Myanmar" in comparison to average values for all countries. Only the results for the WoS Core Collection and WUR Library Peer are shown.

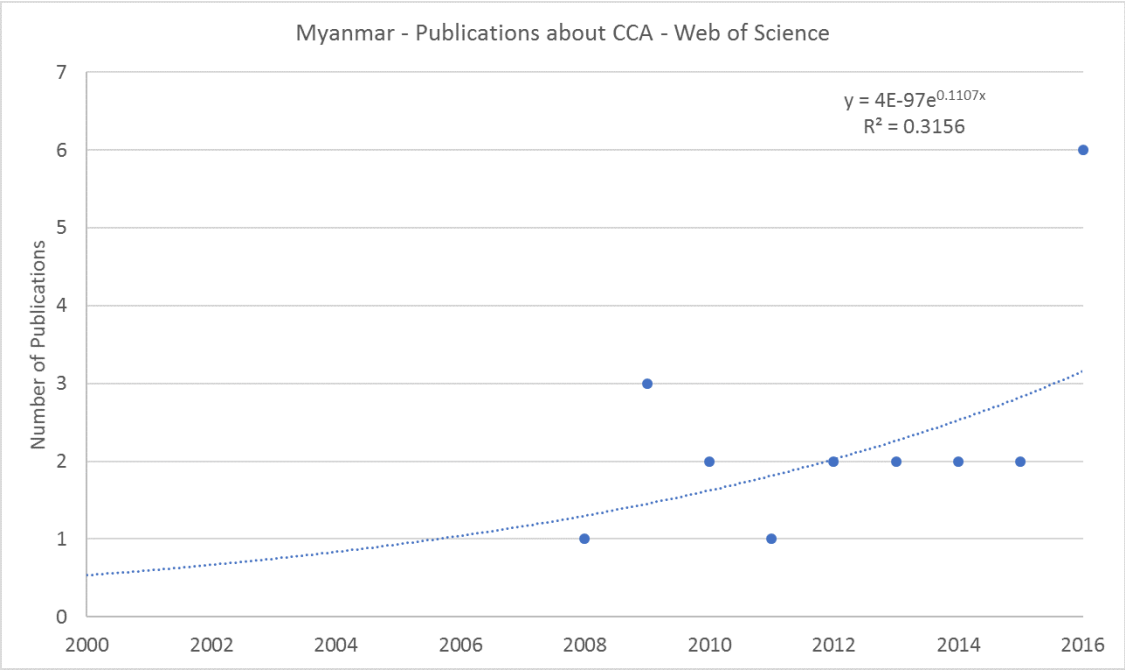

Figure 3.6.2 The graphs shows number of articles about CCA in Myanmar per year of publication in the Web of Science. The search was done with the keywords "Climate Change Adaptation Myanmar" on the 30th of May 2017. While 2017 already showed 3 publications about the topic they were left out due to the ongoing year.

The low number of publications also impacts the relative importance of adaptation topics in the literature. The WoS-CC shows only 4 topics of importance in the literature: Agriculture, Drought, Flooding and Sea Level Rise. Three of these are climate change threats that were also reported by the Ministry of Environmental Conservation and Forestry (2012) to the UNFCCC. Agriculture, as the most important economic sector is the only other topic present in the WoS-CC. Other potentially important adaptation topics like ecosystem-based adaptation are not present. This may be caused by the low number of publications about CCA Myanmar or because we missed a an important keyword for Myanmar in the KWS. This is likely as the values of the four topics do not equal 100%.

The WUR Library Peer search result for Myanmar follow mostly the relative importance of CCA topics of all countries with significantly lower percentage values. We think this may be caused by most of the search results returned for "climate change adaptation Myanmar" not being connected to the other keywords such as agriculture and community-based adaptation. For the other seven countries in our study this effect was not observed. However, they all show several times the search results of Myanmar in the WoS (Fig. 3.6.1). Due to this described effect and bias we are not further interpreting or using the results of the WUR Library Peer in the country analysis of Myanmar.

Longlist (LL) analysis

LL Myanmar - General information

We identified 15 climate change adaptation (CCA) projects for Myanmar from different databases which is the lowest number of projects we collected for all eight countries of the Delta Coalition. Most CCA projects were collected from Web of Science (27%), Prevention Web (20%), UNEP (20%) and UNFCCC (20%). For 9 of these projects we identified in detail the underlying adaptation practices.

LL - CC threats to Myanmar

The CC threats identified by The Ministry of Environmental Conservation and Forestry (2012) are cyclones, floods, intense rain, extreme day temperatures, sea level rise and droughts. The projects in our long-list identified increasing temperatures (20%) and droughts (13%) as climate change threats (Fig. 3.6.3). However, the largest share of projects was classified as Multiple Threats (46%) which refers to general impacts the country faces under CC. We used Multiple Threats to describe CCA projects that target multiple sectors and the national level. That there are no projects that exclusively deal with floods and sea level rise. This may firstly, be caused by Multiple Threats including the missing expected impacts such as flooding & sea level rise and secondly, by the small sample size of 15 projects.

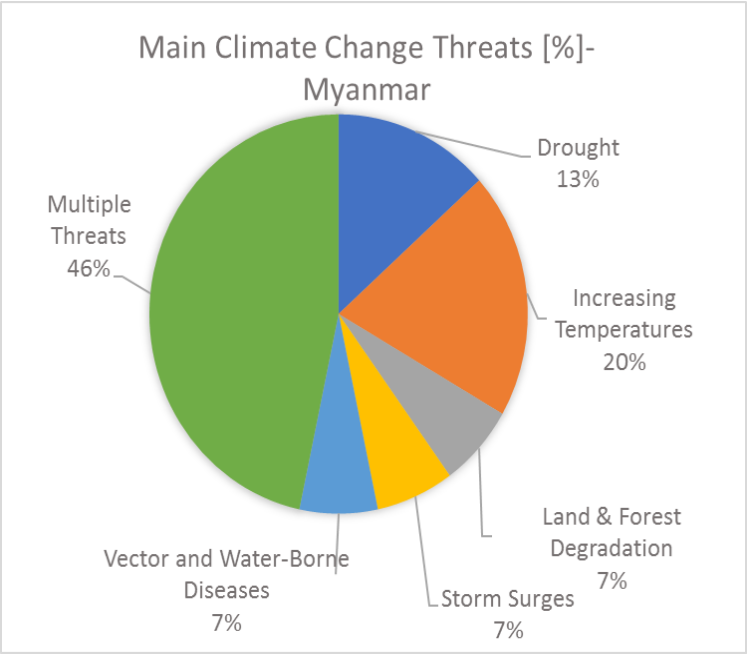

Figure 3.6.3: Main CC threats to Myanmar targeted by the projects of the LL. Multiple threats describe several CC threats with no clear prioritization and can be understood as a representative mix of the relevant CC threats to Myanmar.

Adaptation Elements Myanmar

The Adaptation Elements in Myanmar are focused on Science & Research (>30%), followed by Policy Development (20%), Technical Support (13%) and Education/Training (13%) (Fig. 3.6.4).

Considering that the largest share of our project in the LL stem from the WoS these results are not surprising. It was very hard to find projects in the CCA databases about Myanmar. As stated earlier, our LL shows a peak of CCA projects in the time of 2008 to 2011 which we think this is due to the databases not being kept up-to-date anymore. An alternative to these databases for South-East Asia including Myanmar is SEARCA (Southeast Asian Regional

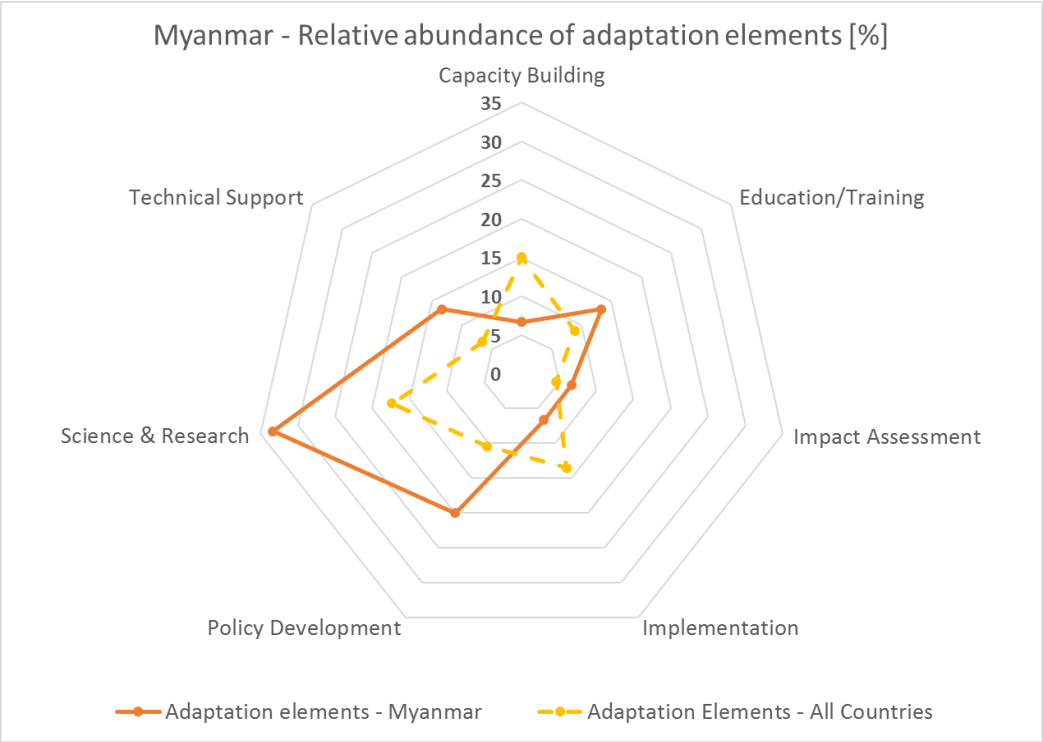

Figure 3.6.4 Relative distribution of Adaptation Elements for CCA projects in Myanmar in comparison to the average values from all countries. Adaptation Elements with values >3% are not shown in this graph. The full list is included in the Appendix.

Center for Graduate Study and Research in Agriculture). SEARCA is a knowledge center in the region (including Vietnam and Indonesia) that actively collects adaptation experiences for agriculture. The restricted time of our review did not allow for a deeper study of the database but we took in CCA options from one project into our LL to illustrate its strength in the field of CCA for agriculture. CCA options from SEARCA are e.g. growing sticky rice (*Oryza sativa* var. *glutinosa*) as a summer crop to help rice farmers cope with salt intrusion and the salt water seed selection technique.

There are more indicators that Myanmar just started off with its CCA effort other than a lack of projects and scientific publications. Next to science & research lot of effort is put into policy development e.g. for the National Adaptation Plan of Action to the UNFCCC. Education/Training is required for CCA and represents in our LL e.g. the already mentioned SEARCA project which aims at local farmers to increase productivity and resilience against droughts. Another prominent sector is Technical Support which helps farmers to improve water storage & use, provides drought resilient crop varieties and helps to create risk hazard maps for townships.

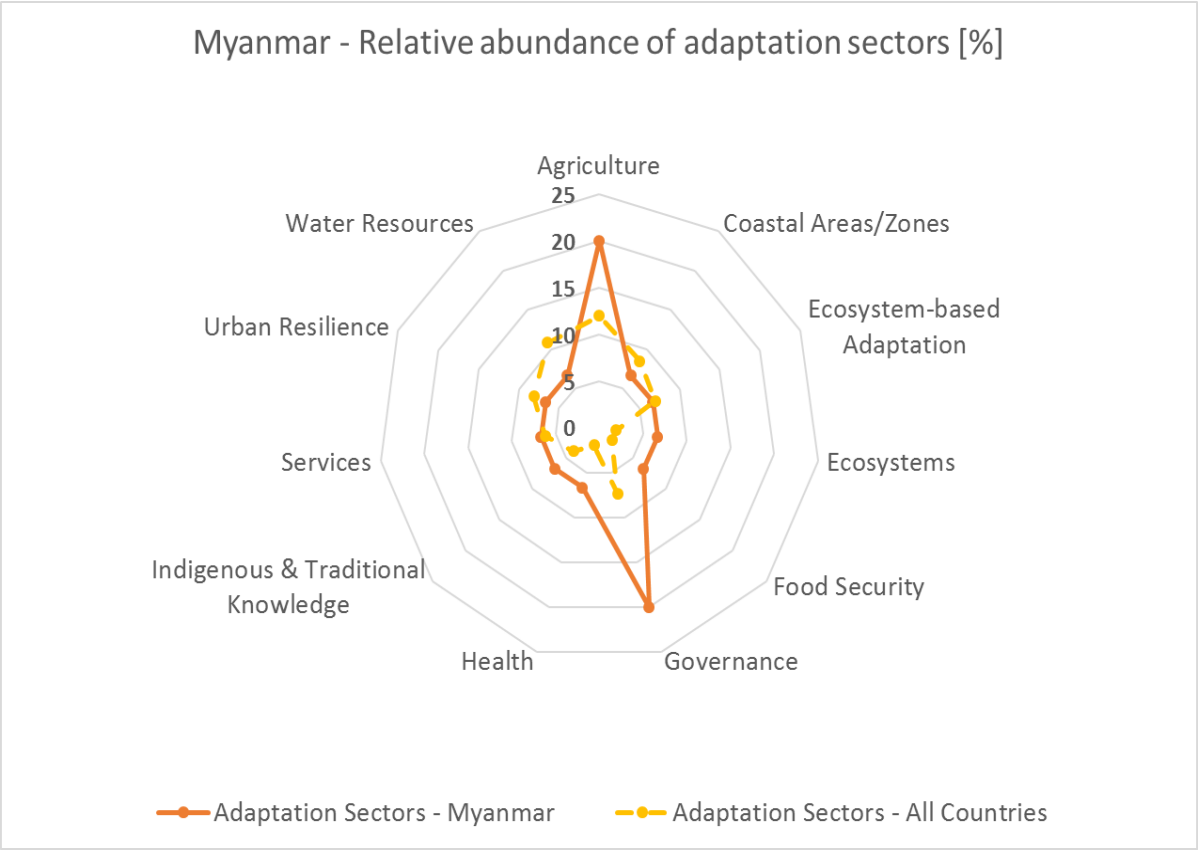

Figure 3.6.5 Relative Distribution of Adaptation sectors in Myanmar in the LL. Projects that applied to more than one sector were classified with the most relevant sector to the adaptation option pursued in the project. Most projects applied to more than one Adaptation sector. Adaptation Elements with values >3% are not shown in this graph. The full list is included in the Appendix.

Adaptation Sectors Myanmar

The most abundant adaption sectors in the LL are Agriculture (20%) and Governance (20%) (see fig. 3.6.5). This echoes the findings in the KWS were agriculture was the only present topic other than CC threats. Governance as a sector was usually chosen together with the Adaptation Element Policy Development. The most common Adaptation Element to the sector Agriculture was Science & Research that identified CCA options to improve agricultural production and increase resilience against climate change. Notably, the sector infrastructure is not present in our projects despite the fact that improved drainage and polders are used to adapt to flooding and storm surges in other countries that have similar problems (e.g. Bangladesh).

CCA Options Myanmar

The following list contains a synthesis of all CCA options in Myanmar. Similar adaptation options were frequently practiced in multiple projects, yet will only be named once in the following overview.

Adaptation options according to our data collection for Myanmar in the long-list focus mainly on Agriculture and Governance.

One study from the WoS, Wassmann et al. (2009), studied the regional vulnerability of rice production to CC impacts in Asia with a focus on the mega-deltas in Myanmar, Bangladesh and Vietnam and potential CCA options. As CCA option the authors propose to adopt practices from Iran and Australia were extreme heat is already present. Flooding, its duration, the conditions of the flood water and the point at which it occurs during the development stage of rice and its genotype require the development of rice varieties that are able to withstand these severe

conditions (Wassmann et al., 2009). While a few rice varieties exist that able to withstand these conditions they are low-yielding.

Blankespoor (2017) identified Myanmar as at further risk from storm surges when mangrove loss proceeds in the future as expected. Despite its importance for coastal protection, mangrove protection/replantation is not present in the compiled list of CCA options.

Agriculture

- Growing sticky rice (*Oryza sativa* var. *glutinosa*) as a summer crop to help rice farmers cope with salt intrusion
- Community-based agroforestry to conserve soil & water
- Use of drought-resilient crop varieties, genotypes with shorter growing season and conservation agricultural practices
- Improving pest management: e.g. "Lay Yin Pyan Knife" (known as the airplane-shaped weeding harrow) against weed infestation of crops as an alternative to chemical pest control
- Diversification of crops / diversification of livestock production to buffer effects of flooding and droughts
- Changing the timing of planting
- Employ resource saving technologies (RCTs): Zero tillage, Laser-aided land leveling, Direct drill seeding of rice, Diversification, Raised-bed planting, Leaf color chart for N management
- Training & education of farmers on effective farming practices to increase productivity (harvest two crops instead of one):

1. Salt water seed selection technique: This method of soaking rice seeds in a salt water mixture and selecting those that sink to the bottom for sowing is simple and cost-free, resulting in healthy crops and a yield increase reportedly averaging 10 – 15%
2. Sow rice seeds systematically at a specific width apart (as opposed to just scatter the seeds
3. Awareness raising about the disadvantages of using chemical fertilizers, which speeds up growth but depletes the land in the long run

Water resources

- Enhance water capture (rainwater, harvesting) & storage
- Tube wells
- Improve water management: e.g. altering irrigation regimes together with earlier plantation of crops to reduce water use
- Protecting & rehabilitate 4,200 hectares of micro-watersheds through Farmer-Managed Natural Regeneration strategies

Disaster Risk Reduction (DRR)

- Development of climate hazard maps and risk scenarios in each township
- Early warning systems including support and communication of risk management planning & preparedness

Awareness raising/ indigenous knowledge

- Training of journalists to cover CC to raise awareness of the public to CC
- Implementation of climate risk information centers
- Indigenous knowledge to predict weather based on plant species and animal behaviour as well as natural phenomena (the authors provide a detailed list)
- Harnessing the indigenous technical knowledge of farmers

Livelihood Security

- Diversification of income by introducing multiple income generating farms (e.g. using agroforestry)
- Better weather forecasts and crop insurance

Science & Research

- Evaluation of flood protective service of coastal mangrove forests under CC scenarios; biggest threat is loss of mangrove forests
- Development of the "Online Ecosystem Value Estimator" tool
- Bayesian Belief Network (BBN) to estimate probability of occurrence for certain events under different management scenarios, which delivers decision making assistance for adaptation planning
- Harnessing the indigenous technical knowledge of farmers

Infrastructure

- Provision of post-harvest processing & storage systems for safe handling of agricultural produce during extreme climate events

Institutions

- Translating National Adaptation Plan of Action (NAPA) to the UNFCCC into local policy & action plans (as that is where adaptation is accomplished

Country summary

The main climate change threats identified by our longlist for Myanmar are, besides 'multiple threats', increasing temperatures and drought. The main climate change adaptation elements in Myanmar are science & research, policy development and education and training. In a similar fashion as Egypt, this can be explained by the fact that the country is still in the beginning phase of implementing adaptation options and there is still need for identification and exploration of data, as well as a need to train and educate people about climate change adaptation. The main CCA sectors in Myanmar are agriculture and governance.

3.7 The Philippines

Introduction

The Philippines is an island country located in the tropical region, consisting of 5100 Islands. It has a strongly monsoonal climate. Its strong industrialization at the end of the 20th century has brought economic growth, but also had a negative impact on the environment. One example of this is that the important river Pasig was so heavily polluted for a while that it was not navigable anymore, and it took great clean-up efforts to restore it to a navigable state. There are several other important rivers in the Philippines, Cagayan, Agno, Pampanga, and Bicol on the island of Luzon and the Mindanao and Agusan on Mindanao. (Britannica, N.D.)

The Philippines were among the first nations to ratify the UNFCCC (1994), the Kyoto Protocol (2003), and to send their initial national communication to the UNFCCC (2000). In its second national communication to the UNFCCC in 2014, the Philippine government states that the most important climate change impacts to its country are increased intensity of tropical cyclones, which causes floods and landslides. Also it is expected that the monsoon will become more active, resulting in more rainfall in the wet season (Philippine Government, 2014). These threats are then even exacerbated by the extreme drop in groundwater levels, which have dropped by 20 to 50m in Manila (UNESCO, 2012).

Keyword Search Philippines

The keyword search (KWS) in the peer-reviewed literature highlights several topics that are more relevant for the Philippines than for the average of all countries (Figure 3.7.1). Especially Community-Based Adaptation and to a lesser extend Ecosystem-Based Adaptation are of interest to the scientific community. Interesting to see is that in the Web of Science Flooding and Agriculture are of significantly less importance than in the overall keyword search whereas in the WUR Library they are of higher and equal importance to the overall keyword search respectively.

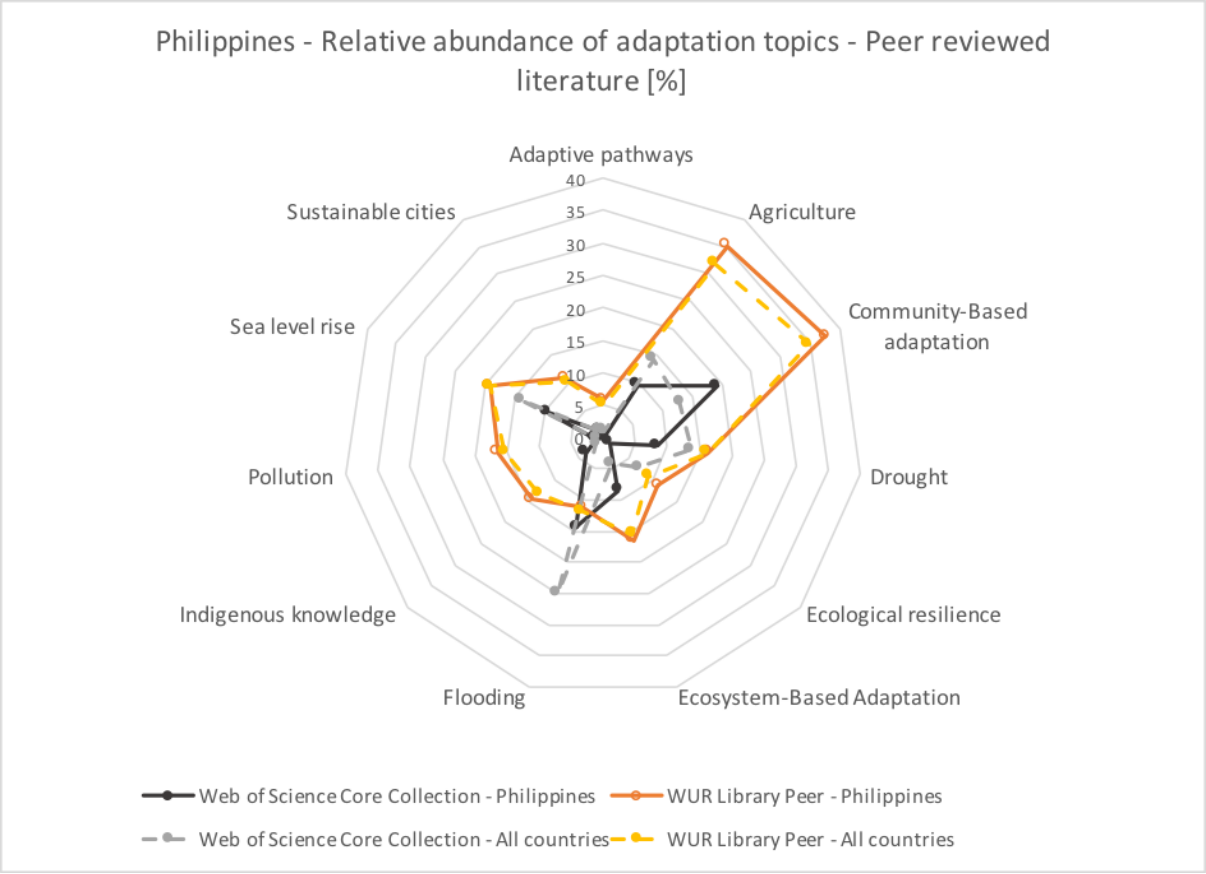

Figure 3.7.1 This radar shows the relative contribution of adaptation topics to the overall keyword search results of "Climate Change Adaptation Philippines" in comparison to average values for all countries. Only the results for the WoS Core Collection and WUR Library Peer are shown.

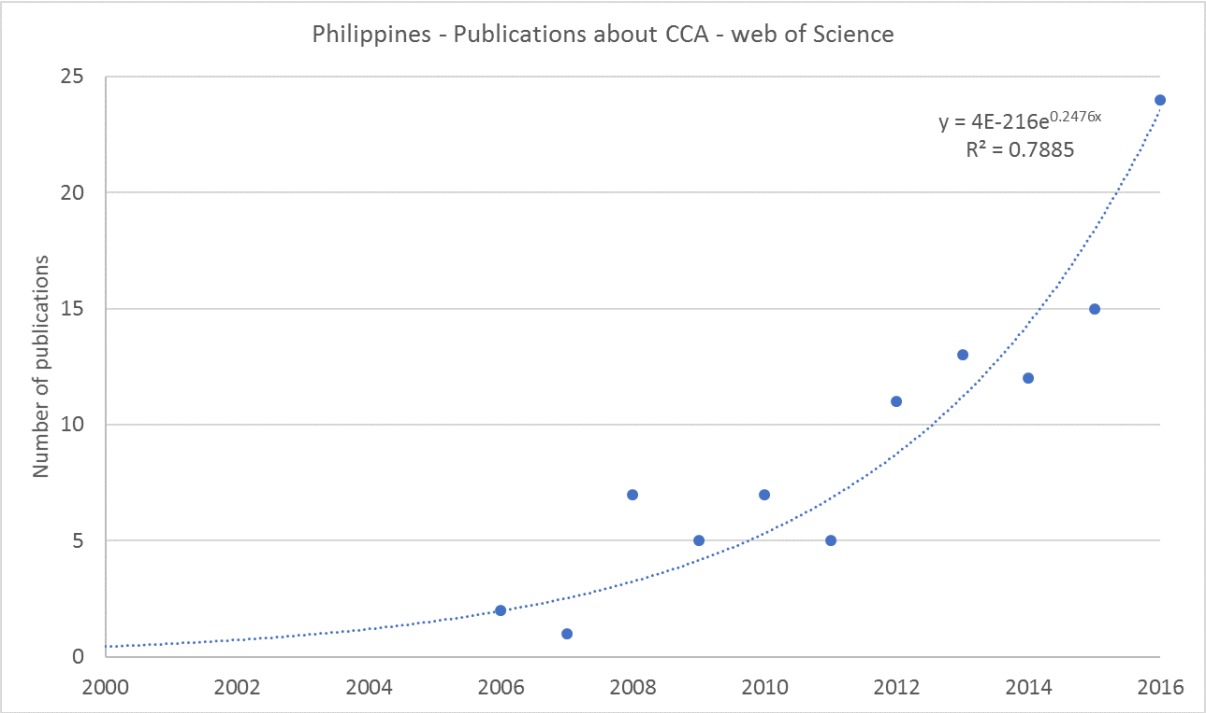

Figure 3.7.2 The graphs shows number of articles about CCA in Philippines per year of publication in the Web of Science. The search was done with the keywords "Climate Change Adaptation Philippines" on the 30th of May 2017. While 2017 already showed 4 publications about the topic they were left out due to the ongoing year.

Longlist (LL) analysis

LL Philippines - General information

We identified 28 climate change adaptation (CCA) projects for the Philippines from different databases. Most CCA projects were collected from Adaptation Learning Mechanism (37%), Prevention Web (26%), Web of Science (15%) and Asia-Pacific-Adapt (11%). For 17 of these projects we identified in detail the underlying adaptation practices.

LL Philippines - Climate Change Threats

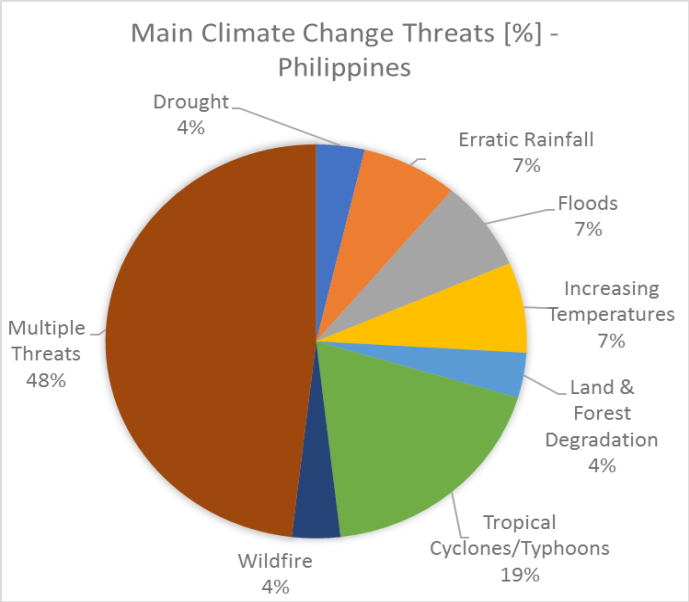

Figure 3.7.3: Main CC threats to the Philippines targeted by the projects of the LL. Multiple threats describe several CC threats with no clear prioritization and can be understood as a representative mix of the relevant CC threats to Philippines.

In our results we can see that the spread is quite well reflected in our database, with the largest threat being tropical cyclones, then erratic rainfall, floods, and landslides. However more than half of the projects deal with multiple threats. Surprisingly, although the Philippines is an island nation, sea level rise is not mentioned as a prominent threat in the national communication and also isn't an important aspect of the projects that we found in our long-list.

Adaptation Elements Philippines

The largest amount of projects in the Philippines are in the field of Implementation (22%), Education/Training (15%), Vulnerability Assessment (11%) and Policy Development(12%) (see fig. 3.7.4).

Education and Training is provided relatively often in the Philippines, whereas Capacity Building (7%) is done relatively little. These are quite closely linked, but there is a clear difference between them. Where Education/Training teaches people to use a certain type of method (e.g. micro-economic accounting), Capacity Building is more broad and system focused (e.g. a comprehensive set of measures and trainings) aimed at making sure an organization or community can develop the process itself. In the Philippines there seem to be more projects aimed at teaching specific scales than more broad developing projects.

Implementation (22%) has the largest amount of projects, most of them targeted at Tropical Cyclones. Philippines may therefore have stronger knowledge on implementation of cyclone protection measures both infrastructure-based and ecosystem-based.

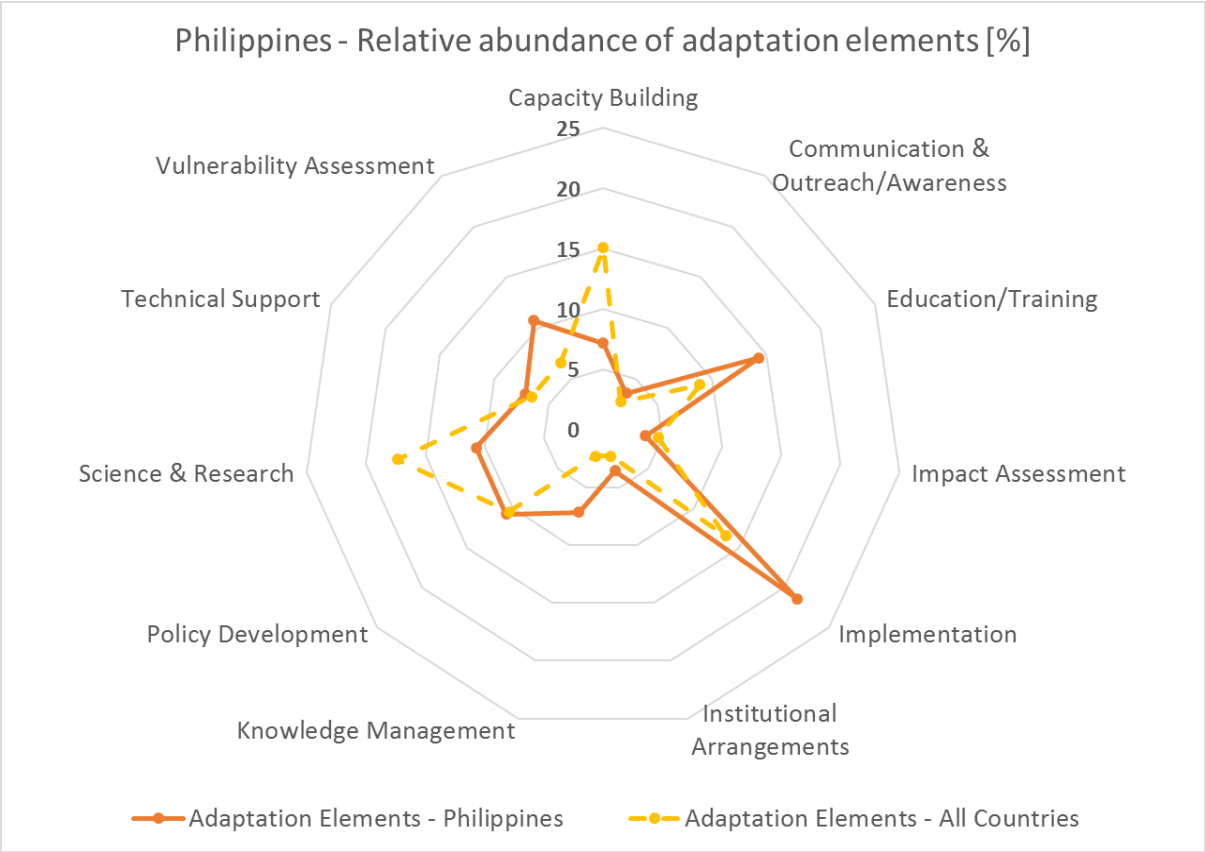

Figure 3.7.4 Relative distribution of Adaptation Elements for CCA projects in Philippines in comparison to the average values from all countries. Adaptation Elements with values >3% are not shown in this graph. The full list is included in the Appendix.

Adaptation Sectors Philippines

Disaster Risk Reduction (DRR), Ecosystems and Agriculture are the three main adaptation sectors, each contributes to 15% of the projects (see fig. 3.7.5). DRR is a response to the largest climate change threat to the Philippines, namely Tropical Cyclones. Ecosystems normally is not a main adaptation option, but it is in our longlist, which is mostly due to several projects that target the Coral Triangle between the Philippines, Indonesia and Malaysia. Agriculture is still quite important for the livelihoods of many Philippine citizens and this is reflected in the amount of projects that deal with the topic.

There are some Community-based (11%) and Ecosystem-based (7%) Adaptation projects in the Philippines, and an interesting approach was taken on community-based fire management.

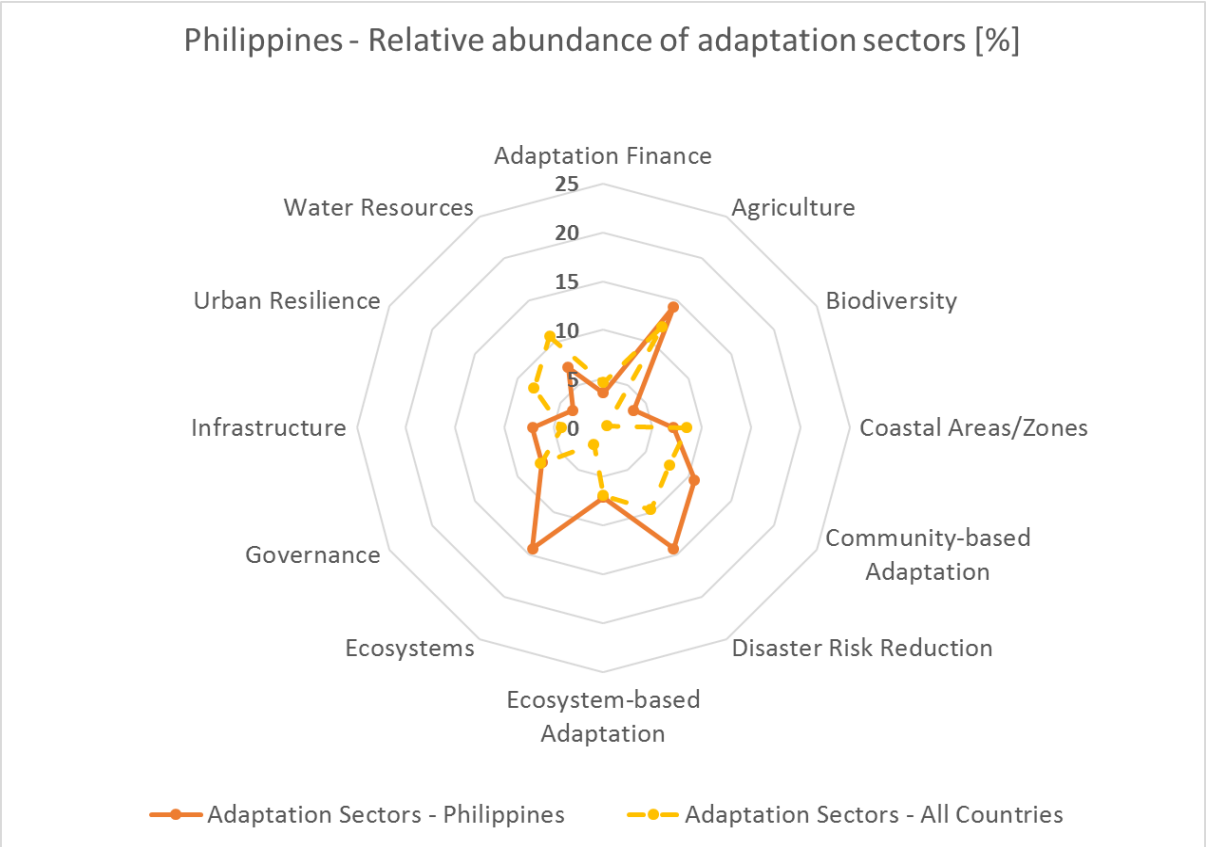

Figure 3.7.5 Relative Distribution of Adaptation sectors in Philippines in the LL. Projects that applied to more than one sector were classified with the most relevant sector to the adaptation option pursued in the project. Most projects applied to more than one Adaptation sector.

CCA Options Philippines

The following list contains a synthesis of all CCA options in the Philippines. Many options were implemented more than once, but only unique measures are listed.

Adaptation options according to our data collection for Philippines in the long-list focus mainly on Agriculture, DRR and EbA, reflecting the results from the Adaptation Sectors (Figure 3.7.4.). The following list of practices include indigenous and traditional knowledge but these CCA options are not separately marked.

Agriculture

- Green farming practices at municipality level
- Drought/ flood tolerant crops e.g. rice
- Tested pilot scheme of crops mechanism
- New Farming techniques e.g: Resource-Conserving Tech. (RCTs)
- Crop diversification
- Pest management
- Crop management practices

Water resources

- Water management improvement

Disaster Risk Reduction (DRR)

- Early Warning System / Disaster Management Centre

- Training of officials/ institutions in Disaster Risk Management
- Affected household relocation

Ecosystem-based Adaptation

- Mangrove afforestation, rehabilitation and conservation
- Upland reforestation

Livelihood Security

- Education & training of farmers
- Development of climate resilience and additional livelihoods, e.g: shell-craft, screw pines handicraft, soil conditioner of shore-swept seagrass and household waste, heavy rainfall and drought-facing innovations, and mobile gardens
- Home-based weather station system
- Local actors capacity building/training
- Learning by doing promotion
- Women empowerment
- Weather forecast and crop insurance

Science & Research

- Education and training of local researchers
- Scientific climate risk management
- Climate forecast application
- Loss and Damage / exposure area of increasing temperature assessment
- Evaluation of flood protective service of coastal mangrove forests under CC scenarios; biggest threat is loss of mangrove forests

Infrastructure

- Seawall, breakwater, dike/levee construction
- Riverbank rehabilitation

Institutions

- Financial investment e.g: Integrated Finance Package (IFP), Weather Index Based Insurance (WIBI)
- Coordination of CCA policy
- Development of local & national capacity
- Wildfire sanctions development

Country summary

The most important climate change adaptation sectors in the Philippines are Ecosystems, Disaster Risk Reduction and Agriculture. The Philippines are characterized by coral reefs of high ecological value, which are threatened by increasing temperatures. In addition, agriculture is negatively influenced by increasing temperatures, as well as by droughts (lowering the groundwater level) and monsoons that are increasing in intensity. These factors are reflected in the most important climate change adaptation sectors in the Philippines: Ecosystems, Disaster Risk Reduction, and Agriculture. The most common way to solve the problems in these sectors is through implementation of measures, but education/training and policy development are also often used.

3.8 Vietnam

Introduction

As the country which has the second most publications about CCA in our long-list, Vietnam started to join the Climate Change Convention in February 1995. They also signed the Kyoto Protocol in December 1998, which was ratified in February 2005 (UNFCCC, n.d).

Vietnam lies in the Mekong Delta which is particularly vulnerable to the impacts of extreme climate events and climate variabilities. The Mekong Delta region is also home to one-fifth of Vietnam's population, and is therefore also marked as the area with the largest population density. This area is also known as 'the rice bowl' of Vietnam with approximately 10.000 km^2 of land under rice cultivation, which occupies 46% of total national food production. However, the Agriculture sector faces multiple burdens because they are often exposed to overlapping risks, of which one of them is climate change impacts (Garschagen et al., 2011) such as drought.

Several studies about climate change found that Vietnam also suffered from threats such as the increase of temperatures, annual rain, and depth-duration of floods, sea level rise, and salinity intrusion (MRC, 2009). Dasgupta et al., 2009 stated that about 7% of Vietnam's agriculture land may be submerged due to 1-m sea level rise. Moreover, the coastal and deltaic rice production areas in Asia are severely threatened by sea level rise (Wassmann et al., 2009).

Keyword Search Vietnam

The number of publications for "Climate Change Adaptation Vietnam" shows a strong exponential increase of publications over the past 15 years (R^2=0.76). Overall Vietnam shows the second most publications in the WoS and the 4th most in the WUR. The keyword search (KWS) in the peer-reviewed literature highlights several topics that are more relevant for Vietnam than for the average of all countries (Figure 3.8.1). Flooding and Sea Level Rise is more prominent in both databases than on average, which is to be expected looking at the climate change threats identified in the previous paragraph. Agriculture has also historically been an important topic in Vietnam, and is still subject of much scientific interest. Strangely for Community-Based adaptation, there are more results than average in the WUR Library but much less than average in the Web of Science Core Collection. The reason for this may have something to do with the fact that the WUR Library Peer takes into account more sources than the WoS, a.o. Books, and has in general a wider scope than the WoS (see chapter 2.1). The less than average representation of Community-Based Adaptation in the WoS indicates that it is underrepresented in the core scientific literature.

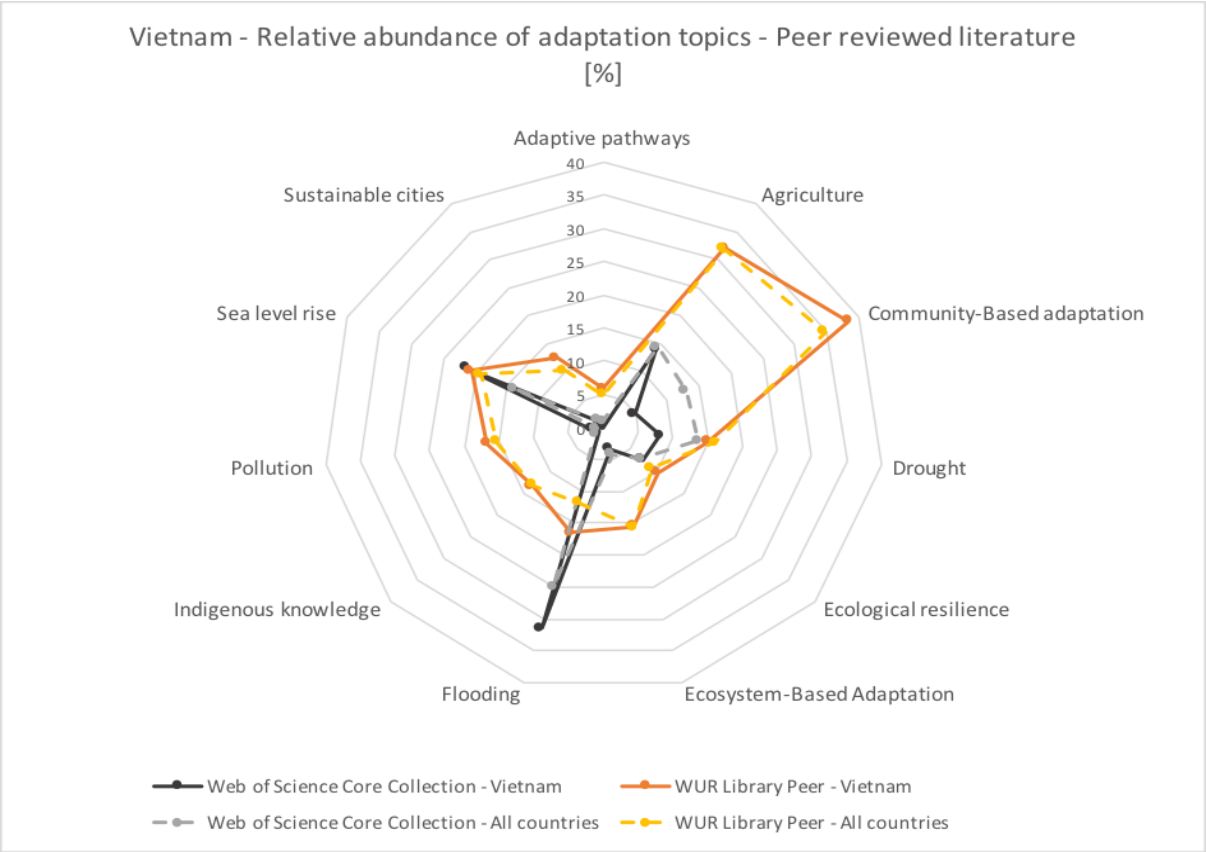

Figure 3.8.1 This radar shows the relative contribution of adaptation topics to the overall keyword search results of "Climate Change Adaptation Vietnam" in comparison to average values for all countries. Only the results for the WoS Core Collection and WUR Library Peer are shown.

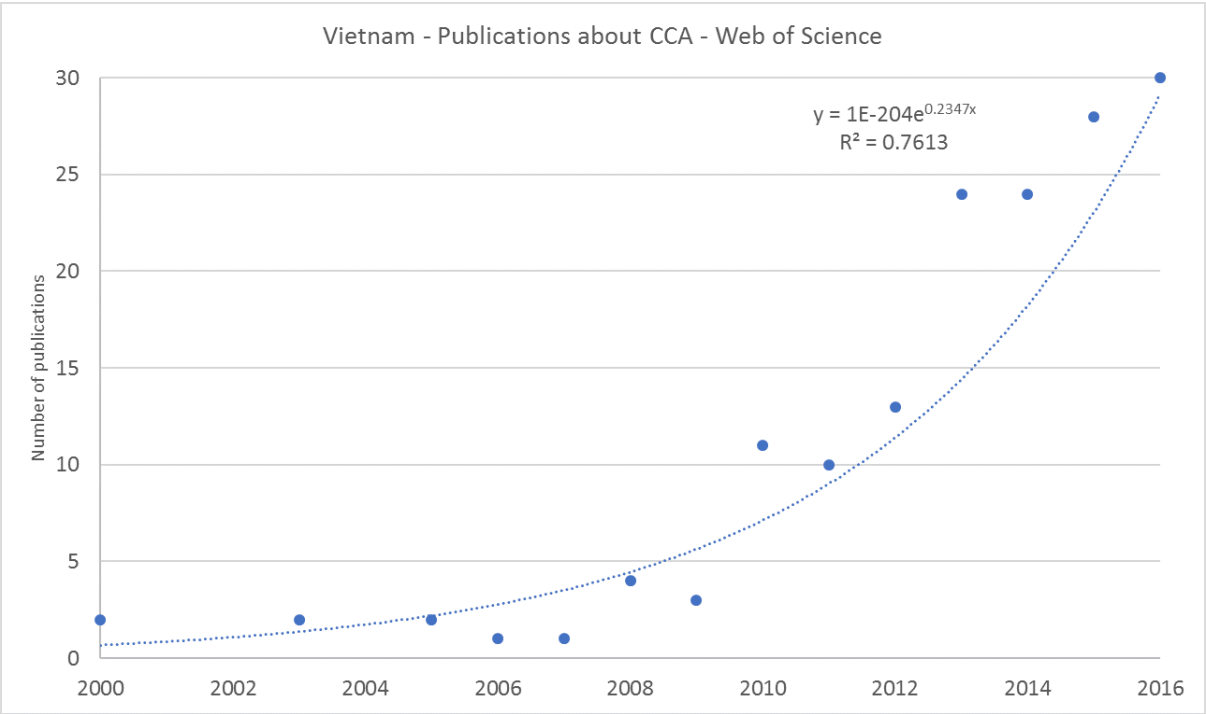

Figure 3.8.2 The graphs shows number of articles about CCA in Vietnam per year of publication in the Web of Science. The search was done with the keywords "Climate Change Adaptation Vietnam" on the 30th of May 2017. While 2017 already showed 14 publications about the topic they were left out due to the ongoing year.

Longlist (LL) analysis

LL Vietnam - General information

We identified 49 climate change adaptation (CCA) projects for Vietnam from different databases. Most CCA projects were collected from Prevention Web (34%), Web of Science (18%), UNFCCC (14%) and the Adaptation Learning Mechanism (12%). For 23 of these projects we identified in detail the underlying adaptation practices.

LL - CC threats to Vietnam

Vietnam's second national communication to the United Nations Framework Convention on Climate Change (UNFCCC) (2010) states that the main climate change impacts threatening the country are floods due to sea level rise and increase of precipitation in the wet season, rising temperatures, and a drastic drop in groundwater level after 2020.

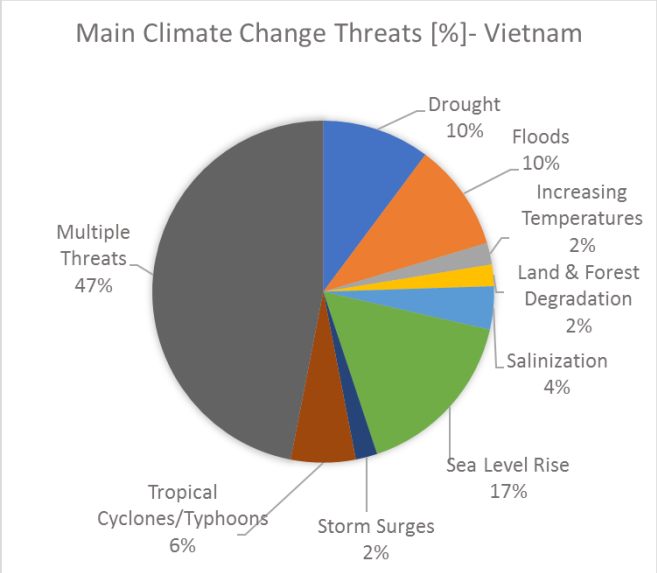

Figure 3.8.3: Main CC threats to Vietnam targeted by the projects of the LL. Multiple threats describe several CC threats with no clear prioritization and can be understood as a representative mix of the relevant CC threats to Vietnam.

The threats addressed in the longlist are mostly connected to sea level rise. Droughts and floods are both 10.2%, which is not really consistent with the findings in the national communication (2010) that does not specifically name droughts and calls floods the largest threat. Also rising temperatures are not a big subject in adaptation, with only one project specifically targeting this. However, these deviations can partially be explained by the fact that the climate change threats as identified by the literature often go hand-in-hand, and are therefore usually listed as 'Multiple threats' in our longlist.

Adaptation Elements

The largest amount of projects in Vietnam are in the field of Science & Research (22%) and Capacity Building (20%) (see fig. 3.8.4). To a lesser extend Implementation (10%) and Education/Training (8%) also play an important role.

Vietnam is a country that is a bit more developed than most countries that we assessed in this research. This may make it easier to conduct Science & Research in this country because for instance there are more local researchers with better connections to international research platforms. This may also be the reason why there is more Capacity Building in this area, many of

the projects that build capacity in Vietnam target already existing institutions, who need to incorporate adaptation into their agenda. In less developed countries these institutions may not be ready to incorporate climate change adaptation in their agenda.

Although there are just four policy development programs, these do seem to be cutting edge programs and would be interesting to take a look at. In contrast, there are more financial support programmes than on average, but these do not seem very innovative.

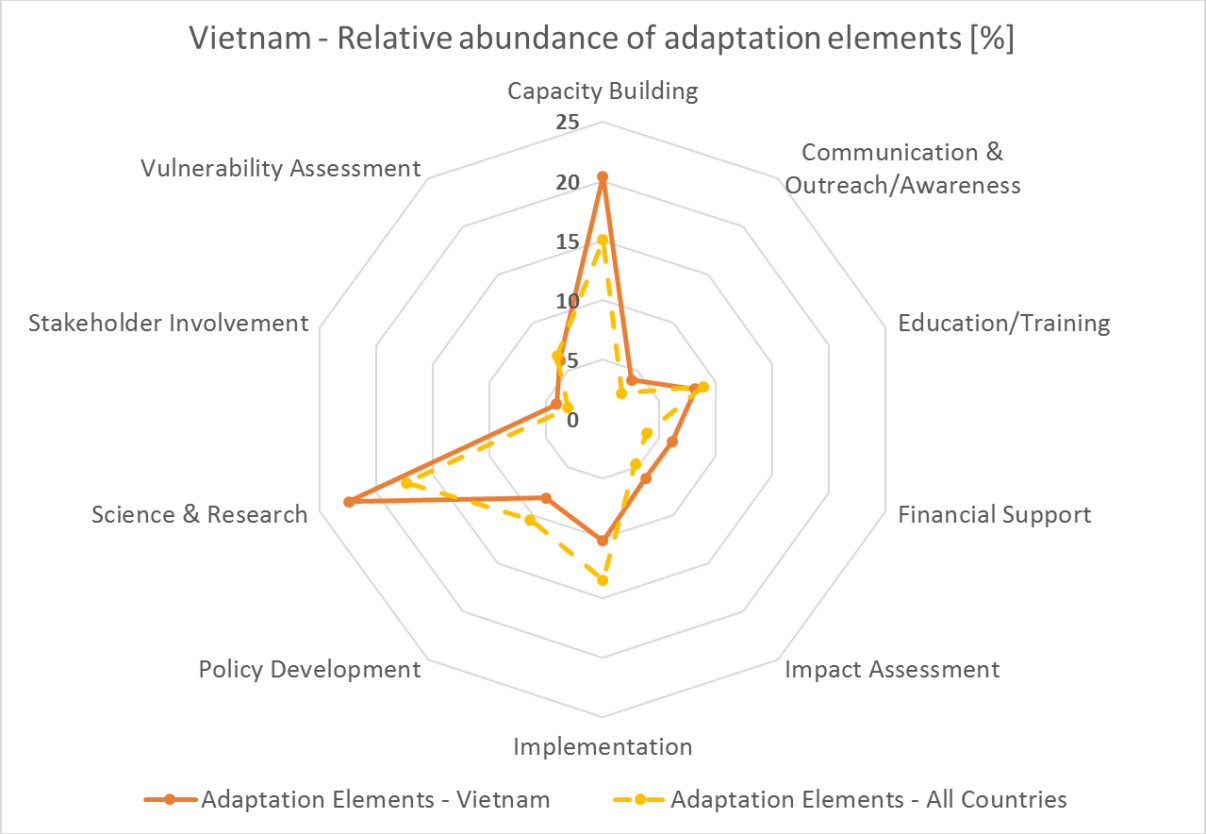

Figure 3.8.4 Relative distribution of Adaptation Elements for CCA projects in Vietnam in comparison to the average values from all countries. Adaptation Elements with values >3% are not shown in this graph. The full list is included in the Appendix.

Adaptation Sectors Vietnam

The main sector in Vietnam is the Water Resources Sector (18%). After that there is an equal distribution of projects between the Urban Resilience (10%), Services(10%), Disaster Risk Reduction(10%), and Coastal Areas (10%) sectors (see fig. 3.8.5).

From the projects listed in our database, Vietnam really seems to be a frontrunner in the field of adaptation in Water Resources. Ranging from projects like using wastewater for agriculture to artificially recharging groundwater aquifers to incorporating water resources into other policy domains.

In Coastal Areas the focus seems to be on information management, while in Disaster Risk Reduction the focus is more infrastructural. Urban Resilience projects in Vietnam are mostly small programs that focus on policy development and capacity building, but they do not seem very innovative.

Although only 8% of projects in Vietnam are infrastructural projects, they are very interesting. The Infrastructure projects are all quite comprehensive and have some innovations described in them.

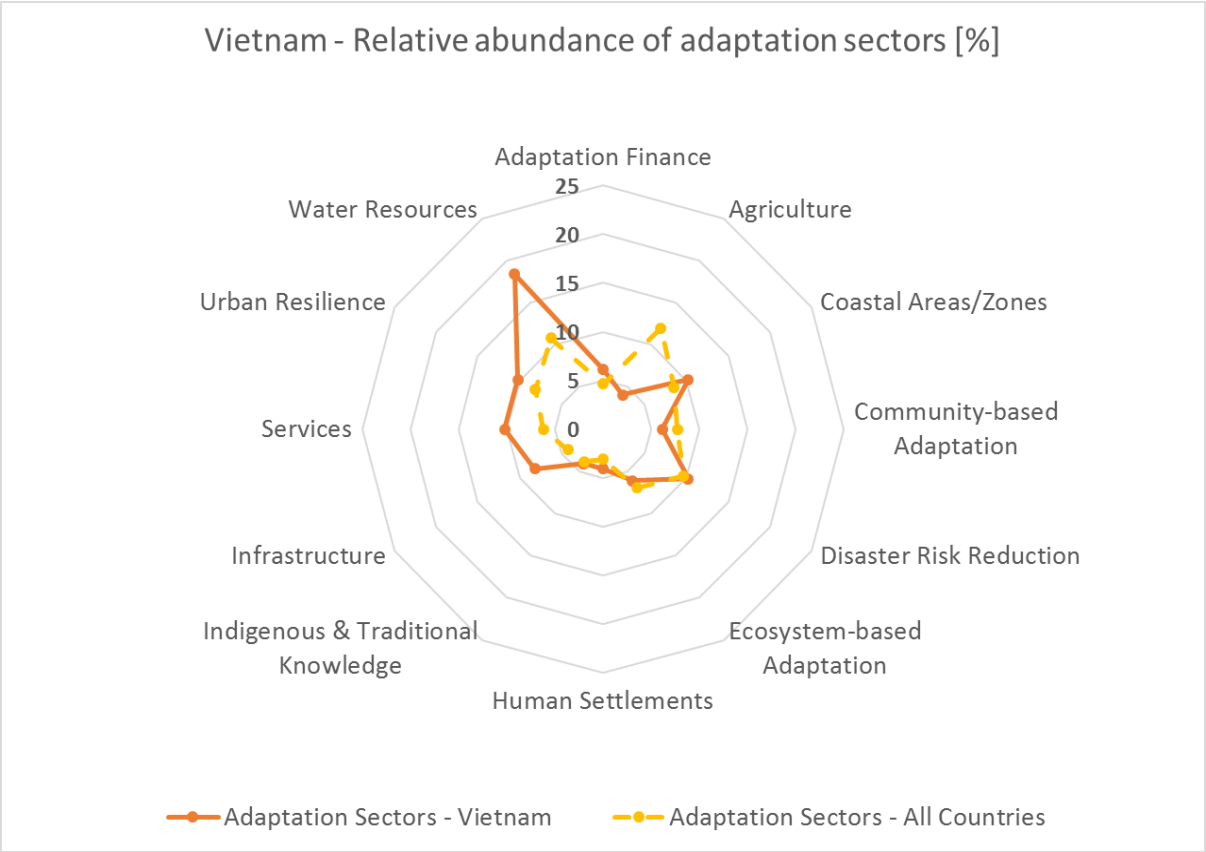

Figure 3.8.5 Relative Distribution of Adaptation sectors in Vietnam in the LL. Projects that applied to more than one sector were classified with the most relevant sector to the adaptation option pursued in the project. Most projects applied to more than one Adaptation sector.

CCA Options Vietnam

The following list contains a synthesis of all CCA options in Vietnam. Many options were implemented more than once, but only unique measures are listed.

Adaptation options according to our data collection for Vietnam in the long-list focus mainly on Agriculture and Water Resources followed by Disaster Risk Reduction and Ecosystem-based Adaptation, reflecting the results from the Adaptation Sectors (Figure 3.8.5.).

With respect to the two most common Adaptation Sectors in Vietnam, Trinh et al. (2013) in their paper found that wastewater reuse in the agricultural sector has good potential as a climate change adaptation strategy, which could be possibly applied to urban/per-urban areas of the Mekong Delta. These two sectors are also assigned in National Water Resources Council which Ministry Agriculture and Rural Development and other ministries with water-related responsibilities. They could manage public water service such as surveys, inventory, and assessment of water resources and implementation of measures to protect water resources. Therefore the suggested adaptation measure to reuse wastewater in the agricultural sector could possibly be listed in national projects.

The following list of practices includes indigenous and traditional knowledge and human settlements but these CCA options are not separately marked.

Agriculture

- Integrated farming system: horticulture, pisciculture, and animal husbandry
- Weeds prevention technique
- Regenerated Rice ratoon system
- Crop management practices
- Flood and drought tolerant rice varieties
- New Farming techniques e.g: Resource-Conserving Tech. (RCTs)
- Crop diversification
- Pest management

Water resources

- Artificial recharge of the local aquifer layers
- Monitoring of water quality
- Water / groundwater management strategies e.g: fresh water extraction
- Irrigation and drainage
- Improvement of sanitation
- Wastewater reuse
- Construction of fresh water supplying factory and water reservoirs

Disaster Risk Reduction (DRR)

- Disaster warning system
- Provision of temporary evacuation centre
- Periodic beach nourishment

Ecosystem-based Adaptation

- Rehabilitation & afforestation of mangroves (including replanting, nursery for propagation, and mangrove care)
- Upland reforestation
- Restoration of dune/wetland
- Awareness and capacity of mangrove forest

Livelihood Security

- Diversification / Change of livelihoods (limited firewood collection, honey production, seafoods harvesting)
- Women empowerment
- Water user associations
- Mapping interdependencies in coastal system

Science & Research

- Vulnerability / Environmental assessments
- Development of 3D modelling in geological, hydro(geo)logical, geotechnical sectors
- Financial support for science & research

Infrastructure

- Climate resilience infrastructure planning e.g: dikes, levees, flood wall/floodgates, riverbank, breakwater construction; tidal and saltwater intrusion barriers
- Low cost physical measures to rural infrastructure
- Road / bridge improvements
- Scour and bank erosion

Institutions

- Rural infrastructure policy and planning
- Increasing of communication between authorities and local communities
- Group benefit-sharing systems e.g: Integrate Learning Alliance
- Political agenda of fresh groundwater availability, salinization, and subsidence issues
- Pilot program of agriculture practices
- Assistance of adaptation planning network e.g: Bayesian Belief Network
- Stakeholder involvement including Awareness raising
- Transparency of cost and benefit
- Crop insurance
- Crop weather forecast

Country summary

The main individual climate change threats to Vietnam are sea level rise, floods, drought and salinization, although 'multiple threats' can be assigned to most projects. The main adaptation elements in Vietnam are science and research and capacity building. Publications about these elements also exceed the mean of the eight countries together. Vietnam's main adaptation sector as identified by our longlist is water resources, followed by urban resilience, services, DRR and coastal areas.

4. Conclusion

Our research contains a substantial language bias in the keyword search but also in the long-list. We were not able to incorporate publications in other languages than English, but there are many resources available in the local languages that could be consulted.

The WUR Library exhibits substantial biases, shown in the number of search results returned and its wide scope of included literature. However, it shows the local research focus of Wageningen University and Research such as the expertise in community-based adaptation and many publications about Egypt. The Web of Science discriminates more strictly according to the keywords and includes only results where all words are present. We therefore argue that the WoS gives a global overview of the state of and development of research about CC in all countries. From this follows that especially Mozambique, Myanmar and Colombia require more research.

Keyword Search

Increased attention for climate change adaptation

The number of scientific publications about climate change adaptation in the eight member countries of the Delta Coalition shows strong exponential growth (R^2=0.96) over the past 15 years. Asian countries exhibit the most scientific publications – with the exception of Myanmar which shows the least publications in all four databases – whereas Colombia and Mozambique are not well represented in the literature. Myanmar has only recently joined the international community after a political transition in 2010 which probably causes this low representation. Egypt is very well represented in the WUR Library, but not as much in the WoS. The high number of publications in the WUR Library about Egypt is probably due to the long-standing collaboration between the Netherlands and Egypt. However, in recent years Egypt experienced political unrest which could have contributed to less studies in the WoS (UNFCCC, 2010).

Climate change threats

The most important climate change threat for the delta countries as represented in the WoS was flooding, followed by sea level rise and drought. In contrast, the WUR Library showed another focus: the most prominent climate change threat was sea level rise, followed by drought and only then flooding. While we can not explain the difference between the databases, the IPCC report presents evidence that flooding is presently the prevailing natural hazard in coastal systems and deltas around the world, which will be exacerbated successively by sea level rise towards the end of the century (Wong et al., 2014).

Agriculture dominates the adaptation topics

The most important adaptation sectors in the WUR Library are, in order: Community-based Adaptation, Agriculture, Ecosystem-based Adaptation and Pollution. In the WoS, the results are similar, with the most important CCA sectors being Agriculture, Community-based Adaptation, Ecological Resilience and Ecosystem-based Adaptation. In both databases agriculture is one of the top sectors. This is consistent with evidence by given by the OECD (2016) and the IPCC (Burkett et al. 2014; Wong et al. 2014) and other authors (e.g. Wassmann et al., 2009) that agriculture is the most important economic sector in non-western countries which secures the livelihood of the rural population and the general food security.

Long-List

Adaptation projects increased over the past 15 years

We found a weak exponential increase of adaptation projects and publications about CCA options in our long-list over the past 15 years (R^2=0.66). The correlation is not very strong because there is a peak of adaptation projects in the period of 2008 to 2011. In more recent

years, the number of projects in our list increased again but this mainly attributable to contributions from the Web of Science. We attribute this peak not to a peak of actual adaptation projects in the countries of this review but to a biases in the databases. Most of the databases used in this review, and especially Prevention Web, do not provide up-to-date information. Many of the databases rely on submissions about projects like the UNFCCC Adaptation Knowledge Portal and others search for the information themselves. Therefore, the provided information does not represent a comprehensive list of adaptation options.

Highest number of CCA projects in Asia
Most projects – in order – were recorded for Bangladesh, Vietnam, Mozambique and Indonesia. Following the trend in keyword search, Myanmar has the lowest recorded number of projects. However, Egypt only has one more project also consistent with the publication trend in the Web of Science.

Climate Change Threats
The main climate change threats was Multiple Threats which was attributed to almost half of all projects. This generally describes a representative set of threats for the respective country. The second most important threat was floods followed by drought and sea level rise. We did not further discuss this together with the keyword search because our classification did give no opportunity to account for the individual threats of the Multiple threats.

Adaptation Elements
The most important adaptation element is science & research occupying 17% of total elements. Adequate adaptation needs to be informed by science and research to allow for the best possible outcome under uncertain impacts from climate change (Burkett et al., 2014).

Agriculture, as the most important adaptation sector in the long-list and topic in the keyword search, provides food security and livelihoods of the main part of the population in all studied countries. The OECD (2016) advocates that the agricultural sector is where modernisation starts that facilitates development in Myanmar. In Bangladesh the rise of agricultural productivity has increased the number of people able to afford flood proof housing. Olsson et al. (2014) also report that agricultural self-employed laborers are the only group that could benefit from rising food prices while all especially the urban poor would be negatively affected by projected rising food prices. This makes adaption in this sector vital to the population's well-being and security.

Capacity Building is the second most important element in the long-list. It is very important for governments and institutions to build the expertise necessary to incorporate CCA into the policy development. This goes along with another IPCC recommendation that CCA action should be integrated into existing institutions and plans (Burkett et al., 2014). It should also be noted that education & training accounts for only 9% of all projects in the long-list. The dissemination of knowledge is very important to built the adaptive capacity of local farmers and the rural population in general to cope and adapt to climate change.

Adaptation sectors
The most important adaptation sector is agriculture, followed by water resources, disaster risk reduction and governance. The maintenance and protection of water resources is vital in developing countries where groundwater provides affordable means to clean water and is exceedingly required for irrigation of crops. This extraction however brings about substantial subsidence in our reviewed delta countries, especially in Asia. Decreasing rainfall during the dry season and the shift of seasons exacerbate the pressure on water resources. Disaster risk reduction is vital in Southeast Asian countries that experience cyclones and storm surges on a regular basis. Governance is crucial, as it provides the framework for adaptation implementation. Together these sectors seem to reflect the dualism of adaptation and

development that need integration because without the other neither can be successful to increase resilience for people living in poverty (Olsson et al., 2014). If synergies between adaptation action and poverty reduction are not addressed properly the emergence of new poor people in both developed and developing countries is seen as likely, jeopardizing sustainable development especially in urban areas and some rural areas in Africa and Southeast Asia (Olsson et al., 2014).

Missing issues
None of the projects in the long list mention ocean acidification as a climate change threat that they are targeting. This is surprising because the Fifth IPCC report explicitly refers to ocean acidification as one of the main climate change threats, affecting coral reefs, fish production, and contributing to soil acidification, depleting agricultural productivity in coastl zones and areas (Wong et al., 2014).

Another missing issue regards water savings technology, which is available but employed almost nowhere except for Egypt. The expertise from Egypt could prove essential for adaptation to droughts in other countries.

Good Practices

Good practice guidelines
In this report we have established a list of good practice guidelines that have the ability to transform an adaptation measure into a successful one. We have distinguished between policy-process based and practice-process based good practice guidelines. Policy-process based good practice guidelines are concerned with guiding the process of the formation of adaptation policy, whereas practice-based good practice guidelines are focused on the guiding execution and implementation process of these measures.

Policy process-based good practice guidelines (derived mainly from UNFCCC documents) are the presence of, in random order: authority, stakeholder involvement, a road map, knowledge management, baseline establishment, a development-first approach, planning approaches, monitoring and evaluation, and finally a risk and vulnerability assessment.
Practice process-based good practice guidelines are the presence of actionable knowledge (a combination of multidisciplinary information and traditional knowledge), priority setting and finally multi-sectoral planning.

Good practices on adaptation options in deltas can be exchanged between delta countries/regions, as long as the context is taken into account. Countries and even regions vary greatly, not only geographically but also economically, politically and culturally. For successful transfer of adaptation elements this variability should be taken into account.

There are some most important take-home messages from the good practice analysis. One of them is the importance of integrating adaptation policy with development policy (the 'development first approach') in order to ensure coherency between adaptation efforts and broader sustainable development efforts. The tension between development versus adaptation is a problem that is flagged by the UNFCCC, UNDP, and the IPCC (Wong et al., 2014). Sometimes the climate change adaptation agenda and development agenda are conflicting. However neither can be successful if the other is not taken into account. Another note is to stress the importance of involvement of the (local) community in order to create conformity, compliance and goodwill of the society, as well as the ability to integrate long-standing traditional knowledge ('stakeholder involvement').

Limitations on the transferability of adaptation practices

The transferability of adaptation measures from one area to another is often not easy to realize (successfully) due the high contextual variability between countries. As an example, adaptation measures on crop diversification of agricultural production is limited in deltas. Diversification of crops is only possible in some specific areas and at specific times. For example, rice is the only crop that can be grown during the monsoon season (Wassmann et al. 2009). Therefore, climate change adaptation requires very specific responses in the local context that need to be informed by policy and science to prevent maladaptation

Adaptation requires investment and commitment by the international community to avoid maladaptation and provide possibilities for sustainable development. This is a void that can be filled by the Delta Coalition in the future by facilitating knowledge exchange about good and bad practices in climate change adaptation alike and provision of mutual assistance.

Table 1. Synopsis of the findings for each of the 8 individual countries.

Bangladesh	Drought and flooding are the most studied threats relative to the other countries. Stakeholder involvement, institutional arrangements, and community outreach are elements that are the subject of study more often compared to the other countries, which seem to correlate with the sectors Indigenous & Traditional knowledge and Ecosystem based adaptation. The most important adaptation elements in Bangladesh are science & research, capacity building and implementation. Finally agriculture and water resources seem to be very important sectors for adaptation in Bangladesh.
Colombia	Erratic rainfall is the most studied threat relative to the other countries. The main climate change threats in Colombia are erratic rainfall, floods and storm surges. Colombia does not seem very vulnerable to the impacts of climate change, and most climate change problems that are addressed in Colombia also have a strong human element. The main adaptation elements in Colombia are capacity building, policy development and impact assessment. The main adaptation sectors are governance and human settlements, again reflecting the human element that is present in the climate change problems in Colombia. As a practice, Silvopastoral farming is a topic that is more developed in Colombia.
Egypt	The main climate change threats in Egypt are drought, erratic rainfall, sea level rise and salinization. Especially sea level rise is the most studied threat compared to other countries. Results from literature seemed to comply with findings from our longlist. The main adaptation elements in Egypt are capacity building, science & research, monitoring & evaluation and vulnerability assessments. This can be explained by the fact that Egypt is currently facing many other struggles and adaptation planning is not the country's main priority. The projects that are running are more of inventorying and explorative nature rather than focused on implementing hard measures. The main adaptation sectors are community-based adaptation (which often goes together with capacity building) and water resources. Important adaptation measures are about diminishing leakage of water in agricultural irrigation systems to cope with diminishing water resources.
Indonesia	Indonesia suffers mostly from floods as the main climate change threat, which is also the most studied threat relative to other countries. After floods, sea level rise is the most important climate change threat to Indonesia. The main climate change adaptation elements in Indonesia are capacity building, policy development and implementation. Most strategies to adapt to climate change are related to the sectors of coastal zones/areas, urban resilience and agriculture. The most implementation practices focus on hard measures related to ecosystem-based adaptation. Building dikes, sea wall, and mangrove plantation are the most preferable measures in Indonesia coastal line.

Mozambique	Climate change adaptation projects in Mozambique address a range of sectors and climate change threats, and an extensive number of unique measures is employed towards adaption. The main climate change threat (besides 'multiple threats') in Mozambique can be assigned to floods, followed by drought. The main adaptation elements are policy development and implementation, which diverts from the results in the other countries. The main adaptation sectors are disaster risk reduction and governance. A reader interested in innovative measures should take notice of Mozambique, as it has such measures almost every sector, most notably in Agriculture, Infrastructure, Disaster Risk Reduction, and Community-Based adaptation. These measures are mostly geared towards floods and droughts, but other climate change threats are also discussed.
Myanmar	The main climate change threats identified by our longlist for Myanmar are, besides 'multiple threats', increasing temperatures and drought. The main climate change adaptation elements in Myanmar are science & research, policy development and education and training. In a similar fashion as Egypt, this can be explained by the fact that the country is still in the beginning phase of implementing adaptation options and there is still need for identification and exploration of data, as well as a need to train and educate people about climate change adaptation. The main CCA sectors in Myanmar are agriculture and governance.
Philippines	The most important climate change adaptation sectors in the Philippines are Ecosystems, Disaster Risk Reduction and Agriculture. The Philippines are characterized by coral reefs of high ecological value, which are threatened by increasing temperatures. In addition, agriculture is negatively influenced by increasing temperatures as well, as well as by droughts (lowering the groundwater level) and monsoons that are increasing in intensity. These factors are reflected in the most important climate change adaptation sectors in the Philippines: Ecosystems, Disaster Risk Reduction, and Agriculture. The most common way to solve the problems in these sectors is through implementation of measures, but education/training and policy development are also often used.
Vietnam	The main individual climate change threats to Vietnam are sea level rise, floods, drought and salinization, although 'multiple threats' can be assigned to most projects. The main adaptation elements in Vietnam are science and research and capacity building. Publications about these elements also exceed the mean of the eight countries together. Vietnam's main adaptation sector as identified by our longlist is water resources, followed by urban resilience, services, DRR and coastal areas.

5. Recommendations for further research

Based on the conclusions shown above and in the rest of the review, we would like to give the following suggestions for the Delta Coalition and for further research.

First that it should ensure further focus and exchange on Agriculture, since this is the sector that is most important for the livelihoods of local people and also the sector that is attracting most attention.

Secondly, we would like to suggest to improve the dialogue between member countries about their institutional arrangements, both to learn from each other and to ensure that adaptation options that work in one country don't become maladaptation in another.

Thirdly, where possible, long standing indigenous knowledge of local adaptation options should be sought out.

Fourth, further analysis of the long-list could reveal 'specialities' of specific organizations.

Fifth, this database can be used in the starting phase of a project to find organizations that did similar projects.

Sixth, it would be valuable to look further into regional adaptation databases such as SEARCA and WISDOM as they are better updated, and to have a someone who speaks the local language to look at local projects. This would help to overcome the predominantly western bias of our research as presented in this report.

Seventh, this database in combination with the series of recommendations from the literature synthesis, is the perfect base for an analysis of actual use of these recommendations in the field. This analysis can follow the methodology of Gruber et al. (2010).

Eighth, further analysis into the origins of the money for adaptation projects is an interesting topic for further analysis, to identify the motives of the largest sponsors.

Ninth, deeper analysis of adaptation initialised by business has promise to reveal some innovative adaptation measures. The public-private sector would be interesting to be analysed.

Tenth, the Delta Coalition should promote the sharing of bad experiences (and analysis of what has made them a bad practice), as they might be even more valuable for learning than good practises.

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Appendix

Appendix A: Keyword Search

Data collection

The data collection for the keyword search was done in the Reuters Web of Science (WoS) and the Wageningen University & Research (WUR) Library search engine.
The WoS focusses on peer-reviewed literature in accomplished journals which they call the WoS Core Collection. Additionally, they also provide the possibility to include a selection of other scientific databases into the search which is called the WoS All databases. The WUR Library search engine provides a wider scope than the Web of Science by including books, conference proceedings among others next to peer-reviewed scientific articles. Similarly, the WUR Library provides an extended search and a search that focuses on peer-reviewed literature.

As opposed to earlier plans, we could not use Google for the keyword search, as the search engine operators (e.g. the operator 'Allintext:') do not provide the possibility to exclude / include results definitively. This becomes clear when more results are found when additional words are added rather than that the number of results decreases. This unreliability makes a conclusive data analysis impossible.

For the identification of adaptation projects using WoS and the WUR Library we chose keywords focussing on adaptation in deltas, the water sector and popular concepts in adaptation such as ecosystem-and community-based adaptation. Furthermore, we added the terms project, options and practices to our search to get an indication of how relative abundance of these terms is in the literature per country. The complete list of 16 search terms can be seen in Appendix XX.

The search was conducted for the WoS Core Collection and the WoS All databases. For the WUR Library the result of the extended search as well as only the peer-reviewed literature was recorded. All in all we recorded the no number of results of 4 databases for 16 keywords.

1. Climate change adaptation + country
2. Climate change adaptation + country + delta
3. Climate change adaptation + country + agriculture
4. Climate change adaptation + country + flooding
5. Climate change adaptation + country + drought
6. Climate change adaptation + country + sea level rise
7. Climate change adaptation + country + ecological resilience
8. Climate change adaptation + country + sustainable cities
9. Climate change adaptation + country + ecosystem based adaptation
10. Climate change adaptation + country + community based adaptation
11. Climate change adaptation + country + indigenous knowledge
12. Climate change adaptation + country + pollution
13. Climate change adaptation + country + adaptive pathways
14. Climate change adaptation + country + project
15. Climate change adaptation + country + options
16. Climate change adaptation + country + practices

Appendix B: Long-list Methodology

In order to make our extensive longlist of data more searchable, the decision was made to reposition columns, add a new one ('Adaptation Sector/Theme'), and re-organize the content of the columns in a way that only the *main* adaptation measure, adaptation sector (new) and climate change threat were identified. These criteria form the basis of our country specific analysis and allow for intercomparison of the countries. The columns that were used for this more streamlined search were, in the right order: '*Country*', '*Starting year*', '*Size of Project*', '*Adaptation Elements*', '*Adaptation Sector/Theme*' and '*Main Climate Change Threat*' (Matrix 1, sheet 'Bangladesh'). This section will provide an explanation and justification of the chosen categories and their content (with an exception of country and starting year, as these are regarded as self-explanatory).

Size of Project

We have defined three categories for size: small, medium and large. The size of the project was preferably based on the available budget for the project (see the table below).

Size of Project	**Budget of Project**
Small	$ 4.0 million or less
Medium	$ 4.0 - 20 million
Large	$ 20 million and more.

Table 1: Justification of the size of the projects.

If monetary data were not available, the size of the projects was determined according to the (geographic) scale of the projects. Projects were listed as 'large' if the project was based in multiple countries or many provinces/cities, 'medium' if the project was planned/implemented on a regional scale and 'small' if the project was relatively more local or e.g. based in a (part of a) city rather than an entire country. If both monetary and spatial data were missing, the time frame of the project was used as an indicator for the size of the project.

Adaptation Elements

The following table presents the adaptation elements that have been identified and used in the development of our data longlist and a description of what is captured within this adaptation element. Most of these adaptation elements that have been used in our analysis have been developed and predefined by the UNFCCC database (source).

Adaptation Element	**Content**
Field Implementation	Field Implementation includes adaptation measures that are aimed at facilitating implementation or the practical implementation of (existing) adaptation plans.
Policy Development	The integration of (adaptation) objectives, strategies, policies, measures or operations such that they become part of the national and regional development policies, processes and budgets.

Capacity Building	Improving the ability of people, organizations and systems to manage adverse conditions, risk or disasters, using available skills and resources, and thereby building resilience. The capacity to cope requires continuing awareness, resources and good management, both in normal times as well as during disasters or adverse conditions (UNISDR, 2009).
Climate Observations	Monitoring the climate system; detecting and attributing climate change; assessing impacts of, and supporting adaptation to, climate variability and change; application to national economic development; research to improve understanding, modelling and prediction of the climate system (GCOS, n.d.)
Climate Scenarios	Promoting the development of, access to, and use of information and data on projected climate change.
Communication & Outreach/Awareness	Adaptation measures that are focused on communicating about climate change and its (possible) impacts, thereby expanding the audience and raising more awareness.
Education/Training	Adaptation measures aimed at the education and/or training of involved stakeholders or other actors, providing them with knowledge, insights and resources to improve sustainable behaviour.
Financial Support	Financial aid provided to a community, organization or country in order to develop or implement adaptation measures when resources are otherwise limiting.
Impact Assessment	Assessments aimed to characterize, diagnose, and project risks or impacts of environmental change (climate change in particular) on people, communities, economic activities, infrastructure, ecosystems, or valued natural resources.
Institutional Arrangements	Cooperation structures carried out between public or private institutions and organizations with the intention to establish a legal, organizational and productive framework.
Knowledge Management	The process of creating, sharing, using and managing the knowledge and information of an organization. Knowledge transfer is also included in this category.
Monitoring & Evaluation	The establishment of a monitoring and assessment framework in order to analyze existing (adaptation) practices and/or policies.
Science & Research	Conducting research and/or analyzing existing scientific databases with the aim to produce new insights aimed at improving climate change adaptation.
Socio-Economic Data & Information	Promoting the availability of information on the socio-economic aspects of climate change and improving the integration of socio-economic information into impact and vulnerability assessments (UNFCCC, 2014).
Stakeholder	The process by which people are involved who may be affected by the

Involvement	decisions that are being made, or can influence the implementation of these decisions.
Technical Support	Technological aid in the form of knowledge, tools or resources provided to a community, organization or country in order to develop or implement adaptation measures when resources and knowledge are otherwise limiting.
Vulnerability Assessment	Assessment of the conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards (UNSIDR, .

Table 2. Adaptation elements as used in our database with their accompanying definitions.

Adaptation Sector/Theme

In a similar fashion, the table below provides an overview of the defined adaptation sectors/themes (largely also defined by the UNFCCC database, in combination with the Asia Pacific Adaptation Network) and their contents.

Adaptation Sector/Theme	**Content**
Governance	The efforts by private and public actors to steer, control, and/or manage climate adaptation, as well as the institutions that take up this task.
Adaptation Finance	Reducing the vulnerability of local communities exposed to climate change by increasing the volume and effectiveness of finance directed towards adaptation (WRI, n.d.).
Agriculture	Adaptation projects that are mainly focused on agricultural measures such as crop production, often also related to food security.
Biodiversity	Projects that are focused on enhancing biodiversity as a measure to adapt to climate change, often closely related to ecosystem based adaptation.
Coastal Areas/Zones	Projects that focus on coastal areas/zones that often help coastal communities prepare for and adapt to impacts from climate change such as sea level rise and runoff (APAN, n.d.).
Community-Based Adaptation	Community based adaptation empowers communities by sharing knowledge and lessons on effective ways to adapt to climate change impacts and implementing successful and sustainable adaptation projects (APAN, n.d.).
Ecosystem-Based Adaptation	The approach uses biodiversity and ecosystem services as part of an overall adaptation strategy to help people and communities reduce and adapt to the adverse impacts of climate change at local, national, regional and global levels (APAN, n.d.).

Ecosystems	Adaptation projects that focus on rebuilding or strengthening ecosystems, rather than using them for ecosystem based adaptation.
Disaster Risk Reduction	Disaster risk reduction is aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development (UNISDR, 2007). It is a systematic approach to identifying, assessing, developing and applying of policies, strategies and practices to minimise vulnerabilities and disaster risks throughout society (APAN, n.d.).
Energy	The energy sector, predominantly focused on mitigation rather than adaptation (which is why it was disregarded in this project).
Food Security	Projects that have the protection and securitization of food production at heart, often closely related to agriculture.
Gender	Though Climate Change affects everyone, there are gender and sociopolitical and economic differences in impacts and adaptive capacities. For example, women from poor communities are highly dependent on local natural resource and often disproportionately vulnerable to the impacts of climate change (APAN, n.d.).
Health	Adaptation options focused on improving conditions concerning human health, such as better medicines to treat diseases that spread faster through global warming, yet also air and water purification, etc.
Heavy Industry	Also mainly concerned with mitigation rather than adaptation.
Human Settlements	Projects with human settlements as focus of their adaptation sector are concerned with villages, towns and cities and the influence of climate change on those, often aimed at strengthening the resilience of citizens.
Indigenous & Traditional Knowledge	Adaptation options that focus on traditional knowledge from indigenous populations and incorporating this in adaptation strategies.
Infrastructure	The physical structures, facilities, networks and other assets which provide services that are essential to the social and economic functioning of a community or society.
Services	Services that are outside of the governance sector: transactions, facilitating, etc.
Tourism	Focused on the tourism sector.
Urban Resilience	The ability of urban systems exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management.
Water Resources	Concerned with the quantity and quality of water sources (rivers, groundwater, etc.) and the focus to strengthen or protect them.

Table 3: Adaptation sectors as used in our database and their accompanying definitions.

4 Type of organization doing the project

As far as the categorization of the type of organization doing the project is concerned, some generalizations had to be made too. The identified types of organizations doing the projects are the following:

- Government
  - National governments, ministries, etc.
- Governmental organization
  - A government-based organization such as GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) or GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit)
- Intergovernmental organizations
  - Governmental organizations of international and cooperative character such as the African Union, World Trade Organization, Global Water Partnership.
- International Organization
  - International organizations that are not intergovernmental at heart, e.g. the Organization of the Islamic Conference or the International Institute for Sustainable Development
- United Nations
  - United Nations related/owned organizations such as the World Bank, UNEP, UNDP and Global Environment Facility.
- Development bank / Financial Institution
  - E.g. trust funds or Asian Development Bank (ADB)
- Research Institute
  - Universities and research centers (e.g. African Centre for Technology Studies, etc.)
- Non-Governmental Organization
  - E.g. Red Cross, etc.
- Foundation
  - US AID, Rockefeller Foundation, etc.
- Business
  - Bunge, Water provision companies, etc.