Integrated coastal management program (GIZ-ICMP)
Strategic Advice for Coastal Protection Planning in the southern of Mekong Delta
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1 Introduction

In November 2015 the author has been assigned by the „Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) to provide consultancy for the project „Integrated Coastal Management Programme“. The general framework of the contract focusses on concrete coastal protection planning and on strategies in order to implement coastal protection strategies and policies on the longer term. The focus areas are located in the southern Mekong Delta area at West Sea in the middle part of Ca Mau Province and the East Sea in the provinces of Bac Lieu und Soc Trang for the field trips and are including Kien Giang Province concerning general aspects of coastal protection.

According to section two of the terms of reference, the assignment should address the following issues and tasks:

1. Field trip to selected sites at the West-sea coast and East-sea coast
2. Meetings (arranged by GIZ ICMP) with relevant knowledge institutions in the Mekong Delta
3. Contribution (documented) to expert round table
4. Workshop with the respective Ministry (MARD-DWR), the Southern Institute for Water Resource Planning (SIWRP in HCMC), other knowledge institutions and selected representatives of the four Southern Mekong Delta provinces.
5. Report with findings and recommendations
6. Finally to elaborate a concept for a (later) capacity building with special emphasis on organizational development, institutionalizing and implementing of coastal protection and flood risk management strategies, systems and planning.

By January 4th 2016 interim report has to be provided to GIZ by the customer concerning a draft evaluation of the state of coastal protection along selected stretches of the West-Sea and the East-Sea coast of the southern Mekong delta based on the field trips.

2 Fieldtrip Ca Mau Province

2.1 Existing coastal protection structures West Sea U Minh District

Selected sites at the West Sea and the East Sea coast of Ca Mau province have been visited by GIZ-boat on November 9th and 10th by a team of GIZ stuff experts from provinces and the author. On 9th of November the coastal stretch north of Huong Mai in U Minh district has been inspected (Figure 1). This stretch of the coast is characterized partly existing mangrove belts that undergo erosion and a clay dike, which provides flood protection for the hinterland. Several channels connect the sea with the hinterland. Near the mouth of the channels sluices are located. The landward side of the mangroves is bordered by a small dyke parallel channel from which the material for dyke construction has been excavated. The canal is used by local population especially fishermen in order to provide a navigation route for smalls boats sheltered by wave impact. Sikora (2015) evaluated medium to strong annual erosion rates for this coastal stretch.
2.1.1 Groyne systems

Since about 5 years the province started coastal protection works in order to stop or reduce erosion of the mangrove belts by erecting shore-parallel groyne constructions and direct erosion protection schemes at the edge of the mangrove belt.

![Site map field trip November 9th west sea coast district U Minh (Google Earth)](image1)

The general construction of groynes consists of two rows of precast reinforced concrete piles. They show a diameter of about 35 cm and gap of about half the size of the diameter in axial direction and of 2.5 m in cross direction (Figure 2a and 2b). The younger construction show an about 50 cm reduced distance in order to save construction costs. The poles are fixed with one concrete binding beam for each pile row and cross beams with an axis distance of about 2m (Figure 3). The binding beam and the cross beam mark sections with a spacing of about 2 x 2 m. The height of the construction estimates to about 1 m above mean high tide with is marked by the upper growth limit of mussels and barnacles. Construction plans were not provided by GIZ.

![Concrete pile groyne north of Khanh Hoi vertical and coast parallel section (Photos Thorenz)](image2)
The space between the columns is filled with high quality rock armor with maximum size of about 60 cm. The original construction has been executed with a complete rock armor filling. In order to enhance the sediment transport of suspended mud through the construction, in a later phase the stone filling has partly been removed by removing the rock armor in two neighbored sections. The distance of the openings estimates to 50 to 70 m. The construction is in tendency cost intensive caused by the applied construction and materials. The placement of the piles, the concreting of the bindings and the rock armour filling has been executed offshore based on barges. In order to gain a long life cycle in such an aggressive environment like salt water und attack by waves, currents, biota und abrasion by sediments, durable high quality materials and precise execution of the construction are needed.

In the inspected more southern and older construction is situated south of a canal outlet at sluice gate no.4 and shows a distance between 100 m and 150 m from the edge of a 70 – 120 wide mangrove belt (Figure 2a and 2b). It is interconnected with the canal entrance and open to its southern side. Close to the entrance a small gap is established in order to provide a passage for smaller boats. Several execution failures in concreting, such as gaps, remnants of packaging, non-covered steel armor and cracks and damages were found (Figure 4a to 4c). These are also in general described in Thorenz (2014).
Visually significant sedimentation on the mud flats landward the construction can be monitored. Directly close to the construction significantly less sedimentation occurred (Figure 2b). Reasons for this might be construction parallel wind and/or tide induced currents or turbulence effects due to wave attack and wave energy dissipation at the landward side of the construction which cause a lower ground level and the tendency of development of a construction-parallel shallow channel. Also the openings are directly interconnected by this channel. Additionally recent reforesting of site-adapted Avicenna mangroves in the sedimentation area shows good success (Figure 5a and 5b).

**Recommendations:**
- The construction height should be considered in term of costs and efficiency. These kinds of construction in general should functional induce significant effects on sedimentation, mainly during regular or even slightly higher water levels and accompanying wave conditions, in order to reduce currents and wave energy. Hence the construction height should be adapted to these boundary conditions. A height reduction might be possible. The general pile-based construction is very expensive and not easy to execute. Under salt water conditions ongoing corrosion of the steel armor and as a consequence growing damages can be expected which are facilitated by the suboptimal execution quality. This can reduce the lifecycle of the construction significantly. Maintenance of damages is complex to handle and expected to be cost-intensive. The construction is hardly removable and very cost intensive.
- The nearly vertical construction leads to high wave impact in storm conditions especially concerning breaking waves. This demands a heavier construction than for example sloped profiles.
and leads to the risk of scour protections and settlement of the rock fill or even an collapse of the structure.

- The construction is not connected to the mangrove belt on its southern end. Due to this layout coast parallel waves and currents can develop between construction and mangrove belt, whereby the effects of the construction are reduced. A connection to the mangroves and a separation of the mud flats in e. g. three fields by coast perpendicular groynes is recommended. Due to reduced energy impact by waves and currents they may be planned as a lighter construction e. g. as wooden groynes. Such groynes might also be suitable as separating elements to enhance the sediment transport through the openings in sheltered area and prohibit construction parallel currents.

- The effects of the construction especially on morphology should be monitored in a proper way by means of a structured monitoring program. A relatively simple method mark cross shore profiles with a distance of 200 m or even better 100 m, which cover the area from the mangrove belt up to 200 m seaward the construction. It is important to extend the monitored area to the adjacent costal stretches in order to monitor possible negative effects and provide a comparison to unprotected areas. Monitoring should be carried out systematically covering a longer time period. In the first years at minimum two measurements per year considering seasonal weather conditions are recommended. Depending on how huge the morphological changes are, the amount of cross shore profiles as well as the measuring intervals can be reduced.

- More insight in the effects of the construction on wave energy reduction and currents considering the geometrical layout by means of hydraulic ad numerical model tests are recommended.

### 2.1.2 Shoreline protection by gabions

At the northern part of the channel outlet the edge of the mangrove belt was directly protected with gabion type erosion protection over a length of up to 500 m (Figure 6a and 6b). Northward shore parallel groynes are executed. Partly the construction has been heightened by a second row of gabions which is placed directly behind the first row on a higher level. Both rows mark nearly vertical constructions. On some stretches significant parts of the steel mesh wire are destroyed whereby the structure of the gabion stones is heavily damaged or even destroyed. The reason for this not known since a closer look to the structure was not possible. A scour protection has not been detected since it was not possible to reach the gabions directly.

![](image1.png) Figure 6a and 6b: Mangrove belt protection by gabions north of channel outlet (Photos Thorenz)
**Recommendations:**

In general massive erosions protections can be useful in order to prohibit the mangrove belts from further erosion. This is especially the case if no groyne fields exist.

- It is recommended to reconsider the implementation of gabion constructions in general. In salt water environments the durability even of high quality steel mesh wires is very limited and much shorter than the rock fill of natural stones. The steels wires additionally undergo heavy forcing during wave attack by movement of the rock fill and might be damaged by overload.
- If a failure of the mesh wire occurs, the rock fill can be displaced by wave energy impact or currents since the weight of the rock fill is too low.
- A maintenance of damaged the steel mesh wires and therewith of the whole construction is not easy to handle. Hence reparation of such constructions is technically very difficult to execute and a complete reconstruction can be needed, which is very cost intensive.
- The nearly vertical construction leads to high wave impact in storm conditions especially concerning breaking waves. Higher stone weights and thicker wires are needed in order to guarantee the stability of the construction compared to a mild sloped rip-rap construction.

**2.2 General Recommendation on erosion protection constructions**

It is strongly recommended to consider alternative groyne layouts and profiles in order to reduce construction costs as well as expected future maintenance coast.

Especially due to the comparatively relative low tidal range of about 1 m, T-groyne constructions which are connected to the mangrove belt, should be considered as a general layout. Since the establishing of maintenance is complex to organize, alternative to the bamboo pile based construction types such as erected in Soc Trang province, rip-rap based constructions or stronger piles are recommended to consider.

The rip-rap constructions consist of a core of non-cohesive material like sand, a geotextile in order to guarantee filter stability, a gravel layer and a rip-rap consisting preferably of two stone layers. The rip-rap should be placed very carefully aiming on a high friction between the single stones. This is preferably reachable by armour stones, that are carefully placed carefully by excavator and finally placed by hand. The slope of the construction should show 1 : 2,5 or better 1 : 3. The rip-rap should reach a level below the mudflat and should be spread out with a very shallow slope of less than 1 : 10. Figure 7a and 7b show an example of this kind of construction, successful applied also in Germany. Such kind of constructions show the following advantages:

- Reduction of wave reflection
- Reduction of scour development
- Reduction of loading due to mild slopes
- Technically easy and cost effective maintenance
- High adaptability und flexibility
- Armour stone rip-raps can be re-used in case of rebuilding
- General advantages of these kind of measures are:

In general similar construction can be applied alternatively in order to protect the edge of the mangrove belt by using one slope connecting the mangrove belt with the tidal flats.
2.3 Coastal protection and erosion situation East Sea

On the 10th of November the coastal stretches at Ca Mau Province and the border between Ca Mau and Bac Lieu Province and have been inspected via GIZ-boat (Figure 8).

2.3.1 Ganh Hao shoreline protection

The Ganh Hao river marks the border between Ca Mau and Bac Lieu Province. In order to protect the river banks against erosion and flooding, in each province different types of constructions have been applied.

The right river bank lies in Ca Mau province. Here a technical similar construction to a one described in chapter 2.2 has been constructed of is under construction. Partly a scour protection at the seaward side consisting of armor stone fixed by a mesh of steel wires is applied (Figure 9a and 9b).

Figure 7a and 7b: Groyne fields and groyne maintenance in Lower Saxony, Germany (Photos NLWKN).

Figure 8: Site map field trip November 10th east sea coast Ca Mau province (Google Earth)

This might be needed due to a stronger wave impact from south-western direction. Several failures and displacements of the rock armor are visual. From the constructional point of view in general the same observations and recommendations as for the groynes at the West Sea can be stated.
The left side river banks are situated in Bac Lieu Province. Here a sloped revetment and a vertical flood protection wall is present. Directly adjacent the settlement area of Ganh Hao begins. The sloped revetment has been erected in the last years and is partly still under construction. It consists of six-edged concrete blocks. The blocks are connected by steel wires estimated 5 mm thick based on a steel reinforcement mesh and form mattresses. The construction seems to be based on a relatively thin geotextile.

For strengthening of the lower part of the revetment mattresses are placed in the middle part of the revetment in order to be pulled down.

**Recommendations:**

For the Ca Mau river banks similar recommendation than on the East Sea groynes can be given. At the Bac Lieu for the concrete block revetment following aspects should be considered:

- The relatively thin steel wire connection from the stones to the steel reinforcement mesh is endangered to be corroded in a mid-term perspective. In case of failure of the wires the hole construction will lose its stability. In case of application of concrete block revetments interconnected vertically and horizontally concrete blocks are recommended since steel wire connection cannot provide longer term stability due to corrosion.

- Maintenance of failures is due to the underlying steel wire mesh complicated to execute and cost intensive.

- In case of wave attack pressure shocks can migrate through the relatively wide gaps between the stones. Since there is no gravel layer beyond the concrete slabs applied, displacement of the soil and in consequence a failure of the revetment can be expected.
The areas where the construction is applied seems to be partly been affected by waves during storm. Since the thickness of the concrete blocks is only about xxx cm it is recommend to check the stability of the construction under design sea state conditions.

A armour stone rip-rap with a slop of 1 : 4 with sufficient weight of the single stones based on a geotextile base and a gravel layer and without any steel meshes should be considered. In order to enhance the flexibility and adaptability of the structure. Maintenance is much easier to execute and the costs expected to be lower.

2.3.2 Ganh Hao east sea coastline

The promenade of Ganh Hao orientates to the south-east direction. It has been inspected by GIZ car an November 11th. Here a touristic area has been developed. The existing mangrove belt seems to erode strongly. Recently a several hundred meters long erosion protection consisting of geotextile tubes has been applied in a mainly shore parallel direction. The profile seems to have flattened and partly undergoing stronger settlement (Figure 11a and 11b). As the local GIZ-Staff explained, the original crest level has been much higher than the recent situation and settled down as a hole. In the present state no positive effects on sedimentation are visible.

It is recommended to reconsider the use of such constructions since they are on one hand relatively easy to erect but on the other hand tend to settle down. This can be caused by liquefaction induced by wave attack and small movements of the tubes and scour development at the foot of the construction due to wave and current exposure.

![Figure 11a and 11b: Geotextile tube at Ganh Hao (Photos Thorenz)](image)

2.3.3 Unprotected shoreline southwest of Ganh Hao

Further south-west of Ganh Hao river two smaller river mouths as exemplary coastal stretches with significant erosion has been inspected (Figure 8). Due to stronger south-eastern winds during the date of visiting, wave attack at the cliffs of the mangrove belt could be visually observed (Figures 12a and 12b, 13a and 13b, 14a-d). The cliffs are quite steep. This implies that the eroded material is a cohesive type. The cliff height reaches up to several decimeters.

Different sedimentation layers are visible. The roots of the mangroves are undermined by the ongoing erosion which leads to a collapse of the mangrove trees. This shows that these mangrove species is compared to Avicenna not well adapted to this environment with a high energy input.

At the southern river mouth the erosion processes were visited from the landward site
Figure 12a and 12b: River mouth east sea south-west of Ganh Hao left rivers banks (Photos Thorenz)

Figure 13a and 13b: River mouth east sea south-west of Ganh Hao left and right river banks (Photos Thorenz)

Figure 14a-d: River mouth east sea south-west of Ganh Hao right rivers banks - site visit (Photos Thorenz)
3 Fieldtrip Bac Lieu and Soc Trang Province

Selected sites at the East Sea coast of Bac Lieu and Soc Trang province have been visited by GIZ-car on November 11th by a team of GIZ stuff, experts from provinces and the Sub-FIPI and the author 11th in order to get a visual overview of the situation and the actually executed activities. Figure 14 shows the visited sites.

![Site map field trip November 11th east sea coast provinces Bac Lieu and Soc Trang](Google Earth)

In the vicinity of a nearshore windmill farm a test site to stop erosion and enhance sedimentation processes by construction of bamboo-pile based T-shaped groynes are visited (Figure 15a and 15b). The groyne system is not maintained any longer. The accompanying morphological monitoring program covering a four year period has been discussed with the local GIZ-staff. Hints for evaluation of the data sets where provided. Additional cross shore and longshore based time-depended analysis of to height development was recommended in order to gain a deeper insight in the effects of the groynes and the effects of maintenance. In context of an agricultural research program a new coast parallel row of bamboo piles as a breakwater has been erected and Avicenna mangroves have been planted (figure 15b). The growth of the mangroves seems to be very limited compared to the U-Minh test field mentioned in chapter 2.

![Remnants of bamboo T-groynes and Avicenna plantation](Photos Thorenz)
Visually also no positive effects on reducing cliff erosion or sedimentation can be seen. The vertical construction of the piles is expected to be harmed by stronger waves and higher water levels. Since no landward connection exists, it can be expected that shore parallel currents and waves will limit the effects of the construction as well of the plantation significantly. Additional measures to enhance the situation are recommended.

In the vicinity near an on outlet and an accompanying bridge strong erosion effects can be stated. The road crossing the bridge is located on top of the dike. The mangrove belt shows severe erosion which has effected both sides of the bridge access. On both sides the slopes are heavily eroded. On the north eastern side the seaward part of the bridge is already collapsed. A provisional shelter of thin and spaced melaleuca piles, partly connected with light mattresses of organic material is applied. Former foot protection for the bridge consisting of concrete slaps and a rip-rap collapsed (Figure 16a and 16b). The bridge and the access dams are highly endangered to collapse. Hence the access dams are part of the flood protection system in this case flooding can occur.

It is strongly recommend to construct a heavy temporary erosion protection for the dam and the bridge foundation in order to prohibit the collapse of the construction. This can be executed by building up a mild sloped rip-rap of armor stones found on a filter-stable thick geotextile. The stones can be re-used in a later phase in order to construct a new permanent revetment.

![Figure 16a and 16b: Strong erosion at a bridge and dike (Photos Thorenz)](image)

About 2 km in northeastern direction a dyke strengthening measure was visited. The mangrove belt has been eroded over a stretch of about 200 meters. The core of the dike has been heightened with cohesive material, excavated at the landward side of the dike. A protection of the outer slope was constructed by of two rows of double bamboo piles. The landward row is covered with a light filter construction consisting of a braided mattress of organic material and a light geotextile. To the seaward row no filter seemed to be applied (Figure 17a and 17b).

It is recommended to rethink the seaward protection in general. The vertical construction is relatively week in case of wave attack. The filling can be eroded easily and the filter construction seems to be too weak to withstand any wave attack in case of failure of the filling. Hence in storm situations heavy damages can be expected. Application of a mild slope rip-rap-based construction as mentioned above in order to achieve a stable construction.
Finally a strong eroded coastal stretch in the vicinity of My Thanh river was visited. Here a sluice gate exists. Over a stretch of several hundred meters the mangrove belt has been eroded completely. Extensive protection works in order to provide a temporary protection were in progress. As the technical representative from Soc Trang province explained is planned to relocate the dyke line about 200 m landward.

The site was visited nearly during high tide. Since a significant north-easterly wind was present, wave attack on the construction can be seen. The construction works consist of a mixture of massive octagonal concrete blocks, multi-roe melaleuca fences and non-interlocked concrete slabs. Gaps are partly covered with filled simple geotextile bags (Figure 18a and 18b). In general the construction shows no homogeneous layout. Caused by the vertical parts of the construction, gaps between the construction elements and partly only very light materials, development of scours, undermining and displacement of the filling material can be expected. A longer term functionally of the construction considering the direct exposure of the construction to wave attack seems might be not given.
4 Meeting with the Southern Institute for Water Resources Research (SWIRR)

On November 12th, the Southern Institute of Water Resources Research (SWIRR) in Hi Chi Minh City has been visited by the MARD, the GIZ team and the author. Main objective was the get in overview over the tasks of the institute in general, provided by the director of SWIRR and two vice-directors. Total staff of the institute amounts to 150 persons. A major focus was put on facilities, means and stuff in order to execute hydrodynamic and numerical modelling for applied coastal engineering research questions regarding the Mekong delta area.

One key facility consists of a new experimental hall, which covers 20 m x 40 m sized wave basin. The wave machine is able to generate irregular, uni-directional waves, maximum wave heights of 0.42 m and wave-periods from 0.5 to 5 seconds. Wave absorption is established by means of a armour stone rip-rap situated on the opposite side of the wave-generator.

![Wave basin at the SIWRR experimental hall with wave-generator and rip-rap absorber](Photos Thorenz)

Furthermore a 40 m long wave flume with a width of 1.2 and a maximum water depth of 1.0 m is situated in the hall. In the flume wave spectra and maximum wave heights of 0.42 m and wave-periods from 0.5 to 5 seconds can be generated. The use of the wave basin and the wave flume seems to be in a starting phase. The SWIRR staff explained that some tests have already been carried out.

![Wave flume at the SIWRR experimental hall](Photos Thorenz)
In a second experimental hall, where 3-d hydraulic model of a river section with a weir was currently investigated. Additionally geotechnical and chemical laboratories have been introduced.

Furthermore 1d and 2d-hydro-numerical models and Geographical Information Systems (GIS) are in use at the institute. Namely these are MIKE11 and MIKE21 developed by DHI and ARC-GIS developed by ESR. The use of the hydro-numerical models seems so far to be focused on modeling of currents and discharges for inland waters in the Mekong Delta Area, whereas some modeling for the coastal waters has been applied. These tools are in general also applicable for coastal engineering projects.

In general, the facilities seen to be suitable in order to carry out hydraulic model tests for future coastal protection structures in the Mekong delta. The needed measurement equipment for such kind of experiments has not been visited in detail as well as their application in the wave basin and the wave flume. Hence a more detailed visit focusing on these issues is recommended. Since the preparation, execution and evaluation of hydraulic model tests is a complex scientific task, it is recommended to establish special trainings for the scientific and operating staff on preparing hydraulic model tests in order to achieve reliable and usable results for planning of coastal constructions.

Similar recommendations can be made for the application of hydro-numerical models in coastal waters. The demands and work-flow concerning conception, model setup, calibration and validation as well as interpretation of the modeling results should be focused in special trainings. Additionally the implementation of wave-modelling is recommended, since for costal constructions a detailed knowledge concerning wave induced forces is crucial.

It is recommended to carry out the trainings in cooperation with well experienced German University Institutes in the field of coastal engineering in cooperation with experienced planners.

5 Workshop with MARD-DWR, Provinces, SIWRR, SIWIPR

On November 13th a Workshop on integrated planning for protection for the southern coastal areas including ideas and technical support from Germany was held in Ho Chi Minh City. Participants were the respective Ministry MARD-DWR, the provinces Kiên Giang, Cà Mau, Bạc Liêu, Sóc Trăng, the Southern Institute of Water Resources Research (SWIRR), the Southern Institute for Water Resource Planning (SIWRP), GIZ-ICMP and the author. After introductory speeches of GIZ concerning integrated planning in the southern Mekong Delta area, MARD-DWR provided a general overview over coastal protection in southern coastal areas of Vietnam according to decision 667/2009, the status of implementation, technical guidance and responsibility of the provinces. The author presented strategies, master planning and tasks of coastal protection planning in Germany.

In a further step the four provinces reported on the status of their coastal protection system, gained experiences and further needs for improving. The following from the presentation can be drawn:

- In general all provinces are aware of further needs to improve the coastal protection system.
- The main challenges consist of erosion of mangrove belts, unsufficient dikes und sluices.
- The awareness of mangrove belts role for coastal protection is given in general.
The technical solutions to hinder erosion of the mangrove belts and enhance accretion, the construction dike profiles including revetments differ significantly as well from the functional as from the constructional approach. Design of technical measures seems to be empirical based on regional experiences on province level. The evaluation of hydrodynamic design parameters and morphological boundary conditions for the constructions is carried out very limited often in combination with a lack of relevant data.

In a further phase of the workshop, working groups discussed the challenges, needs and problems for implementing coastal protection strategies and measures focusing on the following topics:

- Knowledge and understanding of coastal systems
- The appropriate solution is not adversely impact
- The link between land use planning / spatial planning and planning for mangrove rehabilitation
- Capacity building and training on Technical Guidelines
The results have been presented by the groups and were reflected and summarized by the experts. The following main topics and needs were found:

- Monitoring concepts and systems for morphological development especially of the nearshore area of the Mekong Delta, water levels, sea state conditions and meteorological parameters are a necessary basis for future implementing of coastal protection strategies and coastal protection planning
- Monitoring in order to understand the effects of the applied coastal protection constructions
- Better understanding of the role of natural protection elements such as mangroves for a coastal protection system
- Further development of technical standards for coastal protection structures
- The stability and effects of coastal protection constructions can be tested preferably by hydraulic model tests and constructions can be improved
- A common coastal data base containing all relevant data (including geodata) for coastal protection and other purposes
- Coastal protection strategies and spatial plans have to be integrated on different scales
- Cooperation and knowledge exchange between relevant institutions (MARD, State institutes, Universities and provinces) in cooperation with international experts facilitates the development of strategies and measures
- Trainings on defined technical and management issues with international experts

6 Findings and Recommendations

The visit of typical sites at the West Sea and the East Sea coastline by field trips, the visit of SIWRR and the workshop showed, that a lot of general understanding for a need of enhancing the coastal protection system for the southern Mekong delta is given at the different institutional levels involved. These are mainly MARD, the provinces and the state research and planning institutes SIWRR and SIWRP as well as experienced universities in the field of coastal engineering. It is recommended to prove whether also relevant authorities for forest and mangrove protection should be integrated. Different thematic fields have been found, for which a further improvement of the knowledge basis is recommended. The author’s advices from his project reports 2014 and 2015 should be integrated in these (Thorenz 2014 and 2015). Special recommendations are included in chapters 2 to 4.

The following main topics are recommended to take into account to improve the knowledge basis of the Vietnamese decision makers and technical experts:

Block 1: Coastal protection policy and strategies

- Elements of coastal risk management
- Coastal Protection strategies and safety standards
- Implementation of coastal protection strategies and objectives in spatial planning
- Needs for legal regulations
- Budget planning and financing schemes
- Evaluation of needs and prioritization

Block 2: Hydrological and morphological basis and data management

- Needs of hydrological and morphological data for monitoring and planning processes (water levels, currents, waves, nautical and terrestrial survey including remote sensing techniques)
- Technical and spatial layout of monitoring systems
- Evaluation strategies and methods for data
- Data management for spatial and coastal engineering data

Block 3: Hydrodynamic modeling

- Scope, conception, application and evaluation of hydraulic models for coastal constructions with a focus on wave impact
- Scope, conception, calibration and validation of hydro-numerical models for water levels, currents and waves especially in 2d
- Interaction between hydraulic and hydro-numerical model as well as monitoring

Block 4: Planning and maintenance of coastal protection works

- Basics of coastal protection policies and strategies
- Basics of measure planning
- Types of constructions for different purposes
- Determination of design parameters
- Design of dykes, revetments, shoreline and erosion protection constructions including emergency measures
- Interaction between constructions and morphology
- Building with nature
- Effects of coastal protection on nature
- Design and implementation planning
- Supervision of construction execution
- Construction inspection and deficit analysis
- Maintenance and emergency planning
- Documentation

A recommended method in order to enhance to knowledge base is seen by a direct interaction of external experts in the topics addressed above and the responsible institutions by means of a capacity building. Preferred in order to guarantee a substantial knowledge transfer are workshops, in which abstract and concrete strategic and practical topics are discussed and elaborated by means of workshops and trainees as well as practical visualization and solution development by field-trips

For the certain blocks the following methods and participants are proposed:

Block 1: Coastal protection policy and strategies

- Participants: MARD, DARD administrative and technical management level
- Method: Workshop

Block 2: Hydrological and morphological basis and data management

- Participants: SIWRR, SIWIRP, Universities, technical experts from DARD
- Method: Workshop, field visits

Block 3: Hydrodynamic modeling

- Participants: SIWRR, SIWIRP Universities, technical experts from DARD
- Method: Workshop, assistance in model application by stuff exchange, trainees
Block 4: Planning of Coastal protection works

- Participants: SIWIRP, technical experts from DARD, SIWRR
- Method: Workshop, field visits at relevant sites

7 Literature:


Norden, February 28th 2016

Frank Thorenz