

**JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
NATIONAL CENTRE FOR RURAL WATER SUPPLY AND
ENVIRONMENTAL SANITATION (N-CERWASS)**

**THE STUDY
ON GROUNDWATER DEVELOPMENT
IN THE RURAL PROVINCES
OF THE SOUTHERN COASTAL ZONE
IN THE SOCIALIST REPUBLIC
OF VIETNAM**

**FINAL REPORT
(Summary)**

MARCH 2009

**TOKYO ENGINEERING CONSULTANTS CO., LTD.
IN ASSOCIATION WITH
OYO INTERNATIONAL CORPORATION**

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PREFACE

In response to a request from the Government of Socialist Republic of Vietnam, the Government of Japan decided to conduct a study on Groundwater Development in the Rural Provinces of the Southern Coastal Zone and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Toshifumi Okaga of Tokyo Engineering Consultants Co., LTD. and consists of Tokyo Engineering Consultants Co., LTD. and OYO International Corporation between May, 2007 and March, 2009. In addition, JICA set up an advisory committee supported by Dr. Saburo Matsui, Emeritus Professor, Kyoto University and Dr. Yuji Maruo, Senior Advisor, JICA, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of Vietnam and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Vietnam for their close cooperation extended to the study.

March 2009

Ariyuki Matsumoto,
Vice-President
Japan International Cooperation Agency

Mr. Akiyuki Matsumoto
Vice-President
Japan International Cooperation Agency

March 2009

LETTER OF TRANSMITTAL

Dear Sir,

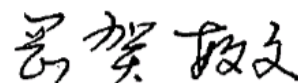
We are pleased to submit you the final report entitled “The Study on Groundwater Development in the Rural Provinces of the Southern Coastal Zone in the Socialist Republic of Vietnam”. This report has been prepared by the Study Team in accordance with the contracts signed on 15th May 2007, between Japan International Cooperation Agency and Tokyo Engineering Consultants Co., Ltd. in association with OYO International Corporation.

The report examines the existing conditions concerning water supply of the Southern Coastal Zone and presents the master plan and feasibility study on priority project selected from the master plan.

This study aimed to improve the water supply conditions of the Southern Coastal Zone. We are sure that the recommendations made in the report shall contribute to improving the water supply conditions of the Southern Coastal Zone.

All the members of the Study Team wish to acknowledge gratefully to the personnel of your Agency, Ministry of Foreign Affairs, JICA Vietnam Office, and also to the officials and individuals of the Government of the Socialist Republic of Vietnam for their assistance extended to the study team.

Yours faithfully,



Toshifumi OKAGA

Team Leader

Summary

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Abbreviation and Acronyms

ADB	Asian Development Bank
AusAID	Australian Agency for International Development
BHN	Basic Human Needs
CD	Capacity Development
CEMA	Committee for Ethnic Minorities
CPC	Communal People's Committee
CPRGS	Comprehensive Poverty Reduction and Growth Strategy
DANIDA	Danish International Development Assistance
DARD	Department of Agriculture and Rural Development (Provincial Level)
DOET	Department of Education and Training (Provincial Level)
DOH	Department of Health (Provincial Level)
DONRE	Department of Natural Resources and Environment (Provincial Level)
DPC	District People's Committee
DPI	Department of Planning and Investment (Provincial Level)
DVCL	Double Vault Composting Latrine
EIA	Environmental Impact Assessment
FS	Feasibility Study
GOV	Government of Vietnam
HEP	Horizontal Electrical Profiling
IEC	Information, Education and Communication
IEE	Initial Environmental Evaluation
MARD	Ministry of Agriculture and Rural Development
MOC	Ministry of Construction
MOET	Ministry of Education and Training
MOF	Ministry of Finance
MOH	Ministry of Health
MOLISA	Ministry of Labour, War Invalids and Social Affairs
MONRE	Ministry of Natural Resources and Environment
MP	Master Plan
N-CERWASS	National Centre for Rural Water Supply and Environmental Sanitation
NGO	Non Government Organization
NRWSSS	National Rural Water Supply and Sanitation Strategy

NTP	National Target Programme
ODA	Official Development Assistance
O&M	Operation and Maintenance
P-CERWASS	Provincial Center for Rural Water Supply and Sanitation
PMU	Project Management Unit
PPC	Provincial People's Committee
RWSS	Rural Water Supply and Sanitation
SRTM	Shuttle Radar Topography Mission
TPBS	Targeted Programme Budget Support
UNICEFF	United Nations Children's Fund
USD	US Dollar
VBSP	Vietnam Bank for Social Policy
VES	Vertical Electrical Sounding
VND	Vietnamese Dong (The Vietnamese currency unit)
WSS	Water Supply and Sanitation

CURRENCY EQUIVALENTS

(July 2008)

USD 1.00 = JPY 106.17

USD 1.00 = VND 16,852

CHAPTER 1 INTRODUCTION

1.1 Background

Vietnam has promoted an open, market-oriented, and globally integrated economy. However, the gap between rural area and urban area is getting wider. Based on Comprehensive Poverty Reduction and Growth Strategy (CPRGS) established by the government, in 1999 the government worked out to formulate National Rural Clean Water Supply and Sanitation Strategy (NRWSSS) with the target year 2020.

In 1998 Five year plan (NTP 1: National Target on Rural Water Supply and Sanitation, Phase1) was formulated and the implementation started from 2000. Subsequently, the second Five year plan NTP2 started from 2006. In these plans, the target for the rate of population served has been set as 85 % of total population and target for the rate of population served sanitary toilet is set as 70% by 2010.

Meanwhile, the Government of Japan has implemented Technical Cooperation and Grant Aid cooperation for the improvement of water supply in rural area through the groundwater development in the north provinces and the central highlands provinces since year 1998.

Subsequently, improvement of water and sanitation for the Southern coastal zone, in 4 provinces of Phu Yen, Khanh Hoa, Ninh Thuan and Binh Thuan, have been requested by the Vietnam. The rate of access to clean water in these areas is confined to 42 to 60 % due to difficulty in water source development for complicated hydro-geological structure. The aim of the study is to achieve improvement in hygiene and promotion of sound socio-economical activities through the project.

Based on the results and lessons learned from these development projects, this study can expect not only contribution to improvement of living standard, but also support the capacity development for sustainable management of the water supply facility owned by the counterpart of Vietnam.

1.2 Objectives of the Study

The objectives of the Study are;

- (1) To formulate a master plan in order to secure sufficient water and to improve sanitary conditions in the rural area of the southern coastal province: Province of Phu Yen, Khan Hoa, Ninh Thuan and Binh Thuan.
- (2) To conduct a feasibility study
- (3) To promote technical transfer
- (4) To disseminate knowledge obtained through the study.

1.3 Study Area

The study areas are located in 24 candidate Communes of four (4) provinces. Location of the Study area is shown in Figure 1.3.1.

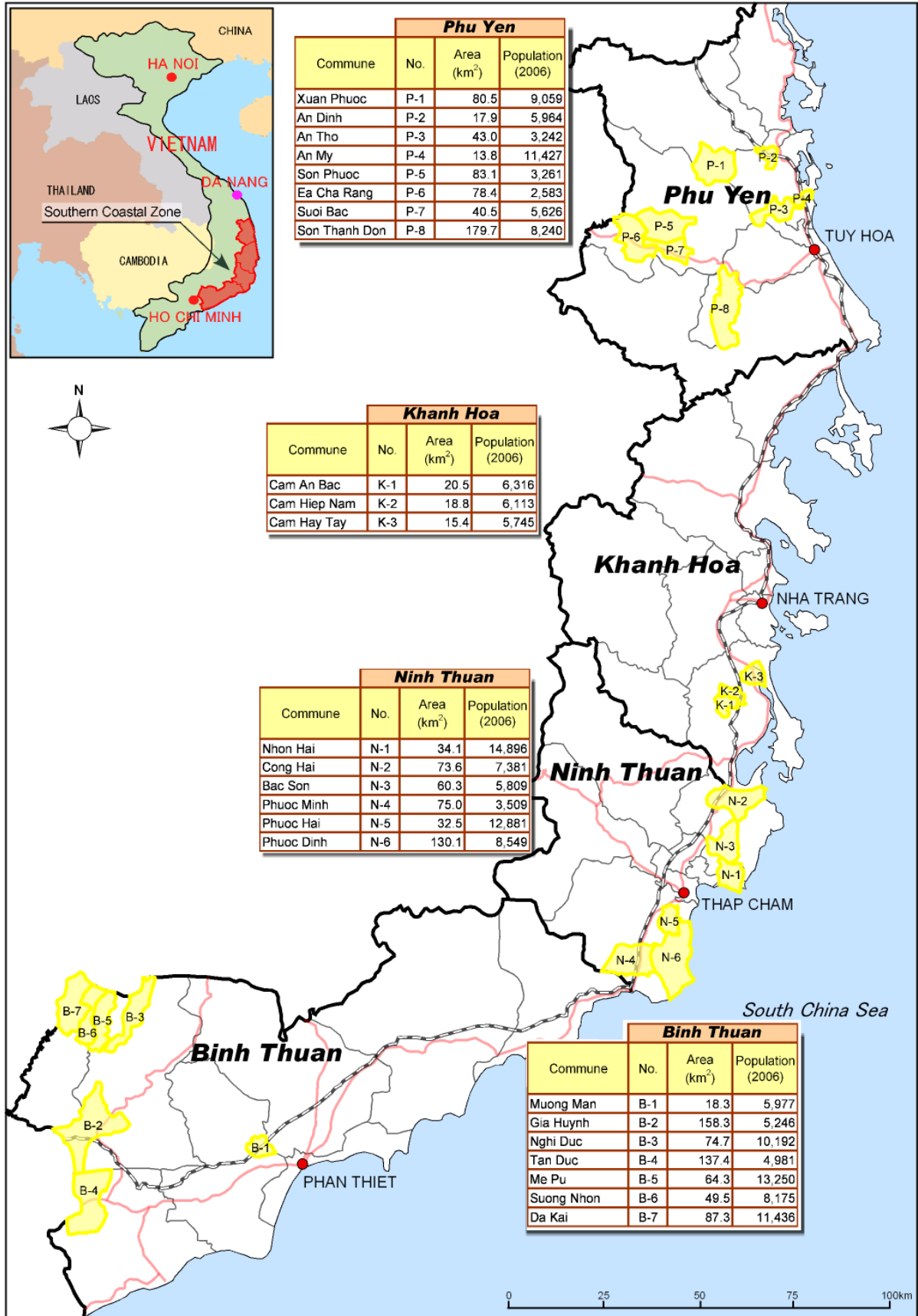


Figure 1.3.1 Location of the Study Area

CHAPTER 2 CURRENT STATUS

2.1 Natural Condition

2.1.1 Meteorology

According to “Köppen-Geiger Climate Classification” (Updated by Univ. of Vienna, April 2006), the study area belongs to the tropical savanna climate (Aw) entirely.

(1) Precipitation

1) Annual Precipitation

The annual precipitation in most of the study area is greater than 1,500 mm. Especially, the mountainous area in Khanh Hoa and Binh Thuan province reaches to greater than 2,500 mm. On the other hand, it is less than 1,000 mm and significantly low in the dry season in the coastal lowland areas in Ninh Thuan province and the northern part of Binh Thuan province.

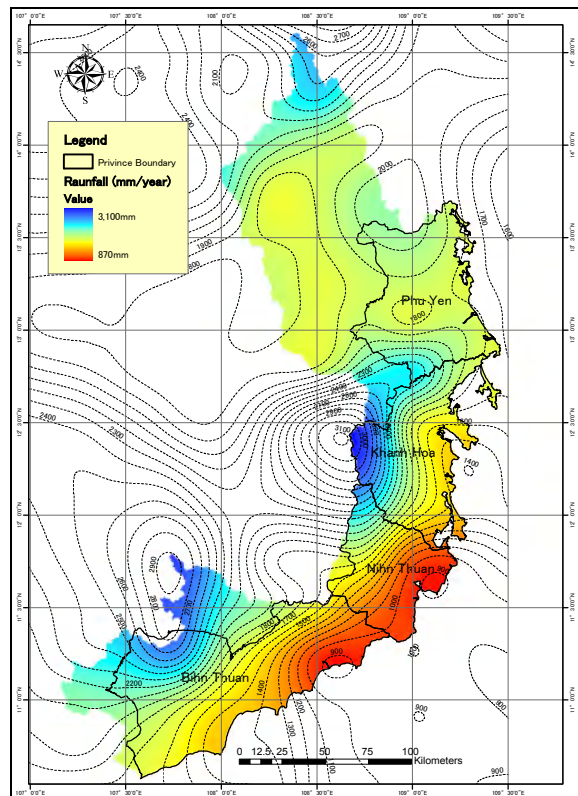


Figure 2.1.1 Annual Precipitation of the Study Area

2) Monthly Precipitation

Monthly variation pattern of the precipitation is divided into two groups, which are Phu Yen, Khanh Hoa and Ninh Thuan group and Binh Thuan group. The former shows that the rainy season is September to December and the latter is May to October.

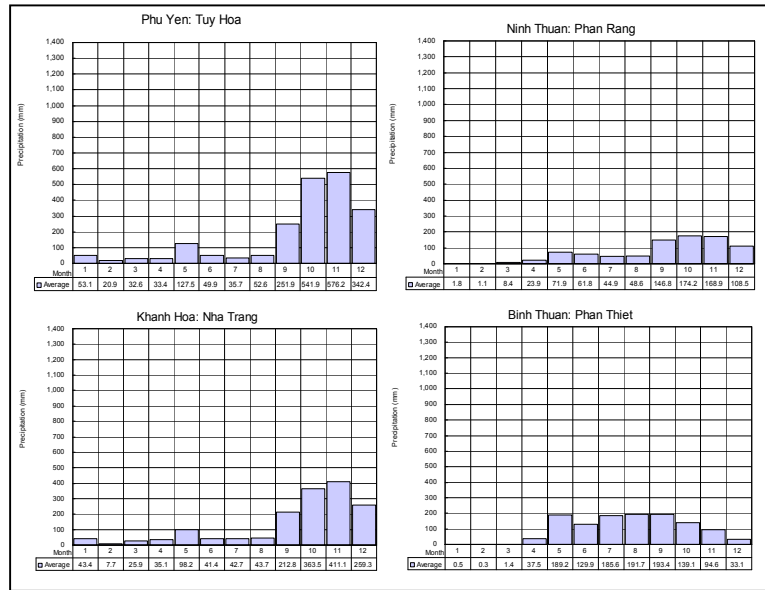


Figure 2.1.2 Monthly Precipitation of Four Provinces

(Figure 2.1.2 to 6 are based on the data from “Regional Hydro-meteorological Center, South of Central Vietnam”)

(2) Air Temperature

Maximum temperature is about 30 degrees in June and July. Two stations at Binh Thuan Province (Phan Thiet and La Gi) have a slightly lower temperature from June to August due to the rainy season. (Figure 2.1.3)

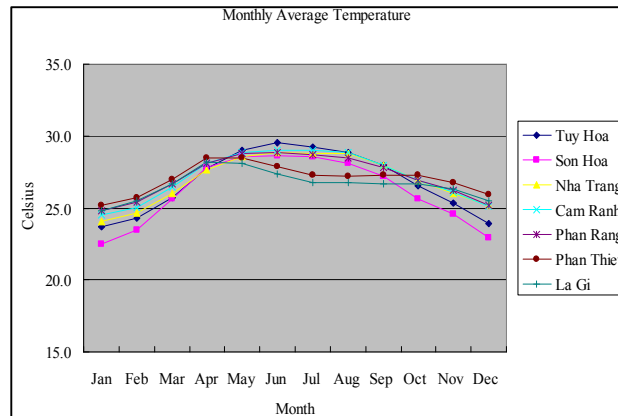


Figure 2.1.3 Monthly Average of Air Temperature

(3) Sunshine Duration

Annual variation patterns of sunshine duration among the stations are divided into two groups, which are Tuy Hoa and Nha Trang group, and Phan Rang and Phan Thiet group. The distributions of the former group show sharper change pattern than that of the latter group. (Figure 2.1.4)

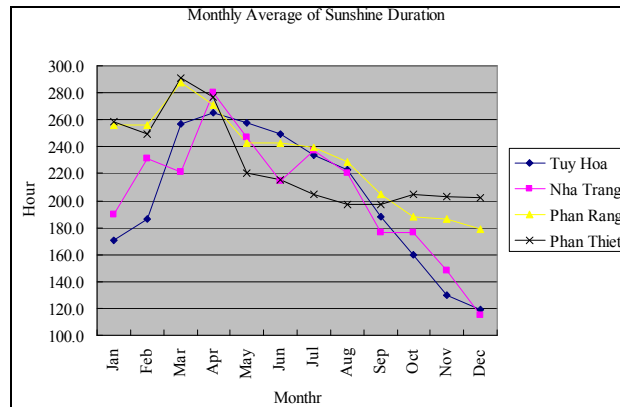


Figure 2.1.4 Monthly Average of Sunshine Duration

(4) Pan Evaporation

Average pan evaporation of each station follows monthly average temperature and period of those rainy seasons. It shows the highest value of 190 mm in September and the lowest value of 50 to 80 mm in November and December at Tuy Hoa and Son Hoa stations in Phu Yen Province.

In Khanh Hoa Province, Nha Trang and Cam Ranh stations have the highest value of 130 to 150 mm in July and August, and the lowest value of 90 to 110 mm from September to November.

In Ninh Thuan Province, Phan Rang station has the highest value of 190 mm in July, and the lowest value of 110 to 130 mm in the rainy season from September to November.

In Binh Thuan Province, Phan Thiet and La Gi stations have the highest value of 130 to 140 mm from July to March, and the lowest value of 90 to 100 mm in the rainy season from June to October.

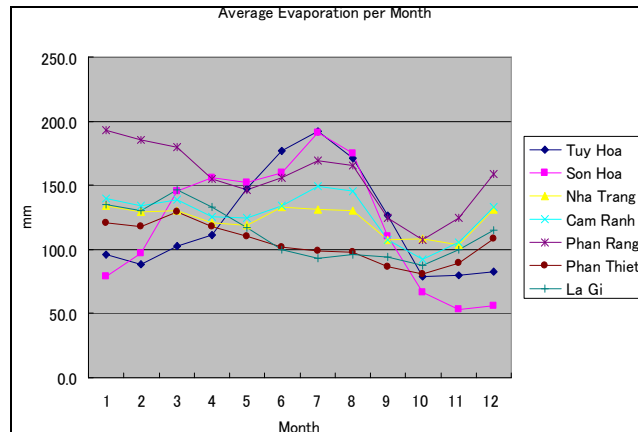


Figure 2.1.5 Monthly Average of Pan Evaporation

2.1.2 Hydrology (river discharges)

Monthly discharges of main four rivers in the study area are shown in Figure 2.1.7. The characteristics of each river discharges are as follows.

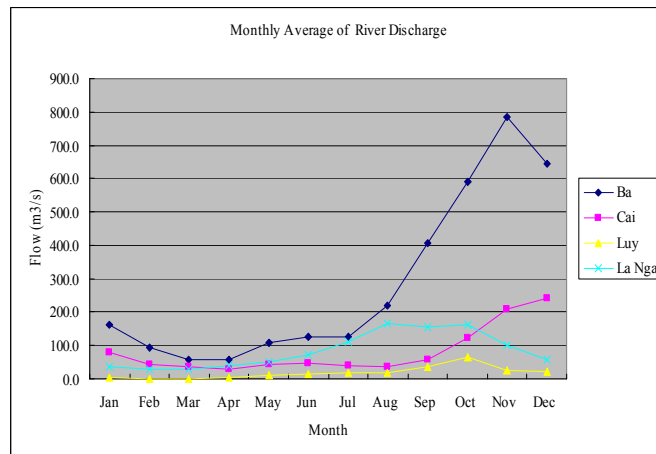


Figure 2.1.6 Monthly Average of River Discharges

(1) Ba river

The tendency of monthly river discharge change is well corresponding to monthly precipitation. The river discharge significantly increases during the rainy season. The monthly discharge shows the highest value of 784 m³/ sec in November and the lowest value of 57 to 59 m³/ sec from March to April.

(2) Cai river

The river discharge increases during the rainy season. The monthly discharge shows the highest value of 241 m³/ sec in December and the lowest value of 30 to 36 m³/sec from March to April.

(3) Luy river

The monthly discharge shows the highest value of 65 m³/ sec in October, and the lowest value of one to four m³/sec from January to April. It gradually increases from May toward October.

(4) La Nga river

The monthly discharge shows the highest value of 154 to 167 m³/ sec during August to October, and the lowest value of 27 m³/sec during February to March.

2.1.3 Geomorphology

Most of the study area is covered by the steep-sided mountainous area which makes up the edge of the Central Highland. The mountainous area runs from the north to the south along the western boundary of the study area, and a part of steep-sided mountains reaches to the coastline bounding the eastern end of the study area and each target province. The lowlands and hills surrounded by the steep-sided mountains occur in the confined areas along the coastlines and rivers. Reflecting these geomorphologic conditions, almost all rivers in the study area except the southern part of Phu Yen and Binh Thuan provinces have short length rivers, and their flood plains are not well developed.

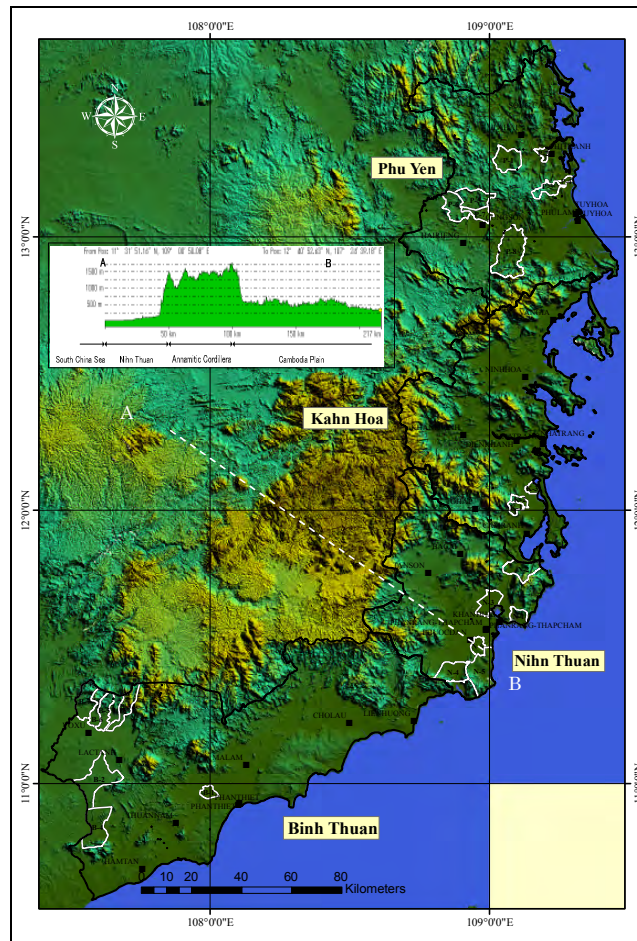


Figure 2.1.7 Geomorphology of the Study Area

2.1.4 Geology

The geology and its lithological classification in the study area are shown in Figure 2.1.9 and Table 2.1.1 respectively. Granitic rocks widely cover the study area, especially in Khanh Hoa and Ninh Thuan provinces. Sedimentary rocks are distributed among the plutonic rocks. Basaltic rocks are mainly distributed in Phu Yen province; however, their distribution in the other provinces are small-scaled and limited. Quaternary deposits are distributed widely near the mouth of large rivers, such as Da Rang River and Cai River. Most of all lineaments are distinguished in the units of the Permian, Triassic and Cretaceous plutonic rocks.

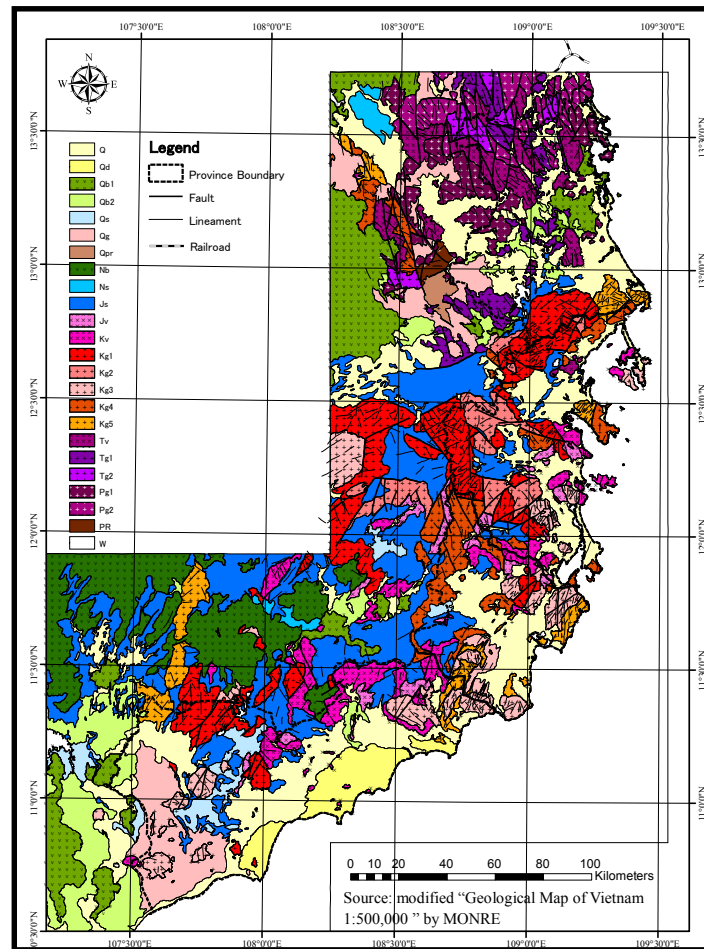


Figure 2.1.8 Geological Map in the Study Area

Table 2.1.1 Lithological Classification in the Study Area

Legend	Geological Time	Formation Name	Lithology
Q	Quaternary		Sand, gravel, silt, clay
Qd			Basalt
Qb1			
Qb2			
Qs			
Qg			Sand, gravel, silt, clay
Qpr			
Nb	Pliocene - Pleistocene Basalts		Tholeiitic basalt, plagiobasalt, basalt-dolerite, alkaline basalt
Ns	Paleogene	Kontum, Songba & Dilinh F.	Volcano sediments (siltstone, diatomite, bentonite, lignite, basaltic layer)
Js	E. - M. Jurassic	Bandon F.	Marine sediments (calcareous sandstone, siltstone, marl, siltstone)
Jv	L. Jurassic - Cretaceous	Baoloc F.	Volcano sediments (conglomerate, sandstone), andesite, dacite, tuff
Kv	L. Cretaceous	Donduong F.	Rhyolite, dacite, tuff, continental sediments
Kg1	L. Jurassic - E. Cretaceous	Ankroet - Dinhquan Complex	Quartz diorite, granodiorite, granite
Kg2			
Kg3			
Kg4			
Kg5			
Tv	E. - M. Triassic	Manggiang F.	Conglomerate, Sandstone, Siltstone, rhyolitic or dacite, tuff
Tg1	E. - M. Triassic	Vancahn Complex	Granite, granophyre
Tg2			
Pg1	L. Permian - E. Triassic	Bengiang - Queson Complex	Gabbro, diorite, granodiorite, granite
Pg2			
PR	E. Proterozoic	Dakmi F.	Gneiss, crystalline schist, marble, migmatite

*E:early, M:mid, L:late, F: formation,