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Private Sector Adaptation to Climate Change (PSACC)

Development of a Climate Change Adaptation Strategy for a Company in the Inland Water Transport and Shipbuilding Sector in Bangladesh

Case Study on Climate Change Impacts and Adaptation Measures for M/S. Rocky Dockyard

CONTENT

This case study has been developed by GIZ in cooperation with adelphi under the Global Programme 'Private Sector Adaptation to Climate Change (PSACC)' on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ).

Part A: Introduction and Background

Project Context

This case study has been developed in the framework of the global programme 'Private Sector Adaptation to Climate Change (PSACC) implemented by GIZ. The aim of the global programme is to develop and test instruments to build SMEs' adaptation capacities to cope up with climate change risks and increase their resilience. The programme is currently being piloted in four countries: Central America, Rwanda, Morocco and Bangladesh.

This case study is based on an example from Bangladesh. It **analyses the climate vulnerability of a company in the inland water transport and shipbuilding sector in Khulna, identifies appropriate adaptation measures and develops an adaptation strategy for the company**. The study is drawn from a field assessment of the company and shall serve as a representative example for other companies in the sector, especially in Khulna.

Case Study Methodology

For the risk assessment as well as the development of an adaptation strategy the **Climate Expert methodology** was applied. This methodology has been developed by GIZ and adelphi in 2011 and is a step-by-step approach for identifying and ranking climate change risks and opportunities for an individual company, identifying suitable adaptation measures and prioritising them. Information on materials on the Climate Expert approach can be obtained free-of charge from www.climate-expert.org.

Picture 1: Company Assessment

The case study was conducted in November 2015. The members of the team were comprised of GIZ, adelphi, CEGIS and an independent consultant. The case study of M/S Rocky Dockyard took 3,5 days where the Climate Expert Working Sheets were filled in jointly with the company owner and employees. Firstly, an overall **assessment** of potential areas impacted by climate change was completed. Secondly, past and future expected changes were analysed. Based on that discussion, **key risks and opportunities** for the company were identified and ranked on probability and damaged caused. Subsequently, several **adaptation options** for the risks most relevant for the company were identified and assessed on technical and financial feasibility. For each adaptation measure the **relevant costs and benefits** were discussed and a cost-benefit as well as cost-effectiveness-analyses has been conducted. Finally, based on these calculations and the general assessment results, a draft **adaptation strategy and a communication plan** were developed. At the debriefing meeting, the results were discussed with and verified by the company representatives.

Company Profile

M/S. Rocky Dockyard is a family run business that was founded in 1992 and is registered in Khulna. The company offers two kinds of services: cargo transportation, which covers 70 % and the dockyard which covers 30 % of the service and includes mainly repair services as well as the construction of new (cargo-) vessels and pontoons. The repairing of ships is the predominant activity in the dockyard. The company employs **20 permanent** and **80**

temporary staff. According to the SME definition in Bangladesh, the company is considered to be medium-sized.

The company already participated in the PSACC Kick-off workshop “Adapting to Climate Change: Risks and Opportunities for Small and Medium-Sized Enterprises (SMEs)” in June 2015 in Khulna and was hence familiar with the project and the terminology. The company took part in a Call for Expression of Interest and was selected based on criteria such as severity and type of climate change impacts on the company and its interest in developing an adaptation strategy.

Picture 2: Rocky Dockyard Premises

The owner from M/S. Rocky Dockyard, Md. Khurshed Alam Kagochi and his entire management team including engineers, accountants and supervisors participated in the assessment. During the field visit, information through interviews was collected, the company’s facilities were examined, and climate change risks and opportunities as well as corresponding adaptation measures were discussed.

The most important input factors for the work at the dockyard are: energy, labour and raw materials. The required energy needed for the welding machine, lighting, offices accounts for 25% of their total running costs. Another 60% are attributed equally to labour and purchasing of raw materials.

The value chain of ship building and maintenance services of M/S. Rocky Dockyard is relatively short. Most raw materials are sourced from Chittagong ship breaking yard directly by own staff. For small quantities raw materials are sourced from the local market in Sheikhpara, Khulna. The local supplier usually sells raw materials to the dockyard with a profit margin of around 20%. In case of government jobs new metal sheets are purchased from Dhaka. Other required raw materials such as steel angles and engine parts are sourced from different supplier in Dhaka and Khulna.

Picture 3: Ship Repairing at Rocky Dockyard

Table 1: Main Raw Materials and its Sourcing Locations

Input	Source
Bulk Raw material (steel sheets)	From Chittagong or Dhaka
Small quantity steel sheet	Khulna
Steel angle, engine parts and others etc.	Dhaka and Khulna
Marine paints	Local vendor

Material is mainly brought by trucks. Even though water cargo transportation of material is comparatively cheaper, the supplier usually prefers road transportation as transportation via vessels takes around 2 to 5 days longer and is only viable for bigger quantities.

Particularly the shipbuilding process and repair service are very energy intensive (e.g. due to the welding activities) and require a lot of raw materials. M/S. Rocky Dockyard sources its electricity from the grid with average electricity costs of 10 BDT per kWh[1]. M/S. Rocky Dockyard consumes 10,000 – 15,000 kWh per month. In the past, electricity had been partly produced with generators, which costs around 70 BDT per kWh. The company does not have a diesel generator anymore, as it would be too expensive for the high electricity demand of the dockyard.

Additionally, **the company is closely engaged with the community as they source their labour from the nearby communities.** Most staff come from the communities close by and from the other side of the river; a good relationship has been established. The company drilled a tube well and filters the water as well as sanitary facilities which are open for the public to use for domestic purposes.

Table 2: Company Key Facts of Rocky Dockyard

Company Facts	
Location	Khulna, Bangladesh
Products	Cargo transport, ship building and ship repair services
Employees	Around 100 (20 permanent, 80 temporary staff, depending on orders)
Member of association	Dockyard owners association, Khulna, Inland Transport Association, Khulna
Supply chain	Downstream supply chain (Purchasing of material) from: Chittagong, Dhaka, Khulna, Bangladesh End-user market: Mongla port anchoring vessels, Khulna, Noapara factories, Mongla, Noapara, Khulna ship owners, Bangladesh
Technology level	Medium: technical processes for repairing Medium: shipping for cargo services
Main inputs	Energy, labour, raw material
Past climate change impacts	Flood, changing rainfall patterns, rough weather and waters, siltation of rivers, salinity, river erosion
Expected climate change impacts	Increased number and intensity of storms, increasing salinity and siltation of rivers, heat waves, flooding

[1] Current exchange rate is 10 BDT = 0,12 € (12.2015)

Part B: Climate Change Impacts in Khulna

Climate Change Impacts in Bangladesh

According to the Climate-Risk-Index 2015, Bangladesh is one of the most climate-vulnerable countries in the world. The low elevation of Bangladesh – two thirds of the country are located less than five meters above sea level – makes the country particularly vulnerable to sea level rise and extreme flooding. Future climate projections forecast not only temperature rise and increased precipitation levels but also an increase in the occurrence of extreme weather events such as frequent and severe tropical cyclones, storm surges, heat waves and drought. In addition, the melting of the Himalayan glaciers will contribute to the increasing risk of flooding, while in later years the rivers will carry less water. Already today, the coastal regions belong to the most vulnerable areas worldwide regarding floods, cyclones, saline water intrusion into groundwater and river bank erosion. Climate change impacts are a significant challenge for the private sector and especially for SMEs which can be seen as the economic growth engine of Bangladesh.

Figure 1: Map of Company Location in Khulna

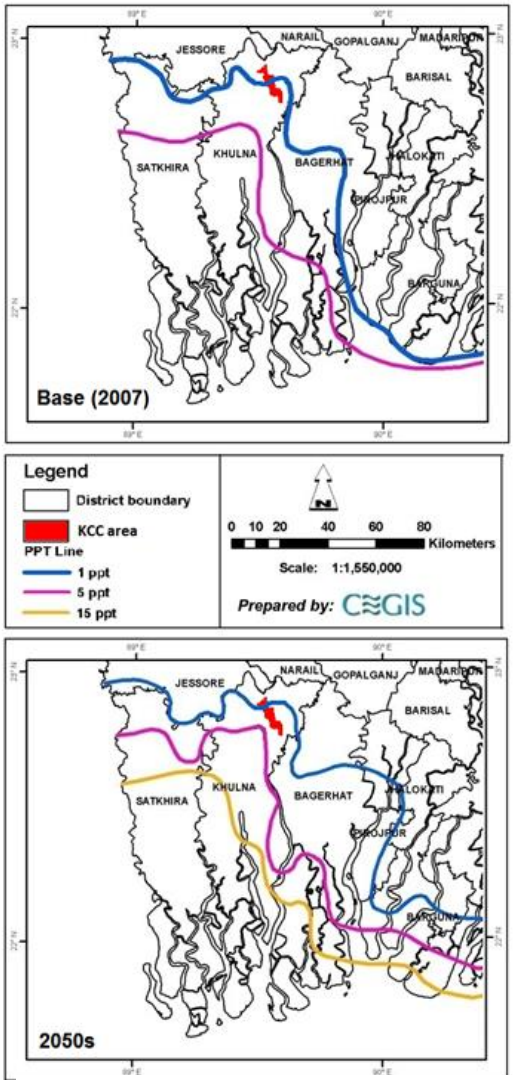


Figure 2: Increased Salinity in Khulna District

Climate Change Impacts in Khulna

M/S. Rocky Dockyard is located is Khulna, one of the most vulnerable climatic zones, located in the south-western coastal belt (Khulna Development Authority (KDA), 2012). Figure 1 shows the company location within Khulna. Khulna is the third largest metropolitan city and is an important industrial hub in the south western Bangladesh. The city is enclosed by the river of Bhairab (northeast), Rupsha (southeast), and Posur (south) which are characterised by strong tidal fluctuations.

According to climate records, the temperatures in Khulna have been increased in the past and will be rising in future. Especially in summer time, heat weaves are expected to increase in future. Additionally, changing rainfall patterns, towards more erratic rainfall during the monsoon season, as well as cyclonic storms with an increased frequency and severity are expected. On the one hand, these rainfall patterns cause a higher river flow and increased sedimentation in the river bed. On the other hand, during dry seasons less and more erratic rainfall might lead to a decrease of water levels and an increase of saline intrusion at the same time.

As a deltaic plain Khulna city is generally flat, large part of the metropolitan area is only approximately 2.5m above mean sea level. Large parts of Khulna city are situated on tidal flood plain with lower relief (KDA, 2012). The city experiences frequent water logging during the rainy season. **The increasing saltwater intrusion** into the city waters and the anticipated sea level rise might have a major impact on the services and infrastructure of the city and its surrounding areas. The prospected high levels of precipitation due to climate change coupled with sea level rise will make the situation even worse. Figure 2 shows the salinity conditions in Khulna in the year 2007 and a prospected development, which clearly show that the level of salinity in the coastal zone area will increase immensely and will cover area further up until 2050. To sum up, Khulna will be affected by **five key climate change impacts** (Afroza et al. 2013):

1) More frequent storms and cyclones with higher intensity;
2) Increased flooding, both in terms of extent and frequency;
3) Increased water logging;
4) Increased salt water intrusion during low tide; and
5) Increased number of heat waves.

Climate Change Impacts on the Water Transport and Ship Building Sector

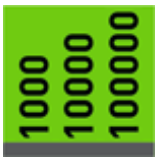
Climate change impacts the inland water transport and shipbuilding sectors in various ways. On the one hand, various ship accidents can be related to extreme weather events which have reportedly increased in the last decades. Due to siltation of rivers, business activities have to stop for longer annual periods and important transport routes had to be closed leading to challenges for many companies in the inland water transport sector. On the other hand, the inland water transport is temporarily the only mode of transport for flooded regions. New boat designs that have less draft and are more robust in climate extremes (e.g. Catamarans) are currently researched and developed by some companies. The sector depends on its waterways which have shrunk from more than 20,000 km to less than 3,000 km in the last decades, not only but certainly also due to climate change impacts like e.g. stronger erosions in the catchment, more sedimentation due to salinization, less lean flows in the dry season.

Part C: Climate Change Risks for M/S. Rocky Dockyard

Based on the information collected beforehand, the discussion with the company representatives and staff as well as the visit to the company's facilities, several risks as well as opportunities for the companies arising from climate change have been identified. Following the Climate Expert approach, these risks and opportunities are attributed to seven impact areas that represent the entire spectrum of business activities. It includes direct impact areas such as the company's location, its production processes, logistics and stock as well as its employees. It also includes more indirect areas such as nearby communities, the markets which it caters to, and financial resources or policies affecting its business activities. Impacts on all of these areas can significantly affect a companys' business activity and are therefore considered in this analysis.

Buildings and location	
	Extreme weather events, like cyclones, pose a risk to the ships of the company as the storms could carry away a ship from the dockyard which could then be damaged significantly. The company location is sensitive towards erratic rainfalls because of the adjacent river. Floods, which are caused by heavy rain events, lead to river erosion and create stronger siltation in the river banks. These impacts endanger the business continuity as the ships cannot be operating anymore.
Processes	
	High energy consumption (e.g. for air-conditioning) leads to frequent power interruptions and load shedding, especially in summer time (June-October). **Interruption of energy supply** is one of the most severe problems as most processes depend on the availability of electricity (e.g. welding) and thus, work activities must stop. Currently, there are no alternative measures to provide the processes with energy in case of energy supply outages. **Very high temperatures** in the summer time heat up the materials in the dockyard, as for example the ship bodies and steel plates heat up to a temperature with which the employees cannot work 2-3 hours a day. **Extreme weather events** like heavy and continuous rain occur regularly during rainy season, and increasingly also outside the rainy season. During heavy rain events, working processes in the dockyard are hampered as there is no roofing to continue working with electronic devices and proceed with painting work. As a consequence working activities on painting and welding hamper. For the cargo business, the **increasing numbers of storms** complicate the reloading of goods from the anchored motherships to the company's ships. In the past, the cargo transportation had to stop completely for several hours or even longer. Rough weather makes the ship navigation more difficult and an increasing number of accidents have occurred during extreme weather conditions. Aggravating factors are the lack of basic navigational equipment like navigation charts, GPS, weather stations, echo sounder or sonar systems in the ship.

	Since the location of the company is close to the river with a low elevation, the dockyard is partially **flooded** around 10-12 times each year which causes a frequent interruption of working processes, as electrical devices cannot be used during flood.
Logistics and stock	
	**A change of rainfall patterns,** which is characterized through prolonged droughts, and heavy rain events, especially in winter time, provokes a decrease of the river water table. This fact leads to the circumstances that the company has limited possibilities to slip ships from water to land and vice versa. In winter time, ships can be slipped only around six days each month whereas on the other days slipping of ships is not possible. Increasingly **silted waterways** complicate the navigation of the cargo ships. Ships cannot be fully loaded in times of low tide, which significantly reduces the capacity of the cargo transportation. Under these conditions, the occurrence of ship accident is increased due to higher probability of grounding. Due to increasing siltation, during low tide and in winter time, ships often cannot dock in the yard for goods to be unloaded; these circumstances severely hamper the business of the company. In the rainy season, usually all waterways are navigable, whereas in the dry season even complete **closings of waterways** impede business continuity. Taking alternative and longer routes result in higher fuel cost and time consumption. **Floods and storms** may pose a risk to the company of losing valuable raw material and cause pollution through leaking substances into the river. **Increased salinity** of river water also has a negative effect on the lifetime of the ships as the ships are more susceptible to rust. The same problem applies for the tools and equipment in the dockyard, like rail lines, trolleys, cables that have a shorter lifespan
Employees / community	
	Very high **temperatures form one of the** biggest problems for workers which rise to above 40 degrees Celsius at the company's site. The labour working conditions deteriorate as the workers are only able to work 70% of their usual working time. Through dense fog in the winter time, many employees have problems coming to work as the usual ferries are not plying under these conditions. As the relationship between M/S Rocky Dockyards and the neighbouring dockyards are good, the companies may exchange on experiences about certain climate change impacts that they are facing.
Government / Regulation	
	The company needs to comply with the national shipbuilding code, consisting of partially very strict regulations that strongly affect the company's business. Regulations limit the number of new ship constructions and obtaining permissions of new ship designs is a long and difficult process. The government is charging value added tax (VAT) for utilising raw materials which results in high costs for

	raw material. Currently, there are no sector specific environmental programmes set up by the government of which the company is affected by. Likewise, no incentives for adaptation to climate change have been set from the government authority until now.
Market	
	With increasing saltwater intrusion, parts of ships are rusting quicker which leads to a rising demand of reparation or supplementation of certain ship components. Thus, the market is demanding these services more frequent.
Finance	
	Some adaptation measures require big investments, which may be a financial burden for the company. Taking out a loan is subject to a high interest rate. Insurances against climate change impacts for the sector are often not yet existent, existing insurances do not cover losses and damages from climate change such as e.g. labour accidents during storm periods.

Part D: Climate Change Adaptation Measures for M/S. Rocky Dockyard

Following the assessment of M/S. Rocky Dockyard's exposure to climate change risks , possible adaptation measures to mitigate the risks and realise the opportunities are identified.

Buildings and location	
	The company regularly gets unreliable **information on current weather forecasts** and thus is not properly prepared for potentially upcoming storms and extreme weather conditions. In cases of cyclones, cargo ships need to be secured or brought to secure ports. The construction of a robust shelter could be an option to protect vessels and cargo from cyclones, strong winds and rough waters. The installation of a local weather station and close collaboration and communication with the Mongla port authority could improve the information level of the vessel owners and captains. . In order to cope with rising temperatures, different shading constructions (e.g. large roof, small shade installation for materials) could be installed, which at the same time provide protection from rainfall. A roof could be combined with the setup of PV cells reducing the company's dependence on grid power.

Processes	
	In order to **reduce the energy consumption**, **trainings for workers** regarding the energy efficient use of electronic devices could be considered. Additionally, the use of energy efficient welding machines would reduce the energy consumption significantly. The deployment of alternative energy sources such as solar system could decrease the energy dependence from the grid and possibly lower the energy costs. Removing the silt from the dockyard in order to slip the vessels is currently a labor-intensive process as it is done manually. An energy-efficient pump could remove the silt efficiently so that working processes will not need to be interrupted.. In order to adapt to the increasing siltation and to maintain the process of slipping of ships, hydraulic structures or the prospection of sediments by e.g. water jet pumps can be considered. This would allow the company to improve its business as more ships can be repaired and labour costs can be saved. Navigation challenge in rough weather could be improved by installing **adequate navigation equipment,** lowering the risk of accidents and interruption of cargo services. It enables the company to identify and use optimized navigation routes. Descent equipment will also ensure the compliance with national and international existing and possible upcoming regulations. The use of equipment such as sonar, echo sounder, weather information system, chart plotter and radar on ships, requires certain navigation trainings for the staff. This could encompass trainings on weather conditions and use of navigation equipment. Improved navigation is likely to contribute to a more reliable on-time service. Another adaptation measure could be **the development of a new ship design** that is more robust in strong storms and cyclones and suitable to run in shallow waters (e.g. lower draft, stronger ship body). In order to improve the lifetime of the cargo ships, options for a more resistant and adapted painting and coating could be acquired. There are certain anti-corrosive paints (improved hardener/coating) as well as improved painting techniques which would require painting less frequent than now. The use of colors of better quality and with less additives and chemicals would reduce negative impacts on the environment, as fewer chemicals of flaking colors would seep into the soil. Trainings on ship maintenance for workers in the dockyard would also reduce the risk of increased repair costs.
Employees / community	
	In order to maintain the productivity of employees, a **fixed shade** would alleviate very high temperatures during summer time. Another option is the **plantation of trees** which could result in multiple benefits. Apart from improving the quality of air through absorption of CO_2 and other pollutant particulates, trees would additionally provide shade and consequently lower the temperatures on premises. Another option to increase the workers' health and productivity is to **shift working hours** so that employees work in the morning and afternoon/evening time.

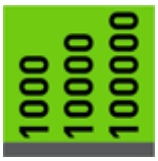
Government / Regulation	
	Companies could seek governmental support for maintenance and dredging of waterways to ensure the continuity of their businesses.. Stronger enforcement of regulations that require more advanced security and safety equipment on the boats would oblige the companies to increase their standards and possible result into fewer accidents. Obligations for vessel owners to use weather forecast instruments as well as navigational aids in bad weather conditions could increase navigation. . Governmental authorities should guarantee the provision and dissemination of appropriate weather and cyclone alerts to all inland ports, dockyards and vessels. The government could set the framework conditions for building new ships with a design better adapted to extreme weather events.
Market	
	A higher demand from the sector for better anti-corrosive paints might occur as a reduced vessels lifetime due to extreme climate conditions and salinity might become a greater challenge in future. . Raising awareness of customers would be needed in order to demonstrate the benefits of reduced repair costs of such paintings. The construction of rough sea resistant and safer ships, in order to respond to changing requirements of customers is another option to generate a market demand within the sector.
Finance	
	The companies could identify alternative funding sources for adaptation measures which could be linked to national and international funding programmes related to climate change (E.g. green credit lines, climate funds).

Table 3 summarises the main risks as well as the corresponding adaptation measures.

Table 3: Climate Change Impacts and related Adaptation Measures

Climate Impact	Cargo Service	Dock yard	Risk for Company	Selected Adaptation Measures
Rising temperatures 	Medium	High	- Lower productivity of workers - Energy interruptions - Lack of affordable alternative electricity generation - Slipping challenges	Fixed shade construction/ Tree plantation – Training on energy efficiency / energy-efficient electrical appliances - Deployment of solar system
Storms 	High	Low	- Interruption of Cargo Service - No or half loading activities - Accidents / safety challenges	- Improved weather information - Navigation training for captains/staff - Navigation equipment - Climate proofed ship designs
Heavy rainfall 	Medium	High	- Interruption of repair/ painting activities - Accidents with electrical appliances	- Dry dock - Fixed shed - Safety trainings
River flooding 	High	Low	- Interruption of cargo service - Interruption of repair/ painting activities - Accidents / Safety challenges - Navigation Problems	- Navigation training for captains/staff - Navigation equipment - Climate proofed ship designs
Salt water intrusion 	High	Medium	- Faster corrosion and damage of ships and equipment	- Improved anti-corrosive paints/ Hardener coat - Equipment maintenance training
Siltation 	High	High	- Slipping problems - Navigation problems - Half cargo loading	- Hydraulic structures / Water jet pumps

Part E: Conclusion

Given the geographic location as well as socio-economic conditions of Bangladesh, exposure to climatic changes is high and the adaptive capacity to cope with climate risks is rather low. Climate change currently poses a high risk to the sustainable development and economic growth of Bangladesh and will become even more severe in future.

The communities and especially small- and medium sized companies (SME) which are oftentimes an integral part of the community belong to the most vulnerable groups in the project area Khulna. SME often lack the skills, resources and infrastructures needed for adaptation to climate change. They also tend to be unaware of, or have only limited access to funding schemes for adaptation measures.

The PSACC programme, therefore, supports SME in strengthening their capacities and knowledge about climate risks and possible adaptation measures. From the risk management point of view, it is important that SME integrate climatic changes into their business strategies. Moreover, climatic changes may also open up new business opportunities as customer demands are changing and the need for adaptation solutions is increasing.

This case study illustrates the development of an adaptation strategy for an individual company – M/S Rocky Dockyard. By applying the Climate Expert methodology, the company was enabled to assess its climate risks and opportunities as well as to identify adequate adaptation measures. Assessing the past and prospected climate change impacts of M/S Rocky Dockyard, rising temperatures, erratic and heavy rainfalls, salinity and more frequent storms belong to the most pressing climate risks which impede their business operations. Suitable adaptation measures to mitigate the risks can vary immensely in terms of required human resources, time, investment costs and technical complexity. Whereas some measures can be considered as no-regret measures[2] (e.g. energy-efficiency measures), other measures are rather considered to be high-cost options (e.g. infrastructure investment). After rating different adaptation measures against technical and financial criteria and conducting a cost-benefit-analysis for certain measures, the most prioritised options for M/S Rocky Dockyard have been:

1.) Navigation training and navigation equipment to improve the navigation abilities in rough weather and silted waterways
2.) Improved anti-corrosive paintings to increase lifetime of ships
3.) Energy-efficiency training for electrical devices to save energy and lower energy dependency
4.) Use of water jets and/or water pumps to ensure continuous slip ways for the vessels

M/S Rocky Dockyard has now identified and prioritised adaptation measures to reduce the risks posed by climate change. The next steps will be to decide on which measures M/S Rocky Dockyard would like to implement and to identify possible funding options. PSACC can provide assistance in finding different funding options and provide knowledge on technologies required.

As companies from the same sector face similar challenges like M/S Rocky Dockyard, this case study can inspire and raise the awareness for climate risks of other dockyard companies as well. The association can play a facilitator role by disseminating the results of the case study. The dockyard companies can cooperate and exchange on experiences with climate-induced risks and possible solutions in order to increase their individual adaptive capacity as well as to increase the adaptive capacity of the entire sector.

The dockyard companies are closely interacting with the community. If the company is able to cope with its climate risks, it will also be able to maintain its jobs for the communities' workers and will be able to provide continuous support to the communities as part of their corporate social activities. Further, certain adaptation measures implemented by the company (e.g. flood protection, tree planting) may also be beneficial for the communities

[22] No-regret measures are measures that are beneficial for the company even in the absence of climate change impacts.

nearby. Responsible corporate adaptation will contribute to strengthening private sector and community resilience.

In order to support SME in coping better with climate risks and to find responsible adaptation solutions, public and private actors as well as communities should collaborate with each other. It must be differentiated between public adaptation measures for which the public actors are responsible (e.g. drainage system, dredging of water ways) and private adaptation measures which can be implemented by an individual company (e.g. energy-efficient equipment). Through Public-Private Dialogues, however, public actors can learn about the risks, concerns but also solutions from the private sector with regard to climate change that might be integrated into planning processes. The private actors might learn about possible support and planned activities from the public sector. Consequently, joint solutions as well as solutions that might be mutually beneficial could be identified.

Picture 4: Assessment team of the case study at Rocky Dockyard

GIZ PSACC would like to express their sincere thanks to the owner of M/S. Rocky Dockyard, management and employees as well as the consultants who made this case study successfully completed.

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