
SOBA 6: PARTICIPATORY 3D MAPPING AND LOCAL CONSULTATIONS

AYEYARWADY STATE OF THE BASIN ASSESSMENT (SOBA)

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Disclaimer

"The Ayeyarwady State of the Basin Assessment (SOBA) study is conducted within the political boundary of Myanmar, where more than 93% of the Basin is situated."

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LIST OF ABBREVIATIONS

2D	two dimensional
3D	three dimensional
AIRBMP	Ayeyarwady Integrated River Basin Management Project
DWIR	Directorate of Water Resources and Improvement of River Systems
GAD	General Administration Department
GIS	geographic information system
HEZ	hydro-ecological zone
MoTC	Ministry of Transport and Communications
NGO	non-governmental organization
NWRC	National Water Resources Committee
PMU	Project Management Unit
P3DM	Participatory 3D Mapping
SOBA	State of the Basin Assessment
SOBA 6	State of the Basin Assessment 6: Participatory 3D Mapping and Local Consultations

EXECUTIVE SUMMARY

Myanmar is a country with magnificent natural resources and one of the last ‘untamed’ rivers on earth. At the same time, Myanmar’s social and economic developments are developing at unprecedented rates. In times of such significant change, and with so much to gain and so much to lose, the government of Myanmar considers it to be of the utmost importance to prepare this *Ayeyarwady State of the Basin Assessment (SOBA)* report to establish a baseline understanding of the status of the river basin as it is today. Only by understanding the present situation can we discuss the desirability of future developments and their impacts on the peace and prosperity of the people of Myanmar.

This section of the SOBA analysis, *SOBA 6: Participatory 3D Mapping and Local Consultations (SOBA 6)*, aims to empower the people of Myanmar by documenting their cultural, ecological, social, and livelihood assets, as well as the thoughts they expressed during community consultations about basin issues and community priorities. Thereby giving a ‘voice to the people’. All the people we spoke to appreciate that we came to listen to them and that their voice was heard. People are eager to learn more and engage in future developments.

In SOBA 6, we analyse the present use of the river and the values people attribute to it – either pragmatic, spiritual, or cultural. We also address what threats people perceive, how they perceive them, and whether their causes are manmade or natural.

In terms of social research, this is a qualitative analysis. The SOBA 6 Team visited 14 townships distributed alongside the entire river basin from July 4, 2017 through August 25, 2017. In each township, the team had several meetings with villagers, entrepreneurs, officials, and sometimes community or spiritual leaders. Townships were selected as representative of locations in the different states, regions, and hydro-ecological zones (HEZs) of the river basin. Additionally, practical criteria, such as accessibility, safety, and prior knowledge of the area played a part in determining which townships were chosen. Based on this selection, we distinguished trends, trade-offs, flashpoints, and storylines, thus providing examples and highlights for the more quantitative conclusions of the other SOBA packages (especially SOBA-5). The results of these meetings are presented in several forms: in this report; in pictures, videos, storylines; a database of findings; and an *Ayeyarwady River Basin Communities Atlas*. The aim is not to present statistically accurate results but to present water values and issues of concern (‘hot topics’) that are recognisable to the people we spoke to and to the parties responsible for future developments along the Ayeyarwady. Our general advice is to continue the conversation. The people of Myanmar spoke with the SOBA 6 Team with great honesty and courage. They demonstrated that they are more than willing to share their hopes and concerns and are eager to engage in future developments that will help improve their quality of life.

Overall, the people we spoke to are confident about the future and strongly connected to the Ayeyarwady River. But they also have real concerns about the future of their livelihoods. A couple of examples are interesting to present in this summary. For instance, people worry about climate change. They tell us that seasonal flooding has become more frequent and lasts longer, thereby disrupting daily life in a more profound way. They are mostly worried about the effect this has on their livelihood. They cannot work while living in shelters, and worst of all, their children cannot go to school. They also acknowledge that part of this worsened seasonal flooding might be caused by manmade erosion due to sand extraction, deforestation upstream, or developments (like the construction of bridges).

The people we interviewed are (still!) very resilient and adaptive, finding ways to cope in challenging circumstances. This is an ability to cherish; in countries with a longer tradition of flood protection like the Netherlands, resilience has been reduced greatly, leaving people with less coping mechanisms when problems do occur. Along the Ayeyarwady River, communities deal with the discomforts of flooding without expecting much help from the outside. When stating ‘hot topics’ and discussing possible solutions for the issues people face for this report, it was remarkable how rarely the inconveniences of the river were mentioned, as compared to how often wanting to improve their livelihoods was mentioned so that they could take better care of themselves and their families.

Awareness of cause and effect related to erosion is generally impressive among people living along the river. Throughout the basin, however, we have not encountered a single story on why it would be unwise to settle on the outer bend of the river, where due to high velocities, erosion is often much more problematic than on the inner bend. Widespread awareness on this issue seems to be lacking. The good news is that it is straightforward to educate people about this natural river phenomenon, with a likely significant positive impact on safety and liveability. Of course, morphological conditions are dynamic and changing, and further understanding is necessary, as is soil conservation in the middle/dry region since erosion there is potentially harmful to agriculture and the general water holding and water infiltrating capacity in the area.

Where people are directly dependent on the river for their livelihoods, like fishermen, the changes in the environment are felt acutely. Fishermen tell us about the reduction in the amount of fish they catch and blame this on other fishermen who fish too much, fish too early in the spawning season, or use illegal means, like batteries or poison. They ask the government to be stricter in law enforcement.

The gold mining industry appears to be highly polluting, with large and generally far-reaching impacts. Diesel residues from the engines, mercury, and waste water containing among others cyanide are discharged into the river. Downstream from the mines, for tens and sometimes hundreds of miles, villagers describe the river as “dead” with hardly any fish remaining. As recently as 20 years ago, the river provided good drinking water, and people bathed in its waters. Today, however, people argue that the loss of a healthy river environment affects their communities in many undesired ways. River water cannot be safely used for drinking water. Swimming in the river reportedly causes skin rashes and other diseases. The pollution also chases away tourists, whereas in theory, because of its natural beauty, the river has a huge potential for tourism.

There are many concerns about the impacts of the big dams planned for hydroelectricity in the north, particularly regarding navigability, economy, livelihoods, and social cohesion.

Sufficient solid waste management is lacking nearly everywhere, which results in garbage ending up in the river. Negative impacts are still limited, but the problem increases, especially with regard to plastic waste, and should be addressed for a cleaner river in the future.

In natural disaster-prone areas like the delta or places where flash floods occur, the concerns raised by extreme weather and the awareness about possible impacts of climate variability and climate change are considerably higher than elsewhere.

Two social issues are the lack of peace in the upper part of Ayeyarwady River Basin and the strong international involvement in large river-related projects, like hydropower. People are concerned about increased environmental and social impacts to their communities.

The methodology, 3D participatory mapping/modelling, has proven to be a good method for this kind of research. The method was especially effective in the first phase of each session, when we asked people to rank their issues of concern by placing a limited number of stickers on pictures of these ‘hot’ issues, which proved to be a very good and low-level technique to start the conversation. It is easy to use and explain to people, even if they have little formal education. The 3D model itself is excellent as a final product, because it strongly communicates the connections and dependencies along the entire basin. It is rather cumbersome to travel with parts of the model, which needs to be taken into consideration for the next stage of the basin research phase. Maps and aerial photos are an excellent means of reference and are much easier to transport. Use of these materials requires explanation to participants and, therefore, additional time. Not everyone finds it easy to translate their location and experiences to a place on a map. One needs to be able to read maps and even 2D pictures. We discovered that it is best to separate local experts, including farmers and local inhabitants, from the rest of the group and have more in-depth conversations with them based on the maps, while the rest of the group receives help filling in the questionnaires.

Concerning the meta-analysis of this methodology, we concluded that 3D participatory modelling is a valuable technique, because it gives voice to the people. On a more theoretical basis, giving voice to the people is desirable for several reasons. First, because it will tap into local knowledge and experience. The importance of resilience when faced with the risk of flooding has already been mentioned. But also, traditional ways of dealing with issues like clean drinking water (such as with the use of crystals or nuts) are interesting to investigate further. Second, it enlarges the license to operate of those responsible for future

developments along the Ayeyarwady River. People tend to be more supportive of developments if they understand the issues and solutions, and see the bigger picture, especially when their point of view and interests are taken seriously. Third, because the database will form the basis for professional stakeholder management, which is a requirement for most donors and financial institutes. A sound database will be updated regularly, with new insights into points of view and local interest, and results of, for example, negotiations with local communities. Listening to the voice of the people also implies that you show that you are listening and understand what you are hearing. It does not mean agreeing to everything that is being said and asked, but rather showing that you hear the concerns and the hopes of the people, and explaining what you can and cannot do. This means maintaining an interactive dialogue with the communities, thereby providing a sound baseline for future community consultations in the Ayeyarwady River Basin.

1 INTRODUCTION

1.1 Community Consultations for the State of the Basin Assessment

Myanmar is endowed with abundant natural resources, including land and water, which are poised for rapid development in the coming years and decades. The Myanmar government has received a World Bank Credit for the Ayeyarwady Integrated River Basin Management Project (AIRBMP), managed by the Directorate of Water Resources and Improvement of River Systems (DWIR) of the Ministry of Transport and Communications (MoTC). The objective of the project is to help Myanmar develop the institutions and tools needed to enable informed decision making in the management of the country's national water resources and to implement integrated river basin management on the Ayeyarwady. The main elements in the Ayeyarwady basin development planning process include the *State of the Basin Assessment (SOBA)*, which is a major technical product of the AIRBMP that represents a comprehensive integrated environmental, social, and economic baseline for the Ayeyarwady River to-date. The SOBA highlights issues, opportunities, risks, trade-offs, and uncertainties, which will need to be addressed in the basin master planning process. To develop the SOBA, the AIRBMP Project Management Unit (PMU) subcontracted six technical packages to cover a specific scope.

This document presents work completed for the sixth package: *Participatory 3D Mapping (P3DM) and Local Consultations (SOBA 6)*. The work had the following two objectives:

1. Development of a three-dimensional (3D) relief model of the Ayeyarwady Basin; and
2. Local consultations – The design and implementation of a public, multi-stakeholder consultation process which uses the 3D relief model and large maps to take stock of the cultural, ecological, social, and livelihood assets as well as discussing issues of the basin that are of priority interest to local basin communities.

The results of the project are twofold:

1. The methodology – A description of the experiences with 3D Participatory Modelling and community consultation. We describe the methodology, present the use of the 3D model in consultation sessions, analyse lessons learned, and advise how to implement (an improved version of) the model and the methodology in future state of the basin assessments.
2. The data – We present quantitative findings (the database) on the cultural, ecological, and livelihood assets, and present key topics of interest to local communities ('hot topics'). It is important to underline that we used a qualitative approach to conduct an in-depth analysis of local communities based on field work we performed in two to three communities within each of the 14 townships we studied. In total, 35 communities were visited. We selected these townships with care and the results of the research provide important insights into key topics of interest pertaining to the main catchment areas of the Ayeyarwady; however, the research is qualitative and is not intended to be statistically representative.

1.2 Methodology

The methodology is based on the principles of 3D participatory modelling, which is used to create a shared understanding of all relevant aspects of, in this case, a river basin, by creating a physical model and discussing the issues and assets that are or should be shown on the model. This method is excellent if:

- Participants have different levels of education (because this method can be used even when people are analphabetic);
- Emotions, frustrations, opportunities, hopes for the future, trends, and trade-offs should be part of the discussion; and/or
- Both participants and researchers desire a heightened understanding of the integrated workings of a river system.

The assumptions were that proactive local participation will:

- Access local knowledge and experience;
- Provide the possibility of public support and understanding;
- Give policy developers and planners license to operate;
- Bring empowerment to local communities;
- Provide an inventory of social, cultural, environmental, and economic assets; and
- Provide learning by doing: design a proactive participation process that will provide capacity development to both participants and future local initiators of public participation processes, and can be reproduced.

Participation during sessions was intended to provide two outcomes:

1. Validation of assumptions/hypotheses of communities on cultural, spiritual, ecological, social, and livelihood assets, based on hypotheses as formulated in the scoping report; and
2. Collection of community priority aspirations, issues, challenges, concerns and best practices, with validation of the method and specific information for each location.

This meant that we needed to find an appropriate combination of listening and talking, as we wanted to verify our own assumptions on several topics, while giving ample opportunity to the communities to tell us their concerns, priorities, and examples of opportunities. Therefore, we presented our assumptions on session maps and posters and asked participants whether they saw anything unusual or could relate to the assumptions. As a result, 80% of the talking during participation sessions was done by the participants.



Figure 1 – People sharing concerns, priorities and opportunities during discussions

Each field visit had a preparation phase in Yangon, where both practical (logistics, people/groups to invite, places to stay, catering, permits) and content of the sessions (local circumstances, assets, key topics of interest) were discussed by the team. A local member of the project team travelled ahead to prepare sessions on-site. People who were invited included local and regional authorities, regional politicians, members of the local communities (including main water users: farmers, fishermen, manual laborers, local entrepreneurs), religious leaders and non-governmental organisations (NGOs).

1.2.1 Data Requirements

We used the technique of participatory 3D relief modelling to provide the framework for local consultations. Results of P3DM will allow the Hydro Informatics Centre to overlay community assets of value and their concerns on top of basin development options, which will help ensure more equitable distribution of benefits from water resource management from Union to Local level (Social Inclusiveness and Equity).

We used the 3D relief model of the specific hydro-ecological zone (HEZ) where the community is located to discuss the broader picture of the river basin and relations in the system (if feasible in planning and logistics). We also used two-dimensional (2D) topographic maps and hypothesis/assumptions/data as input for the local community consultations.

As described in the scoping report dated 26 June, 2017, the following approach was used.

1. **Input** based on the work of SOBA packages 1 to 5, with special focus on the socio-economic data of package 5. Critical path: check planning of other packages.
2. **Throughput:**
 - i. Collection of relevant data to develop a 3D relief model; and
 - ii. Collection of data for 14 township profiles, with information on cultural, spiritual, ecological, social, and livelihood assets.
3. **Validation** during community sessions via a qualitative method. Data and assumptions were tested, based on the input of the other packages, during community sessions and additional field work, however, statistically validated quantitative data was not acquired.
4. **Output:** building blocks for the central database. On the most practical level, information from the sessions are input into the 3D relief model by adding ‘sticky notes’ on the 3D relief model. Additionally, the 3D relief model was used to explain and show the larger river system. In the final model, geographic information system (GIS) maps of the model will include factsheet popup screens.

1.2.2 Township Selection

Township selection for consultations of communities was based on:

- Geographical location in the Ayeyarwady River Basin, with the objective of including all HEZs;
- Ethnic and cultural representativeness;
- Location in relation to the Ayeyarwady River; and
- Alignment with other SOBA activities.

In each township, two or three villages or wards were selected in close cooperation with the local General Administration Department (GAD). Township profiles were created in advance and finalized after our visit. Whenever possible, we visited the GAD office to gather extra input for the township profiles.

1.2.3 Community Consultation Sessions & Data Management

Introduction

Each session started with an explanation of the AIRBMP project, SOBA, and the river system itself by using the 3D relief map and large (double A0 size) printed maps of regional areas and townships.

Data collection and processing took place as described by the following steps and depicted on Figure 1.

Counting participants (asking “Who is present?”)

By counting the participants, asking about their occupations, and keeping participant lists, an overview of the distribution of gender and roles of the people in the community was created. The results are part of the digitized database and the *Ayeyarwady River Basin Communities Atlas*.

Gender

Specific care was taken to make sure that women could participate equally. This was achieved by:

- Having a female team leader and female experts (alongside their male colleagues) leading the sessions and the interviews;
- Ensuring that women were invited to participate in discussions and interviews, and were enabled in those processes, sometimes through further prompting; and
- Registering how many women were present, and whether or not specific remarks were gender-based.

Ethnicity

Communities were not specifically selected with ethnic diversity in mind, nor did we ask people about their ethnic background. In selecting the townships, all HEZs were included evenly, so a geographic spread was achieved.

Collecting participants’ insights on water values and problems (using posters and stickers)

All participants received four green and four red stickers to indicate their most important water values and issues on two different posters. The posters depicted the issues with pictures. This method was used to engage the participants in a more in-depth discussion. The results are included in the digitized database.

Collecting detailed participants’ insights on river issues (using sticky notes)

Each participant received one sticky note to record their issue with regard to the river. The sticky notes were attached to a large (A0 size) map, zoomed in on the specific township and indicating the locations of the issues. All sticky notes were collected after the session and used to develop quotes, and are included in the digitized database.

Recording quotes and storylines

Participant quotes were collected from the sticky notes mentioned above and also from discussions that took place in the last part of each consultation session. Two types of meeting minutes were developed; storylines were prepared by the international experts, and meeting minutes were prepared by the national experts.

Collecting participants’ insights via questionnaires

Hard copies of questionnaires written in Myanmar language were given to the participants. Members of the Myanmar team helped to fill in the questionnaires by creating smaller groups and leading group interviews. The answers were recorded on the questionnaires. The questionnaires enabled people who are (semi) analphabetic to join the discussion and helped the project team reach a deeper understanding of the main issues. An English Questionnaire Microsoft Excel file was populated with raw data from the questionnaires and the data have been analyzed and translated into the digitized database.

Recording testimonials (as videos)

After the session, some people were interviewed for testimonials. A total of 81 testimonial videos in Myanmar language were recorded. One testimonial for each township was subtitled in English. Myanmar language was used in all townships during consultation sessions. However, in Myitkhina Township (Kachin state), the session was also translated into the local language to ensure everyone could understand what was asked and discussed.

Taking photographs

After most sessions (if time was sufficient) the participants showed us their local area and their main issues. This interaction created a different, less formal dynamic, and enabled us to have more private conversations with the participants. Photographs were taken to record the specific issues and people involved. Photographs are relevant and important to this research because they help indicate certain situations more clearly, give testimony to the issues that were shown to us, and indicate our level of involvement.

Photographs are included in the storylines, this SOBA 6 report, the *Ayeyarwady River Basin Communities Atlas*, and the digitized database.

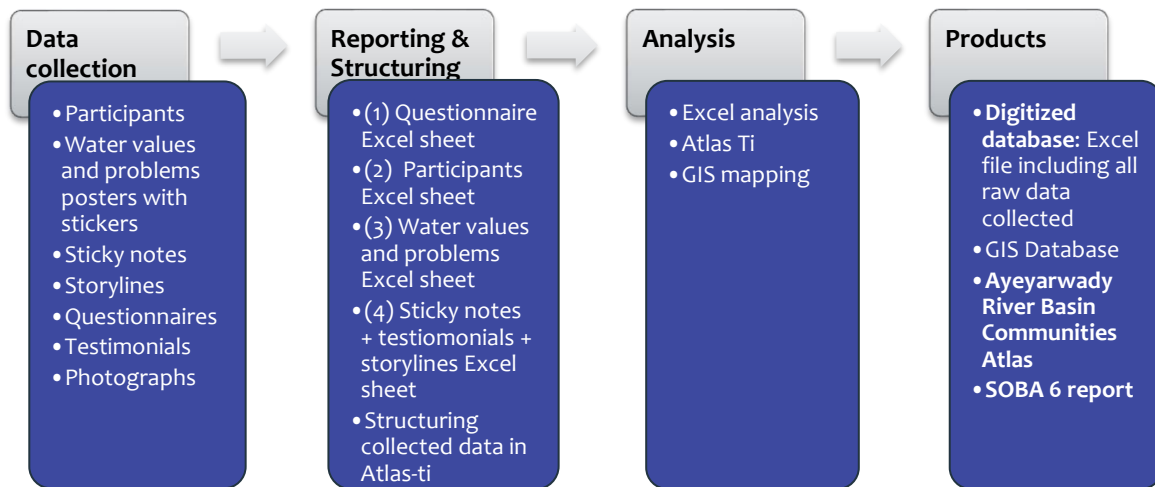


Figure 2 - SOBA 6 process of community consultations and data management

1.2.4 Participatory 3D Mapping and GIS maps

A 3D participatory relief map, measuring approximately 5x3 metres, was developed prior to the community consultations sessions. The relief map consists of a total of seven pieces, for practical reasons. To each consultation session, one or two relevant pieces played a key role to start conversations. The relief map has also been used to explain the river system and possible impacts upstream and downstream of the river. It is important to understand the bigger picture, when it comes to different interests in certain areas.

For each township, two large (double A0 size) maps were printed, one zoomed in on the township and one depicting more detail on the urban area of the township. It motivated people to point to their house, the consultation session location, and the location of certain issues and developments on the maps. The maps were very useful and supportive tools during the discussions.

1.2.5 Data Analysis

Excel & GIS analysis

Excel and GIS-based software (i.e., ArcMap) were used as the main post-processing tools for data management and analysis of the data derived from the community sessions. The tools were used to structure, analyze, and visualize the results of the consultations. Moreover, data is coupled to both tools in order to perform a spatial analysis of the findings and to check the consistency with expectations. The SOBA community database is formed in Excel. It contains an ordered database of all data collected from the sessions, including questionnaires, sticky note comments, and the identification of the problems, values and occupations of people living in the communities we visited. From these data, graphical representations were made for all communities, together with a comparison between the community and the specific township, HEZ, and basin average. GIS-based software was used for data management and geospatial data visualization by creating various maps. Excel data can be retrieved into GIS by the interconnection of both tools to create a readable and understandable link between data and their geographical location. Furthermore, open data sources such as MIMU are consulted from where the essential underlying map layers are obtained. These map visualizations are included in both this SOBA 6 report and the *Ayeyarwady River Basin Community Atlas*.

To explain the effective use and prompt critical thinking about the interconnection of Excel in combination with GIS, a one-day workshop was provided to the most recent Young Water Professionals working on the project as well as a number of Junior Researchers. After explaining the essentials of GIS, remote sensing, and how to perform a spatial analysis, they were tasked with interpreting data obtained from community sessions and establishing a hypothesis. The hypothesis was validated by creating maps in GIS to assess

whether their initial expectations could be validated and to explain why. They also learned to join Excel data with GIS.

Atlas Ti analysis

Atlas-Ti software was used to structure and analyse the different types of qualitative input data. Atlas-Ti is a program which can handle different types of qualitative data input by structuring and coding the different types of text. The output of Atlas-Ti is an overview document of all coded parts of text for the various types of data. Moreover, it provides a “quotation count table” from where one can derive how often a certain code is mentioned throughout all the documents. However, the amount of quotations mentioned should not be tied to any quantitative conclusions because it only shows a relative importance within one data input document.

Additional materials

The following products related to the community consultations were developed for inclusion in the SOBA:

- This SOBA 6 report;
- Readable and useful Excel sheet with all collected raw data and digital GIS-maps (*Digital Database*);
- *Ayeyarwady River Basin Communities Atlas* with all relevant data (analysed and mapped), quotes, photographs, and testimonials as a communication document;
- 3D relief map of the Ayeyarwady River Basin; and
- Testimonial videos of villagers in the Ayeyarwady River Basin.

2 SETTING AND CONTEXT

The Ayeyarwady River Basin consists of five HEZs, indicated on the map below. The 14 consulted townships (red on the map) are either in the Upper, Chindwin, Middle, Lower or Delta zone.

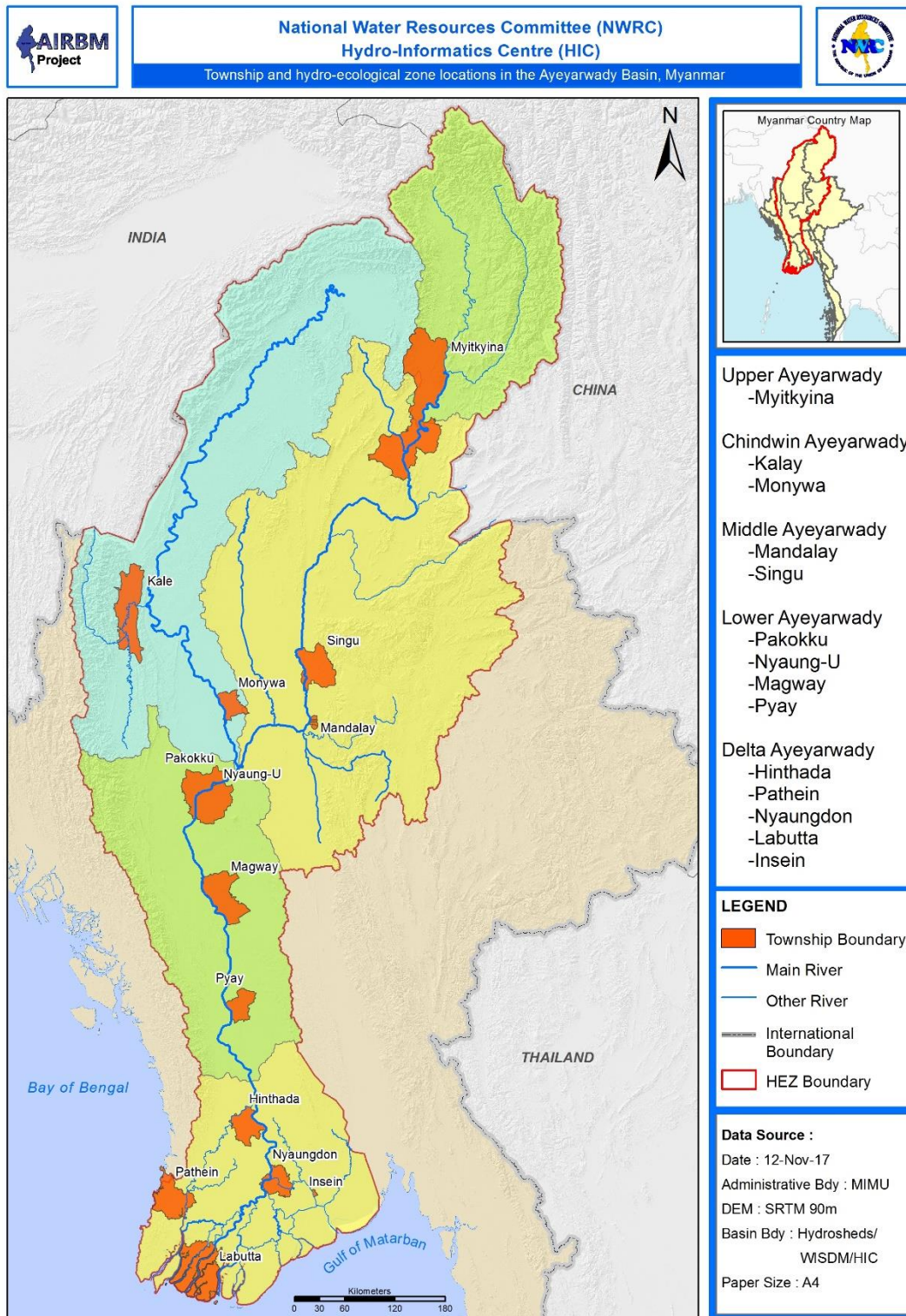


Figure 3 - Consulted townships in the five HEZs

Table 1 - Overview of community locations: HEZ, townships and villages

HEZ	TOWNSHIP	VILLAGE
Upper Ayeyarwady River Basin	Myitkyina	Shitapu Ward
		Naung Nam
		R Lan
Chindwin (Ayeyarwady) River Basin	Kalay	Hlaing Thar Yar
		Nga Pha
		Innsein
	Monywa	Shwe Pyi Aye Ward
		Sith Pin Ward
Middle Ayeyarwady River Basin	Singu	2nd Ward
		Khu Lel
		Nga Pyin Inn
	Mandalay (City)	Shan Kalay Island
		Seth Yeik (South)
		Tha Yet Ta Pin (North)
Lower Ayeyarwady River Basin	Nyaung-U	Kya O
		1st Ward
	Pakokku	Kyun Nyo Gyi
		Kyat Tan Kone
	Magway	Mi Chaung Ye
		Mal Hla Taung
	Pyay	Kone Tha Lin
		Na Win Ward
Ayeyarwady Delta	Nyaungdon	Thaung Tan
		Nyaungdon
	Pathein	9th ward
		Kan Ni
		Ma Yan Chaung
	Laputta	1st ward
		Kyauk Phyu
		La Put Ta Louk (South)
	Hinthada	Phaung Chaung
		Pa Khan
Yangon City (try-out sessions)	Insein	Kan Nar Ward

Land use in the Ayeyarwady basin

The HEZs differ very much regarding cultural, ecological, and social assets. In the Upper HEZ and Chindwin HEZ most of the people are Christian and the religious and cultural assets are dominated by churches. Land use consists of evergreen forest and some dry mixed deciduous forest in the upper HEZ, and scrubland in the Chindwin HEZ.

In the middle and lower HEZs many pagodas can be found along the Ayeyarwady River and in villages. The land use is extremely diverse and includes forest, scrubland, and a lot of agricultural land, as shown on the Figure 2 map.

The Ayeyarwady Delta is dominated by agriculture, particularly paddy fields.

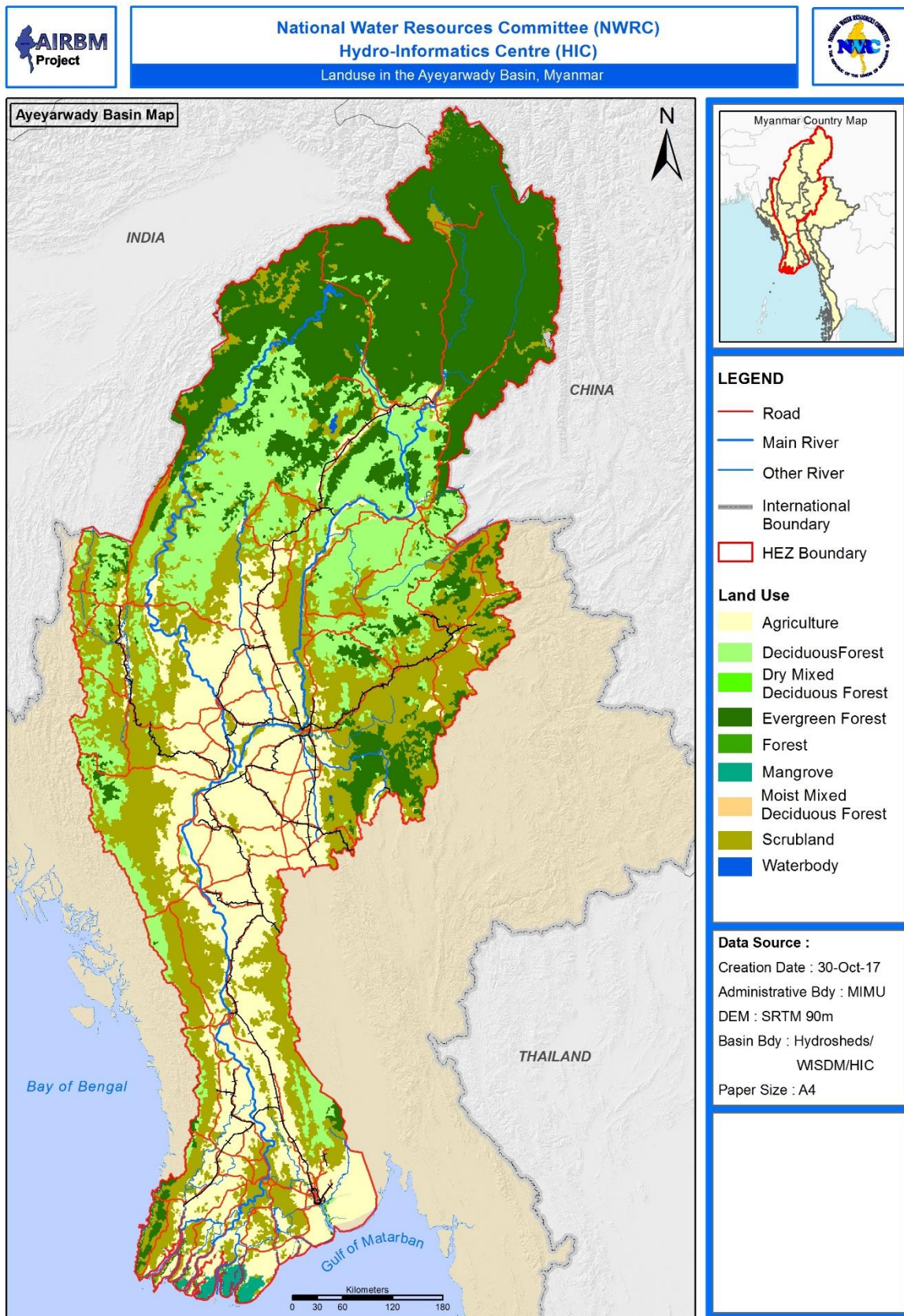


Figure 4 - Land use in the Ayeyarwady River Basin

3 STATUS: ISSUES, VALUES & TRENDS

3.1 Values and Problems in a Glance

Table 2 shows the problems and associated trends mentioned during discussions at the villages. Problems without a specific trend over time are indicated with a “P” in the table. The arrows indicate an increase or decline of a specific trend. The “flashpoints” indicate the most significant problems that were mentioned during the discussions.

Table 2 – Problems and associated trends revealed through discussions with villagers

HEZ	Township	Village	Sanitation	Drinking water from river	Solid waste	Hard infrastructure	Resilience	Governance	Pollution	Fisheries	Erosion	Deforestation	Flooding	Irrigation	Sedimentation	
Upper Basin	Myitkyina	R Lan			↑				⚠	↓	↑	↑	↑			
		Naung Nam			↑	↑			⚠	↓	↑					
		Shitapu Ward		↓	↑	↑			⚠							
Chindwin Basin	Kale	Innsein									⚠	↑	⚠	↓		
		Nga Pha		⚠							⚠	↑	⚠	↓		
		Hlaing Thar Yar		⚠	↑						⚠	↑	⚠	↓		
	Monywa	Shwe Pyi Aye Ward			P			P				↑	⚠			
		Sith Pin Ward					↑			⚠		⚠				
Middle Basin	Singu	Khu Lel		↓	P					↓			⚠			
		Nga Pyin Inn	P	⚠						↓			⚠	↓		
		2nd Ward		↓							P		P			
	Mandalay	Shan Kalay Island			↑			P			⚠				↑	
		Tha Yet Ta Pin (North)							P		↓			⚠		
		Seth Yeik (South)		⚠	P			P		↓						
Lower Basin	Magway	Mal Hla Taung	P		P			⚠	P		↑		P			
		Mi Chaung Ye	↓	↓	P					↓		P	⚠			
	Nyaung-U	Kya O				P	⚠			↓				⚠		
		1st Ward (Nyaung-U)			⚠				⚠							↑
	Pakokku	Kyun Nyo Gyi						P		↑				⚠		
		Kyat Tan Kone			↑		↓		↑		↑			⚠		
	Pyay	Kone Tha Lin		⚠	↑				↑		↑			P		
Na Win Ward			⚠	↑				↓		↓	↑		P			
Delta Basin	Hinthada	Pa Khan								⚠	↑		P		⚠	
		Phaung Chaung		⚠	↑			⚠	⚠	⚠	P		P			
	Labutta	Kyauk Phyu			⚠					↓		↑			⚠	
		1st ward (Labutta)		↓	↑			⚠								
			La Put Ta Louk (South)			↑				↓	↑			↓	↑	
	Nyaungdon	Nyaungdon		↓							⚠		↑		⚠	
		Thaung Tan										↑	↑			
	Pathein	Kan Ni				↑				⚠	↑		↑			
		Ma Yan Chaung				⚠			⚠	⚠				P	↓	↑
9th ward				P				⚠					↑			

↓ = decline ↑ = increase P = mentioned as problem ⚠ = key issue of concern

Table 3 and Table 4 show the relative importance of the problems and values per village, respectively. These data are based on the results of collecting participants’ insights on water values and problems using posters and stickers, as described in Section 1.2.3. Perceived importance is indicated by color and can be used for a first comparison between villages, townships, and HEZ.

Table 3 – Relative importance of problems, as indicated by villagers

HEZ	Township	Village	Solid waste	Pollution	Erosion	Flooding	Conflict
Upper Basin	Myitkyina	R Lan	Orange	Orange	Yellow	Green	Green
		Naung Nam	Orange	Orange	Orange	Yellow	Green
		Shitapu Ward	Orange	Yellow	Orange	Orange	Yellow
Chindwin Basin	Kale	Innsein	Yellow	Yellow	Orange	Red	Green
		Nga Pha	Yellow	Green	Orange	Orange	Yellow
		Hlaing Thar Yar	Orange	Orange	Orange	Orange	Green
	Monywa	Shwe Pyi Aye Ward	Orange	Yellow	Yellow	Red	Green
		Sith Pin Ward	Green	Green	Red	Orange	Green
Middle Basin	Singu	Khu Lel	Orange	Orange	Yellow	Orange	Green
		Nga Pyin Inn	Orange	Orange	Orange	Orange	Green
		2nd Ward	Orange	Orange	Yellow	Orange	Yellow
	Mandalay	Shan Kalay Island	Yellow	Yellow	Red	Yellow	Green
		Tha Yet Ta Pin (North)	Orange	Green	Green	Red	Green
		Seth Yeik (South)	Yellow	Yellow	Red	Yellow	Green
Lower Basin	Magway	Mal Hla Taung	Orange	Orange	Yellow	Orange	Green
		Mi Chaung Ye	Yellow	Orange	Orange	Yellow	Green
	Nyaung-U	Kya O	Green	Green	Orange	Red	Green
		1st Ward (Nyaung-U)	Orange	Orange	Orange	Orange	Green
	Pakokku	Kyun Nyo Gyi	Green	Green	Red	Orange	Green
		Kyat Tan Kone	Green	Yellow	Orange	Orange	Green
	Pyay	Kone Tha Lin	Orange	Yellow	Yellow	Orange	Green
Na Win Ward		Orange	Yellow	Red	Orange	Green	
Delta Basin	Hinthada	Pa Khan	Green	Green	Orange	Red	Green
		Phaung Chaung	Green	Green	Orange	Orange	Green
	Labutta	Kyauk Phyu	Orange	Orange	Orange	Orange	Green
		1st ward (Labutta)	Orange	Orange	Green	Orange	Green
		La Put Ta Louk (South)	Orange	Orange	Yellow	Yellow	Green
	Nyaungdon	Nyaungdon	Orange	Yellow	Orange	Orange	Green
		Thaung Tan	Green	Yellow	Red	Orange	Green
	Pathein	Kan Ni	Yellow	Yellow	Red	Orange	Green
		Ma Yan Chaung	Green	Orange	Orange	Red	Green
9th ward		Orange	Yellow	Green	Red	Green	

Notes: green = not important; yellow = a little important; orange = important; red = very important

Table 4 – Relative importance of values, as indicated by villagers

Basin	Township	Village	Aquatic ecosystem	Irrigation	Sanitation	Fisheries	Aquaculture	Navigation	Recreation	Hydro-power	Good governance	Resilience	Drinking water	Industrial use	Social, culture & religious
Upper Basin	Myitkyina	R Lan	Green	Grey	Grey	Green	Grey	Green	Blue	Grey	Blue	Grey	Blue	Grey	Grey
		Naung Nam	Green	Grey	Grey	Grey	Grey	Green	Blue	Grey	Grey	Grey	Blue	Grey	Grey
		Shitapu Ward	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue
Chindwin Basin	Kale	Innsein	Blue	Green	Blue	Green	Blue	Blue	Blue	Blue	Blue	Green	Blue	Blue	Blue
		Nga Pha	Blue	Green	Blue	Blue	Blue	Green	Blue	Blue	Blue	Green	Blue	Blue	Blue
		Hlaing Thar Yar	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue	Blue	Blue
	Monywa	Shwe Pyi Aye Ward	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue	Blue	Green	Blue	Blue	Blue
		Sith Pin Ward	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue	Blue	Green	Blue	Blue	Blue
Middle Basin	Singu	Khu Lel	Blue	Green	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue	Blue
		Nga Pyin Inn	Blue	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue	Blue
		2nd Ward	Blue	Blue	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue	Blue
	Mandalay	Shan Kalay Island	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue
		Tha Yet Ta Pin (North)	Blue	Blue	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue
		Seth Yeik (South)	Blue	Blue	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue
Lower Basin	Magway	Mal Hla Taung	Blue	Blue	Blue	Blue	Blue	Green	Blue	Blue	Blue	Blue	Green	Blue	Blue
		Mi Chaung Ye	Blue	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue
	Nyaung-U	Kya O	Blue	Green	Blue	Green	Blue	Blue	Green	Blue	Blue	Blue	Blue	Green	Blue
		1st Ward (Nyaung-U)	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue
	Pakokku	Kyun Nyo Gyi	Blue	Green	Blue	Blue	Blue	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue
		Kyat Tan Kone	Blue	Green	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
	Pyay	Kone Tha Lin	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue	Blue	Blue	Blue	Green	Blue
		Na Win Ward	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue
Delta Basin	Hinthada	Pa Khan	Blue	Blue	Blue	Green	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue
		Phaung Chaung	Blue	Blue	Blue	Green	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue
	Labutta	Kyauk Phyu	Blue	Green	Blue	Blue	Blue	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue
		1st ward (Labutta)	Blue	Blue	Blue	Green	Blue	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue
		La Put Ta Louk (South)	Blue	Green	Blue	Green	Blue	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue
	Nyaungdon	Nyaungdon	Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue	Blue	Green	Blue	Blue	Blue
		Thaung Tan	Blue	Blue	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
	Pathein	Kan Ni	Blue	Green	Blue	Green	Blue	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue
		Ma Yan Chaung	Blue	Green	Blue	Green	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue	Blue
9th ward		Blue	Blue	Blue	Blue	Blue	Blue	Green	Blue	Blue	Blue	Blue	Green	Blue	

Notes: grey = no significant value; blue = moderate value; green = high value

3.2 HEZ: Upper Ayeyarwady

3.2.1 Myitkyina Township

Townships assets

Myitkyina is the northernmost river port and railway terminus in Myanmar. Myitkyina has been an important trading town between China and Burma since ancient times and as a business centre of Kachin State. Resources are jade, gold, teak and forestry products, and agricultural products. Myitkyina Airport is the main airport serving the city. Myitkyina is an engaging, quiet, multicultural place, home to Kachin, Lisu, Chinese, and Burmese. It is strongly rooted in Christian and Kachin traditions and most of the population is Christian. Against the backdrop of mountains, not too far away, the river environment around Myitkyina is very picturesque. It explains why people say that they see a great potential for local (river) tourism. Based on the results from the questionnaires, Figure 5 shows river use in Myitkyina Township.

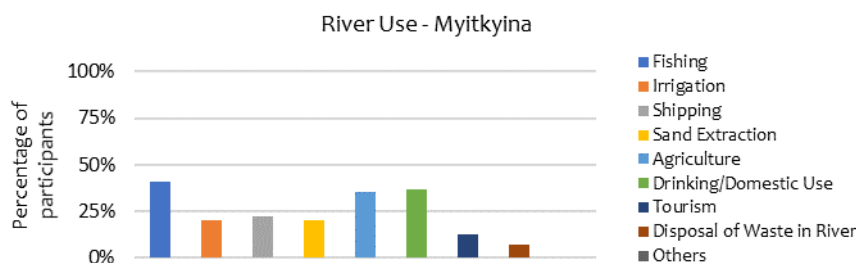


Figure 5 – River use in Myitkyina Township

Issues

What people need most in Myitkyina, is peace. The current civil war in Kachin disrupts society in all aspects; it creates uncertainty, spatial access restrictions, and greatly hinders development. The people feel that a federal system should be created featuring a state constitution based on shared power, with education and opportunities. They would then, perhaps, be open to small-scale developments that meet their needs.

People are also very concerned about gold mining and plans for hydropower dams.

The gold mining industry employs many locals by exploiting them, which leads to exhaustion and widespread escape into the use of opiates, with severe adverse impacts on local society as a result. In addition, the industry is said to be highly pollutive and is discharging toxic waste waters containing mercury and cyanide into the river. This is the main perceived reason for the fact that today the river is ‘dead’ with hardly any fish left swimming around and an unhealthy environment to bathe or extract drinking water from. The river has great touristic potential, but in the current state only chases the tourists away.

Concerning the dams, there are currently no less than six new ones planned. The largest (Mit Sone) is already under construction not far upstream from Myitkyina. A seventh dam is operational on a tributary to the N Mai Kha. The experiences with this existing dam are apparently very negative: there is a lack of transparency on energy yield, beneficiaries, profits, environmental impacts, and social impacts; essential river transportation routes are often blocked; and there is an intervention scope that bypasses the interests of local communities—which all contribute to making the lives of people in Myitkyina more difficult, if not impossible. The people suffer: they are uninformed and often forced to leave their lands. This creates tensions between villages and a decline in faith in the state government. Electricity is produced nearby, but the national government refuses to grant access to the electricity for the local communities. It is unclear how

Kachin or Myanmar share in revenues; in any case, revenues are believed to end up in the wrong hands. The energy that is produced exceeds by far the demand in the region.

Figure 6 shows the main degradation causes in Myitkyina Township.

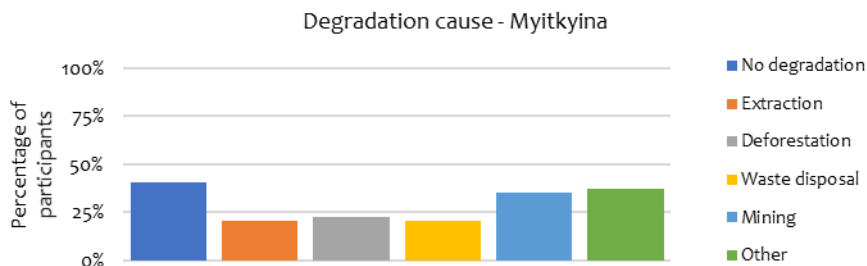


Figure 6 - Degradation causes in Myitkyina Township

Values

The people of Myitkyina value the Ayeyarwady River Basin as it is, and prefer to preserve it so that it can continue to sustain their lives as it has done for centuries, rather than to extract energy and natural resources, especially considering that the extractions are far greater than what the people need to make a reasonable living.

The potential for mining and hydropower is clear, but awareness of impacts on environment and society is lacking, as is knowledge on mitigation. Business owners and managers from the gold mining industry indicate that they need guidance.

The river provides great means for short- and long-distance transportation. This is especially important, given the lack of good roads in the north, which is why navigation was identified as an important value in all sessions.

Fishing used to have a lot of value for local communities, and still has potential, but currently suffers from the polluted river.



Figure 7 - Local Church in Myitkyina

Development trends in the township

The following trends were mentioned in Myitkyina:

- The river has become more polluted (after 2000) due to gold mining, dam construction, and waste from domestic and miscellaneous industrial sources.
- People are starting to use groundwater wells for drinking water. After the first dam was completed (upstream from Myitkyina), the villagers noticed a decline in river water quality and an increase of pollution and waste in the river. (R Lan is now using water from creeks in the mountains as a drinking water source.)
- People have moved away from dependency on fish and fisheries. Due to pollution caused by gold mining and fishing with chemicals and the electric battery method, larger fish have disappeared and only small fish remain in the river.
- Risk of floods has increased in the last several years. This is possibly due to upstream deforestation, which leads to erosion and a decreased capacity for water retention.

3.2.2 Conclusions for Upper HEZ

Peace is what is most needed in the Upper HEZ. Furthermore, awareness is lacking on environmental and social impacts within the gold mining industry and dam development sector. During the sessions, a representative from the gold mining industry acknowledged this. Awareness—combined with the technical know-how for certain industries and water treatment—could improve the quality of the river water. Therefore, an opportunity is perhaps available to improve the situation and start to implement measures to mitigate adverse impacts. This would also enable the government to further strengthen its relationship with the people. Doing so is important, considering earlier experiences on dams and current plans for future dams. Dams should be planned with utmost care in close consultation with the people of the area, and should conform to international standards on human rights, environmental preservation, and protection of small local societies.

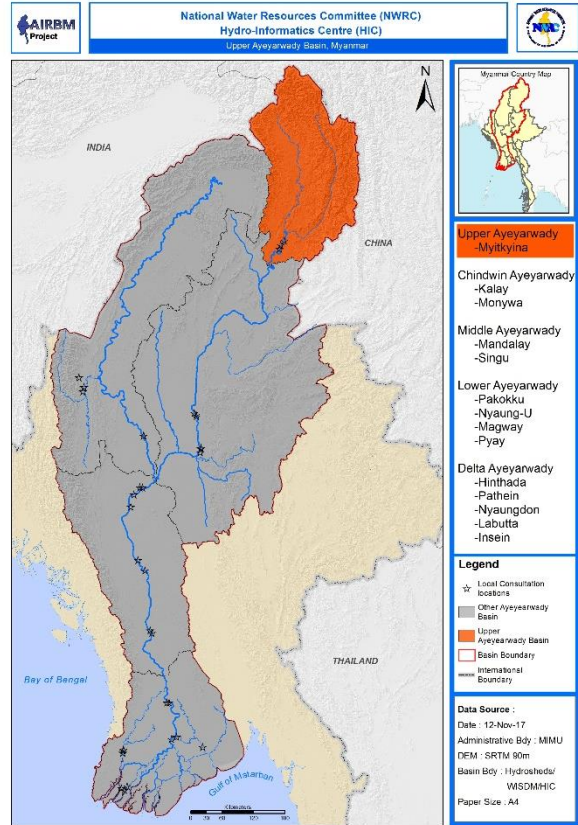


Figure 8 - Upper HEZ in the Ayeyarwady River Basin

3.3 HEZ: Chindwin

3.3.1 Kalay Township

Townships assets

Most Chin living in Kalay are devout Christians, and this makes Kalay Township a fascinating cultural location. There are said to be over 600 churches in the city. The town is the hub of trading activity with India across the border. The place is along the strategic road between India and Myanmar, built with assistance from the Government of India. The population of Kalay is estimated to be 400,000. Kalay is an agricultural town, as well as an industrial town. Cars, jeeps, trucks, fire engines, trailers, and three-wheeled motorcycles are manufactured in the Kalay Industrial Estate. Kalay is located on the Myit Tha River branch of the Ayeyarwady River Basin. It differs from other townships in that the Chin Hills are very near and tributaries onto the main river are, in many cases, mountain rivers with steep upstream sections only a few miles away. This means that when heavy rainfall occurs, the main river’s behavior is strongly influenced by these mountain tributaries: flash floods occur more often than in flatter areas down the Ayeyarwady River Basin. Conditions around the tributaries have a more direct effect on the hydraulics of the main river: deforestation in the mountains, for instance, has a greater likelihood to be felt in the valley. Based on results from the questionnaires, Figure 9 shows the river use in Kalay Township.

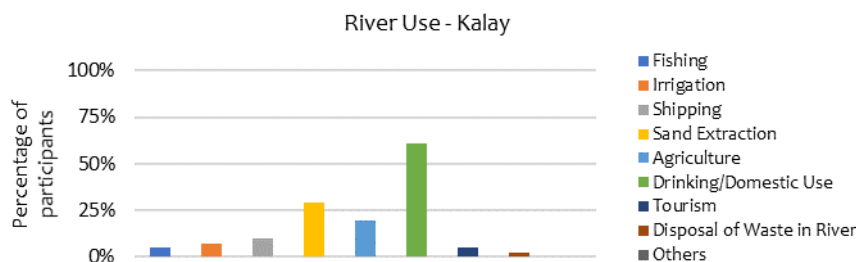


Figure 9 - River use in Kalay Township

Issues

Two of the three villages have suffered heavily from a major flash flood in 2015. Causing significant casualties and forcing many out of their homes, the flood is believed to be induced by extreme weather conditions together with sedimentation of the main river and deforestation in the mountains for plywood production.

Because climate change and deforestation are expected to continue, people are very concerned that flash floods like the one of 2015 will happen again, perhaps more often and with greater intensity.

The third village did not suffer as much from the flash flood of 2015 because it is located on somewhat higher ground closer to the main river. However, any type of flood is still an issue at the third village because crops get damaged on the lower-lying lands where the farmers work.

Apart from flash floods, seasonal floods also occur in parts of the township, but have a much smaller impact, a shorter duration (3 to 5 days), and people are well adapted.

Deforestation is perceived to be an important factor in the flash floods. Other effects of deforestation include landslides on mountain slopes and, in the villages down the slopes, deposition of large amounts of sediments. The sediments (and waste) put drainage systems nearly entirely out of order. The sediment clogs drainage system throughput and the flow stops; as a result, irrigation of the farmers’ rice paddies ceases. Further downstream, small hydropower generators go out of operation in some cases because of little to no flow. Even now, two years after the 2015 flood, the irrigation systems are still filled with sediments from the river. Unlike other places in the wider basin, these sediments consist mostly of large rocks and gravel, so they are not fertile and do not provide any benefit whatsoever.

Drinking water is problematic, partly because of concerns that the flash flood may have disrupted the aquifer balance providing groundwater, and partly because of perceived pollution through waste and lack of hygiene.

Erosion is another issue. Around Kalay, the river is very dynamic and the morphological behavior causes outer and inner bends sometimes to swap every 10 years. This requires a high level of flexibility from the farmers working and owning the adjacent lands, and occasionally disputes arise (and are dealt with locally) on ownership rights.

Figure 10 shows the main degradation causes in Kalay Township.

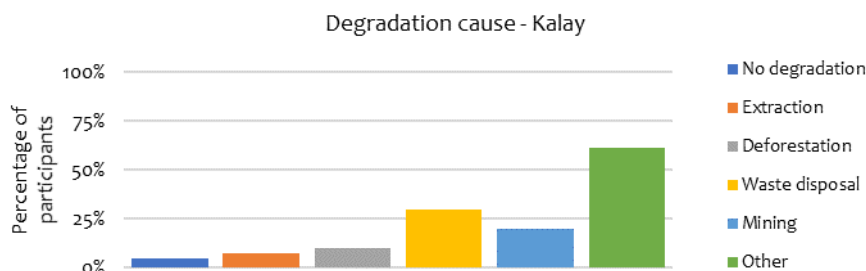


Figure 10 - Degradation causes in Kalay Township

Values

In Kalay, fishing, irrigation, and resiliency are key values of the river. Resilience is of value because people believe it means ‘to help each other’ under all circumstances, and under no conditions. This togetherness is strongly present in the villages in Kalay Township. Perhaps because of their vulnerability, people greatly value resilience and good governance. Many people say that they need to be able to rely on their government during hardship to provide protection, relief, and renewed opportunities after a natural disaster.

Since farming, and to a lesser extent fishing, are the main income providers, these sectors are also of value. Irrigation is of value because it is important for farming.

Drinking water and navigation are often mentioned by the people as important water values. The ability to easily navigate on the river is important, because farmers own land on both sides. Rice paddies are located on the mountainous side, and ground root, sesame, and bean fields are located on the other flat side close to the river.



Figure 11 - Discussion by making use of the 3-D model

Development trends in the township

Trends mentioned in Kalay:

- The effects of climate change and deforestation are feared. A severe flash flood happened in 2015 and is believed to happen again.
- The quality of the groundwater, which people have always used as a source of drinking water, is not as it used to be anymore. A small earthquake occurred in 2015 around the time of the flash flood and is believed to have changed aquifer characteristics.
- Communities are developing resiliency more and more.
- There seems to be a pattern where the rivers’ outer and inner bends swap every 10 to 15 years, taking turns in causing erosion and sedimentation on both sides of the river.
- Fishing used to be important but has been much more difficult since the flood of 2015 due to sedimentation and access to fishing grounds.

3.3.2 Monywa Township

Townships assets

Monywa is also known as Neem city because most of the streets of the city are covered by very old Neem trees. Monywa is a major center for trade and commerce and for agricultural produce from the surrounding Chindwin valley, especially beans, orange, pulses and palm sugar. In addition, the local industry includes mills to produce cotton, flour, noodles, and edible oils. The major tourist attraction in Monywa is Thambuddhe Pagoda, a Buddhist temple with a huge stupa resembling Indonesia's Borobudur. Close by is the Maha Bodhi Tahtaung Laykyun Sekkya standing Buddha statue, the tallest statue in the world. Monywa is served by the Mandalay-Budalin branch railway line, but is best reached by bus via the road from Mandalay.



The people of the two villages in Monywa were remarkably open and forward. Their communities are engaged in day-to-day businesses such as the processing and transportation of bamboo, radiating productivity and a very pleasant sense of optimism. They depend on the river for transportation of their products. In the old days, the villages produced metal goods instead of the current bamboo, because of differences in market and demand. The village has not changed much, apart from the fact that the population has grown. Based on results from the questionnaires, **Error! Reference source not found.** shows the river use in Monywa Township.

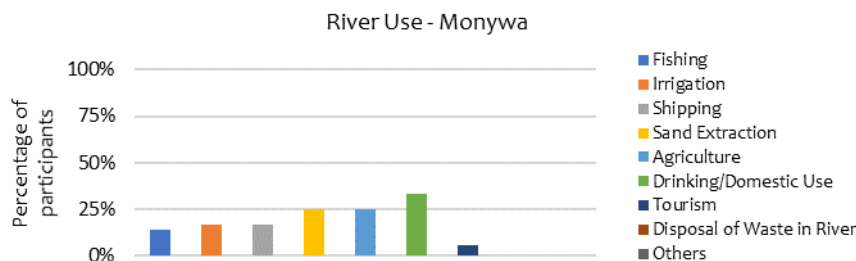


Figure 12 - River use in Monywa Township

Issues

Both villages have issues with bank erosion and flooding. Embankments that would provide protection are not present.

In one village, it was clearly visible that the river bank is eroding and that about a quarter of all houses are under imminent threat. These houses are standing on the outer bend of the river. Remarkably, villagers never mention outer bends as being more vulnerable to erosion than the inner ones due to higher flow velocities. It's a straightforward phenomenon, but hardly anyone seems to be aware of this throughout the basin. Instead, erosion is believed to be mainly caused by wave action of passing boats and by upstream gold and clay mining operations for brick making.

Floods are an issue, but not as strongly as elsewhere in the basin. People are well adapted and do not recognize the threat of floods lasting longer or becoming more intense over the past decades. The only real concern they have is that during floods it is very difficult to transport their children to school.

Linked to the erosion, sedimentation is also an issue: the river's morphodynamics create uncertainty for transportation on the river, especially during the dry season when the water level is very low.

Error! Reference source not found. shows the main degradation causes in Monywa Township.

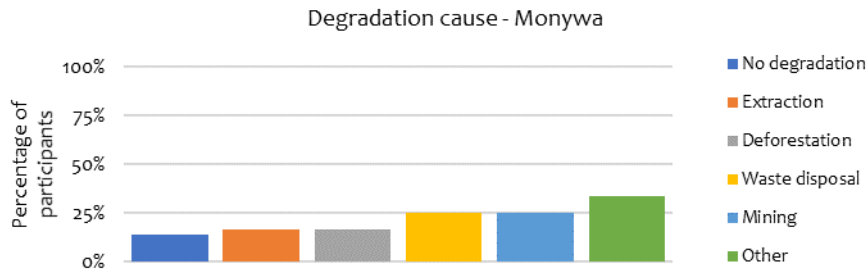


Figure 13 - Degradation causes in Monywa Township

Values

Transportation is essential for this community to be able to export bamboo products like fences and roofing materials. People use the roads for transportation, but also the river (Chindwin), which explains why they find navigation an important value.

In one community, villagers share great appreciation for good governance because their mayor provides roads and electricity for the community. In the other community, the need for good governance is also mentioned, as some discussions about improving embankments are still taking place.

Another important value is drinking water. It is of good quality and comes from groundwater wells.

In one community, fishing is valued as well, and is mainly done in a nearby lake along the river, where during the last decades the fish yields have been constant.

Development trends in the township

The trends mentioned in Monywa are:

- Erosion and sedimentation has become worse since dredging activities started upstream. The bank erosion progresses inwards by approximately one foot per year.

3.3.3 Conclusions for Chindwin HEZ

In the Chindwin HEZ a major flash flood occurred in 2015 and there are concerns that such flash floods will occur more often and with greater intensity due to trends such as climate change and deforestation.

Furthermore, erosion and sedimentation have large impacts on the people’s livelihoods. This is mainly related to drinking water, irrigation, and navigability. Most farmers own land on both sides of the river, which makes navigation crucial to reach their lands and to transport their goods.

Bank erosion, the main issue in Monywa, could be addressed through raised awareness of the risks of settling close to the river, especially on the outer bends. There is an obvious need for data, monitoring and decision support systems.

The villages of Monywa display a ‘can do’ mentality with great potential to contribute economically. Government support should provide relief during floods, stronger law enforcement, infrastructure development, navigability on the river, and protection against bank erosion.

Adaptiveness and social cohesion (togetherness) are important characteristics of the Chindwin communities.

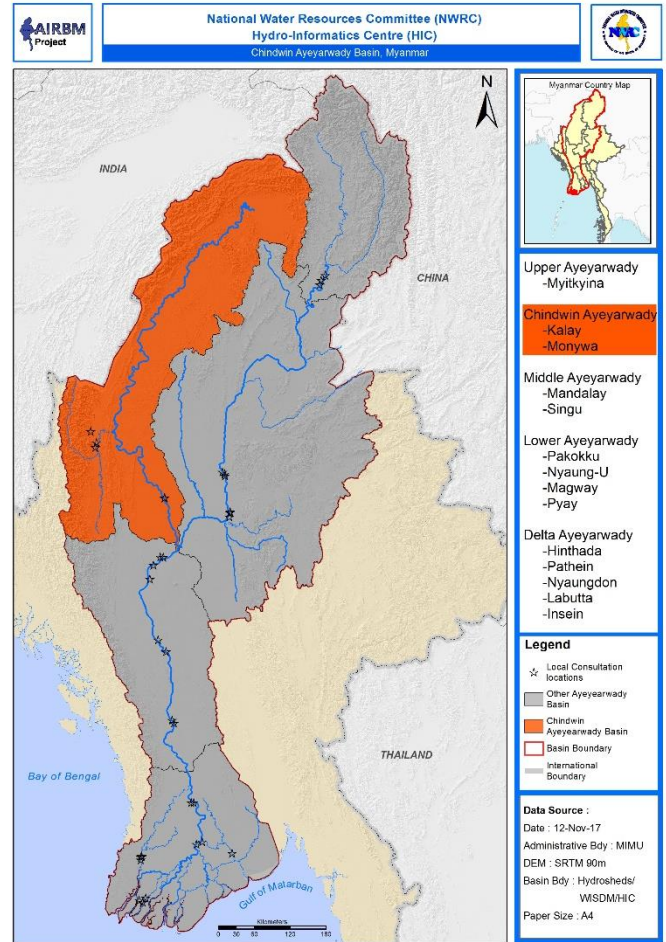


Figure 14 - HEZ Chindwin in the Ayeyarwady River Basin

3.4 HEZ: Middle Ayeyarwady River

3.4.1 Singu Township

Townships assets

Singu is located just upstream of a vast inland delta north of Mandalay, largely flooded at the time of the consultations. The area depends on mainly small-scale farming and fisheries to generate income, and benefits from a relatively healthy section of the river. Unlike many other places, drinking water is still taken directly from the river in this area. Based on results from the questionnaires, Figure 15 shows the river use in Singu Township.

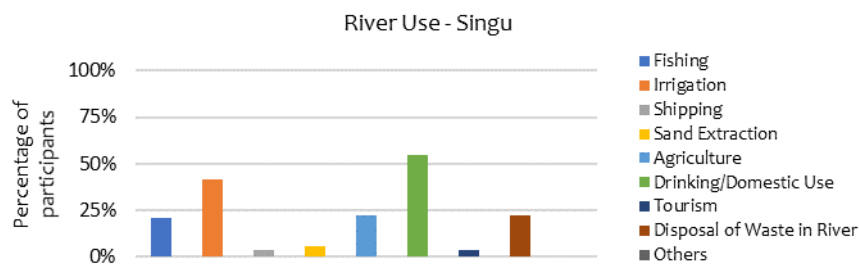


Figure 15 - River use in Singu Township

Issues

The general impression of this township is that it is relatively calm, with issues, but small ones. In one of the villages, people said, "our village has no issues". However, during the consultations extensive floods in the area were going on and in two of the three villages people told us that during a monsoon, life "stops" for two months a year, as they cannot farm or fish, and have great difficulty transporting their children to school. Another reported issue is the lack of solid waste management. In some places there is a collection service, but many people live too far away and garbage mostly ends up in the river.

Figure 16 shows the main degradation causes in Singu Township.

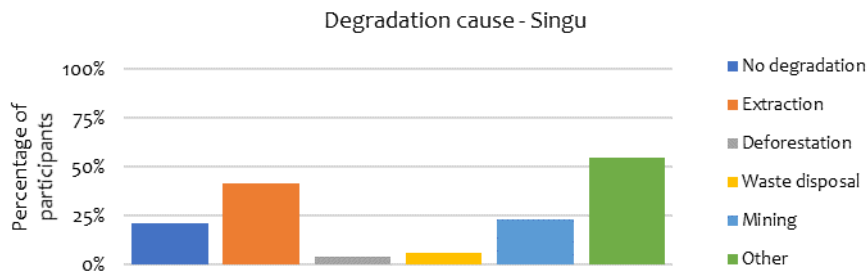


Figure 16 - Degradation causes in Singu Township

Values

The values of the river in Singu are that it provides for farming, fishing, drinking water, and sanitation. More than in other townships in the basin, the river has a spiritual/religious value as well: the villages of Singu honor their heritage, traditions, and ancient rulers by placing Buddha statues on candle-lit boats, and celebrating with nearby villages that they visit.

Development trends in the township

The trends mentioned in Singu are:

- Drinking water from the river is becoming more turbid and, therefore, less drinkable.
- Fish catch has decreased (possibly because of the presence of new methods such as electric battery fishing and the use of chemicals).
- During floods, water levels seem a bit higher and the floods last a bit longer (Khul Lel).
- Waste nowadays includes larger quantities of plastic (2nd Ward).



Figure 17 - Ongoing community session

3.4.2 Mandalay Township

Townships assets

Mandalay's strategic location in Central Myanmar makes it an important hub for transport of people and goods. The city is connected to other parts of the country and to China and India by multiple modes of transportation. The Ayeyarwady River remains an important route for transporting goods such as farm products including rice, beans and pulses, cooking oil, pottery, bamboo, and teak. Mandalay is the major trading and communications center for northern and central Myanmar. Mandalay has the best educational facilities and institutions, after Yangon. Mandalay region is a major population center and one of the country's most genuine cradles of arts, culture, and civilization, with the Ayeyarwady River as a beautiful and crucial artery. The people in Mandalay Township are somehow subject to the dynamic morphology of the local section of the river. This dynamic behavior is a stand-alone feature, but it is also affected by sand mining operations in the river bed for construction. Based on results from the questionnaires, Figure 18 shows the river use in Mandalay Township.

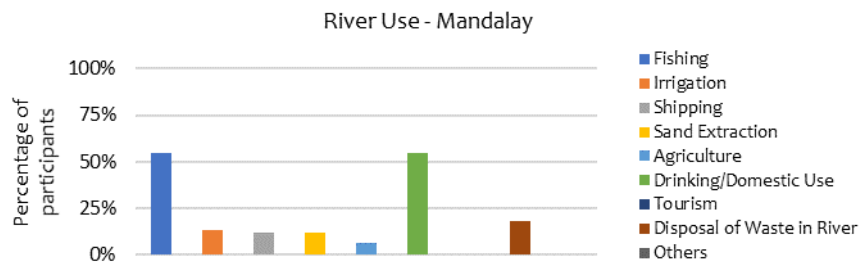
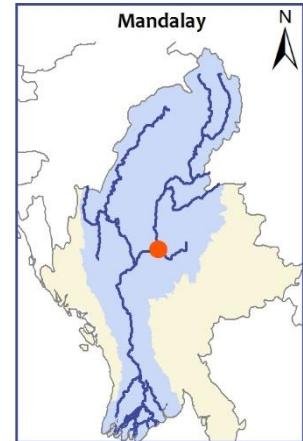


Figure 18 - River use in Mandalay Township

Issues

Because of the river's strong morphodynamics, large volumes of sediment are transported continuously. Some areas are heavily affected by erosion; elsewhere new land emerges because of sedimentation.

The greatest concern that people have is bank erosion. It poses a real threat to farming communities who see their homes and lands being eroded away each year. The sedimentation impedes navigability, making it difficult for boat owners and fishermen to keep their businesses up and running without having to invest beyond their means, or relocate. According to the people, the erosion is worsened by sand mining and dredging practices close to their homes and businesses. They believe that these practices further disrupt the river's morphological balance. Their stories are convincing: they tell us in detail how the timeframes of certain mining and dredging activities exactly match the periods of aggravation of their problems with erosion.



Figure 19 - Dry, fertile clay sediments along the river near Mandalay

To prevent undesired morphodynamical behavior, the villagers believe that controlled dredging should take place and that a fixed navigation channel should be engineered.

The flipside of the coin is that due to sedimentation, new land emerges that is often very fertile. People are eager to start cultivation on those lands, but report that it is difficult to obtain the necessary permissions.

Local fishing suffers from illegal fishing methods, such as electrical battery fishing, killing large stocks in the local section of the river, and forcing local fishermen to travel further and further to bring in a reasonable catch. People are losing faith that fishing as an occupation can continue to sustain their lives the way it used

to, and they are already moving to other activities as a source of income. Regarding the illegal fishing methods, many people tell us that local law enforcement is aware but far too weak or inactive. They see a possible solution as zoning fishing activities.

Figure 20 shows the main degradation causes in Mandalay Township.

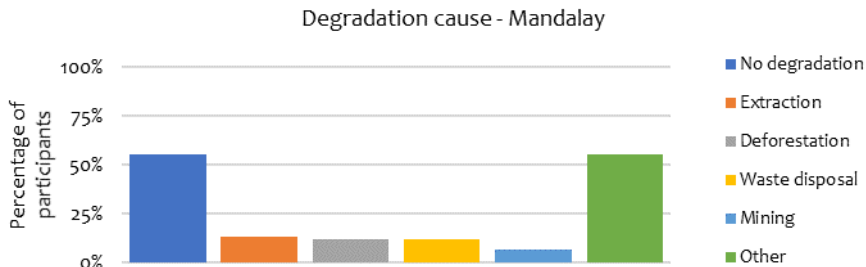


Figure 20 - Degradation causes in Mandalay township

Values

The most important values of the river are farming and fishing. Especially the (potential for) farming on new fertile lands is valued, if licensing procedures for cultivation speed up. Fishing is a value but something must be done about the use of illegal electrical battery fishing. Drinking water is also a value: in certain places it comes directly from the river; in other places it comes from groundwater wells. In two of the three villages visited, it is of good quality. The third village says that because of the quality of the river water, purified water is preferred.



Figure 21 - House located in an erosive river bend

All people are optimistic about the future. They see opportunities for diversification of their jobs, and better education of their children. Improved microfinance schemes would be a great help to further widen their options.

Development trends in the township

The trends mentioned in Mandalay are:

- Erosion is increasing, as caused by: i) heavier wave action due to more and larger ships passing by; and ii) dredging and sand mining operations in the river bed.
- Fishing has become much more difficult in the last 3 to 4 years due to unregulated fishing with the electrical battery method. This leads to an ongoing decline of revenues from fisheries.
- Depths and shallow areas in the river are changing.
- People extract less drinking water from the river and groundwater than they did before. The use of purified drinking water is increasing.

3.4.3 Conclusions for Middle HEZ

The main issues in Singu and Mandalay are floods (Singu) and erosion, navigability, unsustainable fishing practices, and weak law enforcement (Mandalay). Some of the issues can be addressed by raising awareness and provision of support to improve adaptability among the people themselves. However, careful (urban) planning at the level of government is also required, based on knowledge of the river’s hydraulic and morphologic behaviour. In some places, classic civil engineered interventions like protective dikes and channel fixations might be an option; however, it is recommended to first consider all options on awareness, adaptation, and spatial planning. Finally, the issue of law enforcement should be assessed. It is possible that this will lead to the need for more manpower, capacity, and adjustment of work procedures at the level of the enforcers and their managers.

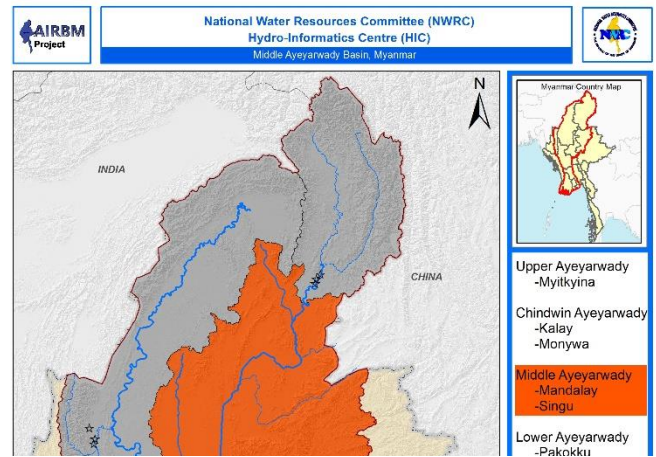
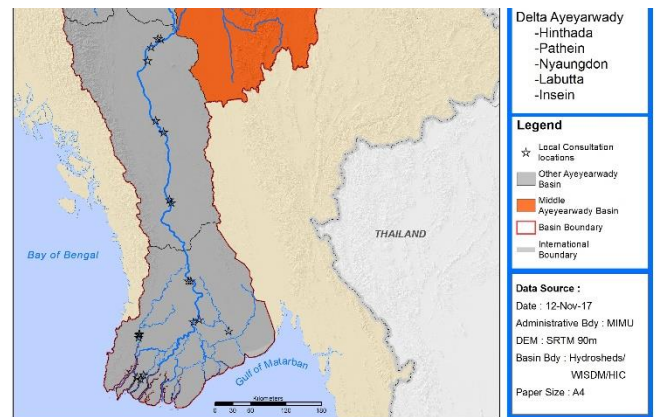


Figure 23- Location Middle HEZ in Ayeyarwady River Basin



3.5 HEZ: Lower Ayeyarwady River

3.5.1 Pakokku Township

Townships assets

Pakokku is a quiet and traditional town on the banks of the Ayeyarwady River, located 25 kilometres north of Bagan and now connected by a new road and rail bridge across the river. The town is best known for tobacco trading. Approximately 20 kilometres to the northwest, the remains of Pakhangyi and one of the oldest surviving wooden monasteries in the region are located. The Thiho Shin Pagoda Festival takes place in Pakokku Township at the end of May or early June and features a large country fair and traditional plays. Furthermore, the Ayeyarwady Bridge (Pakokku) is the longest bridge in Myanmar. Based on results from the questionnaires, Figure 24 shows the river use in Pakokku Township.

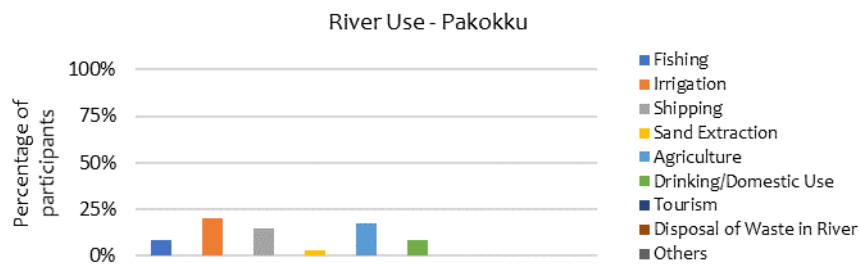


Figure 24 - River use in Pakokku Township

Issues

Again, flooding in relation to good governance are mentioned as main issues. Here people needed to be relocated because they lived in the area where the bridgehead was planned. They had to move to a less favorable area, where they now suffer floods and drainage issues. Solid waste and garbage also gather in their location. The nearby bridge, constructed 10 years ago, causes erosion problems (in the opinion of the community). Apparently local government did try to alleviate the problems by creating retention walls, but the villagers are not satisfied with the solutions that were implemented. Also, part of the issue is that one side of an embankment is the responsibility of one department, while the other side of the embankment may be the responsibility of another department. Figure 25 shows the main degradation causes in Pakokku Township.

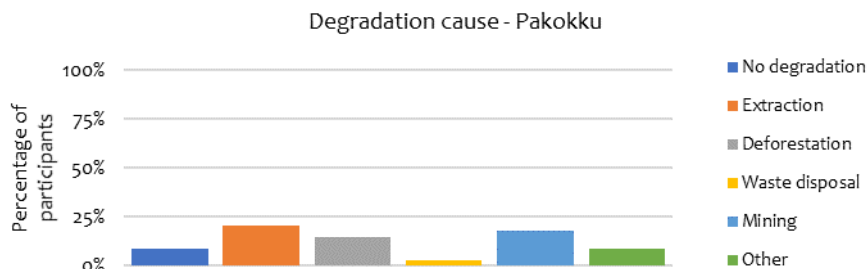


Figure 25 - Degradation cause in Pakokku Township

Values

Values of the river in Pakokku are in particular navigation, irrigation, erosion and sanitation.

Development trends in the township

No clear trends have been mentioned in the community sessions in Pakkoku.

3.5.2 Nyaung U Township

Townships assets

Nyaung-U is only 4 kilometers away from old Bagan, a popular tourist attraction. This township, which includes Bagan, is primarily known for its spiritual and touristic value. Thousands of stupas, temples, religious edifices draw visitors from all over the world. It is also an important focal point for (young, educated) Myanmar people, who like to travel to the Bagan region with their friends and families for short holidays. The tourist industry is still in its early stages, but developing fast. Besides tourism, agriculture is the primary economical source of income, as is lacquer work, a traditional way of painting. Based on results from the questionnaires, Figure 26 shows the river use in Nyaung-U Township.

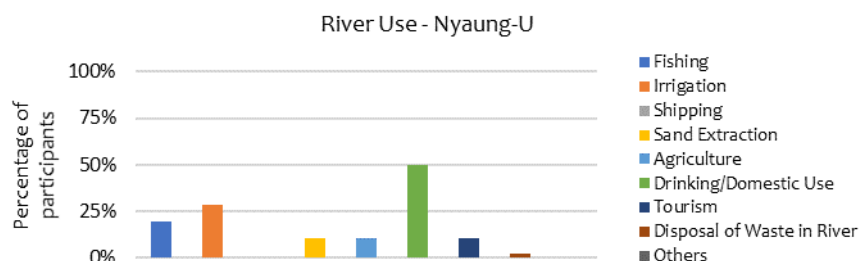


Figure 26 - River use in Nyaung-U Township

Issues

There is a marked difference between people who benefit (or hope to benefit) from the booming tourists market, and the flooded areas surrounding Bagan. The SOBA team spend hours travelling around flooded bridges and roads, thus experiencing firsthand the challenges faced by the local communities in the wet season. Local people are however relatively unconcerned about seasonal flooding, but very worried about flash floods which occur in creeks after heavy rainfall in the pre-monsoon and post-monsoon time periods.

Good governance

Good governance is an elusive concept that is mentioned quite often in the community sessions especially in this HEZ. The common denominator is the notion that conflicts of interest will occur in local communities, and that (local) officials should deal fairly and justly with these tensions. For example, when a community lives in a flood prone area and wants to reallocate, they should be able to buy land at a fair, market conform price. Or when several land owners are asked to maintain a dike, all of them should be made to comply with the agreements.

Good governance is an issue that is mentioned when discussing the risk of flash floods. People take shelter in an area where a nearby dry bedding of a creek should offer relief when flash floods occur. The problem is that the dikes are ill maintained and thus threaten the populated area. Apparently, because it is difficult to collaborate effectively. In another case, the community wants to move to a safer area, but cannot afford the land they like. They suspect that the current land owner has a ‘special relationship’ with the decision makers. When asked in a later conversation, the township official acknowledges the difference between disastrous floods and seasonal flooding. There have been several disastrous floods between 2008 and 2013. The differences between a disastrous flood and a seasonal flood are the speed and the height of the incoming

water. The best solution would be, according to the GAD officer, to make speed and height more predictable so that response time is reduced. This means better data management, monitoring, and modelling.

The issues that are raised in this township are all too familiar: flooding, fishing, solid waste management, pollution. A new aspect is the quality of the drinking water in relation to flooding; in the wet season, the turbidity of the river water is higher, thus hindering the use of the river as a source for drinking water. Figure 27 shows the main degradation causes in Nyaung-U Township.

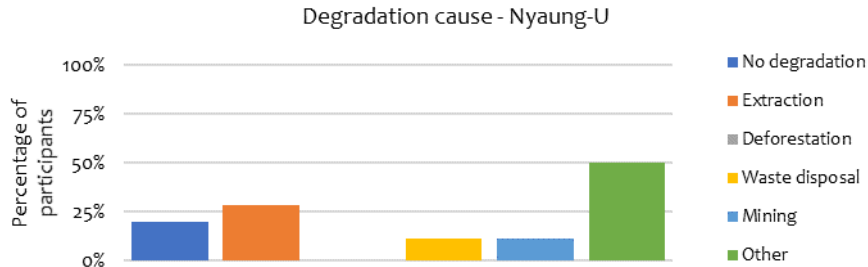


Figure 27 - Degradation causes in Nyaung-U Township

Values

The villagers focus on livelihood improvement and job opportunities. They envision some opportunities due to the connection between the river and tourism, for example rise in river cruises. But mostly they want job opportunities in the garment industry or in agriculture in order to mitigate the negative results of living in the proximity of the Ayeyarwady, like flooding.

Development trends in the township

The following trends are mentioned in Nyaung U:

- A difference has to be made between seasonal flooding, which is a nuisance but not a real danger, and flash floods. The villagers believe that it is raining heavier than before, and ‘the water cannot go away’. They see considerable deterioration over the last three years, with the worst case of flooding in 2016.
- There has been a decline in fish. Possible causes are the use of batteries upstream and fishing in the spawning season.
- Navigation has become more difficult due to sedimentation. The navigation channel becomes narrower, thereby hindering bigger ships.



Figure 28 - Sticky notes with issues placed on the Village map



Figure 29 - Illustrating a problem on the township map

3.5.3 Magway Township

Townships assets

The Ayeyarwady River is the major transportation system in Magway. The principal product of the region is petroleum. Magway is a nice provincial town, with a lively student population and a potentially attractive river front. An obvious problem is the amount of garbage floating in the river and getting stuck on the river sides. Agriculture is practiced on the higher grounds and includes crops such as sesame and peanuts. Based on results from the questionnaires, Figure 30 shows the river use in Magway Township.

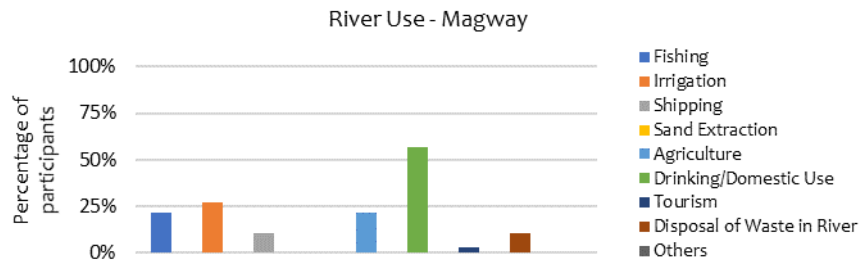


Figure 30 - River use in Magway Township

Issues

Seasonal flooding and waste management are the most important issues. Sanitation is also a problem, especially during floods. In these villages, nurses and school teachers were present, so more in-depth discussion on the questions of health issues and (lack of) awareness could take place. Figure 31 shows the main degradation causes in Magway township.

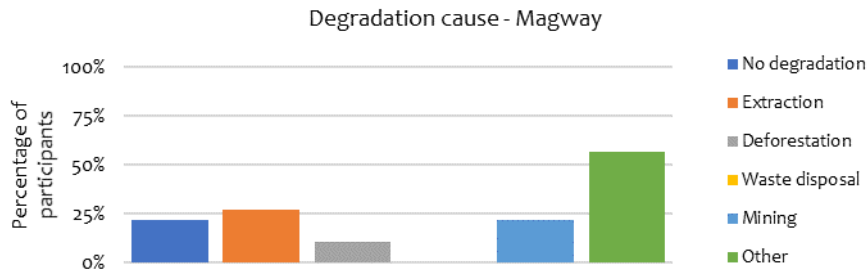


Figure 31 - Degradation causes in Magway Township

Values

Drinking water from the river is an important value because people like the taste of river water better. Groundwater is often too saline; at the same time the quality of the water is an issue. The river is also valued for its navigation options and irrigation.

Sanitation

The issue of sanitation has been addressed in a circumspect way. Sanitation deals with toilets, or the lack thereof. Sanitation was often a recurring topic during the community sessions; however, in the ensuing conversations it was more difficult to talk about it. For example, one of the unpleasant by-products of flooding is that people are unable to use their toilets during high water. Often they have no alternatives, and need to use the toilets of neighbors, or ‘go’ in the bushes. They will only admit to these problems after gentle probing.

Development trends in the township

The following trends have been mentioned in Magway:

- Seasonal flooding is becoming worse and worse. The flooding occurs every year, instead of every couple of years. Although the villagers are used to it, flooding still causes problems and damage.
- The quality of the river water is decreasing, because of turbidity during rainy season and pollution caused by lack of solid waste management.
- The villagers state that there are ever more fishermen, and ever fewer fish. This is caused by exploitation of the fish population during spawning season.

3.5.4 Pyay Township

Townships assets

The north and north-east of the Pyay district is forest-covered, and contains numerous valleys and ravines, which come together in one large stream called the Naweng River. Pyay has a tropical savanna climate. The main crop is rice, but some cotton and tobacco are grown, with the custard apple as famous district grown fruit. Pyay has, furthermore, three universities. A cultural and religious asset in Pyay Township is worth mentioning: there is a special river Nat, who protects people from harm. The people perform offerings on a special altar near the river twice a year, before and after the monsoon. Based on results from the questionnaires, Figure 32 shows the river use in Pyay Township.

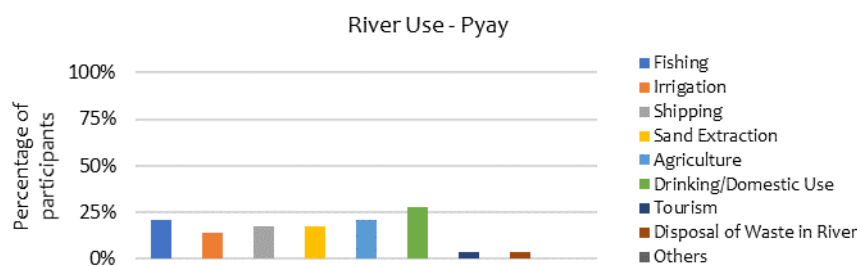


Figure 32 - River use in Pyay Township

Issues

Obviously, flooding is the most important problem in township. The flood causes primarily damage to the crops and erodes the river banks. Most importantly, some villages are isolated during the period of seasonal floods, because they cannot use the road. The only means of transport in this period is navigation. People with odd jobs like farmers and farm laborers try to go to work, the others stay at home. People do not relocate because it has always been like this. The floods themselves do not become worse, however, other effects like erosion and pollution do. The villagers have to rely on river water and rain; they do not have pumps and get the water with buckets. They state that they do not use canals for irrigation, but there is a creek that takes river water to the land.



Figure 33 - Rain pond

Fishing as a livelihood is becoming difficult because there is a reduction in the amount of fish available due to fishing in the spawning season and the use of batteries by other villagers, and the river becomes shallower, which influences the fish habitat. Figure 34 shows the main degradation causes in Pyay Township.

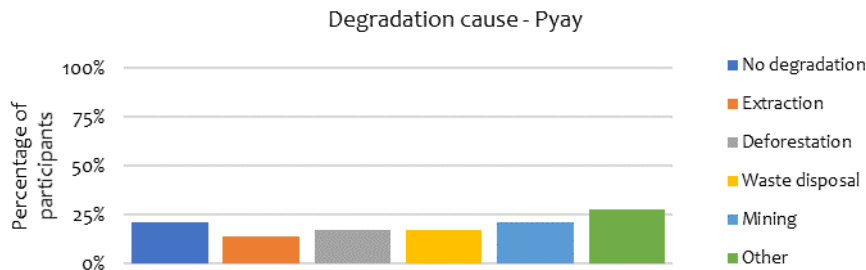


Figure 34 - Degradation causes in Pyay Township

Values

The most important water value in Pyay is drinking water. The people use river water for drinking. In the dry season this is fine, but in the rainy season it becomes more problematic. The water becomes very muddy, and needs to be purified. They do this traditionally with so called Nirmali seeds, known for their purifying quality. People like the river water over ground water, as it tastes better and is better at quenching their thirst.

Development trends in the township

Trends as mentioned in Pyay township:

- Seasonal flooding has always been like this in one village. The floods themselves do not become worse, but the by-products of floods like erosion and pollution do become worse.
- In the other village in Pyay, flooding is becoming worse, and most people want to move.
- Decline in the amount of fish is due to fishing in the spawning season, use of batteries, and shallowing of the river, which influences the fish habitat, according to the villagers.



Figure 35 - Smaller group discussion during the session

3.5.5 Conclusions for Lower HEZ

Somehow people in this area seem to be more aware about the issue of good governance in accordance to flooding, solid waste management, and economic development. They have clear ideas about the necessity to provide fair judgement and interventions by (local) governors when dealing with water issues. People like to be informed about developments. The region suffers from flash floods on top of seasonal floods, which are perceived to be far more dangerous. In the words of one of the respondents: "seasonal flooding causes inconveniences, flash floods kill." Flash floods are perceived to be manmade, which puts pressure on local governments to deal with this issue. The influence of upstream agriculture and the potential of soil conservation needs to be studied. The area is also well known for its economic potential, be it tourism in and around Bagan, or the petrol industry around Magway. But there is a gap in perception between entrepreneurs and, for example, farmers or garment industry workers. Entrepreneurs are eager for change and development; farmers and workers are more reluctant. They, for example, would like to move to higher grounds, but find it difficult to fund this.

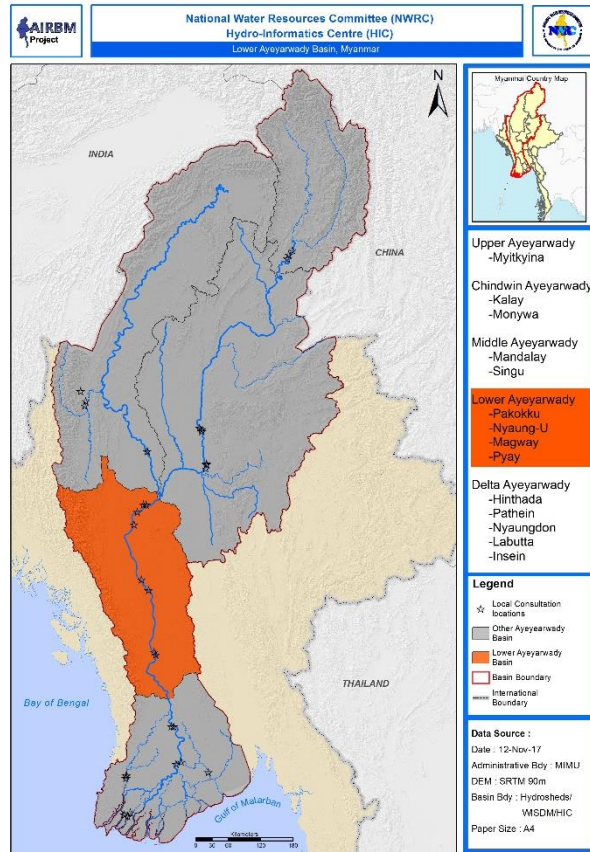


Figure 36 - Lower HEZ in Ayeyarwady River Basin

3.6 HEZ: Ayeyarwady Delta

3.6.1 Hinthada Township

Townships assets

Hinthada is a city located at the Ayeyarwady River in Ayeyarwady Region. Its population was 170,312 in 2010. Hinthada is an archetypical agricultural trading town. It is a port for the rice and tobacco grown in the surrounding agricultural area and is connected by road and rail with Patheingyi and Yangon. The area east of the town is a low-lying region protected by embankments along the Ayeyarwady and is the site of a major irrigation scheme. The villages in the Hinthada Township are clear examples of small communities in close proximity to a big urban center (Hinthada) with fast developments. People are close enough to suffer the ‘fall out’ of developments like sand mining or commercial fishing, but too remote to benefit from the proximity of the city, like access to higher education or professional health care. Based on results from the questionnaires, Figure 37 shows the river use in Hinthada Township.

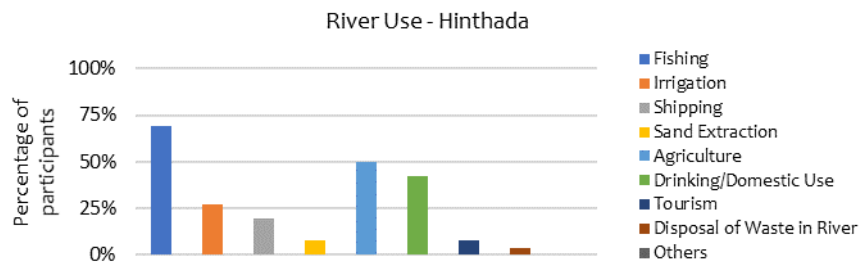


Figure 37 - River use in Hinthada Township

Issues

Fishing is mentioned as an issue, with the additional analysis that the reduction in the amount of fish is caused by commercial fishing boats from the nearby town. The lack of clean drinking water is another issue. People are obliged to drink river water. Hence, this water is being polluted, again because of the nearby town. Solid waste (both industrial and domestic) is being dumped in the river upstream, thereby polluting the river. The people show a keen understanding of the working of cycles and systems: they describe how there used to be a well in the village, but they cannot use this anymore, since deforestation and climate change have caused the groundwater level to be very low. They believe that the trees used to raise the groundwater level in the past. To receive groundwater again, they are forced to dig deeper, which has the negative consequence of hitting layers of arsenic. Flooding is caused by erosion, and this erosion is caused by commercial sand mining upstream. Navigation, another important value, is also made more problematic due to erosion caused by sand mining. Figure 38 shows the main degradation causes in Hinthada Township.

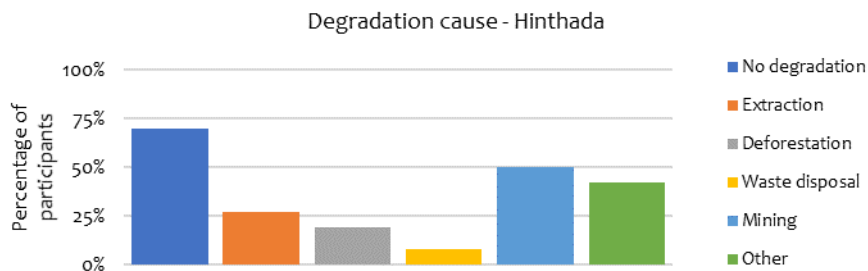


Figure 38 - Degradation causes in Hinthada Township

Values

People prize their own resilience and sense of community. They do not want to leave or live elsewhere, they want to improve their own livelihoods. When asked for a solution to, for example, industrial pollution, they state: “why not move more factories to the region?” If the government subsidizes industrial growth, then make sure that everybody benefits.

Future opportunities in the township

The following opportunities and trade-offs are relevant for Hinthada:

- A licensing system and law enforcement for fishermen: local fishermen do have a committee and licenses. But bigger ships from the cities nearby come and deplete their resources. They have fishing gear that catches all fish, also the very small ones, leaving no fish for the local fishermen. They are also perceived to abuse their licenses. Furthermore, people fish illegally with batteries and poison.
- Villagers used to have their own water management system: rice paddies with dikes. The dikes have been reinforced, while at the same time people live in the paddies. When the water outside the dikes rises, the officials turn the floodgates open (to lessen the pressure on the dikes), causing the houses within the paddies to flood. Community-based floodgate management could be considered.
- Some are convinced that the curriculum should pay more attention to river basin knowledge. They do not include that into their lessons at the moment. They do, however, teach children about hygiene, sanitation, and how to behave during a flood.



Figure 39 – The villagers gather to wish us goodbye

3.6.2 Nyaungdon Township

Townships assets

Nyaungdon is a city located at the junction of Ayeyarwady River and Pan Hlaing River. It is a port lying on the west bank of the Ayeyarwady River delta and is protected by flood-control embankments. Rice production and fishing were the major contributors to the economy. It is a developing town with growing transportation and communication services. The town is linked with Yangon, 40 miles (65 kilometres) east, by the Twante Canal. The main religion is Buddhism and there are many pagodas within the township. The total number of inhabitants of this township is 215,906 people, where 24,455 live in urban areas and 191,451 people in rural areas.

Nyaungdon is also known for its vegetable cultivation. The soil is rich, and farmers like to live (too) close to the river to tilt their vegetable plots. Seasonal flooding, besides being a risk, has additional advantages because it increases the fertility of the soil. Based on results from the questionnaires, Figure 40 shows the river use in Nyaungdon Township.



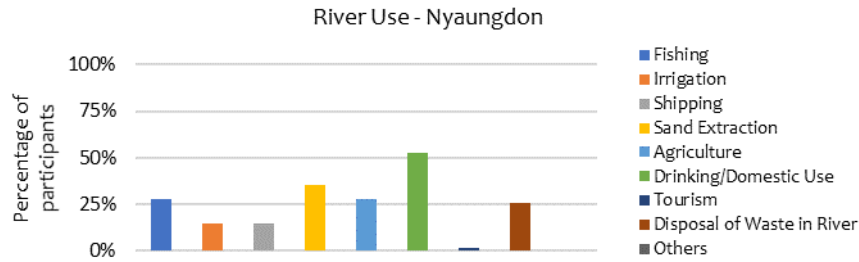


Figure 40 - River use in Nyaungdon Township

Issues

The main issue in this township is seasonal flooding. The villagers are convinced that the floods have increased in duration and velocity. More striking compared to other villages, people acknowledge the advantages of living close to the river and occasional flooding as well: the soil becomes fertile because of the flooding, which is very good for vegetables, the main product of these villages. People are convinced that the worsening of the floods are manmade, and pinpoint the Mezali sluices as the source of their problems. They believe that the trade-off between the advantages of the sluices upstream and the problems they face with erosion and flooding is unbalanced. They urge to take their concerns more into account. They believe that the government has a task to raise more awareness on the cause and effect of measures, in order to ensure that the trade-offs are well balanced. Figure 42 shows the main degradation causes in Nyaungdon Township.



Figure 41 - Explaining the meaning of issues discussed

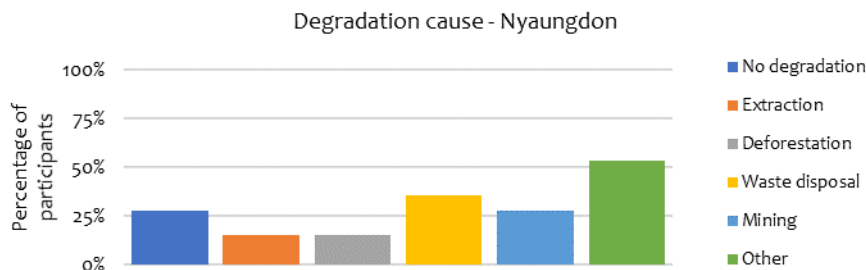


Figure 42 - Degradation causes in Nyaungdon Township

Values

The respondents value the fertility of the silt and the river; they depend on the river for their livelihood.

Development trends in the township

One trend was clearly mentioned in Nyaungdone: every villager in Nyaungdone Township mentions that the flooding has become worse during the last couple of years (ranging from 2012 to 2016).

3.6.3 Patheingyi Township

Townships assets

Patheingyi is the largest city and the capital of the Ayeyarwady Region. The city is a rice-milling and export center. Aside from several rice mills, the town has numerous sawmills and umbrella workshops. The city is home to the Patheingyi Education College, Patheingyi University, and The Computer University. Patheingyi General Hospital serves people in Patheingyi and its surrounding districts. Patheingyi has significant growth potential, due to its position on the main thoroughfare to the coast, and the beach towards the west. The entrepreneurs in the township acknowledge this fact, and showed us the spatial developments going on (e.g., apartments, hotels, shopping malls, port, and more that are being build). Expectations for tourism are high, both on the national and international level. Based on results from the questionnaires, Figure 43 shows the river use in Patheingyi Township.

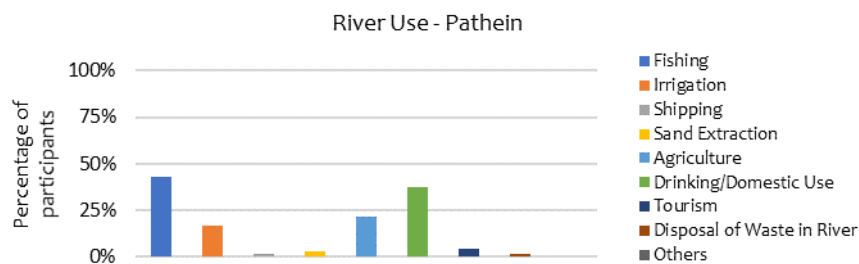
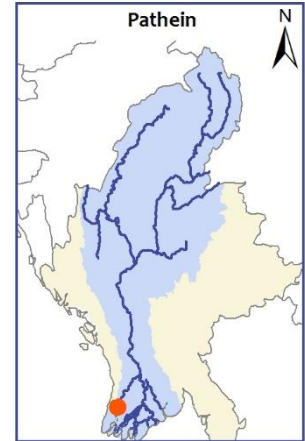


Figure 43 - River use in Patheingyi Township

Issues

Seasonal flooding is the main issue. The floods last up to three months; since 2004 it has become significantly worse. People are concerned about the effects the floods have on their livelihood; as long as they have to stay in shelters, they cannot work and during this period they highly depend on charity. On the other hand, if they have a bit more income, they can build their houses on poles, stay at home during floods, and continue their normal lives. The two bridges are considered to be the cause of the increased seasonal flooding, causing erosion and sedimentation.

Another important issue is solid waste management. People use the river like a ‘garbage chute’, partly (in their own words) due to ignorance, partly due to the lack of opportunities for proper garbage disposal. They think that improvement of local garbage collection would solve this issue. Figure 44 shows the main degradation causes in Patheingyi Township.

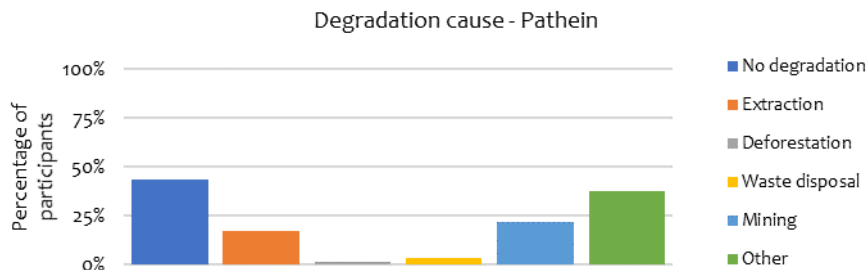


Figure 44 - Degradation causes in Patheingyi Township

Fishing is another value and issue in this township.

Fishing as an issue; less fish, more fishermen, and poor law enforcement

People describe the fact that there used to be – far – more fish to catch a while ago. Many people who describe themselves as fishermen still depend on fishing for their own nutrition and livelihood, but are concerned about their ability to remain fishermen. When asked what the causes of the decline in fish are, they state, "other people catch too many fish" (always in "the other village"), and illegal means are used. Meaning: others catch fish during spawning season and in designated spawning areas, and/or they use illegal fishing techniques (e.g., battery fishing, poison). Sometimes people acknowledge the fact that they also catch fish wherever and whenever they can, out of fear that otherwise the fish will run out before they have their share. The government is supposed to regulate fishing, but lack of law enforcement and implementation power are seen as main issues.

Values

The river is a main thoroughfare for transportation. In the consulted villages there are no bridges. So, people depend on ferries to carry them across. Furthermore, the river provides nutrients for their diet via fish.

Development trends in the township

Trends in Pathein Township are:

- Floods have become worse since 2004. When the villagers were young, floods occurred every three years and would last for a couple of days. Now they have floods every year and the floods last for months, with much higher water levels than before. The worsened floods are thought to be caused by the disappearance of forests near Pathein.
- A significant decline in the amount of fish has been noticed since the last couple of years. Especially saltwater fish have decreased. Fresh water fish are relatively stable. According to the villagers, this has been caused by the fact that there are less fish, more fishermen, and poor law enforcement of licenses and fishing methods. The fishermen suspect that this decrease in saltwater fish is caused by barriers to fish intrusion. These barriers are made up of sandbanks, caused by all the natural debris that floats down the river during the rainy season.

3.6.4 Labutta Township

Townships assets

Labutta is considered former Nargis country; this area is prone to natural disasters like typhoons. Labutta Township was hit very hard by cyclone Nargis in May 2008. Agriculture (rice) and aqua culture (fish ponds) are important means for livelihood. The main fishery products include fish, prawn, fish-paste, dry fish, dry prawn, and fish sauce. Hotel and transportation infrastructure is still very poorly developed in the area. Labutta is developing, sometimes in unsuspected areas like a brand new, very comfortable hotel. Built as a stopover for pilgrims, it now caters to NGOs and fish pond investors. Based on results from the questionnaires, Figure 45 shows the river use in Labutta Township.

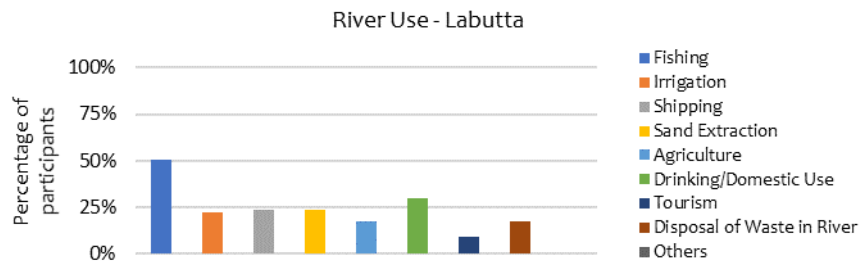
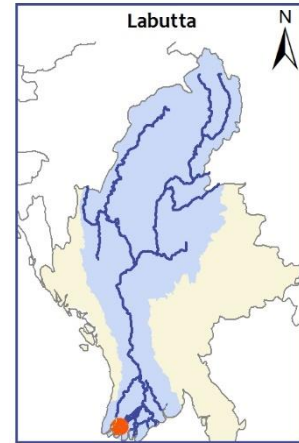


Figure 45 - River use in Labutta Township

Issues

It is unsurprising that climate change and the risk of cyclones are still top of mind in this region. At the same time, people see little opportunity to protect themselves against natural disasters, so they have a wait-and-see approach. The issues they raise have far more to do with the improvement of their own livelihood. For example, they raise the question of fishing as a livelihood, and add that, if they want to abide by the law and fish only in the designated timeframe, they need other sources of income during those months. Figure 46 shows the main degradation causes in Labutta Township.

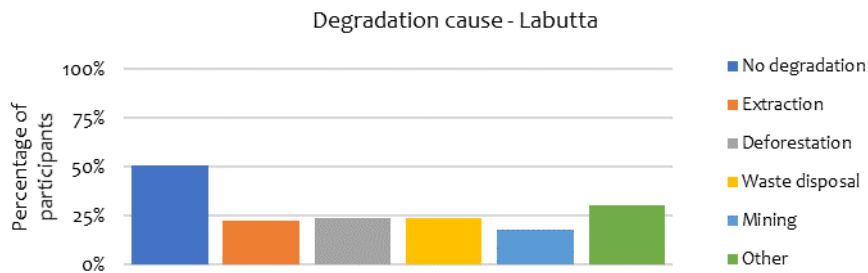


Figure 46 - Degradation causes in Labutta Township

Agriculture and irrigation are also important issues. Rice paddies need a lot of water and careful irrigation systems. Erosion of the little dams around the paddies leads to flooding of the fields. Salt intrusion causes loss of yields. The villagers believe that these issues are caused by climate change, sea level rise, and deforestation in the coastal area. And again, the issue of fishing as a livelihood is mentioned, as are solid waste management and pollution. Specific for this region are the fish ponds. Fish ponds are a strong basis for food security and economic development. The problem the villagers mention is that they are mostly owned by "foreign" investors (foreign as in not local), thereby providing little benefit for local communities, while the fall out of the fish ponds (more erosion, more pollution) hit the local communities.

An example of the poverty gap/ loan trap

The poverty gap in relation to livelihood and resilience were mentioned several times. People do want to become more resilient towards issues like flooding, loss of agricultural land, and fish, but then they need to improve their earning capacity.

The fishermen worry about the fact that during the months they are not allowed to fish, they need to repair their boats and buy their licenses. Both are expensive, so they need to borrow money. The money lenders ask up to 20% in rent, and happen to be the same people they sell their fish to. They suspect that they do not receive the best prices for their fish. The people conclude that, no matter how many fish they catch during the 5 months when they are allowed to, they are never able to pay off their debts. The solution to this problem would be better credits, with lower interest rates. They conclude that if they want to improve their lives and send their children to school, they need to improve their debt balance.

Values

Risk management, Navigation, fishing and irrigation are main issues during the sessions in Labutta, but also the key values in river use by the villagers.

Development trends in the township

The following trends have been mentioned in Labutta:

- The amount of fish caught is dropping, although most fishermen do not know why this is. The major complaint of the fishermen committee is the license system. Some believe that since fishing is regulated (meaning: certain zones are delegated to certain committees, as of 2012) they only catch half of what they used to catch.
- The fishermen also believe that several species of fish became extinct after Nargis.
- In downtown Labutta, people do worry about the effects of climate change and the increase of the risks of cyclones.
- More salination in the fields is causing decreased crop yields. Another source of income is fishing.

3.6.5 Yangon, Insein Township

Townships assets

Insein was the team's trial session. The main asset was the fact that the community provided accommodation for former laborers of the bridge. They were supposed to leave after the bridge was finished, but never did. The status of their area is uncertain; official dwellings are being developed around them, as are for example, a golf course or docks.

Issues

Sanitation and overall living conditions are the main issues here, connected to seasonal flooding. The houses are of poor quality, without toilets, and prone to flooding. Since the houses are in a relatively grey zone between official residential areas and squatters, it is unclear who is in charge or should solve the problems. For example: the houses will flood, but a concrete walkway has been built that remains dry. This walkway has been co-funded by the inhabitants and a political party.

Seasonal flooding

Especially in the Delta, the issue of seasonal flooding is mentioned in almost every community session. People mentioned the fact that their houses are flooded every (couple of) years, for periods of a couple of days up to 3 to 5 months. This is a problem that hits poor households hardest: poor households cannot afford to build their homes on "long legs" and will need to leave their homes. People will find shelter elsewhere, mostly in monasteries or other official buildings like schools. Again, poor households will be hit hardest. If you have earned enough money in the dry season, you will be able to take your own supplies to the shelter, thus, enabling you to work during the daytime; otherwise you will have to stand in line all day long for aid. People are most concerned about the effect this disruption of their daily lives will have on their children. Often children will not be able to go to school while living in the shelters. And when asked about their dreams for the future, everyone answered, "a better education for our children." Health and safety issues in relation to seasonal flooding are, on the other hand, mentioned far less.

Values

People want to be sure about their place of living (they risk being evicted) and to improve their living conditions and livelihoods. They hope for better jobs and more education for their children so that they can take charge of their lives and move to less flood prone areas.

Development trends in the township

In this township people shared spatial planning issues along the riverbanks, when a township is in close proximity to a booming large city. People live in a relatively grey zone between being down right squatters and having some official rights to their homes. In this case, the community consisted of former workmen, who were supposed to leave their temporary homes when the bridge was finished, but never did. This is a trend in other urban centers along the river.

3.6.6 Conclusions for Ayeyarwady Delta HEZ

The Ayeyarwady Delta HEZ is clearly dominated by the fact that it is a flood and cyclone prone region. Seasonal flooding and salinity have become more of an issue in the last couple of years. People attribute this to climate change and manmade causes like deforestation and erosion. What struck us is the amount of local knowledge people seem to have; erosion and sedimentation are no abstract concepts, but are pinpointed rather precisely. "This bridge causes that problem over here," or "sandmining upstream causes sedimentation a couple of kilometres lower." What also struck us is how matter-of-fact people are about river-related issues and solutions. Seasonal flooding is part of their lives, and they are far more concerned about the effect on their livelihoods, their earning capacity and, most of all, the educational opportunities for their children, then about risk reduction or more engineered measures against seasonal flooding. They want job opportunities, economic developments, better law enforcement, more microcredit, and universities. If they improve their livelihood, they can take care of themselves, with the exception of the disadvantages of living close to the river as well as having the benefits of the floods (improvement of soil fertility). Irrigation in the delta is often challenging because of salt intrusion and sedimentation. Just like in other HEZs nationwide, returning issues are solid waste, sanitation, and drinking water.

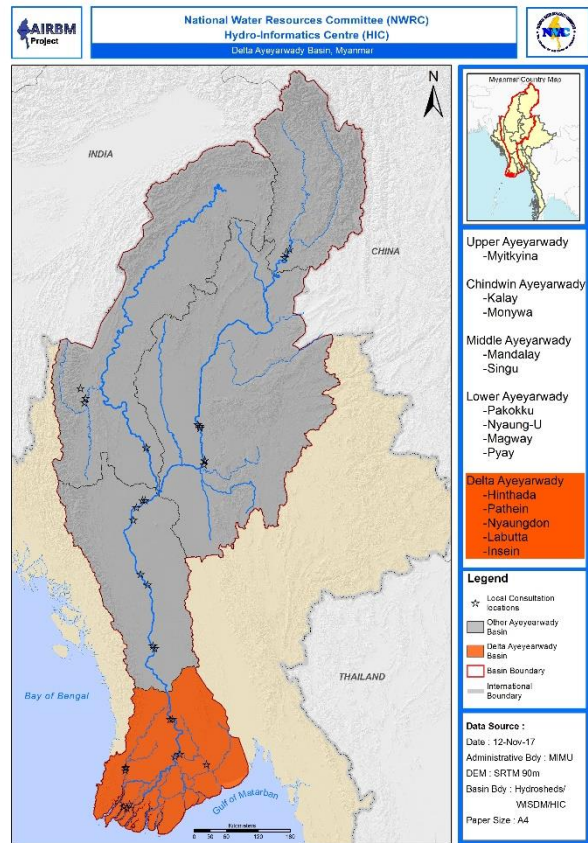


Figure 47 - Delta HEZ in Ayeyarwady River Basin

4 ANALYSIS AND DISCUSSION OPPORTUNITIES & TRADE-OFFS

This section presents opportunities and trade-offs as discovered in the qualitative research.

4.1 HEZ: Upper Ayeyarwady

4.1.1 Myitkyina Township

Opportunities in Myitkyina:

- Development of a tourism sector. The area around Myitkyina is very picturesque and has great touristic potential. It could become an important source of income. However, the river should first return to its natural unpolluted state as much as reasonably possible.
- Mitigation measures for the gold mining industry. The aim would be to reduce environmental pollution, to decrease the disruption of river morphology, and to reduce adverse social impacts such as working conditions and substance abuse. This could be achieved in a relatively straightforward manner (“quick wins”) by working with stakeholders and the industry on awareness raising, capacity building, the exchange of technical know-how and the introduction of international best practices on waste treatment, particularly regarding the use of pollutants such as mercury and cyanide.
- Dealing with the increasing demand for hydropower. Development of enhancements or alternatives by incorporating stakeholders, national, regional and local interests, and by conforming to international standards regarding environmental protection and socio-economic aspects.
- Improvement of solid waste management.
- Improvement of protective measures against bank erosion.



Figure 48 – “Stickering” values and problems

Regarding trade-offs, it would be good to perform social cost-benefit analyses on the above aspects as follows:

- Potential for tourism under the current condition versus improved conditions such as peace, prosperity, and reduced pollution.
- The future of the gold mining industry under the current condition versus conditions in which working procedures are improved to meet international standards on sustainability and socio-economic impacts.
- Extraction of hydropower under the current condition versus an all-inclusive, more sustainable approach.

4.1.2 Conclusions & Trade-offs for HEZ

First and foremost, the strengthening of the peace process in the Upper Ayeyarwady is a priority according to all people that were consulted. Opportunities for the region are plentiful. It is beautiful and extremely rich in natural resources.

Trade-offs relate to how the natural resources are protected, reinforced and used, and to the way by which the people of the north are involved and co-benefit. There are great potential gains, some already on the short term, in the sectors of tourism, gold mining and hydropower.

4.2 HEZ: Chindwin

4.2.1 Kalay Township

Opportunities in Kalay are related to improving resiliency:

- Awareness raising on the effects of deforestation and climate change, and how to be prepared for a next flash flood. This should be aimed at governors and villagers.
- Execution of studies as to which role climate change and deforestation play regarding the flash floods. Based on these studies, mitigation measures can be formulated.
- Improvement of government efficiency in providing relief to the people in case of natural disasters and support during the aftermath.
- Investigation on the reasons for the decline of drinking water quality, and formulation of alternatives for supply.
- Awareness raising on the effects of erosion and sedimentation for people’s livelihoods, their farmlands and their irrigation systems, and how to better adapt.
- Solid waste management: a lot of waste is thrown into the environment and it clogs the drainage canals. A waste collection system is necessary and awareness should be raised among the villagers.



Figure 49 – Visiting the river bank

4.2.2 Monywa Township

Opportunities and trade-offs in Monywa:

- Awareness raising on causes for flooding and erosion, and how to better adapt.
- Protection measures against bank erosion for short term relief.
- Improvement of solid waste management and follow up with proper law enforcement.

4.2.3 Conclusions & Trade-offs for HEZ

The Chindwin HEZ is a mountainous area, vulnerable to flash floods, erosion, and sedimentation. Resiliency can be improved by awareness raising, preparedness training, mitigation of causes, and good governance. Trade-offs are defined by the short, medium, and long-term benefits of these aspects.

4.3 HEZ: Middle Ayeyarwady River

4.3.1 Singu Township

Opportunities and trade-offs in Singu are:

- Improvement of drinking water quality.
- Improvement of irrigation and water retention during the dry season, with as a possible option the installation of a regulating sluice at the inlet near Khul Lel.
- Improvement of solid waste management.

4.3.2 Mandalay Township

Opportunities and trade-offs for Mandalay:

- Awareness raising on the impacts of ever changing river morphology: how to deal with erosion (landowners, farmers, villagers living near the banks of the river) and sedimentation (fishermen, boat owners).
- Investigation into the effects of sand mining and dredging in the river bed, particularly with respect to river morphology.
- Investigation into the status of local fish and fishing as a livelihood. Handling the problem of illegal methods such as electrical battery fishing and the use of chemicals. Identification of the people depending on these methods and providing them with alternatives or restricted zones. Improved law enforcement.
- Improved solid waste management.
- Improved microfinance schemes aimed at diversification of small village level business.



Figure 50 - Filling in questionnaires

4.3.3 Conclusions & Trade-offs for HEZ

The opportunities and trade-offs in the different townships of this HEZ are so diverse that general conclusions cannot be drawn. Conclusions and trade-offs can be found in the sections on the individual townships above.

4.4 HEZ: Lower Ayeyarwady River

4.4.1 Pakkoku Township

The following opportunities and trade-offs are mentioned in Pakkoku:

- Navigation is of crucial importance for the livelihood of the people, in particular during floods. But private boats are expensive. A more affordable system for river transportation in Pakkoku can be considered.
- Improvement of spatial planning and planning rules. People want to reallocate their homes and vegetable gardens to a less flood prone area, but need government interventions to achieve this in a more transparent and fair way. Change of spatial planning rules is possible under a disaster code to be decided by the national government.
- Livelihood improvement by capacity building on good farming practices, irrigation options, crops diversification and so on can contribute to this.
- Increased community involvement and good governance. Villagers state they want more transparency and accountability. They want to be informed by the government about future developments so they can be active participants and agents of change.
- Flood predications. people wish for better monitoring, data management, and modelling. A seasonal flood has advantages, and local people know how to deal with them. Disastrous floods require a warning system so that people can prepare themselves.

4.4.2 Nyaung U Township

Opportunities and trade-offs in Nyaung U:

- For the long term, reallocation of the village or protection by dams, to deal with the threats of flash floods. For the short(er) term, strengthen the ability of the community to collaborate in the development and maintenance of the dry wadi, as an emergency canal.
- The lack of waste collection points in the township can be solved by increasing their number and raising awareness on solid waste management



Figure 51 - Site visit Nyaung U

4.4.3 Magway Township

Opportunities and trade-offs for Magway:

- People feel the need to have more information about the quality of the water for domestic and drinking water use. They hope the government will focus more on data management, water quality monitoring, and information sharing.
- A lot of emphasis is put on the need for awareness and education. People should be made to realize the effects of littering. In addition, littering should be prohibited, according to the villagers.
- Illegal fishing and too many fishermen; it is forbidden to fish in the spawning season and to use batteries, but enforcement of the law is difficult. Besides law enforcement, a solution would be other job opportunities because there are simply too many fishermen.
- The river is becoming shallower, due to sedimentation. This sedimentation is caused by gold-, sand- and gravel digging upstream. The sediments that are loosened by the digging are discharged in this part of the river.
- Land ownership requires attention in this township, with regard to former selling of land and selling this land back, and with regard to the rights to tilt the alluvial islands. Different villages want to make use of the islands in the river, resulting in conflicts.

4.4.4 Pyay Township

Opportunities and trade-offs in Pyay:

- Many industries are active near Pyay Township and it is not clear whether they use water treatments. In addition, it is difficult to define the exact level of pollution; better data management and monitoring are necessary.
- Improvement of solid waste management is required.
- Relocation and land ownership are often returning discussions and will require attention in management of the river basin.
- Microcredits can be considered. People need to borrow money to send their children to school. Some improvements or changes could be considered for the benefits of the livelihoods of the people.

4.4.5 Conclusions & Trade-offs for HEZ Lower Ayeyarwady River

On the whole, relatively much can be achieved by investing in people's participation and strengthening their resilience. A distinction should be made between dealing with natural disasters and annual flooding. Typhoons and flashfloods are deadly, although prevention of effects can be (partly) achieved by a combination of engineered flood protection measures, shelters, better data, monitoring and warning systems, and spatial planning (prohibition to build in dangerous areas). The inconveniences of annual flooding can be mitigated by involving people in decision making and helping them to improve their livelihoods so they are better able to fend for themselves.

4.5 HEZ: Ayeyarwady Delta

4.5.1 Hinthada Township

Opportunities and trade-offs in Hinthada:

- People believe that climate change and deforestation have caused the groundwater level to be very low. Trees are believed to formerly have helped to keep the water table at desired levels. Forced continued use of groundwater by digging deeper carries the risk of being poisoned by the high levels of arsenic thought to be present in the deeper layers. People believe that reforestation could improve ground water quality.



Figure 52 - Using the 3D model

4.5.2 Nyaungdone Township

Opportunities and trade-offs in Nyaungdone are:

- The local council tried to set up a program to collect waste. Improvement and expansion of this program is required.
- Farmers have a keen idea how the delta system works. A trade off near the Mezali sluices could be considered. The people understand that the water is managed in such a way to ensure that enough fresh water reaches Yangon, but they want the regime of the sluices to be changed, so that they have fresh water as well and the water level is not affected too much.
- Increase the responsibility of villages and township upstream with regard to protecting the river. The villagers in Nyaungdone explain that they will take care of the maintenance of the system and the regional/national government should take care of the budgets, law enforcement, and awareness raising.



Figure 53 - Embankment at Nyaungdone

4.5.3 Pathein Township

Opportunities and trade-offs:

- Villagers hope for the development of a new bridge in view of the rapid growth of Pathein.
- Improvement of the solid waste management program with the help of local communities.
- Decrease the amount of fish caught through illegal fishing. The solution would consist of improved law enforcement by the Department of Fisheries, channelization of certain river sections, and removal of blockages in the river system.
- Because of sand mining, the course of the river is changing, thereby causing erosion. The mining is being regulated by permits, but people suspect that development of the coastline is more important than local erosion and flooding.
- People would like to improve their livelihoods by getting cheaper, better fertilizers



Figure 54 - Sand mining

4.5.4 Labutta Township

The following opportunities and trade-offs could be considered for Labutta:

- The people want to be allowed to figure out the fishing rights between the committees. They are sure that this can be resolved without conflict, believing people who work hard, catch more, that is only fair. They believe that the allocation system has been designed for the wetland area, but does not work here in Labutta. If they enforced the system themselves, they would organize monitoring among their committees.
- Dealing with the poverty gap and credits is necessary. With the current system, the people worry about the fact that during the months they are not allowed to fish, they need to repair their boats and buy their licenses. The money lenders ask up to 20% in rent, and happen to be the same people they sell their fish to. They suspect that they do not get the best prices for their fish. The solution to this problem would be better credits, with lower interest rates. Credits for farmers and fishermen is a topic that might require some attention for the development of this area in the river basin.
- Law enforcement for solid waste management is required.



Figure 55 - Labutta



Figure 56 - Fishermen in Labutta

4.5.5 Yangon, Insein Township

People would like more certainty about the status of their residential rights. If they know what the status of their living conditions is, they can decide whether they should stay or go, and try to improve their homes.

4.5.6 Conclusions & Trade-offs for HEZ

Clear trends are the decline in fish (especially saltwater fish) and the increase in flooding over the last years. In this HEZ people would like to be (more) in charge of their trade-offs, whether it is improving their livelihoods or their living conditions. They state that if they can collaborate more with officials and, for example, money lenders, they will be better able to take care of themselves and their families.

4.6 Trade-offs Relevant to the Ayeyarwady River Basin

- People remain resilient and adaptive – throughout the entire Ayeyarwady River Basin, people show resilience and adaptiveness in coping with the downsides of living close to the river, and they would like to be (more) in charge of their destinies, whether it is improving their livelihoods or their living conditions.
- People want to be better informed – people are very eager to understand the forces operating in the Ayeyarwady River Basin, whether man-made or natural, including its morphology.
- People want good governance – current systems of governance were perceived as inadequate and present opportunities for improvement, notably, illegal fishing methods require better law enforcement.
- People have significant concerns about water quality – people expressed concerns about water quality issues, and put great value on clean river water for drinking, washing, bathing and irrigation, as well as for a healthy ecosystem.
- People have concerns about engineered infrastructure – people worry about infrastructure, ranging from hydropower dams in the north, to bridges and even engineered flood protection measures in the south.
- The five HEZs of the Ayeyarwady River Basin represent different natural resources, industries and enterprises, and a range of cultures and beliefs – they also represent different threats and challenges.
- The consultations in 32 villages delivered data about perceived assets, issues of concern, and development trends that can be aggregated to the 14 townships across the Ayeyarwady River Basin.
- Strengthening the peace process is the first priority in the Upper Ayeyarwady HEZ – opportunities for the region are then plentiful as it is beautiful and extremely rich in natural resources.
- There is a general lack of awareness of the environmental and social impacts of industries in the Upper Ayeyarwady HEZ, particularly within the gold mining industry.
- The Chindwin HEZ is a mountainous area, vulnerable to flash floods, erosion, and sedimentation – resilience could be improved by awareness raising, preparedness training, mitigation of causes, and good governance.
- Bank erosion is the main issue in the township of Monywa, which could be addressed through raised awareness of the risks of settling close to the river, especially on the outer bends.
- The main issues in Singu and Mandalay, in the Middle Ayeyarwady HEZ, are floods (Singu) and erosion, navigability, unsustainable fisheries practices, and weak law enforcement (Mandalay).
- The Lower Ayeyarwady HEZ would benefit from a combination of engineered flood protection measures, shelters, better data, monitoring and warning systems, and spatial planning (i.e., prohibition to build in dangerous areas) to reduce the impact of typhoons and flash flooding.
- Clear trends in the Ayeyarwady Delta HEZ are the decline in fish (especially saltwater fish) and the increase in flooding over the last decade.

5 CONCLUSIONS AND RECOMMENDATIONS

This section presents conclusions in three parts. First, basin-wide status and trends are summarised in terms of flooding, erosion, sedimentation, water quality, fisheries, and solid waste. Overall conclusions are then drawn in Section 5.2, which is followed by specific conclusions that relate to the methodological approach used in this work. In Section 5.4 some recommendations for future use of the methodology of 3D participatory modelling and stakeholder consultations are presented.

5.1 Basin-wide Status and Trends

The status and trends of the Ayeyarwady River Basin, according to the communities consulted in 32 villages across 14 townships, are summarised below.

Flooding

- Flash floods, particularly in mountainous areas, are more frequent and extreme—reported causes include climate change, deforestation and river sedimentation.
- Seasonal floods are higher and last longer—farming operations are on hold for a longer period, creating economic stress and disruption to children’s education, which needs to be addressed by adaptation.

Erosion

- Good agricultural land and infrastructure are disappearing or at risk, sometimes resulting in disputes over accountability and land ownership.
- Research is needed to validate perceived causes.
- Increased turbidity reduces water quality for drinking and irrigation.
- People understand the relationship between deforestation and erosion and, hence, the concept of the larger river system.
- More awareness is required on local hydrodynamics to foresee that outer river bends erode more rapidly than inner bends.
- Soil conservation measures are needed in upland areas to reduce erosion and loss of water holding capacity.

Sedimentation

- Navigation for transportation of goods and for reaching agricultural lands are severely impacted by sedimentation.
- Villagers relate sedimentation to flooding as riverbeds rise and drainage systems block.
- Sedimentation also creates new land, some very fertile—these areas around Magway cause disputes amongst villages vying to cultivate the new land.
- Where rocks and gravel are deposited, they destroy good agricultural land.
- Sedimentation makes the river water turbid and spoils drinking water quality.
- Local communities well understand the relationship between erosion and sedimentation.
- The meandering quality of the river is less well understood, resulting in unwise settlements on unstable riverbanks.

Water quality

- Water quality is generally decreasing, particularly during the rainy season.
- In the Upper Ayeyarwady HEZ people use mainly river and groundwater for drinking and domestic use, while in the Middle and Lower Ayeyarwady HEZs people use the river water and tube wells—the quality is poor in the rainy season and people depend on bottled water, rainwater, or their neighbours.
- In the lower Delta people use groundwater, as the river is too salty—in the upper Delta they use river water, as the groundwater is too deep.
- Mercury and cyanide from gold mining, industrial waste, agricultural pesticides, and solid waste (including plastics) all contribute to the declining river ecology and water quality.

- The river has a sanitary function for many villagers.
- In many villages people use special traditional clay pots, seeds, and crystals to clean the water.
- The ecological condition of the river is perceived only indirectly—fishermen worry about the decrease in biodiversity and bio volume, while in the Upper Ayeyarwady HEZ villagers describe the river as “dead”, which they attribute to gold mining.

Fisheries

- There is a general decline in traditional fish catches, coinciding with the increase in illegal electrical battery fishing, the use of chemicals, and fishing in the spawning season.
- Conflicts occur among fishermen on fishing methods and zoning, and a perceived lack of law enforcement.
- High investment costs for equipment, boats, and licences, combined with high loan interest rates create a poverty trap for many fishermen.

Solid waste

- Garbage in the river is on the rise, and is increasingly composed of plastic and other non-degradable waste—this blocks irrigation canals, deters bathing, domestic use and drinking, and discourages tourism.
- Much of the waste problem reflects a lack of awareness, absence of waste management programs, and lack of appropriate regulations.

5.2 Overall Conclusions

People remain resilient and adaptive

Throughout the entire Ayeyarwady River Basin, people show resilience and adaptiveness in coping with the challenges of living close to the river. In countries such as the Netherlands, annual flooding would lead to demand for extensive government intervention, but this is not the case in the Ayeyarwady River Basin. Local people expressed a desire to improve their livelihoods in order to better care for themselves and their families. However, this resilience should not be taken for granted in the light of growing socio-economic pressures and increasing stresses on the natural systems upon which these local communities depend.

People want to be better informed

People are seeking information and knowledge. They are very eager to understand the forces operating in the Ayeyarwady River Basin, whether man-made or natural. When discussing flood risk management, they expressed a need for practical information like weather forecasts, flood predictions, and routes to shelters. When deciding on measures applicable to the mid- or long-term, they want to be informed about the available alternatives, including best practices. People would like to better understand the risks of declining water quality and the implications of the current poor management of solid waste. They also want to know what they can do themselves and what should be done by others, including how to address perceived sources of pollution like industry or mining. In addition, they expressed a desire to contribute information to a broader system of data collection and interpretation through the conduct of grassroots-level monitoring.

People want good governance

Current systems of governance were perceived as inadequate. Aspects of governance perceived as having deficiencies extended to, *inter alia*, data management, capacity development, water law, water policy improvement, rules and regulations, and finance and investment priorities.

People have significant concerns about water quality

People expressed concerns about water quality issues, whether it is the “dead river” in the north or the steep decline of fish in the south. They put great value on clean river water for drinking, washing, bathing and irrigation, as well as for a healthy ecosystem. The latter, for example, was expressed by their concern about the steep decline in fish or mangroves. They blame several sources for the decline in water quality, and requested more regulation and law enforcement for tackling these issues.

People have concerns about engineered infrastructure

People do understand the workings of the Ayeyarwady River Basin – they can pinpoint the causes of erosion and sedimentation upstream, and relate that to their downstream problems. These causes might range from hydropower dams in the north, to bridges and even engineered flood protection measures in the south. A more holistic, inclusive planning process is needed that much more adequately accounts for their perspectives.

5.3 Conclusions on Methodology

The 3D participatory modelling methodology proved a suitable method for research of this kind. This was particularly so for the first phase of the work, which involved asking informants to rank issues of concern by placing a limited number of stickers on pictures of these ‘hot issues’. This simple technique was an effective conversation starter, and well suited to people with little formal education.

The 3D model was a highly effective tool for communicating the connections and dependencies across the entire basin. However, it is quite cumbersome to transport.

Maps and aerial photos provided excellent reference points, and were easy transport. These materials need explanation though, and therefore, more engagement time. Furthermore, the mapping of locations and experiences is not something that all informants will find straightforward. Separating local experts (including farmers and local inhabitants) from the rest of the group can allow for more in-depth map-based conversations, while the remainder are assisted with questionnaire completion.

The meta-analysis of this methodology is considered a valuable technique in that it has given a voice to the people surveyed. In doing so, it has tapped into local knowledge and experience, like traditional ways of improving the quality of water for drinking (e.g., by using crystals or nuts). It may be argued that it has extended the licence to operate of those responsible for future developments along the Ayeyarwady River on the basis that people tend to be more supportive of developments if they understand the issues and options, and see the bigger picture. This is especially so when they perceive that their points of view and interests have been heard and taken seriously. The resultant database from this work will inform the design and implementation of future stakeholder engagement as a core requirement of projects with most donors and financial institutes. Regular updating of the database will add new insights about local perspectives and interests. Ongoing engagement and interactive dialogue with local communities of the Ayeyarwady River Basin is essential.

5.4 Recommendations

First of all, continue the dialogue with local communities and keep giving voice to the people. It is recommended to start with follow-up visits to the same villages, and broaden the circle by including new villages. These new villages might be chosen based on a better, prior analysis of representative ethnicity. Furthermore, another recommendation is to train participation ambassadors. In order to deepen and broaden the dialogue, participation ambassadors can be vocal points and first contact persons for future participation sessions.

It is suggested to add coding to answers, so every answer can be attributed to gender, age group, ethnicity, religious belief, and so forth. This might be useful for the questionnaires, although it is important to point out that at least half of the questionnaires were filled in with help of our team members (many people are illiterate or semi-literate) and were often based on a group conversation. The number of men and women that were present was counted at the beginning of each session, and age groups, occupations, and other obvious distinctions (such as “a majority of Christians”) has been noted. It is not recommended to further formalise the sessions by either forcing people to fill in more detailed questionnaires instead of talking, nor counting who says what every time a question is answered. This will stem the free flow of the dialogue, and will hamper the qualitative strengths of the method.

Cultural and religious assets remained a bit underexposed. Cultural values were included on the value poster in the first phase of every community session. As was shown, cultural values were hardly ever mentioned (i.e., the picture received few stickers). It is recommended to improve on the interview technique on this point. Perhaps cultural values are so obvious that they do not need to be prioritized. Perhaps other values

are more important (e.g., irrigation, navigation, drinking water). Perhaps this is "private" value, not easily discussed with Westerners.

In order to improve interaction between SOBA packages, it might be better to formulate clear and concise 'taps' between packages. For example, for groundwater, water pollution, or income level, quantitative data are gathered in the other packages and should be validated in SOBA 6.

During the Multi Stakeholder Forum Sessions (16 – 19 October 2017), the following recommendations were formulated:

- 1) There is an obvious need for data, monitoring, and decision support systems, so there is strong support for SOBA.
- 2) Institutional arrangements with integration mechanism such as NWRC Secretariat functions are necessary.
- 3) Freshwater is plentiful but need IWRM implementation for various water needs.
- 4) There are major concerns about water quality issues, both surface and groundwater – we need to put up an alarm! There is need for mapping and attention from the government and practical support.
- 5) There are concerns about the impact of engineered infrastructure such as bridges, (hydropower) dams, and even flood protection measures, so there is need for careful holistic planning.
- 6) Concerning water-related disasters, risk mitigation, and reduction, chances for resilience and adaptivity of both socio-economic and natural systems exist. The suggestion is to put it into the National Development Plan.
- 7) There is obvious need for good governance (i.e., data management, capacity development, water law, water policy improvement, rules and regulations, finance, right kind of investments, and so forth).
- 8) There is a need to promote green jobs and Subject Matter Experts in the water sector, as well as a need to improve banking system and insurance and reinsurance business introduction.
- 9) Five ecohydrological regions of the Ayeyarwady River Basin can start to think about economic niches according to their physical and socio-economic characteristics.

COLOPHON

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ANNEXES

Annex I. Ayeyarwady River Basin Communities Atlas

Annex II. Digitized Database and Raw Data