Climate Adaptation Services Bangladesh

The Partners for Water programme has supported the development of a demonstration of the Climate Adaptation Atlas for Bangladesh. The project was performed by a consortium of parties from the Climate Adaptation Services (CAS) foundation and Geocycli BV. The CAS foundation is a cooperation between Dutch knowledge institutes and private sector parties (1). The ambition of the CAS foundation is to provide climate adaptation services within the Netherlands but more importantly the foundation has the ambition to provide services on an international level. In this pilot project, the CAS foundation works closely together with the Centre for Environmental and Geographic Information Services (CEGIS), a leading knowledge centre for information on the environment in Bangladesh. The goals of the Climate Adaptation Atlas project are:

1. To develop a platform for participatory planning for the Haor area in Bangladesh
2. To visualise scenarios of the long term future (climate adaptation atlas)
3. To apply the touch table as a platform for participatory planning
4. To demonstrate the approach for Bangladesh and other regions in the world

Pilot area: The Haor region

The project focuses on the Haor region in the north-east of Bangladesh (figure 2), close to the city of Sylhet . The area has a surface of about twelve thousand square kilometer and a population of 9.8 million people at around 800 inhabitants per square km (BBS, 2011). This mainly flat area is surrounded by steep foothills in the Indian neighboring areas. Heavy rainfall in these surrounding foothills causes sudden flash floods in parts of the Haor area. The Haor area is characterized by many bowl shaped depressions called Haors, which are both from ecological and economical perspective important for the region. These extremely flat low lying areas are flooded every year during the monsoon season. Six to eight months a year during the monsoon the Haors are inundated and provide fertile fishing grounds (Salauddin and Islam, 2011). During the dry winter season the Haors are suitable for agricultural activity, and mostly boro rice is cultivated. Besides agriculture the area is known as a wetland area valuable for migrating birds and fish. In the Haor areas there exists a delicate balance between ecology and other land use functions (such as fisheries and rice cultivation). Producing more than 5.25 million tons of paddy each year, the haor region is an important link in providing food for the entire country. Flash floods occur before the regular monsoon floods and originate from the surrounding steep foothills on the Indian territory. Since boro rice is the major crop produced annually in the Haor area, flash floods pose a substantial risk. Besides fisheries, which also contributes substantially to income earning in the region, the current economic system for non-aquat-

Figure 1 - An impression of the haor region during the wet and the dry season (click on a circle to go to the next picture)

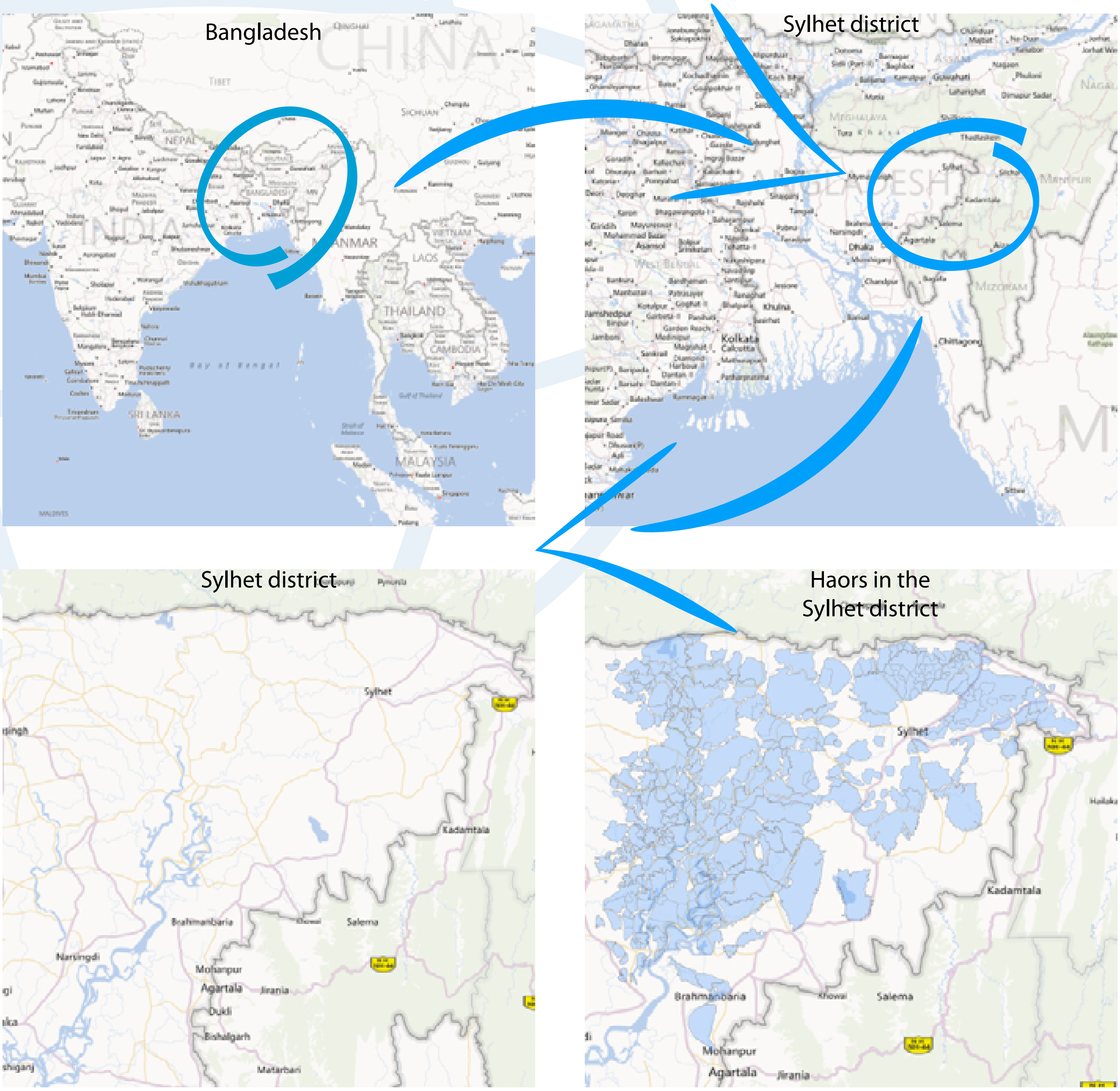

Figure 2 - The haor region in the Sylhet division in the north-east of Bangladesh

ic resources offers very limited potential in terms of income earning and/or poverty alleviation. The single rice crop remains under the constant threat of partial to complete damage from the early onrush of flash floods. The growing season of boro rice is from November-December to the end of May, which fits precisely in the yearly cycle of inundation of the Haor area. The harvest of the rice crop in May often coincides with the beginning of the monsoon period. Based on stakeholder interviews in the field it was concluded that – if a flash flood occurs – virtually all crops in that particular area are lost, making timing of the flash floods a crucial factor in growing rice crops. If flash floods occur after rice harvest damage is limited to other crops (IRRI, 2004). When flash floods occur earlier in the season – and the rice paddies have not been harvested – the impact can be more severe. Trying to delay flash floods, submersible embankments are made by farmers and land owners (IRRI, 2004) as well as the government (BWDB). This works well, and helps to secure the crop. However, there is also a disadvantage. The disadvantage of these embankments is that after the monsoon it takes more time to drain the area. This may lead to impeded drainage and thus a shorter growing season of the boro rice crop or farmers cutting the embankment (which, is not timely repaired, can create a problem in the next year).

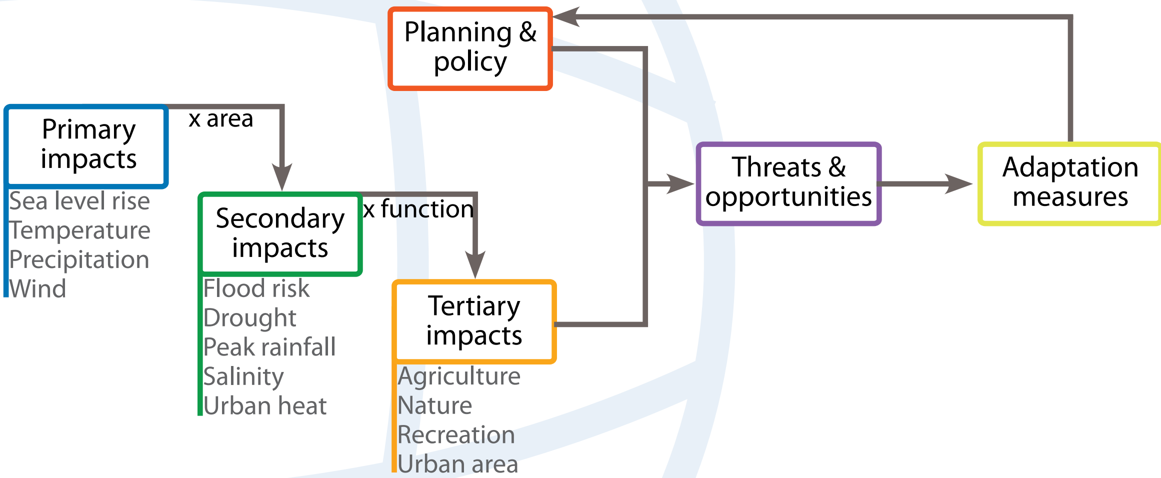

Figure 3 - The Climate Adaptation Services approach

Problem statement

Climate change is likely to influence rainfall patterns and could have an impact on both timing and frequency of flash floods. Flash floods originate from the surrounding steep foothills on the Indian territory. The question is whether climate change will have an impact on future timing and frequency of flash floods. The boro rice crop is most vulnerable to flash floods. At the same time, boro rice is the highest yielding rice crop and important for food security. Population growth increases the demand for new settlements, and also the demand for agricultural production. In developing an adaptation strategy, these processes need to be understood: how will land use claims and flood timing and patterns change over time? The range of land use and services of the region in combination with the vulnerability due to expected climate change makes this an important target region for a participatory planning approach Since population density will increase as well as agricultural productivity, future flash floods are expected to have an increasing impact. The approach aims to establish:

1. a joint problem analysis
2. a participatory design of options for adaptation
3. to gain joint support for action.

The CAS participatory platform for adaptation planning

The partners in the foundation CAS have developed a participatory platform for adaptation planning, of which the climate atlas/touch-table is a key component (fig. 3). The CAS platform provides an integrated perspective on climate change by putting together the dispersed information on different climate change impacts, e.g. flood modelling, salinity, urban heat island effect, crop drought sensitivity and sensitivity of nature types to droughts.

The different aspects of climate change are integrated and visualized using the touch-table. The touch table is a computer devise with a touch-sensitive screen, which is in table format, in which layers of maps can be included and analyzed with functionalities to overlay various maps, and the possibility to add information in an interactive way, e.g. during the discussion of stakeholders on the maps. This touch-table is then applied in workshops with local stakeholders to discuss the information and to harvest local knowledge about impacts and vulnerabilities. The climate adaptation atlas and touch-table can provide a valuable one-stop-shop for planners and water managers (add reference, mention example). The touch-table contains maps on impacts and vulnerability and helps users to identify key adaptation challenges in their areas of interest. It addresses policy makers and highlights areas where proposed investment policies may face future damage or opportunities due to climate change (add reference or mention example). The maps are used in several interactive and multidisciplinary workshops between scientist, policy makers and spatial planners. Together the participants can design adaptation options based on the local impacts of climate change. Experience with such workshops with planners in the Netherlands proved to be very helpful in investigating robust adaptation strategies, leading to an increased political support for action.

Visualizing future climate change for the Haor area in Bangladesh

To visualize future climate change we developed a land use model and performed a climate analysis to indicate changes in flash flood frequency and timing in the Haor. The land use modelling was done building on the EU-ClueScanner framework previously developed for the European Commission (Lavalle et al., 2011). It was calibrated by analysing historic land use data provided by CEGIS. We developed three scenarios: a baseline scenario in which population growth projections (taken from the Haor Master Plan, 2012) were projected in a business as usual policy scenario. We further developed a scenario in which flood risk avoidance was optimized, and a third scenario optimized for food production. The results are presented in the interactive figure below (fig. 4). By moving over the legend of the scenario's one can analyse where changes in land use are likely to take place in the different scenario's. For example, in the food production scenario, new settlement is avoided in areas with multiple crop rotations.

To give an indication of the changes in flash flood frequency and timing we performed an analysis of three climate models (CNCM3, ECHAM and IPSL). We analysed the areas surrounding the Haor region because rainfall in the surrounding Indian hillside area is the cause of flash floods in the Haors. A Digital Elevation Model (SRTM-90) is used to define a basic grid with directions of flow and a simple rainfall accumulation model was developed. For each grid cell (90x90m) and for each month a rainfall extreme threshold (mm2/m) is determined based on historical rainfall time series for each climate model cell relatively contributing to this grid cell. For 40 years of historical rainfall data of Bangladesh obtained from the EU-Watch data set (1960 – 2000) and for each climate model grid cell (0.5 x 0.5 degree), the threshold is defined at the 5% most extreme rainfall events. This threshold value is input for the flow that determines the accumulated value in each grid cell. The analysis is repeated for future rainfall projec-

Figure 4 - Land use scenarios visualizing possible futures for the hoar region in Bangladesh (move the cursor over the menu to show the corresponding maps)

tions. The relative accumulated difference in threshold values (flows) is plotted on the map to show the relative change in flash flood frequency per grid cell compared to the current situation. This leads to a set of maps for the three critical months (March-April-May), three models and two climate scenarios. The result is presented in the interactive map on the below (fig. 5). The figure shows the relative change in pre-monsoon flood frequency in the three months according to the three climate models. Figure 5 shows that there is limited consistency between the climate models used. The results indicate a decrease in May and an average increase in March, but the model consistency is low. It is recommended to analyse a larger ensemble of climate models to be better able to indicate possible impacts of climate change, but this was outside the scope of this demonstration project. Because of the large number of maps (18), the information was combined into one worst case climate map. The worst case map was developed to provide input for the adaptation planning workshop. The purpose of the map is to illustrate which parts of the Haor area are most likely to be affected by climate change. This was done by weighted over-

Figure 5 - Future change in frequency of extreme upstream rainfall events contributing to flash floods; different climate models, climate scenarios and months (move the cursor over the menu to show the corresponding maps)

lay of the following criteria:

- Severity of increase/decrease
- Changes early in the season are more important
- Consistency of the scenarios and models.

The worst case map is presented in figure 6.

Haor related participatory planning session

In February 2013, a one day workshop was held at CEGIS, Dhaka entitled "Integrated Management of Food, Wetland Habitat and Flood Safety under Climate Change". This workshop was organised by the consortium of the Climate Adaptation Atlas project.

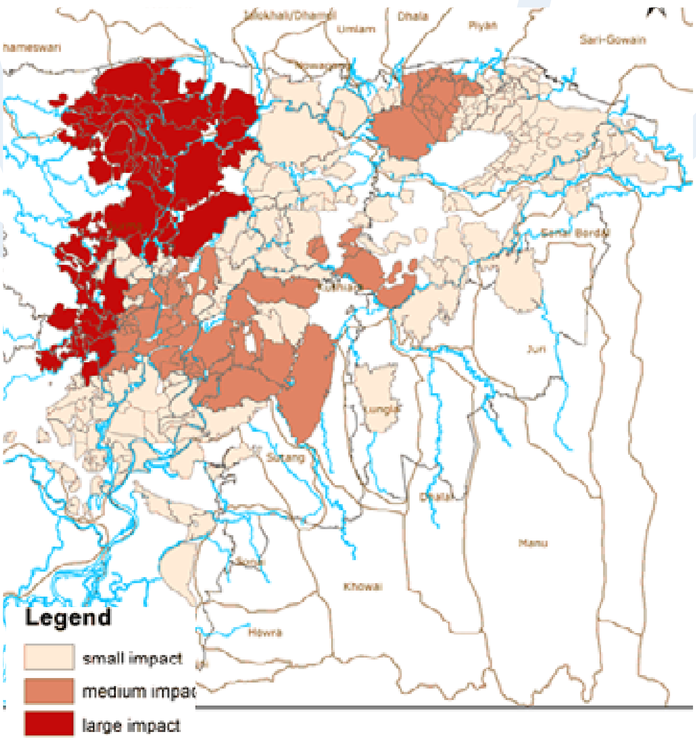

Figure 6 - The potential hazard from climate change (worst case) related to flash flood frequency and timing in the haors of Sylhet, Bangladesh

The goal of the workshop was to demonstrate and use the climate atlas/touch-table tool. The purpose was to use the climate adaptation atlas and touchtable to demonstrate its potential to facilitate participatory planning and decision making processes, in order to design adaptation strategies and measures, for the Haor area, Sylhet region. A group of 10 selected participants from various institutes involved in regional planning were invited to participate. The group was deliberately kept small, because the touch-table allows a maximum of about 10 people to actively participate in the process. During the workshop, this team of experts was asked to develop an adaptation strategy for the Haor area, as an experiment. They shared their local knowledge and expertise, and checked information gathered beforehand by the consortium, using the Touch-table to visualize, cross-reference and record local and expert information.

The expert team analyzed how climate change in combination with expected population growth would affect the vulnerability of the area, particularly in terms of food production, wetland quality and flood safety. In addition, possible adaptation measures were discussed that might reduce this vulnerability, in order to come to an adaptation strategy for the Haor area.

All information generated previously in this project, as well as information from the Haor master plan, was made available on the touch table.

Workshop process, results and observations

The workshop started with an explanation of the purpose of the workshop, a demonstration of the touch table , a discussion on the concept of vulnerability analyses and familiarization with the touch table by the participants.

Subsequently, the participants focused on two series of vulnerability analyses: food security in relation to flash floods and flood safety of settlements in relation to monsoon floods. In order to develop these two vulnerability maps, several base maps were combined with land use data, flood maps, and predicted potential effects of climate change on flash flood frequency. Participants applied their local knowledge and gave input into the vulnerability maps. The diagrams below shows which layers of data were combined in order to come to the vulnerability maps, as well as an example of the vulnerability map for food security.

After producing the vulnerability maps, participants discussed possible adaptation measures that might reduce this vulnerability. A set of measures (ranging from improved Haor drainage to pole housing) taken from the existing Haor master plan was presented, and participants were asked to discuss the appropriateness of the different measures and add measures they felt were missing. Next, the participants allocated appropriate measures to the vulnerability maps in a first attempt towards an indicative

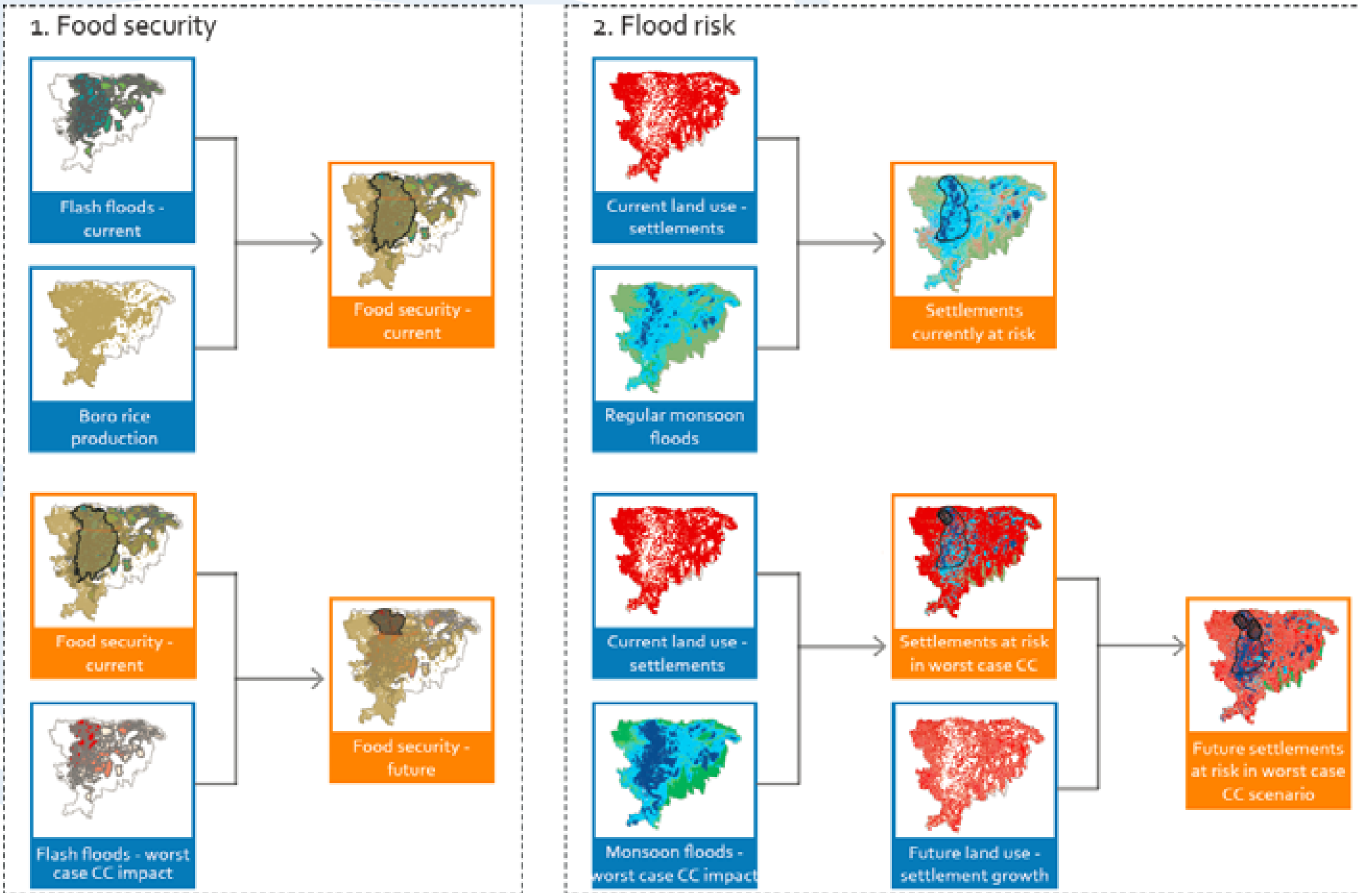

Figure 7 - Vulnerability analysis framework of the case study area

adaptation strategy for the region. The diagram below shows this first schematic attempt, which ideally should be elaborated upon in a following workshop. In a discussion on the added value of the approach, the participants were asked whether they believed it stimulates participation and whether new knowledge had been acquired. All participants were enthusiastic about the approach. Some critical remarks were made, however, regarding the size and weight of the tool: transportability to remote areas was deemed an important consideration. A smaller (tablet) version might then be an alternative. In addition, some participants asked for more advanced functionality, for instance the possibility to get interac-

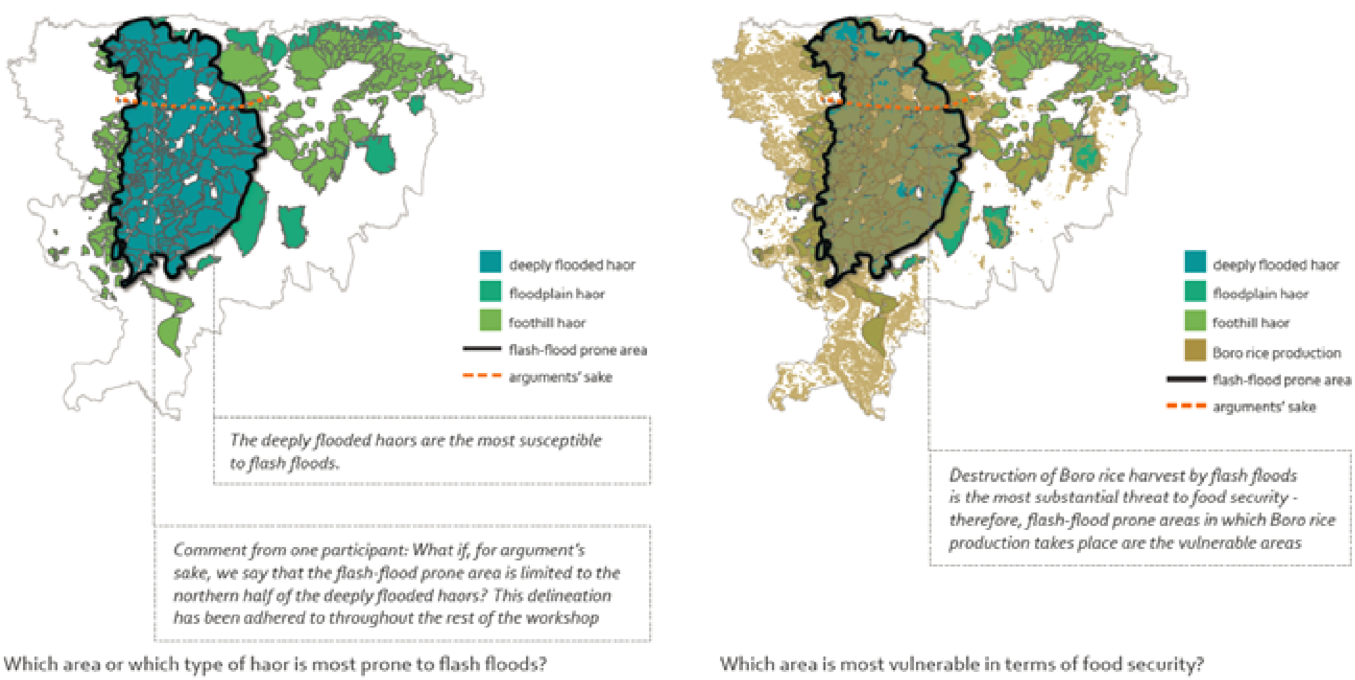

Figure 8 - Vulnerability analysis of food security in the haor region

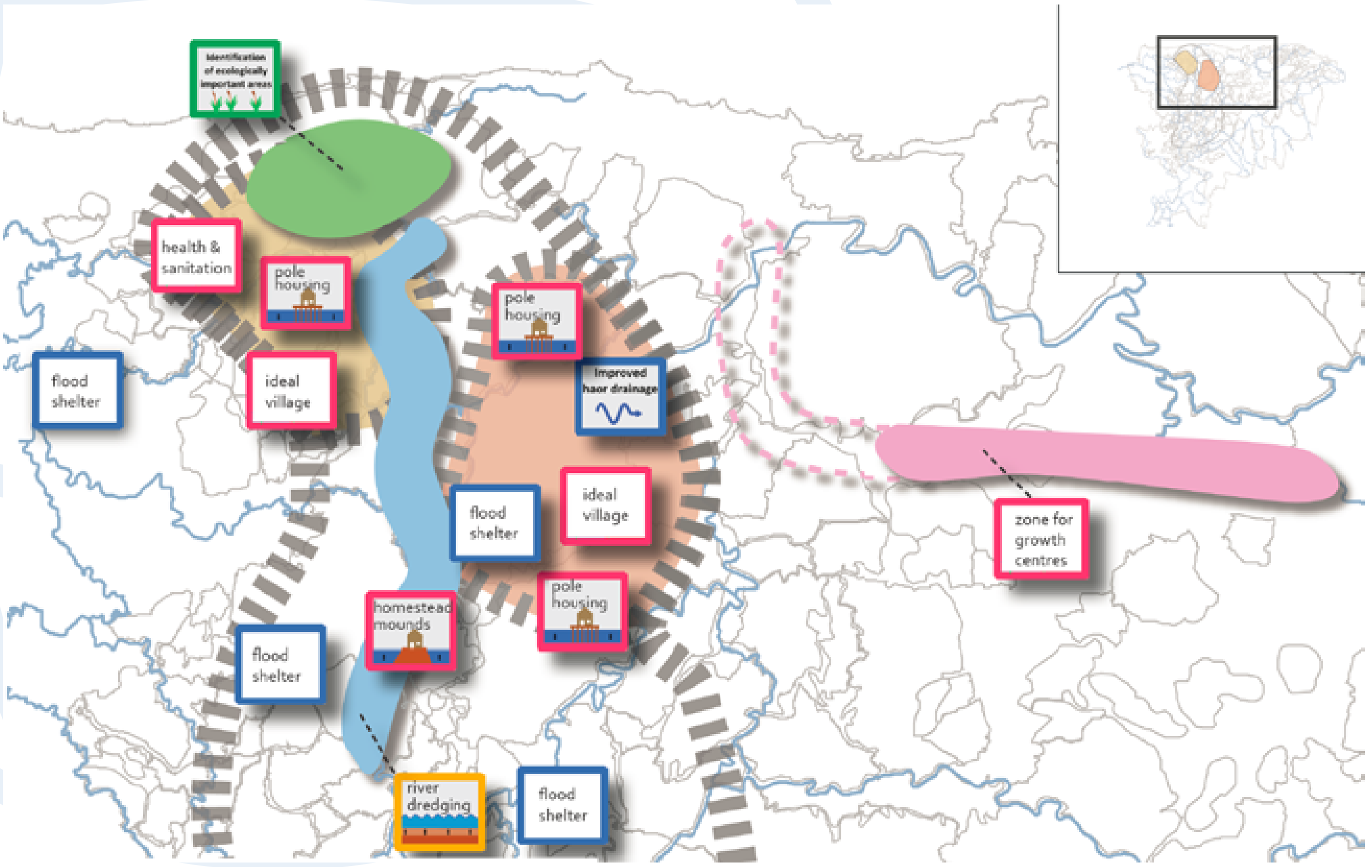

Figure 9 - Allocation of the adaptation measures

tive feedback on costs and returns on investments. This kind of functionality would probably require the coupling of different models, which might lead to the system quickly becoming a black box for the users. Please note that the workshop was limited in time, and also hampered by a power cut. A more developed strategy could be expected when more time would be available. More people could have been included who could follow the discussion, if a wall mounted screen would have been used. This may be considered in future activities.

The project has clearly demonstrated the potential of the participatory platform for adaptation planning. The participants mentioned the following benefits of the approach:

1. The climate atlas makes complex and dispersed knowledge accessible: The approach summarizes and visualises complex climate information into worst case flood maps. The touchtable enables users to easily compare, analyse and compare maps
2. The approach stimulates harvesting of local knowledge: Participants analysed future land use scenario's by making overlays with the worst case flood maps and indicated vulnerable areas within the case study region. The touchtable invited the participants to share their local knowledge.
3. The approach increases acceptance of the workshop outcomes because participants contribute directly to the participatory planning process. Their knowledge was collected and digitized during the workshop. This increases the stakeholder's acceptance of the outcomes of the workshop.

Future opportunities

The CAS platform offers opportunities for future business development and project activities. The partners for water project has identified a number of concrete business leads:

Supporting the Bangladesh Delta Plan. Bangladesh is planning to formulate and implement a nation wide Delta Plan, and the Netherlands is willing to support the formulation. The application of the CAS platform can assist to give important insight in the projected climatic changes by making data visible, comprehensible, prvide integration options and render them easily accessible.

The workshop with experts in Dhaka identified a number of possible applications of the CAS platform that will be followed up:

1. an update of the National Water Management Plan Bangladesh and 2) BWDB: project overview visualised on the touch-table and providing insight in project progress and evaluations, preferably in communication with the Ministry of Agriculture, in order to fine-tune water management/agriculture relationships, as these are continuously changing in a dynamic and fast growing country like Bangladesh.
2. Adaptation of the country of Bangladesh is a continuous process. Implementing new knowledge and innovations will remain an opportunity for many years. Now that the CAS platform has established itself in Bangladesh, updating and maintaining up-to-date knowledge will remain a business opportunity for the CAS foundation, including their international partner(s) in Bangladesh. Besides the activities in Bangladesh we intend to deliver services in other countries. For example:
3. Development of a CAS platform approach in other countries: Setting up a Climate adaptation service infrastructure in other countries (). For this a number of African countries may be considered, and especially in the South Asian region, the networks of CEGIS and the other CAS partners will be used to start up new projects in the region
4. Climate Atlases for cities. CAS platforms can also be applied specifically for city planning. This has been done for the city of Rotterdam (add reference). Though not directly relateed to this project. This may serve as a show case for other cities in the world, and the application of a city-CAS platform may be explored in Bangladesh and the regions

The project has strengthened the cooperation with CEGIS and the Dutch partners within the foundation CAS. The project has demonstrated the added value of the CAS platform in a non-Dutch context and a completely different political setting and culture. This added value is supported by the interest of a growing number of parties in Bangladesh such as WARPO, BWDB, Haor Water Development Board, to work with the CAS platform. It is foreseen that the CAS platform will be further developed for the whole of Bangladesh in support of the upcoming Delta Plan. The CAS foundation and CEGIS have the ambition to continue their strategic partnership. CEGIS has become an international partner of the CAS foundation.

Figure 10 - Working with the touch table in Dhaka, Bangladesh

More information

The Climate Adaptation Services foundation is a cooperation between Alterra, Deltares, KNMI and Geodan . For more information on the CAS foundation please visit the website: climateadaptationservices.com or mail to: info@climateadaptationservices.com.

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