DECCMA

Working Paper

D.6.1.1 Observed adaptation in deltas

Authors: Emma L. Tompkins[1], Natalie Suckall[1], Katharine Vincent[2], Rezaur Rahman[3], Adelina Mensah[4], Tuhin Ghosh[5,] Somnath Hazra[5,]

Affiliations: [1] Geography and Environment, University of Southampton, Southampton, SO17 1BJ, United Kingdom
[2] Kulima Integrated Development Solutions (Pty) Ltd, Postnet Suite H79, Private Bag x9118, Pietermaritzburg, 3200, South Africa
[3] Institute of Water and Flood Management, Bangladesh University of Engineering and Technology, Dhaka 1000, Bangladesh
[4] Institute for Environment and Sanitation Studies, University of Ghana, Box LG209, Legon, Accra, Ghana
[5] School of Oceanographic Studies, Jadavpur University, Kolkata 700032, India

University of Southampton

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About DECCMA Working Papers

This series is based on the work of the Deltas, Vulnerability and Climate Change: Migration and Adaptation (DECCMA) project, funded by Canada's International Development Research Centre (IDRC) and the UK's Department for International Development (DFID) through the **Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA)**. CARIAA aims to build the resilience of vulnerable populations and their livelihoods in three climate change hot spots in Africa and Asia. The program supports collaborative research to inform adaptation policy and practice.

Titles in this series are intended to share initial findings and lessons from research studies commissioned by the program. Papers are intended to foster exchange and dialogue within science and policy circles concerned with climate change adaptation in vulnerability hotspots. As an interim output of the DECCMA project, they have not undergone an external review process. Opinions stated are those of the author(s) and do not necessarily reflect the policies or opinions of IDRC, DFID, or partners. Feedback is welcomed as a means to strengthen these works: some may later be revised for peer-reviewed publication.

Contact
Professor Emma L. Tompkins,
Tel: +44 2380 596711
Email: e.l.tompkins@soton.ac.uk

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1. Introduction and background to creation of the inventory of observed adaptations in deltas

Despite being home to over 500 million people globally, as a geospatial unit deltas are under-researched. The 'Deltas, Vulnerability & Climate Change: Migration and Adaptation' (DECCMA) project aims to address this research gap by researching the role of migration as an adaptation in three deltas in Africa and Asia: the Volta in Ghana, the Mahanadi in India, and the Ganges-Brahmaputra-Meghna (GBM) spanning India and Bangladesh. To understand migration as an adaptation, it is first necessary to identify the spectrum and prevalence of types of adaptation occurring in deltas.

National scale assessments of the spectrum of adaptation occurring have been produced for the developed world (see for example Tompkins et al. 2010, Berrang-Ford et al. 2011), with some assessments focusing on adaptation practice in deltas – for example in the Netherlands and the Spanish Ebro delta (Sánchez-Arcilla et al. 2008, de Bruin et al. 2009, Dircke et al. 2010, PBL Netherlands Environmental Assessment Agency 2011). These studies highlight the prevalence and distribution of adaptation types. Yet few such large-scale studies exist for the developing world, and none exist for a developing world river delta. This is not to say that no research into observed adaptation has been undertaken in developing country deltas. Case study examples of adaptation in deltas abound – e.g. misperceptions of adaptation in the Rewa delta, Fiji (Lata and Nunn 2012), adaptation by farming households in the Niger delta (Nzeadibe et al. 2011), farmers intentions to adapt in the Mekong (Dang et al. 2014), multi-scale adaptations in the Nile delta (Conway 2005), and barriers to adaptation in the Mekong (Chapman et al. 2016) – to name just a few.

What is absent from the literature is a delta-wide assessment of adaptation practice in the developing world, which addresses some of the core questions asked by Smit and Pilifosova (2001), i.e. who is adapting and how are they adapting? We address this gap in the literature by focusing on a delta-wide assessment of documented observed adaptation in the three DECCMA deltas, whereby we identify and categorise empirical evidence of adaptation in three deltas. The three deltas selected fit along a size continuum and are exposed to different environmental and climate change-related hazards. The Volta delta in Ghana is a small delta prone to erosion; the Mahanadi in India is a medium-sized delta exposed to tropical cyclones, floods and droughts; and the Ganges-Brahamaputra-Meghna delta in India and Bangladesh spans an international boundary and experiences a wide range of stressors. By including deltas of different sizes it should be possible to identify if there are size-specific adaptations that are occurring, or whether there are universal adaptations that are occurring across all three deltas. The expected outcome is a clear typology of adaptations that can be identified as generic-delta adaptations.

Following the literature search, the resulting inventory contains 122 documented examples of observed adaptations. Of these, 93 relate to the GBM delta (85 from Bangladesh and 8 from the Indian Bengal Delta), 14 refer to the Mahanadi, and 15 to the Volta.

This working paper first describes the method used to collate the evidence of adaptations (section 2), then presents the raw data collected within the DECCMA project (section 3), as well as the limitations of the inventory (section 4) before we draw some general conclusions (section 5).

2. Method to compile the inventory of observed adaptation

Following Smit and Pilifosova (2001), and drawing on a previously-used methodology (Tompkins et al. 2009), an inventory of observed adaptation was developed for each delta using a standardised template. This method was adapted for the DECCMA project and is described in detail in a methodological protocol (see Annex 1).

The basic approach involved a literature search for **documented empirical evidence** of adaptation. Both published journal articles and grey literature (available online or from governments, research organisations or NGOs) were included. For each adaptation found in the literature, information was collated on the core questions asked of adaptation, set out by Smit and Pilifosova (2001):

- Form: what does the adaptation look like?
- Purposefulness: why is the adaptation being undertaken, what is triggering the adaptation?
- Provider /beneficiary: who is providing the adaptation and who is benefiting from it?
- Timing: is the adaptation occurring in response to or in anticipation of climate change?
- Function/effects: what is the broad aim of the adaptation in terms of its contribution to risk reduction, social vulnerability reduction or creation of ecological resilience?

In terms of clarifying 'what is an adaptation?' for inclusion in the inventory, the DECCMA project applied a broad definition: "Adaptation refers to any choices or adjustments to climate variability and change. These adjustments may be in response to, or in anticipation of, real or perceived climate stressors" (Nicholls et al., 2017). This broad definition allowed inclusion of a wide range of adaptations that could be also categorised as development initiatives, risk management or resilience building (see the typology developed by Eakin et al. 2009).

Each country team holds the current version of the inventory of observed adaptations occurring in their deltas. These are live documents which are regularly updated as new evidence is published. The versions of the inventories, last updated in 2015, are available on www.deccma.com.

The data contained in the inventory reflects the documented empirical evidence of adaptation. This is not a randomly sampled set of adaptations, it is not a description of the complete population of adaptations occurring, rather it is a compilation of some of the literature that has been published and is publically accessible. This method, which has been applied in the UK context (Tompkins et al. 2010) tends to generate a predominance of government and NGO reports, and to underrepresent private sector and individual adaptation activity.

For more information about any country dataset, please contact the relevant co-author of this paper.

3. Overview of observed adaptations in the three DECCMA deltas

Please note that the method of compiling the inventory (outlined in section 3) should be borne in mind when using the inventory, and in interpreting the results.

3.1 Sectoral adaptation

The items found in the literature search and included in the combined dataset from the three deltas, cover most sectoral areas, although agriculture, rural livelihoods, water resources management, disaster risk reduction, and coastal zone management predominate (Table 1).

Table 1: Distribution of sectoral distribution of observed adaptations

Sector	**Frequency**
Agricultural livelihoods/rural development	48
Disaster Risk Reduction/flood risk management	21
Water resources management	20
Coastal zone management	12
Forestry/aquaculture/fisheries	11
Education/research/knowledge	3
Other	7

The high proportion of agricultural adaptations and risk management initiatives could be a result of the predominance of agriculture as a livelihood activity in the deltas. Further, the prevalence of risk management and water resources management initiatives is likely to relate the fact that all three deltas are frequently affected by multiple forms of hydro-meteorological hazards: droughts, floods, storms, tidal waves and tropical cyclones.

3.2 Adaptation providers and beneficiaries

In terms of those providing adaptation, the vast majority of the papers reported adaptations that had been provided by the government (Table 2), with a minority being undertaken by NGOs.

Table 2: Papers founds by type of provider

Adaptation provider	**Frequency**
Government	64
NGOs (local and international)	34
Individual	13
Other (farmers, universities, communities, households)	9
Not stated	2

The lack of any private sector activity is likely to be an artefact of the data, i.e. the private sector is far less likely than governments and NGOs to document their adaptations.

The beneficiaries of the adaptations identified by the papers included in the inventory were almost universally communities (Table 3).

Table 3: Beneficiaries of adaptation in the papers included in the inventory

BENEFICIARY	Frequency
Community	99
Individual/households	14
Other	9

The findings in Table 3 are to be expected, given the extent of both government and NGO provision of adaptation in the papers included. Again, this could be a result of the method used, or a depiction of the reality on the ground – however neither can be inferred from the data.

3.3 Drivers of adaptation

It is interesting to consider what drives adaptation, and to identify whether it is climate change, weather-related shocks or stresses, or other factors. The better we are able to identify triggers of adaptation, the better placed governments can be to use these triggers to encourage wide spread adoption of adaptation strategies. By considering whether the adaptations were triggered by chronic stress (i.e. continuous or slowly increasing pressures such as increasing temperatures), sudden shocks (i.e. one off hazards, such as floods), or other triggers we explored what is driving people to adapt. Many of the examples in the inventory did not document what was driving adaptation, however, some insights can be gained from the information that was collated.

Chronic stress, specifically drought, salinity intrusion, coastal or river erosion and waterlogging, was noted as driving 89 of the 122 adaptations (73%). Sudden shocks, notably floods and tropical cyclones, were identified as driving 57 of the 122 adaptations (47%). Other triggers, such as food insecurity, disease and pest infestation and ground water quality issues, were noted as driving 35 of the adaptations (29%). A combination of both shocks and stresses drove 32 adaptations (26%), and a combination of chronic stress and other triggers drove 27 adaptations (22%). It is clear that while chronic stress is an important trigger of adaptation, most adaptations are not influenced by just one driver.

3.4 Types of adaptation (by function)

In terms of the types of adaptations found, we have classified these in a variety of forms to reflect the multiple ways of categorising adaptation. First, in terms of the broad objective of adaptation (using a modified version of the Eakin et al. 2009 framework) we have used the categories:
(i) to reduce socio-economic vulnerability,
(ii) to address disaster risk, or
(iii) to build ecological resilience.
We find that 46% of the adaptations relate to aspects of disaster risk reduction (DRR) (n=56); 44% relate to reducing vulnerability (n=54), and just 10% relate to ecological resilience building (n=12).

To explore this distribution in more detail, we first consider the different ways in which disaster risk can be reduced. Using the standard framing of the disaster risk reduction cycle, i.e. i) long term risk reduction measure, ii) medium term preparedness, iii) response to the hazard, and iv) post disaster

recovery, reconstruction and rehabilitation (UNISDR 1994), we assess the investment in different aspects of DRR (Table 4).

Table 4. Distribution of types of DRR measures adopted

Aspect of DRR	**Frequency (%)**	**Typical examples**
Long term risk reduction	44 (79%)	PROTECTIVE INFRASTRUCTURE: Creating/repairing embankments, polders, cyclone shelters WATER RESOURCE MANAGEMENT: River management, drainage, irrigation, dredging
Medium term preparedness	6 (11%)	Early warning systems, weather forecasting, training on DRR
Response to hazard	1 (2%)	Provision of temporary shelter
Post disaster recovery	5 (9%)	Rebuilding homes/embankments/infrastructure Reducing consumption/selling assets

The majority of the reported adaptations relate to long term risk management initiatives, notably the creation and preservation of infrastructure for natural resource management, or for shelter. There is some mention of other types of DRR, although far less than we expected. Further, there is little reporting of the more financial and social aspects of DRR, e.g. insurance and vulnerability mapping.

In terms of reducing vulnerability, we consider how each adaptation contributes to the five livelihood assets (physical, natural, social, financial and human) as defined by the Sustainable Livelihood Framework (DFID 1999), see Table 5.

Table 5. Distribution of types of vulnerability reduction measures adopted

Aspect of vulnerability reduction (5 capitals)	**Frequency (%)**	**Typical examples**
Natural capital	46 (85%)	Land use change, new crop variety, livelihood diversification within NRM, planting times change
Human capital	8 (15%)	Education, training
Social capital	0	n.a.
Physical capital	0	n.a.
Financial capital	0	n.a.

The over-prevalence of ways to manage the land are likely due to the natural resource dependency of most delta residents. Surprisingly there was very little evidence of social capital building initiatives, e.g. community based adaptation, and a lack of evidence documenting creation of financial capital to support adaptation.

Finally, we analysed the adaptation through the lens of how the adaptation contributed to the creation of ecosystem resilience. Using the ecosystem services framework (Millennium Ecosystem Assessment 2005), we assessed the distribution of types of ecosystem service that was being

supported/created/affected by the adaptations. We found that there was only documentation of the provisioning services (notably flood risk reduction services).

Using a modified version of the Eakin et al (2009) framework, it is possible to identify that in terms of documented adaptations, the vast majority relate to DRR (through development or management of long term infrastructure), vulnerability reduction through the management of natural capital, or the management of ecosystem services to provide provisioning services.

3.5 Evidence of gender explicitly considered in adaptation

The DECCMA project is committed to highlighting the gendered dimensions of adaptation, of understanding how men and women adapt, and the opportunities and constraints on adaptation for both men and women. Each adaptation in the inventory was therefore reviewed to consider if, and how, gender was taken into account. Of the 122 adaptations, only 13 (11%) of the adaptations explicitly considered the gendered dimensions of adaptation. In the majority of cases, gender was simply not considered. Examples of gender being considered in adaptation are:

- In the Volta, in relation to households' use of sandbags and house wall construction, it is apparent that there are different uses, and construction methods employed by men and women.
- In the Mahanadi, there has been training on livelihood diversification, where specific activities have been specifically aimed at women, e.g. where women have converted water hyacinth ponds into vegetable gardens.
- In the Volta, as part of a mangrove regeneration project, women were trained to add value to products made from extracted mangroves, e.g. mats, crab baskets and fans, to increase market value
- In Bangladesh, women were specifically encouraged to engage in preparing community action plans.

The paucity of reporting on gender in the documentation of adaptation in the deltas is notable, surprising and disappointing. Mainstreaming gender into development has been a focus of the international development community since the Millennium Development Goals (2000) – Goal #3 is "To promote gender equality and empower women". This objective has been carried forward into the Sustainable Development Goals: "Goal 5: Achieve gender equality and empower all women and girls". The lack of reporting on gender may be due to poor reporting practices, or it may simply be a reflection of the lack of consideration of gender in the delivery of adaptation. Whichever the cause, it is an important finding of this work.

3.6 Migration as adaptation

The DECCMA project further focusses on the role of migration as an adaptation. Each adaptation in the inventory was explored to identify whether any consideration was given to the effect of the adaptation on migration, or the interaction between the adaptation and migration. We found very little reporting on the impacts of / relationships between the adaptations and migrations. Only 18 of the 122 adaptations (15%), made reference to migration. The majority of these references related to:

- *Settlement relocation*, e.g. in Bangladesh where people have relocated due to flooding
- *Proactive migration* as an adaptation to general stress (in all three deltas)

- *Rural to urban migration as part of development.* there is a general trend in some areas for young people to move to urban areas to seek employment and life opportunities
- *Seasonal migration, e.*g. after monsoon season, as a formal part of a households livelihood strategy
- *Migration as a response to reduced productivity of land.*

Migration is a complex issue, and this limited set of evidence in the inventory suggests there is a link to adaptation. Better documentation of the possible impacts of adaptations on migration could help to inform our understanding of how adaptations and migration interact, and the possible impacts of future adaptations on migration in deltas.

3.7 Adaptation across the three deltas

Due to the imbalance in the distribution of the adaptations across the three deltas, and the lack of a large enough sample size in the Mahanadi and Volta, it is difficult to confirm statistically if there is a difference in the predominance of specific types of adaptations across the three deltas (Table 6). Based simply on the percentage distribution, in the GBM, there appears to be an almost equal focus on vulnerability reduction and disaster risk reduction adaptations. In the Mahanadi, there appears to be a focus on disaster risk reduction, and in the Volta, it seems that the focus is on reducing vulnerability. It is possible that this distribution reflects the type of change that is most prevalent in each delta. For example, the focus on vulnerability reduction rather than DRR in the Volta may be a response to the infrequent nature of large scale events (such as flooding or storms) that lead to disasters. Such events are more frequent GBM and Mahanadi where there are more DRR type adaptations.

Table 6. Distribution of types of adaptation across the three deltas

	Delta		
Type of adaptation	**GBM % (#)**	**Mahanadi % (#)**	**Volta % (#)**
Disaster Risk Reduction	46% (43)	57% (8)	33% (5)
Reduce socio-economic vulnerability	45% (42)	36% (5)	47% (7)
Build ecosystem resilience	9% (8)	7% (1)	20% (3)
Total	**100% (93)**	**100% (14)**	**100% (15)**

Hence, it was not possible to draw any firm conclusions on this issue from this study. Future studies may wish to explore if size of delta affects the types/ prevalence of adaptations. They may also wish to explore if the types of threat determine the type of adaptation, or if something else is driving the adaptation. If there is a disconnect between the type of threat a delta faces and the focus of the adaptations in that delta, what does this mean for each delta?

4. Limitations of the inventory and method used

The method used to generate the inventory, which has been applied in the UK context (Tompkins et al. 2010), only identifies and includes published works that include empirical evidence of adaptation. The method tends to generate a predominance of government and NGO reports, and to underrepresent private sector and individual adaptation activity.

The method reviews existing documented evidence of adaptation. This automatically reduces the likelihood of identifying any private sector adaptation activity, or any individual activity, as these are unlikely to be documented in publically available resources.

The inventory is not a sample of the population of data that exists on observed adaptation to climate change in deltas. Rather, it is a compilation of the published literature on adaptation in deltas. It therefore reflects what has been published, rather than what exists. Any findings should be interpreted through this lens.

The inventories are live documents, which are constantly being updated by the country teams. This document reviews the content as of January 2017. It is important to note that the content will change as knowledge changes and that:

- Websites change all the time therefore some of the links may no longer work
- While correct references have been sought, in the event of a query about a reference, the WP6 country team should be the first point of call.

Nonetheless, the inventory of adaptation provides a broad overview of the types of adaptations that are occurring in the three country deltas.

5. Discussion and conclusion

This report, produced through the collation of published evidence, draws together examples of adaptations in three deltas: in the Volta, the Mahanadi, and the GBM. Based on the method of reviewing published empirical evidence it is by no means a complete analysis of all the adaptations occurring in these deltas. However it serves to highlight the distribution of types of adaptations occurring across the deltas, using a modified version of the three component Eakin et al. framework, i.e. vulnerability reduction, risk reduction, and resilience building. Risk reducing measures and vulnerability reduction measures predominate, and there is a lack of evidence citing the building of ecosystem resilience to deliver adaptation.

There are many possible reasons for the predominance of risk reducing measures and vulnerability reduction measures. First, risk reduction, and vulnerability reduction are part of the traditional development process. Our ability to find evidence of vulnerability reducing, or risk reducing measures, may simply be an artefact of the data, in that development initiatives are sometimes rebadged/ documented as ‘adaptation’. This may be for the benefit of the funder of the adaptation, or it may simply be for the purposes of more accurate documentation of initiatives, for governments and funders alike. However, due to the prevalence of development initiatives in the three deltas, this change in reporting may skew the apparent distribution of adaptations. Second, risk reduction or vulnerability reduction measures tend to address present day climatic variability, or observed trends

in climate. Simple adaptations, that enable people to cope with present day variability, and fill the existing adaptation deficit, can be initiated without the need for detailed future climate models. This can be seen as a cost-effective way of initiating action on climate change, without needing to rely on uncertain future models. Third, this may simply be a result of the search terms used and the literature found. Future analyses of adaptations in deltas should consider this limitation.

The lack of documentation of gender in adaptation is an important finding. Gender-blind adaptations run the risk of reinforcing existing inequalities and thus taking a gendered approach is essential for those supporting, delivering, or managing adaptation. How should reporting be undertaken to ensure that gender is considered? Our research shows that there is a link between adaptation and migration, yet this study cannot tease out the multiple ways in which adaptation affects migration. Future studies of adaptation, specifically of the effectiveness of adaptations, should consider the migration implications of specific adaptations, or this possibly significant aspect could be ignored.

Interestingly, as with similar inventory studies of observed adaptation undertaken in the developed world, there is a high level of government activity documented in this delta inventory (relative to the private sector, community, or individual action). This could be because government is leading adaptation within the deltas, or it could be because only the government is starting to report specific activities as adaptations. It may be that the private sector is also undertaking adaptation initiatives, however it may not be reporting this. Whatever the reason, this study provides a novel baseline assessment of adaptation in deltas. Future studies of adaptation in deltas should be able to build on this assessment.

To conclude, this review of the literature on adaptation in deltas highlights for the first time, the prevalence of types of adaptations in deltas, using three deltas as exemplars. It makes the interesting finding that there appears to be little evidence of building ecosystem resilience to address long term climatic stress. Yet, most adaptations appear to be driven by long term chronic stress. Future research in deltas should therefore focus on documenting the most effective means of addressing both present day long term stress, and how people may start to adapt to future climatic stresses.

Annex 1: Protocol on how to create inventories of observed adaptation to climate change

Developed by Emma L. Tompkins, Natalie Suckall, Rezaur Rahman, Tasneem Siddiqui

26th August 2014

Overview of Work Task 6.1

The aim of this document is to provide all countries with a template to collect data for a country-specific inventory of adaptation.

To develop an understanding of what adaptation is occurring in each delta, one aspect of work task 6.1 involves the production of an inventory (database) of adaptation currently observed and documented within each delta. This will be collated into an inventory of observed adaptation (Milestone 6.1.2), and a report from each delta (Deliverable 6.1.1). For detailed guidance on how other inventories of observed adaptation have been produced please see Tompkins et al (2009) who documented observed adaptations in the UK:

- TOMPKINS, E. L., BOYD, E., NICHOLSON-COLE, S. A., K.WEATHERHEAD, ARNELL, N. W. & ADGER, W. N. 2009. An Inventory of Adaptation to climate change in the UK: challenges and findings. Tyndall Centre for Climate Change Research Working Paper 135, 133 http://www.tyndall.ac.uk/sites/default/files/twp135.pdf.

Expected outputs, milestones and deadlines related to the task

The deadline for the completion of the inventories is 30 December 2014. The deadline for the publication from the inventories is 30 April 2015.

Once completed, all four databases will be combined into one dataset that will be analysed by the WP6 lead team who will try and find commonalities across the four deltas. This combined analysis will be written up into a peer reviewed paper with authors identified using the Vancouver rules – already circulated.

Actions to deliver Milestone 6.1.1

Data will be collected from published literature (peer-reviewed and grey), and collated in a universal format (in spreadsheet form) to document the adaptation that is currently occurring. Using the suggested template in the DECCMA document 'Defining Adaptation' the inventory will record, among other things: Purposefulness: why is the adaptation being undertaken, what is triggering the adaptation?; Provider /beneficiary: who is providing the adaptation and who is benefiting from it?; Timing: is the adaptation occurring in response to or in anticipation of climate change?; Temporal scope: does the adaptation aim to provide long term of short term benefits?; Spatial scope: who are the beneficiaries, are they localised or does the adaptation affect many people?; Function / effects: what is the broad aim of the adaptation in terms of its contribution to risk reduction, vulnerability reduction or creation of resilience?; Form: what does the adaptation look like?; Performance: can the adaptation be considered a success?

Narrowing the search

Adaptation to climate change is an enormous topic and hence any reference could be considered an adaptation to climate change. We suggest that the search includes the following sectors/policy areas:

- Agriculture
- Water resources management
- Disaster risk reduction/management
- Flood management
- Coastal zone management
- Public health, water supply and sanitation
- Urban planning
- Rural development

Some countries may find that the information from these sectors/policy areas creates a huge volume of examples of observed adaptation. Others may find that it produces few examples. In the event that few examples of adaptation are found in these sectors/areas, please contact the Work Package 6 leads to discuss how to proceed.

The literature must document evidence of adaptation that is currently occurring or has occurred, i.e. not theorised, but actually occurring. Please refer to the DECCMA Defining Adaptation working paper to see how adaptation is being defined. The source material must provide EMPIRICAL EVIDENCE of adaptation. **If this is not present, please do not cite/use**.

Sources to search

3.2.1 Online searches

We suggest that the following sources are searched online:

- Google scholar
- Any academic database to which you have access e.g. ISI web of knowledge, Geobase etc..
- National country academic and research institutions
- International academic and research institutions (e.g. for the UK and US, these institutions have URLs with the suffixes '.ac.uk' and '.edu' respectively), as well as other country academic / research institutions
- National and state level government agencies within the country
- International development agencies, i.e. UNDP, UNEP, World Bank, WHO, FAO, WMO, other relevant UN agencies
- International academic sources, e.g. the UNGEO series, IPCC
- National and international NGOs working on adaptation, DRR, vulnerability reduction, creating resilience
- Annual reports from companies working in the sectors of interest
- PRSPs
- NAPAs and NAPs

3.2.2 Tangible sources/ paper sources

We suggest that the following may be good sources for publications that may not be accessible over the internet:

- Government offices (in the sectors listed in section 3.1 above)
- Local and international NGOs with a presence in the delta
- UN offices in the delta
- Bilateral aid agencies with presence in the delta
- Local consultancy companies – with whom you have working relationships

3.2.3 Guidance on determining acceptable quality for grey literature

It is often difficult to decide on whether to include grey literature due to the lack of quality assurance (e.g. in the form of peer-review). The following guidance may support decisions about whether to include information or not

Include if the following are present:

- Bibliometric data, or, at a minimum
- Author, date of publication and contact details for the author or the institution

Exclude if the following occur:

- Website only
- No author, date of publication or contact details
- No empirical evidence present

Possible keywords for literature search

Country teams may wish to apply the following search keywords using Boolean operators to combine these:

Adapt*; Resilien*; vulnerab*; climat* AND change*; climat* AND variab*; climat* AND extreme*; weather* AND change*; weather* AND variab*; weather* AND extreme*; disaster*; risk*; social safety net; crop insurance;

There may be many others. Please keep a note of which search terms you have used.

Description of Milestone 6.1.2

Milestone 6.1.2 is the creation of four baseline inventories (databases) of current adaptation. This will take the form of an excel spread sheet, with different tabs for different sectors. It is assumed that the inventory will include at least 300 adaptations in each delta. This assumption is based on the research that has occurred in the four countries over the last 10 years. If you have any concerns about this please contact the WP6 lead team (Emma, Tasneem or Rezaur). Table 1 at the end of this document describes the array of information that should be extracted from each piece of evidence used.

Description of Deliverable 6.1.1

Deliverable 6.1.1 is the report on currently observed adaptation in the four deltaic regions. It is suggested that the team writes a report of 20 pages. This can also be converted into a peer reviewed paper for publication. The four reports will have a common structure;

1. Introduction
    a. Aims of the report
    b. Discussion of why an inventory of current climate change adaptation actions is of relevance in the delta
    c. Outline of the report
2. Methodology
    a. Country context
    b. Method applied (i.e. the process followed in section 3)
    c. Limitations
3. Data by sector - for each sector include a description of the key findings from the inventory, including;
    a. Drivers of adaptation
    b. The types of adaptations that are taking place
    c. Who is adapting (e.g. individual, household, private sector, etc) and who else benefits from the adaptation
    d. Evidence of maladaptation / barriers to adaptation
    e. If adaptations successfully reduce disaster risk, address vulnerability, or increase resilience
    f. Any links to migration
4. Summary
    a. Commonalities /difference between each sector

To provide *interim* guidance on the country teams on this WT, please submit a draft of the inventory to the WP6 leads, i.e. Emma Tompkins, Natalie Suckall, Tasneem Siddiqui and Rezaur Rahman, on October 20th 2014. This will allow the WP6 leads to discuss progress towards the deliverable with each country team.

Table 1: Planned data collection sheets to collate empirical evidence of observed adaptation in deltas

Location /sector of adaptation			Adaptor and beneficiary			
Country of adaptation	**Geographic location of adaptation. Please note central point of adaptation + spatial distribution**	**Sector**	**Type of adaptation provider**	**Name of adaptation provider**	**Type of beneficiary**	**Name of beneficiary**
i.e. Country name	*e.g. city name + entire city, or city name + x district, or block x + block Y ,or marginal groups in state X etc..*	*e.g. water, flood risk, sanitation, construction etc.*	*A provider can be an individual, the community, the private sector, an NGO or the government.*	*This could be the name of a community, the name of a private sector organisation, the name of an NGO such as Oxfam, or the name of a government/government department*	*A beneficiary can be an individual, the community, the private sector, an NGO or the government.*	*This could be the name of a community, the name of a private sector organisation, the name of an NGO such as Oxfam, or the name of a government/government department*

Form of adaptation						
Summary of adaptation (keywords)	**Detail of the adaptation**	**Output from the adaptation**	**Details of the output from the adaptation**	**Aim of the adaptation** (to build capacity/ implement action/ change the law)	**Is this a deliberate adaptation to climate change?**	**Is there deliberate attempt to make the option gender appropriate?**
Examples include: Policy to implement agricultural extension workers / Farmers growing drought resistant crops	*Please provide more details to support the statement provided in the previous column. For example, what crops are farmers growing and why did they choose these?*	*e.g. report, programme, new building, new network, revised building code, enhanced DRR, planting new crops*	*Please provide key words/ short statement e.g. Policy to implement agricultural extension workers*	*Select 'taking action' for tangible actions e.g. growing new crops/ migrating. Select 'building capacity' for actions creating new knowledge /institutions. Select 'legislation' for creation of laws that facilitate the adaptive process*	*A deliberate adaptation occurs as a result of real or perceived climate change / A non-deliberate adaptation is an action that addresses a non-climate issues but creates co-benefits*	*Provide examples of successful gender sensitive interventions within the adaptation option; for example- separate room for women in a cyclone shelter*

Understanding drivers of adaptation

Historic evidence of the adaptation (how long as the adaptation been occurring)	**Timing of the adaptation** (reactive or proactive)	**Is the adaptation in response to chronic stress?** i.e. Long term, persistent stress	**Detail of chronic stress**	**Is the adaptation in response to sudden shock?** i.e. a one-off event or surprise	**Detail of sudden shock**	**Other triggers of adaptation** e.g. cost, social pressure, cc legislation,
What did people do before the adaptation and when did the adaptation take place? For example, if migration is an adaptation, is this new? Have people always migrated?	*Anticipatory adaptation occurs before climate change is evident. / Reactive adaptation occurs following the impact of climate change.*	*A stress is a long-tern chronic issue that become more severe over time. For example, gradually increasing temperatures, sea-level rise and sediment decline.*		*A shock is s a sudden and often short lived event that may not be expected. For example, cyclones, sudden flooding and acute food shortage.*		*This may include non-climatic stresses and shocks, such as war, poverty or new policies*

Maladaptation and barriers to adaptation											
Who benefits from the adaptation?	**Who is excluded from the adaptation?**	**Are there barriers to participating in this adaptation**	**What are the barriers?**	**Are there gender specific issues?**	**What are these issues?**	**Are there any damaging aspects of this adaptation that are evident now?**	**What are the current damaging aspects?**	**Are there any damaging aspects of this adaptation that may emerge in the future?**	**What are the future damaging aspects?**	**Is the adaptation likely to be sustainable in the long term?**	**How?**
Please use text and numbers e.g. whole community, men only, 100 households.	*Please use text and numbers e.g. whole community, men only, 100 households.*	*Please select from the dropdown menu*	*Please provide detail in <100 words*	*Please select from the dropdown menu*	*Please provide detail in <100 words*	*Please select from the dropdown menu*	*Please provide detail in <100 words*	*Please select from the dropdown menu*	*Please provide detail in <100 words*	*Please select from the dropdown menu*	*Please provide detail in <100 words*

Link to migration		DRR		Vulnerability		Resilience		Referencing		
Does the document mention migration?	**If yes, how, e.g. displacement, resettlement, abandonment?**	**Does the adaptation reduce disaster risk?**	**How?**	**Does the adaptation reduce vulnerability?**	**How?**	**Does the adaptation increase large-scale systems resilience?**	**How?**	**Reference for the adaptation**	**Website / online link**	**Type of literature**
Please select from the dropdown menu	*Please provide detail in <100 words*	*Disaster Risk Reduction (DRR) is "the concept and practice of reducing disaster risks through systematic efforts to analyse and reduce the causal factors of disasters" Examples may include planting mangroves to reduce the risk posed by tidal surges and raising awareness of natural hazards through school-based education projects*		*Vulnerability to climate change is the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change. Examples of vulnerability reduction may include the use of risk spreading mechanisms such as livelihood diversification*		*Resilience refers to the degree to which a system rebounds, recoups, or recovers from a stimulus such as a flood or acute food shortage. Examples of large scale system resilience may include reforestation*		*i.e. bibliometric data for publications or full grey literature reference*	*Please provide a link to this where it exists*	*e.g. grey literature, World Bank report, peer reviewed literature, advocacy document, legislation*

Reference list

Berrang-Ford, L., J. D. Ford, and J. Paterson. 2011. Are we adapting to climate change? Global Environmental Change **21**:25-33.

Chapman, A. D., S. E. Darby, H. M. Hồng, E. L. Tompkins, and T. P. D. Van. 2016. Adaptation and development trade-offs: fluvial sediment deposition and the sustainability of rice-cropping in An Giang Province, Mekong Delta. Climatic Change:1-16.

Conway, D. 2005. From headwater tributaries to international river: Observing and adapting to climate variability and change in the Nile basin. Global Environmental Change **15**:99-114.

Dang, H. L., E. Li, I. Nuberg, and J. Bruwer. 2014. Understanding farmers' adaptation intention to climate change: A structural equation modelling study in the Mekong Delta, Vietnam. Environmental Science & Policy **41**:11-22.

de Bruin, K., R. B. Dellink, A. Ruijs, L. Bolwidt, A. van Buuren, J. Graveland, R. S. de Groot, P. J. Kuikman, S. Reinhard, R. P. Roetter, V. C. Tassone, A. Verhagen, and E. C. van Ierland. 2009. Adapting to climate change in The Netherlands: an inventory of climate adaptation options and ranking of alternatives. Climatic Change **95**:23-45.

DFID. 1999. Sustainable Livelihoods Guidance Sheets. DfID, London.

Dircke, P., P. Wijsman, and A. Molenaar. 2010. Climate Change Adaptation in Smart Delta City Rotterdam. Urban Coast Research and Policy Working Paper **2**:40-42.

Eakin, H., E. L. Tompkins, D. R. Nelson, and J. M. Anderies. 2009. Hidden costs and disparate uncertainties: Trade-offs involved in Approaches to Climate Policy. Pages 212-226 *in* W. N. Adger, I. Lorenzoni, and K. L. O'Brien, editors. Adapting to climate change: thresholds, values, governance. Cambridge University Press, Cambridge.

Lata, S., and P. Nunn. 2012. Misperceptions of climate-change risk as barriers to climate-change adaptation: a case study from the Rewa Delta, Fiji. Climatic Change **110**:169.

Millennium Ecosystem Assessment, editor. 2005. Ecosystems and Human Well-Being: Scenarios. Findings of the Scenarios Working Group. Island Press, Washington D.C.

Nzeadibe, T. C., C. L. Egbule, N. A. Chukwuone, and V. C. Agu. 2011. Climate Change Awareness and Adaptation in the Niger Delta Region of Nigeria. African Technology Policy Studies Network WORKING PAPER SERIES **57**:1-27.

PBL Netherlands Environmental Assessment Agency. 2011. Climate Adaptation in the Dutch Delta. Strategic options for a climate-proof development of the Netherlands. PBL Netherlands Environmental Assessment Agency, The Hague, The Netherlands.

Sánchez-Arcilla, A., J. A. Jiménez, H. I. Valdemoro, and V. Gracia. 2008. Implications of Climatic Change on Spanish Mediterranean Low-Lying Coasts: The Ebro Delta Case. Journal of Coastal Research:306-316.

Smit, B., and O. Pilifosova. 2001. Chapter 18, Adaptation to climate change in the context of sustainable development and equity. Pages 877-912 *in* J. J. McCarthy, O. Canziani, N. A. Leary, D. J. Dokken, and K. S. White, editors. Climate Change 2001: Impacts, Adaptation, Vulnerability. Contribution of Working Group II. Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge.

Tompkins, E. L., E. Boyd, S. Nicholson-Cole, W. N. Adger, K. Weatherhead, and N. W. Arnell. 2010. Observed adaptation to climate change: UK evidence of transition to a well-adapting society? Global Environmental Change **20**:627–635.

Tompkins, E. L., E. Boyd, S. A. Nicholson-Cole, K.Weatherhead, N. W. Arnell, and W. N. Adger. 2009. An Inventory of Adaptation to climate change in the UK: challenges and findings. Tyndall Centre for Climate Change Research Working Paper 135:133.

UNISDR. 1994. Yokohama Strategy and Plan of Action for a Safer World. Guidelines for Natural Disaster Prevention, Preparedness and Mitigation. Page 19 *in* World Conference on Natural Disaster Reduction. UN Department of Humanitarian Affairs, Yokohama, Japan.