ENHANCING CLIMATE SERVICES
FOR INFRASTRUCTURE INVESTMENT (CSI)

A RECIPE FOR THE SERVICE OF CLIMATE RISK ASSESSMENT
FOR INFRASTRUCTURES IN VIETNAM
BASED ON PIEVC PROTOCOL

FINAL REPORT

December 2019

Executive summary

"*Enhancing Climate Services for Infrastructure Investment (CSI)*" is a global project to promote the use of climate services in planning infrastructure investments, supported by BMU of Germany and implemented by GIZ. This aims to good investment decisions with the minimum economic damage in the face of emerging climate change.

In Vietnam, the CSI has applied the climate risk assessment to the pilot case for Cai Lon - Cai Be Sluice Gates in the Mekong Delta (MKD) and obtained achievements in terms of providing the recommendations on the detail design stage. For facilitating the extension and replica of climate risk assessments in Vietnam, this assignment was to establish a recipe of a typical climate risk assessment service with detail description on the resource inputs and the involved costs required to conduct climate risk assessments.

The recipe was developed based on the successful case of climate risk assessment (CRA) for Cai Lon – Cai Be sluice gate project which was jointly completed by experts from the Southern Regional Hydro-meteorological Center (Southern HydroMet) (under MONRE), Southern Institute for Water Resources Planning (SIWRP) and Water Resources Investment and Construction Board 10 (PMU-10) (under MARD). To address this, a detailed review on this case was conducted to the extent of the PIEVC Protocol, the personnel of the assessment team, workload of experts, timeline, documentation of Cai Lon – Cai Be sluice gate project, climate and hydrological data, workshops, consulting meetings, and field trips. The related cost norms and regulations of service provision in Vietnam were also stocktaken for specifying the required resource needed for a typical climate risk assessment service.

The recipe consists of three main components, including procedure, quantity, and price.

- Procedure covers the main activities of a climate risk assessment on infrastructures as shown in the flowchart in Figure 0-1 (More information under 4.1). Firstly, all the necessary data for climate risk assessment will be collected through Activity 1 (Data purchase) and Activity 2 (Data collection and synthesis). In most cases, it is necessary to have some field trips (Activity 11) for the data collection. These data will be then analysed for historical trend and future forecast, as well as evaluate their sufficiency for the climate risk assessment (Activity 3). Next, risk assessment matrices will be developed (Activity 4) during the risk assessment before considering whether to conduct an engineering analysis or not (Activity 5). It is noted that Activity 5 is optional and implemented only if an engineering analysis is required. The risk assessment matrices and the outcomes of engineering analysis (if any) will be used to propose the conclusions and recommendations for the end-users such as the infrastructure owners (Activity 6). In the next activity, a report on climate risk assessment will be accomplished for the review from the independent experts (Activity 8) before the revised final report is submitted (Activity 9). Furthermore, a number of the workshops and consulting meetings will also be set up during the assessment, including a kick-off workshop, risk assessment workshops, and a dissemination workshop.

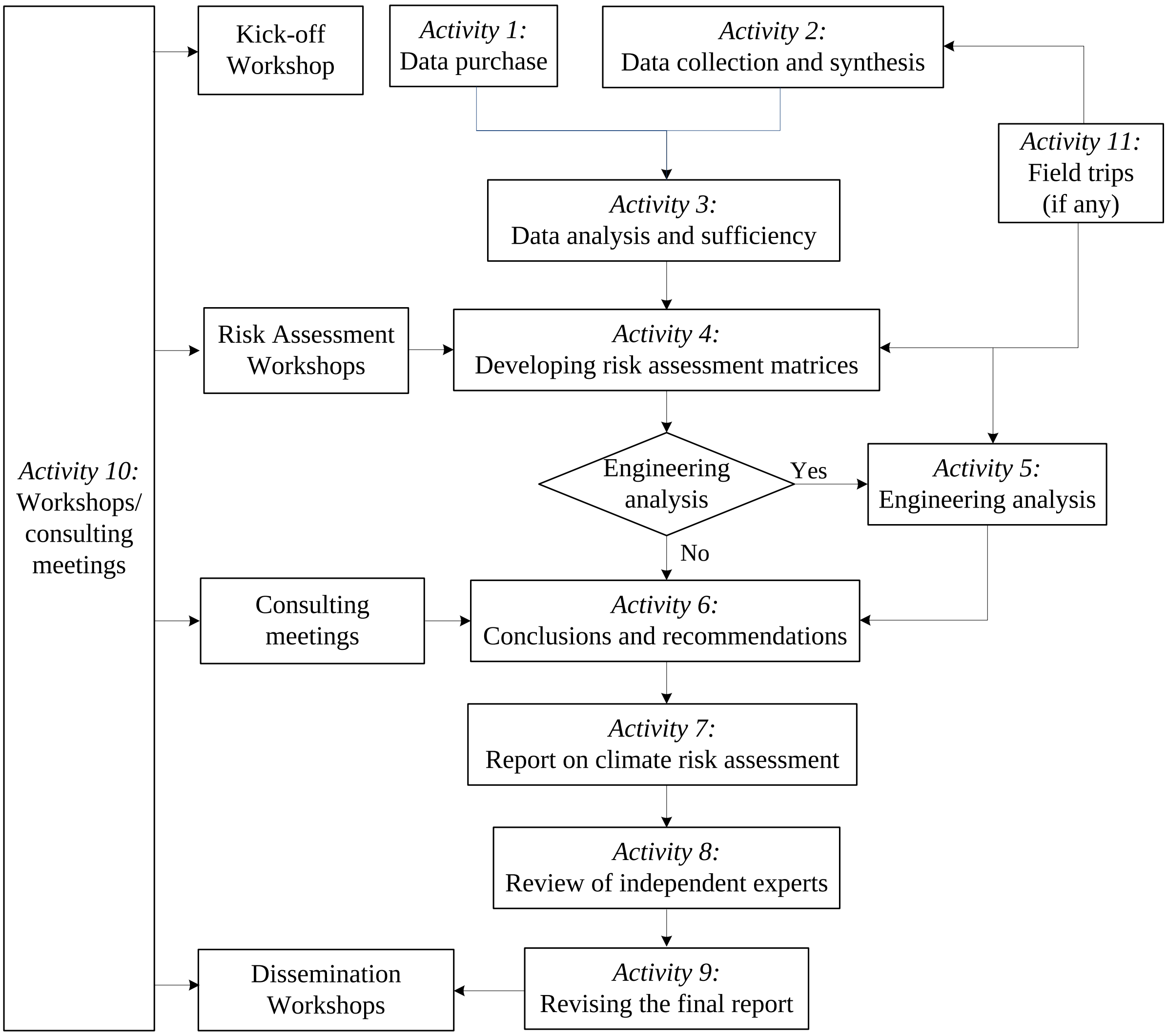

Figure 0-1. Flowchart for the major activities of the procedure

- Quantity clarifies a list of tasks and the corresponding workload (man-days) for the experts of the assessment team in different planning stages of infrastructures. This component also determines the quantity of climate and hydrological data, such as the minimum length of data, method of data collection (free or purchased), and data sources. Furthermore, the number of workshops and field trips (if any) are identified in the quantity component.

- Price identifies unit prices in terms of consultancy, data purchase, workshops, and field trips. The price component also covers a cost estimation to complete a climate risk assessment for different scenarios, including: (1) public sector is commissioning the assessment; (2) private sector is commissioning the assessment; and (3) other potential scenarios that may affect pricing (e.g. GIZ).

The recipe also took into account its applicability for the different stages in the infrastructure planning and implementation process (Figure 0-2). It can be seen that a climate risk assessment was proposed to implement during the stages of "Feasibility study" and "After construction" (10 years).

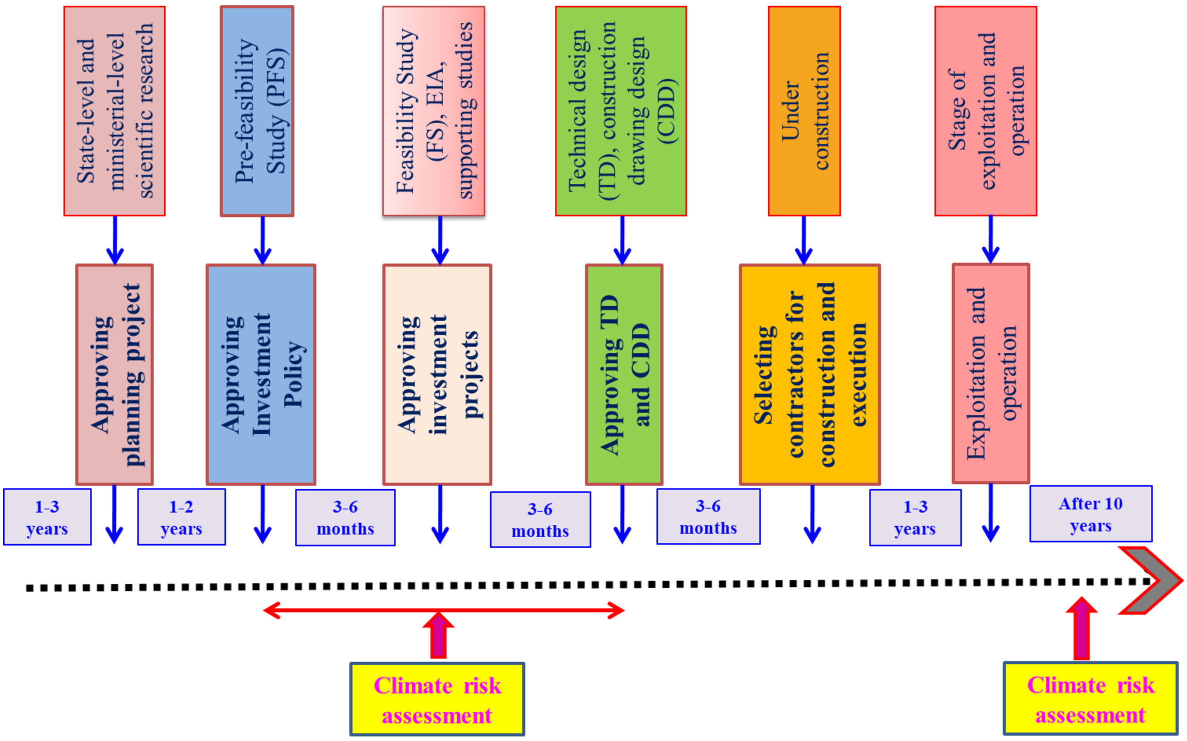

Figure 0-2. The implementation process of a project (Group A) and the periods of climate risk assessment

In order to illustrate the application of the proposed recipe, this assignment established three different cases of climate risk assessment (CRA), from a baseline case (Cai Lon – Cai Be (CL-CB) case) to a replica (CRA for an infrastructure in the Mekong Delta) and extension (CRA for a bridge in Quang Binh province). CRA was applied for the stage of "feasibility study" in both the CL-CB case and Mekong Delta case, while the Quang Binh case conducted CRA for the stages of "feasibility study", and "after construction". The stage of "pre-feasibility study" was not applied as this stage presents preliminary studies to support competent authorities decide investment policies.

- In the Procedure component, almost all activities were considered for all cases excepted for Activity 5 (engineering analysis) in the CL-CB case, the Mekong Delta case and the stage of "feasibility study" of the Quang Binh case.
- The quantity component for all cases is summarised in the following table. Compared to CL-CB case and Quang Binh case, the Mekong Delta case did not assess the impacts of land subsidence on the infrastructure; thus, there were 6 experts in the assessment team for this case. All the cases had 3 workshops (kick-off, risk assessment, and dissemination). The Quang Binh case only had one field trip, while other cases had two.

Table 0-1. Summary of all quantity components for all- three cases

Items	CL-CB case	Mekong Delta case	Quang Binh case
Data	30 years	Same dataset as CL-CB case Plus data in three recent years (2018-2020)	30 years
Tasks		Excluded land subsidence assessment	
Experts	7	6	7
Workshops	3	3	3
Field trips	2	2	1

- The cost estimation for all cases is shown in the table next page. The CL-CB case was signed like an expert contract, so management cost was excluded. In addition, the cost of workshops, independent experts to review, and stationery for this case were covered by GIZ. The total cost for private sector was higher than that for public sector due to the higher consultancy fees, travel cost, accommodation, and DSA. The stage of "feasibility study" had a lower cost than the stage of "after construction" because the stage of "feasibility study" excluded Activity 5.

The following key notes are recommended to apply the recipe effectively:

- The implementation duration of a full CRA is about 8-9 months, but the primary recommendations and conclusions can be provided after 5 - 6 months. Thus, infrastructures having over 5 months planning stage can conduct a CRA with the proposed recipe.
- A CRA on infrastructures can be applied to the stages of "feasibility study" and "after construction" but is not necessary for the stage of "pre-feasibility study".
- A CRA covers all the activities of the procedure for the stage of "after construction", whereas it often excludes engineering analysis (Activity 5 of the Procedure) for the stage of "feasibility study".

- The cost of the CRA for the stage of "feasibility study" is more economical than that for the stage of "after construction". Therefore, an early investment (i.e. in the stage of "feasibility study") for a CRA is more cost effective over the life of the infrastructure.
- The cost for a CRA on infrastructures implemented by a state agency must comply with Decision No. 79/QD-BXD dated 15th February 2017 of Ministry of Construction on standard project management and construction consulting costs, and thus it includes management cost for that agency.
- Hydro-meteorological data for a CRA on infrastructures will not be charged if it serves disaster prevention and control, national defence and security or has non-profit purposes under Law No. 90/2015/QH13.
- There is no official regulation of the Government to calculate cost for a CRA on infrastructures invested by private user, instead of referencing the regulation for public sector or others (such as the UN-EU guidelines for financing of local costs in development cooperation with Vietnam).

Table 0-2. Summary of cost estimation for all- three cases

No.	Items	CL-CB case	Mekong Delta Case		Quang Binh Case			
			Private sector	Public sector	Private sector		Public sector	
					Feasibility study	After construction	Feasibility study	After construction
		(VND/EUR)	(VND/EUR)	(VND/EUR)	(VND/EUR)	(VND/EUR)	(VND/EUR)	(VND/EUR)
1	Consultancy fees	725,828,000 28,310	461,686,000 18,484	346,363,000 13,509	591,520,000 23,071	740,750,000 28,892	434,090,000 16,931	543,180,000 21,186
2	Management costs	Not applicable	253,927,000 10,166	190,500,000 7,430	325,336,000 12,689	407,413,000 15,890	238,750,000 9,312	298,749,000 11,652
3	Other costs	301,600,000 11,763	302,053,000 11,781	209,880,000 8,186	539,105,000 21,027	539,105,000 21,027	481,040,000 18,762	481,040,000 18,762
3.1	Data purchase and processing	260,000,000 10,141	50,380,000 1,965	50,380,000 1,965	259,800,000 10,133	259,800,000 10,133	259,800,000 10,133	259,800,000 10,133
3.2	Workshops	Covered by GIZ	141,554,400 5,521	91,700,000 3,577	153,566,000 5,990	153,566,000 5,990	137,680,000 5,370	137,680,000 5,370
3.3	Field trips	41,600,000 1,623	33,648,640 1,312	27,800,000 1,084	49,269,000 1,922	49,269,000 1,922	43,560,000 1,699	43,560,000 1,699
3.4	Review of independent experts	Covered by GIZ	66,470,400 2,593	30,000,000 1,170	66,470,000 2,593	66,470,000 2,593	30,000,000 1,170	30,000,000 1,170
3.5	Stationery/printing	Covered by GIZ	10,000,000 390	10,000,000 390	10,000,000 390	10,000,000 390	10,000,000 390	10,000,000 390
4	Pre-calculated taxable income	Included in Consultancy fees	Included in consultancy fees	32,212,000 1,256	Included in Consultancy fees		40,370,000 1,575	50,516,000 1,970
5	Value-added tax	Included	Included in other items	56,908,000 2,220	Included in other items		119,425,000 4,658	89,245,000 3,481
Total (Excluded 2, 3.2, 3.4, 3.5)		***1,027,428,000*** 40,073	546,000,000 21,761	459,000,000 17,909	901,000,000 35,142	1,050,000,000 40,953	781,000,000 30,461	901,000,000 35,142
Total (Excluded 2)			764,000,000 29,798	614,000,000 23,948	1,131,000,000 44,112	1,280,000,000 49,924	987,000,000 38,496	1,114,000,000 43,449
Total			1,018,000,000 39,705	836,000,000 32,607	1,456,000,000 56,788	1,687,000,000 65,798	1,266,000,000 49,378	1,463,000,000 57,062

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Acronyms and Abbreviations

BMU	Ministry of Environment, Nature Conservation and Nuclear Safety, Germany
CL-CB	Cai Lon - Cai Be Sluice Gates
CRA	Climate risk assessment
CS	Climate Service
CSI	Enhancing Climate Services for Infrastructure Investment
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IKI	International Climate Initiative
MARD	Ministry of Agricultural and Rural Development
MKD	Mekong Delta
MPI	Ministry of Planning and Investment
PIEVC	Public Infrastructure Engineering Vulnerability Committee
PMU-10	Water Resources Investment and Construction Board 10
SDG	Sustainable Development Goal
SIWRP	Southern Institute of Water Resources Planning
Southern HydroMet	Southern Regional Hydro-meteorological Center
The Protocol	PIEVC Engineering Protocol for infrastructure vulnerability assessment and adaptation to a changing climate
UN	United Nations

1 Introduction

1.1 Background

Developing and emerging countries invest billions of euros into long-lived infrastructure. However, future climate conditions are seldom considered systematically in the planning of such infrastructure. This may lead to bad investment decisions and consequently to high risks for economic damage in the face of emerging climate change. This is why enhancing the resilience of infrastructure enters as goal 9 in the United Nation’s (UN) Sustainable Development Goals (SDG). To address this, existing planning procedures and requirements need to be adapted to incorporate the climate risk assessment with enhanced utilisation of climate services (CS).

In the context of the International Climate Initiative (IKI), the global project “Enhancing Climate Services for Infrastructure Investment (CSI)” has been implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). The objective of CSI is to support stakeholders (i.e. suppliers of CS, decision makers and engineers) in increasingly using CS and considering climate risk in planning infrastructure investment.

In order to support the infrastructure project owners in Vietnam to make climate-risk-informed decisions, a case study of climate risk assessment was conducted for the project of Cai Lon - Cai Be (CL-CB) Sluice Gates System in the Mekong Delta, based on the PIEVC Protocol developed by Engineers Canada. This is a step-by-step methodology of risk assessment and optional engineering analysis for evaluating the impact of changing climate on infrastructure. The observations, conclusions and recommendations derived from the application of this Protocol provide a framework to support effective decision-making about infrastructure operation, maintenance, planning and development as part of climate risk management. The pilot case for Cai Lon - Cai Be Sluice Gates System was the first climate risk assessment on infrastructures in Vietnam, obtained good results which were appreciated and used by the infrastructure project owner in adjusting the detail design and operation, to make the infrastructure more resilient to climate change in the Mekong Delta.

For facilitating the extension and replica of climate risk assessments in Vietnam, the aim of this assignment was to establish a recipe of a typical climate risk assessment service with detail description on the resource inputs and the involved costs required to conduct climate risk assessments. By referring to these recipes, once established, infrastructure planners could easily understand which ingredients make a climate risk service, how much the service costs, how the climate risk assessment (CRA) process is and which resources and time budget could be estimated for the work. In this assignment, a costed “Recipe” for a CRA was developed to provide a clear understanding about the process and necessary resources for such kind of service, in order to serve the planning process in terms of design the CRA work package and its cost estimation. The "Recipe" specifies the types of required inputs (work time of different types of experts, workshops, data and information, and other resources) as well as their quantity, to enable budgeting the inputs to be paired with their estimated costs. The recipe will also elaborate on the procedure, step-by-step, of putting these different inputs together, detailing which inputs become relevant at which stage, what purpose they serve and how the necessary inputs may vary under different circumstances (service packages). This kind of "Recipe" is not only useful for those commissioning climate risk assessments, the climate service users as described above, but also all the other stakeholders involved in the assessment. It helps determining which kind of service is needed for what decision-making context and what costs are associated with it.

The final report covers (i) the objectives of the assignment; (ii) a review of the documentation of the PIEVC climate risk assessment for CL-CB sluice gate project, related cost norms and regulation of service provision in Vietnam; (iii) the development of a "Recipe" for a climate risk assessment in Vietnam with 3 components: procedure, quantity and price; and (iv) developing three cases of conducting time/financial budget estimation of the service in the developed "Recipe".

1.2 Objectives of assignment

The objective of the assignment is to develop a costed "Recipe" for climate risk assessments for infrastructure in Vietnam based on the experiences of the piloted climate risk assessment for Cai Lon - Cai Be sluice gates project. It is to provide potential users of climate risk assessments in the future with an idea of the cost and scope of climate risk assessments for infrastructure for different scenarios in terms of (1) types of users, (2) planning stages of the infrastructure and (3) availability of pre-processed climate service and information. It should also help the project owners and investment planners in determining how to design the climate risk assessment work package and its cost estimation.

1.3 Scope of assignment

This assignment developed recipe for 3 examples with time/financial budget estimation of the service based on the proposed "Recipe", consisting of:

- Case 1 - Baseline Case: Based on the actual process and prices for the pilot case study of CL-CB Sluice Gate project;
- Case 2 - Replica: Applying for an infrastructure in the planning process in Mekong Delta (same climate dataset with the CL-CB case study);

- Case 3 - Extension: Applying for an infrastructure in planning process in other regions of Vietnam (e.g. a bridge in Quang Binh province) (different climate dataset from the Cai Lon – Cai Be case study).

2 Methodology

In a CRA, a climate service is created with a joint effort, expertise and resources from a variety of stakeholders along the CS value chain: from the service provider, intermediate to the end-user. These can be aggregated into 3 groups of key actors:

a. National Hydrometeorological Services in the role of climate information/service provider;

b. Infrastructure Engineers in the role of intermediate who: requests and receives climate data from the provider; requests and receives the technical details and demand from the user; develops the complete service of climate risk assessment for infrastructure; and provides climate risk assessment results and recommendations to make the infrastructure resilient to climate change;

c. Infrastructure Project owner in the role of climate service user.

In this assignment, three experts with expertise on: (1) Water infrastructure engineering and planning, (2) Water infrastructure management and operation, and (3) Hydro–meteorology, climate change and climate service from the above-mentioned key stakeholders have worked in a team to achieve the assignment objectives. These experts were also the key members of the Vietnamese assessment team who experienced in the piloted case of climate risk assessment for the Cai Lon - Cai Be sluice gates project and also attended the trainings of climate risk assessment on infrastructures.

The methodology of the assignment consists of four major parts as shown in Figure 2-1.

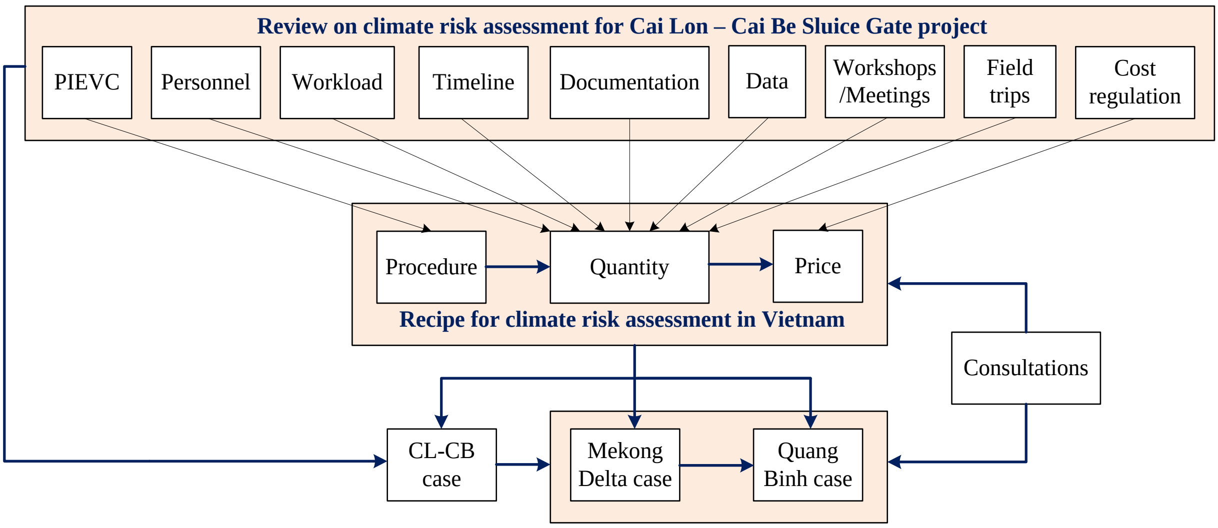


Figure 2-1. Methodology for the assignment

- ❖ *Part 1: A desk review on the pilot case of the PIEVC climate risk assessment for Cai Lon – Cai Be sluice gate project*

In order to accomplish this part, all technical reports, financial documents and other involving materials related to the piloted climate risk assessment for Cai Lon – Cai Be sluice gate have been collected, synthesized and analysed systematically. The document review process got useful information from the existing documents and provided a systematic overview of the pilot case. Thus, the outputs of the desk review serve as basis to develop a recipe for a climate risk assessment in Vietnam (Part 2).

The main contents reviewed in this part include:

- The implementation steps of the PIEVC Protocol;
- The members of the assessment team;
- Workload of experts;
- Timeline of the assessment;
- The documentation of Cai Lon - Cai Be Sluice Gate project;
- Climate and hydrological data;
- Risk assessment workshops and consultant meetings;
- Field trips; and
- Related cost norms and regulation.

- ❖ Part *2: Recipe for a climate risk assessment in Vietnam*

In this part, a recipe for a climate risk assessment in Vietnam has been developed with three components: procedure, quantity and price. Firstly, the activities of a procedure were identified based on the implementation steps of PIEVC from the document review process. Next, the procedure provided a list of the main tasks of experts in the quantity of the recipe. Furthermore, in the quantity, the number of working days as well as the minimum length of data and method of data collection was also determined based on the review of personnel, the documentation, data, workshops/meetings, and field trips. Finally, the price framework of the recipe for public, private, and other sectors was established based on the quantity component and cost norms reviewed in Part 1.

- ❖ *Part 3: Application of the developed recipe to 3 examples*

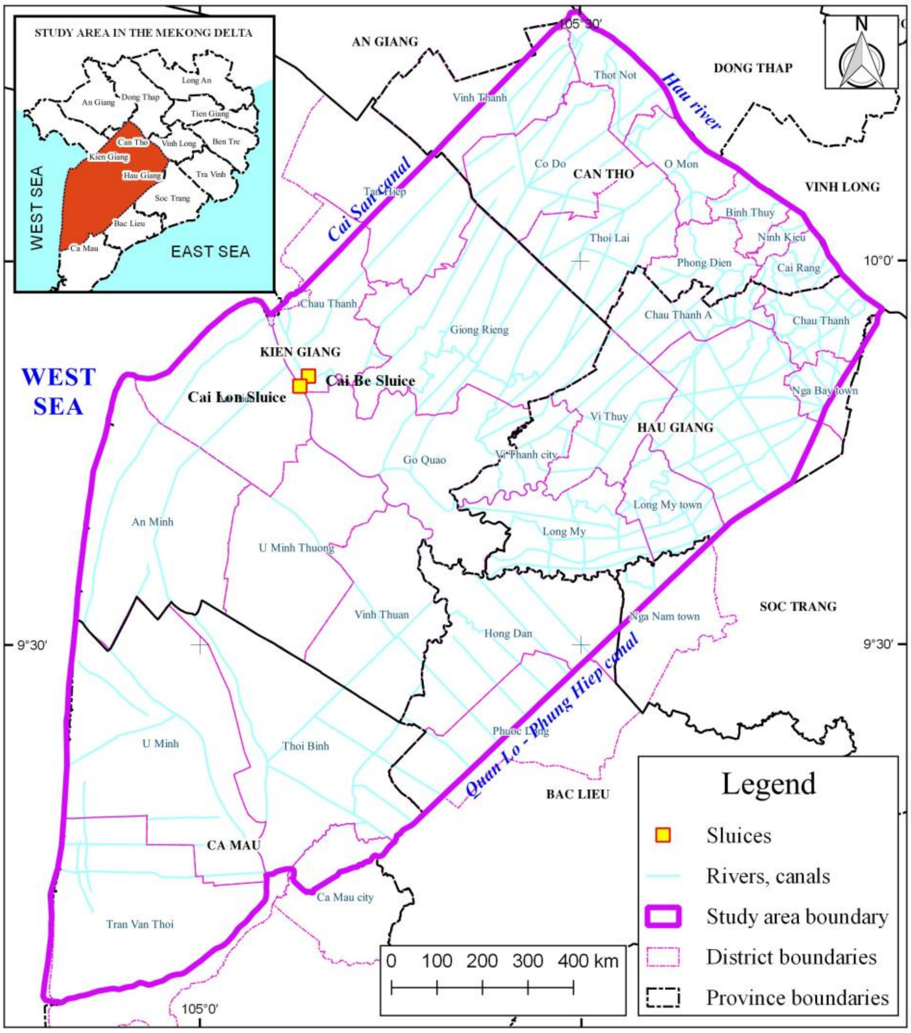
After the recipe is developed, it will be applied to 3 examples corresponding to the pilot case of Cai Lon – Cai Be sluice gate project, a case in Mekong Delta and a case in Quang Binh. The components of the recipe will be detailed for each example based on stages in the infrastructure planning and implementation process. However, the pilot case will be specified from the review process. Furthermore, the pilot case will be considered as a foundation to develop the Mekong Delta case and the Quang Binh case.

- *Part 4: Consultations*

After completing the first 3 part, consultations in person will be conducted via email and telephone with the PIEVC team, MARD, MPI and with the GIZ/CSI team. This part is to ensure the implications and findings in this assignment are (i) understood by all involved parties, (ii) are in line with the needs and requirements of the PIEVC team and MARD, MPI and, (iii) to adapt recommendations and the respective report in accordance with the results of the consultations.

3 Reviewing climate risk assessment for Cai Lon - Cai Be sluice gates project

The project on "*Climate risk analysis and assessment report for Cai Lon - Cai Be Sluice Gate project based on the PIEVC Protocol*" was conducted from August 2018 to May 2019. The location and overall perspective of CL-CB sluice gates are shown in Figures 3-1 and 3-2. This project was completed by a Vietnamese assessment team under the guidance of Engineers Canada (supported by Canadian experts), and managed by the GIZ/CSI team in Vietnam jointly with the Water Resources Investment and Construction Board 10 (PMU-10), and the Ministry of Agricultural and Rural Development (MARD). This project considered the potential impacts of existing and future climate conditions and hydrological factors and their potential influences on project engineering and operations. The outcomes of this project provided a framework to support effective decision-making about infrastructure design, operation, maintenance, planning and development for climate risk management of CL-CB sluice gates.



(Source: GIZ, 2019)

Figure 3-1. Location of the Cai Lon – Cai Be sluice gates

(Source: GIZ, 2019)

Figure 3-2. Overall perspective of Cai Lon – Cai Be sluice gates

In the next sections, a review of the PIEVC climate risk assessment for CL-CB Sluice Gate project will be carried out. This is a basis for developing a recipe for climate risk assessment in Section 4.

3.1 The PIEVC Protocol - Climate Risk Assessment for infrastructures

The PIEVC Engineering Protocol is a step-by-step process to assess the responses of infrastructure components to the impacts of a changing climate. The Protocol was developed by Engineers Canada, the national organization of the 12 sub-national engineering associations in Canada. Specifically, the Protocol provides engineers with a flexible tool that allows them to evaluate climate risks while at the time being adaptable to different circumstances in terms of available information, resources and purposes. Since 2008, the Protocol has been applied to assess climate risks and vulnerabilities across a wide range of infrastructure systems in Canada and internationally (Engineers-Canada, 2019). In general, the Protocol has five major steps as shown in Figure 3-3 (for more details refer to *the Protocol Principles and Guidelines* (Engineers-Canada, 2016)).

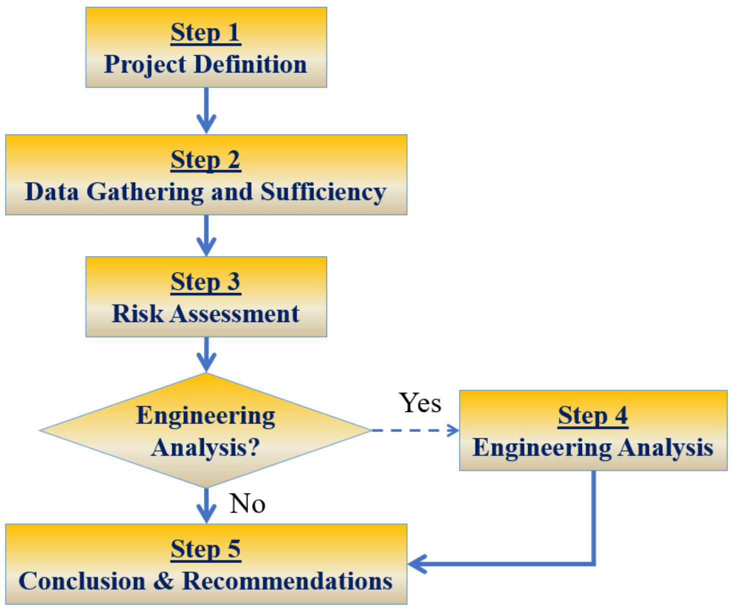


Figure 3-3. The major steps of PIEVC

- **Step 1:** General information about infrastructures (i.e. location, main infrastructure components, design standard, etc.), and climate and hydrological data (including parameters, trends, and events which may impact on the infrastructure) are collected and introduced for screening and scoping of the assessment work.

- **Step 2:** The data collected in Step 1 is used to identify the main infrastructure systems and their breakdown, and any climatological and hydrological phenomena that may be relevant for the infrastructure and are hence to be considered in the assessment.

- **Step 3:** This is the core step in the Protocol as it implements the actual assessment of risk based on the interaction between the identified components and climate and hydrological parameters. The main output of this step is the risk assessment matrices. This also includes analyzing cumulative effects of two phenomena occurring at the same time. The interactions are then evaluated in terms of frequency and severity of impact before the risk score of each interaction is calculated as product of the corresponding severity and probability. All these activities are usually carried out at risk assessment workshops with the attendance of experts in different aspects (e.g., climate, hydrology, water resources, civil, etc.) and other stakeholders.

- **Step 4:** This is an optional step that is only conducted if for any of the interactions the available information is insufficient to determine the severity of impact. If this step is implemented, the total load on the infrastructure and its total capacity for both current and future conditions will be calculated to identify whether there is a vulnerability (i.e., total projected load exceeds total projected capacity) or whether sufficient adaptive capacity exists (i.e., total projected load is less than total projected capacity). In the case of Cai Lon - Cai Be sluice gates project, Step 4 was excluded as it was not deemed necessary in the context of the assessment.

- **Step 5:** In this step, the assumptions, limitations and recommendations from the assessment process are elaborated, on the basis of interpretation of the risk matrices and actual conditions for adaptation.

3.2 The personnel of the assessment team

The assessment team for CL-CB Sluice Gate project is a group of seven experts of different expertise, including climate, hydrology, geology, water resources, and civil engineering (Table 3-1). All the team members had over 6-year experiences in the relevant fields with only two experts of bachelor degrees. Furthermore, most of these experts attended to the first PIEVC Protocol training in Can Tho. The members of the assessment team were the representatives for the main components of a climate service chain; in which, Southern Regional Hydro-meteorological Center is the climate provider, SIWRP is intermediate, and PMU-10 is the climate user.

Table 3-1. Members of the assessment team

No.	Role in team	Organisation	Degree	Years of experience	Man-days
1	Project Coordinator - Water resource specialist	SIWRP	Master	> 11	29
2	Technical secretary - Water resources specialist	SIWRP	PhD	6 - 10	39
3	Geology specialist	SIWRP	Master	> 11	38
4	Water resources specialist	SIWRP	Master	6 - 10	41
5	Hydrology specialist	SIWRP	Bachelor	6 - 10	38
6	Civil specialist	PMU-10	Master	6 - 10	37
7	Climate specialist	Southern HydroMet	Bachelor	6 - 10	37

3.3 Workload of experts

A number of working days for experts to complete the climate risk assessment for Cai Lon and Cai Be sluice gates project are shown in Table 3-1. This workload was estimated in the proposal for an infrastructure. However, in this study, the climate risk assessment was implemented for both Cai Lon and Cai Be sluice gates. Based on the experiences of the assessment team, the actual workload for this assessment was greater than the proposed one.

3.4 Timeline

The timeline to carry out the climate risk assessment for CL-CB sluice gate is presented in Table 3-2. It can be seen that it took about 6-7 months to complete the final report. The duration of this assessment matched to the basic design stage (Figure 3-4). Thus, the recommendations and conclusions of this assessment timely supported the detailed design stage of Cai Lon - Cai Be sluice gates project.

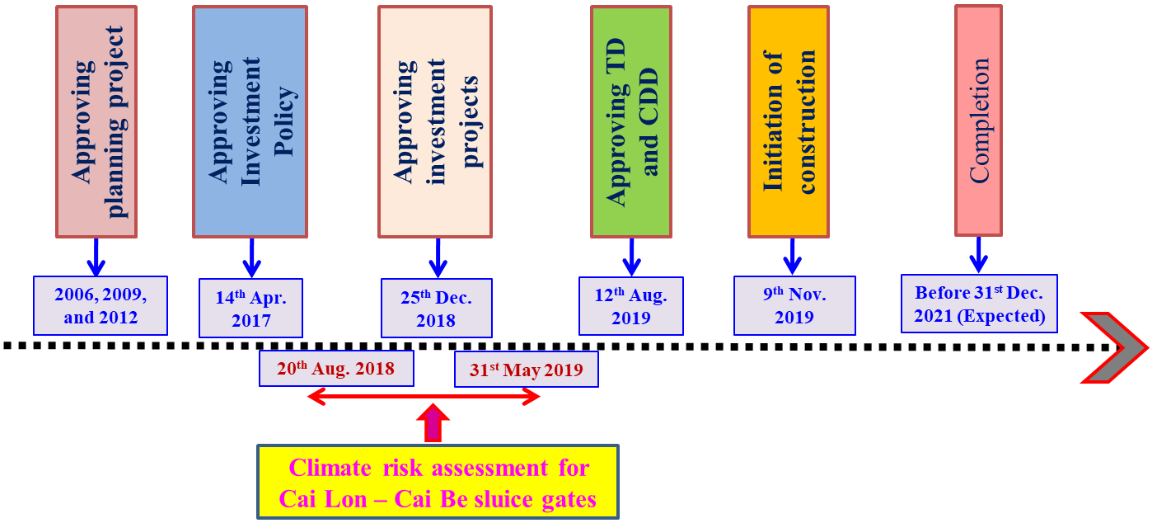


Figure 3-4. The implementation process of CL-CB sluice gates project and the period of climate risk assessment

Table 3-2. Timeline of climate risk assessment for CL-CB sluice gate

ID	ACTIVITIES	TIMELINE
I	**Collection and synthesis of data/documents and scoping of project**	
1.1	Desk study: collection and synthesis of data/documents	20.8-15.9.2018
1.2	Desk study: Data sufficiency and project scope	25.8-20.9.2018
2	**Data analysis and Sufficiency**	
2.1	Identification and preparation of data on infrastructure components	20.8-10.9.2018
2.2	Identification and preparation of applicable climate information/data	21.8-15.9.2018
2.3	Identification and preparation of applicable hydrology information	21.8-15.9.2018
2.4	Identification and preparation of applicable geography, geology and topography information (if any)	21.8-15.9.2018
3	**Risk Assessment**	
3.1	A matrix showing the interactions between infrastructure components and extreme climatic events	01.9-25.9.2018
3.2	Climate data and initial risk matrix necessary and ready for the PIEVC workshop	15-25.9.2018
	Risk Assessment Workshop, to be organized in HCMC	16-18.10.2018
3.3	A matrix showing the interactions between infrastructure components and extreme hydrology events and salinity intrusion	22.10-15.11.2018
3.4	Data analysis and drafting report on climate risk assessment of CL-CB Sluice Gate	20.10-20.11.2018
3.5.	CSI and Engineer Canada read the Report on climate risk assessment of CL-CB Sluice Gate	20.11-10.12.2018
3.6	Review Report on climate risk assessment of CL-CB Sluice Gate	01.2019-02.2019
	Final workshop to present the risk assessment report	3.2019
5.1	Update and Finalize the report on climate risk assessment of Cai Lon – Cai Be	4.2019
5.2	Close the contract	5.2019

3.5 Documentation of Cai Lon - Cai Be Sluice Gate project

The documentation of CL-CB Sluice Gate project was provided by PMU-10 (the investor) for climate risk assessment, including:

- Feasibility research report;
- Basic design report (the version of December 2018);
- Technical drawings;
- Decisions of Prime Minister, MARD and MONRE regarding to CL-CB Sluice Gate project (Appendix 1);
- Timeline for implementation of the Cai Lon – Cai Be Sluice Gate project;
- Standards and regulations used for designing Cai Lon and Cai Be sluice gates (Appendix 2).

3.6 Climate and hydrological data for climate risk assessment on CL-CB Sluice Gate project

The identification of climate data plays an important role on a climate risk assessment on infrastructures. In the case of CL-CB Sluice Gate project, hydrological factors and salinity intrusion were also considered as they are the significant features impacting infrastructures in the Mekong Delta (MKD). Basically, the relevant climate and hydrological factors for climate risk assessment on CL-CB Sluice Gate project were selected based on:

- The list of climate parameters associated with the design, development, and management of the infrastructure as guided in the vulnerability assessment module (Engineers Canada, 2012);
- The natural condition and geographic features of the study area;
- The previous studies in the literature which considered the impacts of climate and hydrological factors on infrastructures in the MKD; and
- Decision No. 44/2014/QD-TTg on 15th August 2014 of Prime Minister on detailed regulations on natural disaster risk levels.

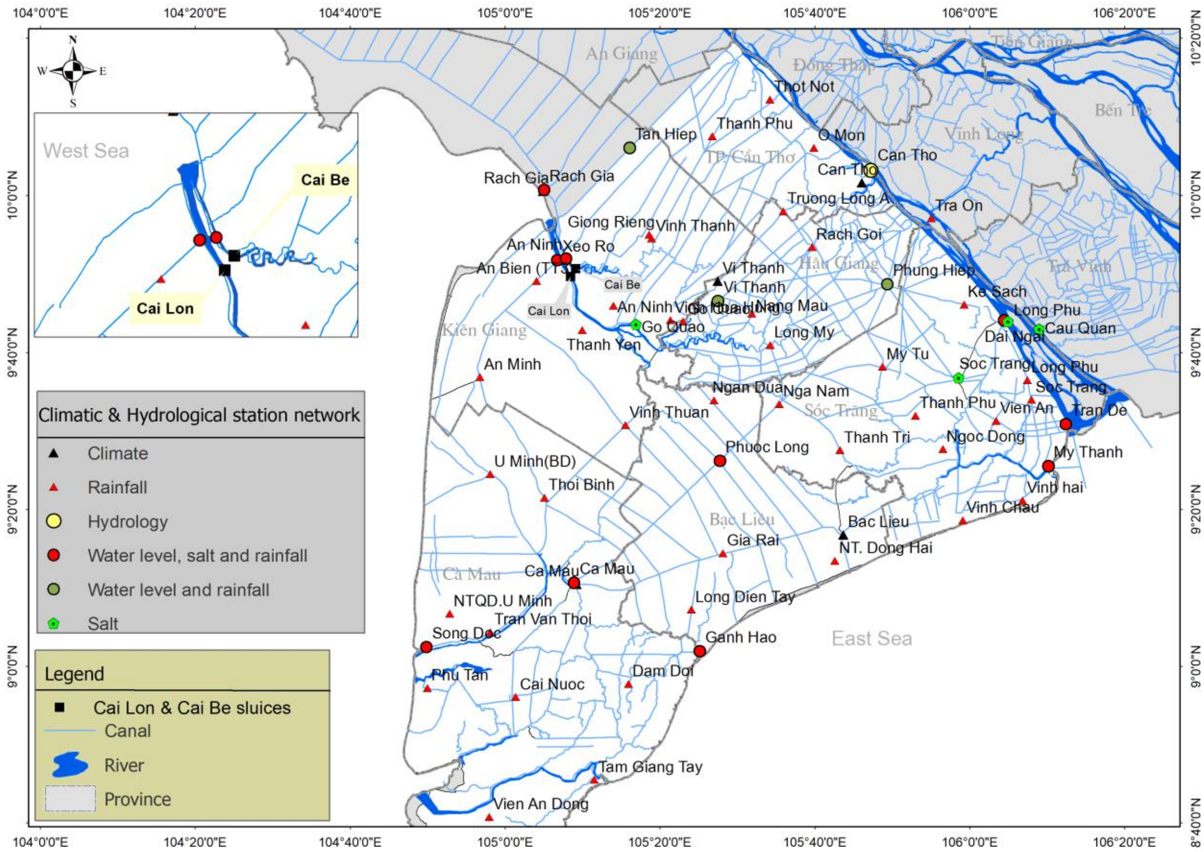
A list of climate and hydrological factors were determined for the climate risk assessment for CL-CB Sluice Gates as shown in Table 3-3. These data were then collected by three main sources: (i) purchased from Southern Regional Hydro-meteorological Center, (ii) free from NOAA and Vietnam Center of Hydro-meteorological data, and (iii) the report of the Provincial Committee for Flood and Storm Control, and Search and Rescue of Kien Giang.

Table 3-3. Relevant climate and hydrological factors for climate risk assessment on CL-CB Sluice Gate project

No.	Climate/ hydrological factors	Number of stations	Length of data (years)	Collection method
1	Daily rain	11	30 (1988 - 2017)	Purchased/ available from SIWRP (29 years)
2	Sub-daily rainfall	6	30 (1988 - 2017)	Purchased
3	Daily temperature	5	30 (1988 - 2017)	Purchased
4	Daily wind	5	30 (1988 - 2017)	Purchased
5	Daily evaporation	5	30 (1988 - 2017)	Purchased/ available from SIWRP (19 years)
6	Daily humidity	5	30 (1988 - 2017)	Purchased/ available from SIWRP (17 years)
7	Water level	10	30 (1988 - 2017)	Purchased/ available from SIWRP (17 years)
8	Hourly flow	1	23 (1995 - 2017)	Purchased/ available from SIWRP (17 years)
9	Salinity	8	22 (1996 - 2017)	Purchased/ available from SIWRP (7-16 years)
10	Monthly thunderstorm/ Lightning	5	30 (1988 - 2017)	Purchased
11	Storms		30 (1988 - 2017)	Free from NOAA and Vietnam Center of Hydro-meteorological data
12	Tornado		10 (2005 - 2015)	From report of the Provincial Committee for Flood and Storm Control, and Search and Rescue of Kien Giang

Regarding with the data which need to be purchased, the SIWRP was willing to provide the available data. Thus, the amount of the actual purchased data dropped significantly, including daily rain, daily evaporation, daily humidity, water level, hourly flow, and salinity.

Table 3-3 also presents the number of meteorological and hydrological stations used in climate risk assessment for CL-CB Sluice Gate project. These stations were chosen because they are located in the study area and have available/collectable data (Figure 3-5). In addition, the length of data in years was also identified for the trend analysis and future projection of the data. It can be seen that most of climate and hydrological factors used dataset of 30 years, except for flow and salinity with over 20 years.



(Source: GIZ, 2019)

Figure 3-5. Climatic and hydrological station network in Ca Mau Peninsular

3.7 Risk assessment workshops

One of the important parts in the climate risk assessment for CL-CB Sluice Gate project is to conduct two risk assessment workshops. The first workshop was organized in Can Tho during 22-26 April 2018, aimed to introduce the context of Cai Lon – Cai Be and the Public Infrastructure Engineering Vulnerability Committee protocol (PIEVC) to the assessment team. The workshop was attended by 45 participants from MPI, MONRE, MARD, the Department of Agriculture and Rural Development, the Department of Construction, consultants from this field, 3 international experts form Engineers Canada, 1 hydrometeorological expert from DWD and 3 officers from CSI. Step 1 and Step 2 of the PIEVC protocol were practiced for 3 days by 25 technical experts of those participants to apply for assessment of Cai Lon – Cai Be sluice gate project, with a field survey at the site for verification. Those include: identifying project framework, compiling a list of relevant climatic parameters and infrastructure components and developing the risk assessment matrix.

The second workshop was organized for 3 days (16-18 October 2018) in Ho Chi Minh City. The objectives of this workshop were (i) to train the assessment team on the implementation steps of the PIEVC Protocol and improve the capacity of the

Vietnamese technical experts for climate risk assessments for infrastructure development; and (ii) to apply the PIEVC Protocol to assess climate risks for the Cai Lon - Cai Be Sluice Gate Project. This workshop was organised by GIZ with the attendance of the infrastructure project owner, infrastructure designers, engineers in charge of operations and other relevant stakeholders. In detail, the participants of this workshop included:

- Representatives of GIZ;
- Canadian consultants to train on the PIEVC Protocol;
- Representatives of Vietnam Disaster Management Authority (VDMA);
- Representatives of PMU-10;
- Climate and hydrological experts of the Southern Regional Hydro-meteorological Center;
- Water resources experts of the Southern Institute of Water Resources Planning (SIWRP);
- Representative of Kien Giang Department of Water Resource;
- Representatives of Kien Giang hydro-meteorological station.

In addition, a PIEVC dissemination workshop was organised in 2 April 2019 in Ho Chi Minh City. The participants at the workshop came from GIZ, MPI, MARD, VDMA, the Kien Giang Department of Water Resource, PMU-10, Southern HydroMet, SIWRP, Southern Institute of Water Resources Research (SIWRR), Hydraulic Engineering Consultants Corporation No.II (HEC-2), and Thuyloi University. In this workshop, the assessment team presented the results of the climate risk assessment for CL-CB Sluice Gate. A discussion section on climate risk assessment and management for infrastructure planning and management in Vietnam was implemented among the participants.

3.8 Consulting meetings

As this was the first application of PIEVC in Vietnam, there were the consulting meetings in person and online (fortnight webinars) during the implementation process to discuss about the progress of the risk assessment for CL-CB Sluice Gate project and how to solve any involved problems. The participants of the meetings consisted of the assessment team, the GIZ/CSI team in Vietnam, and the Canadian experts.

3.9 Field trips

Regarding to the climate risk assessment for CL-CB Sluice Gate project, two field trips were also conducted for collecting the documentation on the administration and operation of the similar infrastructures in Kien Giang, Tra Vinh, Ben Tre and Long

An, as well as learning experience from administration and operation staff on the impacts of past events.

3.10 Related cost norms and regulation of service provision in Vietnam

In this assessment, cost estimation only consisted of consultancy fees, data purchase, field-trip cost, and value-added tax (VAT); other costs (such as workshop costs, independent experts for reviewing the report, stationery, and printing) were covered by GIZ. Furthermore, although SIWRP played a role of the contractor (i.e., representative of the experts in the assessment team), the total cost of the assessment was estimated in a contract for experts and did not include management cost and pre-calculated taxable income as regulated under Decision No. 79/QD-BXD dated 15th February 2017 of Ministry of Construction on standard project management and construction consulting costs.

In regard to the cost estimation for rate of service, data purchase and travel cost in the climate risk assessment for CL-CB Sluice Gate project, some regulations were applied as follows:

- Circular No. 197/2016/TT-BTC dated 08/11/2016 by the Ministry of Finance regarding regulations on charge rates, charge methods, payment, management and use of exploitation fee, and use of information and hydro-meteorological data.
- GIZ honorary scheme for daily rates of local consultants in Vietnam, version 2015.
- Local travel regulation for business trips within Vietnam (Annex 6A)” of GIZ.

4 Developing a recipe for a climate risk assessment in Vietnam

In this assignment, a "Recipe" for a climate risk assessment in Vietnam was developed in a combination of 3 components, including procedure, quantity and price. The recipe was established based on the experiences of the pilot climate risk assessment of Cai Lon - Cai Be sluice gate, other available information on the PIEVC Protocol as well as a review of existing regulations and practice in Vietnam. The recipe also took into account its applicability for the different stages in the infrastructure planning and implementation process (Figure 4-1).

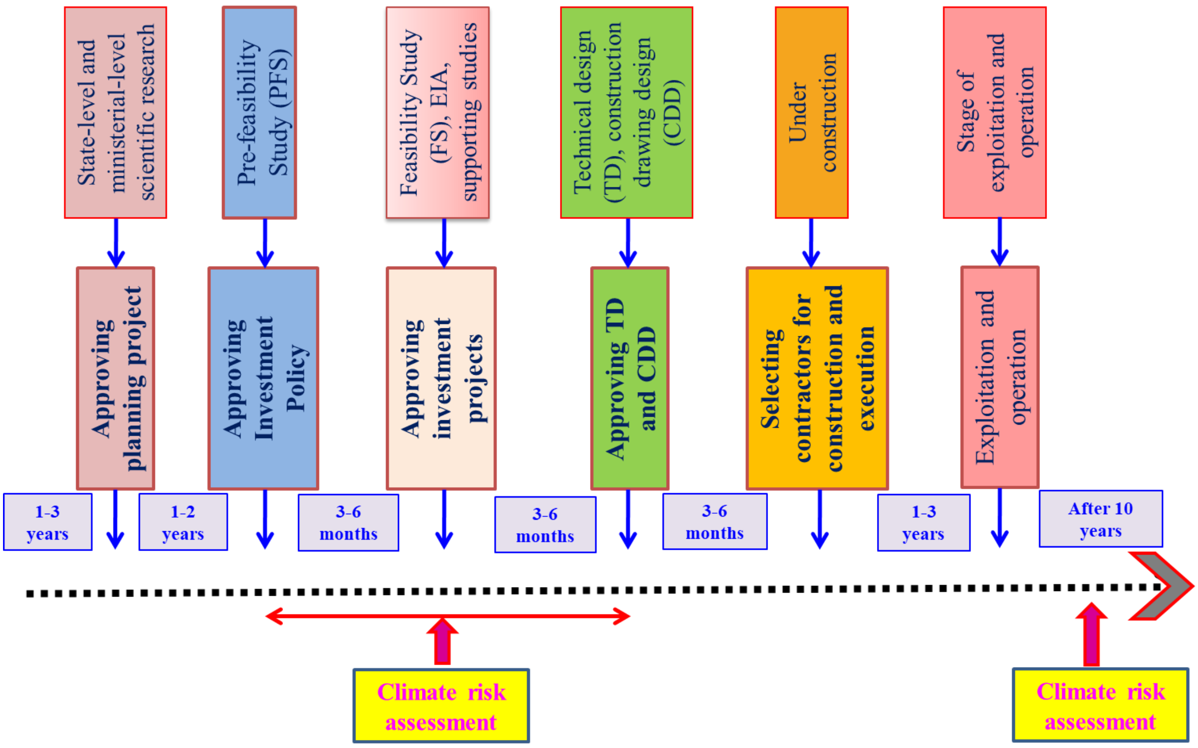


Figure 4-1. The implementation process of a project (Group A) and the periods of climate risk assessment

❖ For the stage of "Pre-feasibility study"

According to Decree No. 63/2018/ND-CP dated 4th May 2018 of the Government on investment in the form of public-private partnership, the aim of pre-feasibility study is to check whether a project is feasible to implement or not. A pre-feasibility study report will present preliminary studies about the necessity, feasibility and effectiveness of the project as a basis for competent authorities to decide investment policies. In this stage, there is little of information relating to the design of infrastructures, except for a preliminary design in the main report. Thus, the climate risk assessment for the stage of pre-feasibility study is not necessary.

❖ For the stage of “Feasibility study”

In this stage, the main documentation of the infrastructure will include: a feasibility research report, a basic design report and technical drawings. Similar to the climate risk assessment for Cai Lon - Cai Be sluice gates project, the recipe suggested to exclude the engineering analysis (refering to Activity 5 in the Procedure component – Section 4.1) in a climate risk assessment on infrastructures at this stage.

❖ For the stage of “After construction” (10 years)

In this stage, the main documentation of the infrastructure will include: a completion report, a detail design report, technical drawings, and a logbook of management and maintenance. As a result, a full climate risk assessment on the infrastructure should be carried out, i.e. the recipe will include engineering analysis activity.

4.1 Procedure

The procedure of the recipe describes how the necessary activities for a climate risk assessment figure into the procedure. These activities will be identified based on the specific requirement of each assessment, especially Activity 5 is optional. In order to accomplish these activities, a risk assessment team needs to be set up with the different expertise (such as climate, hydrology, geology, water resources, and civil engineering, etc.). The duration of a risk assessment will depend on the planning stage of the infrastructures. Normally, such assessment should take at least 6 months to be able to timely provide the recommendations to users.

The major activities of the procedure in Figure 4-2 are summarised below.

❖ *Activity 1:* Data purchase, combination and processing for climate risk assessment

In this activity, all the non-free necessary data for climate risk assessment will be collected through purchase. It is noted that the free data will be collected from the internet or from some specific reports/documents during Activity 2. The data processing can be applied if necessary.

❖ *Activity 2:* Collection and synthesis of data/documents and scoping of project

This is a desk-study activity covering the collection and synthesis of free data and documents, preliminary assessment of data sufficiency, and project scope. The main outputs of this activity include:

- a report on relevant inputs, in accordance with sections/ chapter in the project report; and
- a list of the gathered documents and information sources on the general information of project (such as natural and socio-economic conditions, and

legal basis), detailed design of the infrastructure, and climate and hydrological data.

❖ *Activity 3:* Data analysis and sufficiency

This activity will focus on identifying and preparing information and data on infrastructure components, and applicable climate, hydrology, geography, geology and topography (if any). Furthermore, the particular climate and hydrological trends and projections will be considered before data sufficiency is assessed. The main outputs from this activity include:

- a list of the main infrastructure systems and their breakdown;
- a list of climate, hydrology, and geography (if any) factors that may potentially impact on the infrastructure; and
- a report on analysing historical trend and projections of climate, hydrology, and geography (if any) factors.

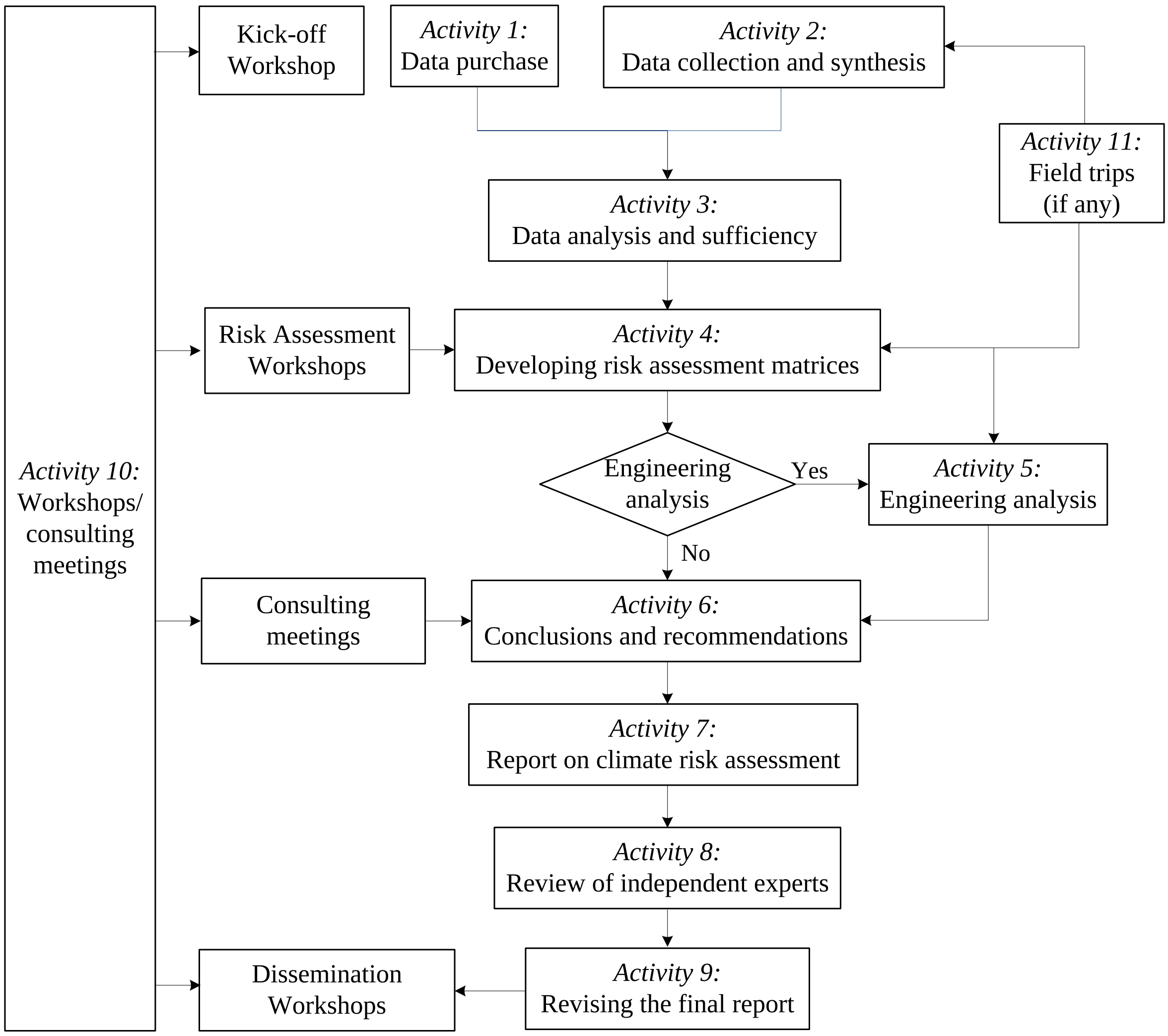


Figure 4-2. Flowchart for the major activities of the procedure

❖ *Activity 4:* Developing risk assessment matrices

In this activity, risk assessment matrices will be established to show the interactions between infrastructure components and climate, hydrological and geography (if any) events. As guided by the Protocol Principles and Guidelines (Engineers-Canada, 2016), these matrices will be implemented at risk assessment workshops with the attendance of experts in different aspects (e.g., climate, hydrology, water resources, civil, etc.) and other stakeholders. Besides, data sufficiency will be also assessed to identify a process to develop or infill the insufficient data.

The main outputs from this activity include:

- risk assessment matrices;
- risk tolerance thresholds; and
- a report describing how to develop risk assessment matrices.

❖ *Activity 5:* Engineering analysis (optional)

This activity will identify whether the infrastructure is vulnerable or sufficient adaptive capacity. This is an optional activity and it is only implemented as required or if for any of the interactions the available information is insufficient to determine the severity of impact. Besides, data sufficiency assessment will be carried out. The main outputs from this activity include:

- a list of interactions for engineering analysis; and
- a report to describe how to calculate the total load on the infrastructure, the total capacity for both current and future conditions, vulnerability ratio and capacity deficit.

❖ *Activity 6:* Conclusions and recommendations

This activity will provide conclusions and recommendations based on the risk assessment matrices, and thus its output is a list of conclusions and recommendations.

❖ *Activity 7:* Report on climate risk assessment of the infrastructure

The output of this activity is the final report for the whole process of climate risk assessment.

❖ *Activity 8:* Review of independent experts

❖ *Activity 9:* Revising the final report based on comments of independent experts

The output of this activity is the revised final report to response the comments of the independent experts.

❖ *Activity 10:* Workshops and consulting meetings

This activity will cover workshops during the project, including:

- A kick-off workshop to introduce the project;
- Climate risk assessment workshops to establish risk assessment matrices as mentioned in Activity 4; and
- A dissemination workshop to present the final results of the climate risk assessment.

Furthermore, this activity can also include consulting meetings (in persons or online) with the project owners and relevant stakeholders about the progress of the assessment, involved problems (if any), and particularly the conclusions and recommendations from Activity 6.

❖ *Activity 11:* Field trips (if any)

The activity will suggest a list of field trips during the assessment if necessary. The field trips can be conducted in the process of data collection, developing risk assessment matrices or engineering analysis (corresponding to Activities 2, 4 and 5).

4.2 Quantity

The quantity component of the recipe will specify the number and length of data, the workload of relevant experts, and the number of risk assessment workshops and consulting meetings to provide a service of climate risk assessment on infrastructures.

4.2.1 Data

The quantity of climate and hydrological data (including the minimum length of data and method of data collection) will be identified based on the following factors:

- Using the list of climate and hydrological parameters associated with the design, development, and management of the infrastructure for the vulnerability assessment module in Vietnam (Table 4-1);
- Natural condition (particularly climate characteristics and hydrological regime) and geographic features (e.g., mountainous, delta or coastal region) of the area to be assessed;
- The availability of climate and hydrological data in the study area (referring to Tables 4-2, 4-3, and 4-4 for the number of hydro-meteorological stations, rainfall stations, and salinity stations in the regional hydro-meteorological center); and
- Previous studies (if any) on the impacts of climate and hydrological factors on infrastructures in the study area.

Ideally, the longer length of climate and hydrological data is better for climate risk assessment on infrastructures. However, in fact, some data is non-available, or not easy to record. Thus, the minimum length of data can be adjusted for each specific assessment. For instance, only 22 years of salinity data was used in the climate risk assessment for Cai Lon – Cai Be sluice gates projects.

Table 4-1. Potential climate and hydrological parameters for climate risk assessment on infrastructures in Vietnam

No.	Climate/ hydrological factors	Minimum length of data (years)	Method of data collection
1	Daily rain	30	Purchased
2	Sub-daily rainfall	30	Purchased
3	Daily temperature	30	Purchased
4	Daily wind	30	Purchased
5	Daily evaporation	30	Purchased
6	Daily humidity	30	Purchased
7	Sunny Hour	30	Purchased
8	Fog	30	Purchased
9	Barometric pressure	30	Purchased
10	Water level	30	Purchased
11	Hourly flow	30	Purchased
12	Salinity	30	Purchased
13	Monthly thunderstorm/ Lightning	30	Purchased
14	Storms	30	Free from NOAA and Vietnam Center of Hydro-meteorological data
15	Tornado	30	From report of the Provincial Committee for Flood and Storm Control, and Search and Rescue
16	Freeze	30	Purchased/From report of the provincial Committee for Flood and storm Control and Search and Rescue
17	Hailstorm	30	Purchased/From report of the provincial Committee for Flood and storm Control and Search and Rescue
18	Snow	30	Purchased/From report of the provincial Committee for Flood and storm Control and Search and Rescue

Table 4-2. Distribution of hydro-meteorological stations in Vietnam

No.	Regional Hydro-Meteorology center	Meteorological stations (*)				Hydrological stations (**)			
		I	II	III	Total	I	II	III	Total
1	Northwest region	6	9	11	26	21	13	16	50
2	Viet Bac	9	6	12	27	13	9	8	30
3	Northeast region	11	6	9	26	14	3	8	25
4	Northern Delta	8	6	2	16	15	1	11	27
5	North Central Region (Thanh Hoa - Ha Tinh)	9	7	5	21	12	4	17	33
6	Central Region (Quang Binh- Quang Ngai)	8	7	0	15	14	10	18	42
7	South Central Region	9	3	2	14	7	0	13	20
8	Central Highlands	4	9	7	20	9	4	3	16
9	Southern Region	5	14	6	25	29	0	110	139
Total		**69**	**67**	**54**	**190**	**134**	**44**	**204**	**382**

** The meteorological factors recorded include temperature, wind, humidity, evaporation, number of sunny hours, barometric pressure, rainfall, and other weather phenomena (such as thunderstorms, hailstorm, snow, frost, fog, whirlwinds, and gusts).*
*** The hydrological factors recorded include Flow, water level, rainfall and salinity.*

Table 4-3. Current and planned distribution of rainfall stations in Vietnam

No.	Regional Hydro-Meteorology center	By 2016	Planned		
			2016-2020	2021-2025	2026-2030
1	Northwest region	77	378	49	10
2	Viet Bac	98	569	55	56
3	Northeast region	64	228	82	84
4	Northern Delta	73	68	10	19
5	North Central Region (Thanh Hoa - Ha Tinh)	80	220	34	30
6	Central Region (Quang Binh- Quang Ngai)	51	281	15	54
7	South Central Region	65	213	30	32
8	Central Highlands	102	464	122	26
9	Southern Region	145	302	81	37
Total		**755**	**2,723**	**478**	**348**

Table 4-4. Current and planned distribution of salinity stations in Vietnam

No.	Regional Hydro-Meteorology center	By 2016	Planned		
			2016-2020	2021-2025	2026-2030
1	Northwest region	No salinity intrusion			
2	Viet Bac				
3	Northeast region	16		1	
4	Northern Delta	10		3	2
5	North Central Region (Thanh Hoa - Ha Tinh)	3	4	3	4
6	Central Region (Quang Binh- Quang Ngai)	13	4	2	2
7	South Central Region	10	5	5	6
8	Central Highlands	No salinity intrusion			
9	Southern Region	39	12	9	10
Total		**91**	**25**	**23**	**24**

It is noted that the meteorological and hydrological stations in Table 4-2 are classified in Class I, II and III as regulated by Circular No. 05/2016/TT-BTNMT dated 13th May 2016 of Ministry of Natural Resources and Environment on hydro-meteorological monitoring for stations within the national network of hydro-meteorological stations. According to this Circular, the type and quantity of the meteorological and hydrological factors monitored in each class are presented in Table 4-5. The locations of meteorological and hydrological stations in Vietnam are shown in Figures 4-3 and 4-4.

Table 4-5. Meteorological and hydrological monitoring factors at Class I, II, III stations

Items	Meteorological factors	Hydrological factors
Class I	All the meteorological factors of Class II; and Radiation.	All the hydrological factors of Class II; and Flow of suspended substance.
Class II	All the meteorological factors of Class III; and Atmospheric pressure.	All the hydrological factors of Class III; and water flow.
Class III	Surface wind; Evaporation; Air temperature; Soil temperature; The high air temperature and ground temperature; The low air temperature and the ground temperature; Air humidity; Rain; Foresight; Meteorological phenomenon; Sunny hours; Clouds; The past weather; Current weather; Ground state.	Water level; Rainfall; Water temperature; Other auxiliary factors: water flow direction, wind, waves, river bed changes.

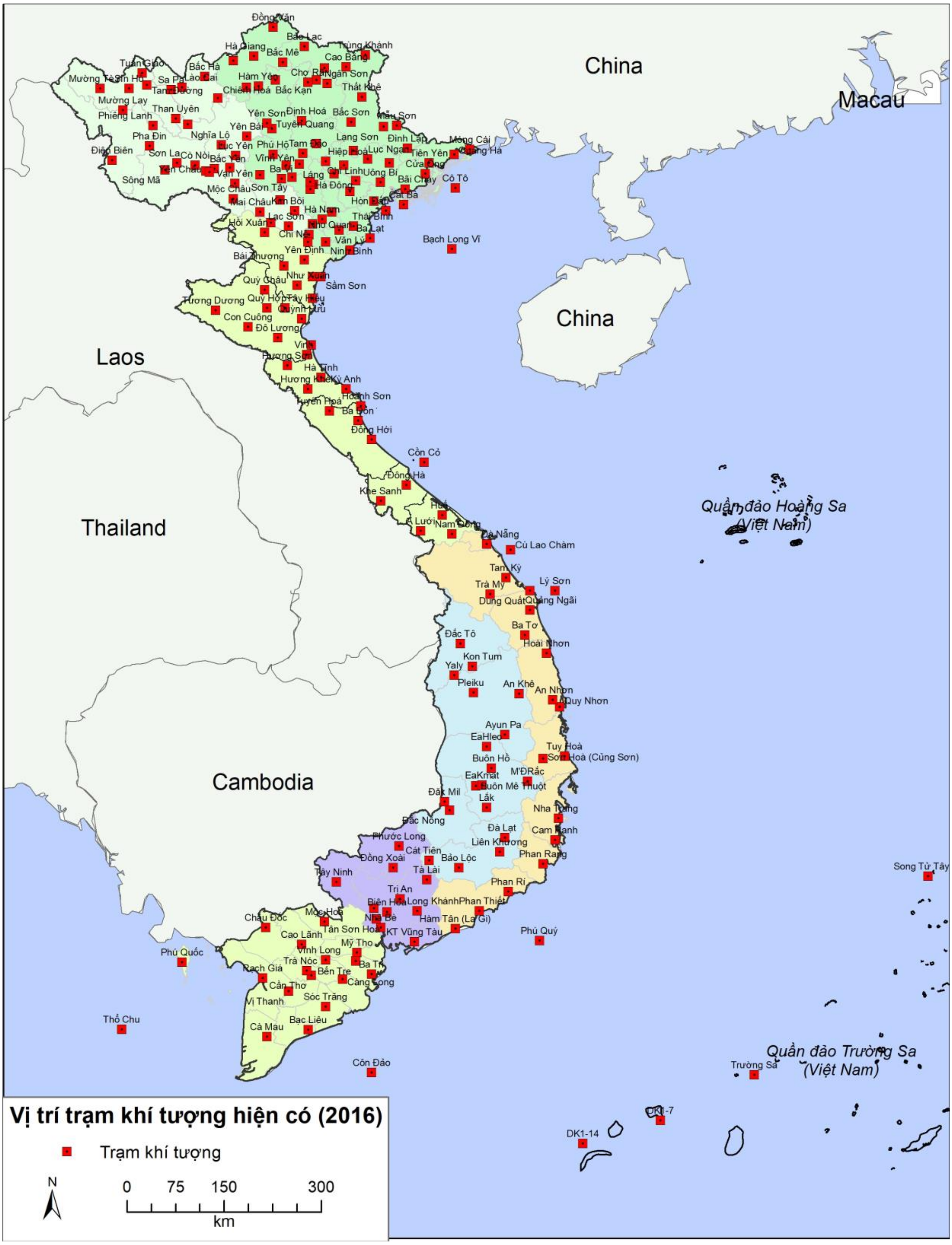


Figure 4-3. Location of meteorological stations in Vietnam (as of 2016)

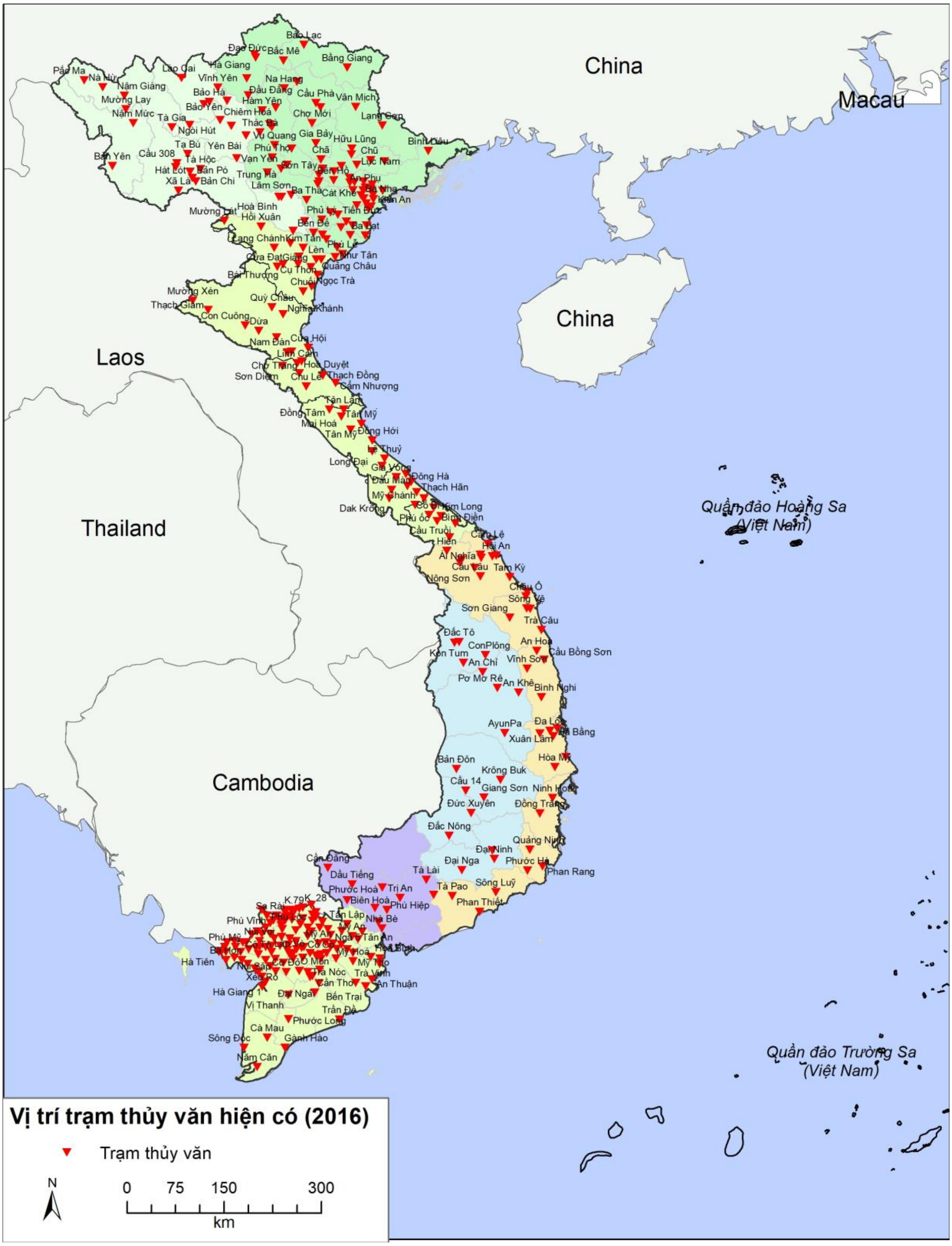


Figure 4-4. Location of hydrological stations in Vietnam (as of 2016)

4.2.2 Workload of experts

In the quantity of the recipe, tasks and responsibilities of relevant experts (including water resource, civil engineering, climate, hydrology, geology, etc.) in a risk assessment team will be specified in Table 4-6. A general requirement for the experts is that they should attend to a PIEVC Protocol training at least. This table also shows an estimation of the number of man-days for each task. It is noted that these man-days are estimated to implement climate risk assessment for an infrastructure. In a case of a set of infrastructures (such as Cai Lon – Cai Be sluice gates project), the workload of experts needs to be adjusted based on the number of infrastructures assessed. In an actual situation, the man-days can be also changed to be suitable with each risk assessment in terms of complexity and planning stages of infrastructures. In addition, the number of risk assessment workshops, consulting meetings and field trips (if any) will be also determined in the list of tasks.

Table 4-6. Tasks and responsibilities of experts

No.	Tasks	Man-days	Experts
I	**Activity 2: Collection and synthesis of data/documents and scoping of project**	**41**	
1	Collect the relevant documents/data of the project	2	TS
2	Summarise the general information of the project (scope, objectives, natural and socio-economic conditions, legal basis, …)	2	TS
3	Prepare maps (location, boundary, components of project)	2	HE
4	Clarify the land subsidence issue	2	GE
5	Clarify salinity intrusion	2	WRE
6	Collect technical reports of the infrastructure (including designed standards) and similar projects (if any in the region)	1	CVE
7	Collect assessments how climate issues have been concerned and deal in the design so far	1	CVE
8	Summarise the detailed design of the infrastructure	2	CVE
9	Collect documents of regulatory settings, legal considerations, working policies, guidelines on operation and management	2	WRE
10	Clarify plans to operate and manage the infrastructure	2	TS
11	Collect hydrological data (main factors) in the study region	2	HE
12	Summarise historical extreme events (i.e. flooding)	2	TS
13	Collect meteorological data (main factors) in the study region	2	CE
14	Collect information/documents/data of gauges (including location, maps, photos, time series and measurement methods)	2	CE
15	Collect information of climate change scenarios	1	HE
16	Carry out preliminary assessment of data sufficiency	7	All
17	Scope of project	7	All
18	Consultant meetings (in persons or online)		All
II	**Activity 3: Data analysis and sufficiency**	**57**	
19	List the main infrastructure systems (e.g., operation, sensors, electricity system, connected canal, dike)	1	CVE
20	List the main components for each system above	2	CVE
21	Identify the material of construction, design life of infrastructure, importance within the region, physical condition	1	CVE

No.	Tasks	Man-days	Experts
22	List specific regulations, standards, guidelines, and administrative processes	2	WRE
23	Analyse data and assess data sufficiency	7	All
24	State climate baseline and their potential impacts on each component of infrastructure individually and jointly	1	CE
25	State historical extreme weather events (timing, duration, impacts)	1	CE
26	State projected climate change inputs (trend, timespan, frequency…)	2	CE
27	Analyse data and assess data sufficiency	7	All
28	State hydrology baseline (water level, flood, inundation)	1	HE
29	State historical extreme hydrological events (timing, duration, impacts)	1	HE
30	State projected hydrology change inputs (sea level rise)	2	HE
31	State environment baseline (salinity intrusion)	1	WRE
32	State projected salinity intrusion	2	WRE
33	State the potential impacts of above issues on infrastructure (each items)	2	TS
34	Analyse data and assess data sufficiency	7	All
35	State geography condition	3	WRE
36	State land subsidence	3	GE
37	State projected land subsidence	2	GE
38	State the potential impacts of land subsidence to infrastructure	2	GE
39	Analyse data and assess data sufficiency	7	All
40	Consultant meetings (in persons or online)		All
III	**Activity 4: Developing risk assessment matrices**	**140**	
41	Select risk assessment methodology for Probability Scale Factors (S_c)	7	All
42	Select risk assessment methodology for Severity Scale Factors (S_r)	7	All
43	Determine the infrastructures being sensitive to changes in climate factors	7	All
44	Assign the Probability Scale Factors (S_c)	10.5	All
45	Assign the Severe Scale Factors (S_r)	10.5	All
46	Calculate the Risk (R)	7	All
47	Determine the risk tolerance thresholds to assess R	7	All
48	Identify the risk ranks for the components	7	All
49	Assess data sufficiency in this step	7	All
50	Select risk assessment methodology for Probability Scale Factors (S_c)	7	All
51	Select risk assessment methodology for Severity Scale Factors (S_r)	7	All
52	Determine the infrastructures being sensitive to changes in hydrological factors	7	All
53	Assign the Probability Scale Factors (S_c)	10.5	All

No.	Tasks	Man-days	Experts
54	Assign the Severe Scale Factors (S_r)	10.5	All
55	calculate the Risk (R)	7	All
56	Determine the risk tolerance thresholds to assess R	7	All
57	Identify the risk ranks for the components	7	All
58	Assess data sufficiency in this step	7	All
59	Conduct Risk Assessment Workshops		All
60	Consultant meetings (in persons or online)		All
IV	**Activity 5: Engineering analysis (optional)**	**70**	
61	Select the interactions which need to implement engineering analysis	7	All
62	Calculate the Existing Load (L_E)	7	All
63	Calculate Changing Climate Load (L_C)	7	All
64	Calculate Other Change Loads (L_O)	7	All
65	Calculate the Existing Capacity (C_E)	7	All
66	Calculate the Projected Change in Existing Capacity ($C_{\Delta E}$)	7	All
67	Calculate Additional Capacity (C_A)	7	All
68	Calculate Vulnerability Ratio	7	All
69	Calculate Capacity Deficit	7	All
70	Assess Data Sufficiency	7	All
71	Consultant meetings (in persons or online)		All
72	**Activity 6: Conclusions and Recommendations**	**14**	All
73	**Activity 7: Report on climate risk assessment of the infrastructure**	**14**	All
74	**Activity 9: Revising the final report based on comments of the independent experts**	**14**	All
75	**Activity 10: Workshops/Consulting meetings**		All
76	**Activity 11: Field trips (if any)**		

Note: PC = Project Coordinator; TS = Technical Secretary; CVE = Civil Engineering Expert; WRE = Water Resource Expert; CE = Climate Expert; HE = Hydrological Expert; GE= Geological Experts; All = the whole assessment team.

4.3 Price

Generally, price of the recipe is divided into 3 main parts, including consultancy fees, data purchase, and miscellaneous costs (e.g. workshops, field trips and stationery/printing). The unit price for each input (except for data purchases) is specified for different scenarios, including: (1) public sector is commissioning the assessment; (2) private sector is commissioning the assessment; and (3) other potential scenarios that may affect pricing (e.g. GIZ). As climate risk assessment on infrastructures is a component in planning infrastructure investments, cost estimation of such assessment must comply with Decision No. 79/QD-BXD dated 15th February 2017 of Ministry of Construction on standard project management and construction consulting costs (Table 4-7). It is noted that the items of cost estimation in Table 4-7 are applied for the contract with agencies. In other words, a contract which is signed for each expert in an assessment team will not include management costs and pre-calculated taxable income.

Table 4-7. Items of cost estimation for climate risk assessment on infrastructures under Decision No. 79/QD-BXD

No.	Items	Reference/Formula	Abbreviation
1	Consultancy fees	Refer to Section 4.3.1	CF
2	Management costs	55% x CF	MC
3	Other costs		OC
	Data purchase, combination and processing	Refer to Section 4.3.2	DP
	Workshops/Consulting meetings	Refer to Section 4.3.3.2	
	Field trips	Refer to Section 4.3.3.1	
	Review of independent experts	Refer to Section 4.3.3.3	
	Stationery	Refer to Section 4.3.3.3	
4	Pre-calculated taxable income	6%*(CF +MC)	TN
5	Value-added tax	10%*(CF+MC+OC+TN)	VAT
	Total	(CF+MC+OC+TN+VAT)	

4.3.1 Consultancy fees

❖ *Public sector*

Consultancy fees for public sector must comply with the following cost norms regulated by the Government:

- Circular No. 02/2015/TT-BLDTBXH dated 12th January 2015 of Ministry of Labour, War Invalids and Social Affairs on regulation on payment levels for domestic consulting specialists as the basis for cost estimation of consultancy services applicable to contract forms using state capital;
- Decree No. 204/2004/ND-CP dated December 14th 2004 of the Government on salary regime for cadres, public servants, officials, and armed force personnel;
- Decree No. 38/2019/ND-CP dated May 9th 2019 of the Government on statutory pay rate for public officials and public employees and armed forces' personnel;

The consultancy fees for domestic specialists are regulated in Circular No. 02/2015/TT-BLDTBXH. According to this Circular, there are four categories of payment levels based on relevant education and work experience of the specialists (Table 4-8). The remuneration can be paid monthly, weekly, daily and hourly.

Table 4-8. Payment levels for domestic consulting specialists in Vietnam

Category	Relevant education and work experience	Maximum remuneration in VND			
		Hourly	Daily	Weekly	Monthly
Level 1	- Bachelor degree plus 15 years relevant full-time experience; - Master degree plus 8 years relevant full-time experience; or - Role as a consultancy team leader or the project manager.	250,000	2,000,000	11,076,923	40,000,000
Level 2	- Bachelor degree from 10 up to 15 years relevant full-time experience; - Master degree from 5 up to 8 years relevant fulltime experience; or - Role as the leader of a small team.	187,500	1,500,000	8,307,692	30,000,000
Level 3	- Bachelor degree from 5 up to 10 years relevant full-time experience; or - Master degree from 3 up to 5 years relevant full-time experience.	125,000	1,000,000	5,538,462	20,000,000
Level 4	- Bachelor degree less than 5 years relevant full-time experience; or - Master degree less than 3 years relevant full-time experience.	93,750	750,000	4,153,846	15,000,000

Another way to estimate the consultancy fees is based on the statutory pay rate and the salary rate. This way is often applied for regular tasks under the main functionalities of a state agency. The statutory pay rate has been updated yearly by the Government. In the latest version of 2019 (Decree No. 38/2019/ND-CP), the statutory pay rate is 1,490,000 VND. On the other hand, the basic salary rates (Table 4-9), the salary allowances in terms of position, region and working environment, as well as social and health insurances are regulated in Decree No. 204/2004/ND-CP. The daily consultancy fees are estimated as follows:

Salary Rate = Basic Salary Rate + Allowance Rate + Insurance Rate

Allowance Rate = 11% of Basic Salary Rate

Insurance Rate = 24% of Basic Salary Rate

Monthly Salary = Salary Rate x Statutory Pay Rate

Daily Consultancy Fees = Monthly Salary / 22

Table 4-9. Basic salary rate for engineers in Vietnam

Category of engineer	Step/rate								
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**
Professional experts	8.80	9.40							
Professional engineers (A3.1)	6.20	6.56	6.92	7.28	7.64	8.00			
Chief engineers (A2.1)	4.40	4.74	5.08	5.42	5.76	6.10	6.44	6.78	
Engineers (A1)	2.34	2.67	3.00	3.33	3.66	3.99	4.32	4.65	4.98

In Table 4-9, there are four categories of engineers: engineer (A1), chief engineer (A2.1), professional engineer (A3.1) and professional expert. It can be seen that a fresh graduate engineer has a salary step of 2.34. This step will be increased after each three years or if he or she achieved an excellent performance during the work. In other words, the salary steps/rates are only depended on working experience. Thus, the salary rates can be the same for two persons with the different educational levels. It is noted that the higher levels of engineers (i.e., chief engineers, professional engineers and professional experts) require a technical certificate issued by Ministry of Science and Technology.

To ensure the benefits of workers having a higher education level, a benefit coefficient should be added to the salary rates. This benefit coefficient is ranged from 1.3 to 3.0, depended on the educational level and the difference between the steps/rates in Table 4-9. For example, a Step-3 worker in group A1 with a master degree should be paid higher than that with a bachelor degree or similar to that in group A2.1. As a result, the benefit coefficient of this case is about 1.7.

In addition, if there is a lack of the higher levels of engineers, groups of workers can be established to accomplish the complex tasks. A number of group members are identified based on the working experience, and the requirement of the tasks. For example, a task for a professional expert can be solved by a group of three Step-3 engineers. In this case, the salary rate is similar to that of the professional expert and is triple compared to that of a Step-3 engineer.

In addition to consultancy fees, management costs can be required for consulting agencies based on Decision No. 79/QD-BXD dated 15th February 2017 of Ministry of Construction on standard project management and construction consulting costs. In this Decision, management costs for consulting agencies are equal to 55%, 50% and 45% of consultancy fees, if consultancy fees are less than 1 billion VND, from 1 to less than 5 billion, and greater than or equal to 5, respectively.

❖ *Private sector*

The consultancy fees for private sector are categorised based on academic degrees and working experience. At present, there is no official regulation of the Government to estimate the consultancy fees for private sector. Generally, these fees can be estimated by referencing the consultancy fees for public sector or the UN-EU guidelines for financing of local costs in development cooperation with Vietnam (more detail in the next section "*Other potential scenarios that may affect pricing*"). On the other hand, as there is the significant difference of basic salaries between public and private sectors, the consultancy fees for private sector should be adjusted for each specific case. A base for this adjustment as shown in Figure 4-5 is to compare the consultancy fees with a range of Vietnam salary which is surveyed by the Career Builder.

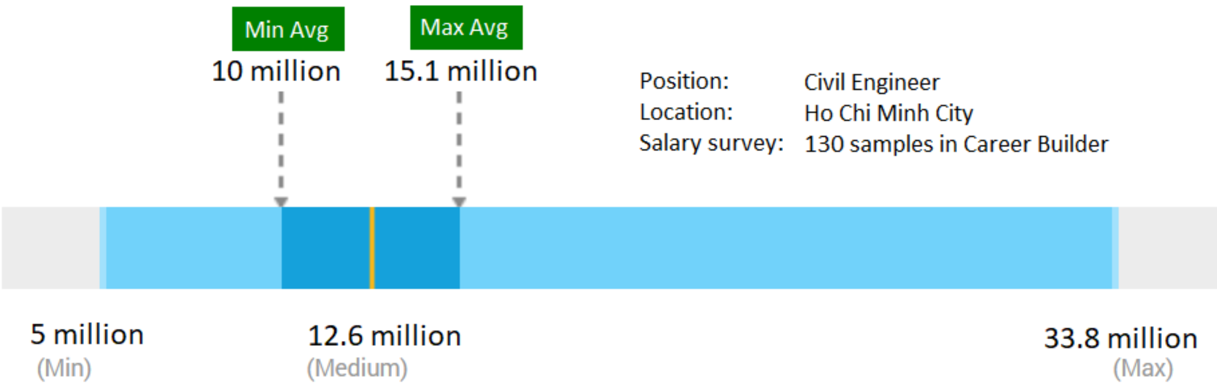


Figure 4-5. Example of a range of Vietnam salary for civil engineer [1]

❖ *Other potential scenarios that may affect pricing*

For cooperation projects with Vietnam, the national consultant rates (including personal income tax) are estimated based on the UN-EU guidelines for financing of local costs in development cooperation with Vietnam (EU-UN cost norm). This is a set of unified norms for local costs related to the management of Official Development Assistance (ODA) in Vietnam. These guidelines have been constructed by a joint collaboration between the Government of Vietnam, United Nations and European Union. The latest version of the EU-UN cost norm in 2017 is shown in Table 4-10, which describes four categories of national consultants in terms of the scope of service, education, experience and remuneration.

Moreover, some organisations or projects have their own policies to regulate consultancy fees. For example, GIZ has been using the own honorary scheme for daily rates of local consultants in Vietnam.

[1] More detail in https://vietnamsalary.careerbuilder.vn/detail/K%E1%BB%B9-S%C6%B0-X%C3%A2y-D%E1%BB%B1ng-kwl8s0-en

Table 4-10. National consultant rates of EU-UN cost norm in 2017

Category	Scope of service	Relevant education and work experience	Remuneration in VND[2]	
			Daily maximum	Monthly maximum
VNM 1	Working on an assignment under the supervision of another person	Bachelor degree plus 3-5 years relevant full-time experience	1,661,760	24,926,400
VNM 2	Formulating or managing assignments	Bachelor degree plus 4-6 years relevant full-time experience	2,700,360	40,413,080
VNM 3	Formulating, organizing and managing assignments/ leading a small team of advisers/ supervising a team of technical or multi sector advisers	Master degree plus 5-10 years relevant full-time experience	4,431,360	66,493,480
VNM 4	Leading a team entrusted with conceiving, implementing, monitoring, development programs and/or strategies of national scope or development policies	Master degree plus 5-10 years relevant full-time experience	6,231,600	93,312,440

4.3.2 Data purchases, combination and processing

According to Law No. 90/2015/QH13 dated 23/11/2015 by the National Assembly on hydro-meteorology, state agencies will not be charged to exploit hydro-meteorological information and data in the cases below; they have to pay data processing cost only.

- Announcement on the mass media for non-profit purposes;
- Serving disaster prevention and control, national defence and security;
- Exchanging information with foreign countries and international organizations under treaties to which the Socialist Republic of Vietnam is a signatory;
- Other purposes at the request of competent state agencies.

For non-free data, data purchases are calculated based on Circular No. 197/2016/TT-BTC dated 08/11/2016 by the Ministry of Finance regarding regulations on charge rates, charge methods, payment, management and use of exploitation fee, and use of information and hydro-meteorological data. The price units of some climate/hydrological factors are presented in Table 4-11. In addition, data processing costs have to be estimated, but there is no official regulation for these costs. In real, these processing costs are usually negotiated between data buyers and suppliers.

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[2] According to the EU-UN cost norm, the remuneration is in USD, but payable in VND. The values in this table are exchanged into VND under the Vietcombank exchange rate on 12th December 2019 (1 USD = 23,080 VND)

Table 4-11. Price unit of climate/hydrological factors

No.	Climate/hydrological factors	Price/year (VND)
1	Daily rain	200,000
2	Sub-daily rainfall	200,000
3	Daily temperature	200,000
4	Daily wind	200,000
5	Daily evaporation	200,000
6	Daily humidity	200,000
7	Sunny Hour	200,000
8	Fog	200,000
9	Barometric pressure	200,000
10	Water level	300,000
11	Hourly flow	300,000
12	Salinity	220,000
13	Monthly thunderstorm/ Lightning	200,000
14	Storms	Free
15	Tornado	200,000
16	Freeze	200,000
17	Hailstorm	200,000
18	Snow	200,000

4.3.3 Miscellaneous costs

4.3.3.1 Field-trip costs

Field-trip costs include travel expenses, accommodation fee and daily subsistence allowance. In general, the field trip costs include the following items:

- Accommodation cost = the number of trips x nights x persons x rate
- Daily subsistence allowance (DSA) = the number of trips x days x persons x rate
- Others (car, airfare, etc.) = calculated by the actual cost.

In Vietnam, field-trip costs for public sectors must comply with Circular No. 40/2017/TT-BTC dated April 28th 2017 of Ministry of Finance on work-trip allowances and conference expenditures. The per diems in this scenario are shown in Table 4-12. Similar to consultancy fees, there are no officially general regulations to estimate these costs for private sector. Normally, these costs for private sector are regulated by the own policy of each company.

Table 4-12. Per Diem (VND) for public sector in Vietnam

Position	Location/Area	Accommodation		DSA
		Package costs	Actual fees VND/day/room	
Ministerial level and equivalent	Any place in the country	1,000,000	2,500,000	200,000
Vice Ministers and other leaders with a position allowance coefficient of 1.25 or more	Urban districts of Hanoi and Ho Chi Minh City, Can Tho, Da Nang and Hai Phong and other grade 1 cities.	1,000,000	1,200,000	200,000
	Other places	1,000,000	1,100,000	200,000
Other officers and employees	Urban districts of Hanoi and Ho Chi Minh City, Can Tho, Da Nang and Hai Phong and other grade 1 cities.	450,000	500,000	200,000
	Rural districts of Hanoi and Ho Chi Minh City, Can Tho, Da Nang and Hai Phong and other cities.	350,000	500,000	200,000
	Other places	300,000	350,000	200,000

Regarding international cooperation projects, the per diems are regulated on the UN-EU guidelines for financing of local costs in development cooperation with Vietnam or the local travel regulation for business trips within Vietnam of each international organisation (Table 4-13). Moreover, an airport taxi cost can also be applied based on the UN-EU guidelines (Appendix 3).

Table 4-13. Per diems for international cooperation projects

Location/Area	Per Diem (in VND)*		
	Accommodation	Subsistence allowance	Total
Urban districts of Hanoi and Ho Chi Minh City	946,280	784,720	1,731,000
- Urban districts of Can Tho, Da Nang and Hai Phong; - Tourism cities including Da Lat, Do Son, Hoi An, Hue, Ha Long, Nha Trang, Phu Quoc and Vung Tau	853,960	692,400	1,546,360
- Other townships and Sapa town; - Rural districts of Hanoi, Ho Chi Minh City, Can Tho, Da Nang, and Hai Phong	507,760	438,520	946,280
Other places	369,280	323,120	692,400

** The Vietcombank exchange rate on 12th December 2019 (1 USD = 23,080 VND)*

4.3.3.2 Workshop costs

Workshop costs include meeting package costs, per diems, airport taxi, and use of private vehicle. In a similar way to field-trip costs, workshop costs for public sectors must comply with Circular No. 40/2017/TT-BTC of Ministry of Finance (Table 4-14), while these costs for international cooperation projects are estimated based on the UN-

EU guidelines for financing of local costs in development cooperation with Vietnam (Table 4-15). Regarding travel cost, a reimbursement can be applied for private vehicle. For public sector, if a motorbike is used with over 15 km, the reimbursement is 0.2 liter of gasoline per km. For international cooperation projects, the reimbursement is about 4,039 VND/km (*the Vietcombank exchange rate on 12th December 2019: 1 USD = 23,080 VND*). There are no officially general regulations to estimate the workshop costs for private sector.

Table 4-14. Workshop costs for public sector

No.	Items	Remuneration in VND
1	Presentation cost	300,000-600,000
2	Hire of workshop rooms and equipment	Calculated by the actual cost
3	Travel	Calculated by the actual cost
4	Time break (per person)	20,000
5	Lunch and diner	
	Urban districts of Hanoi, Ho Chi Minh City, Can Tho, Da Nang, Hai Phong, and other grade 1 cities.	200,000
	Other cities	150,000
	Rural areas	100,000
6	Accommodation	See Table 4-12
7	Others (stationery)	Calculated by the actual cost

Table 4-15. Workshop costs for international cooperation projects

Location/Area	Package costs per participant (VND)*			
	Half day event		Full day event	
	Standard	High	Standard	High
Urban districts of Hanoi and Ho Chi Minh City	438,520	507,760	669,320	923,200
- Urban districts of Can Tho, Da Nang and Hai Phong; - Tourism cities: Da Lat, Do Son, Hoi An, Hue, Ha Long, Nha Trang, Phu Quoc and Vung Tau.	369,280	415,440	600,080	738,560
Other places	323,120	346,200	507,760	623,160

** The Vietcombank exchange rate on 12th December 2019 (1 USD = 23,080 VND)*

4.3.3.3 Other costs

In addition to the above costs, other expenses are also included in the cost estimation of each project as follows:

- Cost of independent experts to review final reports (calculated by the actual cost);

- Cost of interpretation services (Appendix 4);
- Cost of translation (Appendix 4);
- Costs of resource person (where applicable) (Appendix 4);
- Contingency cost (not over 10% of the whole project cost as regulated in Decree No. 38/2019/ND-CP);
- Stationery cost (calculated by the actual cost).

5 Application of the recipe

5.1 Case 1 - Baseline Case

The baseline case is the pilot case of Cai Lon - Cai Be sluice gate project. This project was classified into Group A of new construction works in Vietnam. It was first proposed in 2006, and then in 2017 approved for investment by the Prime Minister and managed by the Water Resources Investment and Construction Board No. 10 under the Ministry of Agriculture and Rural Development (MARD). The study area of this project is a part of Ca Mau Peninsula and borders the Cai San canal in the North – West, Quan Lo – Phung Hiep canal in the South – East, the Hau River (the Bassac River) in the North – East and the West Sea in the West.

The climate risk assessment for the Cai Lon - Cai Be sluice gates project was applied to the stage of basic design, particularly the design version as of December 2018. This assessment was implemented from August 2018 to May 2019 by the Vietnamese assessment team under the guidance of Engineers Canada, and managed by the GIZ/CSI team in Vietnam jointly with the PMU-10 and MARD.

In this assessment, Step 4 of the PIEVC Protocol was excluded as it was not deemed necessary in the context of the assessment. In addition, only the Cai Lon and Cai Be sluices were selected in this assessment, as they are major infrastructures of the planned project and are considered to be representative of other similar infrastructures in the MKD generally and in the study area particularly. The Cai Lon and Cai Be sluice gates are located 2.1 km and 1.9 km, respectively, upstream from the Cai Lon and Cai Be bridges in Kien Giang province. While Cai Lon sluice gate is a Grade I hydraulic work, Cai Be sluice gate is a Grade II hydraulic work (based on QCVN 04 - 05: 2012/BNNPTNT).

Three components of the recipe were identified below.

5.1.1 Procedure

The main activities of this assessment are scheduled in Table 5-1. In the CL-CB case, Activity 5 in the procedure component of the recipe (corresponding to Step 4 of the Protocol) was excluded. This assessment was the first application of PIEVC in Vietnam, so the consulting meetings (in person and online) were organised with the attendance of the assessment team and the PIEVC Canadian experts every two weeks to be able to solve any involved problems. The draft of the final report was completed after 6 months before it was reviewed by the independent experts. A risk assessment workshop was organised with the attendance of different experts and other stakeholders. Two field trips were also implemented collect data and information for climate risk assessment.

Table 5-1. Schedule of climate risk assessment for Cai Lon - Cai Be sluice gate project

No.	Activities	Month								
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th
1	Data purchase, combination and processing									
2	Collection and synthesis of data/documents and scoping of project									
3	Data analysis and sufficiency									
4	Developing risk assessment matrices									
5	Conclusions and recommendations									
6	Report on climate risk assessment of the infrastructure									
7	Consulting meetings									
8	Review of independent experts									
9	Revising the final report based on comments of independent experts									
10	Workshops									
11	Field trips									

5.1.2 *Quantity*

❖ The quantity of data

The climate and hydrological data for the CL-CB case were determined based on the guidelines of the recipe. Referred to Table 4-1, the meteorological factors of sunny hour, fog, barometric pressure, freeze, hailstorm and snow were not considered because they do not feature for the climate condition in the Mekong Delta. In contrast, as the CL-CB sluice gates will be constructed in the coastal area and impacted by tidal regime, salinity intrusion needs to be included in the assessment.

In addition, the CL-CB sluice gates are located in the Southern Region, so the necessary climate and hydrological data were collected from Southern Regional Hydro-meteorological Centre. The details of climate and hydrological data purchases are shown in Table 5-2. The data purchased in this case excluded the data available from SIWRP (as shown in Table 3-3).

Table 5-2. Climate and hydrological data purchase for the CL-CB case

No	Data/ station	Number of Years	Price/year (VND)	Total (VND)
I	**DAILY RAIN**			
1	Bac Lieu	1	200,000	200,000
2	Xeo Ro	1	200,000	200,000
3	Go Quao	1	200,000	200,000
4	An Ninh	1	200,000	200,000
5	Vinh Thuan	1	200,000	200,000
6	Phuoc Long	1	200,000	200,000
7	Phung Hiep	1	200,000	200,000
8	Song Doc	1	200,000	200,000
9	Ganh Hao	1	200,000	200,000
10	My Thanh	1	200,000	200,000
11	Vinh Hoa Hung	1	200,000	200,000
II	**SUB-DAILY RAINFALL**			
1	Can Tho	30	200,000	6,000,000
2	Soc Trang	30	200,000	6,000,000
3	Rach Gia	30	200,000	6,000,000
4	Bac Lieu	30	200,000	6,000,000
5	Ca Mau	30	200,000	6,000,000
6	Vi Thanh	2	200,000	400,000
III	**DAILY TEMPARATURE**			
1	Can Tho	30	200,000	6,000,000
2	Soc Trang	30	200,000	6,000,000
3	Rach Gia	30	200,000	6,000,000

No	Data/ station	Number of Years	Price/year (VND)	Total (VND)
4	Bac Lieu	30	200,000	6,000,000
5	Ca Mau	30	200,000	6,000,000
IV	**WATER LEVEL**			
1	Can Tho	13	300,000	3,900,000
2	Rach Gia	13	300,000	3,900,000
3	Ca Mau	13	300,000	3,900,000
4	Vi Thanh	13	300,000	3,900,000
5	Xeo Ro	13	300,000	3,900,000
6	Phuoc Long	13	300,000	3,900,000
7	Phung Hiep	13	300,000	3,900,000
8	Song Doc	13	300,000	3,900,000
9	Ganh Hao	13	300,000	3,900,000
10	My Thanh	13	300,000	3,900,000
V	**DAILY WIND**			
1	Can Tho	30	200,000	6,000,000
2	Soc Trang	30	200,000	6,000,000
3	Rach Gia	30	200,000	6,000,000
4	Bac Lieu	30	200,000	6,000,000
5	Ca Mau	30	200,000	6,000,000
VI	**STORMS**	**FREE FROM NOAA**		
VII	**MONTHLY THUNDER STORM/ LIGHTINGS**		200,000	-
1	Can Tho	15	200,000	3,000,000
2	Soc Trang	15	200,000	3,000,000
3	Rach Gia	15	200,000	3,000,000
4	Bac Lieu	15	200,000	3,000,000
5	Ca Mau	15	200,000	3,000,000
VIII	**TORNADO DATA**	**NO DATA**		
IX	**SALINITY**			
1	Soc Trang	12	220,000	2,640,000
2	Rach Gia	6	220,000	1,320,000
3	Ca Mau	12	220,000	2,640,000
4	Go Quao	15	220,000	3,300,000
5	An Ninh	22	220,000	4,840,000
6	Phuoc Long	22	220,000	4,840,000
7	Song Doc	13	220,000	2,860,000
8	My Thanh	22	220,000	4,840,000
X	**DAILY EVAPORATION**			
1	Can Tho	13	200,000	2,600,000

No	Data/ station	Number of Years	Price/year (VND)	Total (VND)
2	Soc Trang	11	200,000	2,200,000
3	Rach Gia	11	200,000	2,200,000
4	Bac Lieu	11	200,000	2,200,000
5	Ca Mau	11	200,000	2,200,000
XI	**DAILY HUMIDITY**			
1	Can Tho	13	200,000	2,600,000
2	Soc Trang	13	200,000	2,600,000
3	Rach Gia	13	200,000	2,600,000
4	Bac Lieu	13	200,000	2,600,000
5	Ca Mau	13	200,000	2,600,000
XII	**HOURLY FLOW**			
1	Can Tho	6	300,000	1,800,000
Total				**200,080,000**

❖ The quantity of workload of experts

The details of tasks, experts and the number of working days in the quantity component of the recipe for the baseline case are shown in Table 5-3. There were 7 experts in the assessment team for the CL-CB case, including a project coordinator, a technical secretary, a civil engineering expert, a water resource expert, a climate expert, a hydrological expert, and a geological expert.

Table 5-3. Tasks, experts and the number of man-days for climate risk assessment for CL-CB sluice gate project

No.	Tasks	PC	GE	TS	WRE	HE	CVE	CE	Total
Activity 2: Collection and synthesis of data/documents and scoping of project									
1	Collect the relevant documents/data of CL-CB Sluice Gate project			2					2
2	Summarise the general information of CL-CB project (scope, objectives, natural and socio-economic conditions, legal basis, …)			2					2
3	Prepare maps (location, boundary, components of project)					2			2
4	Clarify the land subsidence issue		2						2
5	Clarify salinity intrusion				2				2
6	Collect technical reports of CL-CB Sluice Gate (including designed standards) and similar projects (if any in the region)						1		1
7	Collect assessments how climate issues have been concerned and deal in the design so far						1		1
8	Summarise the detailed design of CL-CB Sluice Gate						2		2
9	Collect documents of regulatory settings, legal considerations, working policies, guidelines on operation and management				2				2

No.	Tasks	PC	GE	TS	WRE	HE	CVE	CE	Total
10	Clarify plans to operate and manage the infrastructure			2					2
11	Collect hydrological data (main factors) in the study region					2			2
12	Summarise historical extreme events (i.e. flooding)			2					2
13	Collect meteorological data (main factors) in the study region							2	2
14	Collect information/documents/data of gauges (including location, maps, photos, time series and measurement methods)							2	2
15	Collect information of climate change scenarios					1			1
16	Carry out preliminary assessment of data sufficiency	1	1	1	1	1	1	1	7
17	Scope of project	1	1	1	1	1	1	1	7
Activity 3: Data analysis and sufficiency									
18	List the main infrastructure systems for CL-CB Sluice Gate (e.g., operation, sensors, electricity system, connected canal, dike)						1		1
19	List the main components for each system above						2		2
20	Identify the material of construction, design life of infrastructure, importance within the region, physical condition						1		1
21	List specific regulations, standards, guidelines, and administrative processes				2				2
22	Analyse data and assess data sufficiency	1	1	1	1	1	1	1	7
23	State climate baseline and their potential impacts on each component of infrastructure individually and jointly							1	1
24	State historical extreme weather events (timing, duration, impacts)							1	1
25	State projected climate change inputs (trend, timespan, frequency…)							2	2
26	Analyse data and assess data sufficiency	1	1	1	1	1	1	1	7
27	State hydrology baseline (water level, flood, inundation)					1			1
28	State historical extreme hydrological events (timing, duration, impacts)					1			1
29	State projected hydrology change inputs (sea level rise)					2			2
30	State environment baseline (salinity intrusion)				1				1
31	State projected salinity intrusion				2				2
32	State the potential impacts of above issues on infrastructure (each items)			2					2
33	Analyse data and assess data sufficiency	1	1	1	1	1	1	1	7
34	State geology condition				3				3
35	State land subsidence		3						3
36	State projected land subsidence		2						2
37	State the potential impacts of land subsidence to infrastructure		2						2
38	Analyse data and assess data sufficiency	1	1	1	1	1	1	1	7

No.	Tasks	PC	GE	TS	WRE	HE	CVE	CE	Total
Activity 4: Developing risk assessment matrices									
39	Select risk assessment methodology for Probability Scale Factors (S_c)	1	1	1	1	1	1	1	7
40	Select risk assessment methodology for Severity Scale Factors (S_r)	1	1	1	1	1	1	1	7
41	Determine the infrastructures being sensitive to changes in climate factors	1	1	1	1	1	1	1	7
42	Assign the Probability Scale Factors (S_c)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	10.5
43	Assign the Severity Scale Factors (S_r)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	10.5
44	Calculate the Risk (R)	1	1	1	1	1	1	1	7
45	Determine the risk tolerance thresholds to assess R	1	1	1	1	1	1	1	7
46	Identify the risk ranks for the components	1	1	1	1	1	1	1	7
47	Assess data sufficiency in this step	1	1	1	1	1	1	1	7
48	Join a webinar with experts	1	1	1	1	1	1	1	7
49	Select risk assessment methodology for Probability Scale Factors (S_c)	1	1	1	1	1	1	1	7
50	Select risk assessment methodology for Severity Scale Factors (S_r)	1	1	1	1	1	1	1	7
51	Determine the infrastructures being sensitive to changes in hydrological factors	1	1	1	1	1	1	1	7
52	Assign the Probability Scale Factors (S_c)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	10.5
53	Assign the Severity Scale Factors (S_r)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	10.5
54	Calculate the Risk (R)	1	1	1	1	1	1	1	7
55	Determine the risk tolerance thresholds to assess R	1	1	1	1	1	1	1	7
56	Identify the risk ranks for the components	1	1	1	1	1	1	1	7
57	Assess data sufficiency in this step	1	1	1	1	1	1	1	7
58	**Activity 6 - 7:** Conclusions and recommendations, and submission of final report	2	2	2	2	2	2	2	14
60	**Activity 9:** Revising the final report based on comments of the independent experts								
Total number of man-days		**29**	**38**	**39**	**41**	**38**	**37**	**37**	**259**

Note: PC = Project Coordinator; TS = Technical Secretary; CVE = Civil Engineering Expert; WRE = Water Resource Expert; CE = Climate Expert; HE = Hydrological Expert; GE= Geological Experts

5.1.3 Price

❖ **Data purchases and processing**

Data purchase for CL-CB case were based on unit price of climate and hydrological parameters in Circular No. 197/2016/TT-BTC (more detail in Table 5-2). Furthermore, the data processing was charged by the 59.92 million VND. In total, the data purchase and processing cost was 260,0 million VND (including VAT).

❖ **Consultancy fees**

As this assessment was supported by GIZ, its consultancy fees were calculated based on GIZ honorary scheme for daily rates of local consultants in Vietnam, version 2015

(Table 5-4), and are shown in Table 5-5. The management cost was not included in this case.

Table 5-4. GIZ honorary scheme for daily rates of local consultants in Vietnam, 2015

Category	Scope of service	Relevant minimum education and work experience	Daily rates in VND up to
VNM1	Conducting assignment requiring policy and technical research	A University degree, plus 3-5 years relevant fulltime work experience	1,565,000
VNM2	Formulating or managing assignments requiring policy and technical research, analysis and formulation of advice, communication and/or writing	A University degree, plus 6-10 years relevant fulltime work experience	2,544,000
VNM3	Formulating, organizing and managing assignments requiring complex specialised policy, technical research, analysis and formulation of advice, communication and/or writing	A relevant Master's degree, plus 11-15 years relevant fulltime work experience	4,174,000
VNM4	1. Formulating, organizing and managing assignments (that may also involve engaging and leading a team of top-quality experts), requiring complex specialised policy, technical research, analysis, formulation of advice, communication and/or writing 2. Conceiving, implementing, monitoring development programmes and/or strategies of national scope or development policies	A relevant Master's degree, plus more than 15 years relevant fulltime work experience	5,870,000

Table 5-5. Consultant fees for experts (including VAT)

Items	PC	TS	WRE	HE	CVE	CE	GE	Total
Total number of man-days	29	39	41	38	37	37	38	259
Rate of consultancy fees (million VND)	3.8	3.2	2.5	2.2	2.544	2.2	3.4	
Consultancy fees (million VND)	110.2	124.8	102.5	83.6	94.128	81.4	129.2	**725.828**
Consultancy fees (Euro)[3]	4,298	4,868	3,998	3,261	3,671	3,175	5,039	**28,310**

Note: PC = Project Coordinator; TS = Technical Secretary; CVE = Civil Engineering Expert; WRE = Water Resource Expert; CE = Climate Expert; HE = Hydrological Expert; GE= Geological Experts

[3] *The Vietcombank exchange rate on 12th December 2019 (1 Euro = 25,639 VND)*

❖ **Miscellaneous costs**

In the CL-CB case, the assessment team carried out two field trips from Ho Chi Minh City to Kien Giang in order to collect further information on maintenance and operation of gates and survey the staff on the interactions of sluice gates and climatic factors. Each field trip had 4 participants during 4 days. The field-trip costs are shown in Table 5-6. Other miscellaneous costs (such as workshop costs, review of independent experts, stationery, and printing) were not included in the contract of this case.

Table 5-6. The field-trip costs for the CL-CB case

No.	Items	Quantity	Total (VND)	Total (Euro)
1	Accommodation	2 trips x 3 nights x 4 persons x 500,000 VND	12,000,000	468
2	DSA	2 trips x 4 days x 4 persons x 300,000 VND	9,600,000	374
3	Others (car, airfare, etc.)	2 trips x 4 days x 2,500,000 VND	20,000,000	780
Total travel costs			**41,600,000**	**1,623**

- In summary, the total cost of the CL-CB case was 1,027,428,000 VND (about 40,073 EUR) (Table 5-7).

Table 5-7. Summary of cost estimation for CL-CB case

No.	Items	Reference/ Formula	Cost (VND)	Cost (EUR)	Acronym
1	Consultancy fees	Refer to Table 5-5	725,828,000	28,310	EC
2	Management costs	55% x EC	Not applicable		MC
3	Other costs		301,600,000	11,763	OC
	Data purchase, combination and processing	Refer to Table 5-2	260,000,000	10,141	DP
	Workshops		Covered by GIZ		
	Field trips		41,600,000	1,623	
	Review of independent experts		Covered by GIZ		
	Stationery/printing		Covered by GIZ		
4	Pre-calculated taxable income	6%*(EC+MC)	Included in Consultancy fees		TN
5	Value-added tax	10%*(EC+MC+OC+TN)	Included		VAT
Total		(EC+MC+OC+TN+VAT)	***1,027,428,000***	40,073	

5.2 Case 2 – Replica

Case 2 or the Mekong Delta case will conduct a climate risk assessment for an infrastructure in the planning process in Mekong Delta, where its climate dataset is the same as that of the CL-CB case. It is assumed that this infrastructure is a Grade II hydraulic work (based on QCVN 04 - 05: 2012/BNNPTNT). Furthermore, the Mekong Delta case will be developed for two scenarios, a user from the private sector (Scenario 1) and from the public sector (Scenario 2).

In order to conduct the cost estimation, the following assumptions will be applied for the Mekong Delta case:

- The experts selected for the Mekong Delta case have the same education and work experiences as those in the CL-CB case.
- Costs for private sector will be estimated based on the EU-UN cost norm, while public sector will apply Circular No. 02/2015/TT-BLDTBXH for calculating costs.
- The number of field-trips and workshops for both private and public sectors are the same.

5.2.1 Procedure

In the CL-CB case, the step of the data analysis and sufficiency concluded that the geological data did not meet the data sufficient requirements for climate risk assessment on infrastructures in the Mekong Delta. As a result, it was recommended that the individual impacts of the geological features were not considered or the additional survey of the data needs to be implemented. Thus, in the Mekong Delta case, the tasks relating to the analysis of geological data will be ignored.

Similar to the CL-CB case, the Mekong Delta case will not also carry out Activity 5 in the procedure component as it is not necessary in a climate risk assessment during the planning process. There will be three workshops during this assessment, including a kick-off workshop, a risk assessment workshop, and a dissemination workshop. Two field trips will be also set up to collect data/documents, and gain experiences from administration and operation staff of the similar infrastructures in the Mekong Delta

The schedule of the Mekong Delta case is shown in Table 5-8. The assessment will be completed for 8 months, but some primary recommendations and conclusions can be provided after the fifth month.

Table 5-8. Schedule of the Mekong Delta case

No.	Activities	Month							
		1st	2nd	3rd	4th	5th	6th	7th	8th
1	Data purchase, combination and processing								
2	Collection and synthesis of data/documents and scoping of project								
3	Data analysis and sufficiency								
4	Developing risk assessment matrices								
5	Conclusions and Recommendations								
6	Report on climate risk assessment of the infrastructure								
7	Review of independent experts								
8	Revising the final report based on comments of independent experts								
9	Workshops								
10	Field trips								

5.2.2 Quantity

❖ The quantity of data

As mentioned above, the climate and hydrological data for the Mekong Delta case are the same as those of the CL-CB. In addition, the climate and hydrological data in three recent years (2018-2020) will be collected.

❖ The quantity of workload of experts

Compared to the CL-CB case, there are only 6 experts in the assessment team of the Mekong Delta case, consisting of a project coordinator, a technical secretary, a civil engineering expert, a water resource expert, a climate expert, and a hydrological expert. The geological expert will not be selected because of ignoring geological analysis in the procedure. The details of tasks, experts and the number of man-days in the quantity component of the recipe for the Mekong Delta case are shown in Table 5-9.

Table 5-9. Tasks, experts and the number of man-days for the Mekong Delta case

No.	Tasks	PC	TS	WRE	HE	CVE	CE	Total
Activity 2: Collection and synthesis of data/documents and scoping of project								
1	Collect the relevant documents/data of the project		2					2
2	Summarise the general information of the project (scope, objectives, natural and socio-economic conditions, legal basis, …)		2					2
3	Prepare maps (location, boundary, components of project)				2			2
4	Clarify salinity intrusion			2				2
5	Collect technical reports of the infrastructure (including designed standards) and similar projects (if any in the region)					1		1
6	Collect assessments how climate issues have been concerned and deal in the design so far					1		1
7	Summarise the detailed design of the infrastructure					2		2
8	Collect documents of regulatory settings, legal considerations, working policies, guidelines on operation and management			2				2
9	Clarify plans to operate and manage the infrastructure		2					2
10	Collect hydrological data (main factors) in the study region				2			2
11	Summarise historical extreme events (i.e. flooding)		2					2
12	Collect meteorological data (main factors) in the study region						2	2
13	Collect information/documents/data of gauges (including location, maps, photos, time series and measurement methods)						2	2

No.	Tasks	PC	TS	WRE	HE	CVE	CE	Total
14	Collect information of climate change scenarios				1			1
15	Carry out preliminary assessment of data sufficiency	1	1	1	1	1	1	6
16	Scope of project	1	1	1	1	1	1	6
17	Consultant meetings (in persons or online)							
Activity 3: Data analysis and sufficiency								
18	List the main infrastructure systems (e.g., operation, sensors, electricity system, connected canal, dike)					1		1
19	List the main components for each system above					2		2
20	Identify the material of construction, design life of infrastructure, importance within the region, physical condition					1		1
21	List specific regulations, standards, guidelines, and administrative processes			2				2
22	Analyse data and assess data sufficiency	1	1	1	1	1	1	6
23	State climate baseline and their potential impacts on each component of infrastructure individually and jointly						1	1
24	State historical extreme weather events (timing, duration, impacts)						1	1
25	State projected climate change inputs (trend, timespan, frequency…)						2	2
26	Analyse data and assess data sufficiency	1	1	1	1	1	1	6
27	State hydrology baseline (water level, flood, inundation)				1			1
28	State historical extreme hydrological events (timing, duration, impacts)				1			1
29	State projected hydrology change inputs (sea level rise)				2			2
30	State environment baseline (salinity intrusion)			1				1
31	State projected salinity intrusion			2				2
32	State the potential impacts of above issues on infrastructure (each items)		2					2
33	Analyse data and assess data sufficiency	1	1	1	1	1	1	6
34	Consultant meetings (in persons or online)							
Activity 4: Developing risk assessment matrices								
35	Select risk assessment methodology for Probability Scale Factors (S_c)	1	1	1	1	1	1	6
36	Select risk assessment methodology for Severity Scale Factors (S_r)	1	1	1	1	1	1	6
37	Determine the infrastructures being sensitive to changes in climate factors	1	1	1	1	1	1	6
38	Assign the Probability Scale Factors (S_c)	1.5	1.5	1.5	1.5	1.5	1.5	9

No.	Tasks	PC	TS	WRE	HE	CVE	CE	Total
39	Assign the Severe Scale Factors (S_r)	1.5	1.5	1.5	1.5	1.5	1.5	9
40	Calculate the Risk (R)	1	1	1	1	1	1	6
41	Determine the risk tolerance thresholds to assess R	1	1	1	1	1	1	6
42	Identify the risk ranks for the components	1	1	1	1	1	1	6
43	Assess data sufficiency in this step	1	1	1	1	1	1	6
44	Select risk assessment methodology for Probability Scale Factors (S_c)	1	1	1	1	1	1	6
45	Select risk assessment methodology for Severity Scale Factors (S_r)	1	1	1	1	1	1	6
46	Determine the infrastructures being sensitive to changes in hydrological factors	1	1	1	1	1	1	6
47	Assign the Probability Scale Factors (S_c)	1.5	1.5	1.5	1.5	1.5	1.5	9
48	Assign the Severe Scale Factors (S_r)	1.5	1.5	1.5	1.5	1.5	1.5	9
49	Calculate the Risk (R)	1	1	1	1	1	1	6
50	Determine the risk tolerance thresholds to assess R	1	1	1	1	1	1	6
51	Identify the risk ranks for the components	1	1	1	1	1	1	6
52	Assess data sufficiency in this step	1	1	1	1	1	1	6
53	Consultant meetings (in persons or online)							
54	**Activity 6:** Conclusions and recommendations	1	1	1	1	1	1	6
55	**Activity 7:** Report of climate risk assessment	2	2	2	2	2	2	12
56	**Activity 9:** Revising the final report based on comments of the independent experts	1	1	1	1	1	1	6
Total number of man-days		**31**	**41**	**40**	**40**	**39**	**39**	**230**

Note: PC = Project Coordinator; TS = Technical Secretary; CVE = Civil Engineering Expert; WRE = Water Resource Expert; CE = Climate Expert; HE = Hydrological Expert.

In regard to the workshop participants, there are about 20 delegates for each workshop, including the assessment team, state authorities (such as MONRE, MARD, Department of Agriculture and Rural Development, Department of Construction), investors and other stakeholders. The kick-off workshop and risk assessment workshop will be organised in Can Tho City, while the dissemination workshop will be in Ho Chi Minh City. In addition, each field trip has 4 participants during 3 days.

5.2.3 Price

- **Data purchases and processing**

In addition to the inherited data from the CL-CB case, the climate and hydrological data (2018-2020) will be purchased for the assessment in the Mekong Delta case (Table 5-10). The total cost for data purchase and processing will be 50.38 million VND (about 1,965 EUR), in which the processing fee will be 10.0 million VND. It is noted that in case of free data under Law No. 90/2015/QH13, only the data processing cost will be charged.

Table 5-10. Climate and hydrological data purchase for the Mekong Delta case

No	Data/ station	Dataset	Price/year (VND)	Total (VND)
I	**DAILY RAIN**			
1	Bac Lieu	2018-2020	200,000	600,000
2	Xeo Ro	2018-2020	200,000	600,000
3	Go Quao	2018-2020	200,000	600,000
4	An Ninh	2018-2020	200,000	600,000
5	Vinh Thuan	2018-2020	200,000	600,000
6	Phuoc Long	2018-2020	200,000	600,000
7	Phung Hiep	2018-2020	200,000	600,000
8	Song Doc	2018-2020	200,000	600,000
9	Ganh Hao	2018-2020	200,000	600,000
10	My Thanh	2018-2020	200,000	600,000
11	Vinh Hoa Hung	2018-2020	200,000	600,000
II	**SUB-DAILY RAINFALL**			
1	Can Tho	2018-2020	200,000	600,000
2	Soc Trang	2018-2020	200,000	600,000
3	Rach Gia	2018-2020	200,000	600,000
4	Bac Lieu	2018-2020	200,000	600,000
5	Ca Mau	2018-2020	200,000	600,000
6	Vi Thanh	2018-2020	200,000	600,000
III	**DAILY TEMPARATURE**			
1	Can Tho	2018-2020	200,000	600,000
2	Soc Trang	2018-2020	200,000	600,000
3	Rach Gia	2018-2020	200,000	600,000
4	Bac Lieu	2018-2020	200,000	600,000
5	Ca Mau	2018-2020	200,000	600,000
IV	**WATER LEVEL**			
1	Can Tho	2018-2020	300,000	900,000
2	Rach Gia	2018-2020	300,000	900,000
3	Ca Mau	2018-2020	300,000	900,000
4	Vi Thanh	2018-2020	300,000	900,000
5	Xeo Ro	2018-2020	300,000	900,000
6	Phuoc Long	2018-2020	300,000	900,000
7	Phung Hiep	2018-2020	300,000	900,000
8	Song Doc	2018-2020	300,000	900,000
9	Ganh Hao	2018-2020	300,000	900,000
10	My Thanh	2018-2020	300,000	900,000
V	**DAILY WIND**			

No	Data/ station	Dataset	Price/year (VND)	Total (VND)
1	Can Tho	2018-2020	200,000	600,000
2	Soc Trang	2018-2020	200,000	600,000
3	Rach Gia	2018-2020	200,000	600,000
4	Bac Lieu	2018-2020	200,000	600,000
5	Ca Mau	2018-2020	200,000	600,000
VI	**STORMS**	**FREE FROM NOAA**		
VII	**MONTHLY THUNDER STORM/ LIGHTINGS**			
1	Can Tho	2018-2020	200,000	600,000
2	Soc Trang	2018-2020	200,000	600,000
3	Rach Gia	2018-2020	200,000	600,000
4	Bac Lieu	2018-2020	200,000	600,000
5	Ca Mau	2018-2020	200,000	600,000
VIII	**TORNADO DATA**	**NO DATA**		
IX	**SALINITY**			
1	Soc Trang	2018-2020	220,000	660,000
2	Rach Gia	2018-2020	220,000	660,000
3	Ca Mau	2018-2020	220,000	660,000
4	Go Quao	2018-2020	220,000	660,000
5	An Ninh	2018-2020	220,000	660,000
6	Phuoc Long	2018-2020	220,000	660,000
7	Song Doc	2018-2020	220,000	660,000
8	My Thanh	2018-2020	220,000	660,000
X	**DAILY EVAPORATION**			
1	Can Tho	2018-2020	200,000	600,000
2	Soc Trang	2018-2020	200,000	600,000
3	Rach Gia	2018-2020	200,000	600,000
4	Bac Lieu	2018-2020	200,000	600,000
5	Ca Mau	2018-2020	200,000	600,000
XI	**DAILY HUMIDITY**			
1	Can Tho	2018-2020	200,000	600,000
2	Soc Trang	2018-2020	200,000	600,000
3	Rach Gia	2018-2020	200,000	600,000
4	Bac Lieu	2018-2020	200,000	600,000
5	Ca Mau	2018-2020	200,000	600,000
XII	**HOURLY FLOW**			
1	Can Tho	2018-2020	300,000	900,000
Sub-total (VND)				**40,380,000**
Sub-total (EUR)				**1,575**

❖ **Consultancy fees**

- Scenario 1 (private sector):

According to the EU-UN cost norm, daily rates and consultancy fees of experts for the Mekong Delta case are estimated as shown in Table 5-11.

Table 5-11. Daily rates and consultancy fees for private sector

No.	Role in team	Relevant education and work experience	Payment level	Rate (VND)	Man-days	Total fee (million VND)	Total fee (EUR)
1	PC	Master; > 10 years	VNM 3	2,747,664	31	85,178,000	3,322
2	TS	PhD; > 10 years	VNM 3	2,747,664	41	112,654,000	4,394
3	WRE	Master; > 10 years	VNM 2	1,669,962	40	66,798,000	2,605
4	HE	Bachelor; > 10 years	VNM 2	1,669,962	40	66,798,000	2,605
5	CVE	Master; > 10 years	VNM 2	1,669,962	39	65,129,000	2,540
6	CE	Bachelor; > 10 years	VNM 2	1,669,962	39	65,129,000	2,540
Total					**230**	**461,686,000**	**18,007**

Note: PC = Project Coordinator; TS = Technical Secretary; CVE = Civil Engineering Expert; WRE = Water Resource Expert; CE = Climate Expert; HE = Hydrological Expert

- Scenario 2 (public sector):

Based on the Circular No. 02/2015/TT-BLDTBXH, the rates of domestic consulting specialists and consultant fees are estimated as shown in Table 5-12.

Table 5-12. Daily rates of domestic consulting specialists for public sector

No.	Role in team	Relevant education and work experience	Payment level	Rate (VND)	Man-days	Total fee (million VND)	Total fee (EUR)
1	PC	Master; > 10 years	Level 1	1,818,182	31	56,364,000	2,198
2	TS	PhD; > 10 years	Level 1	1,818,182	41	74,545,000	2,907
3	WRE	Master; > 10 years	Level 2	1,363,636	40	54,545,000	2,127
4	HE	Bachelor; > 10 years	Level 2	1,363,636	40	54,545,000	2,127
5	CVE	Master; > 10 years	Level 2	1,363,636	39	53,182,000	2,074
6	CE	Bachelor; > 10 years	Level 2	1,363,636	39	53,182,000	2,074
Total					**230**	**346,363,000**	**13,509**

Note: PC = Project Coordinator; TS = Technical Secretary; CVE = Civil Engineering Expert; WRE = Water Resource Expert; CE = Climate Expert; HE = Hydrological Expert

❖ **Miscellaneous costs**

The miscellaneous costs (including workshops, field trips, review of independent experts, and stationery) for the Mekong Delta case are presented in Table 5-13 (detail in Appendix 5 and 6).

Table 5-13. Summary of cost estimation for the Mekong Delta case

No.	Items	Private sector		Public sector	
		VND	**EUR**	**VND**	**EUR**
1	Consultancy fees	461,686,000	18,484	346,363,000	13,509
2	Management costs	253,927,000	10,166	190,500,000	7,430
3	Other costs	302,053,000	11,781	209,880,000	8,186
	Data purchase and processing	50,380,000	1,965	50,380,000	1,965
	Workshops	141,554,000	5,521	91,700,000	3,577
	Field trips	33,649,000	1,312	27,800,000	1,084
	Review of independent experts	66,470,000	2,593	30,000,000	1,170
	Stationery	10,000,000	390	10,000,000	390
4	Pre-calculated taxable income	Included in consultancy fees		32,212,000	1,256
5	Value-added tax	Included in other items		56,908,000	2,220
Total		**1,018,000,000**	**39,705**	**836,000,000**	**32,607**
Total for expert contracts		**764,000,000**	**29,798**	**614,000,000**	**23,948**

- In summary, the total costs of the Mekong Delta case are 1,089,000,000 VND (42,474 EUR) for private sector and 836,000,000 VND (32,607 EUR) for public sector. In case of the expert contracts (i.e. excluding management costs), the corresponding costs are 764,000,000 VND and 614,000,000 VND (29,798 EUR and 23,948 EUR).

5.3 Case 3 – Extension

Case 3 will consider a climate risk assessment for a bridge in planning process in Quang Binh province. It is assumed that the bridge is a Group A project of new construction works in Vietnam (based on Decree No. 59/2015/ND-CP dated 18th June 2015 of the Government on construction project management). The Quang Binh case will be developed for both private (Scenario 1) and public sector (Scenario 2), and for different stages in the infrastructure planning and implementation process: (1) pre-feasibility study, (2) feasibility study and (3) after construction.

Similar to the Mekong Delta case, the Quang Binh case will also apply the following assumptions to conduct the cost estimation:

- The experts selected for the Quang Binh case have the same education and work experiences as those in the CL-CB case.
- Costs for private sector will be estimated based on the EU-UN cost norm, while public sector will apply Circular No. 02/2015/TT-BLDTBXH for calculating costs.
- The number of field-trips and workshops for both private and public sectors are the same.

5.3.1 Procedure

The activities of the procedure for the Quang Binh case are different from three different stages in the infrastructure planning and implementation process. As suggested in the recipe, a climate risk assessment is not necessary for the stage of “Pre-feasibility study”. For the stage of “Feasibility study”, Activity 5 can be excluded from the main activities in the procedure of the recipe, while the stage of “After construction” will implement a full climate risk assessment on the bridge, i.e. Activity 5 will be included in the assessment.

Generally, the schedule of the Quang Binh case is presented in Table 5-14. While the assessment will be completed for about 9 months, some primary recommendations and conclusions can be provided after 5-6 months. There will be three workshops during this assessment, including a kick-off workshop, a risk assessment workshop, and a dissemination workshop. A field trip will be set up to collect data/documents, and gain experiences from administration and operation staff of the similar infrastructures in Quang Binh Province and surrounding areas.

Table 5-14. Schedule of the Quang Binh case

Activities	**Month**								
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
Activity 1: Data purchase, combination and processing									
Activity 2: Collection and synthesis of data/documents and scoping of project									
Activity 3: Data analysis and sufficiency									
Activity 4: Developing risk assessment matrices									
Activity 5: Engineering analysis *									
Activity 6: Conclusions and Recommendations									
Activity 7: Report on climate risk assessment of the infrastructure									
Activity 9: Review of independent experts									
Activity 10: Revising the final report based on comments of independent experts									
Activity 11: Workshops									
Activity 12: Field trips									

** Activity 5 will be excluded for the stage of "Feasibility study"*

5.3.2 *Quantity*

❖ The quantity of data

The climate and hydrological data for the Quang Binh case will be determined based on a list of potential climate and hydrological parameters for climate risk assessment on infrastructures in Vietnam (Table 3-3), natural condition of the study area, and the availability of climate and hydrological data (Figure 5-1).

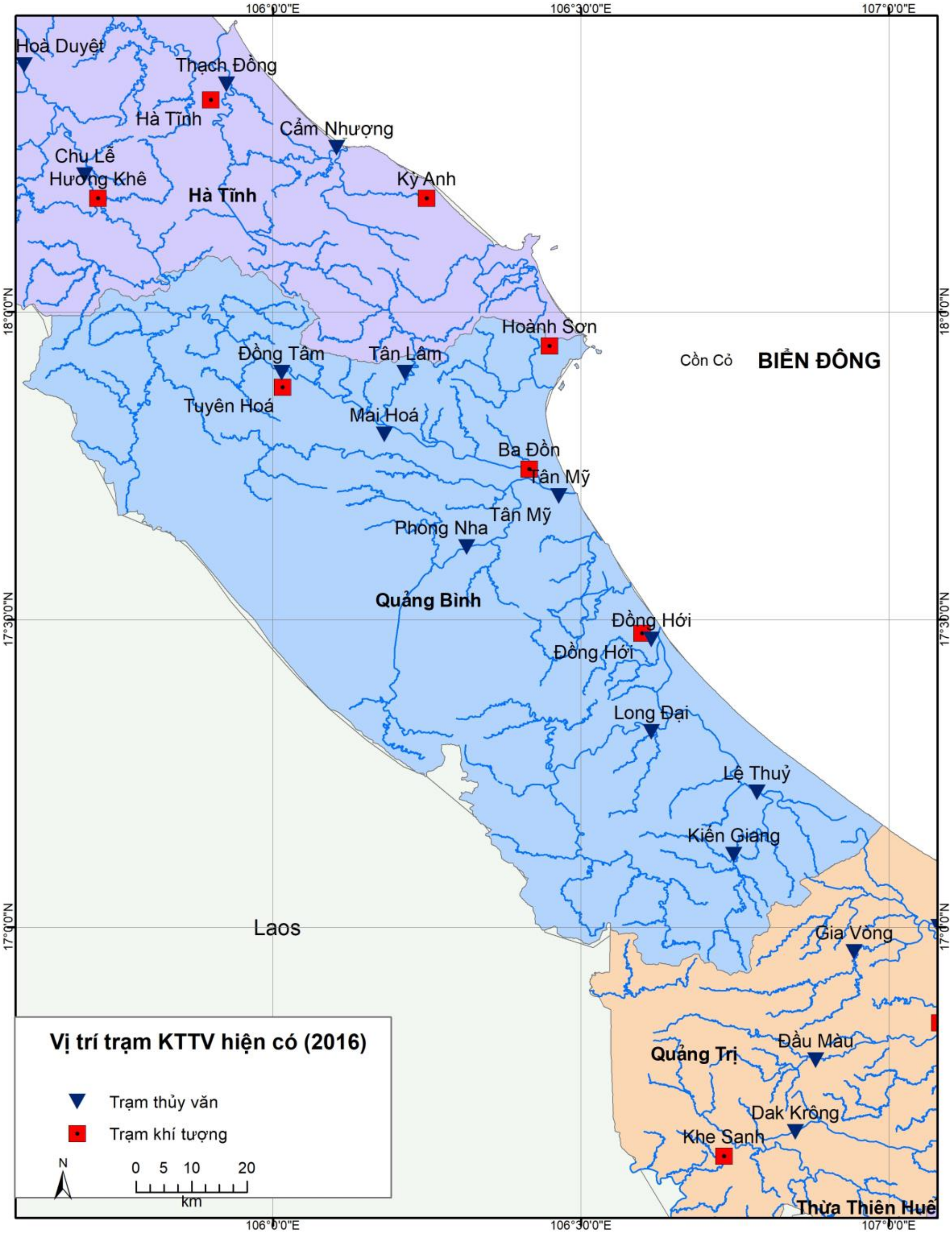

Figure 5-1. Location of hydro-meteorological stations in Quang Binh

It can be seen that there are two salinity stations (Tan My and Mai Hoa) in Gianh River in the North of Quang Binh province. Therefore, if the bridge is not located in this area, the salinity factor can be ignored.

In addition, as Quang Binh province is located in the Central Region, the necessary climate and hydrological data for the assessment can be mainly collected from Hydro-meteorological Centre in Central Region (from Quang Binh to Quang Ngai). It is assumed that the consultancy team does not have any available data, so all the data required must be purchased. The details of climate and hydrological data purchases are shown in Table 5-15.

Table 5-15. Climate and hydrological data purchase for the Quang Binh case

No	Data/ station	Number of Years	Price (VND)	Total
I	**Daily Rain**			
1	Ba Don	30	200,000	6,000,000
2	Tuyen Hoa	30	200,000	6,000,000
3	Dong Hoi	30	200,000	6,000,000
II	**Sub-Daily Rainfall**			
1	Ba Don	30	200,000	6,000,000
2	Tuyen Hoa	30	200,000	6,000,000
3	Dong Hoi	30	200,000	6,000,000
III	**Daily Temperature**			
1	Ba Don	30	200,000	6,000,000
2	Tuyen Hoa	30	200,000	6,000,000
3	Dong Hoi	30	200,000	6,000,000
IV	**Water Level**			
1	Dong Tam	30	280,000	8,400,000
2	Mai Hoa	30	300,000	9,000,000
3	Tan My	30	300,000	9,000,000
4	Kien Giang	30	280,000	8,400,000
5	Le Thuy	30	280,000	8,400,000
6	Dong Hoi	30	300,000	9,000,000
V	**Daily Wind**			
1	Ba Don	30	200,000	6,000,000
2	Tuyen Hoa	30	200,000	6,000,000
3	Dong Hoi	30	200,000	6,000,000

No	Data/ station	Number of Years	Price (VND)	Total
VI	**Storms**	Free from NOAA		
VII	**Monthly Thunder Storm/ Lightings**			
1	Ba Don	30	200,000	6,000,000
2	Tuyen Hoa	30	200,000	6,000,000
3	Dong Hoi	30	200,000	6,000,000
VIII	**Tornado Data**	From report of the Provincial Committee for Flood and Storm Control, and Search and Rescue		
IX	**Salinity**			
1	Mai Hoa	30	220,000	6,600,000
2	Tan My	30	220,000	6,600,000
X	**Daily Evaporation**			
1	Ba Don	30	200,000	6,000,000
2	Tuyen Hoa	30	200,000	6,000,000
3	Dong Hoi	30	200,000	6,000,000
XI	**Daily Humidity**			
1	Ba Don	30	200,000	6,000,000
2	Tuyen Hoa	30	200,000	6,000,000
3	Dong Hoi	30	200,000	6,000,000
XII	**Hourly Flow**			
1	Dong Tam	30	280,000	8,400,000
Total (VND)				**199,800,000**
Total (EUR)				**7,793**

❖ The quantity of workload of experts

Similar to the CL-CB case, the assessment team of the Quang Binh case has 7 members, consisting of a project coordinator, a technical secretary, a civil engineering expert, a water resource expert, a climate expert, a hydrological expert, and a geological expert. The details of tasks, experts and the number of man-days in the quantity component of the recipe for the Quang Binh case are shown in Table 5-16. As mentioned above, for the stage of “after construction”, all the tasks in Table 5-16 will be considered, while the stage of “feasibility study” will skip 10 tasks (from 62 to 72) of Activity 5.

Table 5-16. Tasks, experts and the number of man-days days for the Quang Binh case

No.	Items	PC	GE	TS	WRE	HE	CVE	CE	Total
I	**Activity 2: Collection and synthesis of data/documents and scoping of project**								*41*
1	Collect the relevant documents/data of the project			*2*					*2*
2	Summarise the general information of the project (scope, objectives, natural and socio-economic conditions, legal basis, …)			*2*					*2*
3	Prepare maps (location, boundary, components of project)					*2*			*2*
4	Clarify the land subsidence issue		*2*						*2*
5	Clarify salinity intrusion				*2*				*2*
6	Collect technical reports of the infrastructure (including designed standards) and similar projects (if any in the region)						*1*		*1*
7	Collect assessments how climate issues have been concerned and deal in the design so far						*1*		*1*
8	Summarise the detailed design of the infrastructure						*2*		*2*
9	Collect documents of regulatory settings, legal considerations, working policies, guidelines on operation and management				*2*				*2*
10	Clarify plans to operate and manage the infrastructure			*2*					*2*
11	Collect hydrological data (main factors) in the study region					*2*			*2*
12	Summarise historical extreme events (i.e. flooding)			*2*					*2*
13	Collect meteorological data (main factors) in the study region							*2*	*2*
14	Collect information/documents/data of gauges (including location, maps, photos, time series and measurement methods)							*2*	*2*
15	Collect information of climate change scenarios					*1*			*1*
16	Carry out preliminary assessment of data sufficiency	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
17	Scope of project	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
18	Consultant meetings (in person or online)								
II	**Activity 3: Data analysis and sufficiency**								*57*
19	List the main infrastructure systems (e.g., operation, sensors, electricity system, connected canal, dike)						*1*		*1*

No.	Items	PC	GE	TS	WRE	HE	CVE	CE	Total
20	List the main components for each system above						*2*		*2*
21	Identify the material of construction, design life of infrastructure, importance within the region, physical condition						*1*		*1*
22	List specific regulations, standards, guidelines, and administrative processes				*2*				*2*
23	Analyse data and assess data sufficiency	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
24	State climate baseline and their potential impacts on each component of infrastructure individually and jointly							*1*	*1*
25	State historical extreme weather events (timing, duration, impacts)							*1*	*1*
26	State projected climate change inputs (trend, timespan, frequency…)							*2*	*2*
27	Analyse data and assess data sufficiency	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
28	State hydrology baseline (water level, flood, inundation)					*1*			*1*
29	State historical extreme hydrological events (timing, duration, impacts)					*1*			*1*
30	State projected hydrology change inputs (sea level rise)					*2*			*2*
31	State environment baseline (salinity intrusion)				*1*				*1*
32	State projected salinity intrusion				*2*				*2*
33	State the potential impacts of above issues on infrastructure (each items)			*2*					*2*
34	Analyse data and assess data sufficiency	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
35	State geography condition				*3*				*3*
36	State land subsidence		*3*						*3*
37	State projected land subsidence		*2*						*2*
38	State the potential impacts of land subsidence to infrastructure		*2*						*2*
39	Analyse data and assess data sufficiency	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
40	Consultant meetings (in person or online)								
III	**Activity 4: Developing risk assessment matrices**								*140*
41	Select risk assessment methodology for Probability Scale Factors (S_c)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
42	Select risk assessment methodology for Severity Scale Factors (S_r)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*

No.	Items	PC	GE	TS	WRE	HE	CVE	CE	Total
43	Determine the infrastructures being sensitive to changes in climate factors	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
44	Assign the Probability Scale Factors (S_c)	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*10.5*
45	Assign the Severe Scale Factors (S_r)	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*10.5*
46	Calculate the Risk (R)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
47	Determine the risk tolerance thresholds to assess R	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
48	Identify the risk ranks for the components	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
49	Assess data sufficiency in this step	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
50	Select risk assessment methodology for Probability Scale Factors (S_c)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
51	Select risk assessment methodology for Severity Scale Factors (S_r)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
52	Determine the infrastructures being sensitive to changes in climate factors	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
53	Assign the Probability Scale Factors (S_c)	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*10.5*
54	Assign the Severe Scale Factors (S_r)	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*10.5*
55	calculate the Risk (R)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
56	Determine the risk tolerance thresholds to assess R	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
57	Identify the risk ranks for the components	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
58	Assess data sufficiency in this step	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
59	Conduct Risk Assessment Workshops								
60	Consultant meetings (in person or online)								
IV	**Activity 5: Engineering analysis (optional)**								*70*
61	Select the interactions which need to implement engineering analysis	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
62	Calculate the Existing Load (L_E)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
63	Calculate Changing Climate Load (L_C)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
64	Calculate Other Change Loads (L_O)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
65	Calculate the Existing Capacity (C_E)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
66	Calculate the Projected Change in Existing Capacity ($C_{\Delta E}$)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
67	Calculate Additional Capacity (C_A)	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
68	Calculate Vulnerability Ratio	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
69	Calculate Capacity Deficit	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
70	Assess Data Sufficiency	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*7*
71	Consultant meetings (in person or								

No.	Items	PC	GE	TS	WRE	HE	CVE	CE	Total
	online)								
72	**Activity 6: Conclusions and Recommendations**	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*14*
73	**Activity 7: Report on climate risk assessment of the infrastructure**	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*14*
74	**Activity 9: Revising the final report based on comments of independent experts**	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*14*
	Total number of man-days for "feasibility study"	**32**	**41**	**42**	**44**	**41**	**40**	**40**	**280**
	Total number of man-days for "after construction"	**42**	**51**	**52**	**54**	**51**	**50**	**50**	**350**

Note: PC = Project Coordinator; TS = Technical Secretary; CVE = Civil Engineering Expert; WRE = Water Resource Expert; CE = Climate Expert; HE = Hydrological Expert; GE= Geological Experts.

It can be seen in Table 5-16 that a risk assessment workshop will be conducted for the Quang Binh case. Furthermore, a kick-off workshop and a dissemination workshop will be organised in Quang Binh. The participants of these workshops (about 20 persons) include the assessment team, state authorities (such as Ministry of Transport, MONRE, Department of Transport, Department of Agriculture and Rural Development, Department of Construction), Hydro-meteorological Centre in Central Region (from Quang Binh to Quang Ngai), investors and other stakeholders.

In addition, during the assessment, consulting meetings will be implemented after each activity. With regard to the field trip, there are 4 participants for 3 days.

5.3.3 Price

❖ Data purchases and reprocess

All the data necessary for the assessment in the Quang Binh case will be bought from Hydro-meteorological Centre in Central Region (from Quang Binh to Quang Ngai) (Table 5-15). The unit price of the climate and hydrological parameters is regulated in Circular No. 197/2016/TT-BTC. In short, the cost of data purchases will be 199,800,000 VND (7,793 EUR) in total and 186,600,000 VND (7,278 EUR) without salinity data. Similar to the CL-CB case, the data processing will be charged by 60 million VND. It is noted that in case of free data under Law No. 90/2015/QH13, only the data processing cost will be charged.

❖ Consultancy fees

The daily rates of experts for the Quang Binh case are illustrated in Table 5-17. While Scenario 1 (private sector) applies the EU-UN cost norm, Scenario 2 (public sector) comply with the Circular No. 02/2015/TT-BLDTBXH. The consultant fees for the Quang Binh case are summarised in Table 5-18.

Table 5-17. Daily rates of domestic consulting specialists for the Quang Binh case

No.	Role in team	Relevant education and work experience	Private sector		Public sector	
			Payment level	Rate (VND)	Payment level	Rate (VND)
1	PC	Master; > 10 years	VNM 3	2,747,664	Level 1	1,818,182
2	TS	PhD; > 10 years	VNM 3	2,747,664	Level 1	1,818,182
3	WRE	Master; > 10 years	VNM 2	1,669,962	Level 2	1,363,636
4	HE	Bachelor; > 10 years	VNM 2	1,669,962	Level 2	1,363,636
5	CVE	Master; > 10 years	VNM 2	1,669,962	Level 2	1,363,636
6	CE	Bachelor; > 10 years	VNM 2	1,669,962	Level 2	1,363,636
7	GE	Master; > 10 years	VNM 3	2,747,664	Level 1	1,818,182

Note: PC = Project Coordinator; TS = Technical Secretary; CVE = Civil Engineering Expert; WRE = Water Resource Expert; CE = Climate Expert; HE = Hydrological Expert; GE= Geological Experts

Table 5-18. Consultant fees for the Quang Binh case

Sector	Stage	Unit	PC	GE	TS	WRE	HE	CVE	CE	Total
Private	Feasibility study	Man-days	32	41	42	44	41	40	40	
		Million VND	87.9	112.7	115.4	73.5	68.5	66.8	66.8	**591.5**
		EUR	3,429	4,394	4,501	2,866	2,670	2,605	2,605	**23,071**
	After construction	Man-days	42	51	52	54	51	50	50	
		Million VND	115.4	140.1	142.9	90.2	85.2	83.5	83.5	**740.8**
		EUR	4,501	5,466	5,573	3,517	3,322	3,257	3,257	**28,892**
Public	Feasibility study	Man-days	32	41	42	44	41	40	40	
		Million VND	58.2	74.5	76.4	60	55.9	54.5	54.5	**434.1**
		EUR	2,269	2,907	2,978	2,340	2,181	2,127	2,127	**16,931**
	After construction	Man-days	42	51	52	54	51	50	50	
		Million VND	76.4	92.7	94.5	73.6	69.5	68.2	68.2	**543.2**
		EUR	2,978	3,617	3,688	2,872	2,712	2,659	2,659	**21,186**

Note: PC = Project Coordinator; TS = Technical Secretary; CVE = Civil Engineering Expert; WRE = Water Resource Expert; CE = Climate Expert; HE = Hydrological Expert; GE= Geological Experts

- Miscellaneous costs

The miscellaneous costs (including workshops, field trips, review of independent experts, and stationery) for the Quang Binh case are shown in Table 5-19 (detail in Appendix 7 and 8).

Table 5-19. Summary of cost estimation for the Quang Binh case

No.	Items	Private sector				Public sector			
		Feasibility study		After construction		Feasibility study		After construction	
		Million VND	EUR	Million VND	EUR	Million VND	EUR	Million VND	EUR
1	Consultancy fees	591.5	23,071	740.8	28,892	434.1	16,931	543.2	21,186
2	Management costs	325.3	12,689	407.4	15,890	238.8	9,312	298.7	11,652
3	Other costs	539.1	21,027	539.1	21,027	481.0	18,762	481.0	18,762
	Data purchase and processing	259.8	10,133	259.8	10,133	259.8	10,133	259.8	10,133
	Workshops	153.6	5,990	153.6	5,990	137.7	5,370	137.7	5,370
	Field trips	49.3	1,922	49.3	1,922	43.6	1,699	43.6	1,699
	Review of independent experts	66.5	2,593	66.5	2,593	30.0	1,170	30.0	1,170
	Stationery	10.0	390	10.0	390	10.0	390	10.0	390
4	Pre-calculated taxable income	Included in Consultancy fees				40.4	1,575	50.5	1,970
5	Value-added tax	Included in other items				119.4	4,658	89.2	3,481
Total		**1,456**	**56,788**	**1,687**	**65,798**	**1,266**	**49,378**	**1,463**	**57,062**
Total for expert contracts		**1,131**	**44,112**	**1,280**	**49,924**	**987**	**38,496**	**1,114**	**43,449**

- In summary, the total costs for the Quang Binh case are shown in Table 5-19.

6 Conclusion

In the context of climate change, it is necessary to conduct climate risk assessment on infrastructures for climate-resilient infrastructure investment. Thus, this assignment developed a recipe for a climate risk assessment in Vietnam in order to support potential users (including public sector, private sector, and others) identify the cost and scope of climate risk assessments on infrastructures in the future.

The recipe covers the main activities of a climate risk assessment (procedure), clarify the list of tasks and climate/hydrological data (quantity), and identify the unit price in terms of data purchase, consultancy, workshops, and field trips (price). The recipe also considered the different planning stages of the infrastructure (i.e., pre-feasibility study, feasibility study, and after construction) as well as the different users (i.e. private sector, public sector, and others). Furthermore, the recipe evaluated the availability of climate and hydrological data in Vietnam for climate risk assessment.

In this assignment, the recipe used the Cai Lon – Cai Be Sluice Gate as a baseline case. In addition, it was applied to the Mekong Delta case and Quang Binh case. Obviously, the application of the recipe depends on the actual conditions of each case. The users need to adjust the recipe to be suitable for the specific requirements in their application.

The following key notes are recommended to apply the recipe effectively:

- The implementation duration of a full CRA is about 8-9 months, but the primary recommendations and conclusions can be provided after 5 - 6 months. Thus, infrastructures having over 5 months planning stage can conduct a CRA with the proposed recipe.
- A CRA on infrastructures can be applied to the stages of “feasibility study” and “after construction”, but is not necessary for the stage of “pre-feasibility study”.
- A CRA covers all the activities of the procedure for the stage of “after construction”, whereas it often excludes engineering analysis (Activity 5 of the Procedure) for the stage of “feasibility study”.
- The cost of the CRA for the stage of “feasibility study” is more economical than that for the stage of “after construction”. Therefore, an early investment (i.e. in the stage of “feasibility study”) for a CRA is more cost effective over the life of the infrastructure.
- The cost for a CRA on infrastructures implemented by a state agency must comply with Decision No. 79/QD-BXD dated 15th February 2017 of Ministry of Construction on standard project management and construction consulting costs, and thus it includes management cost for that agency.

- Hydro-meteorological data for a CRA on infrastructures will not be charged if it serves disaster prevention and control, national defence and security or has non-profit purposes under Law No. 90/2015/QH13.
- There is no official regulation to calculate cost for a CRA on infrastructures invested by private user.

References

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- Nguyen Duc Cong Hiep, Le Viet Minh, Do Duc Dung, Nguyen Thi Minh Ngoc, Benjamin Hodick, Katharina Lotzen, 2019, Climate Risk Assessment for Infrastructure: An Application for Cai Lon - Cai Be Sluice Gates in the Mekong Delta, International Conference Water Resources Research on Water Resources Security, Disaster Prevention and Climate Change Adaptation.
- GIZ, 2019, Climate Risk Analysis and Assessment Report for Cai Lon - Cai Be Sluice Gate Project Based on the PIEVC Protocol: Final Report, Enhancing Climate Services for Infrastructure Investment (CSI).

Appendix 1. Decisions of Prime Minister, MARD and MONRE regarding to CL-CB Sluice Gate project

- Decision No. 84/2006/QD-TTg on April 19th 2006 of Prime Minister for approving "*Adjusting and implementing Water Resources Planning for the Mekong Delta in the period of 2006 – 2010 and orientation to 2020"*;
- Decision No. 1336/QD-BNN-KH on May 8th 2009 of MARD for approving "*Water Resources Planning for Southern Ca Mau Peninsula*";
- Decision No. 1397/QD-TTg on September 25th 2012 of Prime Minister for approving "*Master plan for water resources in the Mekong Delta in context of climate change and sea level rise*";
- Decision No. 3113/QD-BNN-KH on October 10th 2009 of MARD's Minister about the agreement of investment and investor assignment on "*The Cai Lon – Cai Be sluice gate project (1st phase)*";
- Decision No. 498/QD-TTg on April 17th 2017 of Prime Minister for approving investment policy of "The Cai Lon – Cai Be sluice gate project (1st phase)";
- Decision No. 3805/QD-BTNMT on December 18th 2018 of the Ministry of Natural Resources and Environment approving the report on environmental impact assessment of The Cai Lon – Cai Be sluice gate project (1st phase);
- Decision No. 5078/QD-BNN-XD on December 25th 2018 of the Ministry of Agriculture and Rural Development approving the investment of the Cai Lon – Cai Be sluice gate project (1st phase).

Appendix 2. Standards and regulations used for designing Cai Lon and Cai Be sluice gates

❖ ***Sluice gate structure, ship lock and bridge design standards***

- QCVN 04-05-2012/BNNPTNT: National technical regulation on hydraulic structures - The basic stipulation for design;
- QCVN 07-2012/BKHCN: National technical regulation on steel for the reinforcement of concrete;
- TCVN 10400-2016: Hydraulic structures - Pillar dam - Technical requirements for design;
- TCVN 9144:2012: Hydraulic structures – Requirement for ship lock design.
- TCVN 5664-2009: Technical decentralization of inland waterways;
- TCVN 8422-2010: Hydraulic structure – Design of adverse filter;
- TCVN 9152-2012: Hydraulic structures - Designing process for retaining walls;
- TCVN 9139-2012: Hydraulic structures - Concrete and reinforced concrete structures in coastal areas - Technical specifications;
- TCVN 4116-1985: Hydraulic concrete and reinforced concrete structures;
- TCVN 9902-2013: Hydraulic structures - Requirements for river dyke design;
- TCVN 4253-2012: Hydraulic structures - Foundation of hydraulic projects - Design standard;
- TCVN 8421-2010: Hydraulic Structures – Loads and actions of wind-induced and Ship-induced waves on structures;
- TCVN 10304-2014: Pile foundation – Design standard;
- TCVN 5575-2012: Steel structures - Design standard;
- 22TCN 272-05: Specification for bridge design;
- TCVN 4054-2005: Highway – Specifications for design;

❖ ***Gate design standards***

- TCVN 8298-2009: Hydraulics structures - Technical requirements for manufacturing and installing mechanical equipment, steel structures;
- TCVN 8299-2009: Hydraulics structures –Technical requirements for steel gate and groove design;

- TCVN 8640-2011: Hydraulic structures - Operating cable mechanism - Technical requirements for designing, manufacturing, installation and inspection;
- TCVN 8646-2011: Hydraulic structures - Zinc covered surface of steel structure and mechanical equipment - Technical requirements;

❖ ***Embankment design standard***

- TCVN 8419-2010: Hydraulic structure - Design of river bank flood protection structures;
- 22TCN 219-94: Design standards for river port facilities.

❖ ***Electric power system design standard***

- TCVN 9163-2012: Hydraulic structures - Electro-mechanic drawing - Content requirements;

❖ ***Operational and management procedure standards***

- TCVN 8412-2010: Hydraulic structure - Guideline for setting operation procedure;
- TCVN 8418-2010: Hydraulic structure - Process for management, operation and maintenance of sluice;

❖ ***Relevant standards and circulars***

- TCVN 9345:2012: Concrete and reinforced concrete structures - Guide on technical measures for prevention of cracks occurring under hot humid climate;
- TCVN 8828:2011: Concrete - Requirements for natural moist curing;
- TCVN 12041:2017: Concrete and reinforced concrete structures – General requirements for design durability and service life in corrosive environments;
- QCVN 02:2017/BTC: National technical regulations on generators for national reserve;
- Circular No. 70/2015/TT-BTNMT: issued on 23 December 12, 2015 about “Automatic hydro-meteorological gauges - Technical requirements for designing, installing and operating”.

Appendix 3. Airport taxi

No.	Airport	Location	Airport taxi – one way (in VND)
1	Dien Bien	Dien Bien	40,000
2	Noi Bai	Ho Noi	275,000
3	Cat Bi	Hai Phong	100,000
4	Vinh	Vinh City	95,000
5	Dong Hoi	Dong Hoi City	140,000
6	Phu Bai	Hue City	210,000
7	Da Nang	Da Nang	70,000
8	Chu Lai	Tam Ky City and Quang Ngai City	405,000
9	Pleiku	Pleiku City	110,000
10	Phu Cat	Quy Nhon City	285,000
11	Tuy Hoa	Tuy Hoa City	95,000
12	Buon Ma Thuot	Buon Ma Thuot City	150,000
13	Cam Ranh	Nha Trang City	300,000
14	Lien Khuong	Da Lat City	210,000
15	Tan Son Nhat	Ho Chi Minh City	130,000
16	Rach Soi	Rach Gia	120,000
17	Phu Quoc	Phu Quoc	85,000
18	Can Tho	Can Tho City	200,000
19	Con Dao	Con Dao	220,000
20	Ca Mau	Ca Mau	45,000
21	Tho Xuan	Thanh Hoa	420,000

Appendix 4. Interpretation services rate and translation rate

- **Interpretation services rate**

Interpretation Rates in USD (payable in VND)	
Level	**Rate**
Simultaneous (*)	
Daily	600
Half Day	300
Hourly	75
Non Simultaneous	
Daily	200
Half Day	100
Hourly	25

Sign Language Interpretation Rates in USD (payable in VND)	
	Rate
In Vietnamese	
Daily	100
Half Day	50
English-Vietnamese or Vietnamese-English	
Daily	600
Half Day	300

- **Translation rate**

Translation rate in USD (VND)*	
English to Vietnamese	USD 11 (253,880) per page of 350 words
Vietnamese to English	USD 11 (253,880) per page of 350 words

* *The Vietcombank exchange rate on 12th December 2019 (1 USD = 23,080 VND)*

- **Resource person rate**

Resource Person Daily Rates (VND)	
1. Complex tasks that require thorough technical knowledge, autonomy, analytical and problem solving skills, and ability to communicate clearly.	960,000
2. Tasks that require application of a known methodology with technical knowledge, autonomy, and analytical skills.	750,000
3. Logistics and administrative support.	320,000

Appendix 5. Miscellaneous costs of private sector for the Mekong Delta case

No.	Items	Unit	Quantity	Unit price (VND)	Costs (VND)
I	**Workshops/Consulting meetings**				**141,554,400**
	Kick-off workshop in Can Tho City (1 day)				**36,080,800**
	Presentation cost (2 sessions/day)	*session*	*2*	*500,000*	*1,000,000*
	Meeting cost	*package*	*20*	*600,080*	*12,001,600*
	Travel (HCM City - Can Tho)	*persons*	*40*	*150,000*	*6,000,000*
	Accommodation (1 night)	*persons*	*20*	*853,960*	*17,079,200*
	Two risk assessment workshops in Can Tho City (2 days)				**66,161,600**
	Presentation cost (2 sessions/day)	*session*	*4*	*500,000*	*2,000,000*
	Meeting cost (2 days)	*package*	*40*	*600,080*	*24,003,200*
	Travel (HCM City - Can Tho)	*persons*	*40*	*150,000*	*6,000,000*
	Accommodation (20 persons x 2 nights)	*persons*	*40*	*853,960*	*34,158,400*
	Dissemination workshop in Ho Chi Minh City (1 day)				**39,312,000**
	Presentation cost (2 sessions/day)	*session*	*2*	*500,000*	*1,000,000*
	Meeting cost	*package*	*20*	*669,320*	*13,386,400*
	Travel (HCM City - Mekong Delta)	*persons*	*40*	*150,000*	*6,000,000*
	Accommodation (1 night)	*persons*	*20*	*946,280*	*18,925,600*
II	**Field trips**				**33,648,640**
1.1	**Accommodation**				**8,124,160**
	- 2 trips x 2 nights x 4 persons	*nights*	*16*	*507,760*	*8,124,160*
1.2	**DSA**				**10,524,480**
	- 2 trips x 3 days x 4 persons	*days*	*24*	*438,520*	*10,524,480*
1.3	**Others (car, airfare, etc.)**				**15,000,000**
	- 2 trips x 3 days	*days*	*6*	*2,500,000*	*15,000,000*
III	**Review of independent experts**				**66,470,400**
	3 experts of civil engineering, climate change and natural disaster (5 man-days/expert)	*days*	*15*	*4,431,360*	*66,470,400*
IV	**Stationery, printing**	*package*	*1*	*10,000,000*	**10,000,000**
Total					**251,673,440**

Appendix 6. Miscellaneous costs of public sector for the Mekong Delta case

No.	Items	Unit	Quantity	Unit price (VND)	Costs (VND)
I	**Workshops/Consulting meetings**				**91,700,000**
1.1	**Kick-off workshop in Can Tho (1 day)**				**24,300,000**
	Presentation cost (2 sessions/day)	*session*	*2*	*500,000*	*1,000,000*
	Hire of workshop rooms and equipment	*package*	*1*	*2,500,000*	*2,500,000*
	Travel (HCM City - Can Tho)	*persons*	*40*	*150,000*	*6,000,000*
	Time break (per person)	*persons*	*20*	*20,000*	*400,000*
	Lunch and diner	*persons*	*20*	*200,000*	*4,000,000*
	Accommodation (1 night)	*persons*	*20*	*500,000*	*10,000,000*
	Others (stationery)	*persons*	*20*	*20,000*	*400,000*
1.2	**CRA workshop in Can Tho (2 days)**				**42,600,000**
	Presentation cost (2 sessions/day)	*session*	*4*	*500,000*	*2,000,000*
	Hire of workshop rooms and equipment	*package*	*1*	*5,000,000*	*5,000,000*
	Travel (HCM City - Can Tho)	*persons*	*40*	*150,000*	*6,000,000*
	Time break (per person)	*persons*	*40*	*20,000*	*800,000*
	Lunch and diner	*persons*	*40*	*200,000*	*8,000,000*
	Accommodation (20 persons x 2 nights)	*persons*	*40*	*500,000*	*20,000,000*
	Others (stationery)	*persons*	*40*	*20,000*	*800,000*
1.3	**Dissemination workshop in HCM City (1 day)**				**24,800,000**
	Presentation cost (2 sessions/day)	*session*	*2*	*500,000*	*1,000,000*
	Hire of workshop rooms and equipment	*package*	*1*	*3,000,000*	*3,000,000*
	Travel (HCM City - Mekong Delta)	*persons*	*40*	*150,000*	*6,000,000*
	Time break (per person)	*persons*	*20*	*20,000*	*400,000*
	Lunch and diner	*persons*	*20*	*200,000*	*4,000,000*
	Accommodation (1 night)	*persons*	*20*	*500,000*	*10,000,000*
	Others (stationery)	*persons*	*20*	*20,000*	*400,000*
II	**Field trips**				**27,800,000**
2.1	**Accommodation**				**8,000,000**
	- 2 trips x 2 nights x 4 persons	*nights*	*16*	*500,000*	*8,000,000*
	DSA				**4,800,000**
2.2	*- 2 trips x 3 days x 4 persons*	*days*	*24*	*200,000*	*4,800,000*
	Others (car, airfare, etc.)				**15,000,000**
2.3	*- 2 trips x 3 days*	*days*	*6*	*2,500,000*	*15,000,000*
III	**Review of independent experts**				**30,000,000**
	3 experts of civil engineering, climate change and natural disaster (5 man-days/expert)	*days*	*15*	*2,000,000*	*30,000,000*
IV	**Stationery, printing**	*package*	*1*	*10,000,000*	**10,000,000**
Total					**159,500,000**

Appendix 7. Miscellaneous costs of private sector for the Quang Binh case

No.	Items	Unit	Quantity	Unit price	Costs
I	**Workshops**				**139,605,818**
1.1	**Kick-off workshop in Quang Binh (1 day)**				**37,209,455**
	Presentation cost (2 sessions/day)	*session*	*2*	*454,545*	*909,091*
	Meeting cost	*package*	*20*	*461,600*	*9,232,000*
	Travel (HCM City - Quang Binh) (3 persons)	*persons*	*6*	*2,727,273*	*16,363,636*
	Airport taxi (3 persons x 2 ways)	*taxis*	*6*	*245,455*	*1,472,727*
	Accommodation (1 night)	*persons*	*20*	*461,600*	*9,232,000*
1.2	**Risk assessment workshop in Quang Binh (2 days)**				**65,186,909**
	Presentation cost (2 sessions/day)	*session*	*4*	*454,545*	*1,818,182*
	Meeting cost	*package*	*20*	*461,600*	*9,232,000*
	Travel (HCM City - Quang Binh) (6 persons)	*persons*	*12*	*2,727,273*	*32,727,273*
	Airport taxi (6 persons x 2 ways)	*taxis*	*12*	*245,455*	*2,945,455*
	Accommodation (20 persons x 2 nights)	*persons*	*40*	*461,600*	*18,464,000*
1.3	**Dissemination workshop in Quang Binh (1 day)**				**37,209,455**
	Presentation cost (2 sessions/day)	*session*	*2*	*454,545*	*909,091*
	Meeting cost	*package*	*20*	*461,600*	*9,232,000*
	Travel (HCM City - Quang Binh) (3 persons)	*persons*	*6*	*2,727,273*	*16,363,636*
	Airport taxi (3 persons x 2 ways)	*taxis*	*6*	*245,455*	*1,472,727*
	Accommodation (1 night)	*persons*	*20*	*461,600*	*9,232,000*
II	**Field trips**				**44,790,400**
1.1	**Accommodation**				**5,539,200**
	- 3 nights x 4 persons	*nights*	*12*	*461,600*	*5,539,200*
1.2	**DSA**				**6,378,473**
	- 4 days x 4 persons	*days*	*16*	*398,655*	*6,378,473*
1.3	**Others (car, airfare, etc.)**				**32,872,727**
	- Airfare (4 persons x 2 ways)	*flights*	*8*	*2,727,273*	*21,818,182*
	- Airport taxi (4 persons x 2 ways)	*taxis*	*8*	*245,455*	*1,963,636*
	- Car rent (4 days)	*days*	*4*	*2,272,727*	*9,090,909*
III	**Review of independent experts**				**60,427,636**
	3 experts of civil engineering, climate change and natural disaster (5 man-days/expert)	*days*	*15*	*4,028,509*	*60,427,636*
IV	**Stationery, printing**	*package*	*1*	*9,090,909*	**9,090,909**
Total					**253,914,764**

Appendix 8. Miscellaneous costs of public sector for the Quang Binh case

No.	Items	Unit	Quantity	Unit price	Costs
I	**Workshops**				**137,680,000**
1.1	**Kick-off workshop in Quang Binh (1 day)**				**34,420,000**
	Presentation cost (2 sessions/day)	*session*	*2*	*500,000*	*1,000,000*
	Hire of workshop rooms and equipment	*package*	*1*	*2,000,000*	*2,000,000*
	Travel (HCM City - Quang Binh) (3 persons)	*persons*	*6*	*3,000,000*	*18,000,000*
	Airport taxi (3 persons x 2 ways)	*taxis*	*6*	*270,000*	*1,620,000*
	Time break (per person)	*persons*	*20*	*20,000*	*400,000*
	Lunch and diner	*persons*	*20*	*200,000*	*4,000,000*
	Accommodation (1 night)	*persons*	*20*	*350,000*	*7,000,000*
	Others (stationery)	*persons*	*20*	*20,000*	*400,000*
1.2	**Risk assessment workshop in Quang Binh (2 days)**				**68,840,000**
	Presentation cost (2 sessions/day)	*session*	*4*	*500,000*	*2,000,000*
	Hire of workshop rooms and equipment	*package*	*1*	*4,000,000*	*4,000,000*
	Travel (HCM City - Quang Binh) (6 persons)	*persons*	*12*	*3,000,000*	*36,000,000*
	Airport taxi (6 persons x 2 ways)	*taxis*	*12*	*270,000*	*3,240,000*
	Time break (per person)	*persons*	*40*	*20,000*	*800,000*
	Lunch and diner	*persons*	*40*	*200,000*	*8,000,000*
	Accommodation (20 persons x 2 nights)	*persons*	*40*	*350,000*	*14,000,000*
	Others (stationery)	*persons*	*40*	*20,000*	*800,000*
1.3	**Dissemination workshop in Quang Binh (1 day)**				**34,420,000**
	Presentation cost (2 sessions/day)	*session*	*2*	*500,000*	*1,000,000*
	Hire of workshop rooms and equipment	*package*	*1*	*2,000,000*	*2,000,000*
	Travel (HCM City - Quang Binh) (3 persons)	*persons*	*6*	*3,000,000*	*18,000,000*
	Airport taxi (3 persons x 2 ways)	*taxis*	*6*	*270,000*	*1,620,000*
	Time break (per person)	*persons*	*20*	*20,000*	*400,000*
	Lunch and diner	*persons*	*20*	*200,000*	*4,000,000*
	Accommodation (1 night)	*persons*	*20*	*350,000*	*7,000,000*
	Others (stationery)	*persons*	*20*	*20,000*	*400,000*
II	**Field trip**				**43,560,000**
2.1	**Accommodation**				**4,200,000**
	- 3 nights x 4 persons	*nights*	*12*	*350,000*	*4,200,000*
2.2	**DSA**				**3,200,000**
	- 4 days x 4 persons	*days*	*16*	*200,000*	*3,200,000*
2.3	**Others (car, airfare, etc.)**				**36,160,000**

No.	Items	Unit	Quantity	Unit price	Costs
	- *Airfare (4 persons x 2 ways)*	*flights*	*8*	*3,000,000*	*24,000,000*
	- *Airport taxi (4 persons x 2 ways)*	*taxis*	*8*	*270,000*	*2,160,000*
	- *Car rent (4 days)*	*days*	*4*	*2,500,000*	*10,000,000*
III	**Review of independent experts**				**30,000,000**
	3 experts of civil engineering, climate change and natural disaster (5 man-days/expert)	*days*	*15*	*2,000,000*	*30,000,000*
IV	**Stationery, printing**	*package*	*1*	10,000,000	**10,000,000**
Total					**221,240,000**