

**The Kingdom of Cambodia
Ministry of Rural Development**

**The Kingdom of Cambodia
Data Collection Survey on
Rural Road Connectivity Improvement**

**Final Report
Summary**

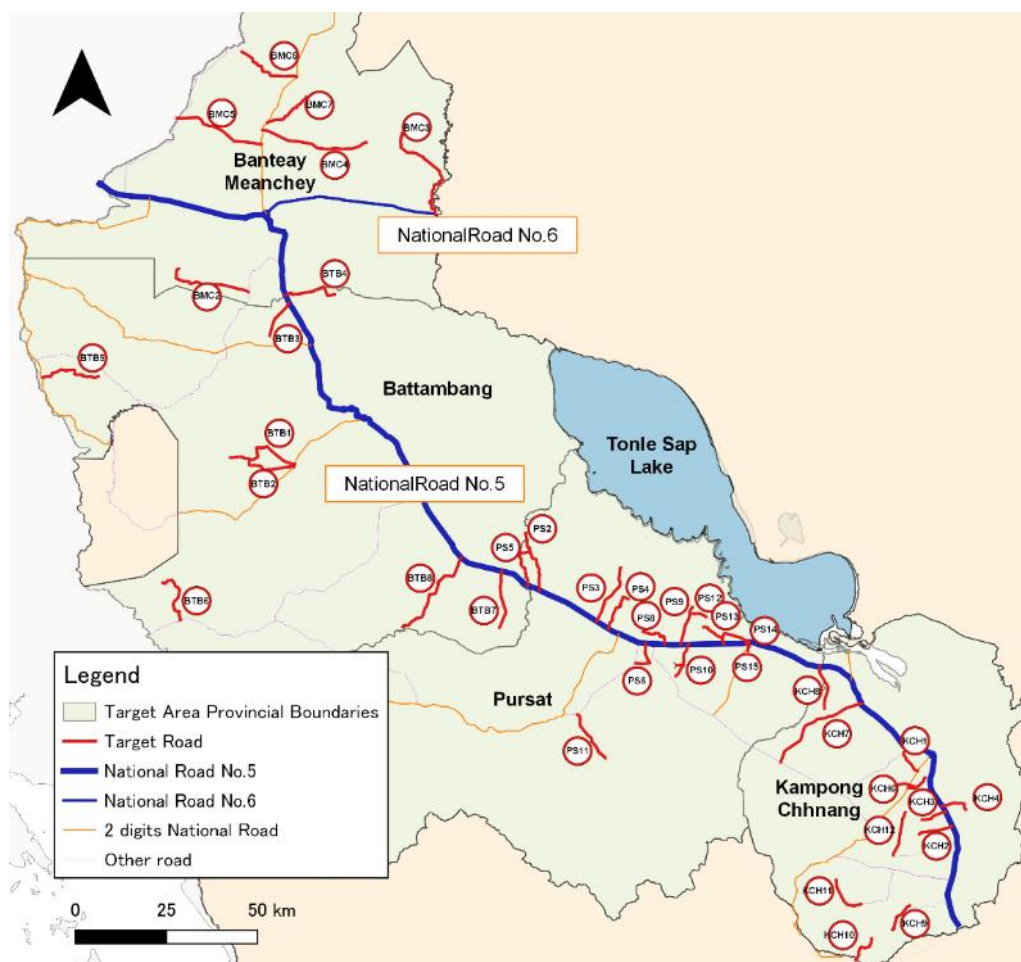
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Japan International Cooperation Agency (JICA)

**Katahira & Engineers International (KEI)
Oriental Consultants Global Co., Ltd. (OCG)
CTI Engineering International Co., Ltd. (CTII)**

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【Location Map of Target Area】



【Cambodia Information】

- Capital city: Phnom Penh
- Population: 1.55 million people
(General Population Census of Cambodia 2019)
- GDP per capita: 1,512\$
(World Data Bank 2020)

【Information on Target Roads】

- Total length: approx. 529.7 km, 38 routes in total
- KCH (Kampong Chhnang) : 11 routes
 - PS (Pursat) : 13 routes
 - BTB (Battambang) : 8 routes
 - BMC (Banteay Meanchey) : 6 routes

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Location Map of Target Area

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List of Abbreviations

Abbreviations	English
AADT	Annual average daily traffic
ACCESS	Australia-Cambodia Cooperation for Equitable Sustainable Services
ADB	Asian Development Bank
AH	Asia Highway Network
BCR	Benefit Cost Ratio
BMC	Banteay Meanchey
BTB	Battambang
CBR	California Bearing Ratio
CPA	Complementary Package of Activity
CPI	Consumer Price Index
DBST	Double Bituminous Surface Treatment
DPWH	Department of Public Works and Highways
DP	Development Partner
DRR	Department of Rural Roads
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ESMS	Environmental and Social Management System
EMC	Environmental Management Contract
EMP	Environmental Management Plan
GDP	Gross Domestic Product
GMAG	Gender Mainstreaming Action Group
GMAP	Gender Mainstreaming Action Plan
GOC	Government of Cambodia
GRDP	Gross Regional Domestic Product
HV	Heavy Vehicle
IBA	Important Bird and Biodiversity Area
ICB	International Competitive Bidding
IEE	Initial Environment Examination
IEIA	Initial Environmental Impact Assessment
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency
JICA GL	JICA Guideline
KBA	Key Biodiversity Area
KCH	Kampong Chhnang
KOICA	Korea International Cooperation Agency
LBT	Labor Based Technology
LV	Light Vehicle
NDC	Nationally Determined Contributions
MC	Motor Cycle
MEF	Ministry of Economic and Finance
MoE	Ministry of Environment
MoWA	Ministry of Women's Affairs
MOWRAM	Ministry of Water Resources and Meteorology
NCB	National Competitive Bidding
MPWT	Ministry of Public Works and Transport

Abbreviations	English
MRD	Ministry of Rural Development
NCDM	National Committee for Disaster Management
NMT	Non-Motored Transport
NR	National Road
NSDP	National Strategic Development Plan
NPV	Net Present Value
OCB	Open Competitive Bidding
OPBRC	Output Performance-Based Road Contract
PCE	Passenger Car Equivalent
PCU	Passenger Car Unit
PDRD	Provincial Department of Rural Development
PMU	Project Management Unit
PS	Pursat
R.O.W	Right of Way
RAP	Resettlement Action Plan
RRIP	Rural Road Improvement Project
RRMP	Rural Road Master Plan
RS3	Rectangular Strategy Phase 3
RS4	Rectangular Strategy Phase 4
SBST	Single Bitumen Surface Treatment
SCF	Standard Conversion Factor
SOP	Standard Operating Procedures
TTC	Travel Time Cost
USDA	United States Department of Agriculture
VOC	Vehicle Operation Cost
WB	World Bank
WFP	United Nations World Food Programme

SUMMARY

CHAPTER 1 INTRODUCTION

1.1 Background of Survey

In the Kingdom of Cambodia (Cambodia), road transport plays the main role for domestic transport. The country's road network consists of a total of 64,211 km, of which 7,261 km correspond to national roads, 9,031 km to provincial roads, and 47,919 km to rural roads (as of August 2022; source: Ministry of Rural Development [MRD]). Among the rural road network, the percentage of paved roads remains at a low level of about 9%. This results in poor visibility due to dust during the dry season and disruption due to heavy rains and flooding during the rainy season, adversely impacting the lives of residents and logistics of the affected areas.

Under such situation, the Government of Cambodia (GOC) has set "Inclusive and Sustainable Development" as one of the policy areas in its "Rectangular Strategy-Phase 4" of the National Strategic Development Plan (2019-2023). Additionally, GOC has decided to continue efforts within the scope of rural development, which includes the improvement of rural roads. In particular, MRD has developed a master plan for rural roads in cooperation with the Asian Development Bank's (ADB) Rural Roads Improvement Project III (approved in 2022).

In the road sector of Cambodia, JICA has been cooperating in the rehabilitation and widening of National Road No.5 (NR5). However, due to inadequate maintenance of rural roads along the route, GOC expects to improve rural roads in four provinces (Kampong Chhnang [KCH], Pursat [PS], Battambang [BTB], and Banteay Meanchey [BMC]) in order to further increase the benefits of NR5, improve living conditions along the route (access to public facilities, services, markets, etc.), and stimulate the local economy.

This study is expected to have a synergistic effect with Japan's cooperation so far by improving rural roads in the four provinces mentioned above, reaffirming the connectivity of the road network, confirming the need to improve the living environment of residents along the road, as well as collecting and studying basic information for the consideration of cooperative approaches that can contribute to the stable socioeconomic development of the region.

1.2 Purpose of Survey

The purpose of this survey is to establish an effective and efficient road network and to improve the living conditions of residents along the road in the target area. The project team will prepare top-level plans and collect information regarding the status of road operation, maintenance, and other related systems. Furthermore, details regarding the current status and issues of similar projects implemented by other donors will be collected. An outline will be prepared for a financial assistance project that includes the prioritization of candidate routes, technical support for rural road development, operation and maintenance plans, as well as the consideration of traffic safety for rural roads in the target area.

1.3 Surveyed Area

The target area covers the four Cambodian provinces that National Highway 5 crosses (i.e., Kampong Chhnang, Pursat, Battambang, and Banteay Meanchey provinces). The region is located on the West side of Tonle Sap Lake, between the capital Phnom Penh and Thailand.

CHAPTER 2 OVERVIEW OF THE RURAL ROAD SECTOR

2.1 Overview of Countries and Regions Covered

2.1.1 Development Policy

The Rectangular Strategy-Phase IV was developed in September 2018 to ensure sustainable growth, job creation and social equity, and to strengthen the governance of government institutions in Cambodia. In this policy, rural areas are recognized to have achieved remarkable development. However, many challenges still remain, including the need to maintain and improve the quality of rural roads. Therefore, it is described that the agricultural sector will be developed by continuing to improve rural roads in The Rectangular Strategy-Phase IV.

In order to realize the development described in The Rectangular Strategy-Phase IV, “National Strategic Development Plan 2019-2023”, “Rural Development Policy 2019-2023”, “Rural Development Policy 2019-2023”, and “Rural Development Strategy, Action Plan 2019-2023” were developed. MRD undertake the following activities to improve the quality and resilience of the rural road infrastructure network in accordance with these plans.

- Road maintenance and rehabilitation
- Improvement of rural roads using criteria related to toughness
- Rural listing and mapping
- Building a new road network
- Maintenance of rural roads by PDRD or other alternatives

In addition, MRD developed a master plan for rural roads and defined selection criteria for prioritizing rural roads. A total of 1,370 roads with a total length of 13,791 km have been surveyed and prioritized according to the established procedure.

2.1.2 Natural Conditions

Cambodia is in the tropical monsoon climate zone, with high temperatures from 25°C to 27°C throughout the year and seasons divided into wet and dry periods. During the rainy season from May to October, Southwestern winds account for 80% to 90% of the annual precipitation. In the target provinces, PS reported the highest average annual precipitation of around 2,500 mm, while BMC reported the lowest precipitation of around 1,300 mm to 1,500 mm.

Cambodia's major natural disasters are floods, droughts, and storms. From these major natural disasters, the scale of damage is larger during floods. Floods often occur along the Mekong River and Tonle Sap Lake. Every year, from early to late June, a phenomenon occurs where the water level at the downstream exceeds the water level at Tonle Sap Lake. This continues until around September due to the backflow phenomenon of the Mekong River flowing into Tonle Sap Lake, causing floods in flood-prone areas due to rising water levels.

Additionally, in mountainous areas such as the Kravan Mountains in Battambang and Pursat provinces, torrential rains cause landslides and debris flows during the rainy season.

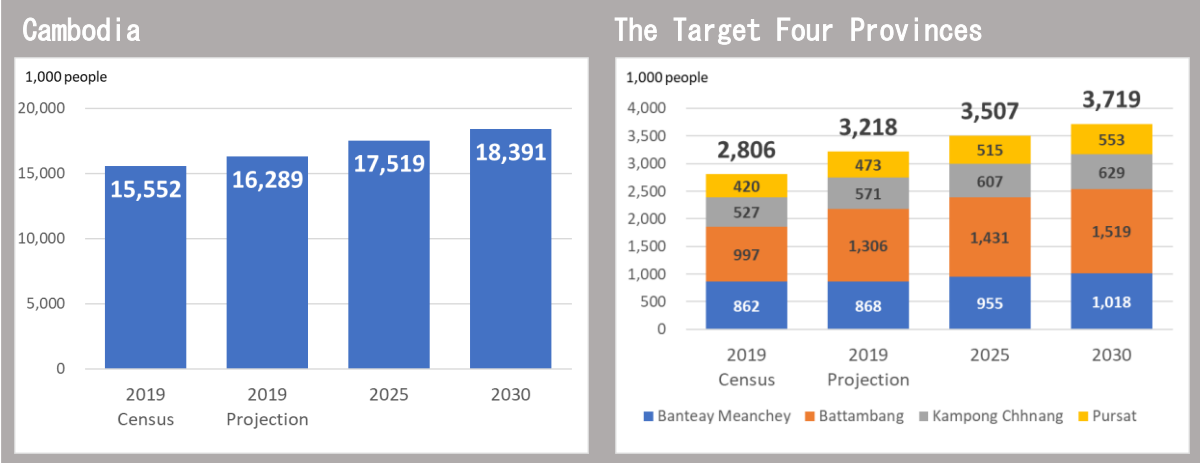
Cambodia's topography can be divided into 3 distinct regions – the Central Plain, flat coastal areas, and mountain ranges with plateaus. The Central Plain forms 75% of the country and consists of the Mekong River and the alluvial plains of the Tonle Sap Basin. Most of the target area is in the central plain, and is one of Cambodia's representative breadbasket areas, having gained fertile soil from repeated flooding; many rice fields and lotus ponds can be found in the area. Due to the topography, some sections of target roads have a steep gradient.

Most of the target roads have laterite surface, and it is common to compact the existing laterite and use it as a subgrade.

2.1.3 Social Conditions

Cambodia's population in 2019 was approximately 15.55 million. It has been growing at a nearly constant rate (The average annual growth rate: 1.5%) since 1998. The four target provinces are home to 2.81 million people, or about 18% of Cambodia's population. The total population of the four target provinces in 2019 increased about 1.1 times, compared to 2008.

According to Population Projections for 2008-2030, Cambodia's future population will be 18.39 million in 2030. The average annual population growth rate is projected to be about 1.2% from 2019 to 2025 and 1.0% from 2026 to 2030, with the rate of growth decreasing each year. The future population of the four target provinces is projected to be 3.72 million in 2030. The average annual population growth rate is projected to be about 1.5% from 2019 to 2025 and about 1.2% from 2026 to 2030, with the population growing faster than Cambodia as a whole.



Source: General Population Census 1998, 2008, 2019, Population Projections for Cambodia 2008-2030

Figure 1 Future Population Projection in Cambodia and the Target Area

In terms of Cambodian industry, the share of agricultural workers has been declining in recent years nationwide. In 2019, the share of agricultural workers was 35.5%, down more than 20% from a decade ago. However, agriculture is still the main industry in the rural areas, as more than half of the workers are engaged in the primary industry. The target area benefits from the vast plains and fertile lands of Tonle Sap Lake, and is a prosperous agricultural area, especially in rice, corn, and cassava production.

Household incomes in the capital, urban, and rural areas in Cambodia are rising; however, comparing the capital (Phnom Penh) to the rural areas, the income disparity is about twice as large.

2.2 Current Status and Challenges of the Rural Road Sector

Roads in Cambodia are classified into three categories: national roads (one-digit and two-digit national roads), provincial roads (three and four-digit national roads), and rural roads. The total road length of national and provincial roads in Cambodia is 16,292 km, of which 7,261 km are national roads (2,254 km of one-digit national roads and 5,007 km of two-digit national roads) and 9,031 km are provincial roads. The pavement rate of one-digit national roads is 100%, two-digit national roads 72%, and provincial roads 30%, indicating that the pavement rate of provincial roads is still low.

Under this context, Japan is committed to supporting the rehabilitation of NR5 (e.g., widening from two to four lanes) with JICA providing a yen loan in May 2013 for the rehabilitation of an 83.5-km section from Sisophon to Battambang, near the Thai border. Since then, JICA has also provided a yen loan for a 368-km section of NR5 from Poipet to Prek Kdam on the Thai border. Currently, the project covers

The Rural Roads Master Plan, which was created for the purpose of prioritizing the development of rural roads, classifies roads into four road hierarchies, ranging from Type 1 through Type 4, with a total length of 46,834 km. The overall paved ratio of rural roads is low, remaining at around 9%.

In relation to road length, Table 1 shows the road length by road classification: the average road length per route for Type 1 is about 14 km, but the average road length per route tends to get shorter as the road hierarchy gets lower. In this aspect, MRD plans to pave a total of 6,000 km of rural roads, increasing the pavement ratio from 9% to 13% by 2030.

Table 1 Description of Road Hierarchy Classification and Extension Distance

Road Hierarchy	Description of Road Hierarchy	No. of Road	Km	Km/Road
Type 1	Roads connecting national roads, provincial roads, local cities, and provinces	550	7,705	14.01
Type 2	Roads connecting local cities or provinces with communes	796	6,913	8.68
Type 3	Roads connecting communes	2,523	12,445	4.93
Type 4	Roads connecting communes to villages and villages to villages	12,392	19,771	1.6
Total		16,261	46,834	2.88

Source: RRMP

According to the Cambodian Road Registry data, there are a total of 12,220 km of rural roads in the four target provinces, with about 1/4 of all Cambodian rural roads concentrated in the target provinces. Of these, 1,470 km (12%) are paved, which is higher than the 9% pavement rate for Cambodia as a whole, but still low considering the total length of roads. Battambang Province has approximately 5,500 km of rural roads, more than twice the length than that of Kampong Chhnang and Pursat Provinces. On the other hand, there is no large difference in the pavement rate among the provinces.

The table below shows the road extensions by road hierarchy listed in the Rural Road Master Plan (RRMP) for the four target provinces, with only Banteay Meanchey province having Type 3 and Type 4 roads listed as candidates. Furthermore, Battambang province has a longer Type 1 road extension of 884 km than the other provinces and Kampong Chhnang province has a shorter Type 2 road extension of 90.9 km.

Table 2 Road Extensions by Road Hierarchy listed in RRMP in the Four Target Provinces

Target Province	Type 1	Type 2	Type 3	Type 4	Total
	(km)	(km)	(km)	(km)	(km)
Kampong Chhnang	90.9	170.9	0	0	261.8
Pursat	564.6	442.0	0	0	1,006.6
Battambang	884.0	530.7	0	0	1,414.7
Banteay Meanchey	239.7	251.7	100.6	33.3	625.3

Source: Based on RRMP

2.3 Support from Japan and Other Donors and Possibility of Cooperation with Other Donors

The National Road Network Study for one-digit national roads, two-digit national roads, and provincial roads, The Project for Strengthening Capacity for Maintenance of Roads and Bridges, The Project for Capacity Enhancement on Environmental and Social Considerations in Implementing Agency in Road Sector, and Project for Improvement of Road Traffic Safety on Trunk Road, etc. were conducted by JICA. Furthermore, JICA conduct NR5 improvement as a yen loan project.

Many projects of other donors have been implemented in the target area since 2011. Most of the other donors' projects are mainly along NR5, but all target roads do not overlapped with them. About half of target roads connect or cross with the rural roads funded by other donors. The target roads which cross with the rural roads funded by other donors will create synergetic effects with them. In order to improve the road network in the target area more effectively and efficiently, it is necessary to consider prioritization in consideration of the connectivity of the target roads with other donor's projects.

In addition, when the target roads intersect with the rural roads funded by other donors, risk of serious traffic accidents increase, because the speed of vehicles entering the intersection become higher. Therefore, it is necessary to work with other donors to study safety measures for the intersection.

CHAPTER 3 DETAILS OF TARGET ROADS

3.1 Overview of Target Roads

Out of the 31 roads (approx. 531.4 km) proposed by MRD as target roads, roads that overlap with other donors' projects and roads that are classified as Category A in the JICA Guidelines for Environmental and Social Considerations (January 2022) were removed. After this initial elimination, additional roads proposed by MRD were considered, resulting in the JICA Survey Team determining 38 target roads through discussions with MRD.

A road condition survey, a road structure survey, and a traffic count survey, were conducted in order to understand the characteristic of each target road. The survey results were used to prioritize road design and sub-projects, as well as quantitative effectiveness indicators.

Table 3 Outline of the Survey

Ref	Rural Road	Road Type	Existing Condition							Remarks	
			Carriage way width (m)	Surface type	Road condition	Bridge		Culvert			
						Concrete or Steel	Wood	BOX L≥8m	BOX L<8m	PIPE	
KCH-1	Srang Kpuos-Kol Kup	T1	10.0	Laterite	Good	0	0	0	0	6	Pagoda Gate Heavy truck traffic. Stone pit.
KCH-2	Kosomak-O'loy	T2	5.0	Laterite	Poor	0	0	0	0	10	2 Residential land development 1 Mosqu
KCH-3	NR5-Dammak Kei	T2	5.0	Laterite	Good	0	2	0	0	12	2 Wooden Bridges. Improve horizontal alignment
KCH-4	NR5-Prek Sala	T2	5.0	Laterite	Good	1	0	0	0	9	Lotus ponds in WFR projects. Residential land development
KCH-6	Phum Thmey-Trapaing Kravan	T3	5.0	Laterite	Good	1	0	0	4	17	Pagoda Gate Flooded 20cm. Improve horizontal alignment
KCH-7	Phsar Kdol Senchey	T1	8.0	Laterite	Poor	0	0	8	0	4	install side ditch
KCH-8	Trapaing Chan-Teuk Chreaop	T2	8.0	Laterite	Good	2	0	0	0	12	install side ditch
KCH-9	Meanok-Trapaing Mtes	T2	5.0	Laterite	Poor	1	0	0	0	11	Railway. 2 Residential lands development
KCH-10	Chrokhrout-Chrok Sdaeh	T2	5.0	Laterite	Poor	2	0	0	0	11	install side ditch. Flooded 20cm
KCH-11	Srae Sar- Ksach Sor	T2	6.0	Laterite	Good	0	0	0	0	13	install side ditch. improve vertical alignment Amusement park
KCH-12	Tbeng Kpous-Ronak	T2	5.0	Laterite	Very Poor	3	0	0	1	26	Removal of existing DBST
Subtotal						10	2	8	5	131	
PS-2	O'Tapomg-Phum Tanai	T1	5.0	Laterite	Poor	0	2	0	3	22	1 Wooden Bridge Flooded 50cm-1m
PS-3	Plov Andongkrasaing-Tram Pae	T1	5.0	Laterite	Good	0	1	0	0	26	1 Wooden Bridge Flooded 30cm-40cm
PS-4	Phnov-Phleah Pring	T1	5.0	Laterite	Poor	0	1	0	5	24	1 Wooden Bridge Flooded 50cm Improve horizontal alignment
PS-5	Plov Phum Svay Daun Keo-Chrop-Phum Sior Klouk	T1	5.0	Laterite	Very Poor	0	5	0	1	43	Pagoda Gate. 2 Wooden Bridges
PS-6	Plov Wat Toul Veng	T1	5.0	Laterite	Good	2	0	0	1	28	Pagoda Gate. Railway Flooded 20cm-30cm
PS-8	Rolus	T1	6.0	Laterite	Good	1	0	3	1	14	Pagoda Gate. 1 Spilway. Canal on both sides.
PS-9	Tbaeng Chrum-Raa Toteng Thngai	T1	8.0	Laterite	Good	2	0	5	0	3	Flooded 30cm Lots of Spilway and Box Culvert.
PS-10	Son Trae-Chher Tum	T1	6.0	Laterite	Good	0	0	0	6	15	Flooded. Canal on both side
PS-11	ToulCha- Keo Mony	T1	6.0	Laterite	Poor	1	3	0	1	15	1 Wooden Bridge Flooded 10cm-50cm install side ditch
PS-12	Kanchhor-Kampong Pou	T2	5.0	Laterite	Good	2	1	0	1	8	Pagoda Gate 2 Wooden Bridges Flooded
PS-13	Ou Sandan- Sna Ansa	T1	5.0	Laterite	Good	0	0	0	7	18	Flooded 20cm
PS-14	Sna Ansa-Anlong Tnaot	T1	5.0	Laterite	Poor	2	2	2	0	14	2 Wooden Bridges Flooded 50cm
PS-16	Anlong Tnaot	T2	5.0	Laterite	Good	0	0	0	0	8	Pagoda Gate
Subtotal						10	15	10	26	236	
BTB-1	NR57-Phum Boeung Krar Sal	T2	5.0	Laterite	Good	3	0	0	1	23	Flooded 1m install side ditch
BTB-2	Sneung NR57-Beoung Praey	T2	6.0	Laterite	Poor	0	0	0	4	23	Pagoda Gate Flooded 50cm
BTB-3	NR5 Phum Beoung Prieng-Wat Rong Chrey	T2	6.0	Laterite	Very Poor	0	0	0	0	14	River side Railway Flooded 50cm
BTB-4	NR5 (Phasar O'Nhor)-Phum Poa Ta Sek	T3	6.0	Laterite	Very Poor	0	0	0	0	15	Pagoda Gate Irrigation Canal Flooded 50cm
BTB-6	Plov 1577 Phum O'Chrab-O'Bok Pael (Phum Sam Loat)	T1	6.0	Laterite	Poor	0	2	0	1	9	Improve horizontal alignment
BTB-7	NR5 Rar Cham Heang-Khum Muk Rar	T1	4.0	Laterite	Very Poor	3	0	1	0	45	1 Wooden Bridge improve horizontal and vertical alignment
BTB-8	NR5 O'kreat-Ba Sak	T1	6.0	Laterite	Poor	2	1	0	2	31	Flooded by poor drainage
BTB-9	NR59-Phum O' Teuk tla	T3	6.0	Laterite	Poor	5	0	1	0	18	Flooded 10cm-50cm Heavy motorbike traffic Construction of road structures
Subtotal						13	3	2	8	178	
BMC-2	Plov Balang Chrey	T2	5.5	Laterite	Poor	1	0	0	1	29	Spilway Irrigation Cnal Flooded 20cm-1m install crossing pipe
BMC-3	Spean Sraeng	T1	5.0	Laterite	Good	10	0	0	8	32	install side ditch and crossing pipe
BMC-4	Ta Phou	T1	5.0	Laterite	Good	1	0	0	7	36	Flooded 50cm install crossing pipe
BMC-5	Plov Tae Hang	T1	6.0	Laterite	Poor	1	0	0	0	7	Construction of watter gate
BMC-6	Plov Sre Lor	T2	5.0	Laterite	Very Poor	0	0	0	7	24	Flooded 20cm-1m There are damaged DBST sections.
BMC-7	Rolus-Phum Tmey	T2	6.0	Laterite	Poor	0	0	0	4	35	Pagoda Gate Flooded 50cm There are damaged DBST sections. Install side ditch and crossing pipe
Subtotal						13	0	0	27	183	
Total						46	20	20	66	708	

Source: JICA Survey Team

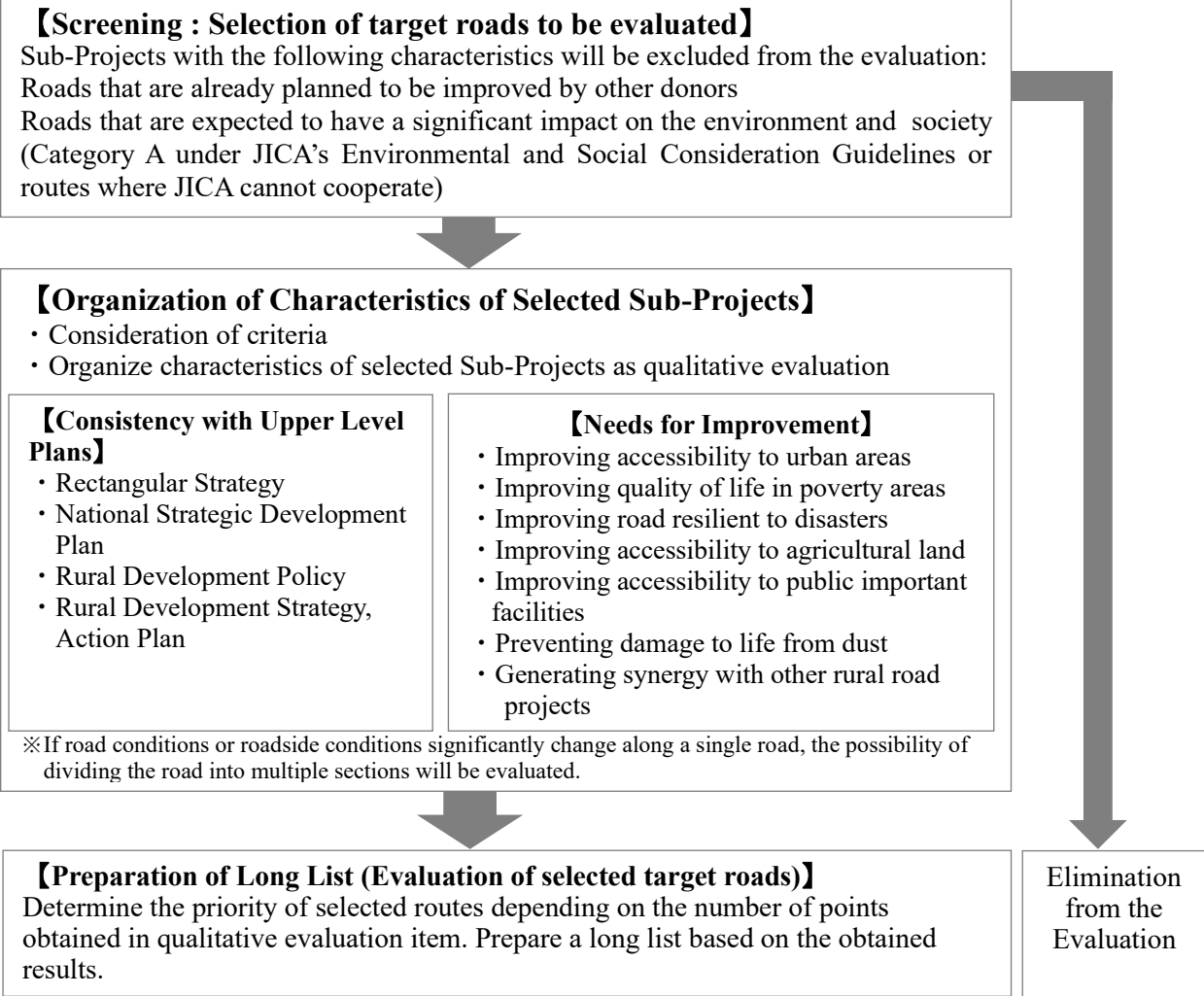
3.2. Consideration of Priority of Sub-Projects

The prioritization process of sub-projects is considered referencing the one for RRMP.

In Accordance with the screening, BMC1, which is likely to be within the Key Biodiversity Area (KBA), was excluded from the sub-projects after discussion with MRD. One of the requirements for sensitive areas is “critical habitats and critical forests.” The other sub-projects in close proximity to protected areas (BTB6, KCH8) are evaluated as not falling under this category

In terms of the criteria, JICA Survey Team considered the two perspectives, such as “Consideration of criteria to evaluate the degree to which the road contributes to the realization of the future regional image envisioned by at the national and rural level.”, “Consideration of criteria to evaluate how much they contribute to solving problems faced by rural areas and rural roads.” In order to quantitatively organize the characteristics of the rural roads. Then Eight (8) criteria are selected for the prioritization: ① Future traffic demand (PCU/day), ② Travel time to one-digit national roads, ③ Poverty rate (%), ④ Flood length/km, ⑤ Agricultural land area/km, ⑥ Total number of public important facilities (schools, hospitals, pagodas, markets)/km, ⑦ Number of population served/km, and ⑧ Number of road connection with other rural roads projects.

JICA Survey Team used adjusted standard deviation score for each criteria. Then, by using the result of the questionnaire for weight of criteria to MRD and Provincial Department of Rural Development (PDRD), the score of each target roads reflected weight was calculated.



Source: JICA Survey Team

Figure 2 Consideration of Priority Levels of Sub-Projects

The longlist for target road is shown below.

Table 4 Longlist


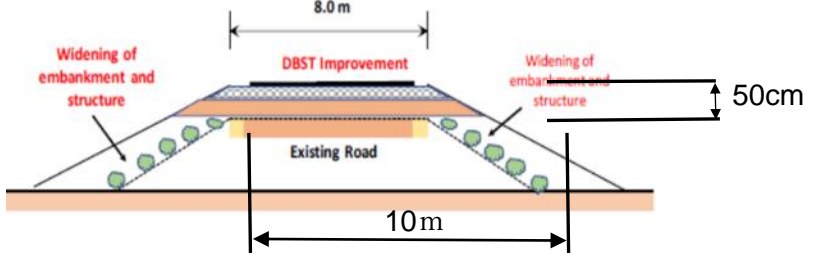

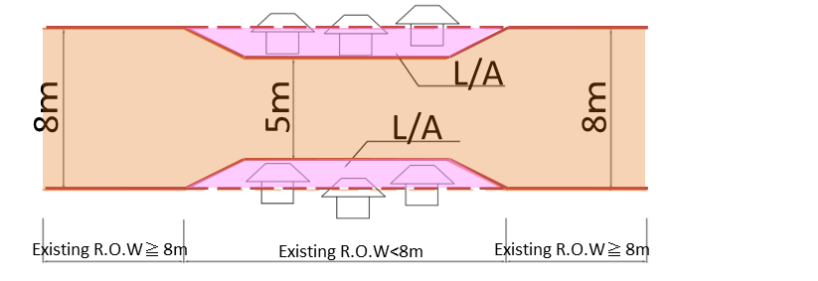

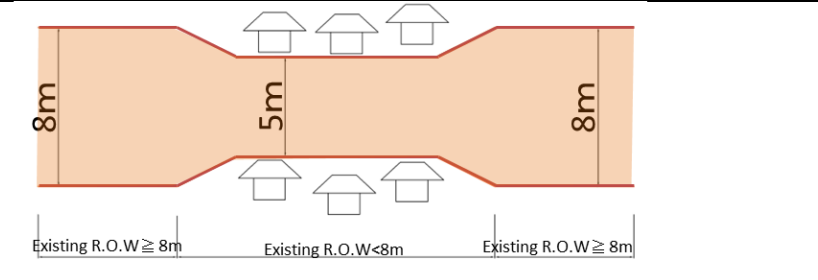
Rank	Target Roads	Provinces	Districts	Rural Road	Existing Condition			Improvement Length by Type (km)				
					Road Length	Carriage way width (m)	R. O. W	Typical (8m)	Alt-1(8m)		Alt-2 (5m)	Total
					(km)	(m)	(m)		Residential land	Cropland		
1	BTB-8	BTB	Moung Russei	NR5 O'Kreat-Ba Sak	18.0	6.0	11.5-13.0	18.0	0.0	0.0	0.0	18.0
2	PS-11	PS	Kandieng	ToulCha- Keo Morry	15.0	6.0	17	11.0	1.0	3.0	0.0	15.0
3	PS-2	PS	Bakan	O'Tapong-Phum Tanai	18.2	5.0	6.0-13.5	6.8	1.2	8.2	2.0	18.2
4	PS-14	PS	Krakor	Sna Ansa-Anlong Tnaot	10.3	5.0	9.5-10.0	10.3	0.0	0.0	0.0	10.3
5	PS-3	PS	Bakan	Plov Andongkra saing-Tram Pae	17.6	5.0	8.0-19.0	12.0	0.0	5.1	0.5	17.6
6	PS-5	PS	Bakan	Plov Phum Svay Daun Keo-Chrop-PhumSlor Klouk	12.9	5.0	6.5-10.0	0.0	2.5	10.4	0.0	12.9
7	PS-4	PS	Bakan	Phnov-Piteah Pring	12.2	5.0	8.0-17.0	0.0	10.5	1.2	0.5	12.2
8	KCH-7	KCH	Bonbo	Phsar-Kdol Senchey	27.5	8.0	15	27.5	0.0	0.0	0.0	27.5
9	BMC-2	BMC	Mongkol Borei	Plov Balang Chrey	24.1	5.5	15	19.5	2.0	2.6	0.0	24.1
10	BMC-3	BMC	Phnum Srok	Spean Sraeng	24.0	5.0	10.0-11.0	6.0	0.0	11.0	7.0	24.0
11	KCH-10	KCH	Samaki Meanchey	Chroktfnout-Chrok Sdach	8.9	5.0	7.0-13.0	8.0	0.9	0.0	0.0	8.9
12	PS-12	PS	Krakor	Kanchhor-Kampong Pou	5.0	5.0	7.5-14.5	3.4	0.5	1.0	0.1	5.0
13	BTB-6	BTB	Samlaut	Plov 1577 Phum O'Chrab-O'BoK Paal (Phum Sam Loat)	17.0	6.0	15.5	13.8	0.0	3.2	0.0	17.0
14	PS-13	PS	Krakor	Ou Sandan- Sna Ansa	6.5	5.0	5.5-9.0	0.0	6.0	0.0	0.5	6.5
15	PS-15	PS	Krakor	Anlong Tnaot	3.9	5.0	5.0-7.0	0.0	2.7	0.0	1.2	3.9
16	PS-10	PS	Phnum Kravanh	Son Trae-Chher Tum	11.8	6.0	6.0-14.0	4.0	2.0	5.0	0.8	11.8
17	BTB-1	BTB	Thmar Kaul	NR57-Phum Boeung Krar Sal	15.0	5.0	12.5-17.5	15.0	0.0	0.0	0.0	15.0
18	BMC-6	BMC	Tmar Puok	Plov Sre L'or	18.6	5.0	10.0-19.0	11.4	0.0	6.9	0.3	18.6
19	KCH-4	KCH	Rolea B'ier	NR5-Prek Sala	8.2	5.0	8.5-14.0	5.3	1.1	1.8	0.0	8.2
20	BTB-2	BTB	Thmar Kaul	Sneung NR57-Beoung Praey	18.2	6.0	15	5.8	0.0	12.4	0.0	18.2
21	BTB-9	BTB	Kamrieng	NR59-Phum O' Teuk tla	18.2	6.0	15.0-18.0	18.2	0.0	0.0	0.0	18.2
22	BTB-4	BTB	Thmar Kaul	NR5 (Phasar O'Nhor)-Phum Poa Ta Sek	16.1	6.0	8.0-14.0	0.0	4.0	12.1	0.0	16.1
23	KCH-1	KCH	Rolea B'ier	Srang Kpuos-Kol Kup	4.3	10.0	27	4.3	0.0	0.0	0.0	4.3
24	BMC-5	BMC	Svay Chek	Plov Tae Hang	25.0	6.0	10	0.0	0.0	25.0	0.0	25.0
25	KCH-12	KCH	Teuk Phos	Tbeng Kpous-Ronak	12.4	5.0	10.5-21.5	12.4	0.0	0.0	0.0	12.4
26	PS-8	PS	Krakor	Rolus	8.8	6.0	10.0-12.0	8.8	0.0	0.0	0.0	8.8
27	PS-6	PS	Krong Pursat	Plov Wat Toul Veng	9.7	5.0	9	9.7	0.0	0.0	0.0	9.7
28	KCH-3	KCH	Rolea B'ier	NR5-Damnak Kei	7.1	5.0	14.5	3.8	0.0	3.3	0.0	7.1
29	PS-9	PS	Krakor	Tbaeng Chrum-Raa Toteng Thngai	11.2	8.0	11.0-20.0	11.2	0.0	0.0	0.0	11.2
30	KCH-8	KCH	Bonbo	Trapaing Chan-Teuk Chreaop	12.2	8.0	18	12.2	0.0	0.0	0.0	12.2
31	BMC-7	BMC	Svay Chek, Tmar Puok	Rolus-Phum Tmey	14.1	6.0	7.0-13.0	4.5	0.6	9.0	0.0	14.1
32	KCH-9	KCH	Samaki Meanchey	Meanok-Trapaing Mites	8.8	5.0	17	8.8	0.0	0.0	0.0	8.8
33	BMC-4	BMC	Phnum Srok	Ta Phou	29.0	5.0	11.5-15.5	29.0	0.0	0.0	0.0	29.0
34	BTB-3	BTB	Thmar Kaul	NR5 Phum Beoung Prieng-Wat Roung Chrey	10.6	6.0	8.0-10.0	0.0	0.0	10.1	0.5	10.6
35	KCH-6	KCH	Rolea B'ier	Phum Thmey-Trapaing Kravan	11.3	5.0	7.5-10.0	9.9	0.1	1.3	0.0	11.3
36	BTB-7	BTB	Moung Russei	NR5 Rar Cham Heang-Khum Muk Rar	16.2	4.0	10.0-13.0	16.2	0.0	0.0	0.0	16.2
37	KCH-11	KCH	Samaki Meanchey	Srae Sar- Ksach Sor	12.7	6.0	15.0-20.0	12.7	0.0	0.0	0.0	12.7
38	KCH-2	KCH	Rolea B'ier	Kosomak-O'LoY	9.1	5.0	8.5-17.0	8.6	0.5	0.0	0.0	9.1

Source: JICA Survey Team

3.3. Study of Road Improvement Plan

Road improvement specifications were adopted in consideration of, the “Rural Road Standards” (MRD), Rural Road Master Plan, and past Rural Road Improvement Plan III (RRIP III) results. Road improvement classifications were determined by whether it was easy to acquire land for the road or not.

Table 5 Improvement Classification

Improvement Classification	Photo of Existing Road	Image
<p>Typical Improve the road with the width of the typical cross-sections (8.0 m). A new roadbed of 6.0 m and Double Bituminous Surface Treatment (DBST) pavement will be laid over the existing road. The shoulders are 1.0 m in length, of which 0.5 m is to be paved with SBST¹ (on both sides). The road will be raised by 50 cm, and the land will need 10 m between embankment slopes on the flat area.</p>		
<p>Altanative-1 Acquire a site and improve it with the width of the typical cross-sections (8.0 m). This is an improvement classification where the existing road width is less than 8.0 m, and the roadside is wooden fences of houses, cropland, etc.; where it is easy to acquire land for the improvement.</p>		
<p>Altanative-2 Improvement by width that can be constructed. This is an improvement classification where the existing road width is less than 8.0 m and the roadside is adjacent to buildings, concrete walls, rice fields or canal, and it is difficult to acquire land for the improvement.</p>		

Source: JICA Survey Team


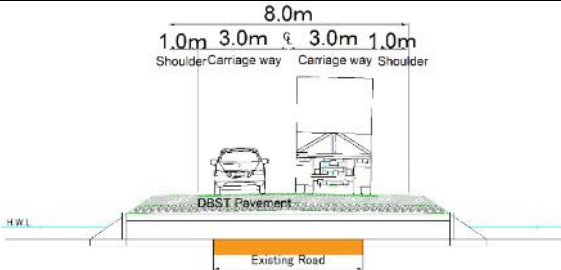
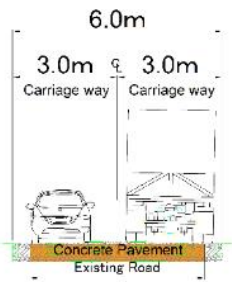
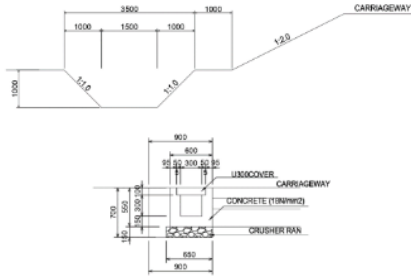
¹ Single Bituminous Surface Treatment : SBST

In areas that have flooded in the past, field interviews survey and other surveys revealed that they flood every year.

If the road is improved following the typical cross-section, the road will be raised approximately 50 cm above the existing road surface, so that the road surface will be higher than the flood level in areas where the flood level is less than 50 cm.

In areas where flood levels of 50 cm or more, the following improvement policies were adopted to avoid pavement damage due to flooding of the road surface. For the inundation area of Tonle Sap Lake, a flood level MSL+10.0 m is used as reference.

Table 6 Improvement Policy for Flooded Areas

Classification by Flooded Level	Improvement Image
<p>Flooded level is less than 0.5 m: Construct a new sub-base on top of the existing road with a typical cross-section (raised approximately 50 cm).</p>	
<p>Flooded level is between 0.5 m to 1.5 m: Construct crossing pipe culverts on the ground (raised approximately 150 cm, with one crossing pipe every 500 m).</p>	
<p>Flooded level is 1.5 m or more: The pavement shall be concrete pavement that can withstand overflow without being raised.</p>	
<p>The ditch structure in the flooded area: • Typical or Alt-1 section is earthen ditch • New U-ditch with cover will be installed on both sides of the road in the Alt-2 section</p>	

Source: JICA Survey Team

In terms of the cost estimation of this project, base costs of the construction, procurement, land acquisition costs are quoted by the JICA Survey Team. The consultant fee, physical contingency, and price contingency are calculated through JICA Cost Kit. The project cost shown below is posted from JICA's Cost Kit.

Table 7 Project Cost (Confidential)

Following table shows the project implementation schedule.

Table 8 Project Implementation Schedule (Confidential)

3.4 Procurement Plan

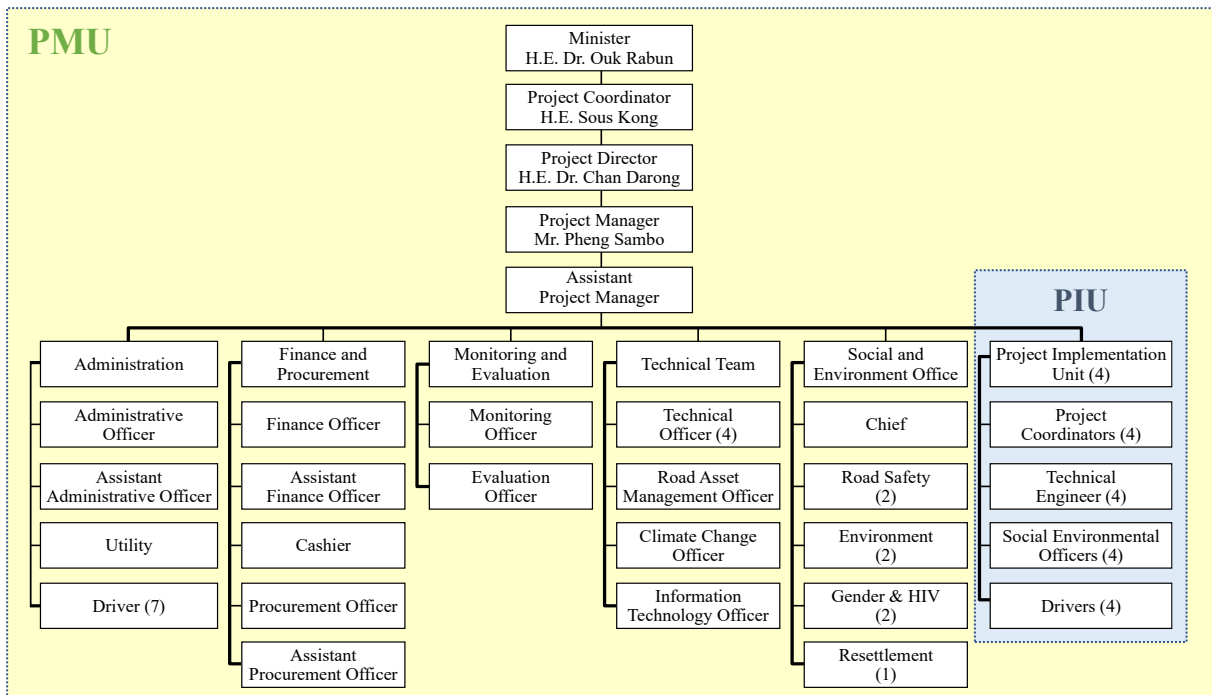
This project consists mainly of DBST pavements, and the bridges/structures are small in scale. Therefore, it falls under the case where "the amount involved in the procurement is so small that foreign firms clearly would not be interested, or that the advantage of International Competitive Bidding (ICB) would be outweighed by the administrative burden involved" as stated in Article 1.03 of JICA's "Guidelines for Procurement under Japanese ODA Loans.". The Cambodian Standard Operating Procedures (SOP) also states "National Competitive Bidding (NCB) is normally used when the procurement is unlikely to attract foreign competition and the advantages of approaching the international market are clearly outweighed by the administrative and financial burden involved" and "NCB is generally used when the size of the contract is small or when the domestic Contractor can offer better prices.". Therefore, in light of the considerations up to the previous section and the development of Cambodian domestic firms, it is considered desirable to apply NCB in this project.

Through discussions with MRD, a following draft procurement package was developed. The final procurement package will be decided at the detailed design stage based on the construction plan, cost estimation, land acquisition plan for each target road.

Figure 3 Location Map of Proposed Package (Confidential)

A project management unit (PMU) and Project Implementation Unit (PIU) will be established in MRD. The PMU will implement, manage, and coordinate project activities to cover the project scope. PIU will be established in each province.

The proposed organization char of the project implementation is shown below.



Source: MRD

Figure 4 Project Management Unit (PMU) and Project Implementing Unit (PIU)

3.5 Operation and Maintenance Structure

The number of DRR/PDRD office staff is very small, as mentioned above, and the number of technicians is unknown. In addition, experience with DBST is very limited and no guidelines or manuals exist. There is also no plan for training within the Ministry. Equipment for O&M is limited in type and number as mentioned above. MRD has very limited experience in maintaining and managing DBST, and its maintenance capacity is not high. JICA Survey Team could not confirm the content and status of the maintenance of the DBST, although the budget has been allocated to DRR and the maintenance of DBST has been managed by DRR. DRR states that the challenge is to improve PDRD's technical capabilities.

However, the maintenance of agricultural roads (laterite roads) has actually been carried out by PDRD by hiring people living near agricultural roads, in accordance with the "maintenance and management agricultural roads to be carried out by local residents" stipulated in the Prakas. The amount of work required for maintenance and management per length of the project is the same as in the past, and it is thought that maintenance and management can be carried out without any problems by utilizing residents in the surrounding area. The total length of the 529-km project is expected to require 233 workers/day, and 0.44 workers/km is considered to be an easily procurable number of workers.

Table 9 shows Routine Maintenance and Periodic Maintenance costs by road: Routine Maintenance consists of (1) Pothole Repair, (2) Grass Cutting, (3) Pipe/Box Culvert Desilting and (4) Side Ditch Desilting. The maintenance cost by item for each road is shown below: Periodic Maintenance is planned as resurfacing once every five years based on the Rural Roads Master Plan (RRMP) published in February 2021. The unit cost of resurfacing is based on the Feasibility Report issued in March 2018.

Table 9 O&M Cost by Road Per Year (Confidential)

CHAPTER 4 ENVIRONMENT AND SOCIAL CONSIDERATION

4.1 The Screening for the Prioritization of Sub-projects

Since this project was required to be implemented as a Category B project, the sub-projects were checked in terms of environmental and social considerations, and sub-projects that are expected to result in significant impacts were excluded. There are protected areas designated by Cambodia and important natural habitats such as Key Biodiversity Areas (KBA) and Important Bird and Biodiversity Areas (IBA) near the sub-projects, and it was necessary to exclude sub-projects that would have an impact on these protected areas. Therefore, after collecting and reviewing relevant data, four sub-projects were located in or near protected areas. One of these was identified to be located in a KBA. Therefore, it was excluded from the sub-project. The other three sub-projects, although close to protected areas, were evaluated as having almost no impact. In addition, it has not been confirmed at this time that the sub-project is in an indigenous peoples' living area and historical heritage.

4.2 Environment and Social Consideration

The sub-projects to be implemented in this project will be determined at the time of detailed design. Therefore, this survey does not examine environmental and social considerations for individual sub-projects. The items that will be required in the future as environmental and social considerations were compiled into an environmental assessment framework and a resettlement framework. And a draft scoping was conducted in order to investigate the implementation of environmental and social considerations during the detailed design phase.

Draft scoping

Draft scoping was conducted to evaluate the sub-project as a whole based on the information available at this time. This project is an improvement project of the existing road, and the environmental impact on the area surrounding the project site is expected to be small; however, dust, muddy water, waste, noise, and other impacts during construction are anticipated. In addition, land acquisition and removal of structures such as fences along the road will be required. Noise and traffic accidents are expected to occur on the target roads when the project is put into service. Mitigation and monitoring measures are proposed for these issues.

Environment and Social Consideration

After the sub-projects are finalized in the detailed design, an Environmental Impact Assessment (EIA) survey and a Resettlement Action Plan (RAP) survey will be conducted for each sub-project. Since Environmental Management Contract (EMC) procedures do not require public consultation, additional public consultation will be conducted.

In terms of land acquisition and resettlement, sub-projects will be selected and designed on the assumption that resettlement will not occur; RAP surveys will be conducted and compensation will be provided to affected residents in accordance with JICA guidelines.

CHAPTER 5 PROJECT EVALUATION AND POINTS TO CONSIDER

5.1 Consideration of Project Effect

For the evaluation of operation and project effects, the year 2029 is used as the evaluation year referring the JICA Project Evaluation Handbook (Ver. 2.0, p.39) and the “Annual Average Daily Traffic Volume”, “Travel Time to One-digit National Roads”, “Annual Traffic Impassibility Dates due to Flooding”, and “Number of Isolated Villages Due to Flooding” were calculated. In terms of qualitative effects, “Improvement for Accessibility to Important Facilities” and “Decreasing Road Traffic Accidents” will be expected.

Table 10 Quantitative Project Effects

Project Effect	Before Improvement (2022)	After Improvement (2029)
Annual Average Daily Traffic Volume 38 roads total (PCU / day)	29,585	54,137
Travel Time to One-digit National Road (Rain Weather) 38 roads average (Minute)	3115.7	1398.8
Annual Traffic Impassibility Dates due to Flooding (day / year)	268	78
Number of Isolated Villages Due to Flooding (Village)	207	48

Source: JICA Survey Team

As synergy with rural roads and National Road 5 improvement, which is currently under construction, “Number of Communes and Population to Access Provincial Center within 1 hour”, “Number of Communes and Population to Access Referral Hospitals within 30 minutes” were calculated.

In terms of qualitative effects, “Improving Transportation for Agricultural Product” and “Decreasing Road Traffic Accidents” will be expected.

Table 11 Quantitative Effects of Synergy with Rural Roads and National Road 5 Improvement

Project Effect		Before Improvement (2022)	After Improvement (2029)
Number of Communes and Population to Access Provincial Center within 1 hour	The cumulative total number of communes	198	256
	The cumulative total number of population	2,123,782	2,766,632
Number of Communes and Population to Access Referral Hospitals within 30 minutes	The total number of communes	176	191
	The total number of population	1,910,004	2,030,574

Source: JICA Survey Team

As the results of economic analysis of this project, EIRR is 23.2%, which is bigger than 12% of the opportunity cost of capital. The values indicate that the project is economically viable.

5.2 Consideration of Gender Mainstreaming and Poverty Reduction Measure

In order to promote gender and reduce the poverty of people related to the rural road projects, the projects should consider including several terms and conditions to the construction company as listed below:

- At least 25% of unskilled female employment need to include in rural road construction within government project as this will create more job opportunities for women and the poor
- Ensure an equal payment for the same work for unskilled female laborers
- Ensure that female laborers receive the training related to work safety and health protection at the construction site
- Provide skill improvement training to unskilled female laborers, so they could easily get jobs after the project ended with a higher salary
- Contractor company should consider hiring local female laborers, as most of the sub-contractors have their own teamwork
- Provide side-drains and flood protection structures in case needed along the rural road in order to keep the roads maintained and prevent flooding over the village and rice fields
- Set clear information and give a notice about the construction starts in advance, so people could well prepare themselves and their properties that could be affected during road excavation.

MAIN PART

CHAPTER 1 INTRODUCTION

1.1 Background of Survey

In the Kingdom of Cambodia (Cambodia), road transport plays the main role for domestic transport. The country's road network consists of a total of 64,211 km, of which 7,261 km correspond to national roads, 9,031 km to provincial roads, and 47,919 km to rural roads (as of August 2022; source: Ministry of Rural Development [MRD]). Among the rural road network, the percentage of paved roads remains at a low level of about 9%. This results in poor visibility due to dust during the dry season and disruption due to heavy rains and flooding during the rainy season, adversely impacting the lives of residents and logistics of the affected areas.

Under such situation, the Government of Cambodia (GOC) has set "Inclusive and Sustainable Development" as one of the policy areas in its "Rectangular Strategy-Phase 4" of the National Strategic Development Plan (2019-2023). Additionally, GOC has decided to continue efforts within the scope of rural development, which includes the improvement of rural roads. In particular, MRD has developed a master plan for rural roads in cooperation with the Asian Development Bank's (ADB) Rural Roads Improvement Project III (approved in 2022).

The disparity between rural and urban areas in terms of income and consumption is still significant in Cambodia. The population living in rural areas, accounting for around 80% of the total population, has a household income as low as 60% of the one corresponding to urban areas (source: International Monetary Fund, 2019). Therefore, inclusive development and economic growth in rural areas are recognized as important development issues.

In the road sector of Cambodia, JICA has been cooperating in the rehabilitation and widening of National Road No.5 (NR5), which is one of the main roads of the country and is part of the Southern Economic Corridor, as well as supporting the construction of a bypass on the same route. However, due to inadequate maintenance of rural roads along the route, GOC expects to improve rural roads in four provinces (Kampong Chhnang, Pursat, Battambang, and Banteay Meanchey) in order to further increase the benefits of NR5, improve living conditions along the route (access to public facilities, services, markets, etc.), and stimulate the local economy.

In JICA's "Country Analysis Paper for Cambodia" (March 2014) priority is given to the "development of a road network centered on the Southern Economic Corridor", in addition to "industrial development" being identified by the Government of Japan (GOJ) as a priority area in its "Country Development Cooperation Policy for Cambodia" (July 2017). Thus, cooperating in the improvement of rural roads in Cambodia is in line with the above analysis and policy through the "strengthening of the logistics network (roads, ports, customs, etc.) in both hard and soft components from the perspective of strengthening regional connectivity and promoting industrial development".

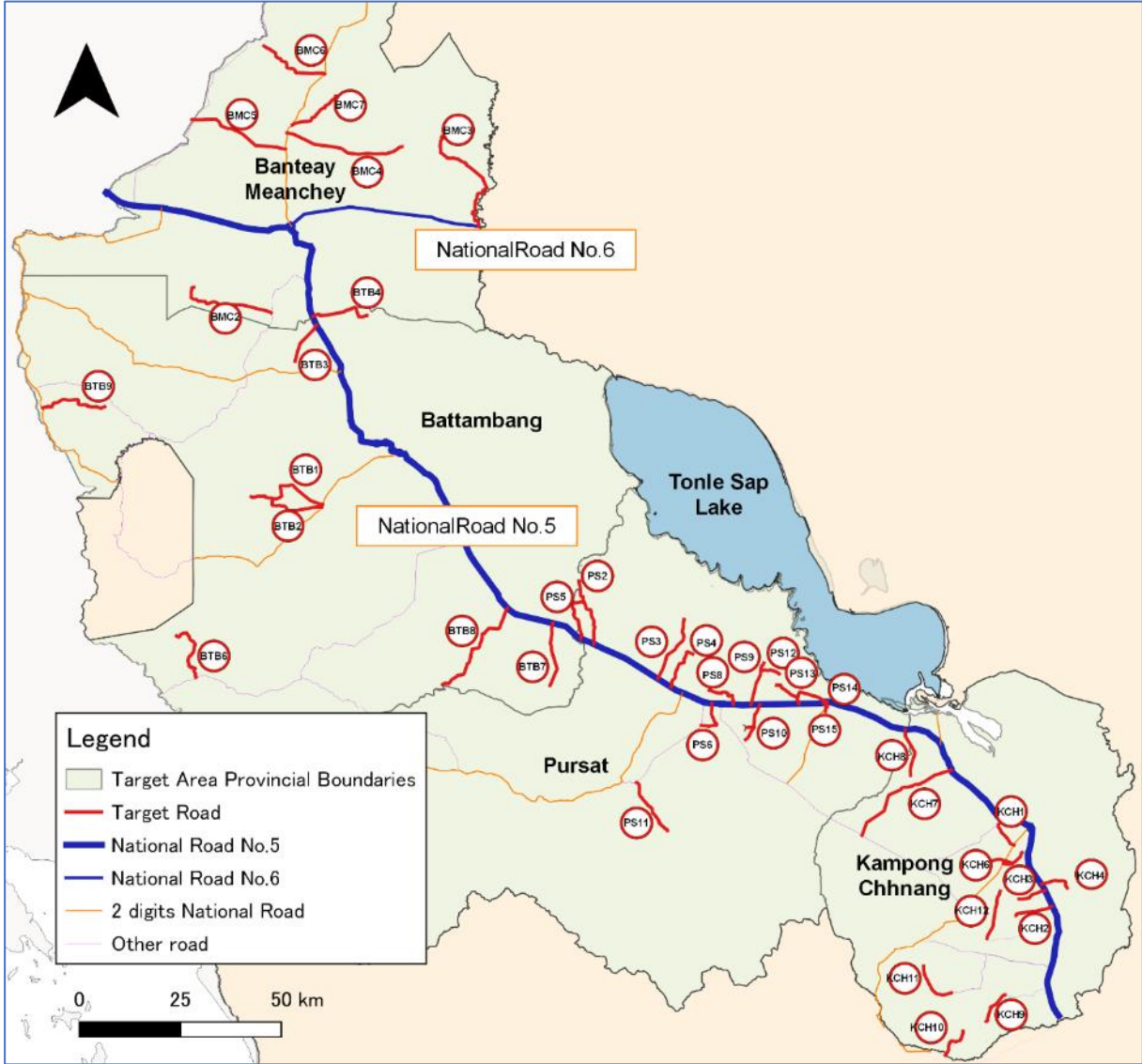
This study is expected to have a synergistic effect with Japan's cooperation so far by improving rural roads in the four provinces mentioned above, reaffirming the connectivity of the road network, confirming the need to improve the living environment of residents along the road, as well as collecting and studying basic information for the consideration of cooperative approaches that can contribute to the stable socioeconomic development of the region.

1.2 Purpose of Survey

The purpose of this survey is to establish an effective and efficient road network and to improve the living conditions of residents along the road in the target area. The project team will prepare top-level plans and collect information regarding the status of road operation, maintenance, and other related systems. Furthermore, details regarding the current status and issues of similar projects implemented by other donors will be collected. An outline will be prepared for a financial assistance project that includes the prioritization of candidate routes, technical support for rural road development, operation and maintenance plans, as well as the consideration of traffic safety for rural roads in the target area.

1.3 Surveyed Area

The target area covers the four Cambodian provinces that National Highway 5 crosses (i.e., Kampong Chhnang, Pursat, Battambang, and Banteay Meanchey provinces). As shown in the figure below, the region is located on the West side of Tonle Sap Lake, between the capital Phnom Penh and Thailand.

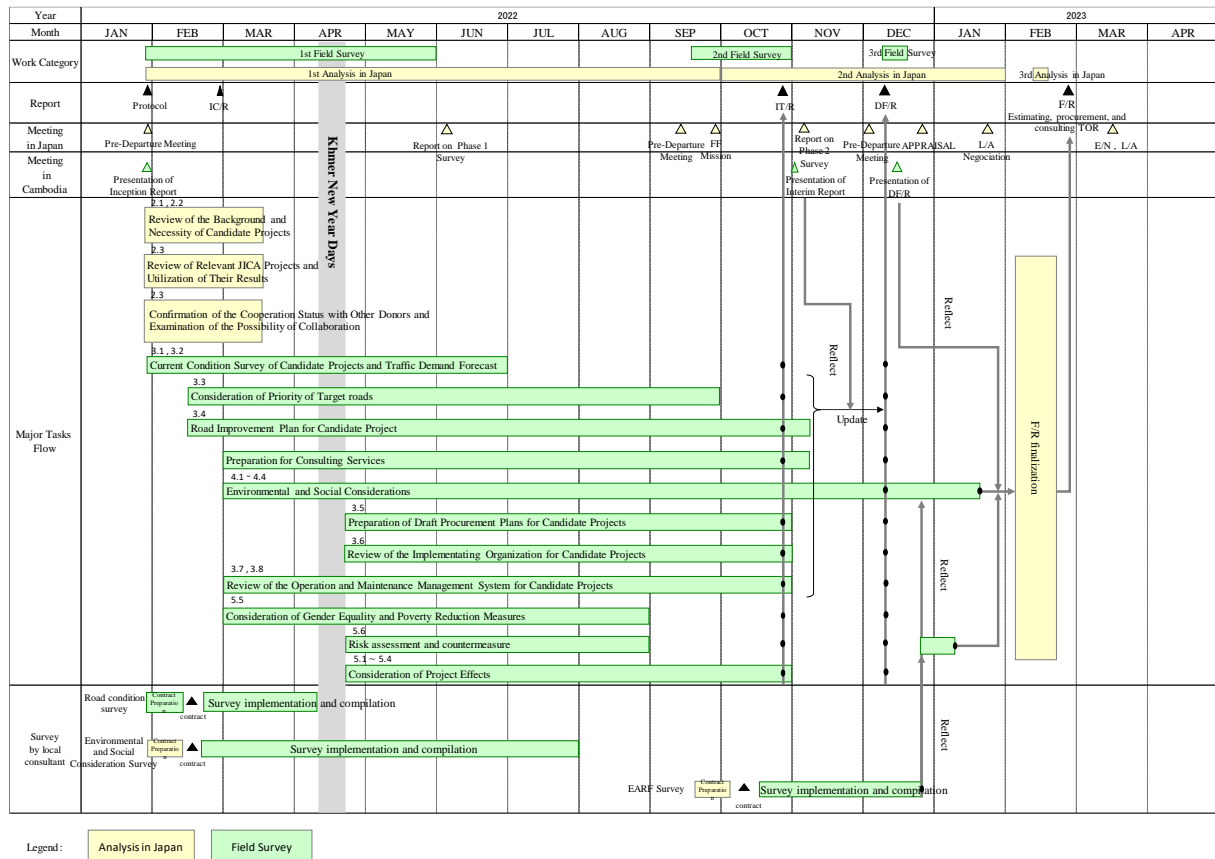


Source: JICA Survey Team

Figure 1.3-1 Survey Area

1.4 Project Implementation

The overall project flowchart is shown below.



Source: JICA Survey Team

Figure 1.4-1 Flowchart of Overall Operations

1.5 Project Team Members

The project team members (collectively referred to as JICA Survey Team) are shown below.

Table 1.5-1 Project Team Members

Name	Position	Organization
Tomomi IBI	Project Director	Japan International Cooperation Agency (JICA)
Kazuko ICHIHARA	Project Formulation/Project Coordinator	Japan International Cooperation Agency (JICA)
Masato WATANABE	Team Leader/Rural Road Planning Expert	Katahira & Engineers International (KEI)
Masahiro TAKAHASHI	Deputy Team Leader/Rural Road Planning Expert	Katahira & Engineers International (KEI)
Yoshihisa NODA	Operation and Maintenance Expert	CTI Engineering International (CTII)
Takahiko SATO	Road Design Expert	Katahira & Engineers International (KEI)
Hiroshi WATANABE	Project Cost Estimation Expert	Katahira & Engineers International (KEI)
Tsutomu SAWAGUCHI	Procurement and Construction Plan Expert	Oriental Consultants Global (OCG)
Shuichi YASHIRO	Traffic Survey and Demand Forecast Expert	Katahira & Engineers International (KEI)
Tatsuya AKIGUCHI	Economic and Financial Analyst	Katahira & Engineers International (KEI)
Taiji TANOGUCHI	Environmental and Social Considerations (Natural Environment)/Climate Change Countermeasures Expert	Katahira & Engineers International (KEI)
Mitsue UMIGUCHI	Environmental and Social Considerations (Social Environment) /Gender Mainstreaming and Poverty Reduction Expert	Oriental Consultants Global (OCG)
Takahashi ONO	Hydraulic/Hydrology Survey Expert	CTI Engineering International (CTII)
Isaac GARCIA	Database Expert	Katahira & Engineers International (KEI)

Source: JICA Survey Team

CHAPTER 2 OVERVIEW OF THE RURAL ROAD SECTOR

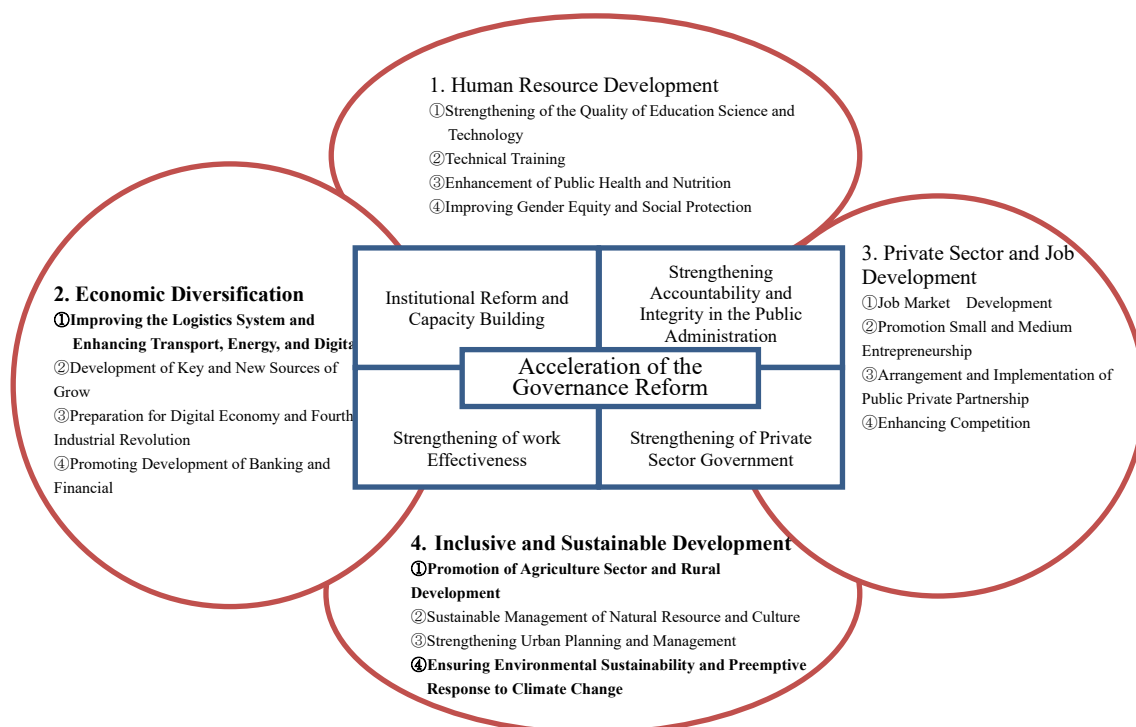
2.1 Overview of Countries and Regions Covered

2.1.1 Development Policy

(1) Rectangular Strategy-Phase IV

The Rectangular Strategy-Phase IV (hereinafter referred to as RS4) was developed in September 2018 to ensure sustainable growth, job creation and social equity, and to strengthen the governance of government institutions in Cambodia.

RS4 reflects the challenges and achievements of Rectangular Strategy Phases I to III, but also responds to the changing global situation and provides a comprehensive direction to become a high-income country by 2050. As shown in the chart below, RS4 has four priority areas (i.e., 1. Human Resource Development, 2. Economic Diversification, 3. Private Sector and Job Development, and 4. Inclusive and Sustainable Development) that includes four tasks to be accomplished, all while aiming to improve the quality of governance.



Source: Rectangular Strategy

Figure 2.1-1 Four Priority Areas in Rectangular Strategy-Phase IV

Of the four priority areas shown above, “2. Economic Diversification” and “4. Inclusive and Sustainable Development” are discussed below because some of the issues are relevant to this study.

In the “Improving Logistics Systems and Strengthening Transportation, Energy, and Communications” section of the Economic Diversification agenda, the study addresses the problems faced by Cambodia, including high logistics costs, relatively weak institutional coordination in the development and maintenance of infrastructure, and inadequate infrastructure in response to rising demand. It therefore states that it will increase its investment budget for the repair, construction, and development of physical infrastructure, such as roads and waterways.

In the “Promotion of the Agricultural Sector and Rural Development” issue of Comprehensive and Sustainable Development, rural areas are recognized to have achieved remarkable development. However, many challenges still remain, including the need to maintain and improve the quality of rural

roads. Therefore, the project will promote the agricultural sector by continuing to improve rural roads.

The comprehensive and sustainable development agenda, “Ensuring Environmental Sustainability and Preemptive Response to Climate Change,” also addresses concerns about flooding. It promotes the development and implementation of management plans to minimize risks from floods and droughts and to ensure long-term water security.

(2) National Strategic Development Plan 2019-2023

The National Strategic Development Plan (hereafter referred to as NSDP) is a development vision that has focused on Cambodia’s issues, such as poverty reduction and economic growth. In November 2019, a new national strategic development plan, NSDP 2019-2023, was released covering the period 2019-2023, setting priority policies for the entire government based on RS4, and drawing on the issues and achievements of previous NSDPs, while also aligning its structure to RS4.

The objective of the NSDP 2019-2023 is to maintain the economic growth achieved in the NSDP 2014-2018 and to turn Cambodia into an upper-middle income country. In order to implement its objectives, RS4 has set forth strategies to realize its goals in the four priority areas of: “1. Human Resource Development”, “2. Economic Diversification”, “3. Private Sector and Job Development”, and “4. Inclusive and Sustainable Development”.

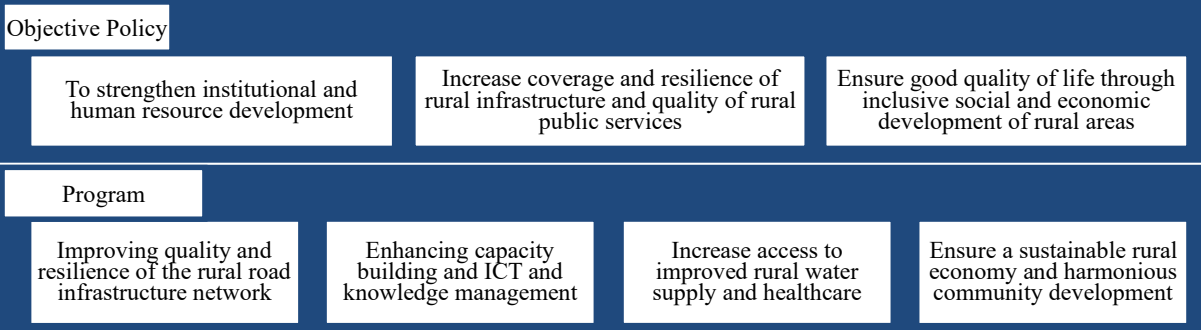
MRD, which has jurisdiction over the roads covered by this study, states that rural road infrastructure development will be undertaken to promote the agricultural sector and rural development within one of the four priority areas, namely “4. Inclusive and Sustainable Development”.

The actions that MRD will undertake in the development of rural road infrastructure are as follows:

- Repair and improve rural roads
- Maintain rural roads with climate resilient DBST, concrete, or other alternatives
- Maintain rural roads on a regular basis
- Prepare road inventories and rural road maps, as well as install traffic signs

(3) Rural Development Policy 2019-2023

Based on the Rectangular Strategy-Phase IV (RS4) and the National Strategic Development Plan (NSDP) 2019-2023, MRD has prepared a Rural Development Policy to guide the actions that MRD should take. The Rural Development Policy is positioned as a major milestone in the implementation of RS4 and NSDP 2019-2023, and the objectives and action plans listed in the Action Guidelines incorporate relevant policies and strategies from other ministries and the international community.



Source: Based on Rural Development Policy 2019-2023

Figure 2.1-2 Rural Development Policy 2019-2023

(4) Rural Development Strategy, Action Plan 2019-2023

The Rural Development Strategy, Action Plan 2019-2023 contains the MRD's action guidelines described in the Rural Development Policy 2019-2023 and the MRD's action plan, which incorporates a climate change component.

The Rural Development Strategy, Action Plan 2019-2023 prioritizes the action plans to be undertaken by MRD and assigns which department of MRD is responsible for the related projects.

The MRD's Rural Road Department, the department most closely associated with this study, is concerned with rehabilitating rural infrastructure, and improving rural public services. The following activities will be undertaken to improve the quality and resilience of the rural road infrastructure network.

- Road maintenance and rehabilitation
- Improvement of rural roads using criteria related to toughness
- Rural listing and mapping
- Building a new road network
- Maintenance of rural roads by PDRD or other alternatives

(5) Rural Roads Master Plan (RRMP)

MRD is committed to improving the vast number of rural roads in Cambodia and in order to continue to improve rural roads in the future, it is important to coordinate the prioritization of rural roads to be developed. Therefore, MRD developed a master plan for rural roads and defined selection criteria for prioritizing rural roads. A total of 1,370 roads with a total length of 13,791 km have been surveyed and prioritized according to the established procedure.

This allows MRD and PDRD to pre-select which rural roads to maintain. It also allows them to direct their investments to the most necessary and effective rural roads.

However, RRMP is a tool to assist in the development, improvement, and maintenance of rural roads. As such, it should be considered along with local information and economic or social development before actually implementing rural road improvement/maintenance. Therefore, for individual projects, as in this study, additional data for each road should be collected, re-prioritized, and evaluated.

(6) Cambodia Industrial Development Policy 2015-2025

RS3 point to the structural transformation of the Cambodian economy in reaching middle-income country status and considers the industrial sector as the main driver of its economic growth. Therefore, an Industrial Development Strategy was prepared as a guide to promote the development of the country's industrial sector, which can help Cambodia sustain sustainable, inclusive, and high economic growth. The Industrial Development Plan states that for Cambodia to achieve further economic development, it is necessary to consider improving socioeconomic infrastructure, energy supply, expanding transportation infrastructure and developing logistics, as well as promoting technical and scientific education along with strengthening institutions.

2.1.2 Natural Conditions

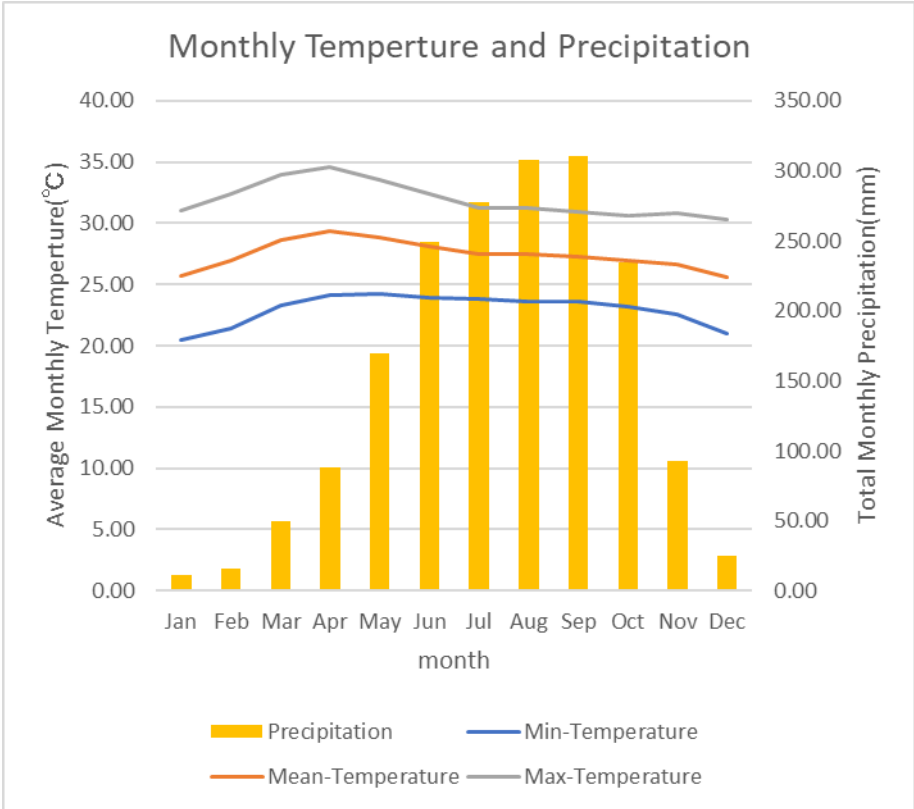
(1) Climate/Weather

Cambodia is in the tropical monsoon climate zone, with high temperatures and seasons divided into wet and dry periods. During the rainy season from May to October, Southwestern winds account for 80% to 90% of the annual precipitation. On the other hand, during the dry season from November to April, there is little precipitation and temperatures are lower than in the rainy season.

Regarding average temperatures, there is relatively little difference in average temperatures across the country. The maximum temperature can exceed 40°C in April while minimum temperatures drop below 20°C in January. The temperature ranges from 25°C to 27°C throughout the year.

In terms of precipitation, the rainy season from May to November brings heavy rainfall to the Southeastern and Northwestern parts of the country. The average annual precipitation is 1,400-2,000 mm, which is higher in the coastal and highland areas than in the inland areas. The average monthly precipitation at the end of the rainy season from September to October is about 250mm to 260 mm. On the other hand, in January, during the dry season, the average monthly precipitation is about 10 mm.

Annual climate change is greatly influenced by the El Niño phenomenon, in which the sea surface temperature rises, and the La Niña phenomenon, in which the sea surface temperature decreases. There is a risk of drought due to rising temperatures and reduced precipitation due to the El Niño phenomenon. Conversely, La Niña causes temperature drops, poor crop growth due to heavy rainfall, and flooding. Either way, disasters and economic losses will occur. Figure 2.1-3 shows the nationwide average monthly temperature and precipitation for a period of 30 years ranging from 1991 to 2021.



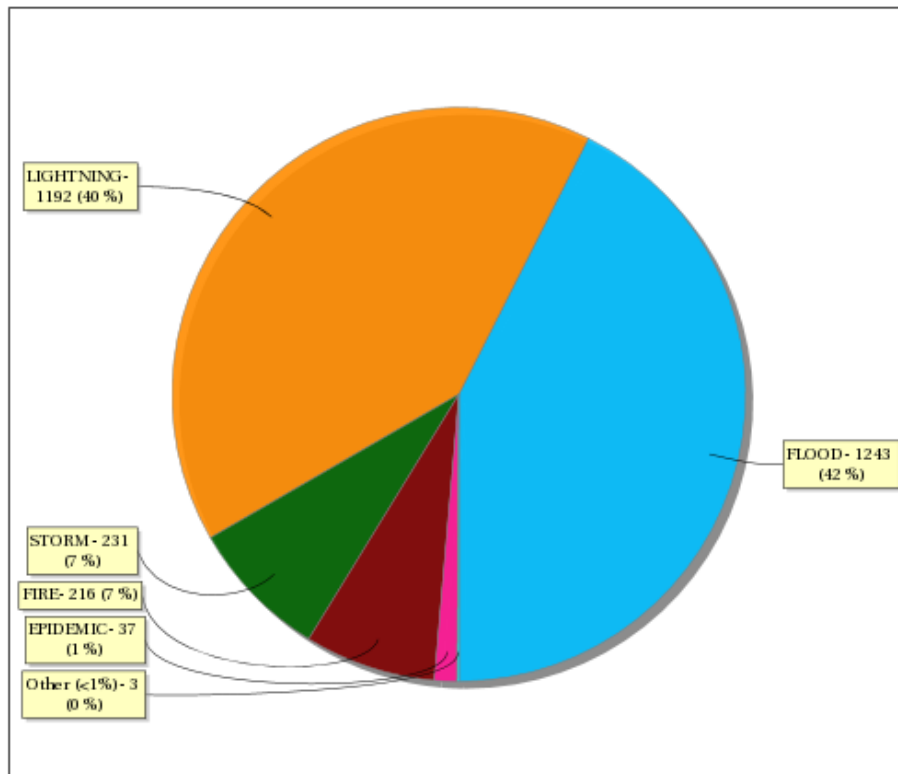
Source: JICA Survey Team, Data “Climate Knowledge Portal”

Figure 2.1-3 Monthly Average Temperature and Precipitation Nationwide (1991-2021)

(2) Natural Disaster

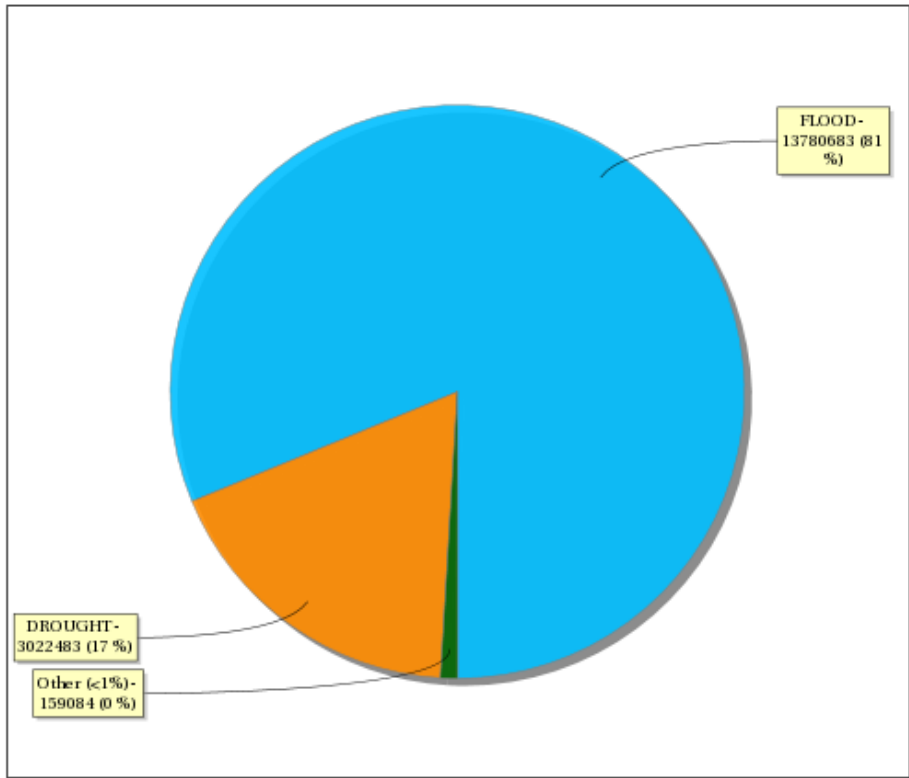
Cambodia's major natural disasters are floods, droughts, and storms. From these major natural disasters, the scale of damage is larger during floods. Although forest fires are frequent, damages caused by them are insignificant. Moreover, there are no earthquakes.

Figure 2.1-4 and Figure 2.1-5 show the number of deaths and figures of directly affected damages caused by natural disasters over the last 30 years, based on data from the National Committee for Disaster Management (NCDM). From this data, it is clear that most of the deaths caused by natural disasters are due to lightning.



Source: 「Cambodia Disaster Damage & Loss Information System (CamDi)」 NCDM

Figure 2.1-4 Ratio of Fatalities by Disaster



Source: 「Cambodia Disaster Damage & Loss Information System (CamDi)」 NCDM

Figure 2.1-5 Ratio of Direct Damage Cases by Disaster

Floods often occur along the Mekong River and Tonle Sap Lake, remarkably about 75% of the country is within the flood area of the Tonle Sap Lake. Floods also occur in the lower Mekong and Bassac plains during the rainy season.

Droughts have recently become more frequent due to the decrease in flow of the Mekong River and occurrence of El Niño phenomenon. The impact of droughts is significant if it occurs continuously for periods of 2-3 years, since years of poor harvests not only weaken livelihoods, but also lead to life-threatening diseases, chronic malnutrition, and other undesirable side effects. Droughts occur frequently in the Eastern, Western, and Northwestern regions, significantly impacting these regions. Additionally, in mountainous areas such as the Kravan Mountains in Battambang and Pursat provinces, torrential rains cause landslides and debris flows during the rainy season. Table 2.1-1 shows an overview of major disasters in the last 10 years.

Table 2.1-1 Summary of Major Disasters in the Last 10 Years

emergence time	Category of natural disaster	Damage overview
2021/10/23	Flood	The rains that began falling in mid-October caused flood damage in the provinces of Banteay Meanchey and Battambang in the western part of Cambodia, and Ratanakiri province in the northeastern part of the country. In addition, part of the southwestern part of Phnom Penh was submerged due to the flooding of the Plechnot River, which flows from the west to the south of Phnom Penh. According to information, 3,200 households and 12,000 people have been evacuated. 3,000 houses were flooded and 135ha of paddy fields were submerged.
2020/10/22	Flood	The rain that began in mid-October due to the effects of a tropical cyclone and cold air caused great damage. By October 20th, 34 people had died. 104,348 households were affected and 42,332 people (10,583 households) were evacuated. 247,408ha of paddy fields were submerged.
2019/9/11	Flood	Flooding has continued since September 11, 2019. Seven to eight provinces along the Mekong River have been hit by floods, 12 people died.
2018/9/21	Flood	The torrential rain caused a large number of victims including Affected people and property damage. The damage was 25 dead (including 8 children), 37,396 evacuees (9,349 households), 56 completely or partially destroyed houses, and 73,720 flooded houses.
2018/5/	Lightning	According to The National Committee for Disaster Management (NCDM), lightning strikes caused a lot of damage in May 2018. More than 90 casualties, more than 50 dead, about 50 cattle dead, more than 2,000 houses damaged.
2017/9/30	Flood	In Cambodia, heavy rains associated with Tropical Storm Sonca caused flooding in the provinces of Preah Vihear, Oddar Meanchey, Stung Treng and Kampot. Two people died and 550 households were affected.
2015-2016	Drought	The drought, which is said to occur once in 50 years, has hit more than 620,000 households in Cambodia, and has also affected millions of people in neighboring countries such as Vietnam. More than 30 wild monkeys died in Battambang province in early May. Due to the heat wave, residents are suffering from many illnesses, soaring vegetable prices, outbreaks of infectious diseases in livestock, and an increase in borrowings from farmers. The number of migrant workers in neighboring Thailand is increasing due to the lack of water and the inability to do farm work.
2013/9/30	Flood	Heavy rains since the third week of September have caused flooding in at least 10 provinces across northwestern Cambodia and along the Mekong River in central Cambodia. In Battambang province, all 14 districts in the province were affected, and many households were evacuated. In October, 168 people died nationwide. About 27,000 households and 120,000 people evacuated.
2011-2012	Drought	The drought in 2011 damaged 3,804ha of paddy fields. Another drought in 2012 damaged 14,190ha of paddy fields and 3,151ha of crops.
2011/10/20	Flood	Flood damage resulted in 350,000 affected households (more than 1.5 million people) and 52,000 evacuated households. Eighteen out of 24 provinces were affected, and four provinces along the Mekong River and Tonle Sap Lake were severely damaged. 250 dead, 23 injured, 431,000 ha of flooded paddy fields, 267,000 ha of paddy fields damaged, 925 km of national, provincial and urban roads damaged, 360 km of other roads damaged. Economic damage amounted to US\$630 million.

Source: Asia Disaster Reduction Center (ADRC)

(3) Hydrology

The Department of Meteorology (DOM) from the Ministry of Water Resources and Meteorology (MOWRAM) has precipitation and water level observatories in the four target provinces, while the Department of Hydrology and Rivers (DHRW) and provinces have also their own precipitation observatories.

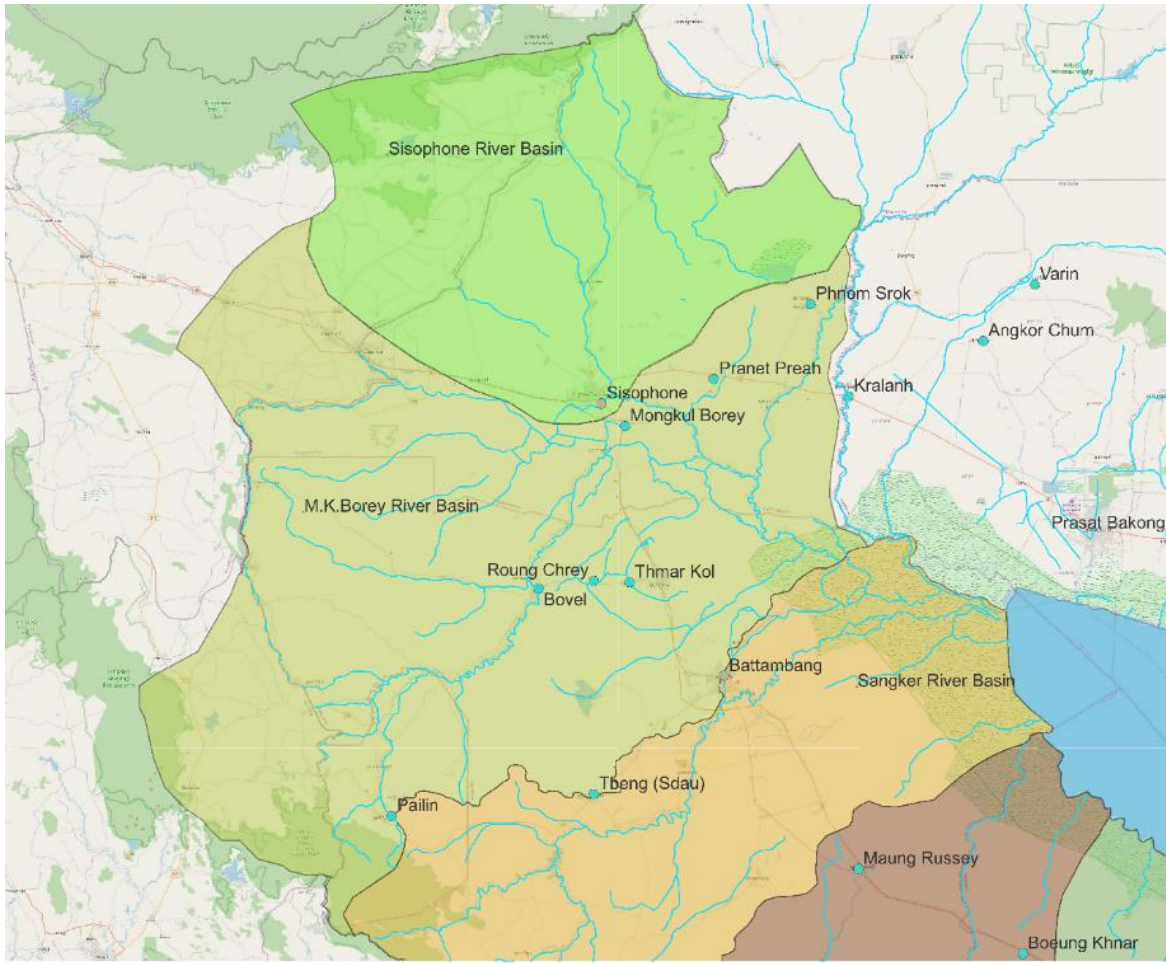
Water level gauging observatories are installed in the tributaries flowing into Tonle Sap Lake, the main ones being Kampong Luong at Tonle Sap Lake and Prek Kdam at Tonle Sap River, both of them also observe precipitation and are managed by the Department of Hydrology and Rivers (DHRW) and the Mekong River Commission Secretariat (MRCS).

Around 40 precipitation observatories of the Department of Meteorology (DOM) are located within the four target provinces. The main precipitation observatories are shown in Table 2.1-2 and their locations are shown in Figure 2.1-6 to Figure 2.1-8.

Table 2.1-2 Major Precipitation Observatories in the Four Target Provinces

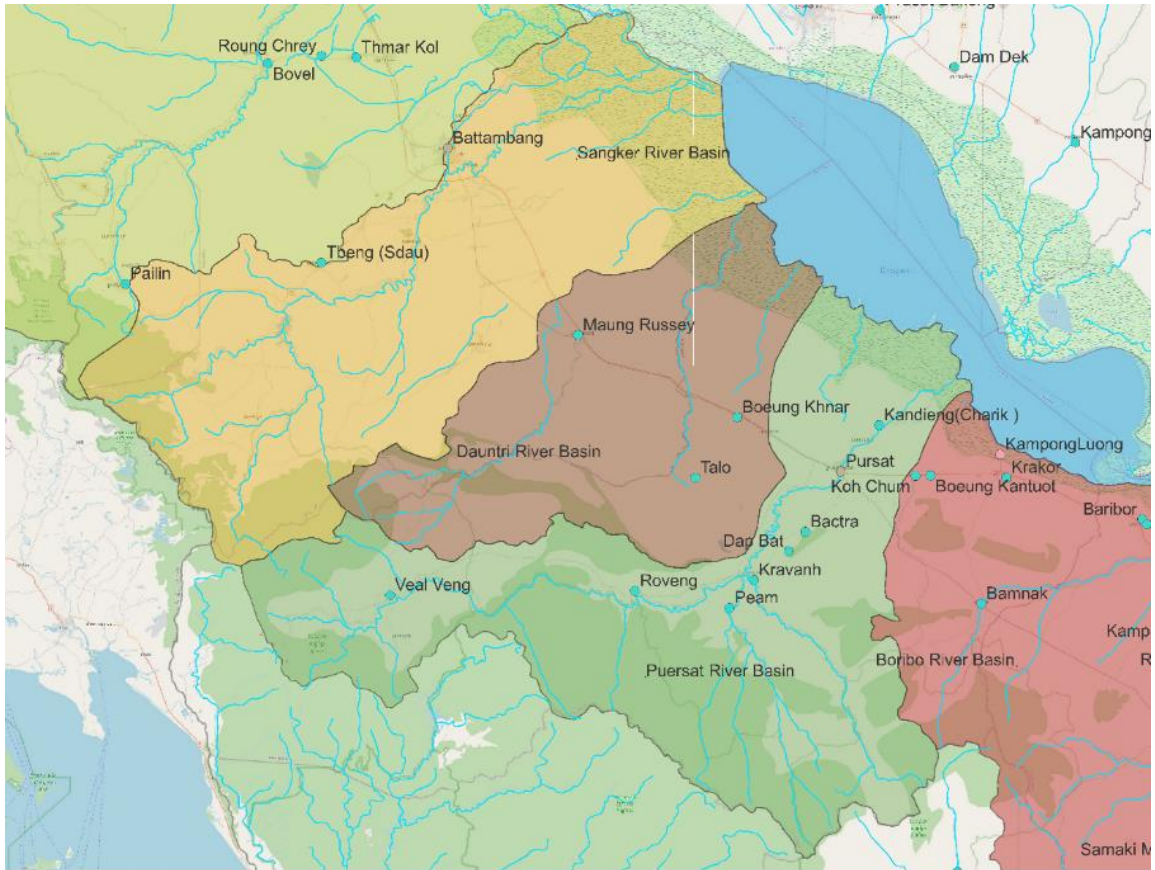
River Basin	Station Name	Province	Observed
Sisophon	Sisophon	Banteay Meanchey	Precipitation + Water Level
M.K.Borey	Pranet Preah	Banteay Meanchey	Precipitation
	Phnom Srok	Banteay Meanchey	Precipitation
	Mongkul Borey	Banteay Meanchey	Precipitation
	Thmar Kol	Battambang	Precipitation
	Bovel	Battambang	Precipitation
	Roung Chrey	Battambang	Precipitation
Sangker	Tbeng (Sdau)	Battambang	Precipitation
	Battambang	Battambang	Precipitation + Water Level
Dauntri	Maung Russey	Battambang	Precipitation
	Talo	Pursat	Precipitation
	Boeung Khnar	Pursat	Precipitation
Pursat	Bactra	Pursat	Precipitation
	Kandieng (Charik)	Pursat	Precipitation
	Kravanh	Pursat	Precipitation
	Peam	Pursat	Precipitation
	Dap Bat	Pursat	Precipitation
	Roveng	Pursat	Precipitation
	Veal Veng	Pursat	Precipitation
Boribo	Bamnak	Pursat	Precipitation
	Koh Chum	Pursat	Precipitation
	KampongLuong	Pursat	Precipitation + Water Level
	Krakor	Pursat	Precipitation
	Boeung Kantuot	Pursat	Precipitation
	Baribor	Kampong Chhnang	Precipitation
	Kampong Chhnang	Kampong Chhnang	Precipitation
	Kampong Leang	Kampong Chhnang	Precipitation
	Ponley	Kampong Chhnang	Precipitation
	Samaki Meanchey	Kampong Chhnang	Precipitation
	Tuk Phos	Kampong Chhnang	Precipitation
	Boeng Leach	Kampong Chhnang	Precipitation
	Pong Ro	Kampong Chhnang	Precipitation
	Kampong Tralach	Kampong Chhnang	Precipitation
	Prek Kdam	Kampong Chhnang	Precipitation + Water Level
	Rolear Pha'ear	Kampong Chhnang	Precipitation
Tuol Kruos	Kampong Chhnang	Precipitation	

Source: JICA Survey Team



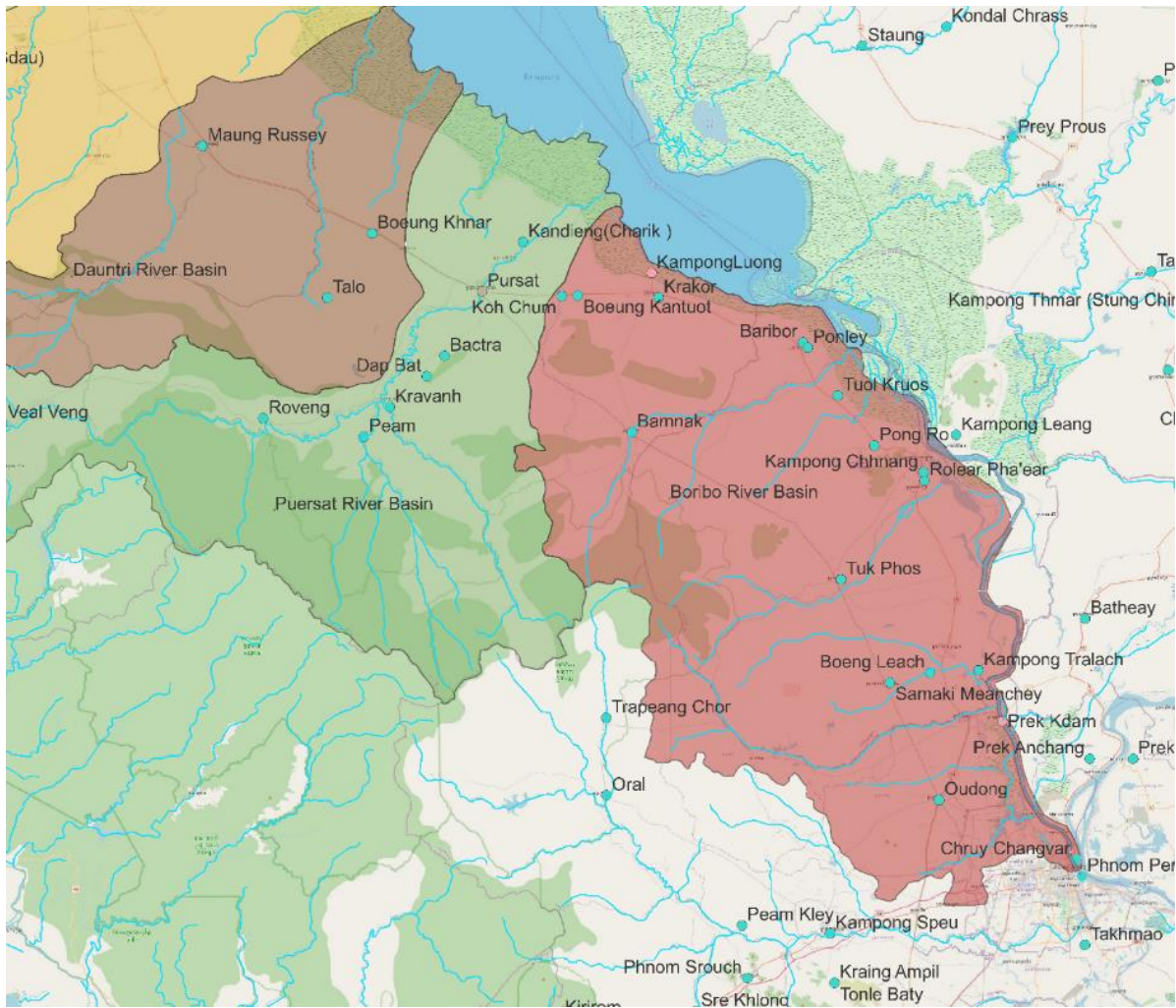
Source: JICA Survey Team

Figure 2.1-6 Location of Precipitation Observatories (1)



Source: JICA Survey Team

Figure 2.1-7 Location of Precipitation Observatories (2)

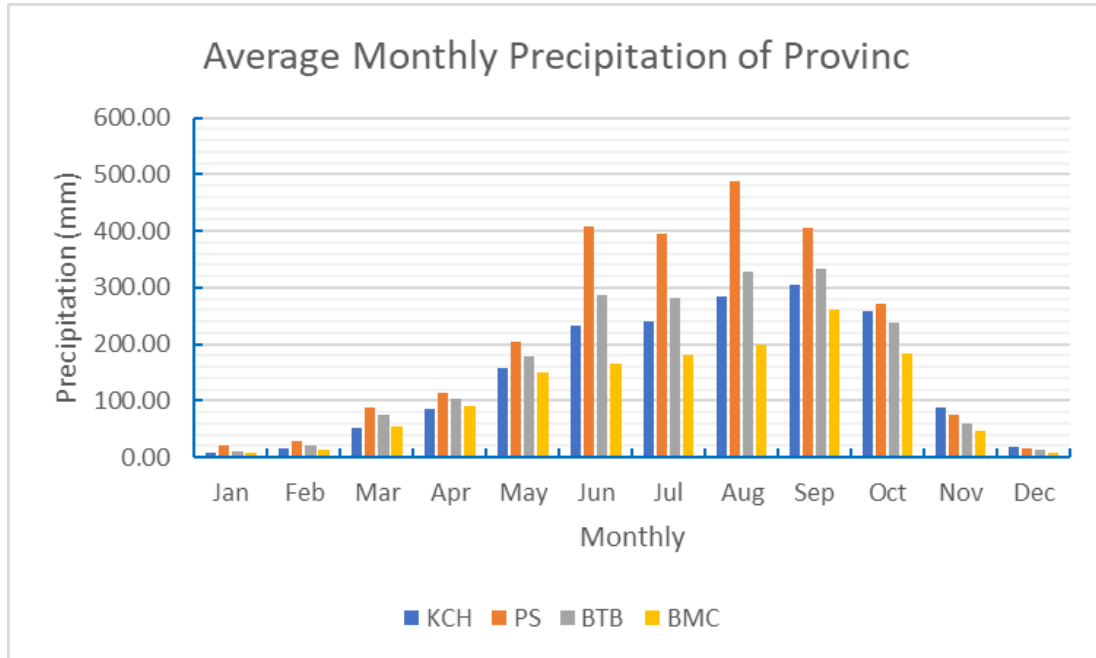


Source: JICA Survey Team

Figure 2.1-8 Location of Precipitation Observatories (3)

1) Precipitation Conditions in the Four Target Provinces

Figure 2.1-9 shows the monthly average precipitation in the four target provinces of Kampong Chhnang (KCH), Pursat (PS), Battambang (BTB) and Banteay Meanchey (BMC) over the last 30 years. Monthly average precipitation data are based on information from the Global Facility for Disaster Reduction and Recovery (GFDRR) global partnership administered by the World Bank.

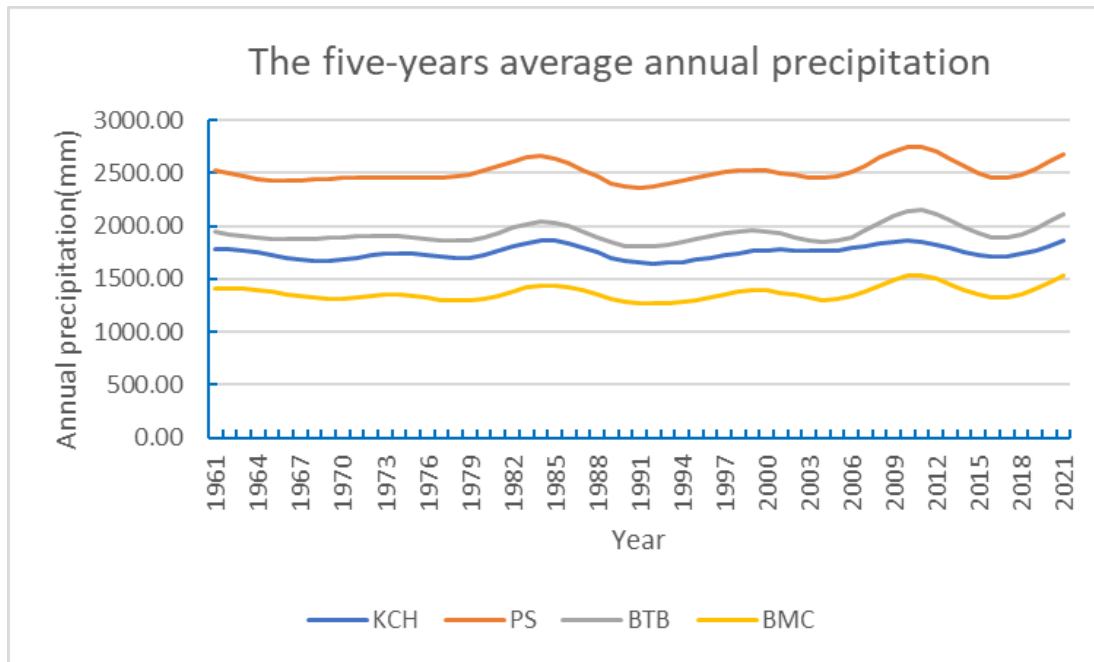


Source: GFDRR (the Global Facility for Disaster Reduction and Recovery)

Figure 2.1-9 Average Monthly Precipitation by Target Province

Precipitation during the rainy season in the target provinces was found to follow the descending order of: PS, BTB, KCH, and lastly BMC. Since PS and BTB are located in the Western coastal areas, they have more precipitation than other areas. In the rainy season, PS exceeds the monthly average of 400mm.

Figure 2.1-10 shows the five-year average annual precipitation over the last 60 years. In the target provinces, PS reported the highest average annual precipitation of around 2,500 mm, while BMC reported the lowest precipitation of around 1,300 mm to 1,500 mm. Overall, it can be seen that there is an increasing trend.

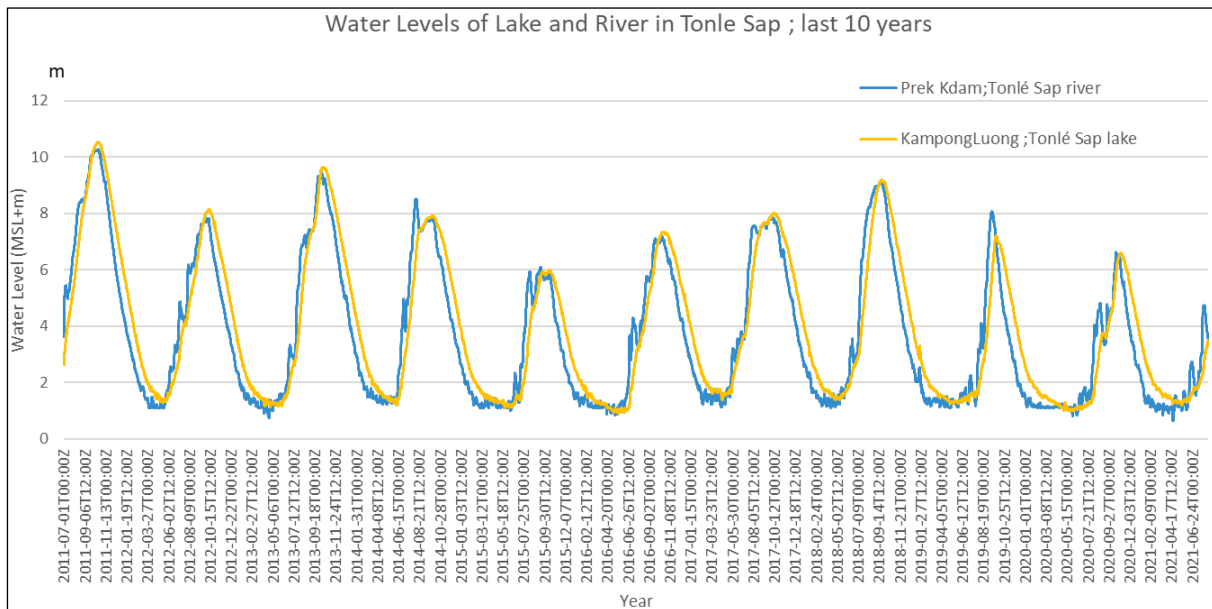


Source: GFDRR (the Global Facility for Disaster Reduction and Recovery)

Figure 2.1-10 Five-Year Average Annual Precipitation by Target Province

2) Water Level of Tonle Sap Lake and Tonle Sap River

Tonle Sap Lake in the Mekong River Basin flows into the Mekong River through the Tonle Sap River, thus the water level changes greatly in accordance with water level fluctuations of the Mekong River. Figure 2.1-11 shows the water levels over the last 10 years recorded by the Kampong Luong observatory on Tonle Sap Lake and the Prek Kdam observatory, located downstream of Tonle Sap River.



Source: JICA Survey Team

Figure 2.1-11 Water Level at Kampong Luong and Prek Kdam Observatory Over the Last 10 Years

Every year, from early to late June, a phenomenon occurs where the water level at the downstream Prek Kdam observatory exceeds the water level at the Kampong Luong observatory. This continues until around September due to the backflow phenomenon of the Mekong River flowing into Tonle Sap Lake, causing floods in flood-prone areas due to rising water levels. The water level of Tonle Sap Lake will rise by nearly 10 m and the flood area will increase to about 16,000 km², 5-6 times that of the dry season. The backflow of the Mekong River also has the advantage of bringing Mekong sediment, nutrients, and abundant fish to the lake. Flooding of agricultural land fertilizes the soil near the Mekong River basin.

The flood water level of Tonle Sap Lake is MSL+10.0 m. The flood warning water level is set at MSL + 9.5 m.

In recent years, the water level of Tonle Sap Lake has been decreasing despite the increasing rainfall. This is thought to be due to the impact of dam development in the Mekong River Basin.

3) Western River Basin of Tonle Sap Lake

Figure 2.1-12 shows the river basins in the Western part of Tonle Sap Lake located within the four target provinces. An overview of each river basin is shown in Table 2.1-3. Half of the Sisophon River Basin consists of an international river that borders with Thailand and the M.K. Borey, Dauntri, and Pursat rivers are prone to landslides and debris flows due to heavy rainfall during the rainy season.



Source: JICA Survey Team

Figure 2.1-12 River Basin in the Western Part of Tonle Sap Lake

Table 2.1-3 Overview of River Basins

River basin name	Dry season basin area (km ²)	Major city	Target province name
Sisophone River Basin	4,310	Sisophone	Banteay Meanchey
M.K.Borey River Basin	10,570	Thma Koul	Banteay Meanchey, Battambang
Sangker River Basin	6,050	Battambang	Battambang
Dauntri River Basin	3,700	Maung Russey	Battambang, Pursat
Puersat River Basin	5,970	Pursat	Pursat
Boribo River Basin	7,150	Kampong Chhnang	Pursat, Kampong Chhnang

Source: JICA Survey Team

(4) Topography and Geology

1) Topography

Cambodia's topography can be divided into 3 distinct regions – the Central Plain, flat coastal areas, and mountain ranges with plateaus. The Central Plain forms 75% of the country and consists of the Mekong River and the alluvial plains of the Tonle Sap Basin.

The project area is located on the Southern side of Tonle Sap Lake, along NR5, which runs North to South. Urban areas are spread along NR5 with target roads connecting the urban areas along NR5 with the rural communities in each region, providing access to rice, maize, cassava, and other croplands located within a 10-20km wide strip centered on NR5.

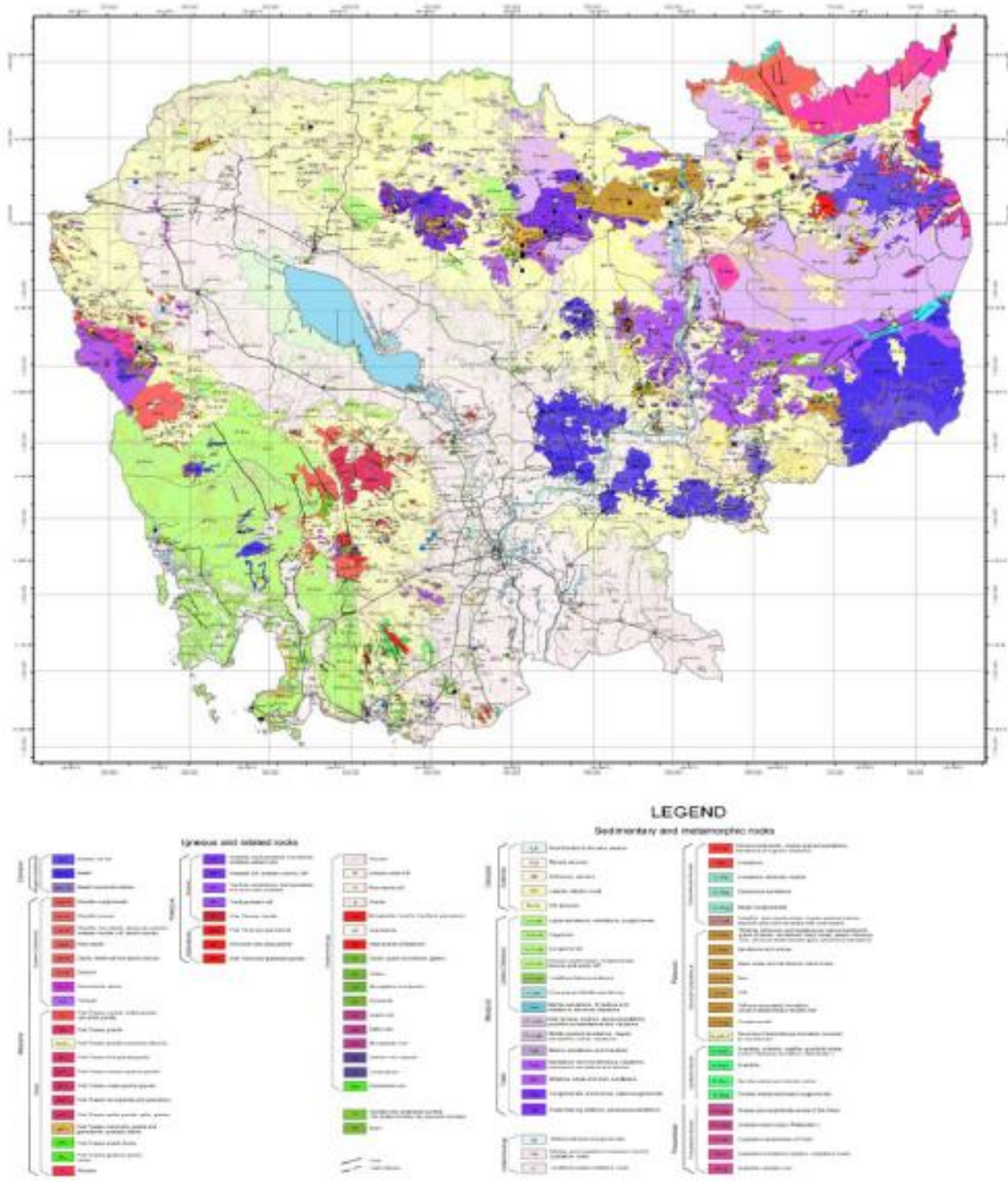
Most of the target area is in the central plain, therefore most of the terrain is flat, however, plateaus and mountains can be found in the Southwest. This region has undulated topography and many orchards, as well as pepper, cassava, and other croplands are located in this area. Due to the topography, some sections of target roads have a steep gradient.

In addition, the Tonle Sap Lake area is one of Cambodia's representative breadbasket areas, having gained fertile soil from repeated flooding, many rice fields and lotus ponds can be found in the area.

2) Geology

The geology of Cambodia is geologically composed of three distinct structures: Triassic, Jurassic-Cretaceous, and Quaternary. The Triassic is widespread in the East, while the Jurassic-Cretaceous forms an important upland in the West. In between, the Quaternary Basin occupies the entire central plain of the country.

The target roads are mainly located along NR5 in the Central Plain and are distributed from the Quaternary Basin to the Jurassic-Cretaceous in the West. Most of the target roads are laterite on the ground surface, and it is common to compact the existing laterite and use it as a subgrade.



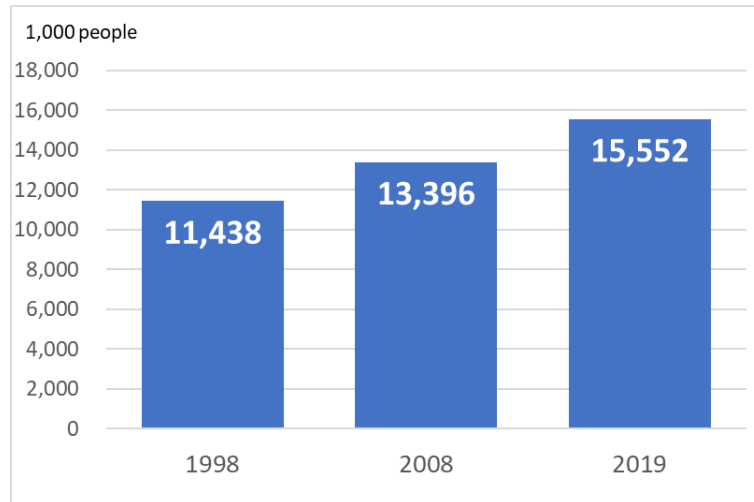
Source: Feasibility Study Report Rural Road Improvement Project III

Figure 2.1-13 Geological Map in Cambodia

2.1.3 Social Conditions

(1) Population

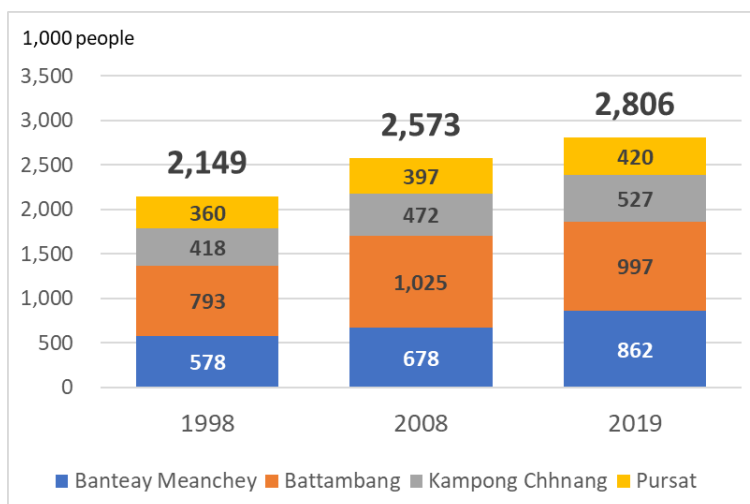
Population censuses were conducted in Cambodia in 1998, 2008, and 2019. Cambodia's population in 2019 was approximately 15.55 million, an increase of 2.16 million or 1.2 times from 2008. The average annual population growth rate is about 1.5%, and the population has been growing at a nearly constant rate since 1998.



Source: General Population Census 1998, 2008, 2019

Figure 2.1-14 Cambodia Population Trends

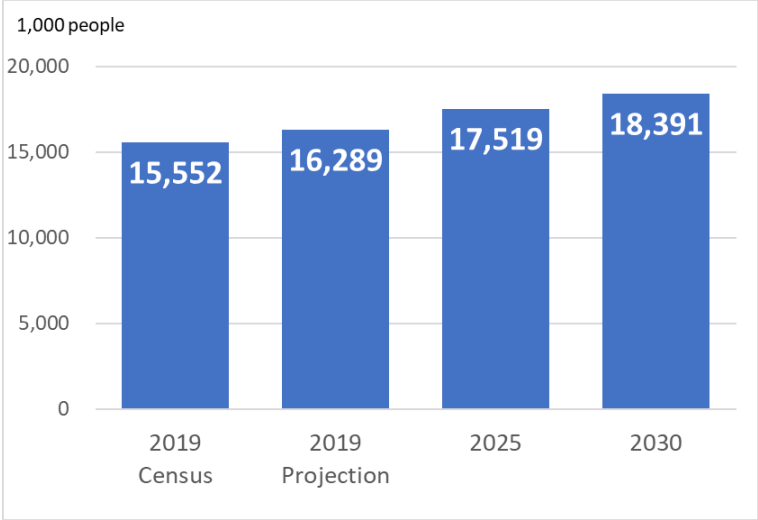
The four target provinces are home to 2.81 million people, or about 18% of Cambodia's population. The total population of the four target provinces in 2019 increased by about 230,000 people, or about 1.1 times, compared to 2008. The average annual population growth rate was about 1.3%, which tends to be slightly lower than that of the Cambodian population as a whole. Battambang Province has the largest population among the four provinces, accounting for about 36% of the total, but it is the only one of the four provinces with a declining population trend. The highest population growth was in Banteay Meanchey Province, where the provincial population in 2019 was about 1.3 times larger than in 2008, with an average growth rate of about 1.9%.



Source: General Population Census 1998, 2008, 2019

Figure 2.1-15 Population Trends in the Four Target Provinces

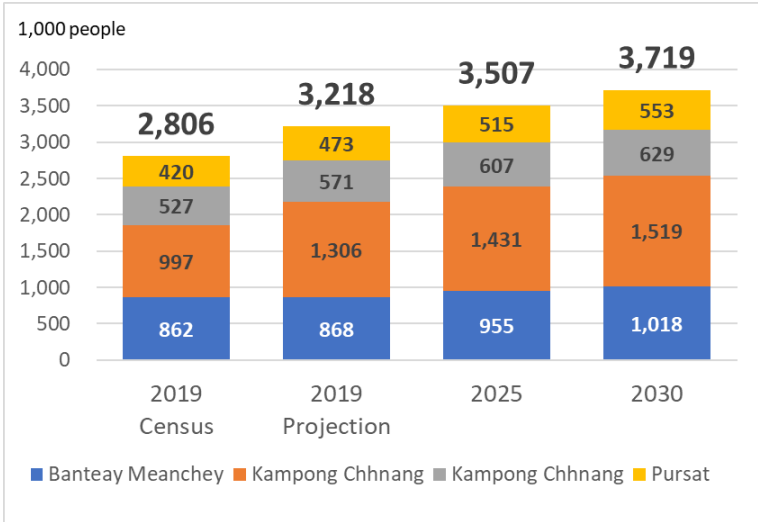
Cambodia's future population projections are based on the Population Projections for 2008-2030 from the 2008 Population Census. The report projects that Cambodia's future population will be 17.52 million in 2025 and 18.39 million in 2030. The average annual population growth rate is projected to be about 1.2% from 2019 to 2025 and 1.0% from 2026 to 2030, with the rate of growth decreasing each year. The population confirmed by the census in 2019 was about 5% (about 740,000 people) less than the report's projections.



Source: Population Projections for 2008-2030

Figure 2.1-16 Future Population Projections for Cambodia

The future population of the four target provinces is projected to be 3.51 million in 2025 and 3.72 million in 2030. The average annual population growth rate is projected to be about 1.5% from 2019 to 2025 and about 1.2% from 2026 to 2030, with the population growing faster than Cambodia as a whole. By province, Banteay Meanchey, Battambang, and Pursat provinces are set to have a higher average annual population growth rate than Cambodia as a whole. On the other hand, Kampong Chhnang Province has a lower rate, approximately 1.0% from 2019 to 2025 and 0.7% from 2026 to 2030. A comparison of the 2019 Population Census with the report's projections reveals that the census population in the four target provinces is about 15% (about 410,000 people) less than the population that had been projected. The gap between actual and projected values is particularly large in Battambang Province, where actual values are more than 30% lower than projected values.



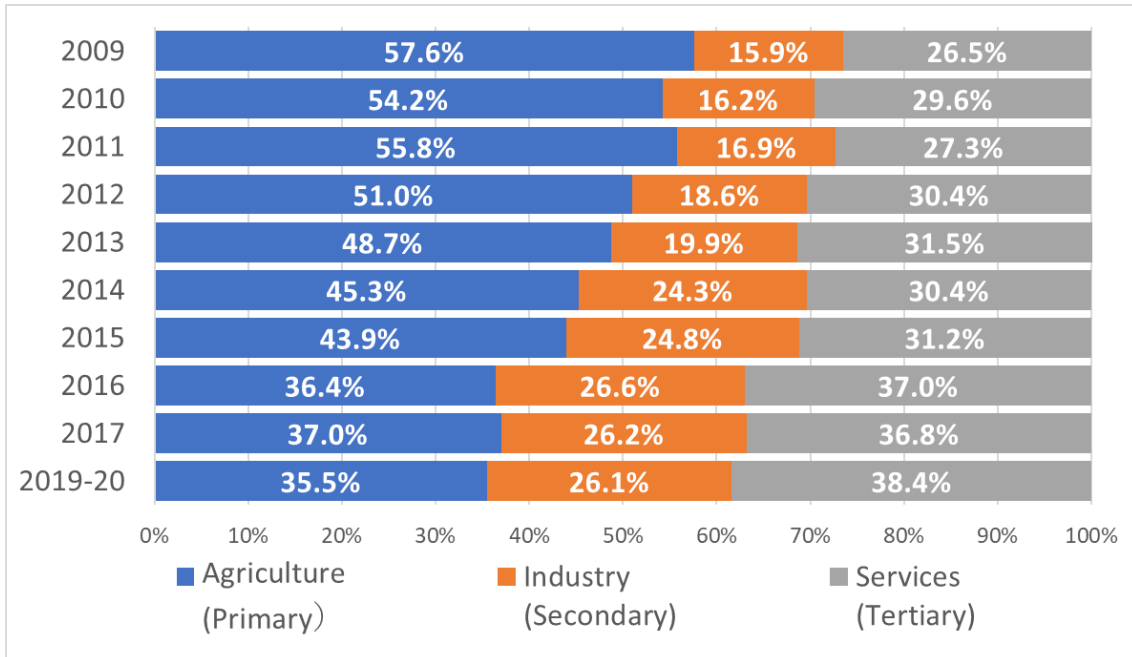
Source : Population Projections for Cambodia 2008-2030

Figure 2.1-17 Population Trends in the Four Target Provinces

(2) Industry

Agriculture has been the main industry in Cambodia for many years, but the share of agricultural workers has been declining in recent years. In 2019, the share of agricultural workers was 35.5%, down more than 20% from a decade ago. On the other hand, the share of secondary and tertiary industry workers has been increasing, and the share of tertiary workers in 2019-2020 was 38.4%, exceeding the share of primary industry workers for the first time.

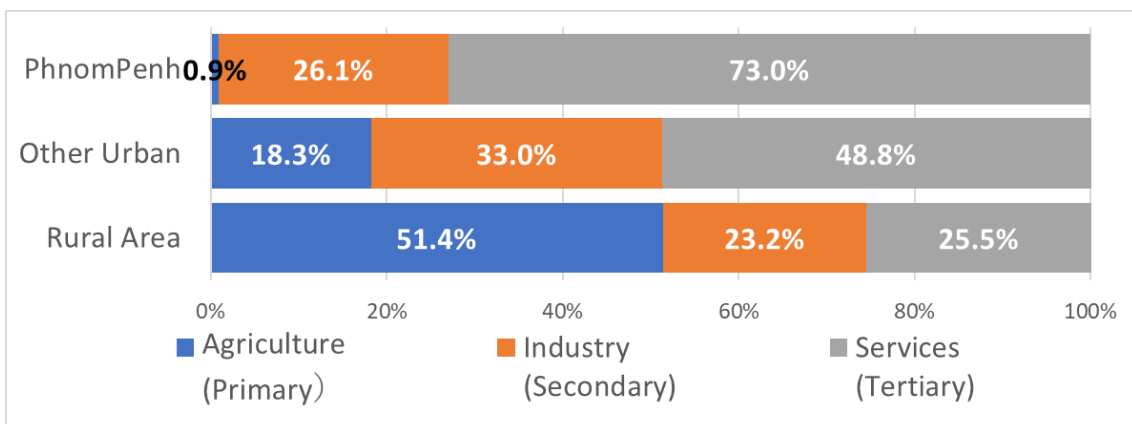
The following table shows the percentage of workers by industry in Cambodia.



Source: Statistical Yearbook of Cambodia 2021

Figure 2.1-18 Percentage of Employed Population by Industry in Cambodia

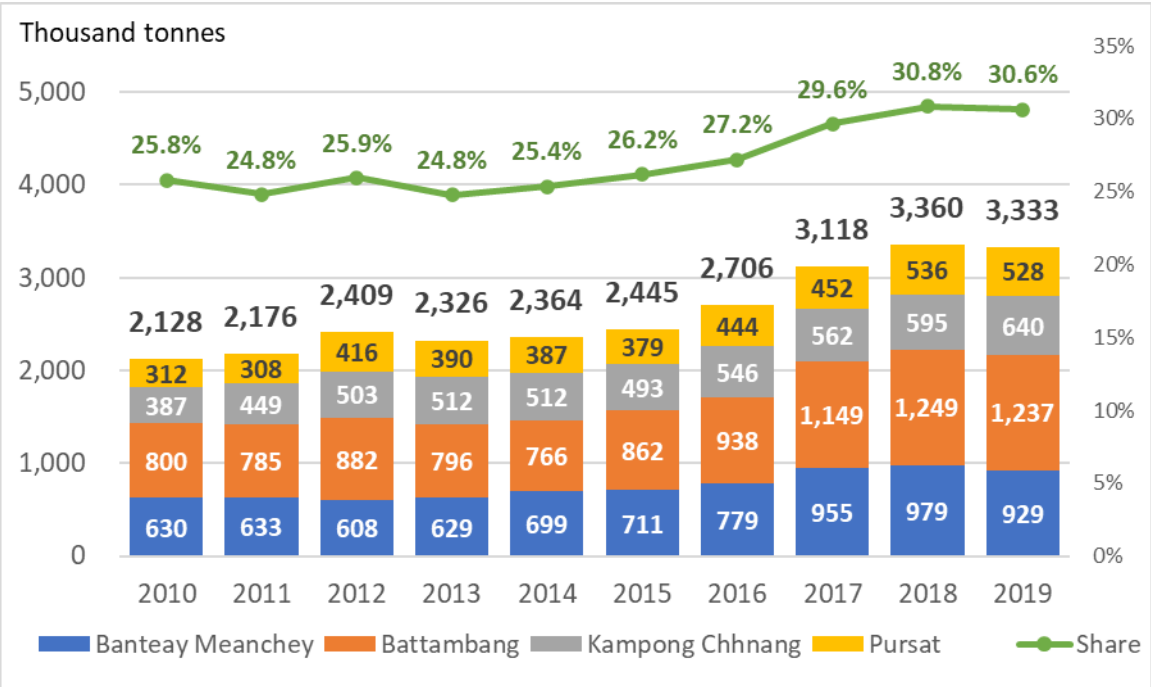
By region, Phnom Penh and the major cities in Cambodia have a large percentage of tertiary industry workers. On the other hand, agriculture is the main industry in the rural areas, as more than half of the workers are engaged in the primary industry. Below are the percentages of employed population by industry (2019-2020) presented in the form of a comparison between Phnom Penh, other urban areas, and rural areas.



Source: Statistical Yearbook of Cambodia 2021

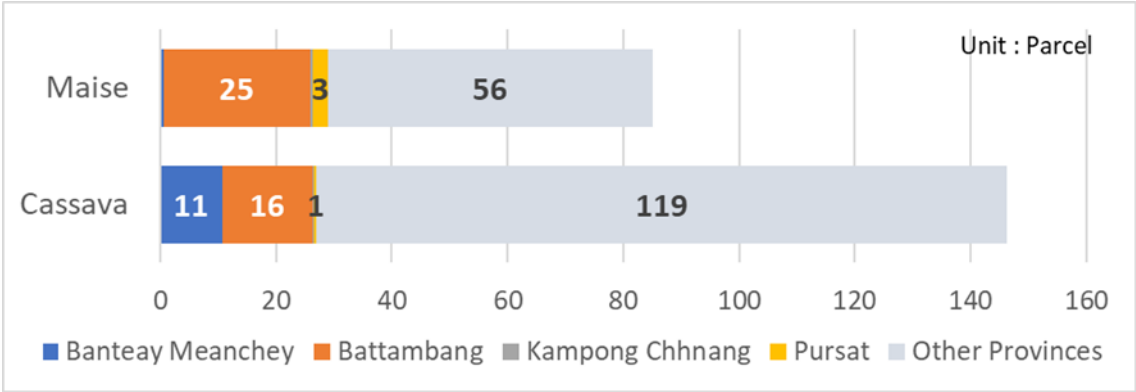
Figure 2.1-19 Percentage of Employed Population by Industry in Cambodia (2019): Comparison of Phnom Penh, Other Urban Areas, and Rural Areas

The target area benefits from the vast plains and fertile lands of Tonle Sap Lake, and is a prosperous agricultural area, especially in rice, corn, and cassava production. Rice production in the target area has been increasing year by year and accounts for about 31% of the total production in Cambodia. By province, rice production is particularly active in Battambang and Banteay Meanchey provinces.



Source: Statistical Yearbook of Cambodia 2021

Figure 2.1-20 Trends in Rice Production and its Share in the Four Target Provinces

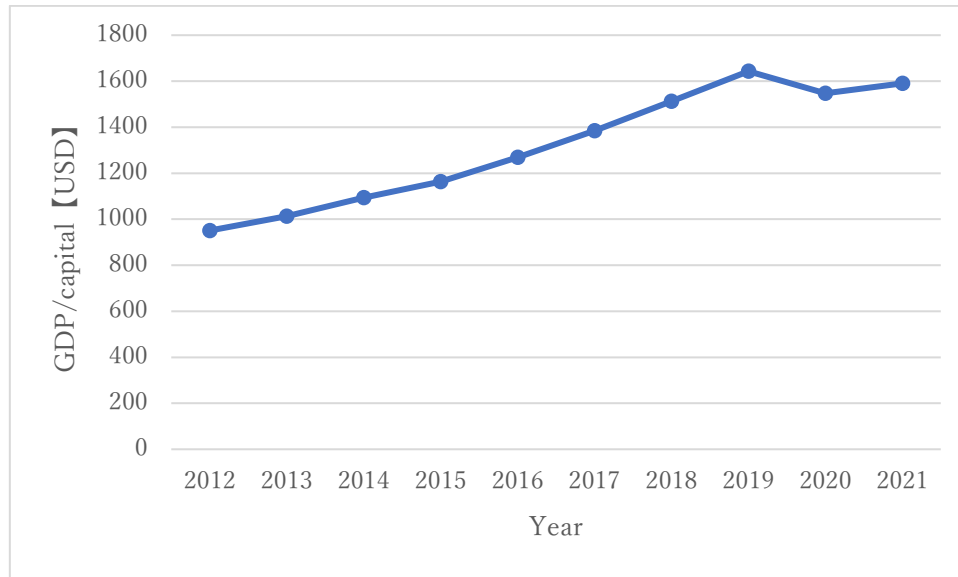


Source: Agriculture Census of Cambodia 2019

Figure 2.1-21 Corn and Cassava Production in the Four Target Provinces (2013)

(3) Income Level

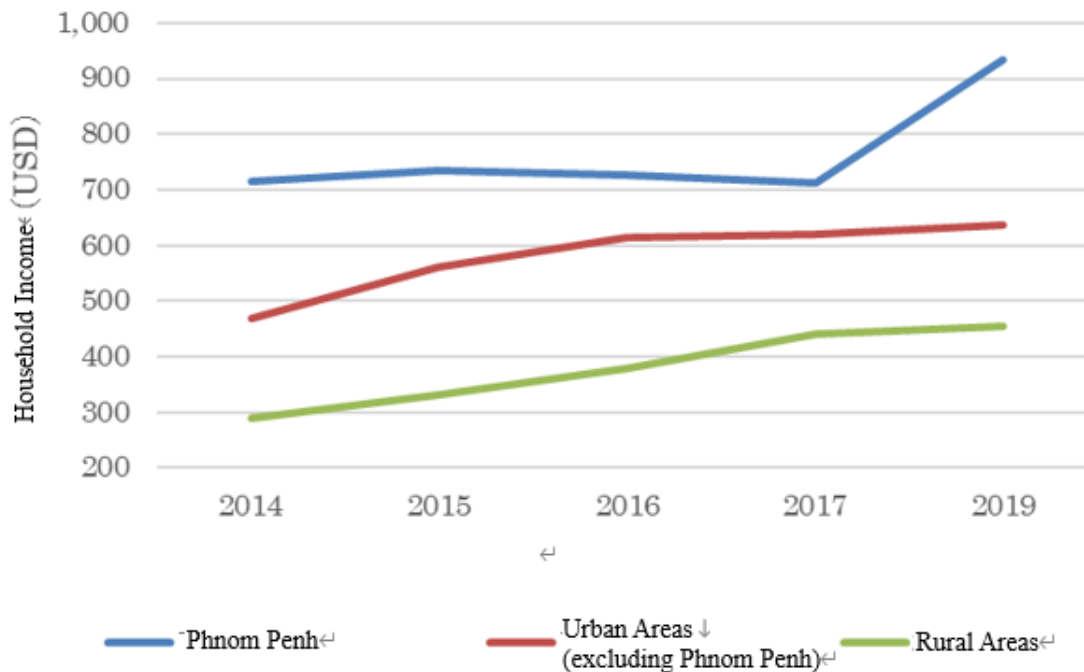
Figure 2.1-22 shows Cambodia's gross domestic product (GDP) per capita, which as of 2021 was 1,590 USD. The year 2020 saw a decrease in GDP per capita due to COVID-19, but an increase of about 1.7 times compared to 2012.



Source: Based on World Bank

Figure 2.1-22 Gross Domestic Product Per Capita

Figure 2.1-23 shows trends in household income per month by region. Household incomes in the capital, urban, and rural areas are rising; however, comparing the capital (Phnom Penh) to the rural areas, the income disparity is about twice as large.



Source: Based on Report of Cambodia Socio-Economic Survey 2019/20

Figure 2.1-23 Household Income Per Month

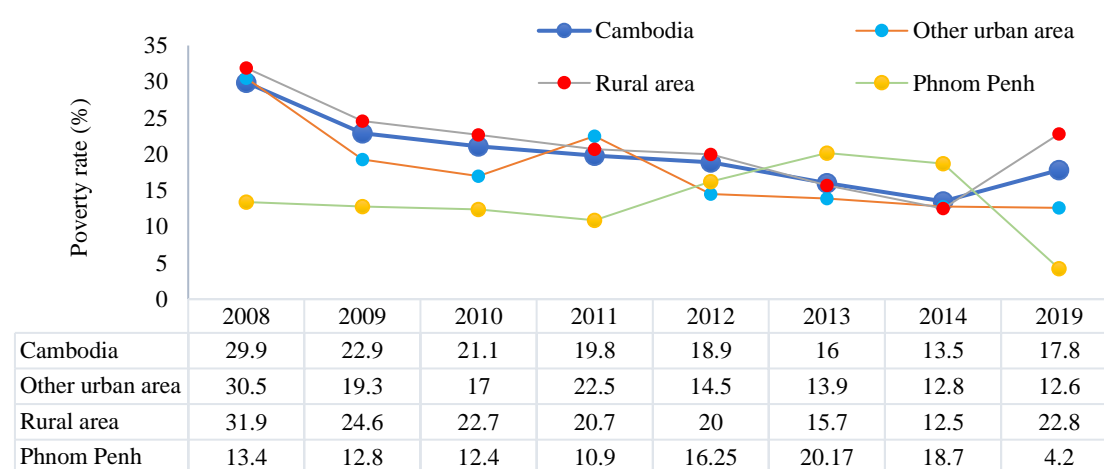
(4) Poverty Rate

The poverty rate is defined as each person having the income and resources to consume 2,000 kilocalories per day, based on daily consumption of food, non-food items, and water. The government defines the amount of that poverty line as shown in Table 2.1-4. In the new poverty line and poverty rate for Cambodia for 2019-2020 published by the Ministry of Planning, the poverty line for Cambodia is set at 10,951 Riel/day.

Table 2.1-4 Comparison of Poverty Rates by Region (Riel/day)²

Area	1997	2009	2019 ³
Phnom Penh	4,185	6,347	10,951
Other urban area	3,438	4,352	9,571
Rural area	3,213	3,503	8,908
Cambodia	3,332	3,871	10,951

Source: POVERTY IN CAMBODIA –A New Approach *Redefining the poverty line*, MOP, 2013



Source: National Institute Statistics

Figure 2.1-24 Cambodia Poverty Rate Transition (2008-2019)⁴

Poverty rates in the target area are detailed in 3.2.3(3).

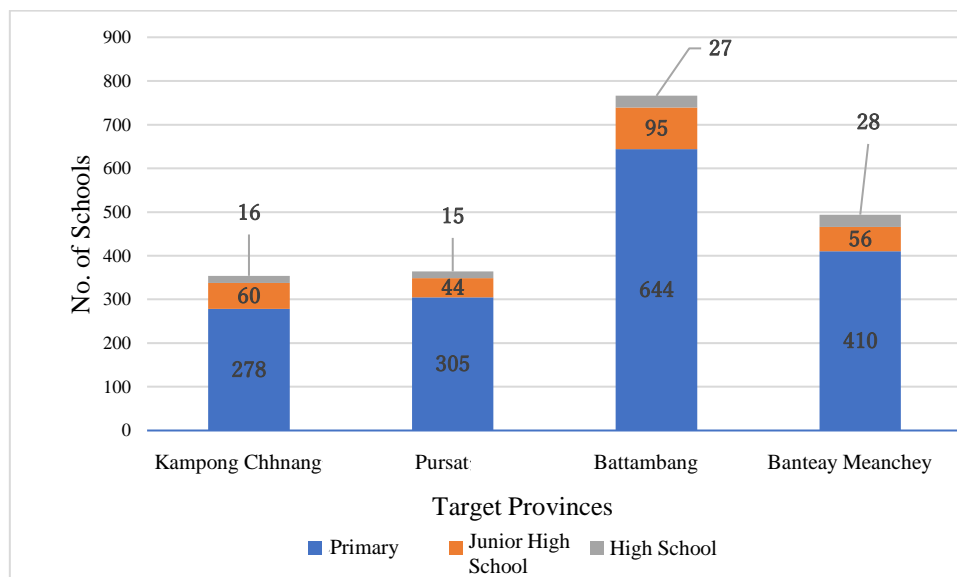
² POVERTY IN CAMBODIA –A New Approach *Redefining the poverty line*, MOP, 2013

³ Declaration No. 0909 on *new poverty line and poverty rate in Cambodia 2019-2020*, MOP, 2021

⁴ National Institute of Statistic, <https://www.nis.gov.kh>

(5) Educational Environment

The education system in Cambodia consists of six years of primary school, three years of junior high school, and three years of high school, with elementary and junior high school education being compulsory. Figure 2.1-25 shows the number of elementary schools, junior high schools, and high schools in the target provinces. There are more elementary schools in Battambang Province than in the other provinces.



Source: Based on Public Education Statistics & Indicators

Figure 2.1-25 Number of Schools by Provinces

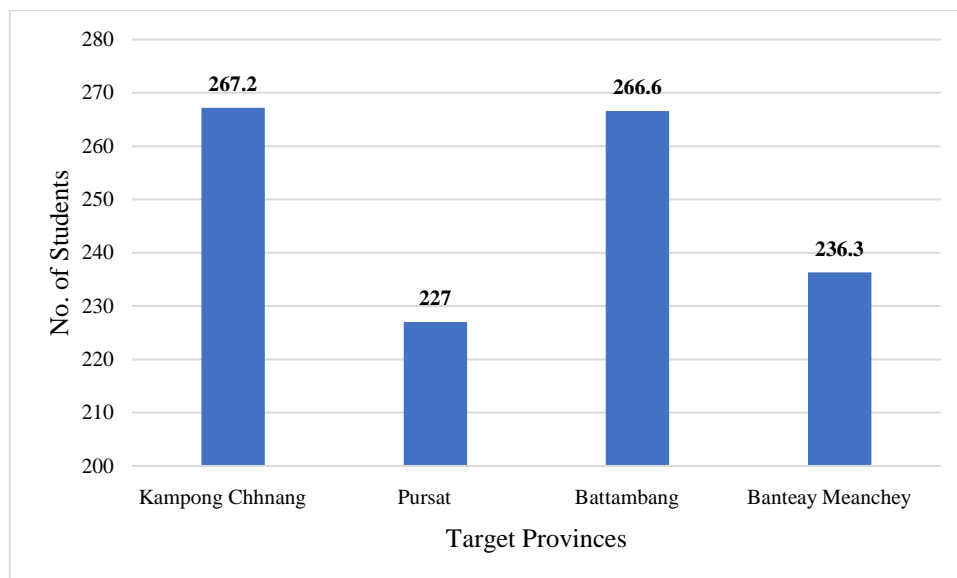
As shown in Table 2.1-5, the coverage area per school tends to be larger in Banteay Meanchey Province for both elementary, junior high and high schools.

Table 2.1-5 Number of Schools Per Provincial Area

	Elementary school	Junior High School	High School
	Km ² /Elementary school	Km ² /Junior High School	Km ² /High School
Kampong Chhnang	19.9	92.0	345.1
Pursat	41.6	288.5	846.1
Battambang	18.2	123.7	435.1
Banteay Meanchey	162.6	1190.7	2381.3

Source: Based on Public Education Statistics & Indicators

Figure 2.1-26 shows the number of elementary school students per school. Students in Kampong Chhnang and Battambang tend to be larger than those in Pursat and Banteay Meanchey. Since there are six grades of elementary schools, the number of students per grade ranges from 37 to 44.



Source: Based on Public Education Statistics & Indicators

Figure 2.1-26 Number of Students Per Elementary School

(6) Medical Insurance

Medical facilities in Cambodia are classified into national hospitals, referral hospitals (provincial/county hospitals), health centers, and health posts. Health centers and health posts are mainly for rural residents and provide primary diagnosis, first aid, treatment of chronic diseases, maternal and child health care, and vaccinations. On the other hand, referral hospitals provide medical care to patients who cannot be cared for by health centers or health posts, and the services provided by referral hospitals are called Complementary Package of Activity (CPA), which are divided into three classes: CPA1, CPA2, and CPA3.

Following the above classification, CPA1 includes hospitals that cannot handle major surgeries requiring general anesthesia, CPA2 refers to hospitals that can handle major surgeries requiring urgent care and anesthesia, and CPA3 includes hospitals that can handle major surgeries requiring urgent care and anesthesia and that have a larger number of beds than the ones provided by CPA2 hospitals. The table below shows the number of public medical facilities in the target provinces, with the largest number of medical facilities in Battambang and Banteay Meanchey provinces.

Table 2.1-6 Number of Public Health Care Facilities in Target Provinces

Target Provinces	National Hospitals	Referral Hospitals (Provincial/County Hospitals)	Health Centers	Health Posts	Total
Kampong Chhnang	0	3	42	2	47
Pursat	0	4	40	4	48
Battambang	0	6	77	6	89
Banteay Meanchey	0	9	66	10	85

Source: Based on Statistical Yearbook 2021

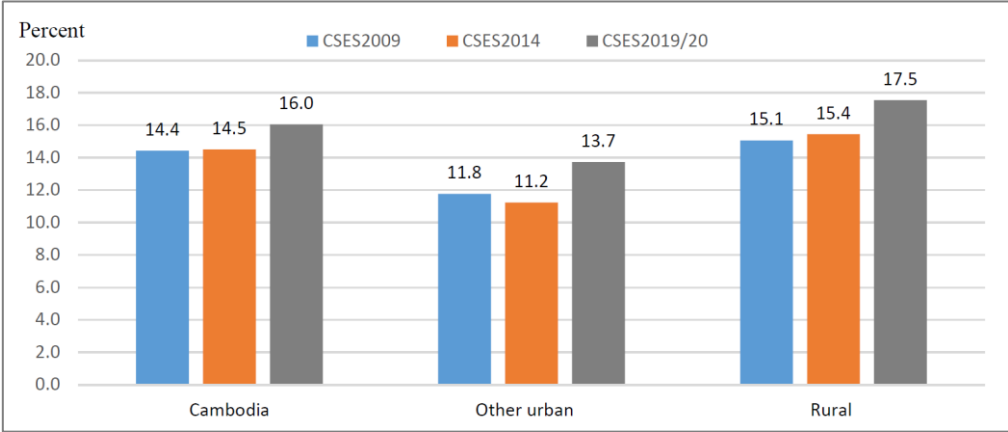
Table 2.1-7 shows the covered population per medical facility and the covered area per medical facility in the target provinces. One medical facility was found to cover approximately 10,000 people, with Pursat having the lowest covered population per medical facility.

Table 2.1-7 Covered Population and Coverage Area Per Medical Facility in the Target Provinces

Target Provinces	Covered Population per Medical Facility	Covered Area per Medical Facility
	Person/Medical Facility	Km2/Medical Facility
Kampong Chhnang	11,213	117.5
Pursat	8,749	264.4
Battambang	11,204	132.0
Banteay Meanchey	10,139	784.5

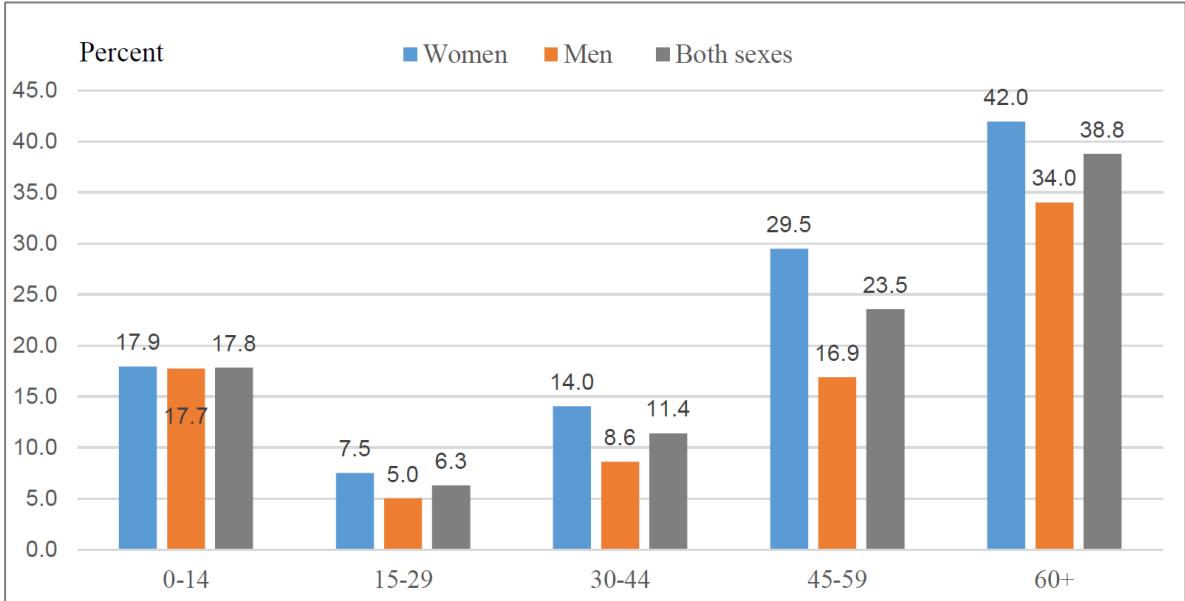
Source: Based on Statistical Yearbook 2021

According to the Cambodia Socio-Economic Survey 2019/2020, 16% of residents were sick or injured in a month, and the percentage is increasing year by year. Rural areas have slightly higher rates of injury and sick than urban. The percentage of respondents aged 60 and over was the highest, accounting for about 40% of the total.



Source: Cambodia Socio-Economic Survey 2019/2020

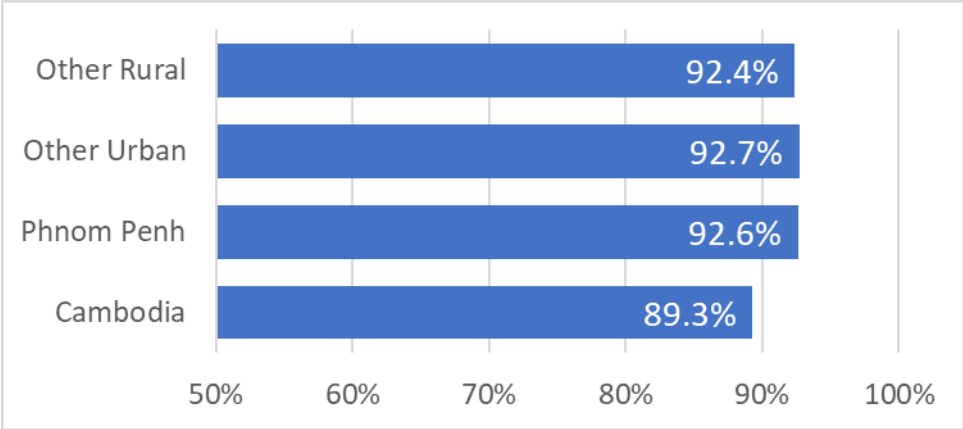
Figure 2.1-27 Ratio of People Injured or Sick in One Month by Region



Source: Cambodia Socio-Economic Survey 2019/2020

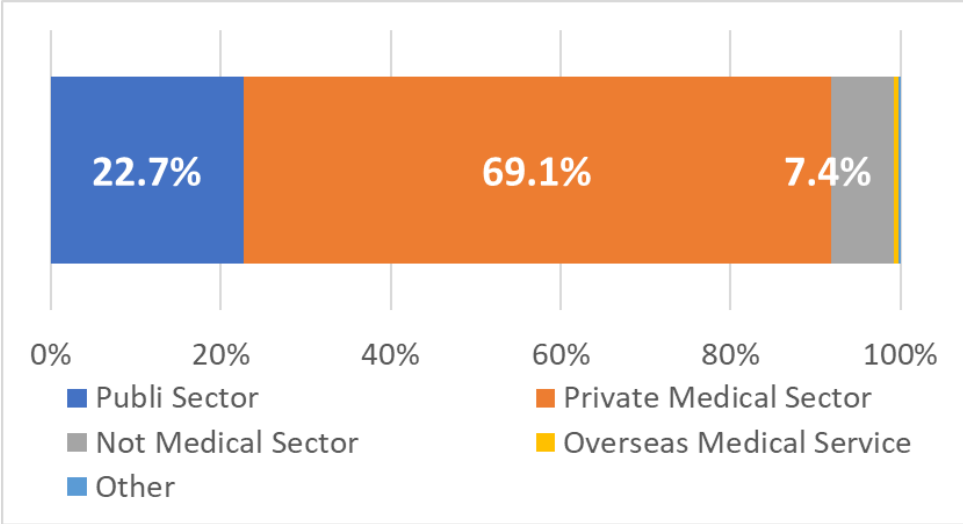
Figure 2.1-28 Ratio of People Injured or Sick in a Month by Age Group

About 90% of the residents who became sick or injured in the past month have been treated at a hospital. In addition, about 70% of the residents who received medical check used private medical facilities, and about 25% used public medical facilities. In Cambodia, it is customary to visit a medical facility when injured or sick, and it is assumed that residents in the target area also regularly visit a hospital.



Source: Cambodia Socio-Economic Survey 2019/2020

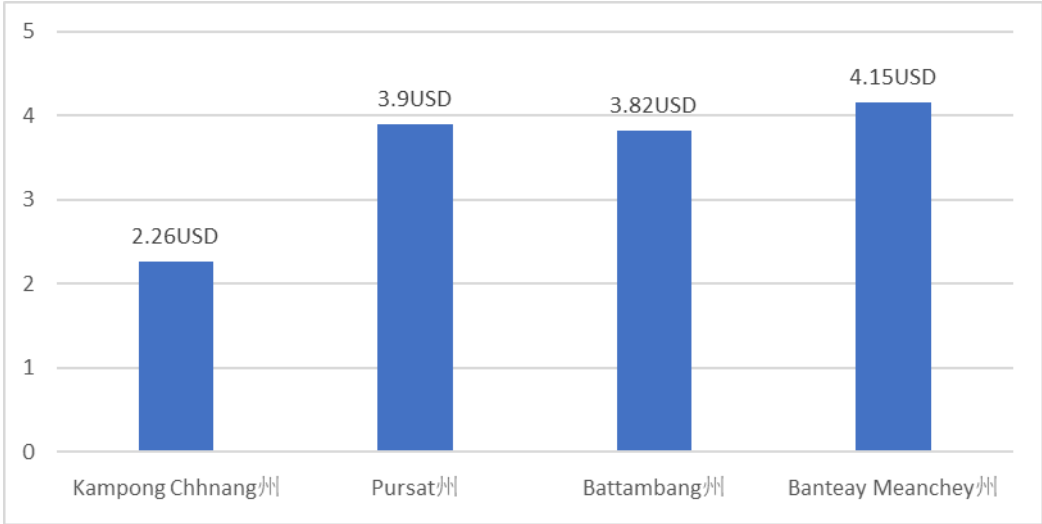
Figure 2.1-29 Ratio of Injured or Sick People Who Used Medical Facilities in a Month



Source: Cambodia Socio-Economic Survey 2019/2020

Figure 2.1-30 Ratio of Patients Using Medical Facilities

Figure 2.1-31 shows the average monthly transportation costs for hospital visits per household. In Kampong Chhnang, transportation costs tend to be lower because the coverage area per medical facility is smaller than in the other target provinces. On the other hand, in Banteay Meanchey, transportation costs tend to be higher due to the larger coverage area per medical facility.



Source: Cambodia Demographic and Health Survey 2014

Figure 2.1-31 Average Monthly Transportation Costs for Hospital Visits

2.2 Current Status and Challenges of the Rural Road Sector

2.2.1 National and Provincial Roads

Roads in Cambodia are classified into three categories: national roads (one-digit and two-digit national roads), provincial roads (three and four-digit national roads), and rural roads. The total road length of national and provincial roads in Cambodia is 16,292 km, of which 7,261 km are national roads (2,254 km of one-digit national roads and 5,007 km of two-digit national roads) and 9,031 km are provincial roads. The pavement rate of one-digit national roads is 100%, two-digit national roads 72%, and provincial roads 30%, indicating that the pavement rate of provincial roads is still low.

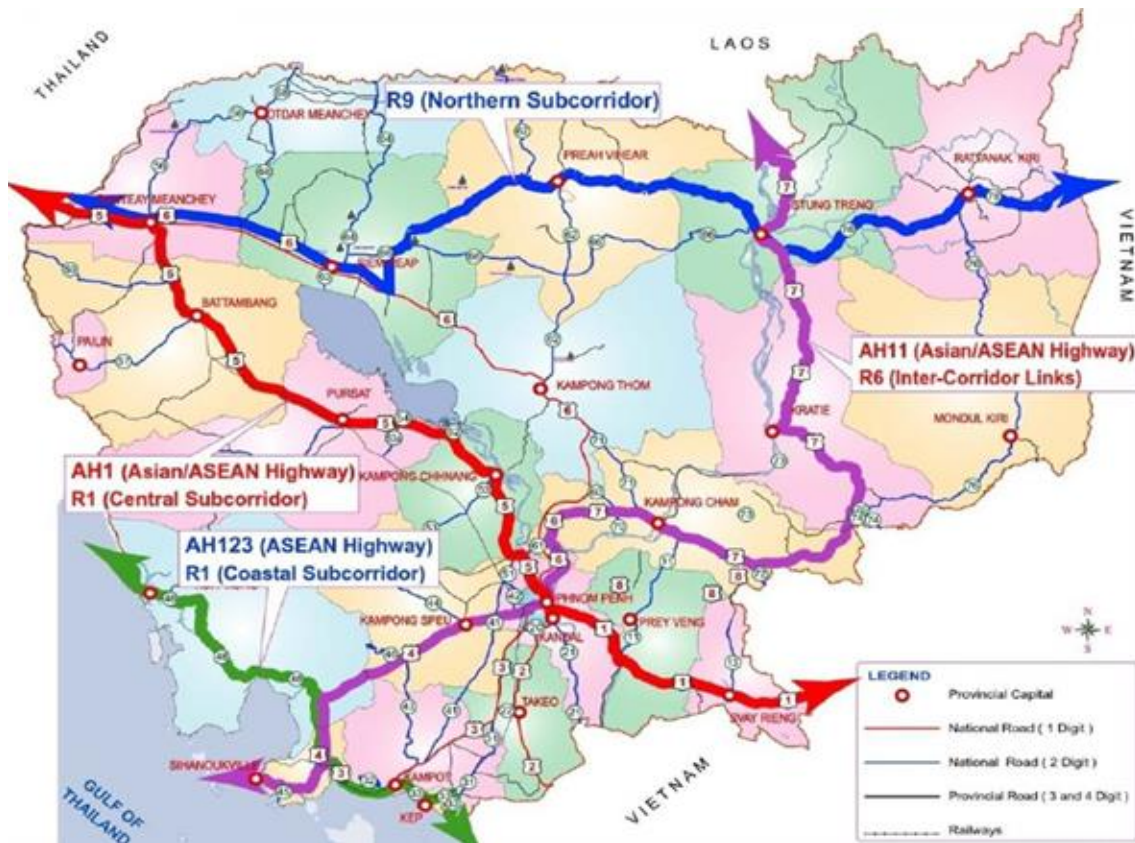
Table 2.2-1 Road Classification and Pavement Ratio

Road Classification	Definition of Road Classifications	Length (Km)	Pavement Ratio (%)	Management Authority
NR (one-digit)	• Roads connecting local cities with the capital and other large cities	2,254	3.41%	MPWT
NR (two-digit)	• Roads connecting local cities to regional cities • Roads connecting national roads to regional cities	5,007	7.58%	MPWT
Provincial Road (three/four-digit)	• Roads connecting local cities to the center of the province • Roads connecting provincial centers to national roads • Roads connecting provincial roads to provincial roads	9,031	30%	MPWT
Total		16,292		

Source: MPWT, 2020 and MRD, 2020 for road and 2017 for bridge

With high economic growth in Cambodia, the volume of logistics is increasing year by year. Roads connecting ports and major cities, as well as roads connecting borders with Thailand and Vietnam, are positioned as Asian Highways (see Figure 2.2-1). National Roads 1 (NR1) and 5 (NR5), the route connecting Bangkok-Phnom Penh-Ho Chi Minh City, are designated as Route 1 of the ASEAN Highway Network and the Asian Highway Network, as well as the Southern Economic Corridor in the Greater Mekong Subregion and the Southern Economic Corridor of the Greater Mekong Subregion (GMS). Therefore, both NR1 and NR5 are important international transportation routes.

Under this context, Japan is committed to supporting the rehabilitation of NR5 (e.g., widening from two to four lanes) with JICA providing a yen loan in May 2013 for the rehabilitation of an 83.5-km section from Sisophon to Battambang, near the Thai border. Since then, JICA has also provided a yen loan for a 368-km section of NR5 from Poipet to Prek Kdam on the Thai border. Currently, the project covers the Southern section (139km between Prek Kdam and Thlea Ma'am), the central section (130km between Thlea Ma'am and Battambang, plus an additional 16 km between Sisophon and Poipet on the Thai border), and the Northern section (139 km between Prek Kdam and Thlea Ma'am and an additional 16 km between Thlea Ma'am and Battambang on the Thai border). In particular, the central section is expected to be in service in 2023. The Northern section (83.5 km between Battambang and Sisophon, including a bypass that bypasses the city) was completed in 2021 and put into service in 2022.



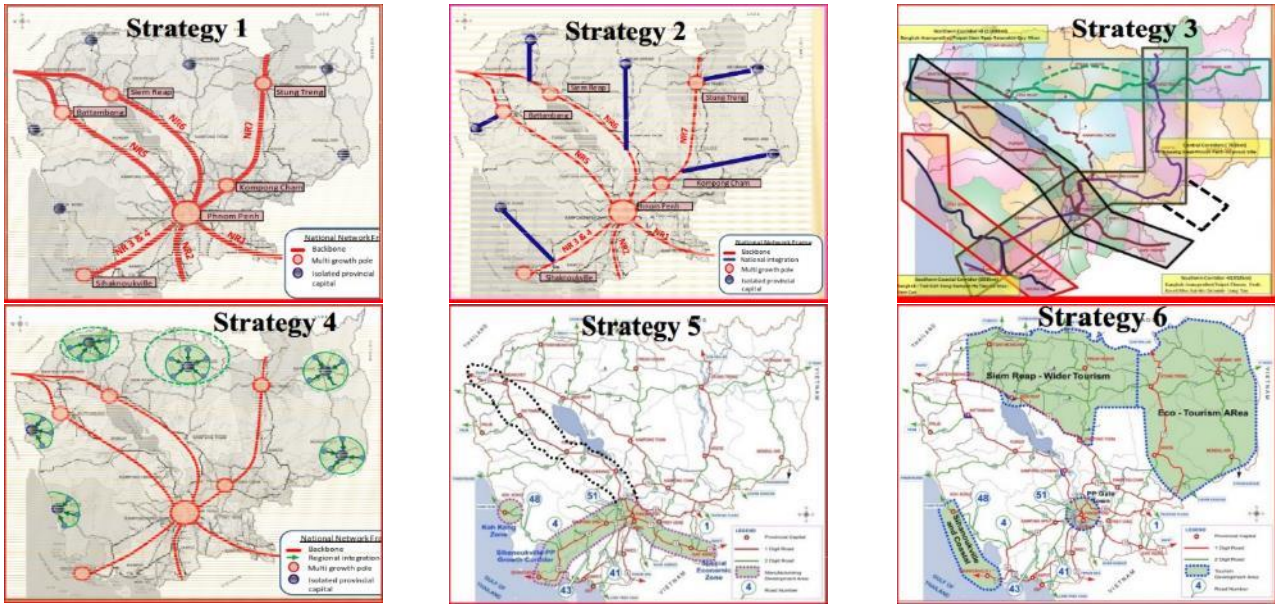
Source: MPWT, 2017

Figure 2.2-1 Asian Highway Network

JICA's "National Road Network Study in Cambodia" (2006) set forth the following six strategies to formulate and revise a master plan for the national road network, develop trunk roads as the national backbone, and promote multipolar growth through major cities as regional development centers.

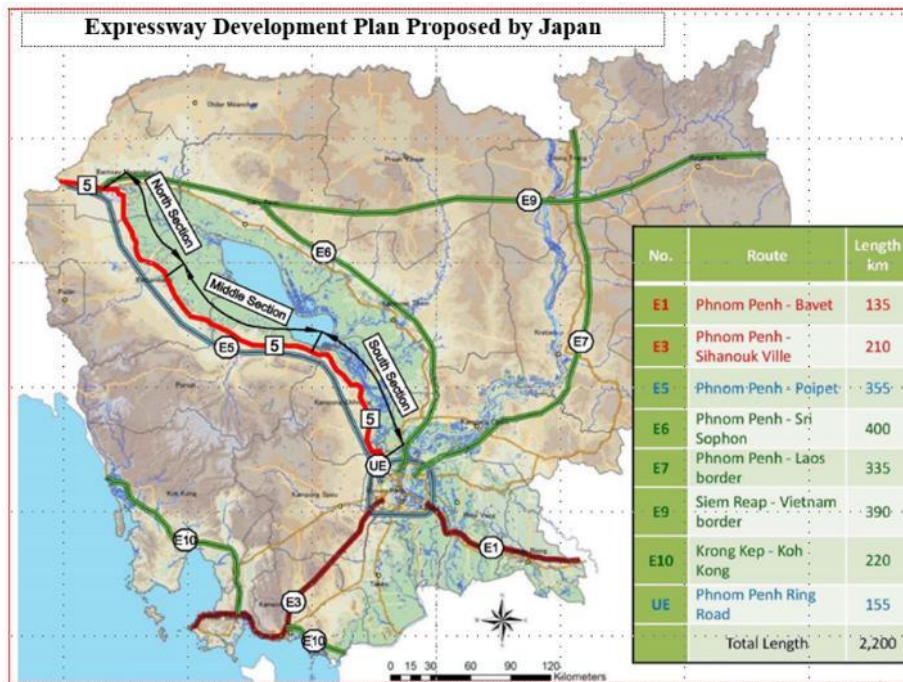
- Strategy 1: Strengthen and improve multipolar growth centers
- Strategy 2: National integration
- Strategy 3: Strengthen international corridors
- Strategy 4: Strengthen regional economic development and regional development for poverty reduction
- Strategy 5: Strengthen economic growth corridors
- Strategy 6: Promote tourism development

Regarding the development of an expressway network, JICA conducted an "Information Collection and Confirmation Study for Expressway Planning" in 2013 as one of the pillars of strengthening the road network functions, wherein it proposed a nationwide expressway network with a total length of 2,200 km to respond to the increasing traffic demand.



Source: Overview on Transport Infrastructure Sectors in the Kingdom of Cambodia (2022)

Figure 2.2-2 Road Development Strategy



Source: Overview on Transport Infrastructure Sectors in the Kingdom of Cambodia (2022)

Figure 2.2-3 National Expressway Network

2.2.2 Rural Roads

The Rural Roads Master Plan (RRMP), which was created for the purpose of prioritizing the development of rural roads, classifies roads into four road hierarchies, ranging from Type 1 through Type 4, with a total length of 46,834 km. The overall paved ratio of rural roads is low, remaining at around 9%.

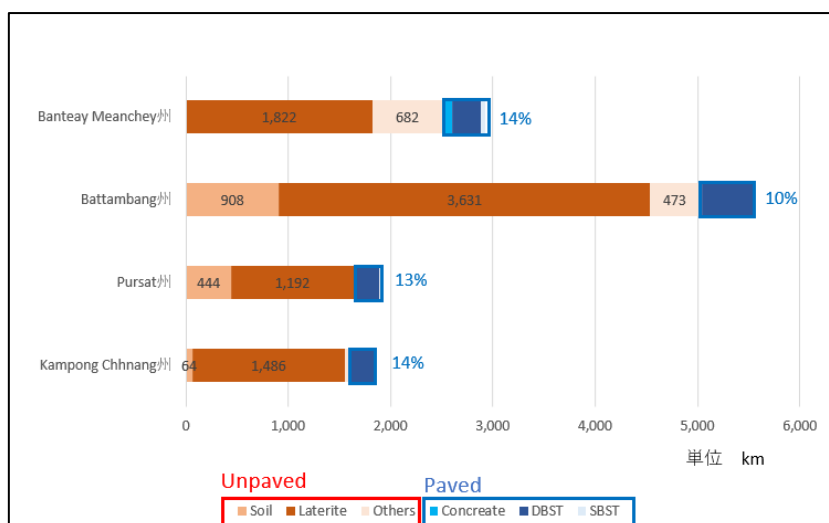
In relation to road length, Table 2.2-2 shows the road length by road classification: the average road length per route for Type 1 is about 14 km, but the average road length per route tends to get shorter as the road hierarchy gets lower. In this aspect, MRD plans to pave a total of 6,000 km of rural roads, increasing the pavement ratio from 9% to 13% by 2030.

Table 2.2-2 Description of Road Hierarchy Classification and Extension Distance

Road Hierarchy	Description of Road Hierarchy	No. of Road	Km	Km/Road
Type 1	Roads connecting national roads, provincial roads, local cities, and provinces	550	7,705	14.01
Type 2	Roads connecting local cities or provinces with communes	796	6,913	8.68
Type 3	Roads connecting communes	2,523	12,445	4.93
Type 4	Roads connecting communes to villages and villages to villages	12,392	19,771	1.6
Total		16,261	46,834	2.88

Source: RRMP

According to the Cambodian Road Registry data, there are a total of 12,220 km of rural roads in the four target provinces, with about 1/4 of all Cambodian rural roads concentrated in the target provinces. Of these, 1,470 km (12%) are paved, which is higher than the 9% pavement rate for Cambodia as a whole, but still low considering the total length of roads. Figure 2.2-4 shows the pavement status in the four target provinces, with Battambang Province having approximately 5,500 km of rural roads, more than twice the length than that of Kampong Chhnang and Pursat Provinces. On the other hand, there is no large difference in the pavement rate among the provinces.



Source: Cambodia National Road Registry

Figure 2.2-4 Pavement Conditions in the Four Target Provinces

The table below shows the road extensions by road hierarchy listed in the RRMP for the four target provinces, with only Banteay Meanchey province having Type 3 and Type 4 roads listed as candidates. Furthermore, Battambang province has a longer Type 1 road extension of 884 km than the other provinces and Kampong Chhnang province has a shorter Type 2 road extension of 90.9 km.

Table 2.2-3 Road Extensions by Road Hierarchy listed in RRMP in the Four Target Provinces

Target Province	Type 1 (km)	Type 2 (km)	Type 3 (km)	Type 4 (km)	Total (km)
Kampong Chhnang	90.9	170.9	0	0	261.8
Pursat	564.6	442.0	0	0	1,006.6
Battambang	884.0	530.7	0	0	1,414.7
Banteay Meanchey	239.7	251.7	100.6	33.3	625.3

Source: Based on RRMP

Table 2.2-4 shows the priority levels for road development in RRMP. In comparison to other provinces, Kampong Chhnang Province has a higher percentage of roads listed as high priority (52%), while the other provinces have about 35% of roads listed as high priority.

Table 2.2-4 Priority Levels of Road Development by Province in RRMP

Target Province	High	Medium	Low	Total
Kampong Chhnang	16 (52%)	6 (19%)	9 (29%)	31 (100%)
Pursat	44 (33%)	66 (50%)	23 (17%)	133 (100%)
Battambang	41 (37%)	37 (33%)	34 (30%)	112 (100%)
Banteay Meanchey	19 (35%)	24 (44%)	12 (21%)	55 (100%)

Source: Based on RRMP

2.3 Support from Japan and Other Donors and Possibility of Cooperation with Other Donors

2.3.1 Review of Existing Projects and Prior Study of Japan

(1) The Study on the Road Network Development in the Kingdom of Cambodia (2006)

The National Road Network Study was conducted for one-digit national roads, two-digit national roads, and provincial roads under the jurisdiction of Ministry of Public Works and Transport (MPWT) and provincial roads under the jurisdiction of MRD, in response to a request for the preparation of a road network development plan. It includes the improvement of administrative capacity of implementing agencies in terms of technological, institutional, and financial resources in Cambodia.

Two parts are included in the National Road Network Study: 1) Nationwide Road Network Development Master Plan Study, which focuses not only on technical aspects, such as road network planning, but also on administrative aspects such as road administration systems and improvements in maintenance and management systems; and 2) Priority Project Pre-Feasibility Study, a study proposed for early implementation by the Master Plan. The National Road Network Study is divided into three parts, of which the Road Development Plan and the Road Maintenance Improvement Plan are highly relevant to this study. The Road Development Plan describes the formulation of a road maintenance plan based on a long-term development strategy, while the Road Maintenance Improvement Plan describes proposed improvements related to the organization and administration of road maintenance and management, including financial resources and budgetary issues.

The similarities and relevance to the current project are as follows:

- Road network development following the basic principle of contributing to national governance and economic development, as well as local economic development and poverty reduction. In response to this principle, a development strategy was formulated, and the road network that needed to be developed was selected and planned.
- Project priorities were evaluated by assessing the social and economic aspects of the project, as well as the project feasibility in terms of implementation difficulty, such as the hazardous nature of the target site and the urgency of the project.
- MRD was maintaining roads without recognizing a series of maintenance and management tasks. This created a situation where MPWT, which oversees and manages road administration, experienced problems with maintenance operations that do not function effectively. These are some of the issues that were identified in the organizational management of road maintenance administration.
- The committee organized and discussed ways to improve the MRD organization's challenges, such as the tight budgetary status of MRD and the lack of knowledge of MRD staff.

(2) National Road No. 5 Improvement Project in the Kingdom of Cambodia (2013)

National Road No. 5 (NR5) is a major arterial road in Cambodia, but most of it was paved with DBST and the road was not wide enough. Moreover, the condition of the road was deteriorating due to annual flooding. Therefore, in April 2014, JICA decided to develop the Northern section of NR5 (about 68 km) as a yen loan project.

In the Southern section, after the flood of September 2011, the urgency and necessity of road rehabilitation increased, and it was decided to conduct the necessary study to rehabilitate the Southern section (about 139 km) as a yen loan project. As a result, in June 2015, the development of the Southern section of NR5 was carried out.

Furthermore, from the viewpoint of consistency in road maintenance, the Government of Cambodia (GOC) requested that the remaining central section (between Sreeramaam and Battambang) be studied in parallel with the study of the Southern section, and after conducting a preparatory study, detailed design and construction supervision are currently being carried out.

The similarities and relevance to the current project are as follows:

- Using the social and natural condition data collected on NR5 as a reference, a survey of natural conditions such as climate, weather, natural disasters, topography, and geology of the latest target area was conducted.
- The project included designing for natural environmental conditions (especially during flood season) such as road rehabilitation, bridge rehabilitation, and the addition of culverts, as well as studying and estimating project costs for the installation of traffic safety facilities in hazardous areas where traffic accidents could occur.
- Concerning the operation and maintenance management system, operational issues and technical support were studied and necessary measures were examined and proposed.

(3) The Project for Strengthening Capacity for Maintenance of Roads and Bridges (2018)

The roads and bridges in Cambodia have been deteriorating due to heavy vehicle traffic and periodic river flooding, thus the importance of road and bridge maintenance in the country has been increasing. MPWT, responsible for infrastructure development and maintenance in Cambodia, had reached the point where it could perform basic tasks such as inspections and records related to road maintenance and management through JICA, but had not yet established a systematic method to make appropriate budget requests. In particular, since basic tasks such as periodic inspections had not yet been implemented for bridge maintenance and management, work focused on improving bridge maintenance and management capacity was to be carried out.

The said project can be used as reference for the current project as described below:

- The bridge maintenance management cycle was developed to promote understanding of the road maintenance cycle, which consists of five elements: inspection, evaluation, handling (repair), and database management.
- The capacity of MPWT's Road Maintenance Department in road/bridge inspection and repair was strengthened.
- The database within MPWT was integrated, shared, and updated among relevant ministries and projects, and existing road maintenance manuals and road repair manuals were revised.

(4) The Project for Capacity Enhancement on Environmental and Social Considerations in Implementing Agency in Road Sector (2019)

In Cambodia, demand for logistics is increasing with economic growth, and regional disparities are widening. In order to correct such disparities and promote further economic growth, it is important to further develop transportation infrastructure. In addition, for sustainable infrastructure development, the

negative impact of project implementation on the natural and social environment must be minimized as much as possible, and the design and construction must meet environmental and social needs.

The Government of Cambodia (GOC) had been facing issues, such as delays in project implementation due to the lack of a system and implementation framework for securing land for roads and resettlement. MPWT, which is in charge of road management, and the implementing agency, which is the main body of the project, did not have a department with jurisdiction over environmental and social considerations, and past information was not organized and shared.

GOC requested the Japanese Government to undertake a technical cooperation project and as a result "The Project for Capacity Enhancement on Environmental and Social Considerations in Implementing Agency in Road Sector" was formulated to strengthen the capacity for environmental and social considerations in MPWT. Project implementation started on December 2016.

The above-mentioned project can be used as reference for the current project as described below:

- Based on the Land Management Framework for Cambodia and other countries, past lessons learned on ROW management were organized and current issues were analysed.
- The preparation of road environmental guidelines has strengthened the implementation system for environmental considerations related to EIAs and EMPs.
- The implementation system of social considerations managed for road land management was strengthened through the formulation of a ROW management system.

(5) Project for Improvement of Road Traffic Safety on Trunk Road (2021)

In view of the deteriorating road conditions and future increase in traffic demand, NR5 was widened, a bypass was constructed, and pavement was repaired under a yen loan project. On the other hand, traffic accidents have been increasing with the acceleration of motorization in Cambodia, and traffic accidents on trunk roads have become particularly serious. Of the 74% of traffic fatalities that occur on trunk roads, 18% occur on NR5. With further economic growth expected in the future, the number of traffic accidents and traffic fatalities is expected to increase along with the increase in traffic volume. Therefore, road traffic safety on NR5 and other trunk roads is an urgent issue. This project will contribute to increasing transportation capacity and improving transportation efficiency in the target area while ensuring the safety of local residents by verifying traffic safety measures, strengthening the organizational structure and human resource development related to traffic safety measures, and promoting educational activities along NR5. The project will contribute to the enhancement of transportation capacity and improvement of transportation efficiency in the target area while ensuring the safety of residents.

The said project can be used as reference for the current project as described below:

- Road maintenance facilitates traffic flow and increases the risk of vehicles over speeding. Therefore, the project aims to promote behavioural change among drivers, identify and analyse traffic behaviours, and verify the effectiveness of the implementation, to identify which are issues in promoting traffic safety.
- To improve the capacity for safe road measures, a manual for road safety assessment, road safety facility measures, and evaluation and verification of measures will be developed and implemented.
- For traffic safety education, regional communities, including schools, businesses and factories, roadside residents, and farmers, were targeted, and local characteristics were taken into account in a comprehensive traffic safety program.

(6) The Preparatory Survey on the Project for Flood Rehabilitation and Mitigation in the Kingdom of Cambodia (2012)

Cambodia is located on the lower Mekong River and much of the country consists of low and flat terrain. As a result, the proportion of the population at risk of death from flooding and the proportion of the economy at risk of flooding are extremely high. In 2000, the Mekong River experienced the worst flood in its history, and the country was in a state of emergency when two embankment roads on National Road No.1 (NR1) were blocked to prevent flooding in the center of Phnom Penh. Furthermore, in 2011 the city of Phnom Penh experienced more rainfall than usual on the upper reaches of the Mekong River, but fortunately the strengthened flood control measures in Phnom Penh were effective and prevented serious damage. However, flooding occurred over a wide area in the surrounding areas, causing extensive damage. In Kampong Chhnang, the target area, most of the city, including NR5, was inundated for more than a month, and roads in the city were severely damaged, requiring full-scale restoration.

The said project can be used as reference for the current project as described below:

- The natural conditions of weather, hydrology, and hydraulics were investigated, and a plan that provided the durability, safety, and functionality required for the facility in question to meet these conditions was proposed.
- For road maintenance and management, a durable and easy-to-maintain structure was considered within an economical range, and road drainage facilities were designed to prevent clogging by installing mud puddles and trash barriers, and other measures were taken into consideration using local drainage conditions.
- Considering the use of construction companies and consultants, a construction plan that would enable local contractors to construct the project under the guidance of Japanese engineers while making the most of their capabilities was examined. In addition, construction plans and schedules that took into account natural conditions and traffic conditions, and proposed construction methods that would not adversely affect the environment, traffic, or residents in the local area were considered.
- Environmental institutions and organizations were identified and reviewed, environmental impact assessments were conducted, environmental and social impact mitigation measures were studied, and draft environmental monitoring plans were prepared.

2.3.2 Trends of Support from Other Donors

The following projects of other donors have been implemented in the target area since 2011.

Table 2.3-1 The Projects Funded by Other Donors⁵

Funds	Project	Year Start	Year End	Provinces
ADB	RRIP I	2011	2016	Battambang, Kampong Cham, Kampong Chhnang, Kampong Speu, Pursat, and Tbong Khmum
ADB	RRIP II	2014	2021	Battambang, Banteay Meanchey, Kampong Chhnang, Kampong Speu, Kampong Thom, Pursat, Siem Reap, Takeo, Tbong Khmum
EDCF	RRIP II	2015	2019	Battambang, Banteay Meanchey, Pursat
EDCF	RRIP III	2020	Ongoing	Kampong Chhnang, Kandal, Kampong Speu, Takeo, Kampot
EDCF	CRRIDP	2021	Ongoing	Tbong Khmum, Kampong Cham, Prey Veng, Kampong Speu, Kampong Chhnang, Kandal
WB	Ketsana	2010	2014	Siem Reap, Kampong Cham, Banteay Meanchey, Kampong Thom, Battambang, and Kampong Chhnang,
KfW AFD	RIP I - III	2007	2010	Siem Reap, Battambang, Preah Vihear, Kampong Thom, Kandal
	RIP IV	2010	2015	Banteay Meanchey, Oddar Meanchey, Preah Vihear
KfW AFD	RIP V	2014	2019	Oddar Meanchey
	RIP VI	2018	2021	Banteay Meanchey
	RID4CAM	2020	Ongoing	Preah Vihear, Battambang, Siem Reap, Kampong Thom, and Kandal
Chinese Fund	Phase I	2015	2019	Kampong Chhnang, Kampong Speu, Kampong Thom, Kampong Cham
	Phase II	2019	Ongoing	Kampong Chhnang, Kampong Speu, Kandal, Tbong Khmum, Prey Veng, Svay Rieng
WB	CASDP	2019	2025	Battambang, Mondulkiri, Ratanakiri, Stung Treng, Preah Vihear, Kampong Cham, Tboung Khmum, Kratie, Siem Reap, Kandal, Kampong Speu, Kampong Chhnang, Phnom Penh
WB	CSLEP	2019	2025	Pursat, Koh Kong, Battambang, Kampong Speu, Kampong Thom, Siem Reap, and Kampong Chhnang
AIIB	NRRPCP	2020	2024	Pailin, Kampong Chhnang, Tboung Khmum, Prey Veng and Koh Kong
EIB	SAAMBAT	2019	2025	Banteay Meanchey, Battambang, Kampong Cham, Kampong Chhnang, Kampong Thom, Kampot, Kandal, Preah Vihear, Pursat, Takeo, Stung Treng and SvayRieng

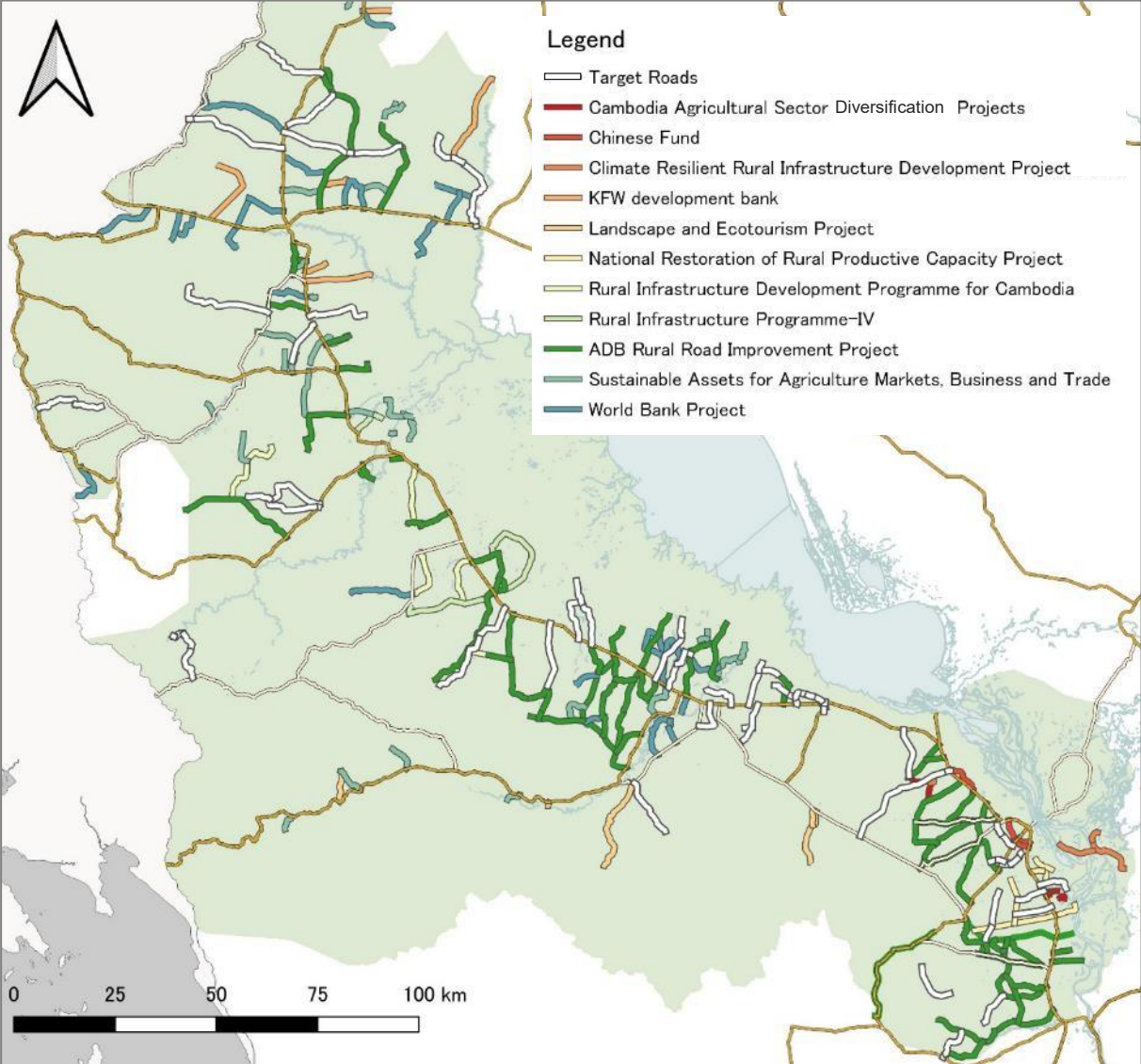
Source: RRMP / Interview with MRD

⁵ EDCF : Economic Development Cooperation Fund
KfW : Kreditanstalt für Wiederaufbau
AFD : Agence Française de Développement
AIIB : Asian Infrastructure Investment Bank
EIB : European Investment Bank
CRRIDP : Climate Resilient Rural Infrastructure Development Project
RIP : Rural Infrastructure Programme
RID4CAM : Rural Infrastructure Development Programme for Cambodia
CASDP : Cambodia Agricultural Sector Diversification Projects
CSLEP : Cambodia Sustainable Landscape and Ecotourism Project
NRRPCP : National Restoration of Rural Productive Capacity Project
SAAMBAT : Sustainable Assets for Agriculture Markets, Business and Trade

Most of the other donors' projects are mainly along NR5, but all target roads do not overlapped with them. About half of target roads connect or cross with the rural roads funded by other donors. The target roads which cross with the rural roads funded by other donors will create synergetic effects with them. In order to improve the road network in the target area more effectively and efficiently, it is necessary to consider prioritization in consideration of the connectivity of the target roads with other donor's projects.

In addition, when the target roads intersect with the rural roads funded by other donors, risk of serious traffic accidents increase, because the speed of vehicles entering the intersection become higher. Therefore, it is necessary to work with other donors to study safety measures for the intersection.

A location map of rural road improvement funded by other donors is shown below. The details are shown in Section 3.3.



Source: RRMP / Interview with MRD

Figure 2.3-1 Location of Rural Road Improvement Funded by Other Donors

JICA Survey Team conducted interviews with a person in charge of ADB project and the consultants of ADB and WB, which are implementing the rural roads improvement projects, in order to understand the cooperation of other donors in the rural road sector on 28th March in 2022.

ADB has been engaged in rural road improvement projects in Cambodia since 2011. ADB has accumulated know-how on rural road improvement projects and provided the JICA Survey Team with information that was helpful for this study. The following are the results of interviews with ADB.

Table 2.3-2 Results of Interview with ADB

Item	Contents of Interview
Outlines of the Project	<ul style="list-style-type: none"> ✓ Rural road improvement projects are implemented with ODA loan. ✓ Some ADB projects, such as capacity building and road safety projects, are funded by grant.
Prioritization	<ul style="list-style-type: none"> ✓ Environmental problems, rice production, and accessibility to schools and markets are particularly important factors and should be considered as criteria for the prioritization ✓ The criteria indicators and its weight will depend on the project objectives; if the project is aimed at connectivity to NR5, then the weighting may be given to that connectivity. ✓ The weights of the criteria indicators for the RRMP were first drafted by the consultant, and the values were adjusted and determined by the discussions with MRD
Design of Rural Road	<ul style="list-style-type: none"> ✓ Since MRD wants road improvements without resettlement, improvements that would significantly change the alignment of existing roads are rarely implemented on rural roads. ✓ For shoulders, SBST is sufficient. The cost of DBST for shoulders on rural roads would be expensive. ADB uses DBST for carriageway and SBST for shoulders, with the first layer constructed at 19 mm and the second layer at 12.5 mm. The contractor is also accustomed to using SBST for the shoulders and DBST for the carriageway. ✓ In cases where high water level of flood is less than 1 m, ADB raised the existing road up in order to avoid flooding. On the other hand, in cases where high water level of flood is more than 1 m, the rural roads are paved with concrete. ✓ Gates to control overloaded trucks are installed at the beginning and end of each improved rural road after the completion of the construction.
Procurement	<ul style="list-style-type: none"> ✓ DBST pavements generally cost about USD 150,000 per km, while concrete pavements cost about USD 350,000 per km. However, in recent years diesel costs have raised, increasing construction costs by about 20-25%.
Operation and Maintenance	<ul style="list-style-type: none"> ✓ The most significant challenge regarding operation and maintenance is a budget. In the past, operation and maintenance costs were about 500 USD per km, but in recent years the cost has risen to about 900 USD per km. ✓ In rice production areas, pavement deterioration is severe due to overloaded heavy trucks.
Environmental and Social Considerations	<ul style="list-style-type: none"> ✓ ROW depends on road type (30 m/10 m/8 m). ADB considers that a road width of 8 m is sufficient. ✓ Regarding land acquisition, most residents will accept the removal and relocation of fences, etc., if it is explained that land prices will increase as a result of road improvements. Also, many residents have donated farmland. If local leaders persuade residents to donate voluntarily, no major problems will arise. ✓ ADB acquires land for sites in accordance with a donation procedure called the Community Participation Framework.
Effectiveness of Project	<ul style="list-style-type: none"> ✓ Although ADB has not followed up on the traffic volume after the improvement. In a rural road, 50 new buildings were constructed along the road due to the road improvement. Traffic volume is likely to have increased significantly accordingly.

Item	Contents of Interview
	✓ The improvement of rural roads will facilitate truck traffic.

Source: JICA Survey Team

WB is currently conducting surveys similar to this study in Kampong Cham, T'bong Khmom and Kratie provinces. Below are the results of the interviews with WB.

Table 2.3-3 Results of Interview with WB

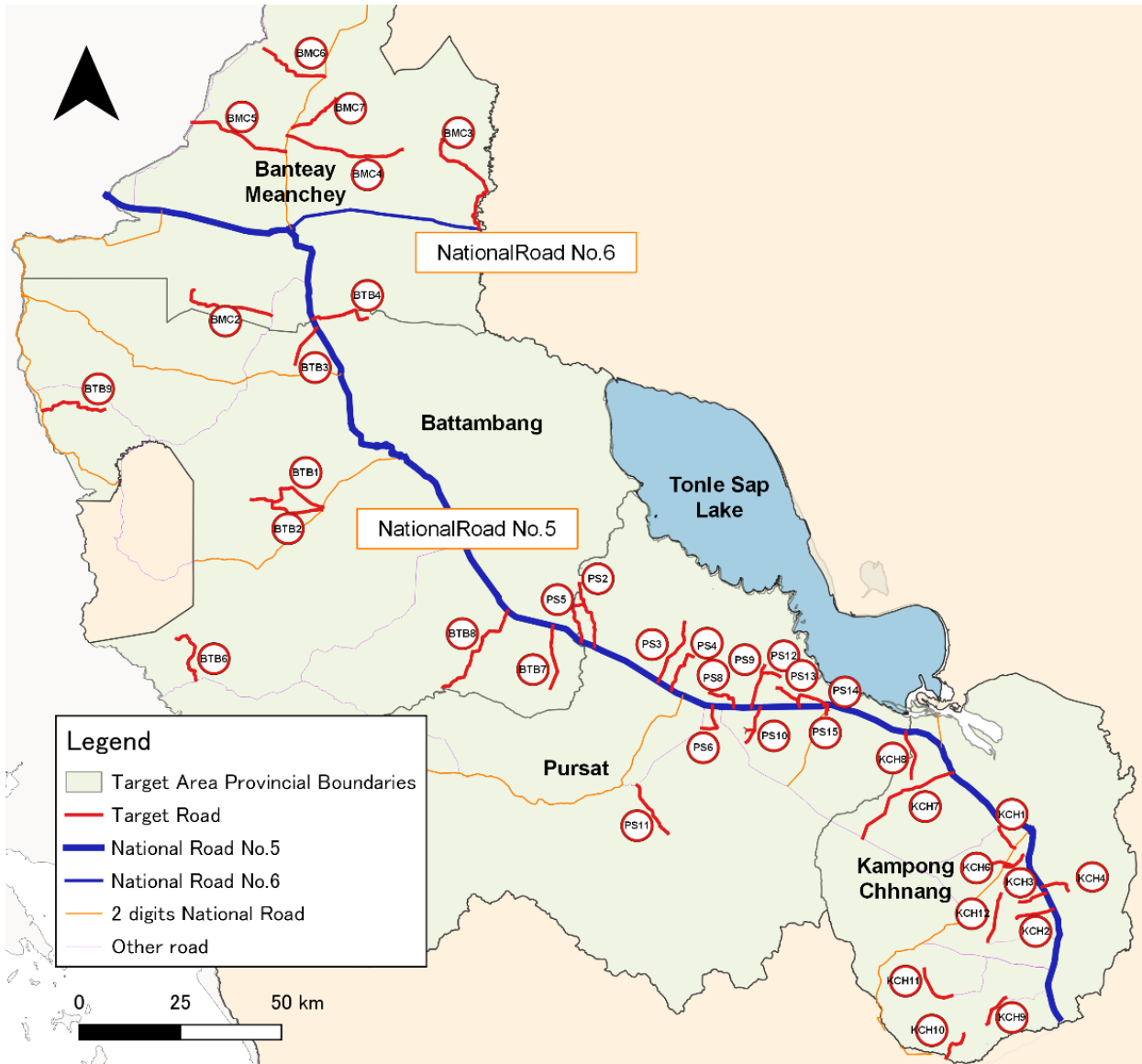
Item	Contents of Interview
Outlines of the Project	<ul style="list-style-type: none"> ✓ All rural road improvement projects are being implemented with ODA loan. ✓ The rural roads under consideration are rural and provincial roads connecting to NR7 in Kampong Cham, T'bong Khmom, and Kratie provinces, with a total length of approximately 270 km.
Prioritization	<ul style="list-style-type: none"> ✓ WB is selecting rural roads for the prioritization based on the guidelines for environmental and social considerations. ✓ Evaluation criteria apart from the Guidelines for Environmental and Social Considerations are currently under consideration.
Design of Rural Road	<ul style="list-style-type: none"> ✓ A design policy will be developed to ensure that resettlement does not occur. ✓ WB is checking with CMAC as the issue of unexploded ordnance and landmines which are unique to Cambodia.
Operation and Maintenance	<ul style="list-style-type: none"> ✓ DBST is easily repairable and can be handled by local contractors. The durability of DBST is expected to be about 3 years. ✓ A major challenge is to secure a budget for operation and maintenance.
Environmental and Social Considerations	<ul style="list-style-type: none"> ✓ Existing roads are utilized, and WB takes caution such that there is no resettlement. The residents in the community have never asked for compensation in rural road projects because they want convenient transportation. ✓ Cooperation with the village mayor is necessary for land acquisition.

Source: JICA Survey Team

CHAPTER 3 DETAILS OF TARGET ROADS

3.1 Overview of Target Roads

Out of the 31 roads (approx. 531.4 km) proposed by MRD as target roads, roads that overlap with other donors' projects and roads that are classified as Category A in the JICA Guidelines for Environmental and Social Considerations (January 2022) were removed. After this initial elimination, additional roads proposed by MRD were considered, resulting in the JICA Survey Team determining 38 target roads through discussions with MRD. An overview and location map of the 38 target roads are shown below. The details of the target roads are described in Section 3.3.



Source: JICA Survey Team

Figure 3.1-1 Location Map of Target Roads

Table 3.1-1 Outline of the Survey

Ref.	Rural Road	Road Type	Existing Condition							Remarks	
			Carriage way width (m)	Surface type	Road condition	Bridge		Culvert			
						Concrete or Steel	Wood	BOX L≥8m	BOX L<8m		PIPE
KCH-1	Srang Kpuos-Kol Kup	T1	10.0	Laterite	Good	0	0	0	0	6	Pagoda Gate Heavy truck traffic. Stone pit.
KCH-2	Kosomak-O'loy	T2	5.0	Laterite	Poor	0	0	0	0	10	2 Residential land development 1 Mosqu
KCH-3	NR5-Damnak Kei	T2	5.0	Laterite	Good	0	2	0	0	12	2 Wooden Bridges. Improve horizontal alignment
KCH-4	NR5-Prek Sala	T2	5.0	Laterite	Good	1	0	0	0	9	Lotus ponds in WFR projects. Residential land development
KCH-6	Phum Thmey-Trapaing Kravan	T3	5.0	Laterite	Good	1	0	0	4	17	Pagoda Gate Flooded 20cm. Improve horizontal alignment
KCH-7	Phsar-Kdoi Senohey	T1	8.0	Laterite	Poor	0	0	8	0	4	install side ditch
KCH-8	Trapaing Chan-Teuk Chreaop	T2	8.0	Laterite	Good	2	0	0	0	12	install side ditch
KCH-9	Meanok-Trapaing Mtes	T2	5.0	Laterite	Poor	1	0	0	0	11	Railway. 2 Residential lands development
KCH-10	Chrokhnot-Chrok Sdach	T2	5.0	Laterite	Poor	2	0	0	0	11	install side ditch. Flooded 20cm
KCH-11	Srae Sar- Ksach Sor	T2	6.0	Laterite	Good	0	0	0	0	13	install side ditch. improve vertical alignment Amusement park
KCH-12	Tbeng Kpuos-Ronak	T2	5.0	Laterite	Very Poor	3	0	0	1	26	Removal of existing DBST
Subtotal						10	2	8	5	131	
PS-2	O'Tapong-Phum Tanai	T1	5.0	Laterite	Poor	0	2	0	3	22	1 Wooden Bridge Flooded 50cm-1m
PS-3	Plov Andongkrasaing-Tram Pae	T1	5.0	Laterite	Good	0	1	0	0	26	1 Wooden Bridge Flooded 30cm-40cm
PS-4	Phnov-Phteah Pring	T1	5.0	Laterite	Poor	0	1	0	5	24	1 Wooden Bridge Flooded 50cm Improve horizontal alignment
PS-5	Plov Phum Svay Daun Keo-Chrop-Phum Slor Klouk	T1	5.0	Laterite	Very Poor	0	5	0	1	43	Pagoda Gate. 2 Wooden Bridges
PS-6	Plov Wat Toul Veng	T1	5.0	Laterite	Good	2	0	0	1	28	Pagoda Gate. Railway Flooded 20cm-30cm
PS-8	Rolus	T1	6.0	Laterite	Good	1	0	3	1	14	Pagoda Gate. 1 Spilway Canal on both sides.
PS-9	Tbaeng Chrum-Raa Toteng Thngai	T1	8.0	Laterite	Good	2	0	5	0	3	Flooded 30cm Lots of Spilway and Box Culvert.
PS-10	Son Trae-Chher Tum	T1	6.0	Laterite	Good	0	0	0	6	15	Flooded. Canal on both side
PS-11	ToulCha- Keo Momy	T1	6.0	Laterite	Poor	1	3	0	1	15	1 Wooden Bridge Flooded 10cm-50cm install side ditch
PS-12	Kanchhor-Kampong Pou	T2	5.0	Laterite	Good	2	1	0	1	6	Pagoda Gate 2 Wooden Bridges Flooded
PS-13	Ou Sandan- Sna Ansa	T1	5.0	Laterite	Good	0	0	0	7	18	Flooded 20cm
PS-14	Sna Ansa-Anlong Tnaot	T1	5.0	Laterite	Poor	2	2	2	0	14	2 Wooden Bridges Flooded 50cm
PS-15	Anlong Tnaot	T2	5.0	Laterite	Good	0	0	0	0	8	Pagoda Gate
Subtotal						10	15	10	26	236	
BTB-1	NR57-Phum Boeung Krar Sal	T2	5.0	Laterite	Good	3	0	0	1	23	Flooded 1m install side ditch
BTB-2	Sneung NR57-Beoung Praey	T2	6.0	Laterite	Poor	0	0	0	4	23	Pagoda Gate Flooded 50cm
BTB-3	NR5 Phum Beoung Prieng-Wat Rong Chrey	T2	6.0	Laterite	Very Poor	0	0	0	0	14	River side Railway Flooded 50cm
BTB-4	NR5 (Phsar O'Nhor)-Phum Poa Ta Sek	T3	6.0	Laterite	Very Poor	0	0	0	0	15	Pagoda Gate Irrigation Canal Flooded 50cm Improve horizontal alignment
BTB-6	Plov 1577 Phum O'Chrab-O'Bok Pael (Phum Sam Loat)	T1	6.0	Laterite	Poor	0	2	0	1	9	1 Wooden Bridge improve horizontal and vertical alignment Flooded by poor drainage
BTB-7	NR5 Rar Cham Heang-Khum Muk Rar	T1	4.0	Laterite	Very Poor	3	0	1	0	45	Flooded 10cm-50cm Heavy motorbike traffic Construction of road structures
BTB-8	NR5 O'Kreat-Ba Sak	T1	6.0	Laterite	Poor	2	1	0	2	31	1 Wooden Bridge Flooded 2.5m install crossing pipe
BTB-9	NR50-Phum O' Teuk Ila	T3	6.0	Laterite	Poor	5	0	1	0	18	Flooded Improve horizontal alignment install side ditch
Subtotal						13	3	2	8	178	
BMC-2	Plov Balang Chrey	T2	5.5	Laterite	Poor	1	0	0	1	29	Spilway Irrigation Cnal Flooded 20cm-1m install crossing pipe
BMC-3	Spean Sraeng	T1	5.0	Laterite	Good	10	0	0	8	32	install side ditch and crossing pipe
BMC-4	Ta Phou	T1	5.0	Laterite	Good	1	0	0	7	36	Flooded 50cm install crossing pipe
BMC-5	Plov Tae Hang	T1	6.0	Laterite	Poor	1	0	0	0	7	Construction of water gate
BMC-6	Plov Sre L'or	T2	5.0	Laterite	Very Poor	0	0	0	7	24	Flooded 20cm-1m There are damaged DBST sections.
BMC-7	Rolus-Phum Tmey	T2	6.0	Laterite	Poor	0	0	0	4	35	Pagoda Gate Flooded 50cm There are damaged DBST sections. Install side ditch and crossing pipe
Subtotal						13	0	0	27	163	
Total						46	20	20	66	708	

Source: JICA Survey Team

3.2 Current Condition and Traffic Demand Forecast of Target Roads

3.2.1 Roads, Structures, and Other Facilities

(1) Road Conditions

1) Objectives of the Survey

A road condition survey was conducted on 38 roads of the Project. The purpose of the survey is to determine the road and surrounding conditions of the target road and to collect the information necessary for studying improvements. The survey results were also used to prioritize road design and sub-projects, as well as quantitative effectiveness indicators.

2) Outline of the Survey

The road condition survey was started on February 21, 2022 and lasted for about 3 weeks until March 11, 2022. The outline of the survey is shown below.

Table 3.2-1 Outline of the Survey

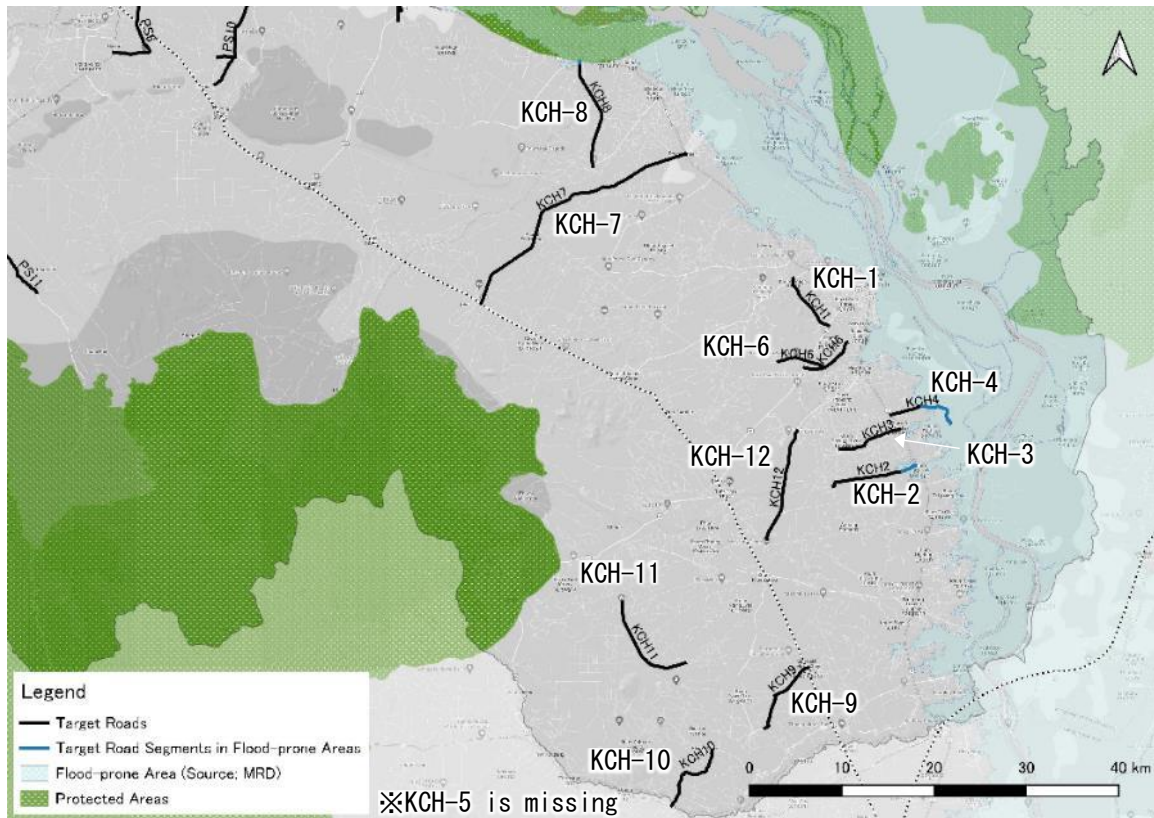
Contents	Outline
Target provinces	Kampong Chhnang, Pursat, Battambang, Banteay Meanchey
Survey Locations	38 routes, Total length L=529.7 km
Day of week and time	Weekdays, 8:00-17:00
Survey Items	Road width, road structure, road surface condition, pavement damage, flooding conditions around the target road, drainage conditions of drainage facilities, surrounding land use conditions, road right-of-way width, and location of major facilities.
Survey Method	The road surface conditions were identified from the image data obtained by using a drive recorder with GPS to capture images of all routes. Road widths and road right-of-way (ROW) widths were measured at points of change in road width and road structure; flood areas based on past flood information were mainly identified at arbitrary points by interviewing residents to confirm past flood history, timing, and extent (duration and level); measurements were taken at drainage ditch locations; and locations surrounding land uses and major facilities were visually identified and recorded.

Source: JICA Survey Team

3) Results of Survey

Kampong Chhnang

The location of the target roads in Kampong Chhnang is presented below. There are 11 routes in the province, KCH-1 to KCH-12, with a total length of 122.6km. The existing conditions and characteristics of each road are shown below.



Source: JICA Survey Team

Figure 3.2-1 Location Map of Target Roads (Kampong Chhnang)

Table 3.2-2 Road Condition Survey Results (Kampong Chhnang)

Name	Type	Improvent length	Existing									
			Road Wide	Type of pavement	Road surface condition	R.O.W (m)	Facilities (nos)					
							Primary school	Junir high school	High school	Pagoda	Medical facility	Market
KCH-1	T1	4.3	10.0	Laterite	Good	27.0	0	0	0	0	0	0
KCH-2	T2	9.1	5.0	Laterite	Poor	8.5-17.0	1	0	0	0	0	0
KCH-3	T2	7.1	5.0	Laterite	Good	14.5	1	0	0	3	0	0
KCH-4	T2	8.2	5.0	Laterite	Good	8.5-14.0	1	0	0	1	0	0
KCH-5	T3	0.0	5.0	Laterite								
KCH-6	T3	11.3	5.0	Laterite	Good	7.5-10.0	1	1	0	2	0	0
KCH-7	T1	27.5	8.0	Laterite	Poor	15.0	5	1	0	5	0	2
KCH-8	T2	12.2	8.0	Laterite	Good	18.0	2	0	0	1	0	1
KCH-9	T2	8.8	5.0	Laterite	Poor	17.0	0	0	0	0	0	0
KCH-10	T2	8.9	5.0	Laterite	Poor	7.0-13.0	4	1	0	2	0	0
KCH-11	T2	12.7	6.0	Laterite	Good	15.0-20.0	1	0	0	1	0	0
KCH-12	T2	12.4	5.0	Laterite	Very Poor	10.5-21.5	2	0	1	0	2	0
Subtotal		122.5					18	3	1	15	2	3

Source: JICA Survey Team

KCH-1 L=4.3 km

All sections of this road are more than 8 m wide (10-11 m), and the road surface condition is good, allowing for good driving performance. The 2.2 km-section from the beginning point (North side) of this road has already been paved with DBST pavement, and earth ditches have been constructed along the road. In addition, there is a stone pit near the middle of the road, and construction vehicles on NR5 often come and go. Just before the intersection near the end point (South side), there is a pagoda gate. The width between the pillars of the gate is 4.7 m, and large vehicles are diverted around the outside of the gate. The connecting road at the end point (NR53) is of DBST pavement and connects to NR5.



Source: JICA Survey Team

Figure 3.2-2 Road Conditions (KCH-1)

KCH-2 L=9.1 km

All sections of this road are 5.0 m wide, and the road surface is poor with some unevenness on the laterite. There are residential areas, a primary school, and a mosque around the connection with NR5, the beginning point of the road, and in the intersection at the end point (West side) of the road. In addition, there are two residential areas under construction near the middle of the road. The land use along the road is mainly croplands, such as fields and orchards, and the distance between wooden fences, walls, and utility poles along the road is more than 10 m. The connecting road at the end point is a 4-m wide laterite road, which connects to the end point of KCH-3.



Source: JICA Survey Team

Figure 3.2-3 Road Conditions (KCH-2)

KCH-3 L=7.1 km

This road is 4.5 to 5.5 m wide, and the road surface condition is good. The land use around the road is mainly cropland, with rice fields and residential areas scattered along the road. There are 3 pagodas along the road, one of which has a section with a very small curve radius so that the road bypasses the pagoda. There are two wooden bridges along the way, which are 2.8 m wide and have one lane of alternating traffic. It connects with NR5 at beginning point and the connecting road at ending point is a 4m wide laterite road, which connects with the end point of KCH-3.



Source: JICA Survey Team

Figure 3.2-4 Road Conditions (KCH-3)

KCH-4 L=8.2 km

The road width is 5.5 to 9.0 m from the beginning point (West side) up to 5.3 km, and 4.0 to 6.5 m for the remaining 2.9 km to the end (East side), and the road surface condition is good. From the starting of the road (West side) to about 4.0 km, the road is lined with residential areas, a primary school, and a pagoda. At the end of the road (East side), there is a large reservoir that drains water to rice fields along the road. There is a concrete bridge with a water gate on the way, which controls the water to the Lotus Pond (WFP2001). The connecting road at the end point is a 4 m-wide laterite road that circles the pond and connects to NR5.



Source: JICA Survey Team

Figure 3.2-5 Road Conditions (KCH-4)

KCH-6 L=11.3 km

This road is 4.0 to 6.0 m wide, and the road surface condition is good. The road is divided into West side (5.3 km) and East side (6.0 km) by NR53 (DBST paved road). The land use along both West and East sides is mainly rice fields and residential land, with schools and pagodas on both sides. On the West side, near a pagoda, there is a section where the road has a very small curve radius so that the road bypasses the pagoda. Furthermore, there is a pagoda gate near the intersection of NR53 with NR5, and a bypass is under construction at the Eastern end of the road. The connecting road at the West beginning point consists of an 8 m-wide laterite road, while on the East beginning point, at NR53, road conditions consist of DBST pavement.



Source: JICA Survey Team

Figure 3.2-6 Road Conditions (KCH-6)

KCH-7 L=27.7 km

The road is 8 m wide in all sections, and the road surface condition is poor with some unevenness on the laterite. The 2.0 km-section from the beginning point of the road has already been paved with DBST pavement, and earth ditches have been constructed along the road. The land use along the road is mainly cropland, with rice fields and residential areas scattered along the road. Due to the long road length (27 km), there are many primary schools, junior high schools, and pagodas along the road. The North-South Road connecting at the end point is planned to be paved with DBST by DPWT.



Source: JICA Survey Team

Figure 3.2-7 Road Conditions (KCH-7)

KCH-8 L=12.2 km

All sections of this road are more than 8-m wide (8-10 m), and the road surface condition is good, allowing for good driving performance. The land use along the road is mainly cropland, such as orchards, with rice fields and residential areas scattered along the road. There is a primary school and a pagoda along the road. It connects with NR5 at the beginning point and the connecting road at the ending point is an 8 m-wide DBST paved road.



Source: JICA Survey Team

Figure 3.2-8 Road Conditions (KCH-8)

KCH-9 L=8.8 km

This road is 4.5 to 5.5 m wide, and the road surface condition is poor, with some rutting and sunken shoulders on the laterite. Land use along the road is mainly cropland and rice fields, with residential areas scattered along the road. There is a railway crossing at the beginning point (North side) of the road. Near the end of the road (South side), residential land is scattered, and two residential development sites are under construction. The connecting road at the beginning point is a DBST paved road, and it leads to NR5 on the North of KCH-9. The connecting road at the end point is a 4 m-wide laterite road.



Source: JICA Survey Team

Figure 3.2-9 Road Conditions (KCH-9)

KCH-10 L=8.9 km

This road is 3.0 to 5.5 m wide, and the road surface condition is poor with some unevenness on laterite. The 1.0-km section from the beginning point (South side) of the road has already been paved with DBST pavement, and earth ditches have been constructed along the road. The land use along the road is mainly residential land with rice fields and croplands scattered along the road. There are many primary schools, junior high schools, and pagodas along the road. The connecting road at the end point is a 4-m wide laterite road.



Source: JICA Survey Team

Figure 3.2-10 Road Conditions (KCH-10)

KCH-11 L=12.7 km

This road is 5.5 to 6.5 m wide, and the road surface is in good condition. The land use along the road is mainly cropland, such as fields and orchards, with some residential areas scattered along the road. There is also a primary school and a pagoda along the road. Near the middle point of the road, there is a section where the longitudinal alignment is wavy with a series of sag points. Moreover, there are several road crossing facilities, such as spillways and pipe culverts. The connecting roads at the beginning and end points are laterite roads with a width of 6 m, and the connecting road at the beginning point leads to NR53 and NR53 leads to NR5 on the North.



Connecting road at beginning point



Around middle point



Around beginning point



Connecting road at end point

Source: JICA Survey Team

Figure 3.2-11 Road Conditions (KCH-11)

KCH-12 L=12.4 km

All sections of this road are 5.0 m wide, and the road surface condition is very poor, with some unevenness on the laterite, significant damage to the DBST pavement that was laid in the past, and many potholes. The land use along the road is mainly rice fields and residential land, schools and medical facilities are also located along the road. The connecting road at the beginning and end point is a 5 m-wide DBST paved road and the beginning point connects with Road 141 and the ending point connecting road connects with NR 53.

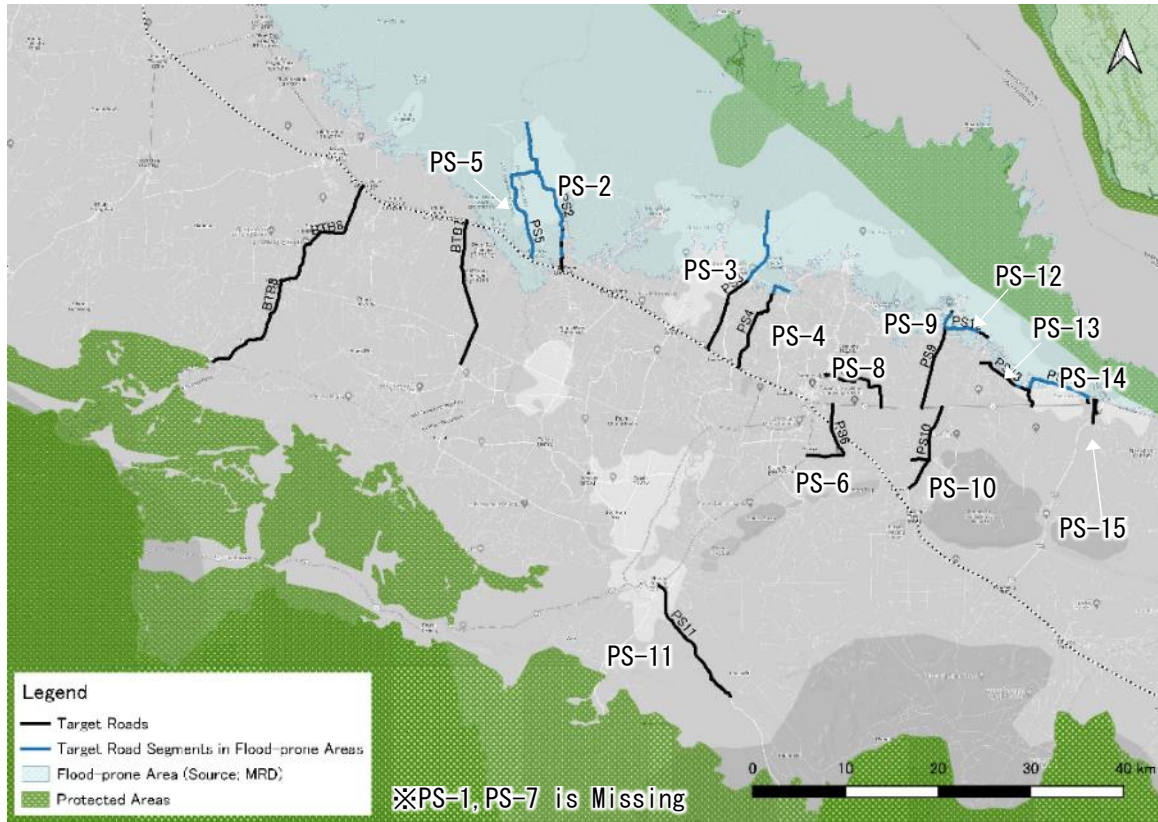


Source: JICA Survey Team

Figure 3.2-12 Road Conditions (KCH-12)

○Pursat

The location map of target roads in Pursat is shown below. There are 13 routes in the province, PS-2 to PS-15, with a total length of 143.1 km.



Source: JICA Survey Team

Figure 3.2-13 Location Map of Target Roads (Pursat)

Table 3.2-3 Road Condition Survey Results (Pursat)

Name	Type	Improvment length	Existing											
			Road Wide	Type of pavement	Road surface condition	R.O.W (m)	Facilities (nos)							
							Primary school	Junir high school	High school	Pagoda	Medical facility	Market		
PS-1	T1	0.0	5.0	Laterite										
PS-2	T1	18.2	5.0	Laterite	Poor	6.0-13.5	4	0	0	2	0	2		
PS-3	T1	17.6	5.0	Laterite	Good	8.0-19.0	2	1	0	1	0	1		
PS-4	T1	12.2	5.0	Laterite	Poor	8.0-17.0	2	0	0	1	0	0		
PS-5	T1	12.9	5.0	Laterite	Very Poor	6.5-10.0	3	0	0	1	0	1		
PS-6	T1	9.7	5.0	Laterite	Good	9.0	1	0	0	1	0	0		
PS-7	T1	0.0	5.0	Laterite										
PS-8	T1	8.8	6.0	Laterite	Good	10.0-12.0	1	0	0	0	0	0		
PS-9	T1	11.2	8.0	Laterite	Good	11.0-20.0	1	0	0	2	1	1		
PS-10	T1	11.8	6.0	Laterite	Good	6.0-14.0	1	1	0	0	1	0		
PS-11	T1	15.0	6.0	Laterite	Poor	17.0	3	1	0	2	0	1		
PS-12	T2	5.0	5.0	Laterite	Good	7.5-14.5	1	0	0	1	0	0		
PS-13	T1	6.5	5.0	Laterite	Good	5.5-9.0	1	1	0	2	0	0		
PS-14	T1	10.3	5.0	Laterite	Poor	9.5-10.0	2	1	0	0	0	1		
PS-15	T2	3.9	5.0	Laterite	Good	5.0-7.0	1	0	0	1	0	1		
Subtotal		143.1					23	5	0	14	2	8		

Source: JICA Survey Team

PS-2 L=18.2 km

This road is 5.0 to 6.0 m wide, and the road surface condition is poor with some unevenness on the laterite. There is a market, primary school, and pagoda about 5.0 km North of the road's Southern intersection with NR5. The land use along the road is mainly residential areas and rice fields. There are two wooden bridges along the road. The connecting road at the end point is a 4 m-wide laterite road.



Source: JICA Survey Team

Figure 3.2-14 Road Conditions (PS-2)

PS-3 L=17.6 km

This road is 4.5 to 6.0 m wide, and the road surface condition is good. The land use along the road is mainly residential land and rice fields. There are primary schools, junior high schools, and pagodas along the road. There is one wooden bridge along the road. It connects with NR5 at the beginning point, and the connecting road at the end point is a 3.5 m-wide laterite road.



Source: JICA Survey Team

Figure 3.2-15 Road Conditions (PS-3)

PS-4 L=12.2 km

This road is 4.0 to 6.0 m wide, and the road surface condition is poor, with some unevenness and rutting on the laterite. There are primary schools and pagodas along the road. The land use along the road is mainly residential land, with some rice fields and croplands scattered along the road. There is one wooden bridge along the road. It connects with NR5 at the beginning point, and the connecting road at the end point is a DBST paved road.



Source: JICA Survey Team

Figure 3.2-16 Road Conditions (PS-4)

PS-5 L=12.9 km

This road is 5.0 to 6.0 m wide, and the road surface condition is very poor, with some unevenness and rutting on the laterite, especially in the rice fields at the end of the road (North side). There are three primary schools and a pagoda along the road. The land use along the road is mainly residential land and rice fields. There are two wooden bridges on the way and a pagoda gate at the intersection with PS-2 near the end point.



Source: JICA Survey Team

Figure 3.2-17 Road Conditions (PS-5)

PS-6 L=9.7 km

This road is 4.5 to 6.0 m wide, and the road surface condition is good. There are primary schools and pagodas along the road. The land use along the road is mainly residential land, with some rice fields, and cropland, such as orchards scattered along the road. There is a pagoda gate at the intersection of NR5 (North side) of the beginning point, and the width between the pillars of the gate is 4.5 m. In addition, there is a railway crossing 2 km South of the beginning point. The connecting road at the end point is a DBST paved road.

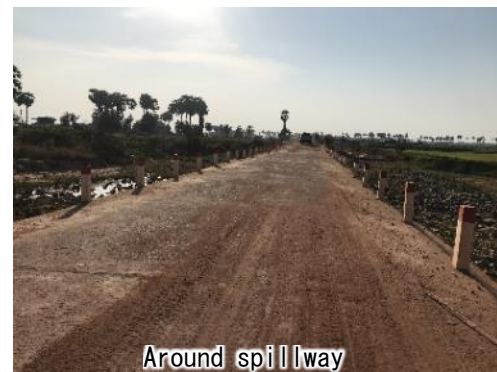


Source: JICA Survey Team

Figure 3.2-18 Road Conditions (PS-6)

PS-8 L=8.8 km

This road is 4.5 to 6.5 m wide, and the road surface condition is good. The 0.5 km-section from the beginning point (East side) of this road has already been paved with concrete. There is one primary school along the road. The land use along the road is mainly rice fields, with a canal between the rice fields and the road. There are also scattered residential areas and croplands, such as orchards. There is a pagoda gate at the intersection of NR5 near the beginning point, and the width between the pillars of the gate is 4.5 m. There is a spillway 3 km East of the end point (West side). The connecting road at the end point is a DBST paved road.



Source: JICA Survey Team

Figure 3.2-19 Road Conditions (PS-8)

PS-9 L=11.2 km

This road is 8.0 m wide in all sections and the road surface condition is good. There are primary schools, pagodas, medical facilities, and a market along the road. The land use along the road is mainly rice fields with some residential areas scattered along the road. There are some concrete bridges, box culverts, and spillways already constructed near the end point (North side). It connects with NR5 at the beginning point, and the connecting road at the end point is a 6 m-wide laterite road.



Source: JICA Survey Team

Figure 3.2-20 Road Conditions (PS-9)

PS-10 L=11.8 km

This road is 5.0 to 6.5 m wide, and the road surface condition is good. There are primary schools, junior high schools, and medical facilities along the road. The land use along the road is mainly residential land, with some rice fields scattered along the road. A canal constructed in the last year is located at the ending point (South side). The road connects with NR5 at the beginning point and the connecting road at the end point is a DBST paved road.



Source: JICA Survey Team

Figure 3.2-21 Road Conditions (PS-10)

PS-11 L=15.0 km

This road is 5.5 to 6.0 m wide, and the road surface condition is poor with some unevenness and rutting on the laterite. There are some primary schools, junior high schools, and pagodas along the road. The land use along the road is mainly cropland, with some residential areas and rice fields scattered along the road. There are two wooden bridges near the ending point (South side). The connecting road at the beginning point is a DBST paved road, and the connecting road at the ending point is a 6 m-wide laterite road.



Source: JICA Survey Team

Figure 3.2-22 Road Conditions (PS-11)

PS-12 L=5.0 km

This road is 3.5 to 5.0 m wide, and the road surface condition is good. There are primary schools and pagodas along the road. The land use along the road is mainly residential land and rice fields, and there are two wooden bridges in the middle of the road. It connects with PS9 at the beginning point and the connecting road at the end point is a DBST paved road.



Source: JICA Survey Team

Figure 3.2-23 Road Conditions (PS-12)

PS-13 L=6.5 km

This road is 4.0 to 5.0 m wide, and the road surface condition is good. There are primary schools, a junior high school, and pagodas along the road. The land use along the road is mainly residential land with some rice fields and croplands, such as fields, scattered along the road. It connects with PS14 at the beginning point, and the connecting road at the end point is a DBST paved road.



Source: JICA Survey Team

Figure 3.2-24 Road Conditions (PS-13)

PS-14 L=10.3 km

This road is 4.5 to 8.0 m wide, and the road surface condition is poor with some unevenness on the laterite. There are primary schools and junior high schools along the road. The land use along the road is mainly residential land with some rice fields scattered along the road. There are two wooden bridges in the middle of the road. Both beginning and ending points connect to NR5.



Source: JICA Survey Team

Figure 3.2-25 Road Conditions (PS-14)

PS-15 L=3.9 km

This road is 4.5 to 5.0 m wide, and the road surface condition is good. There is a primary school and a Pagoda along the road. The land use along the road is mainly residential land, with some rice fields scattered along the road. There is a pagoda gate at the Western provincial road intersection, and the width between the pillars of the gate is 4.0 m. It connects with NR5 at the beginning point, and the connecting road at the end point is a DBST paved road.

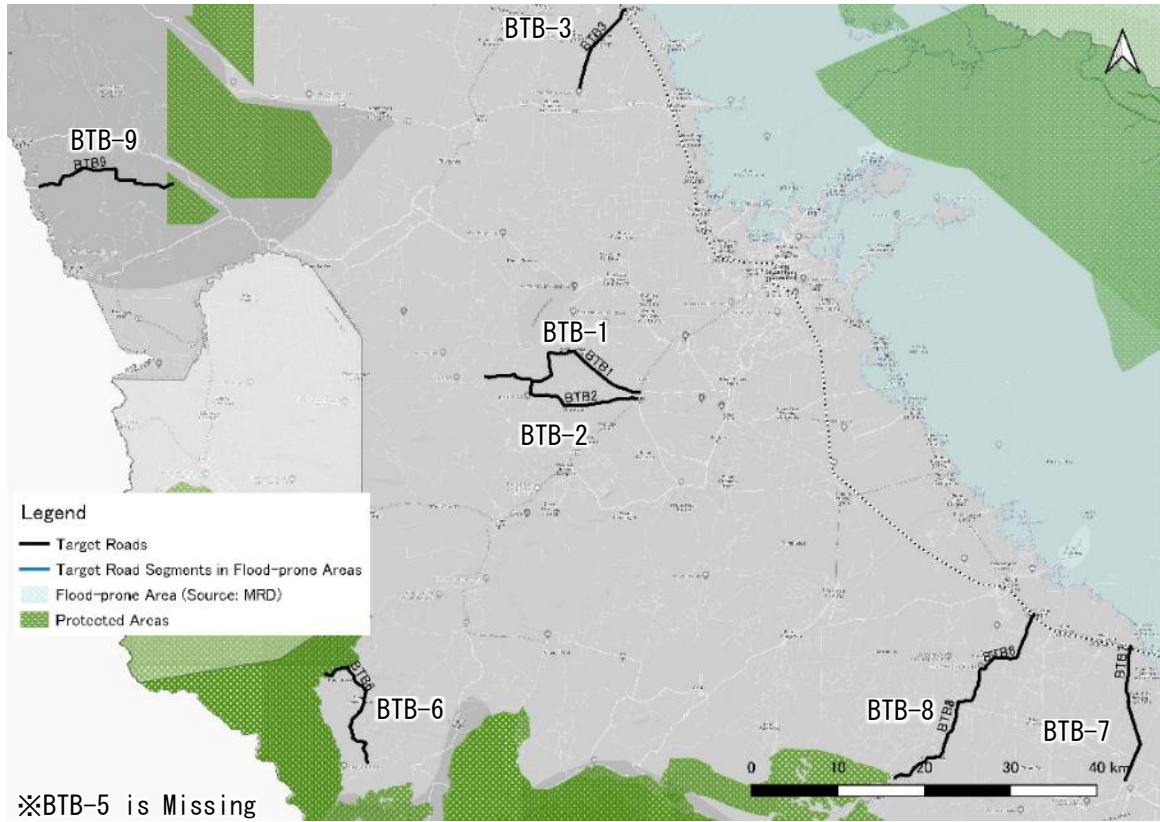


Source: JICA Survey Team

Figure 3.2-26 Road Conditions (PS-15)

○Battambang

The location map of target roads in Battambang is shown below. There are 8 routes in the province, BTB-1 to BTB-9, with a total length of 129.3 km.



Source: JICA Survey Team

Figure 3.2-27 Location Map of Target Roads (Battambang)

Table 3.2-4 Road Condition Survey Results (Battambang)

Name	Type	Improvement length	Existing									
			Road Wide	Type of pavement	Road surface condition	R.O.W (m)	Facilities (nos)					
							Primary school	Junior high school	High school	Pagoda	Medical facility	Market
BTB-1	T2	15.0	5.0	Laterite	Good	12.5-17.5	3	1	0	2	0	0
BTB-2	T2	18.2	6.0	Laterite	Poor	15.0	1	0	0	2	1	1
BTB-3	T2	10.6	6.0	Laterite	Very Poor	8.0-10.0	0	0	0	1	0	1
BTB-4	T3	16.1	6.0	Laterite	Very Poor	8.0-14.0	1	0	0	1	0	1
BTB-5	T2	0.0	6.0	Laterite								
BTB-6	T1	17.0	6.0	Laterite	Poor	15.5	0	0	0	0	1	2
BTB-7	T1	16.2	4.0	Laterite	Very Poor	10.0-13.0	0	0	0	0	0	1
BTB-8	T1	18.0	6.0	Laterite	Poor	11.5-13.0	3	0	0	6	3	2
BTB-9	T3	18.2	6.0	Laterite	Poor	15.0-18.0	3	0	0	1	0	1
Subtotal		129.3					11	1	0	13	5	9
		100.0%										

Source: JICA Survey Team

BTB-1 L=15.0 km

This road is 3.5 to 6.0 m wide, and the road surface condition is good. Concrete pavement has already been constructed for 2.2 km-section from the beginning point (East side) going from km 8.9 to 11.1. There are some primary schools, junior high schools, and pagodas along the road. The land use along the road is mainly residential land and rice fields, with a canal between the rice fields and the road. It connects to NR57 at the beginning point and connects to BTB-2 at the end point.



Source: JICA Survey Team

Figure 3.2-28 Road Conditions (BTB-1)

BTB-2 L=18.2 km

This road is 3.5 to 6.5 m wide, and the road surface condition is poor with some unevenness on the laterite. Concrete pavement has already been laid out in the 1.0 km-section from the beginning point (East side) and in the 1.2-km section going from km 6.8 to 8.0. There are primary schools, pagodas, and medical facilities along the road. The land use along the road is mainly cropland, such as fields and orchards, with some residential areas scattered along the road. There is a pagoda gate at the intersection with the provincial road near the beginning point, having a width between the gate's pillars of 4.5 m. It connects with NR57 at the beginning point and the connecting road at the end point is a 5 m-wide laterite road.



Source: JICA Survey Team

Figure 3.2-29 Road Conditions (BTB-2)

BTB-3 L=10.6 km

This road is 4.5 to 5.5 m wide, and the road surface condition is very poor, with some unevenness and rutting on the laterite. There is a pagoda along the road. The land use along the road is mainly residential land and rice fields. The road is adjacent to a river on the West side of the road. There is a railway crossing near the beginning point (East side). The connecting road at the end point is a 4.5 m-wide laterite road.



Source: JICA Survey Team

Figure 3.2-30 Road Conditions (BTB-3)

BTB-4 L=16.1 km

This road is 3.5 to 6.0 m wide, and the road surface condition is very poor with some unevenness and rutting on the laterite. There are primary schools and pagodas along the road. The land use along the road is mainly rice fields, and canals are located between the rice fields and the road. Scattered croplands and residential areas are also located along the road. There is a pagoda gate at the intersection of NR5, near the beginning point, with a width between the pillars of 5.5 m. The road connects with NR5 at the beginning point and the connecting road at the end point is a 3 m-wide laterite road.



Source: JICA Survey Team

Figure 3.2-31 Road Conditions (BTB-4)

BTB-6 L=17.0 km

This road is 4.0 to 6.0 m wide, and the road surface condition is poor with some unevenness on the laterite. The land use along the road is mainly cropland, such as fields and orchards, with some residential areas scattered along the road. Around 1.5 km from the beginning point (South side), there are some sections with steep gradients, in addition to some crossroad drainage facilities, such as pipe culverts. There are two wooden bridges near the middle of the road. The connecting road at the beginning point is a DBST paved road and connects with NR57. Road surface conditions on DBST pavements are good. NR57 leads to NR5 on the East. The connecting road at the end point is a 6 m-wide laterite road.



Connecting road at beginning point



Around wooden bridge



Around beginning point



Connecting road at end point

Source: JICA Survey Team

Figure 3.2-32 Road Conditions (BTB-6)

BTB-7 L=16.2 km

This road is 3.5 to 7.5 m wide, and the road surface condition is very poor, with some unevenness and rutting on the laterite. The land use along the road is mainly rice fields, with canals between the rice fields and the road. In addition, residential areas are scattered along the road. There is a railway crossing near the beginning point (north side). It connects with NR5 at the beginning point, and the connecting road at the end point is a DBST pavement road.



Source: JICA Survey Team

Figure 3.2-33 Road Conditions (BTB-7)

BTB-8 L=18.0 km

This road is 5.0 to 6.5 m wide, and the road surface condition is poor with some unevenness on the laterite. The 11.0-km section from the beginning point (north side) of this road has already been paved with DBST. There are some primary schools, pagodas, and medical facilities along the road. The land use along the road is mainly residential land and some rice fields and croplands are scattered along the road. There is one wooden bridge near the end point (South side). It connects with NR5 at the beginning point, and the connecting road at the ending point is 8m wide laterite road.



Source: JICA Survey Team

Figure 3.2-34 Road Conditions (BTB-8)

BTB-9 L=18.2 km

This road is 4.0 to 6.0 m wide, and the road surface condition is poor with some unevenness and rutting on the laterite. There are primary schools and pagodas along the road. The land use along the road is mainly cropland, such as fields and orchards, with some residential areas scattered along the road. There is a section with a very small curve radius around 4.0 km from the ending point (east side). It connects with NR59 at the beginning point and the connecting road at the ending point is a 5 m-wide laterite road.

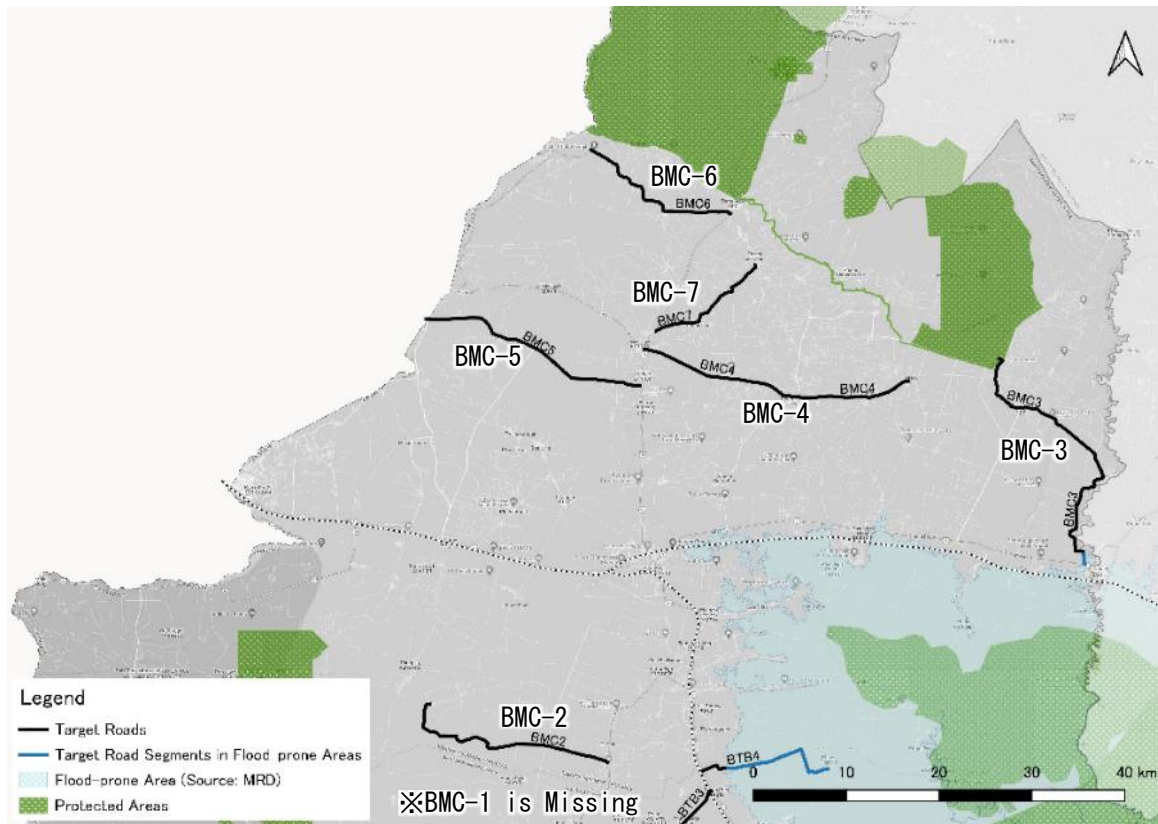


Source: JICA Survey Team

Figure 3.2-35 Road Conditions (BTB-9)

○Banteay Meanchey

The location map of target roads in Banteay Meanchey is shown below. There are 6 routes in the province, BMC-2 to BMC-7, with a total length of 130.8 km.



Source: JICA Survey Team

Figure 3.2-36 Location Map of Target Roads (Banteay Meanchey)

Table 3.2-5 Road Condition Survey Results (Banteay Meanchey)

Name	Type	Improvent length	Existing										
			Road Wide	Type of pavement	Road surface condition	R.O.W (m)	Facilities (nos)						
							Primary school	Junir high school	High school	Pagoda	Medical facility	Market	
BMC-1	T2	0.0	6.0	Laterite									
BMC-2	T2	24.1	5.5	Laterite	Poor	15.0	2	1	0	2	0	1	
BMC-3	T1	24.0	5.0	Laterite	Good	10.0-11.0	1	1	1	1	0	1	
BMC-4	T1	29.0	5.0	Laterite	Good	11.5-15.5	3	3	1	2	0	0	
BMC-5	T1	25.0	6.0	Laterite	Poor	10.0	0	1	0	0	0	0	
BMC-6	T2	18.6	5.0	Laterite	Very Poor	10.0-19.0	0	0	0	2	1	1	
BMC-7	T2	14.1	6.0	Laterite	Poor	7.0-13.0	3	0	0	1	0	0	
Subtotal		134.8					9	6	2	8	1	3	
		100.0%											

Source: JICA Survey Team

BMC-2 L=24.1 km

This road is 5.0 to 5.5 m wide, and the road surface condition is poor with some unevenness and rutting on the laterite. The 0.5 km-section from the beginning point (East side) of this road has already been paved with concrete. There are some primary schools, junior high schools, and pagodas along the road. The land use along the road is mainly rice fields, with irrigation canals between the rice fields and the road, and some residential areas scattered along the road. There are box culverts with water gates and a spillway at 7 km West of the beginning point. The connecting road at the ending point is a 5 m-wide laterite road. The connecting road at the beginning point leads to NR5 on the North.



Source: JICA Survey Team

Figure 3.2-37 Road Conditions (BMC-2)

BMC-3 L=20.0 km

This road is 5.0 to 6.0 m wide, and the road surface condition is good. The 13 km-section from the ending point (North side) of this road has already been paved with concrete and DBST pavement. There is one pagoda along the road. The land use along the road is mainly cropland, with some residential areas and rice fields scattered along the road. It connects with NR6 at the beginning point, and the connecting road at the end point is a concrete pavement road.



Source: JICA Survey Team

Figure 3.2-38 Road Conditions (BMC-3)

BMC-4 L=29.0 km

This road is 5.0 to 8.0 m wide, and the road surface condition is good. The 1 km-section near the middle point of the road has already been paved with concrete. There are some primary schools, junior high schools, a high school, and pagodas along the road. The land use along the road is mainly rice fields, with a canal between the rice fields and the road. In addition, croplands such as orchards and residential areas are scattered along the road. It connects with NR56 at the beginning point, and the connecting road at the ending point is concrete paved road.



Source: JICA Survey Team

Figure 3.2-39 Road Conditions (BMC-4)

BMC-5 L=25.0 km

This road is 5.0 to 7.0 m wide, and the road surface condition is poor, with some unevenness and rutting on the laterite. There is one junior high school at the beginning point (East side) of the road, near the NR56 junction. The land use along the road is mainly cropland, such as fields and orchards, with some residential areas scattered along the road. A box culvert with a water gate is under construction near the beginning point of the road. It connects with NR56 at the beginning point, and the connecting road at the end point is a DBST paved road and it leads to NR5 on the South.



Source: JICA Survey Team

Figure 3.2-40 Road Conditions (BMC-5)

BMC-6 L=18.6 km

This road is 4.5 to 5.0 m wide, and the road surface condition is very poor, with some unevenness on the laterite and some damage to the DBST pavement that was constructed in the past, and many potholes can be seen. The 0.3 km-section from the beginning point (East side) has already been paved with concrete. There are some pagodas and medical facilities along the road. The land use along the road is mainly rice fields, with a canal between the rice fields and the road. In addition, there are some residential areas and croplands such as fields scattered along the road. The connecting road at the end point is DBST paved road.



Connecting Road at beginning point



Around end point



Around beginning point



Connecting Road at end point

Source: JICA Survey Team

Figure 3.2-41 Road Conditions (BMC-6)

BMC-7 L=14.1 km

This road is 5.5 to 6.0 m wide, and the road surface condition is poor, with some unevenness on laterite and damage to the DBST pavement that was constructed in the past. The 0.1 km-section from the beginning point (West side) of this road has already been paved with concrete. There are some primary schools and a pagoda along the road. The land use along the road is mainly rice fields, with some residential areas and croplands such as fields scattered along the road. There is a pagoda gate at the intersection of NR56 near the beginning point, and the width between the pillars of the gate is 5.6 m. The connecting road at the end point is a DBST paved road.



Source: JICA Survey Team

Figure 3.2-42 Road Conditions (BMC-7)

(2) Road Structure Survey

1) Objectives of the Survey

Road structure survey was conducted on 38 roads of the Project. The purpose of the survey is to determine the road structure conditions of the target road and to collect the information necessary for the study of improvement specifications. The survey result is also used to prioritize road design and sub-projects, and as quantitative effectiveness indicators.

2) Outline of the Survey

The road structure survey was started on February 15, 2022 and lasted for about 50 days until April 5, 2022. The outline of the survey is shown below.

Table 3.2-6 Outline of the Survey

Contents	Outline
Target provinces	Kampong Chhnang, Pursat, Battambang, Banteay Meanchey
Survey Locations	38 routes, Total length L=529.7 km
Day of week and time	Weekday 8:00-17:00
Survey Items	Location, shape type, and dimensions (extension, width, height, etc.) of existing bridges and culverts
Survey Method	Structural type and dimensions of existing bridges, box culverts, and pipe culverts were measured and recorded using a measuring tape based on the survey form.

Source: JICA Survey Team

3) Results of Survey

A survey of existing structures along each route was conducted to confirm the size of existing bridges, box culverts, and pipe culverts. A summary of the survey results is shown in Table 3.2-7.

14 bridges (2 wooden bridges), 17 box culverts (9 boxes under 8 m), and 147 pipe culverts were confirmed along the target road in Kampong Chhnang.

25 bridges (11 wooden bridges), 36 box culverts (26 boxes under 8 m), and 236 pipe culverts were confirmed along the target road in Pursat.

16 bridges (3 wooden bridges), 10 box culverts (8 boxes under 8 m), and 178 pipe culverts were confirmed along the target road in Battambang.

12 bridges (no wooden bridges), 28 box culverts (all less than 8m), and 180 pipe culverts were confirmed along the target road in Banteay Meanchey.



Source: JICA Survey Team

Figure 3.2-43 Photo of Survey Status

Table 3.2-7 Summary of Structure Survey Results

Name	Type	Improvement length	Existing					
			Road Wide	Bridge		Culvert		
				Concrete or Steel	Wood	BOX L ≥ 8m	BOX L < 8m	PIPE
KCH-1	T1	4.3	10.0	0	0	0	0	6
KCH-2	T2	9.1	5.0	0	0	0	0	10
KCH-3	T2	7.1	5.0	0	2	0	0	12
KCH-4	T2	8.2	5.0	1	0	0	0	9
KCH-5	T3	0.0	5.0					
KCH-6	T3	11.3	5.0	1	0	0	4	17
KCH-7	T1	27.5	8.0	0	0	8	0	4
KCH-8	T2	12.2	8.0	2	0	0	0	12
KCH-9	T2	8.8	5.0	1	0	0	0	11
KCH-10	T2	8.9	5.0	2	0	0	0	11
KCH-11	T2	12.7	6.0	0	0	0	0	13
KCH-12	T2	12.4	5.0	3	0	0	1	26
Subtotal		122.5		10	2	8	5	131
PS-1	T1	0.0	5.0					
PS-2	T1	18.2	5.0	0	2	0	3	22
PS-3	T1	17.6	5.0	0	1	0	0	26
PS-4	T1	12.2	5.0	0	1	0	5	24
PS-5	T1	12.9	5.0	0	5	0	1	43
PS-6	T1	9.7	5.0	2	0	0	1	28
PS-7	T1	0.0	5.0					
PS-8	T1	8.8	6.0	1	0	3	1	14
PS-9	T1	11.2	8.0	2	0	5	0	3
PS-10	T1	11.8	6.0	0	0	0	6	15
PS-11	T1	15.0	6.0	1	3	0	1	15
PS-12	T2	5.0	5.0	2	1	0	1	6
PS-13	T1	6.5	5.0	0	0	0	7	18
PS-14	T1	10.3	5.0	2	2	2	0	14
PS-15	T2	3.9	5.0	0	0	0	0	8
Subtotal		143.1		10	15	10	26	236
BTB-1	T2	15.0	5.0	3	0	0	1	23
BTB-2	T2	18.2	6.0	0	0	0	4	23
BTB-3	T2	10.6	6.0	0	0	0	0	14
BTB-4	T3	16.1	6.0	0	0	0	0	15
BTB-5	T2	0.0	6.0					
BTB-6	T1	17.0	6.0	0	2	0	1	9
BTB-7	T1	16.2	4.0	3	0	1	0	45
BTB-8	T1	18.0	6.0	2	1	0	2	31
BTB-9	T3	18.2	6.0	5	0	1	0	18
Subtotal		129.3		13	3	2	8	178
		100.0%						
BMC-1	T2	0.0	6.0					
BMC-2	T2	24.1	5.5	1	0	0	1	29
BMC-3	T1	24.0	5.0	10	0	0	8	32
BMC-4	T1	29.0	5.0	1	0	0	7	36
BMC-5	T1	25.0	6.0	1	0	0	0	7
BMC-6	T2	18.6	5.0	0	0	0	7	24
BMC-7	T2	14.1	6.0	0	0	0	4	35
Subtotal		134.8		13	0	0	27	163
		100.0%						
Total		529.7		46	20	20	66	708
		100.0%						

Source: JICA Survey Team

(3) Ancillary Facilities (Drainage facilities, Safety facilities, etc.)

1) Objectives of the Survey

An ancillary facility survey was conducted on 38 roads of the Project. The purpose of the survey is to determine the ancillary facility conditions of the target road and to collect the information necessary for the study of improvement specifications. The survey result is also used to prioritize road design and sub-projects, and as quantitative effectiveness indicators.

The survey was visually confirmed and pictures were taken and recorded during the road condition survey.

2) Results of Survey

The types of existing ancillary facilities confirmed in the survey include drainage facilities such as water gates, spillways, canals, and roadside ditches. Traffic safety facilities include road signs, road lighting, guard posts, and railway crossings.



Source: JICA Survey Team

Figure 3.2-44 Roadside Ancillary Facilities

Some box culverts with water gates and pipe culverts were confirmed in irrigation canals crossing the target roads. Also, some spillway structures were confirmed in flooded areas, mainly in Pursat and Banteay Meanchey.



Source: JICA Survey Team

Figure 3.2-45 Road Drainage Facilities

Many canals for agricultural drainage were confirmed along the target road in the rice field area. In villages and on routes where the road was up and down, ditches were installed for road surface drainage, and crossing pipes of $\Phi 400$ to $\Phi 600$ were confirmed at intervals. Their structures were mainly made of soil ditches and home pipes.



Traffic Sign



Road Lighting

Source: JICA Survey Team

Figure 3.2-46 Traffic Sign

Traffic signs confirmed at the site were crosswalks, speed down, stop, speed limit, weight limit, crossroads, and sharp curves signal, among others. Road lighting was not installed on most roads. The presence of lighting fixtures at intersections was confirmed, which were of solar type and installed at a low height.



Guard Posts

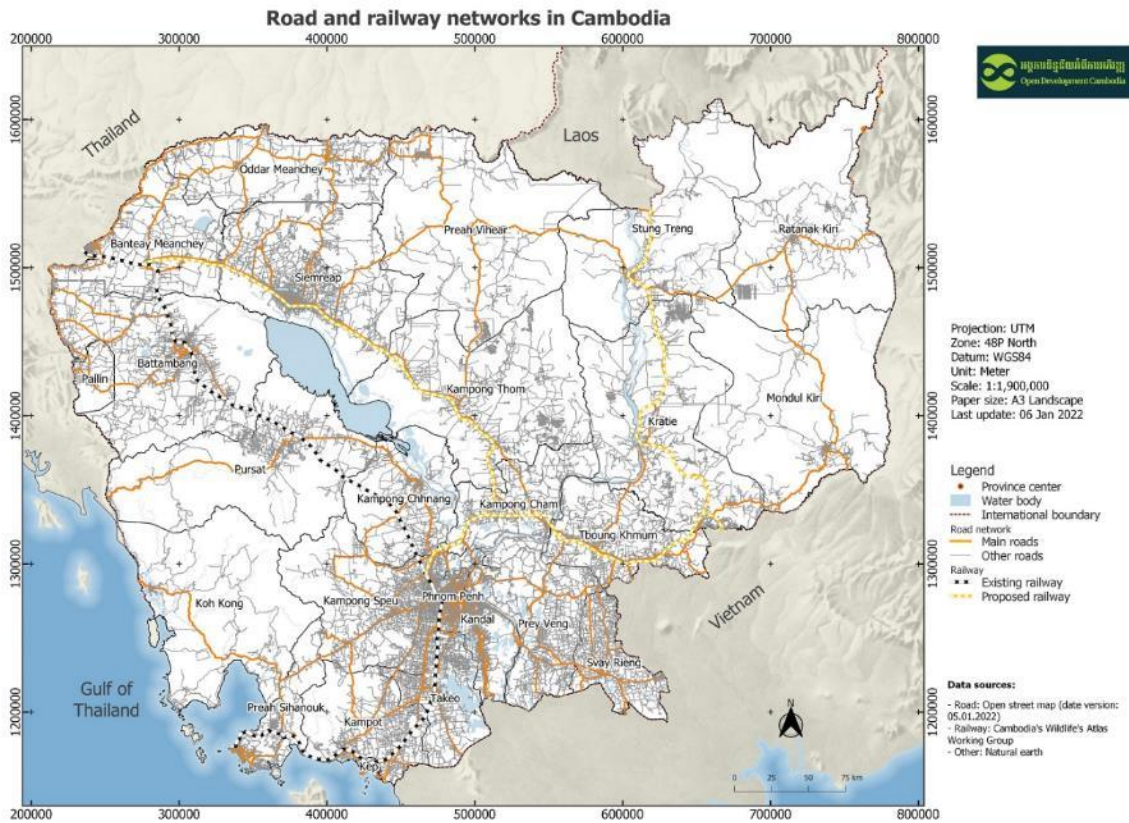


Railway crossing

Source: JICA Survey Team

Figure 3.2-47 Guard Post and Railway Crossing

Concrete guard posts were confirmed on the walls at both ends of the cross-drainage facility and at the sharp curve section. As shown in the RRMP, they do not provide protection, and it is hoped that they will be replaced with plastic products for visual guidance purposes. There is a railway South of NR5 that goes toward Thailand following the national road. This railway connects the port of Sihanoukville to Thailand via Phnom Penh, mainly used for cargo transport. The number of trains in operation is extremely few; according to information from MRD, there are only 1~2 trains per day, so it was not possible to confirm train operation during the field survey. Railway crossings with the target road are mainly in Pursat and Battambang. Figure 3.2-48 shows Cambodia's railway network.



Source: JICA Survey Team

Figure 3.2-48 Railway Network Map

3.2.2 Traffic Count Survey

(1) Traffic Count Survey

1) Objective of the Survey

A traffic volume survey was conducted on 38 target roads in the project. The purpose of the survey was to determine traffic characteristics and to estimate future traffic volumes by understanding actual conditions of the traffic volume. The survey results are also used to prioritize road design and sub-projects, as well as quantitative effectiveness indicators.

2) Outline of the Survey

The traffic volume survey started on February 23, 2022, and lasted for about 1 month until March 24. The 16-hour observation (from 5: 00 in the morning to 21: 00 at night) was conducted only on weekdays (Tuesday, Wednesday, and Thursday). The outline of the survey, survey schedule, and survey locations are shown below.

Table 3.2-8 Outline of the Survey

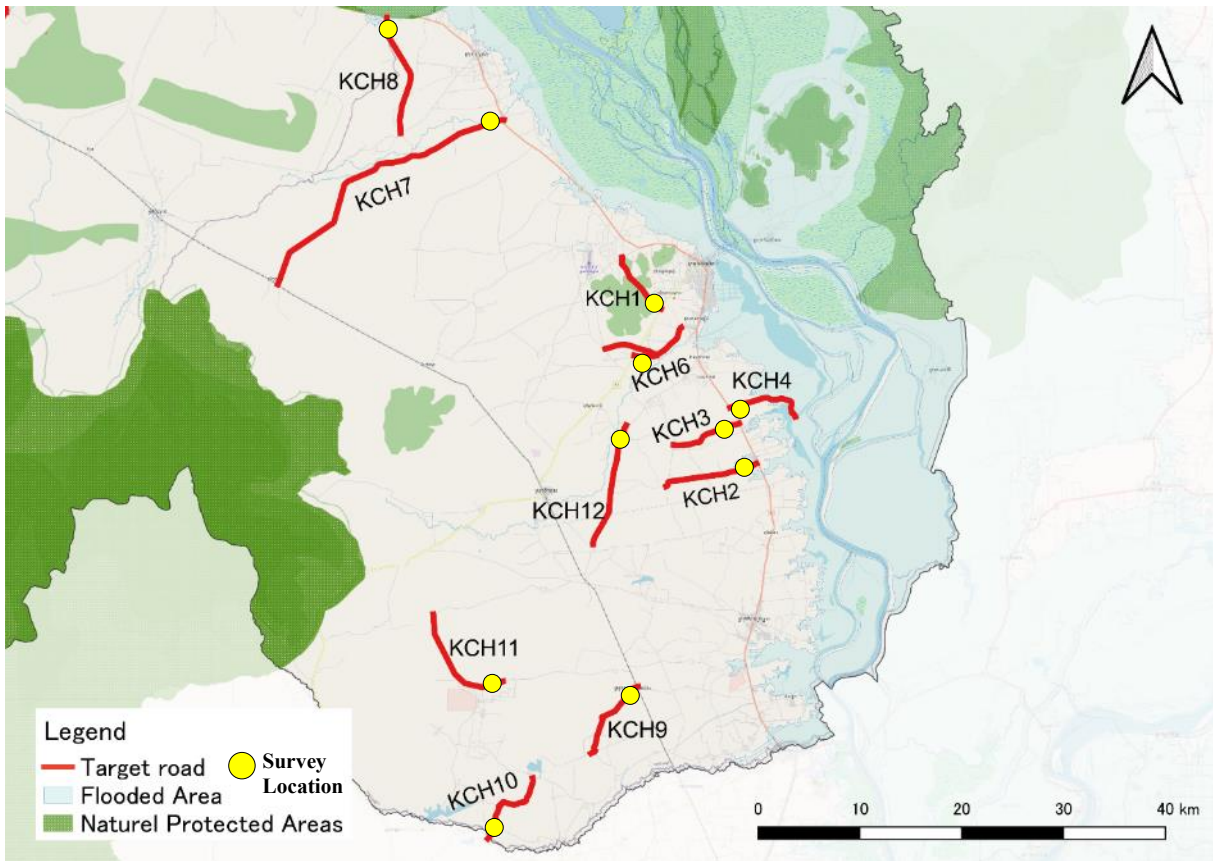
Contents	Outline
Target provinces	Kampong Chhnang, Pursat, Battambang and Banteay Meanchey
No of locations	38 locations on the project's target roads (one per route)
Survey locations	Selected locations near intersections with NR5 and major roads, as well as representative locations where villages are densely populated.
Day of week and time	16 hours observation (5: 00 -21: 00) on a weekday (Tuesday, Wednesday, Thursday selected)
Component of vehicles	Motorized transport: 11 vehicle type / non-motorized transport: 3 types. Detailed vehicle classification is shown in the traffic volume survey results.

Source: JICA Survey Team

Table 3.2-9 Date of Implementation

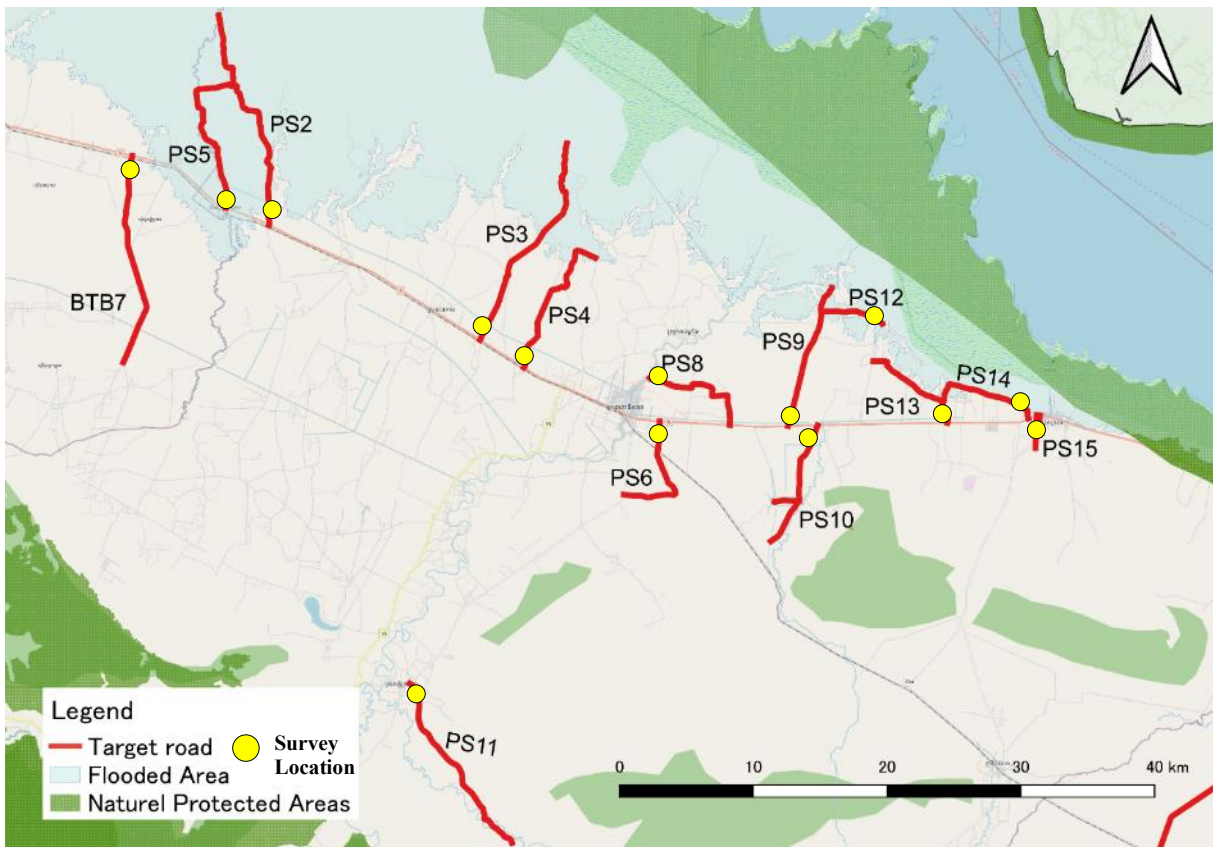
No	Province	Target Route	Date of Implementation	Position	
				Latitude	Longitude
1	Kampong Chhnang	KCH- 1	2/23 (Wed)	12.21433	104.6284
2		KCH- 2		12.07718	104.7162
3		KCH- 3		12.11201	104.6992
4		KCH- 4		12.1269	104.6929
5		KCH- 6		12.17239	104.6066
6		KCH- 7	2/24 (Tue)	12.37602	104.4693
7		KCH- 8		12.47075	104.3812
8		KCH- 9	3/15 (Tue)	11.8762	104.6043
9		KCH- 10	3/16 (Wed)	11.74455	104.4745
10		KCH- 11		11.88239	104.4839
11		KCH- 12	3/17(Thu)	12.00692	104.5683
12	Pursat	PS-2	3/2 (Wed)	12.66136	103.6719
13		PS-3	3/1 (Tue)	12.58424	103.8177
14		PS-4		12.56574	103.8482
15		PS-5	3/2 (Wed)	12.53324	104.2006
16		PS-6	3/1 (Tue)	12.52778	103.941
17		PS-8		12.55755	103.9349
18		PS-9		12.52727	104.0297
19		PS-10		12.52586	104.0495
20		PS-11	3/3 (Thu)	12.34737	103.77526
21		PS-12	3/1 (Tue)	12.59592	104.09379
22		PS-13	2/24 (Tue)	12.52953	104.13921
23		PS-14		12.53652	104.19426
24		PS-15		12.53324	104.20058
25	Battambang	BTB- 1	3/3 (Thu)	12.96874	103.04983
26		BTB- 2		12.96246	103.03937
27		BTB- 3	3/15 (Tue)	13.36803	103.03178
28		BTB- 4	3/16 (Tue)	13.38876	103.02573
29		BTB- 6	3/3 (Thu)	12.58064	102.76461
30		BTB- 7	3/2 (Wed)	12.7044	103.5768
31		BTB- 8		12.64264	103.393
32		BTB- 9	3/22 (Thu)	13.18147	102.41979
33	Banteay Meanchey	BMC-2	3/9 (Wed)	13.3967	102.92842
34		BMC- 3	3/10 (Thu)	13.59359	103.40275
35		BMC- 4		13.79769	102.96405
36		BMC- 5		13.7622	102.95795
37		BMC- 6	3/24 (Thu)	13.81615	102.97572
38		BMC- 7		13.93204	103.04188

Source: JICA Survey Team



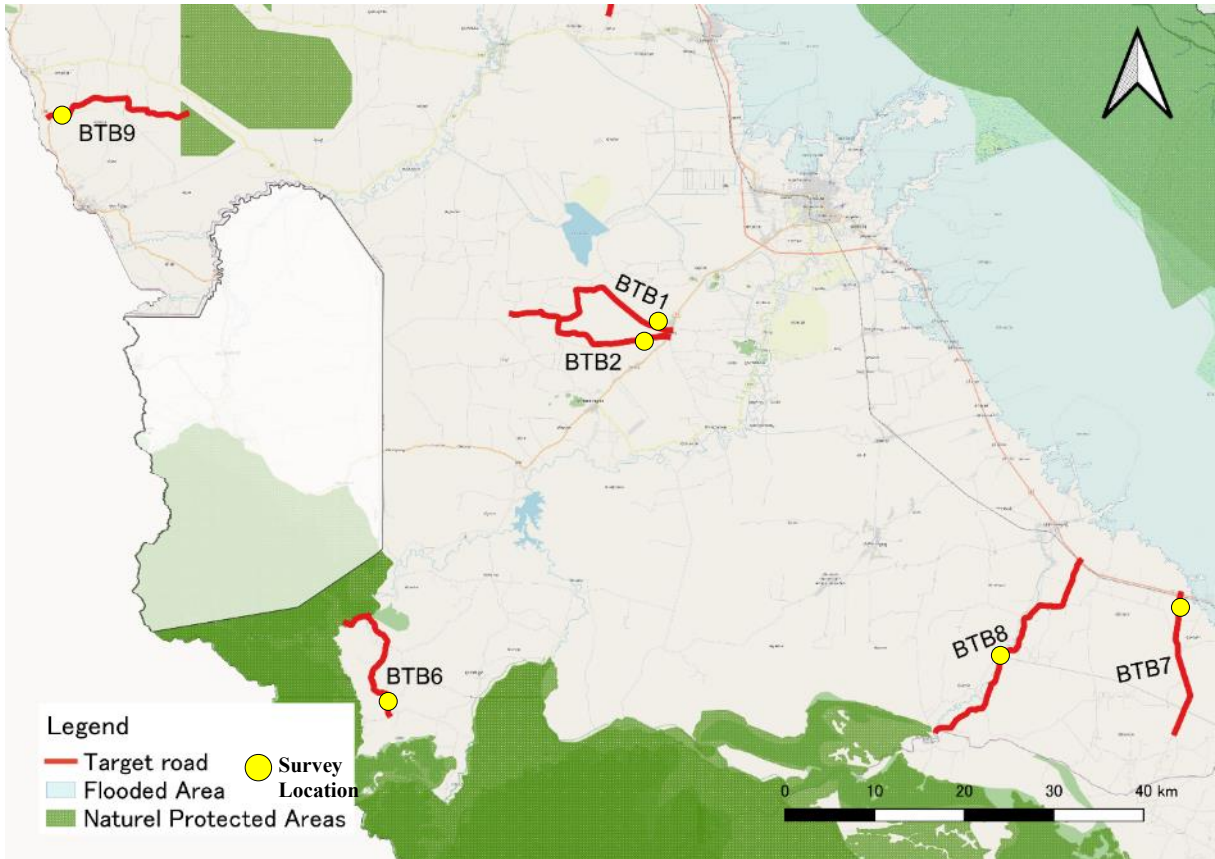
Source: JICA Survey Team

Figure 3.2-49 Traffic Count Locations (Kampong Chhnang)



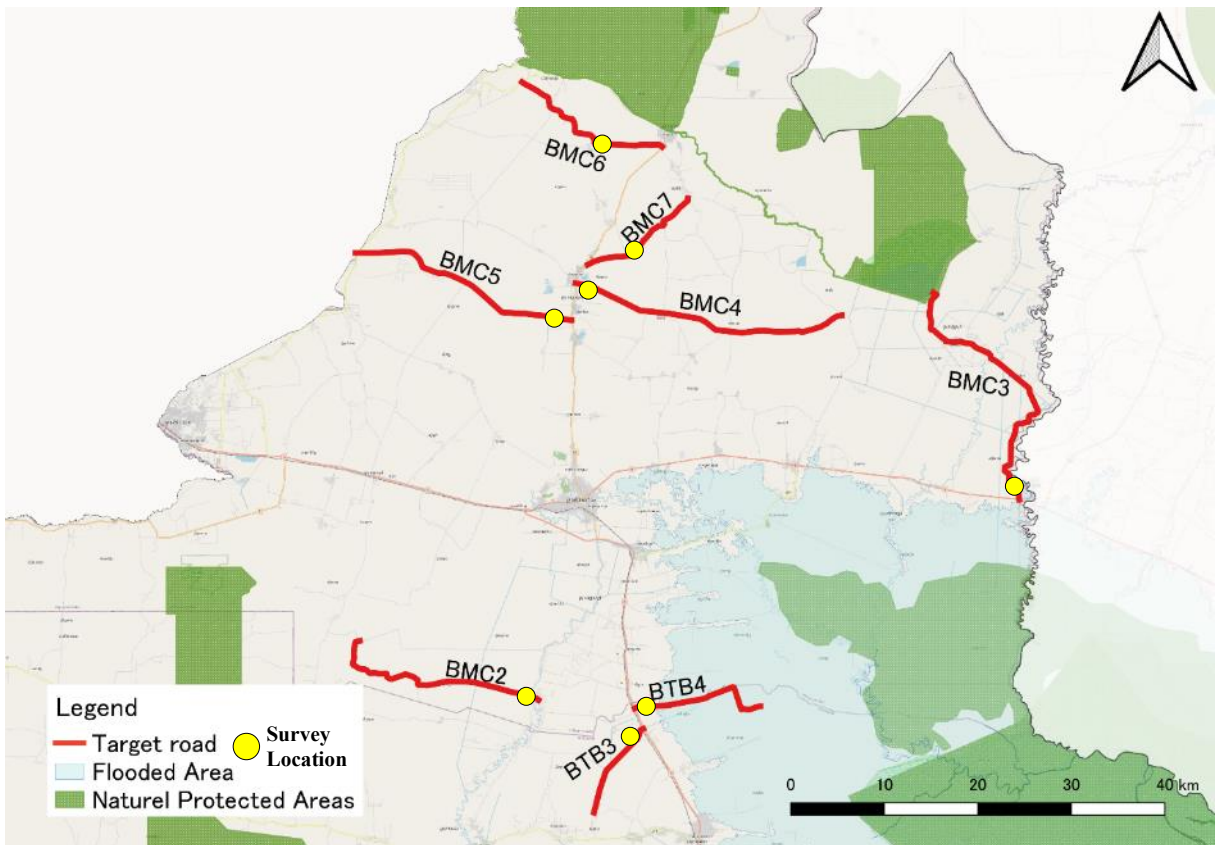
Source: JICA Survey Team

Figure 3.2-50 Traffic Count Locations (Pursat)



Source: JICA Survey Team

Figure 3.2-51 Traffic Count Locations (Battambang)



Source: JICA Survey Team









Figure 3.2-52 Traffic Count Locations (Banteay Meanchey)

3) Traffic Count Results

Traffic volume results for each survey route are shown below. According to vehicle type, the number of motorcycles ranged from 300 to 4,600, small vehicles from 20 to 510, and large vehicles from 0 to 500. The total number of vehicles ranged from 340 to 5,400 with variation depending on the route.

Table 3.2-10 Traffic Count Survey Results (1/2)







Unit: Vehicles (16 hours)

Location	I. Motorcycle			Total	II. Light Vehicle					Total
	1	2	3		4	5	6	7	8	
	Motorcycle 	Tuk Tuk 	Motoremok 		Small Agricultural Tractor 	Lage Agricultural Tractor 	Passenger Car/Jeep/4 WD, Taxi 	Minibus (less than 16 seats) 	Light Truck (4 tires) pick up truck for goods 	
KCH1	542	2	25	569	18	1	15	12	16	62
KCH2	476	1	19	496	12	9	22	10	17	70
KCH3	954	59	43	1,056	44	3	148	52	52	299
KCH4	1,557	41	39	1,637	32	33	104	41	64	274
KCH6	684	7	27	718	13	12	15	7	4	51
KCH7	953	4	22	979	19	31	36	22	39	147
KCH8	829	5	15	849	62	6	31	82	24	205
KCH9	707	8	47	762	20	9	22	44	13	108
KCH10	763	0	20	783	18	5	3	12	2	40
KCH11	487	1	10	498	6	1	20	3	22	52
KCH12	932	4	25	961	19	7	29	6	9	70
PS2	3,022	24	42	3,088	59	40	142	46	41	328
PS3	1,085	17	26	1,128	26	9	11	7	12	65
PS4	678	2	14	694	17	5	16	6	7	51
PS5	1,995	12	53	2,060	17	33	43	11	16	120
PS6	1,976	13	128	2,117	1	9	80	7	89	186
PS8	1,354	10	61	1,425	0	5	90	11	25	131
PS9	491	7	26	524	9	4	33	19	30	95
PS10	1,708	44	86	1,838	22	94	71	90	47	324
PS11	4,495	24	46	4,565	9	53	75	3	84	224
PS12	1,089	26	16	1,131	15	27	6	12	13	73
PS13	1,222	4	27	1,253	17	0	8	11	9	45
PS14	869	20	29	918	8	7	11	14	21	61
PS15	497	10	7	514	0	1	19	15	1	36
BTB1	1,383	6	54	1,443	27	8	65	11	41	152
BTB2	1,548	2	26	1,576	52	7	41	10	34	144
BTB3	290	0	8	298	9	3	2	2	4	20
BTB4	1,848	22	69	1,939	26	19	49	9	23	126
BTB6	2,409	5	24	2,438	34	32	119	64	86	335
BTB7	1,060	19	37	1,116	42	8	32	28	34	144
BTB8	4,024	0	169	4,193	87	7	59	11	46	210
BTB9	1,400	6	123	1,529	49	30	41	5	21	146
BMC2	2,894	55	73	3,022	143	20	40	10	96	309
BMC3	2,094	1	51	2,146	47	250	110	22	83	512
BMC4	1,568	4	20	1,592	40	3	103	18	82	246
BMC5	627	7	4	638	231	0	22	3	45	301
BMC6	745	0	5	750	4	155	30	1	22	212
BMC7	765	2	3	770	4	81	12	1	5	103

Source: JICA Survey Team

Table 3.2-11 Traffic Count Survey Results (2/2)

Unit: Vehicles (16 hours)

Location	III. Heavy Vehicle				IV. Non Motorized				Grand Total
	9	10	11	Total	12	13	14	Total	
	Medium & Large Bus (16 or more seats)	Medium truck (6 tires) including trailer	Heavy truck (8 or more tires) including trailer		Bicycle	Animal Car	Samlor		
									
KCH1	0	375	114	489	117	0	0	117	1,237
KCH2	0	18	17	35	73	0	0	73	674
KCH3	2	28	5	35	265	0	0	265	1,655
KCH4	0	178	8	186	352	0	0	352	2,449
KCH6	0	1	0	1	211	0	0	211	981
KCH7	1	8	26	35	113	0	0	113	1,274
KCH8	1	15	30	46	68	0	0	68	1,168
KCH9	2	26	8	36	50	0	0	50	956
KCH10	1	5	0	6	183	0	0	183	1,012
KCH11	2	3	0	5	27	0	0	27	582
KCH12	0	11	0	11	43	0	0	43	1,085
PS2	14	11	8	33	313	0	0	313	3,762
PS3	0	1	2	3	66	0	0	66	1,262
PS4	0	58	33	91	188	0	0	188	1,024
PS5	2	59	92	153	278	0	0	278	2,611
PS6	3	10	17	30	151	0	0	151	2,484
PS8	2	166	31	199	274	0	0	274	2,029
PS9	12	11	30	53	9	0	0	9	681
PS10	17	147	5	169	289	0	0	289	2,620
PS11	0	14	29	43	585	0	0	585	5,417
PS12	16	0	0	16	363	0	0	363	1,583
PS13	0	14	0	14	205	0	0	205	1,517
PS14	0	8	7	15	609	0	0	609	1,603
PS15	0	2	0	2	90	0	0	90	642
BTB1	1	20	2	23	92	0	0	92	1,710
BTB2	0	15	4	19	83	0	0	83	1,822
BTB3	0	0	0	0	21	0	0	21	339
BTB4	0	41	5	46	120	0	0	120	2,231
BTB6	2	42	5	49	30	0	0	30	2,852
BTB7	3	15	8	26	42	0	0	42	1,328
BTB8	0	48	1	49	437	0	0	437	4,889
BTB9	0	7	1	8	141	0	0	141	1,824
BMC2	1	186	0	187	535	0	0	535	4,053
BMC3	0	75	6	81	74	0	0	74	2,813
BMC4	1	11	6	18	34	0	0	34	1,890
BMC5	0	42	18	60	44	0	0	44	1,043
BMC6	1	15	0	16	10	0	0	10	988
BMC7	0	0	0	0	22	0	0	22	895

Source: JICA Survey Team

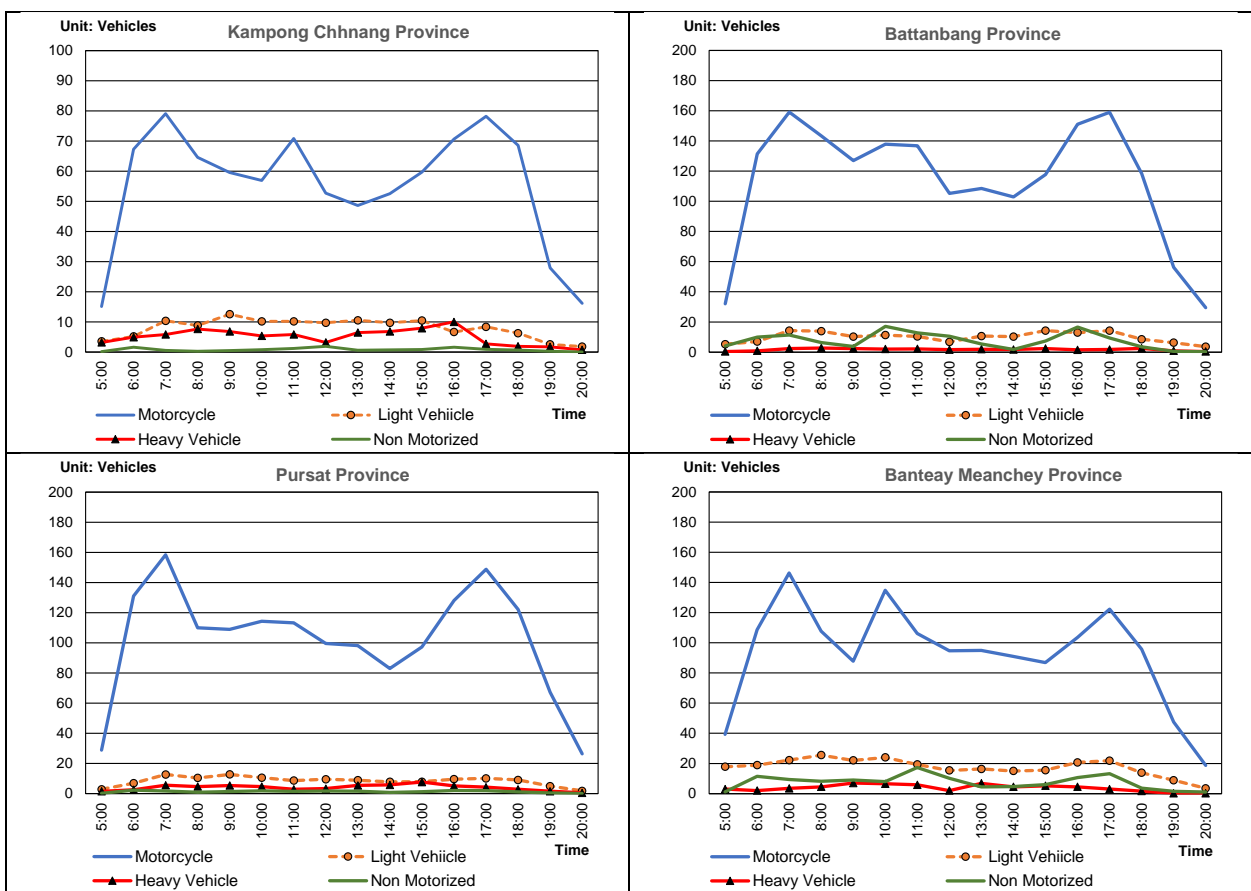
4) Hourly Traffic Volume

The target roads were aggregated by province and average traffic volumes were calculated by hour. For motorcycles, traffic volume in Kampong Chhnang Province is about 50% lower than that in other provinces. The three provinces of Pursat, Battambang, and Banteay Meanchey have generally the same trend in traffic volume and traffic variability.

All provinces have a peak at 7:00 a.m. and a decline from 5:00 p.m. evening. With the exception of motorcycles, the number of light vehicles, heavy vehicles, and non-motorized traffic was almost less than 20 vehicles per hour in all provinces.

The hourly traffic volumes at 19:00 and 20:00 for each of the four provinces as a whole were summed to calculate the percentage decrease in traffic volume for the two-hour period between 19:00 and 20:00.

Through the calculation of the hourly traffic volumes from 21:00 to 5:00, only 20 motorcycles, 3 light vehicles, and zero heavy vehicles were projected. Therefore, 16-hour traffic volume results were applied as 24-hour traffic volume.



Source: JICA Survey Team

Figure 3.2-53 Hourly Traffic Volume

(2) Travel Speed

Road conditions, width, traffic volume, and terrain are factors that greatly affect travel speed on rural roads. JICA Survey Team confirmed that traffic volume on rural roads is relatively low and traffic congestion do not occur through the field survey. Therefore, JICA Survey Team classified rural roads by road condition, width, and terrain, as well as the conduction of a travel speed survey. As a result of the travel speed survey, it was confirmed that the width does not affect the travel speed. Road conditions are classified into three categories: “Good” is a road which is in good condition and can be driven normally, “Poor” is a road which is bumpy but still drivable, and “Very Poor” is a road which is very

bumpy and should be avoided. In general, rural roads were on flat terrain, except for BTB6.

Table 3.2-12 Average Travel Speed by Road Conditions, Width, and Terrain

Road conditions	Terrain in rural roads	Average travel speed(km/h)
Good	Flat	29.8
	Mountainous	N/A*
Poor	Flat	20.8
	Mountainous	18.6
Very poor	Flat	15.7
	Mountainous	N/A*

* Road surface condition is Good or Very poor and there are no roads in mountainous areas on the subject road.

Source: JICA Survey Team

Below are the travel speeds for each of the target roads.

Table 3.2-13 Average Travel Speed and Access for National Roads

Target Road	Rural Road Name	Road Conditions	Terrain	Travel Speed(km/h)
KCH-1	Srang Kpuos-Kol Kup	Good	Flat	29.8
KCH-2	Kosomak-O'Loy	Poor	Flat	20.6
KCH-3	NR5-Damnak Kei	Good	Flat	29.8
KCH-4	NR5-Prek Sala	Good	Flat	29.8
KCH-6	Phum Thmey-Trapaing Kravan	Good	Flat	29.8
KCH-7	Phsar-Kdol Senchey	Poor	Flat	20.6
KCH-8	Trapaing Chan-Teuk Chreaop	Good	Flat	29.8
KCH-9	Meanok-Trapaing Mtes	Poor	Flat	20.6
KCH-10	Chrokhnout-Chrok Sdach	Poor	Flat	20.6
KCH-11	Srae Sar- Ksach Sor	Good	Flat	29.8
KCH-12	Tbeng Kpous-Ronak	Very Poor	Flat	15.7
PS-2	O'Taporng-Phum Tanai	Poor	Flat	20.6
PS-3	Plov Andongkrasaing-Tram Pae	Good	Flat	29.8
PS-4	Phnov-Phteah Pring	Poor	Flat	20.6
PS-5	Plov Phum Svay Daun Keo-Chrop-Phum Slor Klouk	Very Poor	Flat	15.7
PS-6	Plov Wat Toul Veng	Good	Flat	29.8
PS-8	Rolus	Good	Flat	29.8
PS-9	Tbaeng Chrum-Raa Toteng Thngai	Good	Flat	29.8
PS-10	Son Trae-Chher Tum	Good	Flat	29.8
PS-11	ToulCha- Keo Mony	Poor	Flat	20.6
PS-12	Kanchhor-Kampong Pou	Good	Flat	29.8
PS-13	Ou Sandan- Sna Ansa	Good	Flat	29.8
PS-14	Sna Ansa-Anlong Tnaot	Poor	Flat	20.6
PS-15	Anlong Tnaot	Good	Flat	29.8
BTB-1	NR57-Phum Boeung Krar Sal	Good	Flat	29.8
BTB-2	Sneung NR57-Beoung Praey	Poor	Flat	20.6
BTB-3	NR5 Phum Beoung Prieng-Wat Roung Chrey	Very Poor	Flat	15.7
BTB-4	NR5 (Phasar O'Nhor)-Phum Poa Ta Sek	Very Poor	Flat	15.7
BTB-6	Plov 1577 Phum O'Chrab-O'Bok Pael (Phum Sam Loat)	Poor	山地	18.1
BTB-7	NR5 Rar Cham Heang-Khum Muk Rar	Very Poor	Flat	15.7
BTB-8	NR5 O'Kreat-Ba Sak	Poor	Flat	20.6
BTB-9	NR59-Phum O' Teuk tla	Poor	Flat	20.6
BMC-2	Plov Balang Chrey	Poor	Flat	20.6
BMC-3	Spean Sraeng	Good	Flat	29.8
BMC-4	Ta Phou	Good	Flat	29.8
BMC-5	Plov Tae Hang	Poor	Flat	20.6
BMC-6	Plov Sre L'or	Very Poor	Flat	15.7

Target Road	Rural Road Name	Road Conditions	Terrain	Travel Speed(km/h)
BMC-7	Rolus-Phum Tmey	Poor	Flat	20.6

Source: JICA Survey Team

(3) Current Condition of Rural Roads in the Target Area

1) Road Conditions

The average daily traffic volume on the target roads is about 200 vehicles, and the average daily traffic volume of motorcycles is about 1,400 vehicles. The traffic volume on the target roads is small. Vehicles drive one by one, as shown in Figure 3.2-54, and no traffic congestion was observed. During the field survey, it was harvest season for rice and cassava. In Pursat and Battambang provinces, heavy trucks carrying agricultural productions and large combine harvesters passed on narrow rural roads, blocking the passage of oncoming, and following vehicles.



The traffic volume is small. Vehicles drive one by one, not contiguous (PS-4)

Many heavy trucks carrying agricultural productions drive on rural roads in harvest seasons. (PS-2)

Figure 3.2-54 Road Condition of Target Roads



A heavy truck parked on a narrow rural road. Other vehicles cannot pass through it.

Oncoming vehicles have to wait at the large space in order to pass by large combine harvesters (PS-5)

Figure 3.2-55 Heavy Trucks on Narrow Rural Roads

The surface of most of the target road is laterite. When it rains and laterites absorb moisture, the roads become slippery, increasing the risk of bicycles and motorcycles falling over, and vehicles are more likely to get stuck in the mud, greatly reducing their traveling performance. During the field survey, travel speeds were also greatly reduced during rainfall compared to normal conditions. In addition, puddles and mud remain on road sags even several days after rainfall. Motorcycles and vehicles avoid mud and puddles, causing in a temporary significant decrease in speed.



When it rains, the road surface becomes muddy, making vehicles drive very difficult. (BTB-5)



Even several days after the rain, puddles and mud remain in the road sag. It makes drivers difficult to drive motorcycle without slow down. (BTB-4)

Figure 3.2-56 Conditions of Rural Roads after the Rain

2) Commuting

According to the field interview survey, primary school students arrive at school before 7:00 a.m. by bicycle or on foot, return home once for lunch at 12:00 p.m., then arrive at school again around 1:30 p.m. after lunch, and leave school around 4:00 p.m. after the school. When primary school students commute to a school, they often walk in the middle of rural roads. On the day of the rainfall, road conditions are poor, and they ride bicycles or walk in the muddy conditions.



After it rains, the roads become muddy. Primary school students ride bicycles to school through muddy roads. (BTB-4)



Primary school students walk home along the center of the road. Students, motorcycles, and vehicles mix on the road at the commuting time. Road safety risk increases. (BTB-4)

Figure 3.2-57 Primary School Students Commuting to School

Like primary school students, junior high school students and high school students leave home before 7:00 a.m. and go home around 4:00 p.m. Many students commute to school by motorcycle or bicycle, and there are many bicycles and motorcycles around schools. It was also apparent that road safety education was not thoroughly implemented, since some students did not wear helmets and others rode a motorcycle with 2-3 people.



Figure 3.2-58 Secondary and High School Students Commuting to School

According to the field survey, local people mainly use a motorcycle or private car to go to a distant place and they walk or ride a bicycle to go to a nearby places. It is also observed that local people use share ride tractors and motorcycle as public transportation. They come to the intersection of NR5 and the access road to the village where they live, by bus or minibus, then they take a share ride tractor or motorcycle to return to their homes.

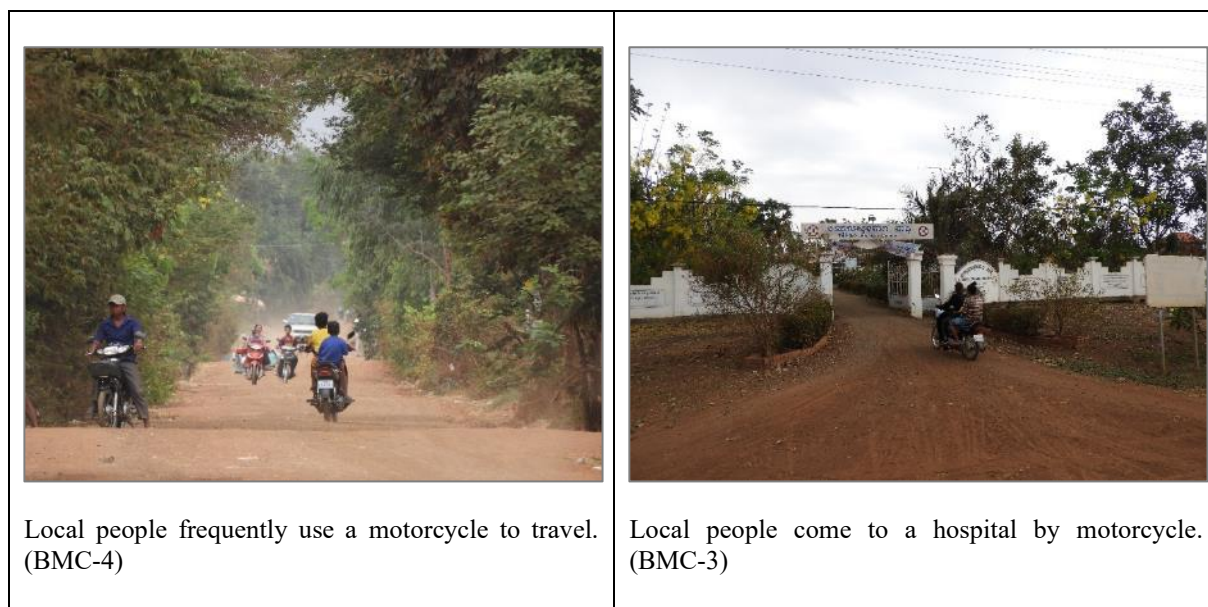


Figure 3.2-59 Local People Traveling by Motorcycle



A minibus waiting at a restaurant on NR5. This is the major public transportation in Cambodia



Local people take a share ride tractor. (KCH-7)

Figure 3.2-60 Public Transportation for Local People

3) Dust

The dust generated when vehicles drive on the road causes a negative impact on the life of the community along the rural roads. Some motorcycle drivers cover their mouths and noses with their clothes while driving. The dust has also increased the risk of road safety. In addition, local people sprinkle water in front of their houses and run water sprinkler trucks to temporarily reduce dust. Reducing dust has become an urgent issue.



A motorcycle driver covers his mouth and nose with his clothes while driving. (PS-2)



A child who takes a bicycle in the dust which a heavy truck blows up. (BMC-7)

Figure 3.2-61 Drivers in the Dust



Local people sprinkle water in front of their houses. (PS-2)



Water sprinkler trucks temporarily reduce dust. (BMC-7)

Figure 3.2-62 Measures of Local People to Reduce Dust

4) Road Safety Facilities

Road signs and bollards have already been installed as road safety facilities. The NSDP (2019-2023) also calls for the installation of road signs as a major priority activity for MRD.



A road sign indicating that the school is located. (BTB-1)



A road sign indicating that complicated road alignment is located. (PS-4)

Figure 3.2-63 Road Sign on the Current Rural Roads 1

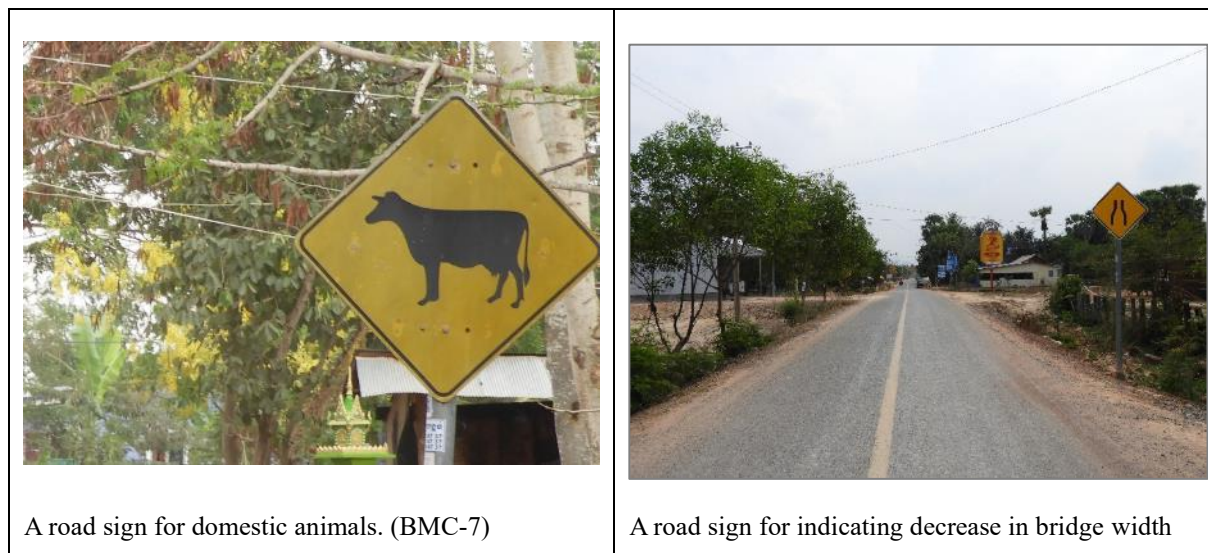


Figure 3.2-64 Road Sign on the Current Rural Roads 2

5) Traffic Accidents

In the ADB study “Consulting Service for Sustainable Community-Based Road Safety Program 2021: CBRSP” published in 2021, traffic accident data on the rural roads improved by RRIP II project from 2015 to 2020 are organized. However, traffic accident data before the implementation of RRIP II is not accurately available, and it is not possible to compare the number of traffic accidents and causes of accidents before and after road improvement.

Excessive speed and dangerous overtaking are one of the major causes of traffic fatalities after pavement improvement, resulting in 45% of fatal accidents being caused by excessive speed. Low helmet-wearing rates are also a cause of many fatal accidents. To prevent over speeding, appropriate road safety facilities such as humps and road signs are needed in villages and important public facilities.

6) Crop Loading

The target area is a major rice production area, and heavy trucks are parked on the rural road near rice paddies to load rice. Narrow rural roads prevent other vehicles from passing through and potentially causing congestion.

Cassava and other products are collected at collection points in each region, and farmers transport their produce to the collection points. Traders come to the collection points to buy the produce, which is then transported by heavy trucks to Phnom Penh and other destinations.



A heavy truck and a tractor parked on a rural road, transshipping crops. (PS-2)



A heavy truck is parked at a farmer's house and loaded with productions. (PS-5)

Figure 3.2-65 Rice Transshipping



Farmers transport cassava to the collection point with a tractor. (BMC-4)



A tractor to transport cassava (BMC-4)

Figure 3.2-66 Transportation of Cassava

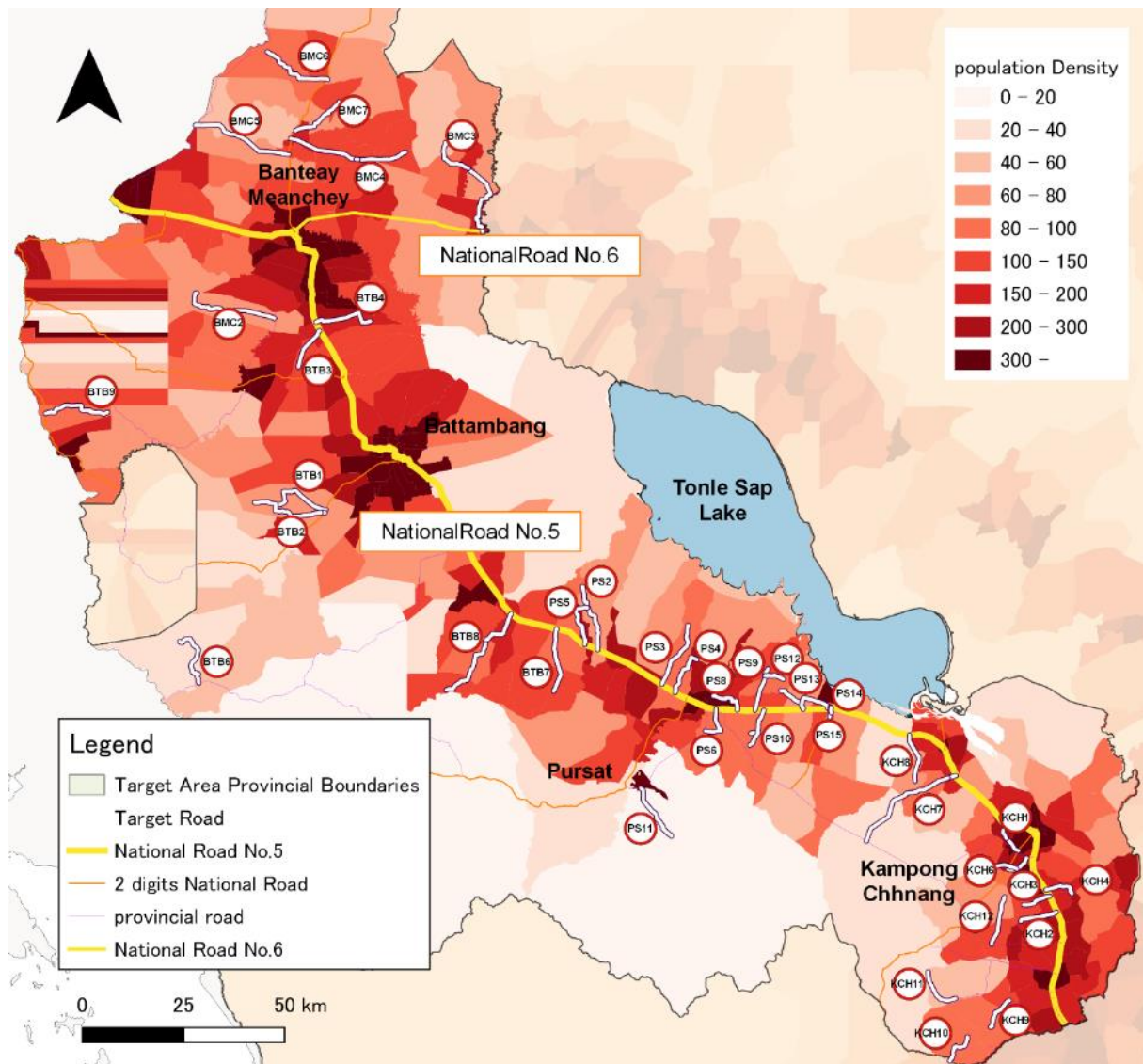
3.2.3 Surrounding Situation

(1) Population Served

In the target area, the populated communes are located along NR5. The farther away from NR5, the smaller commune population. Therefore, the population density along BTB-6 and PS-11, which are located far from NR5, is low.

Figure 3.2-67 shows the population density by commune in the target area.

The details of the population served along each target road are shown in Section 3.3.4.

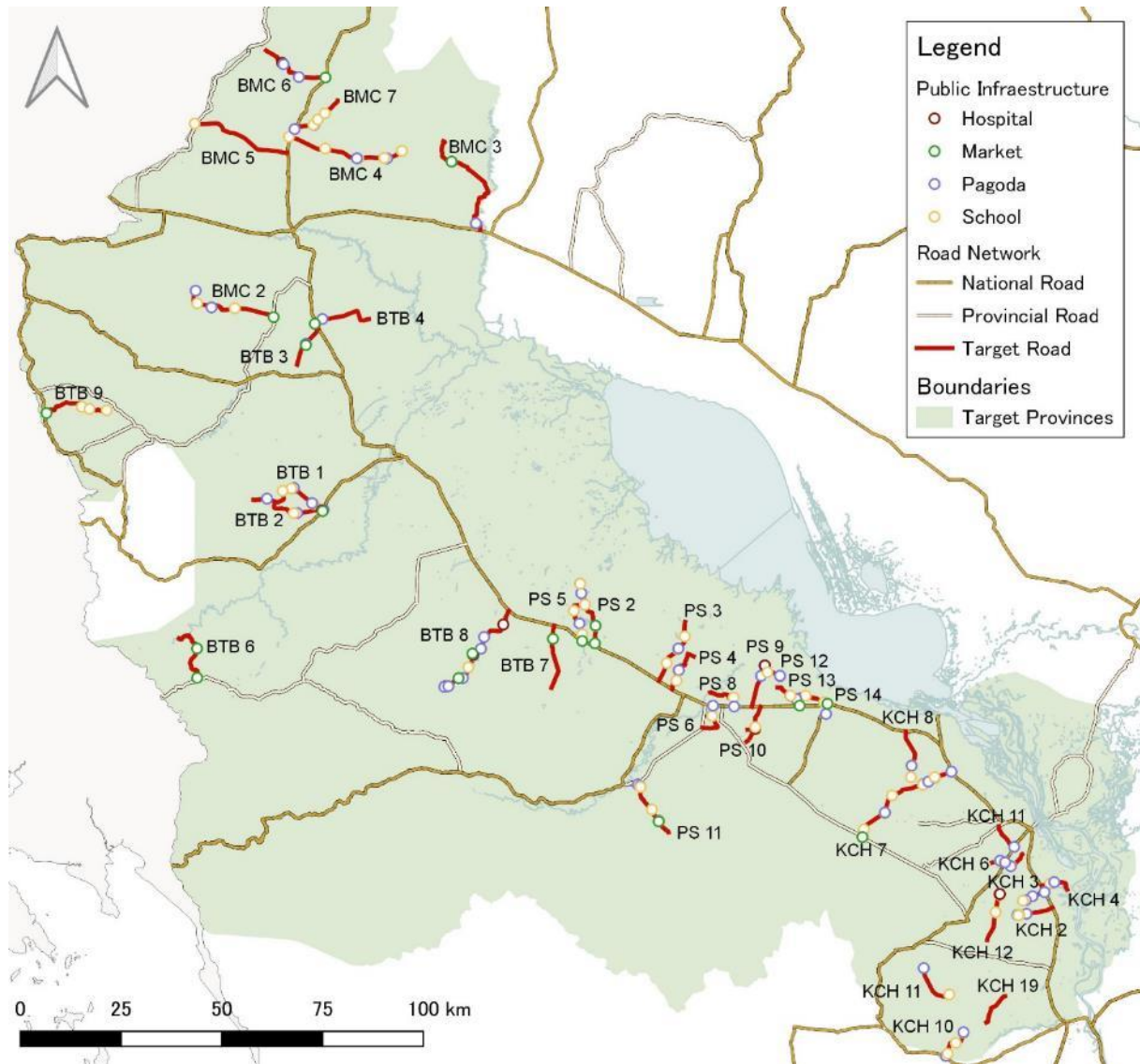


Source: JICA Survey Team

Figure 3.2-67 Population Served in Rural Roads

(2) Important Facilities in Rural Roads (School, Pagodas, Health Centers, Markets)

Public facilities that attract residents such as schools, pagodas, hospitals, community centers, markets, and police stations are located in the settlements along the subject road. Based on the RRMP, field survey, and discussions with MRD, this study identified schools, hospitals, pagodas, and markets as important facilities that are regularly used by residents. The road condition survey was conducted to determine the location and number of important facilities along each target road. The following is a map of the locations of the important facilities. The number of important facilities per road is shown in Figure 3.2-68.



Source: JICA Survey Team

Figure 3.2-68 Location Map of Important Facilities

Many residents use important facilities, and RRMP is also required to improve accessibility to important facilities. The status of important facilities on the target road is shown below.



Primary School (BTB-8)

Secondary School (BMC-4)

Hospital (BMC-4)

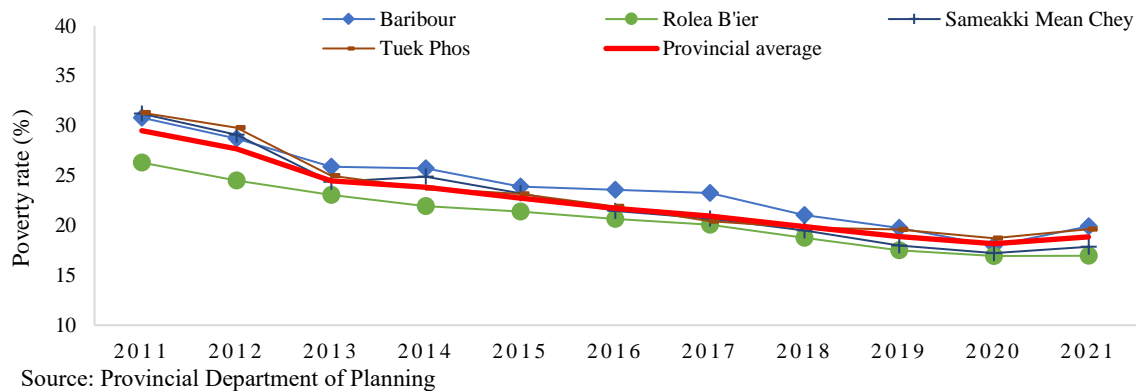
Pagoda (BMC-3)

Figure 3.2-69 Important Facilities Around the Subject Road

(3) Poverty Rate

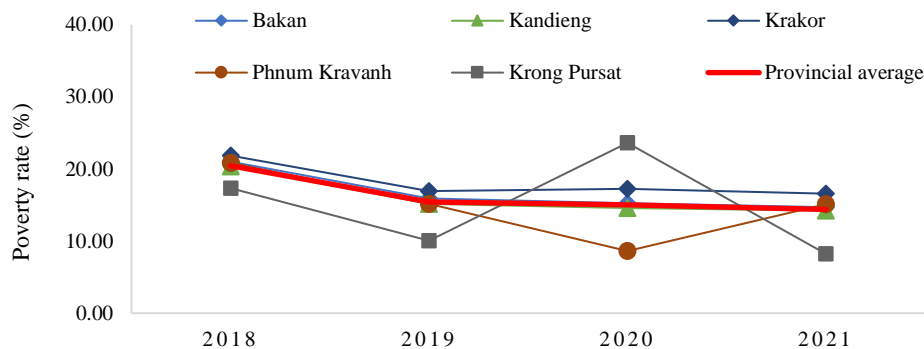
The trends related to the poverty rate in the provinces within the target area, namely Kampong Chhnang, Pursat, Battambang, and Banteay Meanchey are illustrated in Figure 3.2-70 to Figure 3.2-73⁶.

In Kampong Chhnang province (Figure 3.2-70), the poverty rate declined sharply before 2013 and the rate of decline remains constant at about 0.9 percent per year until 2020. However, a slight increase in this province's poverty rate in 2021, similar to the national trend, could be due to the impact of COVID-19 pandemic.



Source: Provincial Department of Planning
Figure 3.2-70 Trend in Poverty Rate of Project related Districts in Kampong Chhnang Province

In Pursat province (Figure 3.2-71), the poverty rate decreased over the observed period. The decrease rate remains steady at 0.52% per year from 2019 to 2021.



Source: Provincial Department of Planning
Figure 3.2-71 Trend in Poverty Rate of Project related Districts in Pursat Province

In Battambang province (Figure 3.2-72), the poverty rate has steadily decreased since 2012 (0.57 percent per year) until 2018, before experiencing a sharp decline of nearly 10 percent. The most likely reasons are the infrastructure development and construction sectors, given that the RGC has made Battambang province the central economic zone of Northwestern Cambodia⁷ especially the agricultural sectors. The province is known as huge agricultural products of Cambodia, with 74% of the total area cultivated in arable land⁸. Along with the boom of agricultural products export in recent years, the province and its people will benefit more from the development of this sector.

⁶ Data obtained from Provincial Department of Planning, by June 2022

⁷ Battambang strategic plan workshop report- *Strategic Planning Workshop on Localizing the 2030 Agenda through Sustainable Urban Resource Management*, UNESCAP, 2019, https://www.unescap.org/sites/default/d8files/event-documents/Battambang_Strategic%20Planning%20Workshop%20Report.pdf

⁸ Economic Development and Service Delivery of Sub-national Government in Battambang Province, PIC, 2016

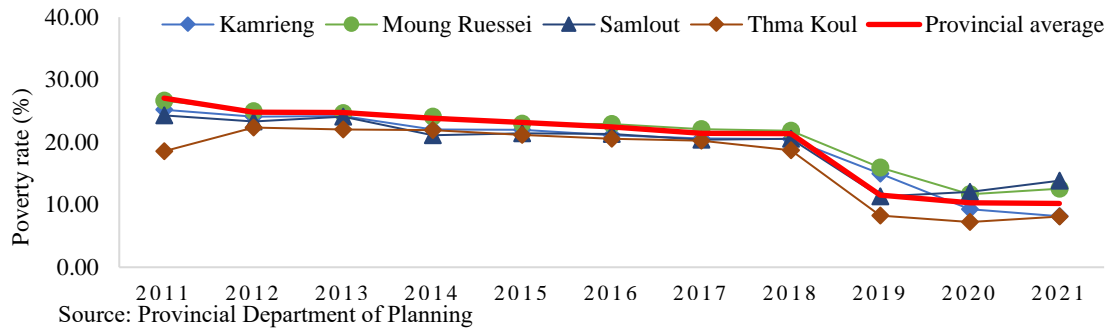
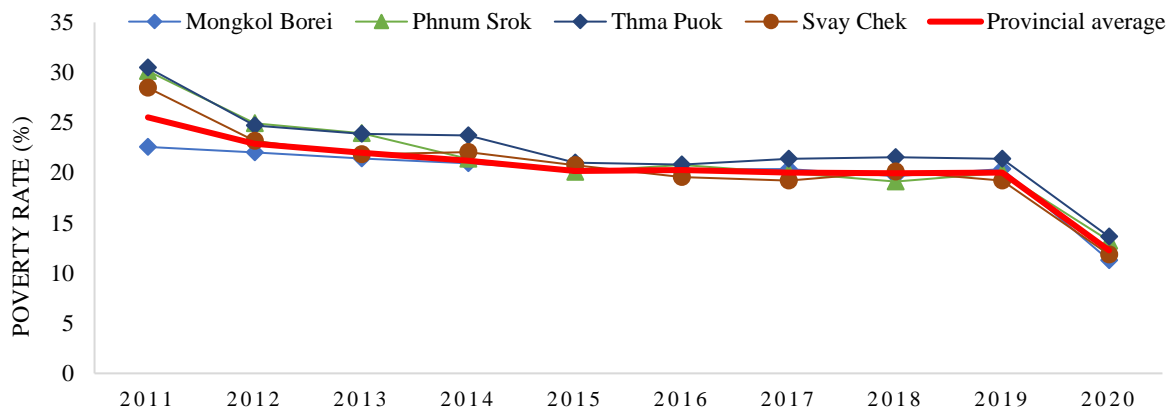


Figure 3.2-72 Trend in Poverty Rate of Project related Districts in Battambang Province

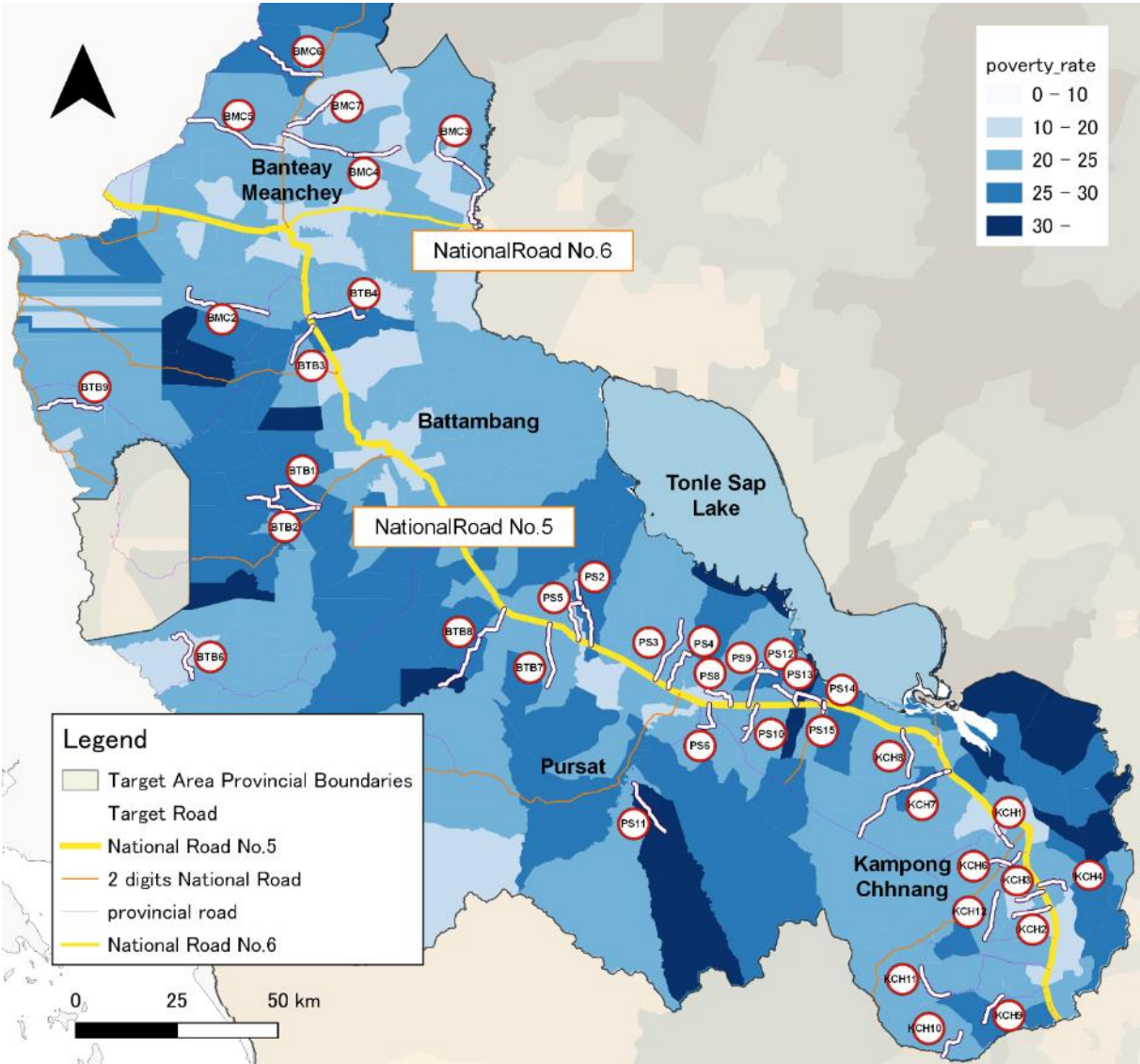
In Banteay Meanchey province (Figure 3.2-73), the poverty rate experienced a slow decrease since 2012 at 0.41% annually until 2019. However, in spite of the Covid-19 pandemic, the province experienced a sharp decrease in the poverty rate by almost 8% in 2020 and could continue to decrease in 2021.



Source: Provincial Department of Planning

Figure 3.2-73 Trend in Poverty Rate of Project related Districts in Banteay Mean Chey Province

The poverty rate per municipality as of 2015 in the target area is shown in the figure below. Poverty rates are higher in areas South of NR5 in Battambang and Pursat and North of NR5 in Kampong Chhnang. Thus, improving accessibility to these areas is an urgent issue to reduce poverty.



Source: Based on poverty rate national statistics from 2015 (Open Development Cambodia)

Figure 3.2-74 Poverty Rates by Commune in the Four Target Provinces

(4) Flood Damage

Major inundation damage occurring in Western Cambodia is caused by flooding of Tonle Sap Lake and rising river water levels. Heavy rains also cause debris flow damage in mountainous areas. The table below summarizes the flood damage in the four target provinces from 2000 to 2019 by item.

Table 3.2-14 Status of Flood Damage by Item (total from 2000 to 2019)

Province	DataCards/Records	Deaths	Houses Destroyed	Houses Damaged	Directly affected	Evacuated	Damages in crops	Damages in roads
Banteay Meanchey	304	60		21	602,850	74,535	207,823	937,165
Battambang	205	36	98	689	524,104	50,144	272,812	506,892
Pursat	111	24	79	72	337,317	5,188	158,721	81,669
Kampong Chhnang	198	30	40	35	229,223	24,766	53,744	50,234

Source: Cambodia Disaster Damage & Loss Information System (CamDi)

Banteay Meanchey (BMC) province has the highest mortality, direct damage, number of evacuees, and road damage. Battambang (BTB) province has a lot of house damage and crop damage. Kampong Chhnang (KCH) has a relatively large number of deaths and displacement. Pursat (PS) causes a lot of crop damage. Table 3.2-15 shows the top five years of flood damage since 2000.

Table 3.2-15 Top Five Years Disaster Situation by Province

Year	DataCards/Records	Deaths number	Houses Destroyed number	Houses Damaged number	Directly affected number	Evacuated number	Damages in crops ha	Damages in roads m
Whole country								
2000	176	347	708	7,244	3,305,582	80,599	561,147	545,194
2009	449	32	210	482	528,597	46,022	144,775	856,766
2011	812	250	435	1,048	1,884,402	155,102	351,937	2,640,686
2013	971	184	252	1,103	1,893,178	191,587	205,185	1,874,467
2018	75	63	7	295	701,775	65,115	70,335	566,410
Banteay Meanchey								
2000	7	2		5	16,628		41,837	
2009	5						9,876	76,365
2011	62	14		4	87,735	19,252	25,409	66,615
2013	129	20		10	275,336	44,516	35,745	236,467
2018	3				14,645			
Battambang								
2000	1	4		132	13,245		69,970	
2009	20				12,064		5,146	74,490
2011	15	8	11		69,605		30,778	132,590
2013	108	17	87	553	356,701	48,730	77,364	293,547
2018	10				28,182		23,318	
Pursat								
2000	5	8		41	145,840		38,117	
2011	26	6	6	16	12,982	1,681	36,095	26,695
2013	27	2	19		50,855	3,507	24,083	46,768
2018	1			3	6,876			
Kampong Chhnang								
2000	9	2			76,029		16,417	
2009	6						404	33
2011	33	18			101,926	18,957	13,577	10,950
2013	46	9	17		30,434	4,184	1,383	37,930
2018	6			1	1,335	1,625		

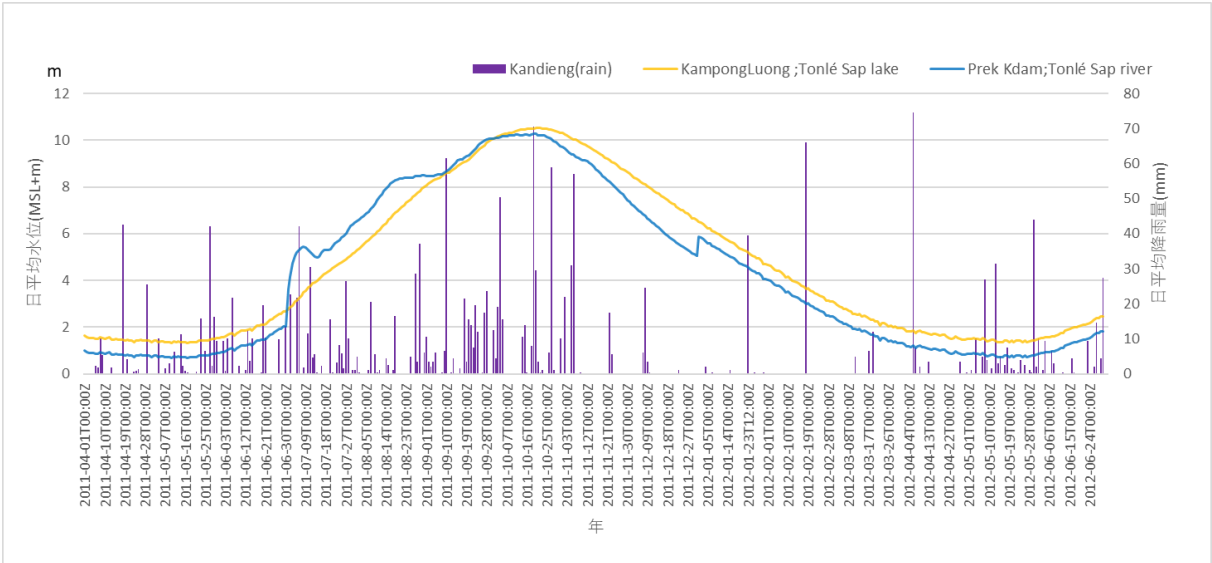
Source: Cambodia Disaster Damage & Loss Information System (CamDi)

Nationwide, 2000 and 2011 had the most deaths. Damage to houses was particularly high in 2000. Overall, major damage occurred in 2000, 2011, and 2013. Regarding road damage, large damage occurred in 2011 and 2013.

By province, Kampong Chhnang (KCH) had the highest number of deaths in 2011, while Banteay Meanchey (BMC) and Battambang (BTB) had the highest in 2013. Damage to houses in 2013 is greater than in 2011. Crop damage was high in 2000, 2011 and 2013. As for road damage, the damage in 2013 was the largest in the whole country.

1) Overview of Flood in October 2011

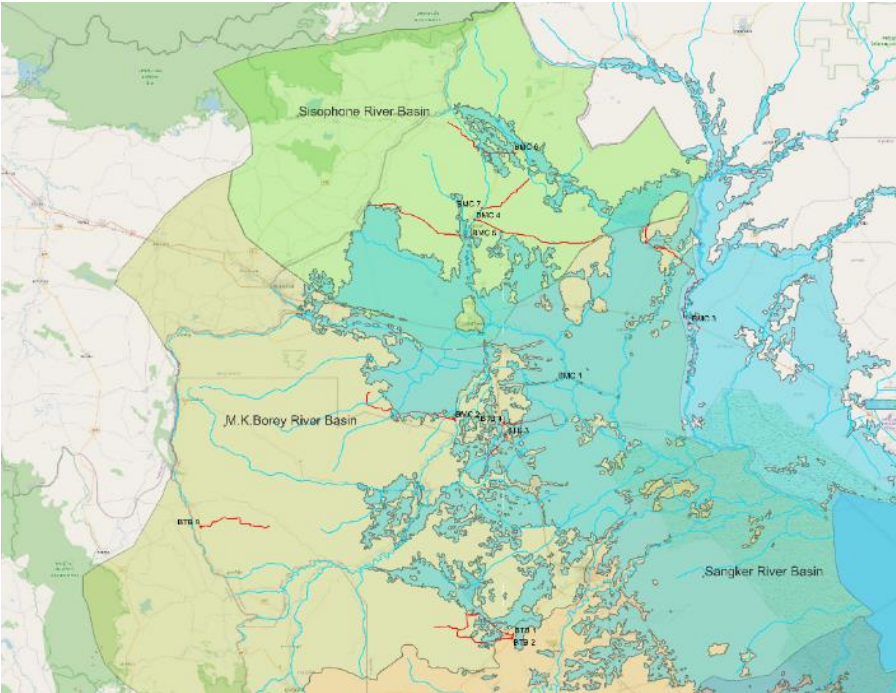
After the year 2000, the October 2011 flood was the largest inundation in the surroundings of Tonle Sap Lake. The figure bellow shows the water level at the Kampong Luong observatory on Tonle Sap Lake and the Prek Kdam observatory on the Tonle Sap River downstream, and the rainfall at the Kandieng observatory near the mouth of the Pursat River. The period is from April 1, 2011, to June 31, 2012, including before and after the rainy season.



Source: JICA Survey Team

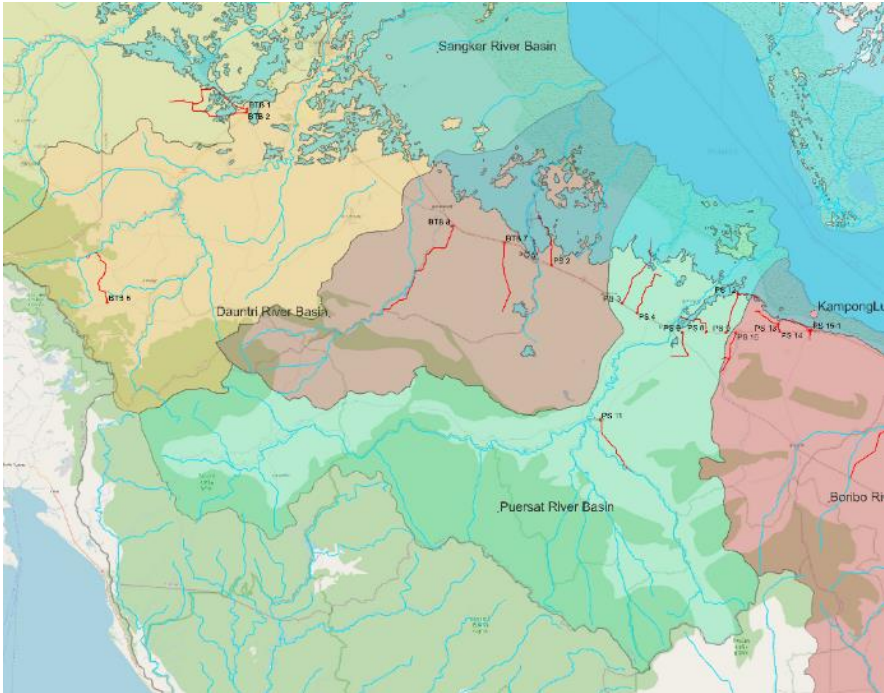
Figure 3.2-75 Water Level of Tonle Sap Lake, Tonle Sap River, and Pursat River Rainfall (2011/4/1-2012/6/31)

Due to the rainfall of more than 50 mm per day, the water level of Tonle Sap Lake rose and exceeded the flood water level of MSL+10.0m for one month. The figure below shows the location of the target roads and the flood area at the time of the October 2011 flood of Tonle Sap Lake.



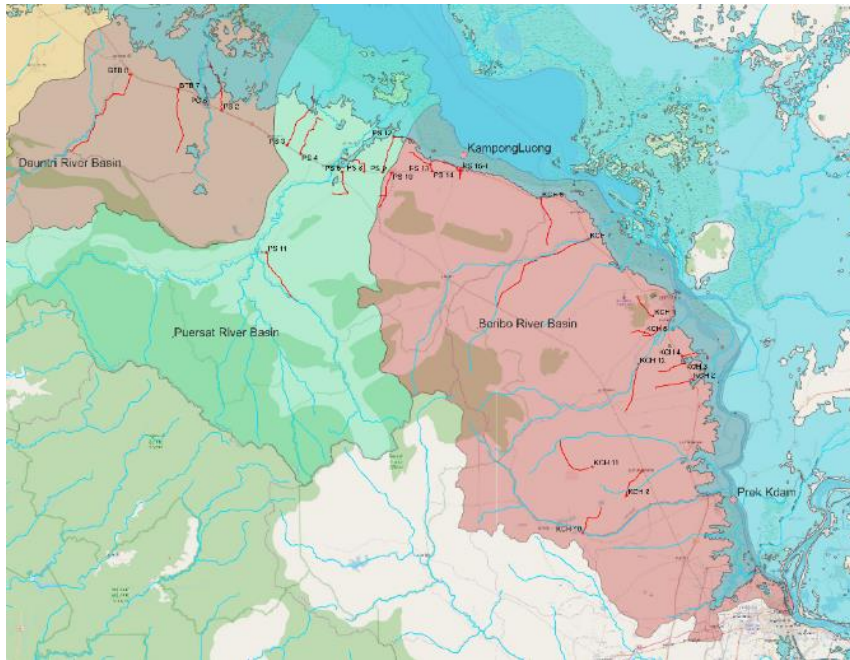
Source: JICA Survey Team

Figure 3.2-76 Target Roads and the Flood Area by the October 2011 Flood of Tonle Sap Lake (1)



Source: JICA Survey Team

Figure 3.2-77 Target Roads and the Flood Area by the October 2011 Flood of Tonle Sap Lake (2)



Source: JICA Survey Team

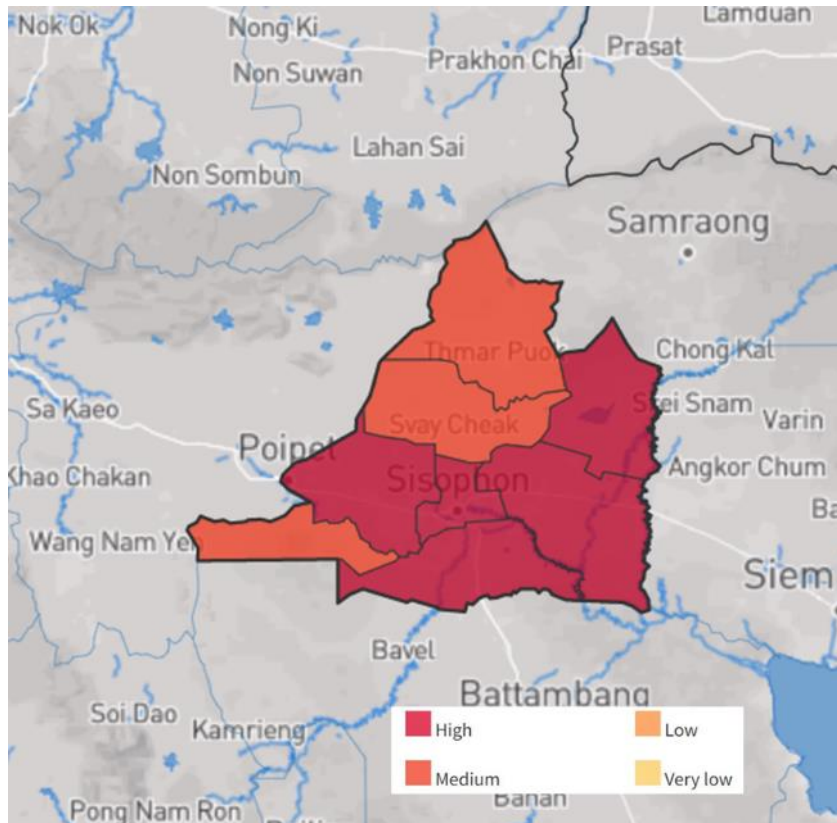
Figure 3.2-78 Target Roads and the Flood Area by the October 2011 Flood of Tonle Sap Lake (3)

2) Overview of River Flood Risk

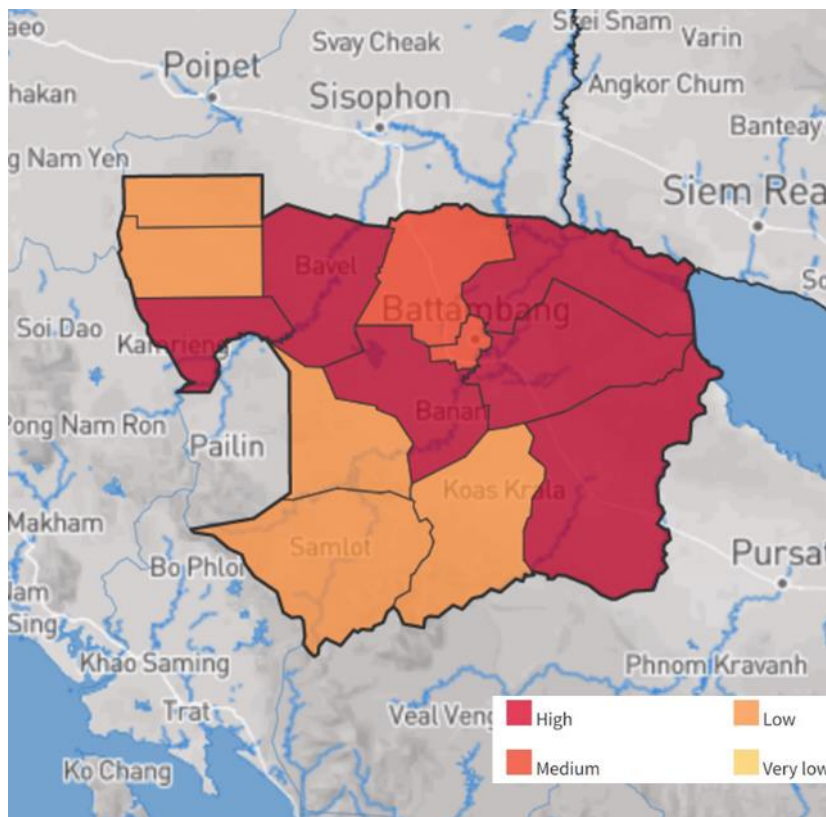
The situation of the target road will be grasped from the risk of river flooding in the four target provinces. Figure 3.2-79 to Figure 3.2-82 show the risk of river flooding by district. The concept of river flood risk is given in Table 3.2-16.

Table 3.2-16 Concept of River Flood Risk

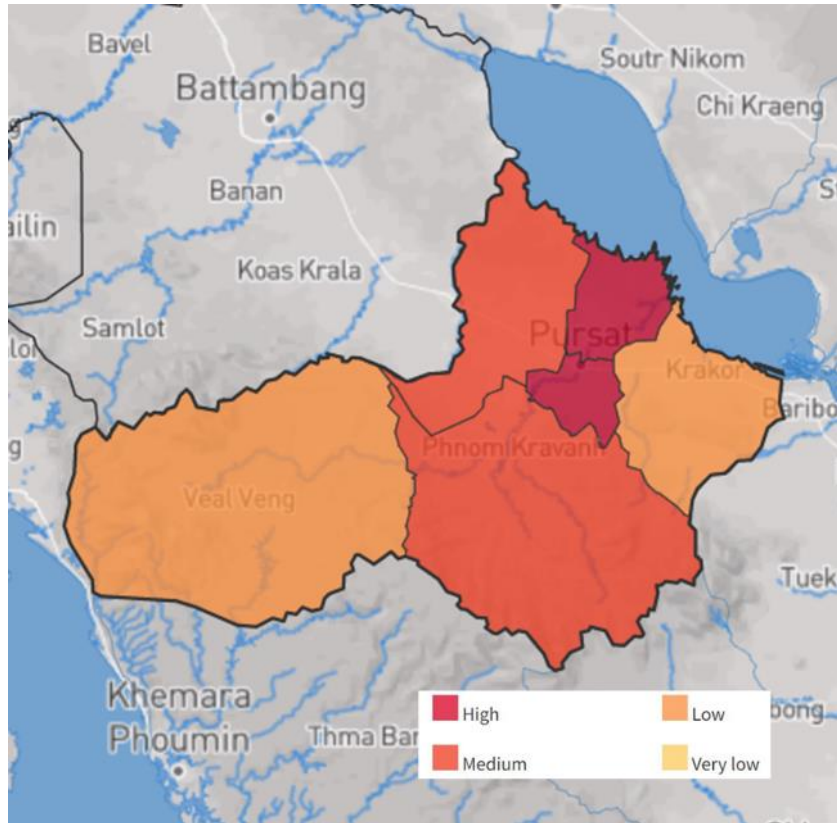
Risk	Overview
High	This means that potentially damaging and life-threatening river floods are expected to occur at least once in the next 10 years.
Medium	This means that potentially damaging and life-threatening river floods are expected to occur at least once in the next 10 years.
Low	This means that there is a chance of more than 1% that potentially damaging and life-threatening river floods occur in the coming 10 years (return period of c. 1 in 1000 years).
Very Low	This means that there is a chance of less than 1% that potentially damaging and life-threatening river floods occur in the coming 10 years (return period of c. 1 in 1000 years).



Source: ThinkHazard of the Global Facility for Disaster Reduction and Recovery (GFDRR)
Figure 3.2-79 Risk of River Flooding in Banteay Meanchey (BMC)

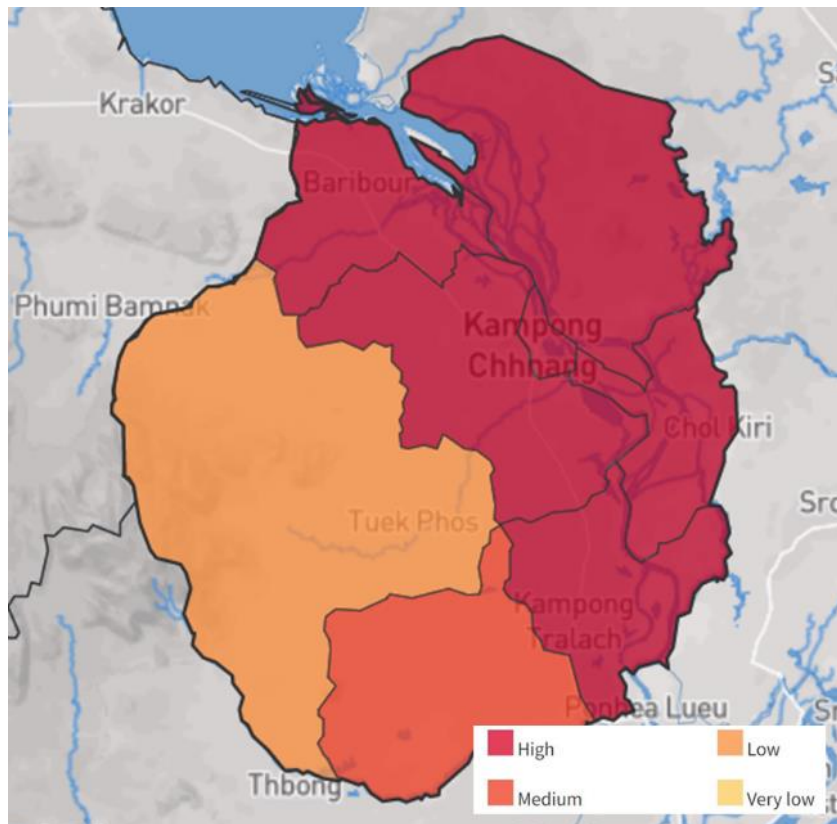


Source: ThinkHazard of the Global Facility for Disaster Reduction and Recovery (GFDRR)
Figure 3.2-80 Risk of River Flooding in Battambang (BTB)



Source: ThinkHazard of the Global Facility for Disaster Reduction and Recovery (GFDRR)

Figure 3.2-81 Risk of River Flooding in Pursat (PS)



Source: ThinkHazard of the Global Facility for Disaster Reduction and Recovery (GFDRR)

Figure 3.2-82 Risk of River Flooding in Kampong Chhnang (KCH)

3) Possibility of Flooding along the Target Road

Table 3.2-17 shows whether targets roads are within or outside of the Tonle Sap flood area, as well as the level of risk of river flooding.

Table 3.2-17 Within or Not-Within Flooding Area of Lake Tonle Sap on the Target Road, Risk of River Flooding

Province	Ref.	MRD Road Code	Districts	Rural Road	Flood condition by hearing	River Basin	River flood risk (thinkhazard.org;GF DRR)	Flooding area of Tonle Sap lake (Flood;20210716)	
Kampong Chhnang	KCH-1		Rolea Bi'er	Srang Kpuos-Kol Kup	0.2m-0.7m	Boribo	High	Not-Within	
	KCH-2		Rolea Bi'er	Kosomak-O'Loy	0.2m-0.7m	Boribo	High	Not-Within	
	KCH-3		Rolea Bi'er	NR5-Damnak Kei	0.2m-0.6m	Boribo	High	Not-Within	
	KCH-4		Rolea Bi'er	NR5-Prek Sala	0.2m-0.6m	Boribo	High	Not-Within	
	KCH-6	None	Rolea Bi'er	Phum Thmey-Trapaing Kravan	0.2m-0.3m	Boribo	High	Not-Within	
	KCH-7	009+NA	Boribo	Phsar-Kdol Senchey	None	Boribo	High	Not-Within	
	KCH-8		Boribo	Trapaing Chan-Teuk Chreaop	0.2m-0.3m	Boribo	High	Not-Within	
	KCH-9		Samaki Meanchev	Meanok-Trapaing Mtes	0.2m-0.7m	Boribo	High	Not-Within	
	KCH-10		Samaki Meanchev	Chrokhnout-Chrok Sdach	0.2m-0.8m	Boribo	High	Not-Within	
	KCH-11	None	Samaki Meanchev	Srae Sar- Ksach Sor	0.2m-0.7m	Boribo	High	Not-Within	
	KCH-12	None	Teuk Phos	Tbeng Kpous-Ronak	None	Boribo	High	Not-Within	
	Pursat	PS-2		Bakan	O'Tapomng-Phum Tanai	0.2m-2.0m	Dauntri	High	within
PS-3			Bakan	Plov Andongkrasaing-Tram Pae	0.2m-2.0m	Pursat	High	within	
PS-4			Bakan	Phnov-Phteah Pring	0.2m-2.0m	Pursat	High	Not-Within	
PS-5			Bakan	Plov Phum Svay Daun Keo-Chrop-Phum Slor Klouk	0.2m-2.0m	Dauntri	High	within	
PS-6			Krong Pursat	Plov Wat Toul Veng	0.2m-0.6m	Pursat	High	Not-Within	
PS-8			Krakor	Rolus	0.2m-0.7m	Pursat	High	within	
PS-9			Krakor	Tbaeng Chrum-Raa Toteng Thngai	0.2m-0.7m	Pursat	High	within	
PS-10			Phnum Kravanh	Son Trae-Chher Tum	0.2m-0.6m	Boribo	High	Not-Within	
PS-11			Kandieng	ToulCha- Keo Mony	0.2m-1.0m	Pursat	Medium	Not-Within	
PS-12		None	Krakor	Kanchhor-Kampong Pou	0.2m-1.7m	Pursat	High	within	
PS-13		225+NA	Krakor	Ou Sandan- Sna Ansa	0.2m-1.0m	Boribo	High	within	
PS-14			Krakor	Sna Ansa-Anlong Tnaot	0.2m-0.6m	Boribo	High	within	
PS-15			Krakor	Anlong Tnaot	None	Boribo	High	Not-Within	
Battambang		BTB-1		Thmar Kaul	NR57-Phum Boeung Krar Sal	0.2m-0.6m	M.K. Borey	High	within
		BTB-2		Thmar Kaul	Sneung NR57-Beoung Praey	0.2m-0.6m	M.K. Borey	High	within
	BTB-3		Thmar Kaul	NR5 Phum Beoung Prieng-Wat ROUNG Chrey	0.2m-1.7m	M.K. Borey	High	within	
	BTB-4	None	Thmar Kaul	NR5 (Phasar O'Nhor)-Phum Poa Ta Sek	0.2m-0.7m	M.K. Borey	High	within	
	BTB-6		Samlaut	Plov 1577 Phum O'Chrab-O'Bok Pael (Phum Sam Loat)	0.2m-0.7m	Sangker	Low	Not-Within	
	BTB-7		Moung Russei	NR5 Rar Cham Heang-Khum Muk Rar	0.2m-0.7m, 1month	Dauntri	High	Not-Within	
	BTB-8		Moung Russei	NR5 O'Kreat-Ba Sak	0.5m-2.0m, 10days-20days	Dauntri	High	Not-Within	
	BTB-9	196	Kamrieng	NR59-Phum O' Teuk tla	0.2m-0.6m	M.K. Borey	Medium	Not-Within	
	Banteay Meanchey	BMC-2		Mongkol Borei	Plov Balang Chrey	0.2m-0.8m, 10days-1month	M.K. Borey	High	within
BMC-3			Phnum Srok	Spean Sraeng	0.2m-1.6m, 1week	M.K. Borey	High	within	
BMC-4			Phnum Srok	Ta Phou	0.2m-0.6m, 1week	Sisophone	Medium	Not-Within	
BMC-5			Svay Chek	Plov Tae Hang	0.2m-0.6m, 1week	Sisophone	Medium	within	
BMC-6			Tmar Puok	Plov Sre L'or	0.2m-2.0m	Sisophone	Medium	within	
BMC-7			Svay Chek, Tmar	Rolus-Phum Tmey	0.2m-0.6m	Sisophone	Medium	Not-Within	

Source: JICA Survey Team

Although the roads in Kampong Chhnang Province are generally outside the flooding area of Tonle Sap Lake, the risk of river flooding is high. Many roads in Pursat are within the Tonle Sap flood zone. The risk of river flooding is also high. Half of the roads in Battambang province are within the flooding area of Tonle Sap Lake. The risk of river flooding is high except for two roads. Many of the roads in Banteay Meanchey Province are within the Tonle Sap Lake flooding area, but the risk of river flooding is low except for two roads.

4) Flood Condition Interview Survey Results

An interview survey to understand the current status of road flooding, such as the depth, duration, and frequency of flooding, was conducted with residents along with the target roads. The most frequent response was "every year". The responses regarding water depth and duration are assumed to be for large scale flooding. Table 3.2-18 shows the results of the interviews.

Table 3.2-18 Results of Interview Survey for Road Flooding

Province	RoadNo.	Road Name	Hearing Result for Flooding	
Kampong Chhnang	KCH-1	Srang Kpuos-Kol Kup	Water depth 0.2m-0.7m at one place	
	KCH-2	Kosomak-O'Loy	Water depth 0.2m-0.7m at 2 places, flooded for 1 month	
	KCH-3	NR5-Damnak Kei	Water depth 0.2m-0.6m at one place, flooded for 3-4 days	
	KCH-4	NR5-Prek Sala	Water depth 0.2m-0.6m at 2 places	
	KCH-6	Phum Thmey-Trapaing Kravan	Water depth 0.2m-0.3m at 3 locations, flooded for 1-2 days	
	KCH-7	Phsar-Kdol Senchey	No flooding	
	KCH-8	Trapaing Chan-Teuk Chreaop	Water depth 0.2m-0.3m at 2 places	
	KCH-9	Meanok-Trapaing Mtes	Water depth 0.2m-0.7m at one place	
	KCH-10	Chrokthnout-Chrok Sdach	Water depth 0.2m-0.8m at 2 places	
	KCH-11	Srae Sar- Ksach Sor	Water depth 0.2m-0.7m at one place	
	KCH-12	Tbeng Kpous-Ronak	No flooding	
	Pursat	PS-2	O'Tapong-Phum Tanai	Water depth 0.2m-2.0m at 2 places
PS-3		Plov Andongkrasaing-Tram Pae	Water depth 0.2m-2.0m in 2 places	
PS-4		Phnov-Phteah Pring	Water depth 0.2m-2.0m at 2 places	
PS-5		Plov Phum Svay Daun Keo-Chrop-Phum Slor Klouk	Water depth 0.2m-2.0m at 2 places	
PS-6		Plov Wat Toul Veng	Water depth 0.2m-0.6m at 2 places	
PS-8		Rolus	Water depth 0.2m-0.7m at one place	
PS-9		Tbaeng Chrum-Raa Toteng Thngai	Water depth 0.2m-0.7m at one place	
PS-10		Son Trae-Chher Tum	Water depth 0.2m-0.6m at 2 places, flooded for 1-2 days	
PS-11		ToulCha- Keo Mony	Water depth 0.2m-1.0m at 3 places	
PS-12		Kanchhor-Kampong Pou	Water depth 0.2m-1.7m at one place	
PS-13		Ou Sandan- Sna Ansa	Water depth 0.2m-1.0m at 2 places	
PS-14		Sna Ansa-Anlong Tnaot	Water depth 0.2m-0.6m at 2 places	
PS-15		Anlong Tnaot	No flooding	
Battambang		BTB-1	NR57-Phum Boeung Krar Sal	Water depth 0.2m-0.6m at one place
		BTB-2	Sneung NR57-Beoung Praey	Water depth 0.2m-0.6m in 2 places
	BTB-3	NR5 Phum Beoung Prieng-Wat Rong Chrey	Water depth 0.2m-1.7m at 2 places	
	BTB-4	NR5 (Phasar O'Nhor)-Phum Poa Ta Sek	Water depth 0.2m-0.7m at 2 places	
	BTB-6	Plov 1577 Phum O'Chrab-O'Bok Pael (Phum Sam Loat)	Water depth 0.2m-0.7m at 3 places	
	BTB-7	NR5 Rar Cham Heang-Khum Muk Rar	Water depth 0.2m-0.7m at 3 places, flooded for 1 month	
	BTB-8	NR5 O'Kreat-Ba Sak	Water depth 0.5m-2.0m at 5 places, flooded for 10 to 20 days	
	BTB-9	NR59-Phum O' Teuk tla	Water depth 0.2m-0.6m at 3 places	
	Banteay Meanchey	BMC-2	Plov Balang Chrey	Water depth 0.2m-0.8m at 3 places, flooded for 10 days to 1 month
BMC-3		Spean Sraeng	Water depth 0.2m-1.6m at 2 places, flooded for 1 week	
BMC-4		Ta Phou	Water depth 0.2m-0.6m at 3 places, flooded for 1 week	
BMC-5		Plov Tae Hang	Water depth 0.2m-0.6m at 6 places, flooding for 1 week	
BMC-6		Plov Sre L'or	Water depth 0.2m-2.0m at 3 places	
BMC-7		Rolus-Phum Tmey	Water depth 0.2m-0.6m at 3 places	

Source: JICA Survey Team

3.2.4 Traffic Demand Forecast

The purpose of the project is to forecast future traffic volumes for the 38 project routes. Traffic volumes for the base year 2022 are determined from traffic count survey and future traffic volume estimates are made from the base year with reference to RRIP reports and economic indicator data.

(1) Traffic Volume in Base Year

In order to estimate the Annual Average Daily Traffic (AADT) based on the result of traffic count survey, it is necessary to take into account the seasonal patterns of traffic fluctuations. People's activities change depending on the rainy, dry, and harvesting seasons which has an effect of increasing or decreasing traffic users.

Monthly traffic counts conducted by the Ministry of Public Works and Transportation (MPWT) on National Highways observe seasonal pattern with 25% increase in traffic in January and February compared to the normal months, followed by an increase of around 10% in March. Since the traffic volume survey was conducted in February and March, when the traffic volume was high, a seasonal adjustment factor of 0.85 was applied this case to set the traffic volume in the base year estimated by AADT.

(2) Future Socioeconomic Framework

1) Future Population

The socioeconomic framework of the target area which was used the 2019 General Population Census of the Kingdom of Cambodia, published in 2020 by the National Institute of Statistics, Ministry of Planning of Cambodia. Based on the 2019 Population Census, the estimates were re-estimated with reference to the Population Projection for Cambodia 2008-2030 published by the same department.

According to the 2019 census data, Cambodia's overall population will be 15.52 million in 2019, and the JICA Survey Team estimates that the population will be 16.15 million in 2022 and 17.53 million in 2030, increasing at a rate of 1.03% per year from 2022 to 2030. Banteay Meanchey, Battambang, Pursat, and Kampong Chhnang provinces will increase by 1.37%, 1.30%, 1.43%, and 0.80%, respectively.

Table 3.2-19 Population of Cambodia by Province (Year 2019 to 2030)

Province	Population			Annual Average (2030-2022)
	2019 (NIS Census)	2022 (revised)	2030 (revised)	
Cambodia	15,552,211	16,155,532	17,531,248	1.03%
Banteay Meanchey	861,883	906,212	1,010,324	1.37%
Battambang	997,169	1,046,687	1,160,331	1.30%
Kampong Cham	899,791	892,814	857,349	-0.51%
Kampong Chhnang	527,027	544,625	580,376	0.80%
Kampong Speu	877,523	897,482	938,217	0.56%
Kampong Thom	681,549	690,757	706,753	0.29%
Kampot	593,829	609,653	661,731	1.03%
Kandal	1,201,581	1,247,498	1,352,870	1.02%
Koh Kong	125,902	136,358	164,641	2.38%
Kratie	374,755	391,858	433,900	1.28%
Monduliri	92,213	101,143	127,364	2.92%
Phnom Penh	2,281,951	2,443,586	2,696,311	1.24%
Preah Vihear	254,827	266,171	297,904	1.42%
Prey Veng	1,057,720	1,076,139	1,157,586	0.92%
Pursat	419,952	438,355	491,236	1.43%
Rattanakiri	217,453	229,534	262,624	1.70%
Siem Reap	1,014,234	1,071,063	1,205,207	1.49%
Preah Sihanouk	310,072	329,409	374,258	1.61%
Stung Treng	165,713	177,528	214,179	2.37%
Svay Rieng	525,497	535,302	575,062	0.90%
Takeo	900,914	920,738	994,027	0.96%
Oddarmeancheay	276,038	299,011	352,338	2.07%
Kep	42,665	48,752	69,647	4.56%
Pailin	75,112	84,038	106,815	3.04%
Tboung Khum	776,841	770,818	740,198	-0.51%

Source: Year 2019: General Population Census of the Kingdom Cambodia 2019, Minister of Planning of Cambodia, Year 2022 and 2030: JICA Survey Team

The Population Projection for Cambodia 2008-2030 is used as a reference to apply population growth rates to non-motorized (bicycle) future projections.

2) Prediction by International Organizations

Cambodia's short term GDP growth rate has been predicted by several international organizations, such as Asian Development Bank (ADB), World Bank (WB), International Monetary Fund (IMF), and the United States Department of Agriculture (USDA). In 2022, it is projected to be over 5.0%, except for WB. According to their forecast, the short term (2023 to 2026) GDP growth rate is estimated to be 5.8% to 6.6% and USDA is projected to be 6.0% from 2028 to 2033.

Table 3.2-20 Annual Growth Rate of GDP Forecasting by Various Organizations

Organization	Annual Growth Rate (%)														
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
ADB	7.1	-3.1	3.0	5.3	6.5	-	-	-	-	-	-	-	-	-	-
WB	7.1	-3.1	3.0	4.5	5.8	-	-	-	-	-	-	-	-	-	-
IMF	7.1	-3.1	1.9	5.7	6.4	6.5	6.5	6.6	-	-	-	-	-	-	-
USDA	7.1	-4.8	3.2	5.6	6.4	6.3	6.3	6.2	6.1	6.0	6.0	6.0	6.0	6.0	6.0

Source: Websites of ADB Cambodia Economy, World Bank Outlook for East Asia and the Pacific IMF Country Report, and Prediction from United States Department of Agriculture (USDA)

3) Future GDP Growth Rate

Considering the above-stated predictions, three scenarios of GDP growth by 2053 are shown in the table below. Based on this growth rate, this paper estimates the future of mobile transportation.

Table 3.2-21 Scenario of Future GDP Growth

Scenario	Term	Annual growth
Based on trends of various institutions	2023 -2027	6.4%- 6.5%
Based on IMF forecasts	2028 -2030	6.5%
Based on USDA forecast	2031 -2040	6.0%
Assumes 1.0% decrease from USDA forecast	2041-2053	5.0%

Source: JICA Survey Team

4) Estimation of GRDP (Gross Regional Domestic Product)

GDP growth rates are often used to estimate future traffic. The growth rate of traffic volume is considered to be different in each province covered in the survey, so the GRDP growth rate for each province was estimated in order to examine future traffic volume.

Since there is no statistical data on GRDP for Cambodia, JICA Survey Team examined the GDP projected by various agencies and used the IMF's GDP (nominal GDP) and projected GDP growth rate as references to calculate GRDP by dividing them by the population of each province. The GRDP growth rate is used to estimate the future traffic volume of motorcycles, as well as light and heavy vehicles in each province.

Table 3.2-22 Estimation of GRDP

Province	GRDP (Unit: Mil USD)							Annual Average Rate					
	2022	2028	2033	2038	2043	2048	2053	2028-2022	2033-2028	2038-2033	2043-2038	2048-2043	2053-2048
Banteay Meanchey	143	213	293	397	523	676	871	6.9%	6.5%	6.3%	5.7%	5.2%	5.2%
Battambang	165	245	335	453	595	765	983	6.8%	6.4%	6.2%	5.6%	5.2%	5.1%
Kampong Cham	141	188	235	290	347	408	479	4.9%	4.5%	4.3%	3.7%	3.3%	3.2%
Kampong Chhnang	86	124	165	218	279	350	439	6.3%	5.9%	5.7%	5.1%	4.7%	4.6%
Kampong Speu	142	201	265	347	439	545	676	6.0%	5.7%	5.5%	4.9%	4.4%	4.4%
Kampong Thom	109	152	198	255	319	391	479	5.7%	5.4%	5.2%	4.6%	4.1%	4.1%
Kampot	96	140	191	258	338	435	558	6.4%	6.4%	6.2%	5.6%	5.1%	5.1%
Kandal	197	287	388	520	675	860	1,094	6.5%	6.2%	6.0%	5.4%	5.0%	4.9%
Koh Kong	22	34	49	70	97	132	179	7.9%	7.6%	7.4%	6.7%	6.3%	6.3%
Kratie	62	92	126	170	224	289	372	6.8%	6.5%	6.3%	5.6%	5.2%	5.2%
Monduliri	16	26	39	57	81	113	157	8.5%	8.2%	8.0%	7.3%	6.9%	6.9%
Phnom Penh	386	574	770	1,019	1,311	1,652	2,079	6.8%	6.0%	5.8%	5.2%	4.7%	4.7%
Preah Vihear	42	63	87	119	157	205	266	6.9%	6.7%	6.5%	5.8%	5.4%	5.4%
Prey Veng	170	245	334	451	590	758	972	6.3%	6.4%	6.2%	5.5%	5.1%	5.1%
Pursat	69	103	143	197	263	343	448	6.9%	6.8%	6.6%	5.9%	5.5%	5.5%
Rattanakiri	36	55	77	106	143	188	247	7.2%	6.9%	6.7%	6.1%	5.6%	5.6%
Siem Reap	169	254	350	478	633	823	1,067	7.0%	6.6%	6.4%	5.8%	5.4%	5.3%
Preah Sihanouk	52	79	109	149	199	259	338	7.1%	6.7%	6.5%	5.9%	5.5%	5.4%
Stung Treng	28	44	64	92	129	176	241	7.9%	7.7%	7.5%	6.9%	6.5%	6.5%
Svay Rieng	85	122	166	224	293	375	481	6.3%	6.4%	6.2%	5.5%	5.1%	5.1%
Takeo	145	211	287	387	506	649	832	6.4%	6.4%	6.2%	5.5%	5.1%	5.1%
Oddaromeanchey	47	74	104	144	195	258	341	7.7%	7.1%	6.8%	6.2%	5.8%	5.8%
Kep	8	14	22	35	55	83	125	10.2%	10.0%	9.7%	9.1%	8.7%	8.6%
Pailin	13	22	32	47	67	93	129	8.7%	8.1%	7.9%	7.2%	6.8%	6.8%
Tboung Khum	122	162	203	250	300	352	413	4.9%	4.5%	4.3%	3.7%	3.3%	3.2%

Source: JICA Survey Team

(3) Other Traffic Demand Factors

Future traffic volume is calculated as the sum of normal traffic, development-generated traffic, and conversion traffic. Normal traffic is expected to increase due to the growth of population and socioeconomic activities as described above.

Development-generated traffic refers to traffic that occurs as a result of road improvements and consists of latent demand that has not yet appeared due to poor road conditions and new traffic that will be generated as development progresses in areas along the road due to improved condition of traffic location. Development-generated traffic shall be omitted in the study due to the fact that the development plans for the target roads are not certain and have not been considered in previous RRIP reports.

Converted traffic is a traffic volume that is expected to increase due to conversion from other routes when the travel time is shorter than other routes due to road improvement. In this study, detailed data analysis, such as an OD survey was not conducted, so the prediction of converted traffic volume is unclear.

Traffic diverting from other routes would inevitably occur due to the improvement of roads, so it should not be ignored. Therefore, the conversion rate by road type is assumed based on the road traffic condition in the field survey.

Table 3.2-23 Conversion Rate by Road Type

Road Type	T1	T2	T3
Conversion Rate	20%	10%	5%

Source: JICA Survey Team

(4) Passenger Car Unit (PCU)

Traffic volume is expressed as passenger car units (PCU), which are converted to the number of passenger cars by multiplying the number of traffic vehicles of different vehicle types such as motorcycles, buses, and trucks by a constant factor. PCE (Passenger Car Equivalent) is a coefficient for calculating the value of PCU. The PCEs for vehicle classes are shown in the table below.

Table 3.2-24 Passenger Car Equivalent (PCE)

Group		Vehicle Classification		PCE
I	Motor Cycle (MC)	1	Motorbike	0.4
		2	Tuk-Tuk	0.4
		3	Motor cycle Trailer	1.0
II	Light Vehicle (LV)	4	Small agriculture tractor	1.1
		5	Large agriculture tractor	1.5
		6	Sedan, Taxi, Wagon, Van, Pick up	1.0
		7	Mini Bus (less than 16 seats)	1.1
		8	Light Truck (4 tires) Pick-up truck (for goods)	1.5
III	Heavy Vehicle (HV)	9	Bus (16 or more seats)	2.3
		10	Medium truck (6 tires), including trailer	2.0
		11	Heavy truck (8 or more tires) including trailer	2.5
IV	Non-Motored Transport (NMT)	12	Bicycle	0.3
		13	Animal Cart	0.4
		14	Samlor	1.1

Source: Feasibility Study Report, Rural Roads Improvement Project III

(5) Result of Future Traffic Demand

Using the above assumptions, future traffic volume was calculated for the target roads. The estimated value for about 30 years from 2022 to 2053 is shown every 5 years.

The largest traffic volume is observed in PS11 with 1,911 PCU/day in 2022, 4,744 PCU/day in 2033, and 8,693 PCU/day in 2043. The average per road is expected to be 779 PCU/day in 2022, 1,826 PCU/day in 2033, 3,256 PCU/day in 2043, and over 5,400 PCU/day in 2053.

Table 3.2-25 Future Traffic Volume

Uni: PCU/day

Target Road	2022	2028	2033	2038	2043	2048	2053
KCH1	1,148	1,985	2,646	3,491	4,472	5,613	7,036
KCH2	317	503	671	885	1,133	1,422	1,783
KCH3	729	1,155	1,539	2,031	2,601	3,265	4,093
KCH4	1,176	1,864	2,485	3,278	4,199	5,270	6,607
KCH6	311	471	628	828	1,061	1,332	1,670
KCH7	573	990	1,321	1,742	2,231	2,801	3,511
KCH8	587	930	1,239	1,635	2,094	2,629	3,295
KCH9	455	720	961	1,267	1,623	2,037	2,554
KCH10	326	517	689	910	1,165	1,462	1,833
KCH11	238	377	503	664	850	1,067	1,338
KCH12	427	676	901	1,189	1,523	1,911	2,396
PS2	1,457	2,606	3,616	4,968	6,627	8,664	11,314
PS3	470	840	1,166	1,602	2,137	2,794	3,648
PS4	462	827	1,148	1,577	2,103	2,749	3,590
PS5	1,152	2,062	2,861	3,931	5,243	6,855	8,951
PS6	1,044	1,869	2,593	3,563	4,752	6,213	8,113
PS8	993	1,776	2,465	3,386	4,516	5,904	7,710
PS9	395	707	980	1,347	1,797	2,349	3,067
PS10	1,307	2,339	3,246	4,460	5,949	7,777	10,155
PS11	1,911	3,418	4,744	6,517	8,693	11,365	14,841
PS12	505	829	1,150	1,580	2,108	2,755	3,598
PS13	508	909	1,261	1,733	2,312	3,022	3,946
PS14	421	753	1,045	1,436	1,916	2,504	3,270
PS15	214	352	488	671	894	1,169	1,527
BTB1	712	1,161	1,587	2,145	2,815	3,621	4,652
BTB2	728	1,188	1,624	2,195	2,881	3,705	4,760
BTB3	126	206	282	381	500	643	826
BTB4	903	1,406	1,921	2,597	3,409	4,384	5,633
BTB6	1,270	2,262	3,090	4,177	5,482	7,051	9,059
BTB7	593	1,056	1,442	1,950	2,559	3,291	4,228
BTB8	1,805	3,213	4,390	5,935	7,789	10,019	12,871
BTB9	747	1,164	1,590	2,149	2,821	3,628	4,661
BMC2	1,708	2,799	3,839	5,209	6,864	8,863	11,431
BMC3	1,478	2,643	3,625	4,920	6,482	8,370	10,796
BMC4	835	1,493	2,048	2,779	3,661	4,728	6,097
BMC5	623	1,115	1,529	2,075	2,733	3,530	4,553
BMC6	541	886	1,216	1,650	2,174	2,807	3,620
BMC7	388	636	872	1,183	1,559	2,013	2,596

Source: JICA Survey Team

Although the traffic volume survey in this study was conducted prior to road improvement, which is necessary for study review, the traffic volume survey was not conducted at the same observation location after road improvement, so it is not feasible to compare traffic volumes before and after improvement. Since traffic volume is the most important indicator for verifying the effect of improvement, it is recommended that a traffic volume survey be conducted after road improvement on a regular basis, for example after one or two years, and if possible, every year.

3.3 Prioritization of Sub Project

3.3.1 Review of Prioritization of Rural Roads in related Projects

In considering the prioritization of the subject roads in this project, JICA Survey Team organize the methodology for prioritizing of rural roads in the RRMP, which is the upper-level plan.

(1) Extraction of Rural Roads

MRD manages more than 46,000 km of rural roads. Therefore, it is difficult to conduct prioritization at same time. RRMP set the following conditions to identify the rural roads to be evaluated.

- Selection of Type 1 and 2 rural roads. Type 3 and 4 roads of high importance are extracted as necessary.
- Rural roads less than 2 km in Phnom Penh, Kep Province, as well as having a length of less than 3 km in other provinces are excluded from the evaluation.

Based on the above two policy of selection, RRMP identifies 1,370 rural roads (13,791 km) out of 16,261 roads (46,834 km) as roads for evaluation.

(2) Selection Method of Criteria in RRMP

First of all, 17 criteria were listed as candidates for evaluation indicators in RRMP.

- Population served (total)
- Population served per km
- Average Daily Traffic (vehicle/day)
- Passenger Car Unit (PCU/day)
- Physical Connectivity (short cut, inter district, inter province)
- Potential for dual-purpose infrastructure (Evacuation route to higher grounds)
- Market places (density of markets) and route to major markets
- Agricultural and agrobusiness development
- Access to social and public services (schools, health centers, employment, locations of worship, etc.)
- Aspects of social safeguards (minorities, women, etc.)
- Aspects of environmental safeguards (protected areas, community forest, etc.)
- Estimated costs (concrete, DBST)
- Vulnerability of the road to natural hazards (DRM)
- Risk increase due to climate change effects/improving the climate resilience of the community
- Government priorities
- Coordination with on-going efforts by the Government and other Partners
- New settlements for retired government employees (e.g. army)

RRMP sets four policies to select criteria. RRMP extracted criteria that can be utilized in the study of priorities for rural roads from the above 17 candidate criteria.

- Available data on a country-wide basis
- Uniqueness of criteria (some criteria did not really produce a new insight e.g. population served per km)
- Difficulty to formulate and assign values or ranges;
- Simply by representing a specific process or development

Finally, the following 5 criteria were selected in the RRMP: (1) population served, (2) physical connectivity, (3) road length connectivity, (4) poverty rate per district, and (5) cropland per district. The outline of criteria is shown below.

Table 3.3-1 Outline of Criteria in RRMP

Criteria	Overview																																							
Population served	<ul style="list-style-type: none"> • This criteria is used to evaluate the number of beneficiaries with road improvement. It is set with the intention of creating more beneficiaries. • Population served is counted within a defined zone of influence (about 20 – 30 minutes walking time, or 10 minutes by bicycle, and about 5 min by motorcycle). RRMP used as the indicator to evaluate the population living along the rural road. • Population was calculated using the population density by province in the Commune Database 2017. • In order to avoid a gap in evaluation scores between provinces with low and high population densities, multiple scoring tables are used to calculate the evaluation score for each rural road. For example, for a rural road with a population of 1,500 people along the road, Mondul Kiri Province posts 1.0 points, while Svay Rieng Province only posts 0.2 points. Below is a table of scores by roadside population category for the two example provinces. <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <table border="1" style="font-size: small;"> <caption style="text-align: center;">Mondul Kiri</caption> <thead> <tr><th>Category</th><th>Value</th><th>% distr.</th></tr> </thead> <tbody> <tr><td>< 100</td><td>0.2</td><td>23%</td></tr> <tr><td>100 - 300</td><td>0.4</td><td>35%</td></tr> <tr><td>300 - 500</td><td>0.3</td><td>23%</td></tr> <tr><td>500 - 1,000</td><td>0.8</td><td>15%</td></tr> <tr><td>> 1,000</td><td>1.0</td><td>4%</td></tr> </tbody> </table> <table border="1" style="font-size: small;"> <caption style="text-align: center;">Svay Rieng</caption> <thead> <tr><th>Category</th><th>Value</th><th>% distr.</th></tr> </thead> <tbody> <tr><td>< 3,000</td><td>0.2</td><td>10%</td></tr> <tr><td>3,000 - 4,000</td><td>0.4</td><td>8%</td></tr> <tr><td>4,000 - 6,000</td><td>0.6</td><td>22%</td></tr> <tr><td>6,000 - 10,000</td><td>0.8</td><td>44%</td></tr> <tr><td>10,000 - 20,000</td><td>0.9</td><td>12%</td></tr> <tr><td>> 20,000</td><td>1.0</td><td>4%</td></tr> </tbody> </table> </div>	Category	Value	% distr.	< 100	0.2	23%	100 - 300	0.4	35%	300 - 500	0.3	23%	500 - 1,000	0.8	15%	> 1,000	1.0	4%	Category	Value	% distr.	< 3,000	0.2	10%	3,000 - 4,000	0.4	8%	4,000 - 6,000	0.6	22%	6,000 - 10,000	0.8	44%	10,000 - 20,000	0.9	12%	> 20,000	1.0	4%
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Physical connectivity	<ul style="list-style-type: none"> • This criteria evaluates the overall connectivity of roads from the perspective of the road network. • The road network is categorized according to the size of the region (province, district, commune, etc.) to which the rural roads connect, and the evaluation scores are calculated using the score table by physical connectivity category. • All provinces are evaluated using same value. <table border="1" style="font-size: small; margin-top: 10px;"> <thead> <tr><th>Category</th><th>Value</th><th>Criterion</th></tr> </thead> <tbody> <tr><td>non</td><td>0.00</td><td>no further connections possible</td></tr> <tr><td>low</td><td>0.25</td><td>inter-commune</td></tr> <tr><td>medium</td><td>0.50</td><td>inter-commune - short cut; inter-district - no short cut</td></tr> <tr><td>high</td><td>0.75</td><td>inter-district , short cut</td></tr> <tr><td>very high</td><td>1.00</td><td>inter- province</td></tr> </tbody> </table>	Category	Value	Criterion	non	0.00	no further connections possible	low	0.25	inter-commune	medium	0.50	inter-commune - short cut; inter-district - no short cut	high	0.75	inter-district , short cut	very high	1.00	inter- province																					
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Criteria	Overview																														
Road length connectivity	<ul style="list-style-type: none"> This criteria is used to evaluate the accessibility of existing paved roads from rural areas. It is set with the intention of developing a more extensive paved roads network. The score is calculated for each rural road extension using the table of scores by road extension category shown in the table below. However, the table of scores set for each province is adjusted for variations in value. For instance, in the cases of Takeo and other provinces having rural roads with short extensions. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Road Length (km)</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>< 2</td> <td>0.20</td> </tr> <tr> <td>02 - 10</td> <td>0.40</td> </tr> <tr> <td>10 - 20</td> <td>0.60</td> </tr> <tr> <td>20 - 30</td> <td>0.80</td> </tr> <tr> <td>> 30</td> <td>1.00</td> </tr> </tbody> </table>	Road Length (km)	Value	< 2	0.20	02 - 10	0.40	10 - 20	0.60	20 - 30	0.80	> 30	1.00																		
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20 - 30	0.80																														
> 30	1.00																														
Poverty rate per district	<ul style="list-style-type: none"> This criteria is used to assess the impact of road maintenance on poverty reduction. It is set with the intention of prioritizing rural road improvement that contributes to poverty reduction. The score is calculated by dividing each road into categories based on the poverty rate of the province. This value are calculated using the scoring table by poverty rate category in the table below. The same scoring table is used for all provinces. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Poverty Rate</th> <th>Value</th> <th>Descriptive</th> </tr> </thead> <tbody> <tr> <td>< 10 %</td> <td>0.20</td> <td>very low</td> </tr> <tr> <td>10 % - 15 %</td> <td>0.40</td> <td>low</td> </tr> <tr> <td>15 % - 20 %</td> <td>0.60</td> <td>medium</td> </tr> <tr> <td>20 % - 25 %</td> <td>0.80</td> <td>high</td> </tr> <tr> <td>> 25 %</td> <td>1.00</td> <td>very high</td> </tr> </tbody> </table>	Poverty Rate	Value	Descriptive	< 10 %	0.20	very low	10 % - 15 %	0.40	low	15 % - 20 %	0.60	medium	20 % - 25 %	0.80	high	> 25 %	1.00	very high												
Poverty Rate	Value	Descriptive																													
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> 25 %	1.00	very high																													
Cropland per district	<ul style="list-style-type: none"> This criteria is used to evaluate the impact of road development on agriculture. Agriculture is a key industry in rural areas, it is intended to give priority to rural roads that contribute to agricultural development. The score is calculated by dividing each road into categories based on the percentage of crop land area in the province. Score are determined using the score table by agricultural land area category. The table of scores by agricultural land area category is set up for each province. the table below shows the scores by crop land area category for Koh Kong and Takeo provinces. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="3">Koh Kong</th> <th colspan="3">Takeo</th> </tr> <tr> <th>Cropland per district</th> <th>Value</th> <th>Category</th> <th>Cropland per district</th> <th>Value</th> <th>Category</th> </tr> </thead> <tbody> <tr> <td>< 5 %</td> <td>0.4</td> <td>very low</td> <td>< 70 %</td> <td>0.70</td> <td>medium</td> </tr> <tr> <td>5 % - 10 %</td> <td>0.7</td> <td>medium</td> <td>70 % - 80 %</td> <td>0.85</td> <td>high</td> </tr> <tr> <td>> 10 %</td> <td>1.0</td> <td>high</td> <td>> 80 %</td> <td>1.00</td> <td>very high</td> </tr> </tbody> </table>	Koh Kong			Takeo			Cropland per district	Value	Category	Cropland per district	Value	Category	< 5 %	0.4	very low	< 70 %	0.70	medium	5 % - 10 %	0.7	medium	70 % - 80 %	0.85	high	> 10 %	1.0	high	> 80 %	1.00	very high
Koh Kong			Takeo																												
Cropland per district	Value	Category	Cropland per district	Value	Category																										
< 5 %	0.4	very low	< 70 %	0.70	medium																										
5 % - 10 %	0.7	medium	70 % - 80 %	0.85	high																										
> 10 %	1.0	high	> 80 %	1.00	very high																										

Source : Based on RRMP

In the RRMP, JICA Survey Team confirmed that the categorical score table was adjusted for the evaluation indicators. But there was no description of the details of the adjustment method. The existence of a categorical score table complicates the calculation of evaluation scores and makes it difficult to transfer them for comparison. In this project, the JICA Survey Team attempted to set a unified evaluation score for all target areas for any evaluation index.

(3) Weight of Criteria

The five criteria were set weights through multi-criteria analysis. The indicator judged to be the most important was population served with a weight of 50%, followed by physical connectivity (15%), cropland per district (15%), road length connectivity (10%), and poverty rate per district (10%).

Table 3.3-2 Weight of Criteria

Criteria	Weight (%)
Population served	50%
Physical connectivity	15%
Road length connectivity	10%
Poverty rate per district	10%
Cropland per district	15%

Source : RRMP

(4) Calculation of Final Evaluation Score

RRMP uses the weights of criteria to calculate the final evaluation score for each rural roads using the formula below.

$$Score = 100 \times (Pop \times 0.5 + phy\ con \times 0.15 + length\ Con \times 0.1 + Poverty \times 0.1 + \times Cropland\ 0.15)$$

The most valuable score is evaluated as "High" for less than 40 points, "Medium" for 40 to 70 points, and "Low" for 70 points or more, and each province road's priority is determined.

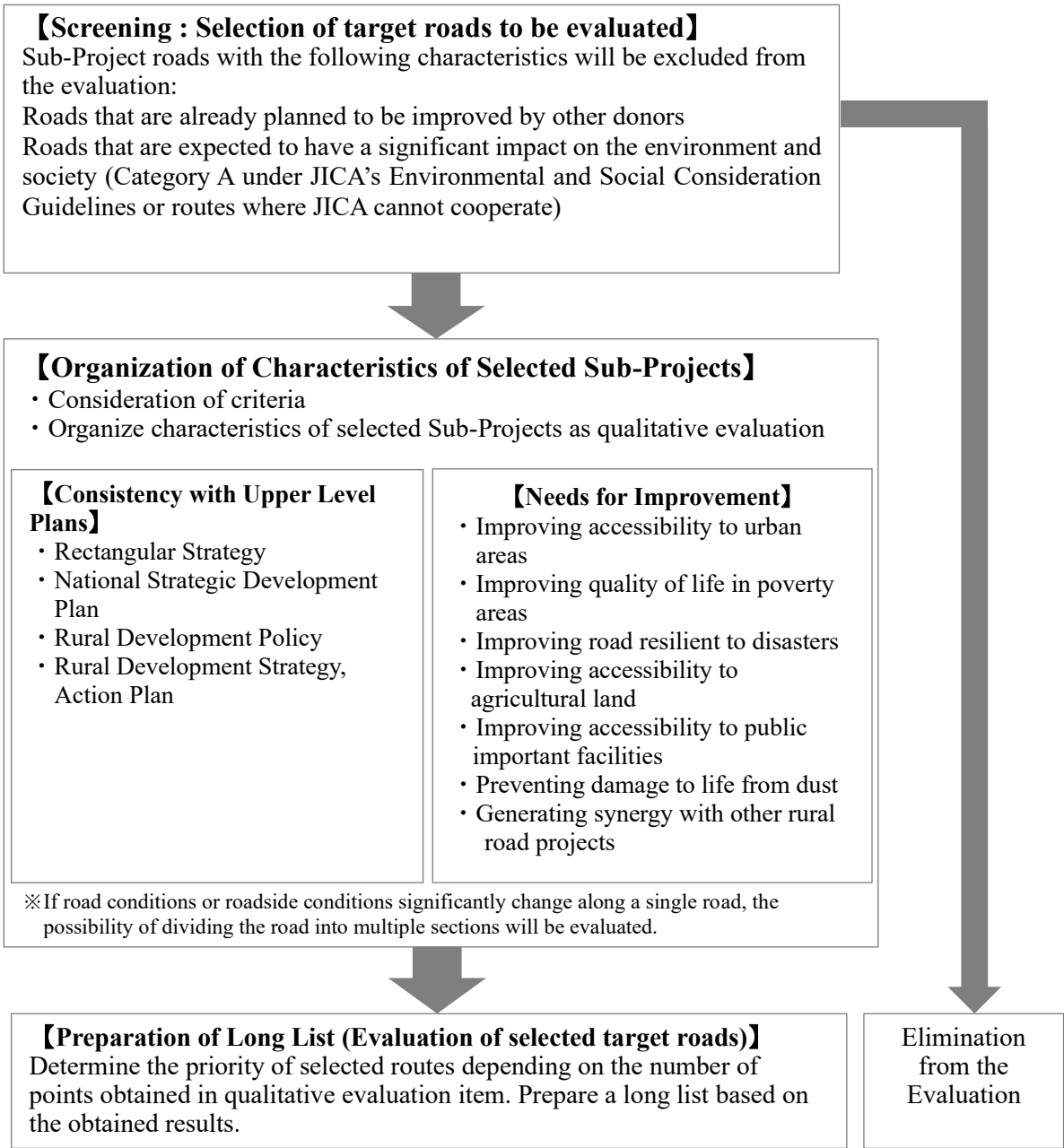
Table 3.3-3 Classification of Final Evaluation Scores for Target Area

Score	Priority	Banteay Meanchey	Battambang	Kampong Chhnang	Pursat
>40	High	19	41	16	34
40-70	Middle	24	37	6	56
>70	Low	12	34	9	43

Source : Based on RRMP

3.3.2 Consideration of Priority of Sub-Projects

The prioritization process of sub-projects is shown below.



Source: JICA Survey Team

Figure 3.3-1 Consideration of Priority Levels of Sub-Projects

3.3.3 Additional Consideration of Target Roads at the Detailed Design Stage

When adding target roads at the detailed design stage (after conclusion of L/A), similar screening and criteria will be used to select roads. Therefore, roads that have development plans by other donors and roads that are expected to have a significant impact on the environment and society (Category A under JICA’s Environmental and Social Consideration Guidelines) are excluded from the evaluation.

3.3.4 Screening

JICA Survey Team confirmed status of sub-projects in order to exclude target roads based on JICA Guidelines for Environmental and Social Considerations (JICA GL) (January 2022) or for which JICA cooperation is not possible. Table 3.3-4 shows the requirements of the projects (improvement of existing roads) for category determination and possible cooperation under JICA GL.

Table 3.3-4 Project Requirements for Category Determination and Availability of Cooperation on JICA GL

		Non-Cooperation Project	Category A	Category B
Project requirement	Sector	-	Road (Large scale) JICA GL Appendix 3	Sectors, characteristics, and regions that do not fall under the left column (Non-Cooperative Projects, Category A)
	Characteristics	<ul style="list-style-type: none"> Projects that are not appropriate with local environmental and social considerations laws, standards, policies, and plans Projects that result in the conversion or significant degradation of critical natural habitats and forests JICA GL. Appendix 1	<u>Projects involving large scale involuntary resettlement</u> JICA GL. Appendix 3	
	Area	<u>In protected areas designated by laws and regulations for the protection of nature and cultural heritage</u> JICA GL. Appendix 1	<ul style="list-style-type: none"> <u>Areas surrounding the left</u> <u>Areas that may require careful consideration for the country or region (natural environment and social environment such as living areas of indigenous peoples)</u> JICA GL. Appendix 3	

Source: JICA Survey Team

(1) Sensitive Characteristics

The sub-project's scope of work includes pavement maintenance of existing roads. The majority of the work will take place within the ROW of the current road and the scale of the work is extremely small. Therefore it does not fall into the category of sensitive characteristics which include (1) large-scale involuntary resettlement, (2) large-scale groundwater pumping, (3) large-scale land reclamation, land development, and land clearing, and (4) large-scale logging.

(2) Sensitive Areas

Some of the target roads are located in or near protected areas designated by Cambodia, while others are inside or outside of Key Biodiversity Areas (KBAs) or other important natural habitats. Based on information from related documents, BMC1 and BMC3 in Banteay Meanchey, BTB6 in Battambang, and KCH8 in Kampong Chhnang are found to be within or near protected areas, etc. Information on the potentially affected protected areas was analyzed and evaluated for acceptability as a target road.

Table 3.3-5 Subject Roads in Close Proximity to Protected Areas

Target Road	Information on nearby protected areas						Evaluation
	Category	Type	Name	IUCN management category IBA Criteria *1	vulnerable species (IUCN) *2	Location with Target Road	
BMC3	National designation	Protected Landscape	Ang Trapeng Thmor	VI (Landscape protection area)	CR3 EN9 VU16	The northern terminus is within the protected area. As a result of the field survey, a section of about 10 km	The project does not fall under the category of "sensitive areas" because the reduced scope of maintenance will ensure a separation
	KBA		Ang Trapeng Thmor				

Target Road	Information on nearby protected areas						Evaluation
	Category	Type	Name	IUCN management category IBA Criteria *1	vulnerable species (IUCN) *2	Location with Target Road	
						close to the protected area has already been developed, and it was decided to exclude it from the scope of development by this project.	distance of approximately 10 kilometers or more from the protected area. Based on the details of the project, it can be said that there will be almost no impact on the protected area.
BMC1	KBA		Preah Net Prear Kra Lah/Pourk	A1 (Globally threatened species) A3 (Biome-restricted species) , A4i (Congregations)		About 5 km of Target Road is within the KBA. On the other hand, recent zoning has set back the location of the KBA, and some information indicates that it is outside the KBA.	It is difficult to select this project as a sub-project because it is likely to be within a KBA and is assumed to be equivalent to Category A.
BTB6	National designation	Multiple Use Area	Samlout	VI (Resource Conservation Areas)	CR2 EN6 VU19	It parallels the river for about 3 km at about 100-300 m across the river.	The project is not located in a protected area and is separated from the protected area by 100-300 meters. Based on the nature of the project, there is almost no impact on the protected area.
KCH8	National designation KBA	Multiple Use Area	Tonle Sap	VI (Resource Conservation Areas)	CR3 EN9 VU16	Located on the other side of Route 5 (about 50-100 m)	The project is not located in a protected area. It is separated from the adjacent protected area by 50-100 meters across the main road. In addition, given the surrounding conditions (development in progress) and the nature of the project, it can be said that there will be almost no impact on the protected area.

*1 : Protected Planet (<https://www.protectedplanet.net/en/>) , Bird Life International (<http://datazone.birdlife.org/site/factsheet/>)

*2 : DOPA Explorer (<https://dopa-explorer.jrc.ec.europa.eu/>)

Source : JICA Survey Team

As a result, BMC1, which is likely to be within the KBA, was excluded from the sub-projects after discussion with MRD. BMC3 was made a target road after reducing the scope of maintenance and excluding the area within and adjacent to the protected area. One of the requirements for sensitive areas is “critical habitats and critical forests.” The other sub-projects in close proximity to protected areas (BTB6, KCH8) are evaluated as not falling under this category (see Table 3.3-6).

Table 3.3-6 Evaluation of BTB6, KCH8 and BMC3 as “critical habitats and critical forests”

Requirements for "critical habitats"	BTB6, KCH8	BMC3
(1) Habitat of significant importance to Critically Endangered (CR), Endangered (EN), Vulnerable (VU), or Near Threatened (NT) species, as listed in the IUCN (International Union for Conservation of Nature) Red List of threatened species or equivalent national approaches;	The sub-project will take place within the existing roads, although there is potential for some widening. It is not a critical habitat (nesting or feeding area).	The sub-project will take place within the existing roads, although there is potential for some widening. It is not a critical habitat (nesting or feeding area).
(2) Habitat of significant importance to endemic or restricted-range species;	See (1). The rare species identified in Samlout and Tonle Sap are species that occur not only in the area but also throughout Cambodia and other Asian countries.	See (1). The rare species identified in the protected area (Ang Trapeng Thmor) are species that occur not only in the area but also throughout Cambodia and other Asian countries.
(3) Habitat supporting globally or nationally significant concentrations of migratory or congregatory species;	See (2). Samlout is not designated as an IBA. Tonle Sap has an area partially designated as an IBA, but it is not applicable because it is a lakeshore about 4 km away from KCH8.	Ang Trapeng Thmor is a wet land protected area, bird colonies can be seen. On the other hand, the sub-project is located in the vicinity of an urban area about 10 km away from the protected area. Therefore, the sub-project is not located in the critical habitat.
(4) Highly threatened or unique ecosystems;	Both Samlout and Tonle Sap are designated as IUCN Management Category VI (Resource Conservation Areas) and are not areas where critical and/or unique ecosystems are recognized.	Ang Trapeng Thmor are designated as IUCN Management Category V (Protected Landscape/Seascape), and not areas where critical and/or unique ecosystems are recognized. Furthermore, the sub-project is located in the vicinity of an urban area about 10 km away from the protected area.
(5) Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (1) to (4).	See (4).	See (4).

Source : JICA Survey Team

In addition, "Areas that are thought to require careful considerations" include indigenous peoples' residential areas, etc. However, it has not been confirmed at this time that the sub-project is in an indigenous peoples' living area. If it is confirmed in the future that the sub-projects are in an indigenous peoples' living area, it will be excluded from the sub-project, or its scope will be reduced.

3.3.5 Organize the Needs for Improvement on the Rural Roads

(1) Consideration for Criteria

In order to quantitatively organize the characteristics of the rural roads, JICA Survey Team considered the two perspectives shown below.

- Consideration of criteria to evaluate the degree to which the road contributes to the realization of the future regional image envisioned by at the national and rural level.
- Consideration of criteria to evaluate how much they contribute to solving problems faced by rural areas and rural roads.

The results of criteria are shown below.

1) Consideration of Criteria based on Upper-level Plan

The policies related to development in the Rectangular Strategy, National Strategic Development Plan 2019-2023, Rural Development Policy 2019-2023, and Rural Development Strategy 2019-2023, which envision the future of Cambodia, are summarized in the Table 3.3-7 below.

Table 3.3-7 Development Policies related to Local Development in the Upper-level Plan

Upper-level plan	Policies Related to Rural Development
Rectangular Strategy	<ul style="list-style-type: none"> • Promotion of agriculture sector and rural development • Ensuring the environmental sustainability and pre-emptive response to the climate change
National Strategic Development Plan 2019-2023	<ul style="list-style-type: none"> • Rehabilitating and constructing rural roads • Improving rural roads to DBST or concrete to be resilient with climate change • Maintaining the rural road periodically • Preparing road inventory and rural road maps as well as putting up traffic signs
Rural Development Policy 2019-2023	<ul style="list-style-type: none"> • Quality and resilience of rural road infrastructure network improved
Rural Development Strategy 2019-2023	<ul style="list-style-type: none"> • Increase coverage and resilience of rural infrastructure and quality of rural public services • Increased access to improved rural water supply and healthcare • Ensure a sustainable rural economy and harmonious

Source : JICA Survey Team

In order to promote rural development, expanding and enhancing infrastructure development in rural areas is a goal of the upper-level plan. In the area of rural roads, the formation of an efficient, high-quality rural road network is required to realize the future vision. In order to efficiently form a high-quality rural road network, it is effective to prioritize improvement of frequently used, heavily trafficked rural roads. Therefore, in this project, the future traffic volume at the time of service is set as criteria to realize the policy objective of the upper-level plan.

Table 3.3-8 Criteria Selection Policy and Criteria from Upper-Level Plan






Rural Development Strategy 2019-2023		In this project	
Policy Objective	Issue	Criteria Selection Policy	Criteria
Increase coverage and resilience of rural infrastructure and quality of rural public services	Improving quality and resilience of rural roads infrastructure network	Prioritize roads with heavy daily traffic volume so that quality and resilience of rural roads infrastructure network can be improved effectively	Future traffic demand (PCU/day)


Source: JICA Survey Team

2) Consideration of Criteria based on Problems and Issues Facing Target Roads

The problems and issues on target roads identified through the field survey and discussions with MRD are summarized in the Table 3.3-9 below.

Table 3.3-9 Founded Problems/Issues by Site Survey

Problems	Issue	Picture
<ul style="list-style-type: none"> • Many local residents commute to neighboring cities for temporary work. Rural roads make driving slow due to unpaved and it takes time to reach the national road. • The driving performance deteriorates further, especially when it rains, which requires even more time. 	Improving accessibility to national roads	
<ul style="list-style-type: none"> • In order to solve the poverty problem, it is important not only to increase job opportunities but also to provide educational opportunities and medical services. • Difficult to access poverty areas due to poor road conditions. As a result, infrastructure such as rural water supply and medical care has not been developed. 	Improving infrastructure in poverty areas	
<ul style="list-style-type: none"> • Rising water levels in the Tonle Sap Lake regularly make roads impassable. • Banteay Meanchey Province flood due to flash flood from Thailand. 	Improving road resilient to disasters	
<ul style="list-style-type: none"> • Heavy vehicle usually passed rural roads for transporting agricultural products. The mix of large vehicles and daily traffic a high risk of accidents. • Many rural roads are unpaved and narrow, making it difficult for large vehicles to pass each other. Poor mobility of transport vehicles makes it difficult to improve logistics efficiency. 	Improving accessibility to agricultural land	
<ul style="list-style-type: none"> • Residents regularly go to schools, hospitals, pagodas and markets but access is difficult because of puddles and muddy conditions that occur the day after a rainfall. • Educational opportunities and public services in rural areas are inadequate to correct regional income disparities. 	Improving accessibility to public important facilities (schools, hospitals, pagodas, markets)	

Problems	Issue	Picture
<ul style="list-style-type: none"> • Damage caused from dust raised by passing vehicles in dry season. • Residents along the roadside are taking measures such as sprinkling water, but they are temporary and not a long-term solution. 	Preventing damage from dust.	
<ul style="list-style-type: none"> • A lot of rural roads are unpaved, and it is important to improve the network effect of rural roads in cooperation with other donor projects within a limited budget. 	Number of road connection with other rural road projects	

Source: JICA Survey Team

Based on the problems and issues faced by rural roads described above, JICA Survey Team quantified the extent to which each rural roads improvement would contribute to solving the issues. Table 3.3-10 shows the criteria used to quantify the contribution to each issue.

Table 3.3-10 Policy for Selecting Criteria from Site Survey and Discussion with MRD

Issue	Policy for selecting criteria	Criteria
Improving accessibility to national roads	Prioritize roads which have highly effective in reducing travel time to trunk national roads so that accessibility to urban areas can be improved effectively.	Travel time to one-digit National Roads
Improving infrastructure in poverty areas	Prioritize roads which pass through poverty areas so that accessibility to poverty areas can be improved effectively. Therefore, quality of life for local people will be improved by expansion of aid in poverty area.	Poverty rate (%)
Improving road resilient to disasters	Prioritize roads in wide inundation area so that inundation damage can be reduced effectively.	Flood risk area /km
Improving accessibility to agricultural land	Prioritize roads which pass through agricultural area so that crop transportation efficiency can be improved.	Agricultural land area/km
Improving accessibility to public important facilities (schools, hospitals, pagodas, markets)	Prioritize roads along which many public important facilities are located, so that quality of life for road users can be improved effectively.	Total number of public important facilities (schools, hospitals, pagodas, markets)/km
Preventing damage to life from dust	Prioritize roads along which many people live so that damage to life from dust can be improved effectively.	Number of Population served/km
Generating synergy with other rural road projects	Prioritize roads which connect with other rural road projects so that rural roads can be generated synergy.	Number of road connection with other rural road projects

Source: JICA Survey Team

3) Methodology for Calculating each Criterion

Eight (8) criteria are selected: ① Future traffic demand (PCU/day), ② Travel time to one-digit national roads, ③ Poverty rate (%), ④ Flood length/km, ⑤ Agricultural land area/km, ⑥ Total number of public important facilities (schools, hospitals, pagodas, markets)/km, ⑦ Number of population served/km, and ⑧ Number of road connection with other rural roads projects.

Table 3.3-11 Calculation Methodology for Selected Criteria

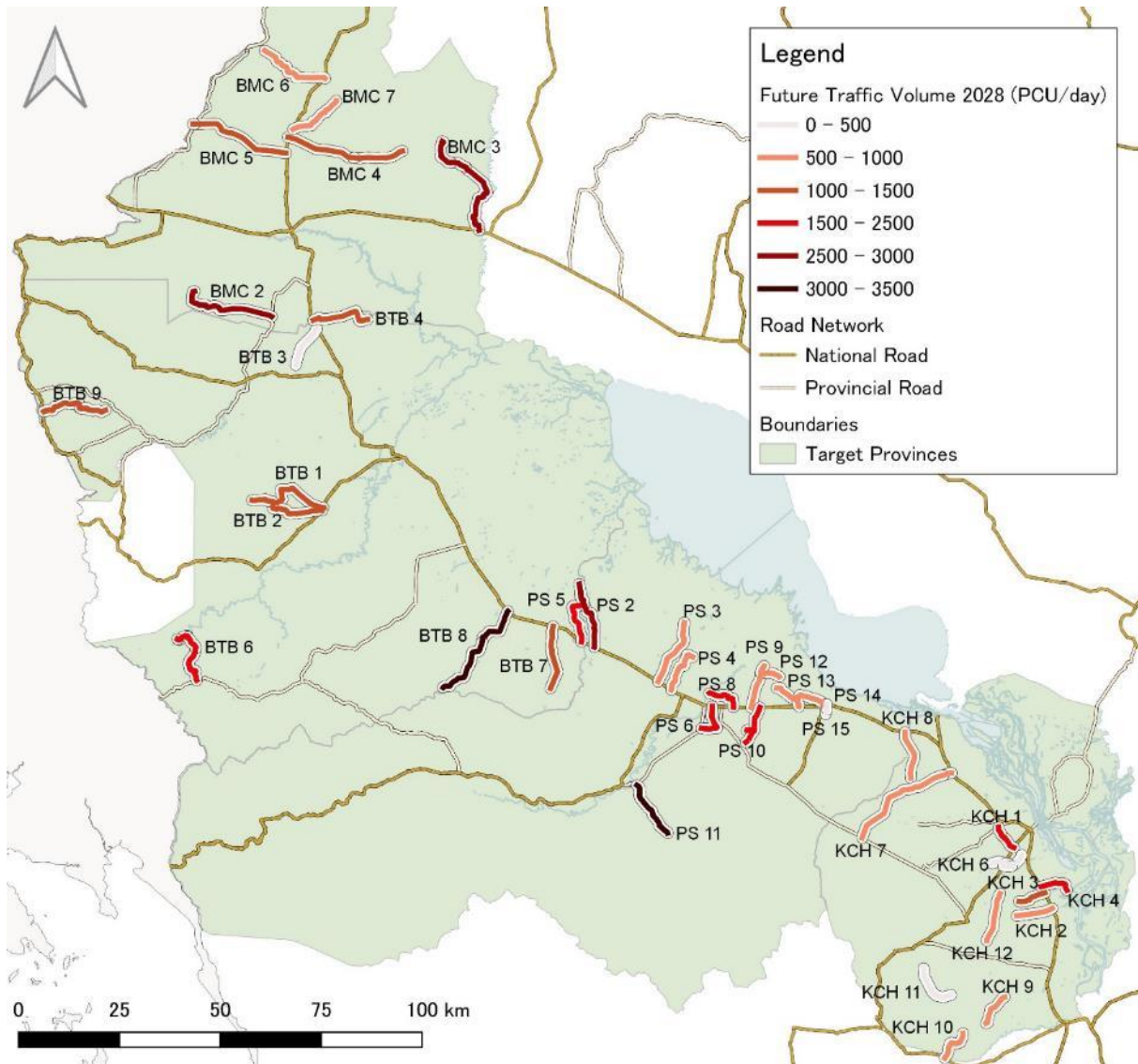
Criteria	Methodology
Future traffic demand (PCU/day)	<ul style="list-style-type: none"> • Used the results of the traffic demand forecast conducted in this survey. • Set the traffic volume at the time of service as criteria.
Travel time to one-digit national roads	<ul style="list-style-type: none"> • To calculate travel times, create a road network that includes national roads, provincial roads, and paved rural. If a one-digit national road cannot be reached without passing on unpaved road, the shortest unpaved road shall be added to the network. • JICA Survey Team measured travel speed of the national roads and provincial roads and target roads and use it. • The shortest travel time from the furthest point of each target roads from the one-digit national roads to the one-digit national road is calculated and set as criteria.
Poverty rate (%)	<ul style="list-style-type: none"> • JICA Survey Team used poverty rate data per commune in 2014, lent by MRD. • JICA Survey Team used poverty rate of commune passes through rural roads as criteria. • For roads that pass through more than one community, the poverty rate is calculated as a weighted average of the poverty rate based on the length of the road passing through each commune.
Flood risk area/km	<ul style="list-style-type: none"> • Based on the flood situation interview survey, JICA Survey Team identified flood risk area. • The flood risk area per 1 km will be calculated and set as criteria.
Agricultural land area/km	<ul style="list-style-type: none"> • JICA Survey Team used GIS data on agricultural area prepared by the Ministry of land Management, Urban Planning & Construction in 2013. • Agricultural land within a 2 km-radius of rural roads is defined as agricultural land along the rural roads. JICA Survey Team measured agricultural land area and found agricultural land per km is set as criteria.
Total number of public important facilities (schools, hospitals, pagodas, markets)/km	<ul style="list-style-type: none"> • JICA Survey Team used the total number of important public facilities (schools, hospitals, and pagodas) observed in the road condition survey. • JICA Survey Team conducted interview with PDRD and counted the number of commune markets (with more than 20 shops and stalls) • Based on the RRMP and field surveys, schools, hospitals, pagodas and markets that are regularly used by rural residents are defined as important public facilities. • Number of important facilities per 1 km is used as criteria.
Number of population served/km	<ul style="list-style-type: none"> • JICA Survey Team used the population census data by commune in 2019. • Population served are counted within a defined zone of influence (about 20 – 30 minutes walking time, or 10 minutes by bicycle, and about 5 min by motorbike) using the same method in RRMP. • The population within a 2 km-radius of rural roads are divided proportionally by the area of commune to calculate the population along the rural road, and the population per 1 km is set as criteria.
Number of road connection with other rural roads projects	<ul style="list-style-type: none"> • Based on the GIS data received from MRD on rural roads that have been planned or implemented, the number of connections to the target road was counted and used as criteria.

Source : JICA Survey Team

4) Current Status of Target Roads Related to Each Criteria

Current status of rural roads for the eight criteria is presented below.

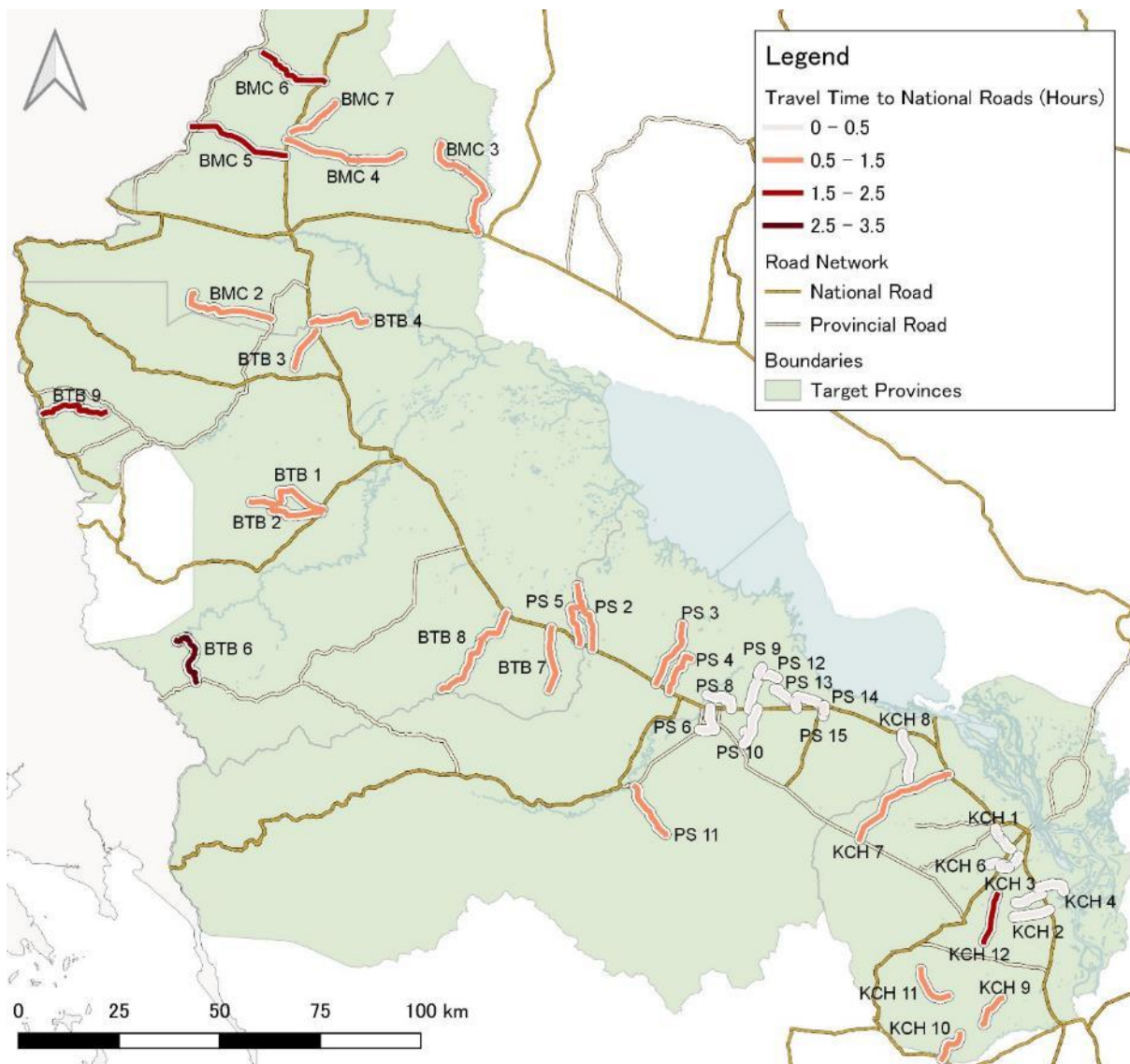
Figure 3.3-2 shows the future traffic volumes (PCU/day). The top three future traffic volumes are 3,418 PCU/day at PS-11, 3,213 PCU/day at BTB-8, and 2,799 PCU/day BMC-2.



Source : JICA Survey Team

Figure 3.3-2 Future Traffic Volume (PCU/Day)

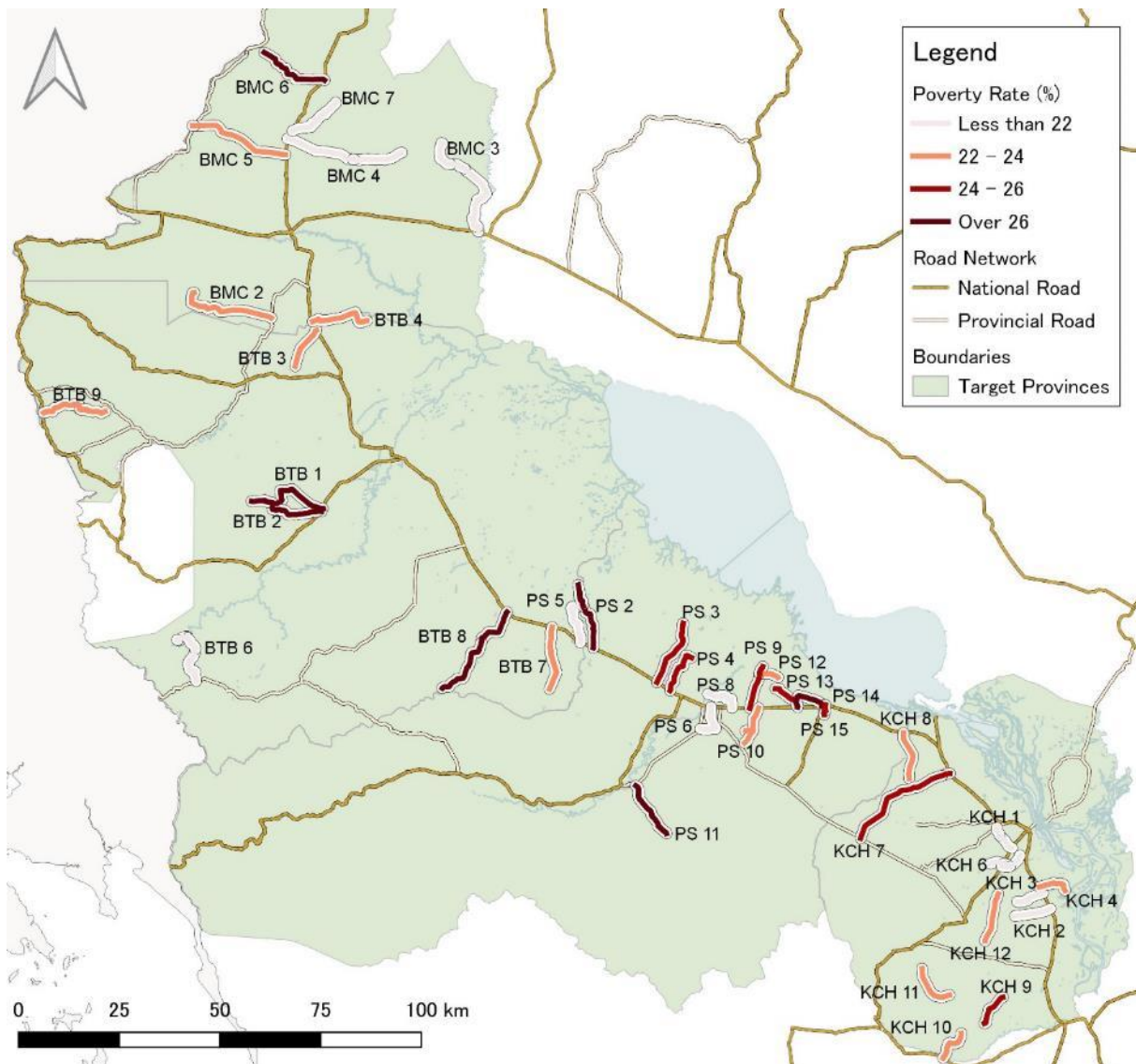
Figure 3.3-3 shows the travel times to one-digit national roads. BTB-6 (2.8 hours), BTB-9 (2.5 hours), and BMC-6 (2.1 hours) were found to be prominently far from one-digit national roads.



Source : JICA Survey Team

Figure 3.3-3 Travel Time to One-Digit National Roads

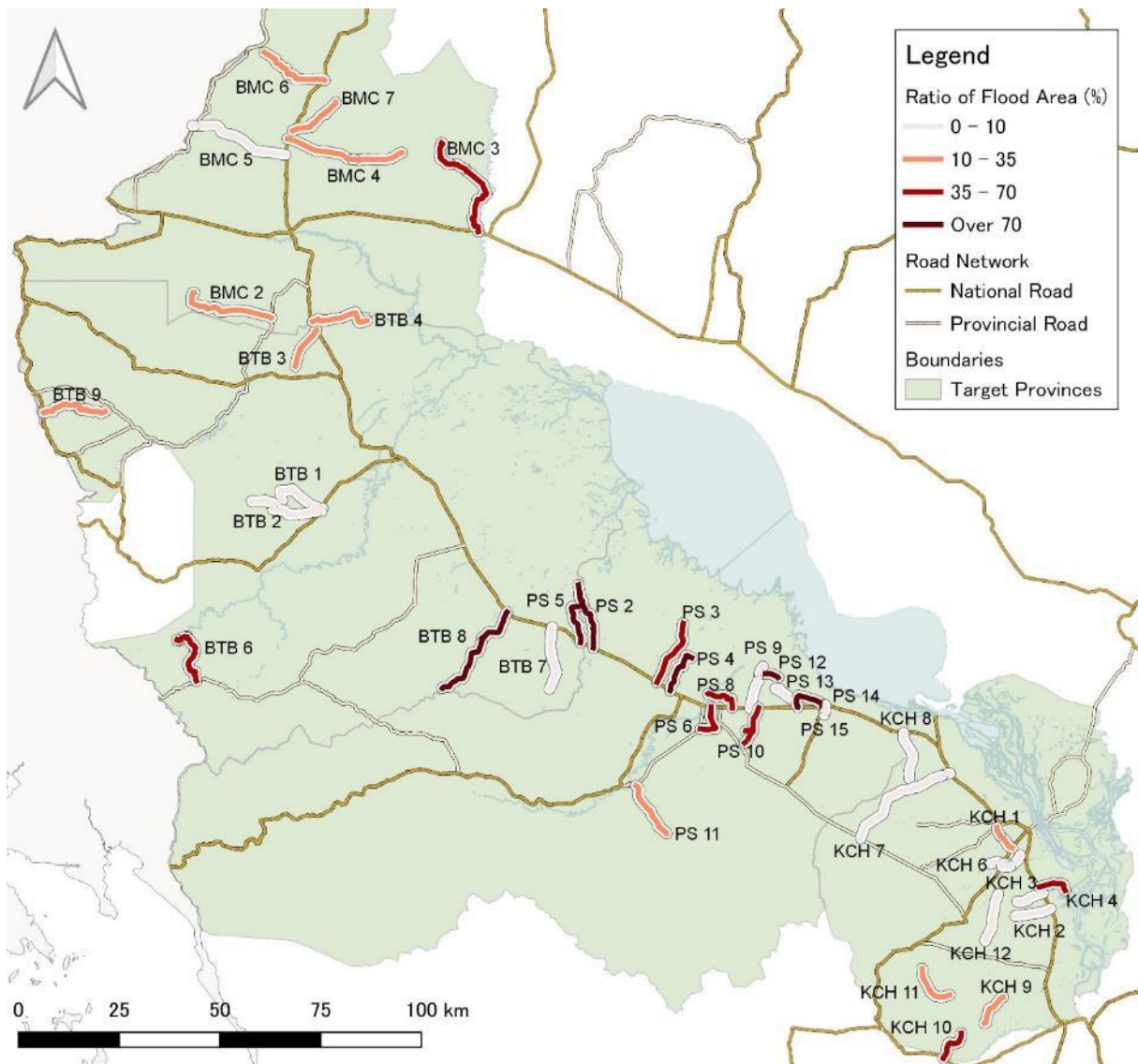
The poverty rates on the target roads are shown in Figure 3.3-4. Roads with the highest rates were PS-11 (30.57%), PS-14 (28.88%), and BTB-8 (26.75%), having registered significantly higher poverty rates than the other target roads.



Source : JICA Survey Team

Figure 3.3-4 Poverty Rates (%)

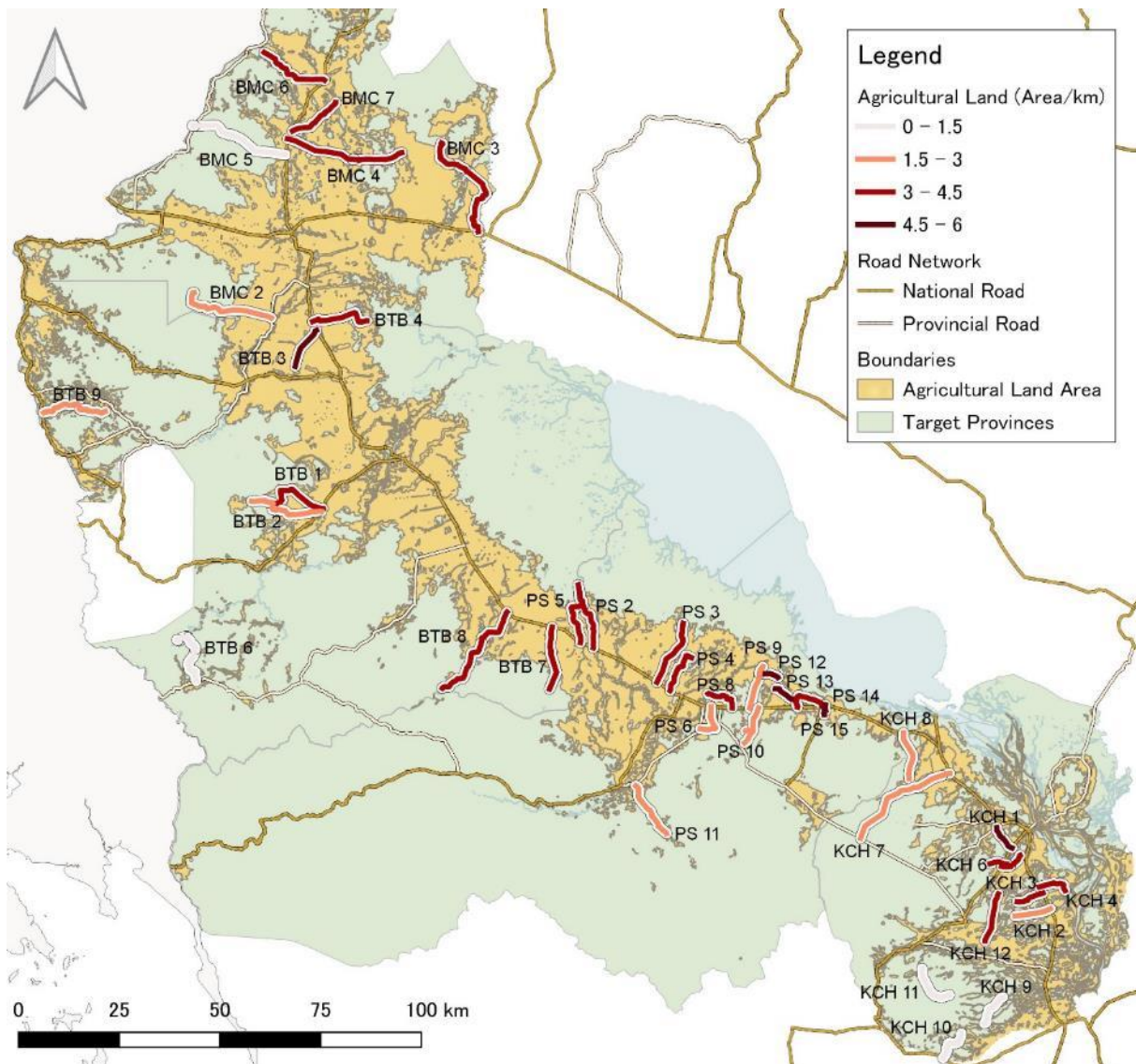
Figure 3.3-5 shows the flood risk area/km. Pursat occupying the top flood risk area, having three significantly affected roads: PS-12 (100%), PS-2 (99%), and PS-5 (99%); in addition to the majority of other roads being located at inundation risk zones.



Source : JICA Survey Team

Figure 3.3-5 Flood Risk Area per km

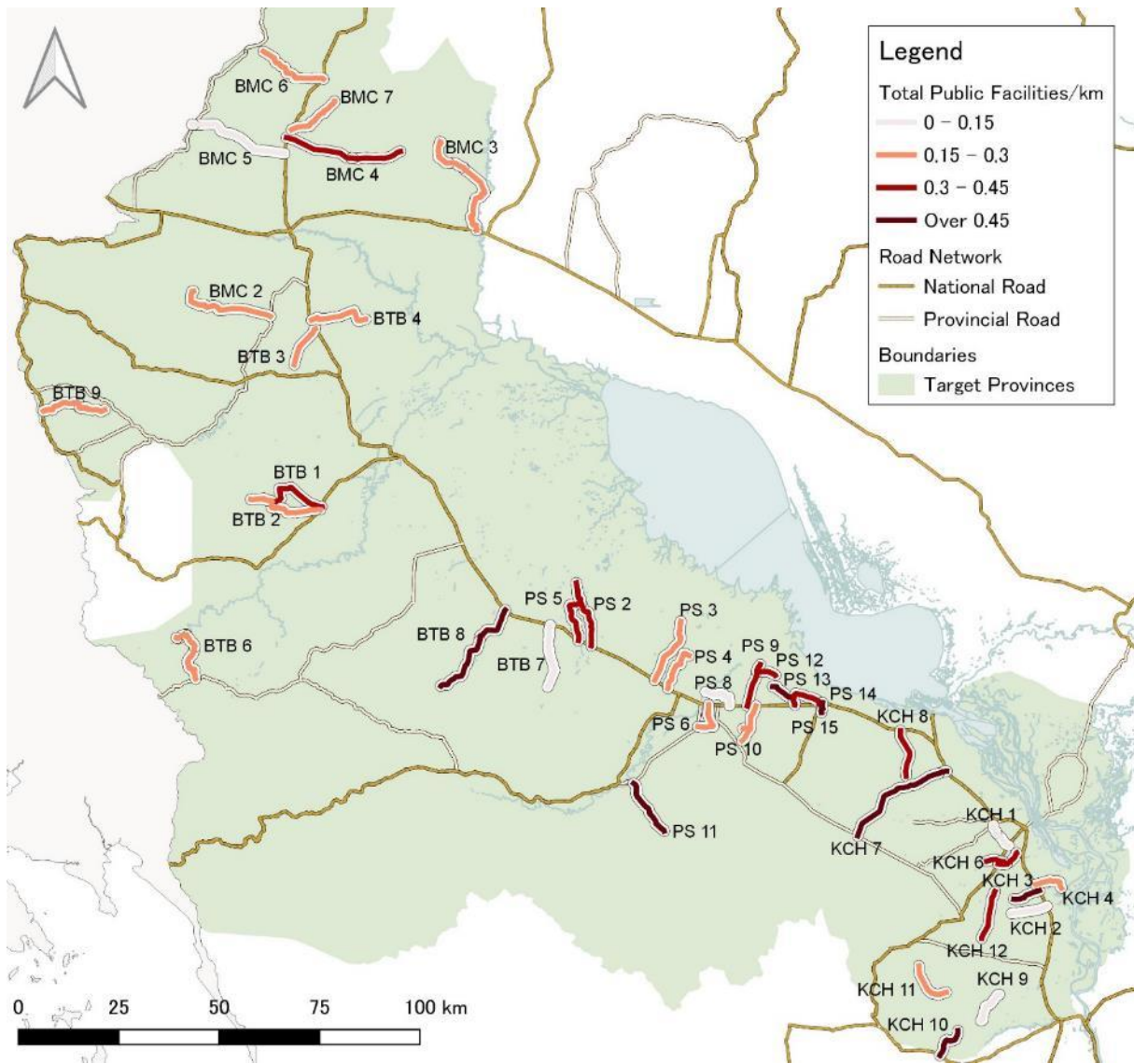
Figure 3.3-6 shows the agricultural land area/km. The top three were registered at PS-12 (5.69 km²), PS-13 (5.54 km²), and KCH-1 (5.54 km²). There is a trend toward more agricultural land area in Pursat and Battambang provinces.



Source : JICA Survey Team

Figure 3.3-6 Agricultural Land Area per km

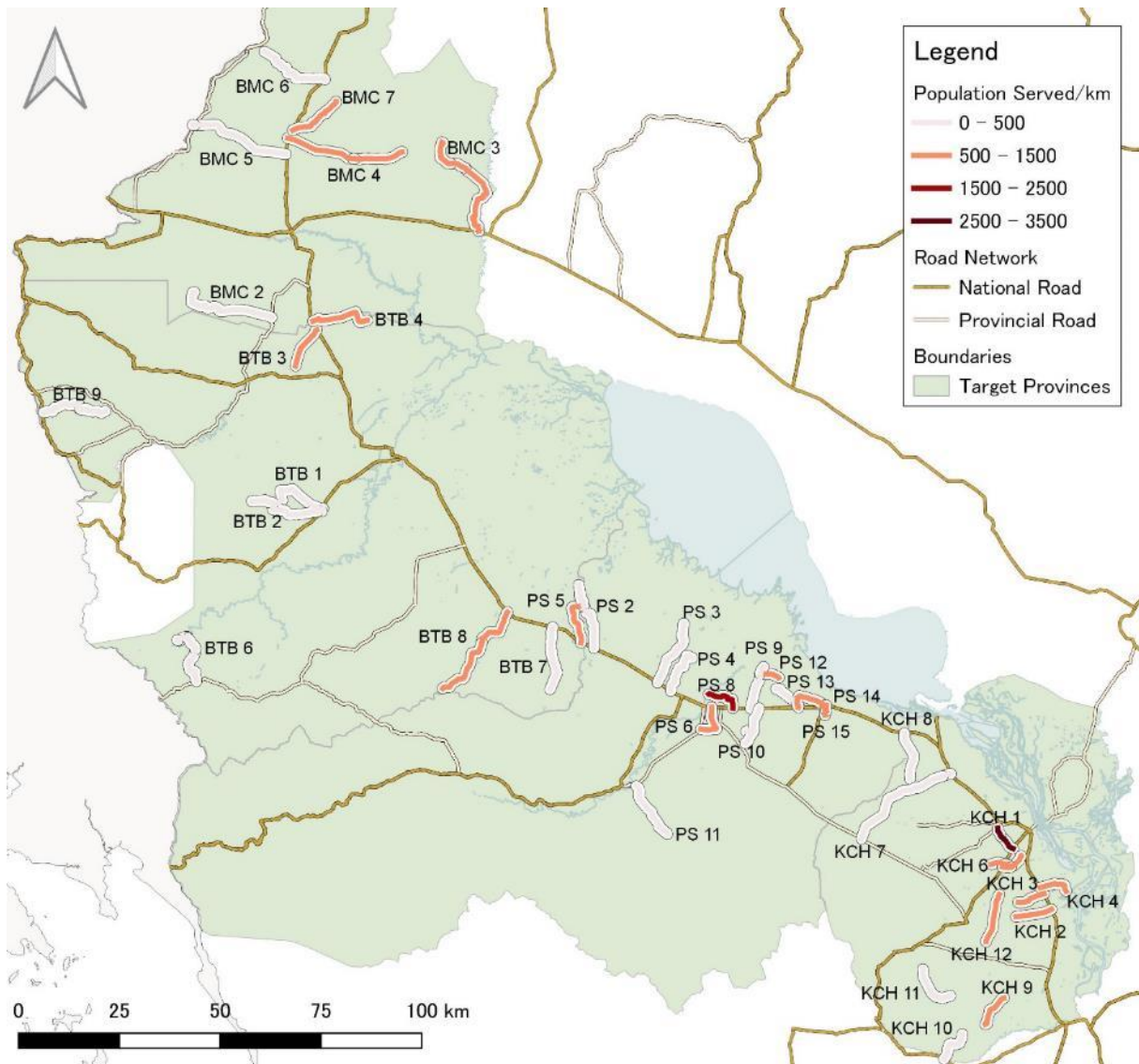
Figure 3.3-7 shows the total number of important public facilities/km. Top roads were identified to be KCH-10 (0.79/km), BTB-8(0.78/km), and PS-15(0.77/km).



Source : JICA Survey Team

Figure 3.3-7 Total Number of Public Important Facilities per km

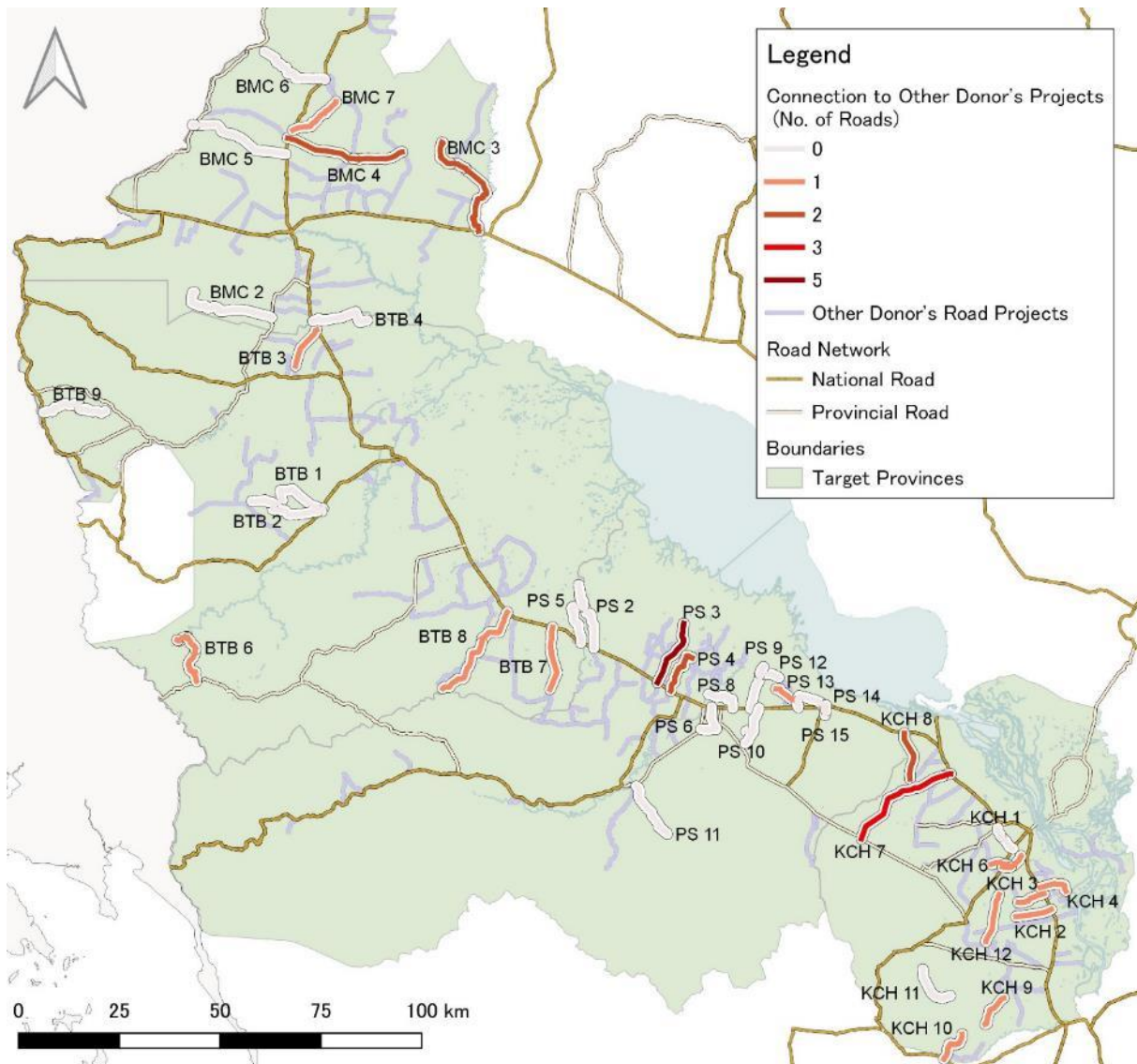
Figure 3.3-8 shows the population/km along rural roads. The top three in population/km are KCH-1 (2,878 persons/km), PS-8 (1,778 persons/km), and KCH-6 (977 persons/km).



Source : JICA Survey Team

Figure 3.3-8 Number of Population served per km

Figure 3.3-9 shows the number of road connections with other rural road projects. PS-3 (5) and KCH-7 (3) were identified to be the most connected target roads.



Source : JICA Survey Team

Figure 3.3-9 Number of Road Connection with Other Rural Road Projects

(2) Scoring Method for Target Roads

JICA Survey Team used adjusted standard deviation score for each target road. Adjusted standard deviation score is an index that shows the relative position. It can be calculated using the standard deviation and the average value. The higher the deviation value, the higher the evaluation priority. the lower the deviation value, the lower the priority. Therefore, there is no need to set the range according to the characteristics of the area unlike RRMP.

3.3.6 Weight of Criteria

(1) Analysis Procedure for Criteria

JICA Survey Team standardized and analyzed criteria using Multi-Criteria Decision Analysis in this project. Multi-Criteria Decision analysis is a method of standardizing and evaluating multiple evaluation indices using the same scale. Multi-Criteria Analysis is a method that simultaneously considers various related effects, such as quantitative effects, qualitative effects, and consideration of benefits, in order to make a comprehensive evaluation. Among the Multi-Criteria Analysis methods, the "weighted summation method" is the most used and the analysis method is easy to understand by a third party. Therefore, the JICA Survey Team used "weighted summation method" in this project. The analysis procedure of the "weighted summation method" is as follows.

- ① Standardize scores of each criteria
- ② Set a weight that quantifies the relative importance of each criteria
- ③ Multiply the standardized score by weight of criteria
- ④ Add all score of each target road and calculate total score

(2) Implementation and Results of the Questionnaire Survey for Weight of Criteria

JICA Survey Team conducted questionnaire survey for weight of criteria using paired comparison method by Thurstone⁹, this questionnaire survey compares two issues by repeating one-by-one comparison for all pairs of issue and quantify the importance of criteria. The questionnaire for weight of criteria was administered to a total of five respondents, one from within the counterpart MRD and four respondents selected from each of the PDRD in the four target provinces. Therefore, MRD responses were multiplied by four to adjust for the disparity between the MRDs and PDRD.

⁹ Paired comparison method by Thurstone is used to rank the importance of each criteria, and quantifying the importance of criteria by repeating one-by-one comparison for all pairs of issues.

Questionnaire for weight of the criteria

Organization: _____

Name: _____

[Request for questionnaire survey for weight of the criteria]

JICA expert team conducts a questionnaire survey to determine weight of the criteria in Data Collection Survey on Rural Road Connectivity Improvement Project. Its purpose is to clarify how important each criteria is for the decision makers and determine the weight of each criteria. It would be appreciated if you would answer the following questionnaire. There are 28 questions in total.

[Method]

This questionnaire survey is conducted by paired comparison method. Please put a check mark “✓” that you think more important between 2 issues.

For example, if you think “Preventing health damage from dust” is more important, please put a check mark as shown below.

Ex	Improving accessibility to urban areas (capital, provincial capital)	[]	[✓]	Preventing health damage from dust
----	--	-----	-------	------------------------------------

[Questionnaire]

Please put a check mark “✓” that you think more important between 2 issues.

1	Improving accessibility to urban areas (capital, provincial capital)	[]	[]	Preventing health damage from dust
2	Improving quality and resilience of rural roads infrastructure network	[]	[]	Improving accessibility to urban areas (capital, provincial capital)
3	Preventing health damage from dust	[]	[]	Improving quality of life in poverty area
4	Generating synergy with other rural road projects	[]	[]	Preventing health damage from dust
5	Improving quality and resilience of rural roads infrastructure network	[]	[]	Improving accessibility to public important facilities (school / hospital / pagoda)
6	Improving accessibility to public important facilities (school / hospital / pagoda)	[]	[]	Generating synergy with other rural road projects
7	Improving quality of life in poverty area	[]	[]	Improving quality and resilience of rural roads infrastructure network
8	Improving quality and resilience of rural roads infrastructure network	[]	[]	Improving road resilient to disasters and inundation
9	Improving road resilient to disasters and inundation	[]	[]	Generating synergy with other rural road projects

Source: JICA Survey Team

Figure 3.3-10 Questionnaire for Weight of Criteria

The result of weight (importance) of each criterion is shown in Table 3.3-12. According to result of questionnaire surveys, those respondents aspire improvement such as “Improving infrastructure in poverty areas”, “Improving accessibility to public important facilities”, “Improving quality and resilience of rural roads infrastructure network”, and “Improving Road resilient to disasters”. On the other hand, “Improving accessibility to agricultural land” tended to low priority.

Table 3.3-12 Weight of Criteria

Criteria	Units	Weight
Future traffic demand (PCU/day)	(PCU/Day)	1.31
Travel time to one-digit national roads	(Min)	0.81
Poverty rate (%)	(%)	1.52
Flood risk area/km	-	1.19
Agricultural land area/km	Km ²	0.16
Total number of public important facilities (schools, hospitals, pagodas, markets)/km	-	1.46
Number of population served/km	Persons/km	0.82
Number of road connection with other rural roads projects	-	0.73
Total		8.0

Source: JICA Survey Team

(3) Prioritization Reflecting the Results of the Questionnaire Survey

Table 3.3-13 shows the score and ranking of each rural roads reflecting weight.

Table 3.3-13 Prioritization Reflecting the Results of the Questionnaire Survey

Rank	Target Roads	Future Traffic Demand	Travel Time to One-Digits NR	Poverty Rate	Flood Risk Area/Km	Agricultural Land Area/Km	Total Number of Public Important Facilities /Km	Number of Population Served/Km	Number of Road Connection with Other Rural Roads Projects	Total Points
		(PCU/day)	(Min)	(%)						
1	BTB-8	95.4	43.7	96.4	84.0	9.0	107.5	40.4	38.2	514.5
2	PS-11	98.5	45.5	119.0	54.4	6.2	84.4	34.9	31.1	474.0
3	PS-2	85.7	40.4	92.6	84.0	8.5	82.3	35.7	31.1	460.3
4	PS-14	56.3	32.9	109.0	73.7	9.3	78.5	39.6	31.1	430.4
5	PS-3	57.6	36.8	85.3	66.0	8.8	70.8	36.9	66.4	428.6
6	PS-5	77.0	39.7	66.7	84.1	9.1	78.4	39.9	31.1	426.0
7	PS-4	57.5	36.8	83.8	83.8	9.4	67.9	38.3	45.2	422.6
8	KCH-7	60.0	46.7	86.6	47.2	6.5	84.8	34.9	52.3	419.0
9	BMC-2	88.7	48.0	77.5	60.1	6.6	68.2	38.3	31.1	418.5
10	BMC-3	86.3	39.4	60.2	69.9	9.5	65.1	42.4	45.2	418.0
11	KCH-10	52.5	43.3	68.7	61.9	6.1	108.2	38.7	38.2	417.6
12	PS-12	57.5	35.3	70.2	84.5	11.0	79.4	39.5	31.1	408.6
13	BTB-6	80.2	64.5	54.4	69.4	5.7	62.8	33.3	38.2	408.4
14	PS-13	58.7	30.8	82.5	50.7	10.8	95.5	38.3	38.2	405.5
15	PS-15	49.9	30.5	83.4	47.2	9.8	106.9	44.4	31.1	403.4
16	PS-10	81.5	33.5	76.2	69.0	6.7	68.5	36.7	31.1	403.1
17	BTB-1	62.7	41.8	93.5	48.4	8.7	79.4	35.5	31.1	401.1
18	BMC-6	58.4	55.2	95.2	52.5	8.4	61.6	37.8	31.1	400.1
19	KCH-4	73.9	32.8	68.6	63.5	7.8	67.7	46.7	38.2	399.3
20	BTB-2	63.1	46.8	93.5	49.3	7.7	70.1	35.1	31.1	396.7
21	BTB-9	62.7	60.6	75.5	53.0	6.1	70.1	36.6	31.1	395.7
22	BTB-4	66.7	42.3	76.8	56.3	8.7	63.5	46.2	31.1	391.5
23	KCH-1	75.8	31.9	56.7	55.0	10.8	49.6	80.3	31.1	391.3
24	BMC-4	68.0	41.0	61.7	53.4	8.0	72.7	40.8	45.2	390.8
25	KCH-12	55.0	49.0	73.6	47.2	8.3	79.6	39.8	38.2	390.7
26	PS-8	72.4	31.3	61.6	62.0	8.5	58.1	61.2	31.1	386.2
27	PS-6	74.0	31.8	67.9	62.2	7.8	65.0	42.4	31.1	382.3

Rank	Target Roads	Future Traffic Demand	Travel Time to One-Digits NR	Poverty Rate	Flood Risk Area/Km	Agricultural Land Area/Km	Total Number of Public Important Facilities /Km	Number of Population Served/Km	Number of Road Connection with Other Rural Roads Projects	Total Points
		(PCU/day)	(Min)	(%)						
28	KCH-3	62.6	32.4	52.4	50.3	8.1	91.5	46.3	38.2	382.0
29	PS-9	55.5	34.1	82.4	50.9	7.1	76.2	38.9	31.1	376.2
30	KCH-8	59.1	34.5	71.1	47.2	6.7	74.0	37.1	45.2	375.1
31	BMC-7	54.4	45.0	57.9	55.5	8.7	70.7	39.9	38.2	370.2
32	KCH-9	55.8	38.5	85.7	54.0	5.9	49.6	40.9	38.2	368.6
33	BMC-5	62.0	52.1	79.6	48.8	4.9	52.6	36.9	31.1	368.0
34	BTB-3	47.6	37.8	70.4	56.8	10.4	63.7	41.2	38.2	366.0
35	KCH-6	51.7	33.6	60.2	47.2	8.2	75.9	47.3	38.2	362.4
36	BTB-7	61.0	42.4	69.5	50.9	8.4	54.2	35.0	38.2	359.5
37	KCH-11	50.3	41.2	69.6	58.9	4.4	61.3	34.7	31.1	351.6
38	KCH-2	52.3	34.9	51.7	47.6	7.3	57.8	45.3	38.2	335.1

Source: JICA Survey Team

(2) Longlist per Province

Table 3.3-15 to Table 3.3-18 show the longlist per province.

Table 3.3-15 Prioritization of KCH

Rank	Target Roads	Provinces	Districts	Rural Road	Evaluation of M/P	Road Type	Road Length
							(km)
1	KCH-7	KCH	Boribo	Phsar-Kdol Senchey	High	T1	27.5
2	KCH-10	KCH	Samaki Meanchey	Chrokhthnout-Chrok Sdach	High	T2	8.9
3	KCH-4	KCH	Rolea Bi'er	NR5-Prek Sala	High	T2	8.2
4	KCH-1	KCH	Rolea Bi'er	Srang Kpuos-Kol Kup	High	T1	4.3
5	KCH-12	KCH	Teuk Phos	Tbeng Kpous-Ronak	-	T2	12.4
6	KCH-3	KCH	Rolea Bi'er	NR5-Damnak Kei	High	T2	7.1
7	KCH-8	KCH	Boribo	Trapaing Chan-Teuk Chreaop	-	T2	12.2
8	KCH-9	KCH	Samaki Meanchey	Meanok-Trapaing Mtes	High	T2	8.8
9	KCH-6	KCH	Rolea Bi'er	Phum Thmey-Trapaing Kravan	-	T3	11.3
10	KCH-11	KCH	Samaki Meanchey	Srae Sar- Ksach Sor	-	T2	12.7
11	KCH-2	KCH	Rolea Bi'er	Kosomak-O'Loy	High	T2	9.1

Source: JICA Survey Team

Table 3.3-16 Prioritization of PS

Rank	Target Roads	Provinces	Districts	Rural Road	Evaluation of M/P	Road Type	Road Length
							(km)
1	PS-11	PS	Kandieng	ToulCha- Keo Mony	High	T1	15.0
2	PS-2	PS	Bakan	O'Tapong-Phum Tanai	High	T1	18.2
3	PS-14	PS	Krakor	Sna Ansa-Anlong Tnaot	High	T1	10.3
4	PS-3	PS	Bakan	Plov Andongkrasaing-Tram Pae	High	T1	17.6
5	PS-5	PS	Bakan	Plov Phum Svay Daun Keo-Chrop-Phum Slor Klouk	High	T1	12.9
6	PS-4	PS	Bakan	Phnov-Phteah Pring	High	T1	12.2
7	PS-12	PS	Krakor	Kanchhor-Kampong Pou	-	T2	5.0
8	PS-13	PS	Krakor	Ou Sandan- Sna Ansa	High	T1	6.5
9	PS-15	PS	Krakor	Anlong Tnaot	Medium	T2	3.9
10	PS-10	PS	Phnum Kravanh	Son Trae-Chher Tum	High	T1	11.8
11	PS-8	PS	Krakor	Rolus	High	T1	8.8
12	PS-6	PS	Krong Pursat	Plov Wat Toul Veng	High	T1	9.7
13	PS-9	PS	Krakor	Tbaeng Chrum-Raa Toteng Thngai	High	T1	11.2

Source: JICA Survey Team

Table 3.3-17 Prioritization of BTB

Rank	Target Roads	Provinces	Districts	Rural Road	Evaluation of M/P	Road Type	Road Length
							(km)
1	BTB-8	BTB	Moung Russei	NR5 O'Kreat-Ba Sak	High	T1	18.0
2	BTB-6	BTB	Samlaut	Plov 1577 Phum O'Chrab-O'Bok Pael (Phum Sam Loat)	Medium	T1	17.0
3	BTB-1	BTB	Thmar Kaul	NR57-Phum Boeung Krar Sal	High	T2	15.0
4	BTB-2	BTB	Thmar Kaul	Sneung NR57-Beoung Praey	High	T2	18.2
5	BTB-9	BTB	Kamrieng	NR59-Phum O' Teuk tla	-	T3	18.2
6	BTB-4	BTB	Thmar Kaul	NR5 (Phasar O'Nhor)-Phum Poa Ta Sek	-	T3	16.1
7	BTB-3	BTB	Thmar Kaul	NR5 Phum Beoung Prieng-Wat ROUNG Chrey	High	T2	10.6
8	BTB-7	BTB	Moung Russei	NR5 Rar Cham Heang-Khum Muk Rar	High	T1	16.2

Source: JICA Survey Team

Table 3.3-18 Prioritization of BMC

Rank	Target Roads	Provinces	Districts	Rural Road	Evaluation of M/P	Road Type	Road Length
							(km)
1	BMC-2	BMC	Mongkol Borei	Plov Balang Chrey	High	T2	24.1
2	BMC-3	BMC	Phnum Srok	Spean Sraeng	High	T1	24.0
3	BMC-6	BMC	Tmar Puok	Plov Sre L'or	Medium	T2	18.6
4	BMC-5	BMC	Svay Chek	Plov Tae Hang	High	T1	25.0
5	BMC-7	BMC	Svay Chek, Tmar P	Rolus-Phum Tmey	Medium	T2	14.1
6	BMC-4	BMC	Phnum Srok	Ta Phou	High	T1	29.0

Source: JICA Survey Team

3.4 Study of Road Improvement Plan

3.4.1 Study of Road Improvement Specifications

(1) Design Standard

The “Rural Road Standards” (MRD, 2013), prepared for rural road improvement were adopted as the road improvement standards. If an item is not included in this standard, the “Road Design Standard” of the Kingdom of Cambodia (MPWT, 2003) is to be used.

This standard classifies rural roads into five categories, RR1-RR5, as shown in the table, and specifies the width, design speed, and road geometric structure for each class. Table 3.4-1 shows the design classification and Table 3.4-2 to Table 3.4-5 show the geometric design standards for each class.

Table 3.4-1 Design Classification of Rural Roads

Class	Traffic Volume	Carriageway Width (m)	Sub-Class		Shoulder (m)	Total Width (m)
RR1	200 to 500	6.0	A	> 300pcu	1.5	9.0
		6.0	B	< 300pcu	1.0	8.0
RR2	100 to 200	5.0	A	> 300pcu	1.5	8.0
		5.0	B	< 300pcu	1.0	7.0
RR3	30 to 100	3.5	A	> 300pcu	1.5	6.5
		3.5	B	< 300pcu	1.0	5.5
RR4	5 to 30	3.0	A	> 300pcu	1.0	5.0
		3.0	B	< 300pcu	0.75	4.5
RR5	< 5	2.5	A	> 300pcu	1.0	4.5
		2.5	B	< 300pcu	0.75	4.0

Source: Rural Road Standards

Table 3.4-2 Geometric Design Standard (RR1 ADT200–500)

Design Parameter	Comments	Definition		
Carriageway width		6.0m		
Shoulder width	Depends on number of non-4-wheeled vehicles	>300 PCUs 1.5m <300 PCUs 1.0m		
Design speed	Defined by terrain	Flat 60 km/h	Rolling 50 km/h	Mountainous 40 km/h
Maximum gradient	A limit of 6% for gravel	6%	8%	10% (1)
Stopping sight distance (m)	Gravel	93	70	50
	DBST	72	55	40
Minimum horizontal curve radius SE=4% (m)	Gravel (2,3) recommended	165	110	67
	DBST	150	70	60
Minimum horizontal curve radius SE=7% (m)	Gravel (2,3)	150	100	60
	DBST	112	70	40
Minimum value of L/G for vertical curves	Gravel (2)	20	11	6
	DBST	12	7	4
Sag	Gravel or DBST	3.5	2.2	1.3
Cross fall	Gravel (see notes 2,3)	6%		
	DBST	4%		

1) Gradients up to 15% permitted in cases where lower gradients would incur excessive earthworks and construction cost and where lengths of alignment 10% are kept to 300m.

2) Gravel surfaces are not usually suitable for this traffic level.

3) Gravel cross-fall must be maintained at between 4 and 6%.

Source: Rural Road Standards

Table 3.4-3 Geometric Design Standard (RR2 ADT 100–200)

Design Parameter	Comments	Definition		
Carriageway width		5.5 m		
Shoulder width	Depends on number of non-4-wheeled vehicles	>300 PCUs 1.5 m <300 PCUs 1.0 m		
Design speed	Defined by terrain	Flat	Rolling	Mountainous
		50 km/h	40 km/h	30 km/h
Maximum gradient	A limit of 6% for gravel	6%	8%	10% (1)
Stopping sight distance (m)	Gravel	70	50	35
	DBST	55	40	30
Minimum horizontal curve radius SE=4% (m)	Gravel (2,3) recommended	110	67	35
	DBST	97	60	32
Minimum horizontal curve radius SE=7% (m)	Gravel (2,3)	100	60	30
	DBST	70	40	20
Minimum value of L/G for vertical curves	Gravel (2)	12	6	3
	DBST	7	4	2
Sag	Gravel or DBST	2.2	1.3	0.7
Cross fall	Gravel (see notes 2,3)	6%		
	DBST	4%		

1) gradients up to 15% permitted in cases where lower gradients would incur excessive earthworks and construction cost and where lengths of alignment 10% are kept to 300m.

2) gravel surfaces are not usually suitable for this traffic level.

3) gravel cross-fall must be maintained at between 4 and 6%.

Source: Rural Road Standards

Table 3.4-4 Geometric Design Standard (RR3 ADT 30–100)

Design Parameter	Comments	Definition		
Carriageway width		3.5 m		
Shoulder width	Depends on number of non-4-wheeled vehicles	>300 PCUs 1.5 m <300 PCUs 1.0 m		
Design speed	Defined by terrain	Flat	Rolling	Mountainous
		50 km/h	40 km/h	30 km/h
Maximum gradient	A limit of 6% for gravel	6%	8%	10%
Stopping sight distance (m)	Gravel	70	50	35
	DBST	55	40	30
Minimum horizontal curve radius SE=4% (m)	Gravel (2,3) recommended	110	67	35
	DBST	97	60	32
Minimum horizontal curve radius SE=7% (m)	Gravel (2,3)	100	60	30
	DBST	70	40	20
Minimum value of L/G for vertical curves	Gravel (2)	12	6	3
	DBST	7	4	2
Sag	Gravel or DBST	2.2	1.3	0.7
Cross fall	Gravel (see notes 2,3)	6%		
	DBST	4%		

1) gradients up to 15% permitted in cases where lower gradients would incur excessive earthworks and construction cost and where lengths of alignment 10% are kept to 300m.

2) gravel surfaces are not usually suitable for this traffic level.

3) gravel cross-fall must be maintained at between 4 and 6%.

Source: Rural Road Standards

Table 3.4-5 Geometric Design Standard (RR4 ADT 5-30)

Design Parameter	Comments	Definition		
Carriageway width		3.5 m		
Shoulder width	Depends on number of non-4-wheeled vehicles	>300 PCUs 1.5 m <300 PCUs 1.0 m		
Design speed	Defined by terrain	Flat	Rolling	Mountainous
		50 km/h	40 km/h	30 km/h
Maximum gradient	A limit of 6% for gravel	6%	8%	10%
Stopping sight distance (m)	Gravel	70	50	35
	DBST	55	40	30
Minimum horizontal curve radius SE=4% (m)	Gravel (2,3) recommended	110	67	35
	DBST	97	60	32
Minimum horizontal curve radius SE=7% (m)	Gravel (2,3)	100	60	30
	DBST	70	40	20
Minimum value of L/G for vertical curves	Gravel (2)	12	6	3
	DBST	7	4	2
Sag	Gravel or DBST	2.2	1.3	0.7
Cross fall	Gravel (see notes 2,3)	6%		
	DBST	4%		

1) gradients up to 15% permitted in cases where lower gradients would incur excessive earthworks and construction cost and where lengths of alignment 10% are kept to 300m.

2) gravel surfaces are not usually suitable for this traffic level.

3) gravel cross-fall must be maintained at between 4 and 6%.

Source: Rural Road Standards

This standard also specifies pavement design, which allows pavement thickness to be determined from traffic volumes according to the CBR value of the subgrade of the existing road.

Table 3.4-6 shows the specified values for pavement thickness in this standard.

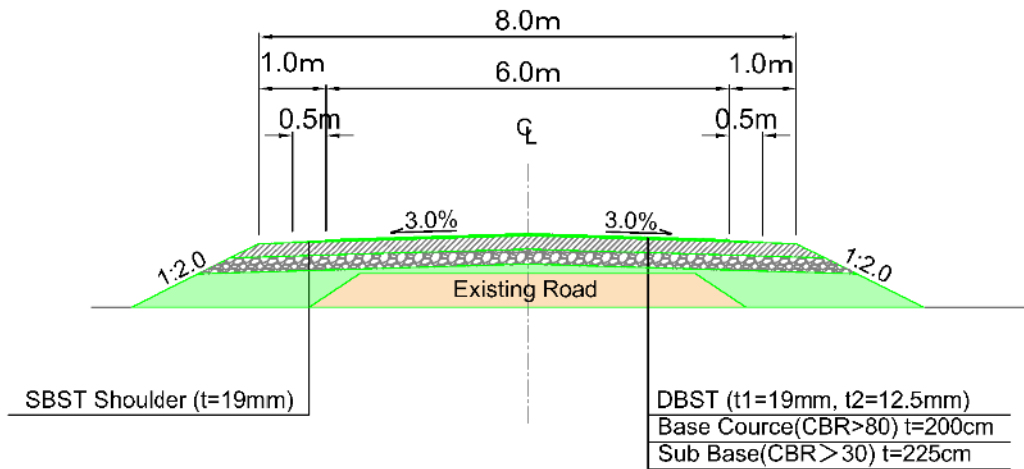
Table 3.4-6 Pavement Thickness based on CBR of Subgrade and Traffic

Subgrade CBR (%)	Layer	Cumulative traffic in mesa					
		0.02	0.05	0.10	0.3	0.5	1.3
2	Surface	DBST					
	Road base (mm)	125	150	150	150	150	200
	Sub-base (mm)	150	150	150	200	200	225
	Fill (mm)	200	225	250	300	350	325
3-4	Surface	DBST					
	Road base (mm)	125	125	150	150	150	200
	Sub-base (mm)	125	150	150	200	200	225
	Fill (mm)	150	175	150	200	250	225
5-7	Surface	DBST					
	Road base (mm)	125	125	125	125	150	175
	Sub-base (mm)	100	125	150	150	150	175
	Fill (mm)	75	100	100	100	175	175
8-14	Surface	DBST					
	Road base (mm)	125	125	125	150	150	175
	Sub-base (mm)	100	125	150	175	200	225
15-29	Surface	DBST					
	Road base (mm)	100	100	125	150	150	175
	Sub-base (mm)	75	100	100	100	125	150
> 30	Surface	DBST					
	Road base (mm)	100	100	125	150	150	175

Source: Rural Road Standards

(2) Typical Cross-Sections

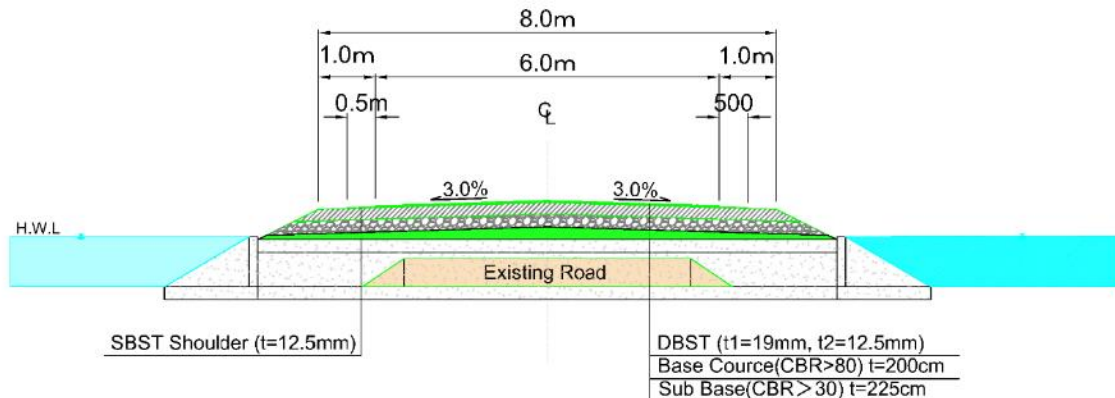
The typical cross-sections for the road improvements were adopted in consideration of the Rural Road Master Plan and past RRIP III results, as shown in Figure 3.4-1 and Figure 3.4-2. This width is equivalent to the RR1-B class width shown in the “Rural Road Standards”.



Source: JICA Survey Team

Figure 3.4-1 Typical Cross-Section

Crossing pipes will be installed in flooded areas.



Source: JICA Survey Team


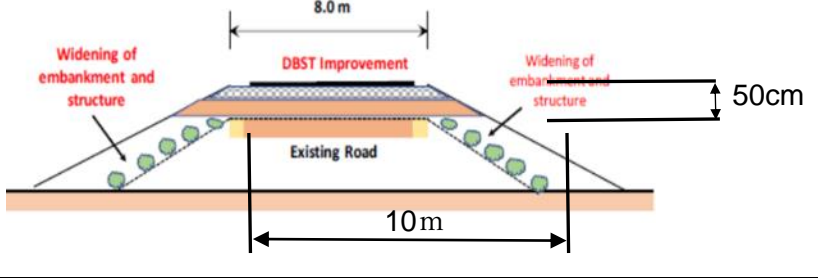

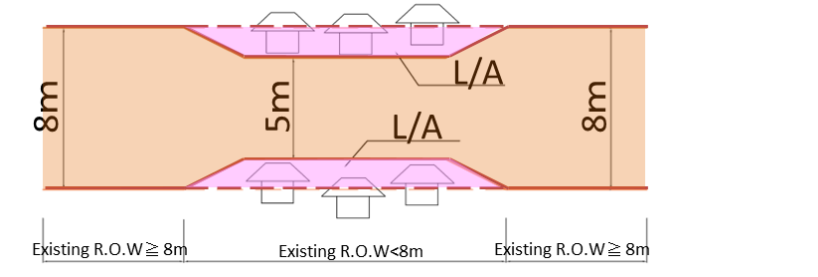

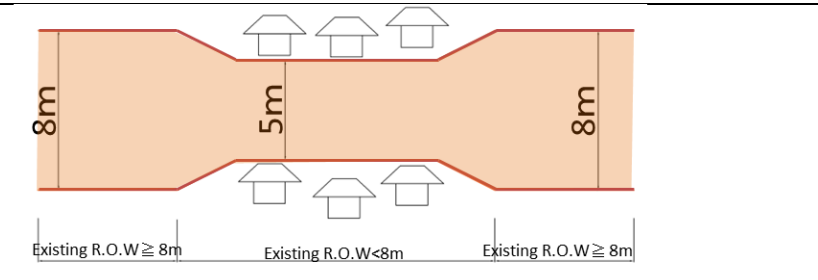
Figure 3.4-2 Typical Cross-Sections of Flooded Areas

(3) Improvement Policy

1) Road Improvement Classification

Road improvement classifications were determined by whether it was easy to acquire land for the road or not. The improvement classification is shown in Table 3.4-7.

Table 3.4-7 Improvement Classification

Improvement Classification	Photo of Existing Road	Image
<p>Typical Improve the road with the width of the typical cross-sections (8.0 m). A new roadbed of 6.0 m and DBST pavement will be laid over the existing road. The shoulders are 1.0 m in length, of which 0.5 m is to be paved with SBST¹⁰ (on both sides). The road will be raised by 50 cm, and the land will need 10 m between embankment slopes on the flat area.</p>		
<p>Alternative-1 Acquire a site and improve it with the width of the typical cross-sections (8.0 m). This is an improvement classification where the existing road width is less than 8.0 m, and the roadside is wooden fences of houses, cropland, etc.; where it is easy to acquire land for the improvement.</p>		
<p>Alternative-2 Improvement by width that can be constructed. This is an improvement classification where the existing road width is less than 8.0 m and the roadside is adjacent to buildings, concrete walls, rice fields or canal, and it is difficult to acquire land for the improvement.</p>		

Source: JICA Survey Team

¹⁰ Single Bituminous Surface Treatment : SBST

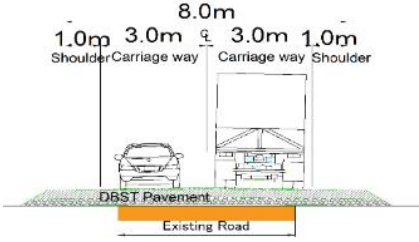
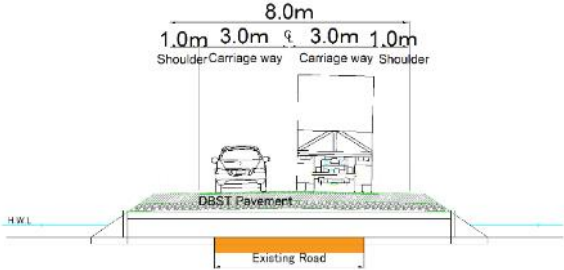

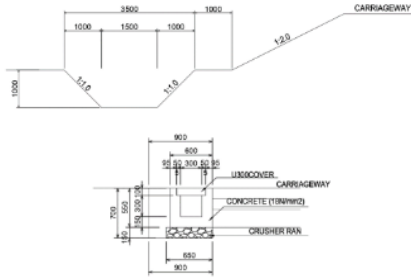
2) Improvement Policy for Flooded Areas

In areas that have flooded in the past, field interviews survey and other surveys revealed that they flood every year.

If the road is improved following the typical cross-section, the road will be raised approximately 50 cm above the existing road surface, so that the road surface will be higher than the flood level in areas where the flood level is less than 50 cm.

In areas where flood levels of 50 cm or more, the following improvement policies were adopted to avoid pavement damage due to flooding of the road surface. For the inundation area of Tonle Sap Lake, a flood level MSL+10.0 m is used as reference.

Table 3.4-8 Improvement Policy for Flooded Areas

Classification by Flooded Level	Improvement Image
<p>Flooded level is less than 0.5 m: Construct a new sub-base on top of the existing road with a typical cross-section (raised approximately 50 cm).</p>	
<p>Flooded level is between 0.5 m to 1.5 m: Construct crossing pipe culverts on the ground (raised approximately 150 cm, with one crossing pipe every 500 m).</p>	
<p>Flooded level is 1.5 m or more: The pavement shall be concrete pavement that can withstand overflow without being raised.</p>	
<p>The ditch structure in the flooded area: <ul style="list-style-type: none"> • Typical or Alt-1 section is earthen ditch • New U-ditch with cover will be installed on both sides of the road in the Alt-2 section </p>	

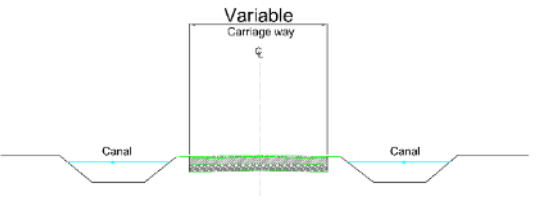
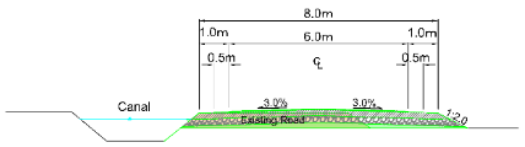
Source: JICA Survey Team

3) Improvement Classification near Irrigation Canals

There are some irrigation canals adjacent to the target road. Since the management of irrigation canals is not under the control of MRD, and changes in the users and management classification of irrigation canals are expected to have a significant impact on the progress of the project, it was decided to avoid road improvements that would involve modification of the existing canals.

The policy was to determine the improvement category according to the location of the existing irrigation canal and the target road, as shown in Table 3.4-9.

Table 3.4-9 Improvement Classification when Adjacent to an Existing Irrigation Canal


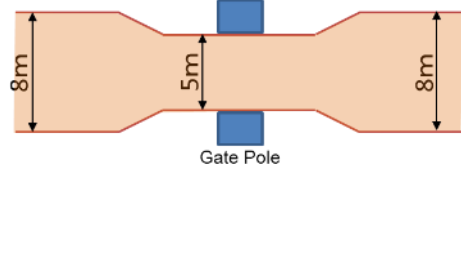

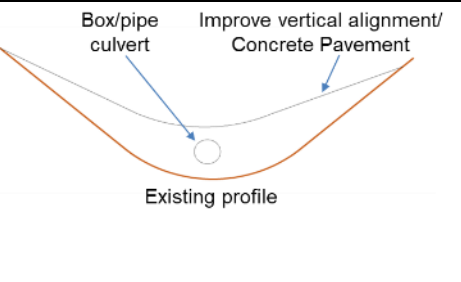

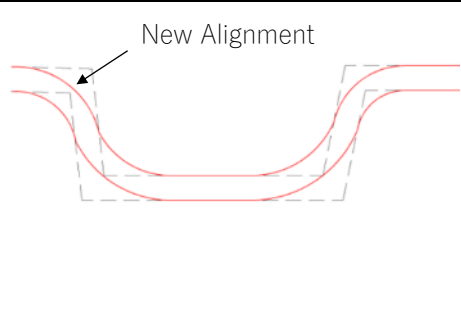
Improvement Classification by Irrigation Canal	Image
<p>If there are existing irrigation canals on both sides of the target road. Adapt Alternative-2.</p>	 <p>The diagram shows a cross-section of a road with a central 'Variable Carriage way' of width ϕ. On either side of the carriage way is a 'Canal'. The road surface is shown with a central raised section and sloping sides.</p>
<p>If there is an existing irrigation canal on one side of the target road. The policy is to improve the road on the opposite side of the existing irrigation canal and adapt Typical or Alternative-1.</p>	 <p>The diagram shows a cross-section of a road with a central 'Carriage way' of 6.0m width and 1.0m shoulders on both sides, for a total width of 8.0m. The carriage way width is labeled ϕ. The road surface has a 3.0% slope on both sides. On the left side, there is an existing 'Canal'. The road is labeled 'Existing Road' and has a 1:2.0 slope on the right side.</p>

Source: JICA Survey Team

4) Policy on Other Improvements

After the road condition survey was completed, the issues identified were discussed with MRD and an improvement policy was determined, as shown in Table 3.4-10.

Table 3.4-10 Policy on Other Improvements

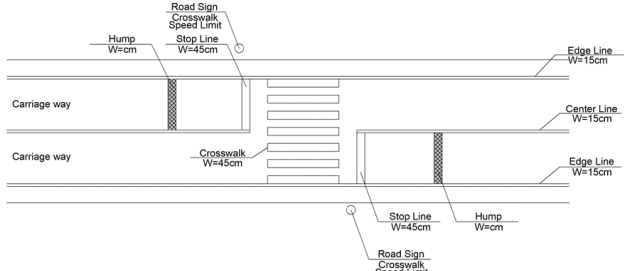
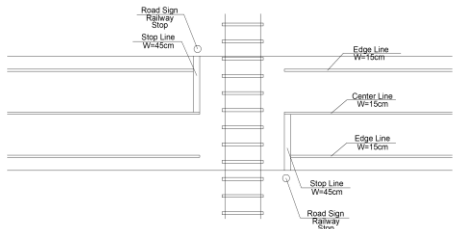
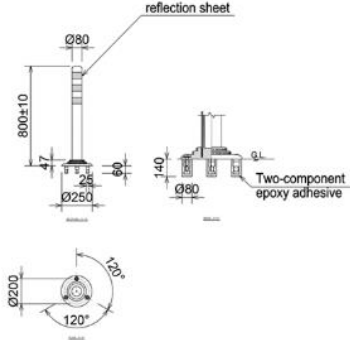

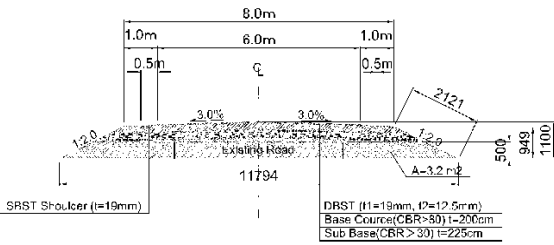
Item	Photo of Existing Road	Concept
<p>Pagoda Gate Since it is difficult to relocate/repair, improve in width, construction will be done where possible</p>		
<p>Vertical alignment In sections where the vertical alignment is wavy and flooded, the vertical alignment should be improved by raising the height of the lower section and, for instance, installing a pipe culvert.</p>		
<p>Horizontal alignment In sections with a series of small curve radius or where the alignment is broken and there is room for R.O.W., plane alignment improvements should be improved by increasing the curve radius, etc.</p>		

Source: JICA Survey Team

5) Improvement Policy for Safety Facilities and Pavements

Improvement policy for safety facility and pavement is shown in Table 3.4-11.

Table 3.4-11 Improvement Policy for Safety Facilities and Pavement

Item	Image
<p>Crosswalks: Crosswalks will be installed front of schools, pagodas, and medical facilities along the road. In addition, road markings and road signs will be installed for safety reasons, as well as humps for speed control.</p>	 <p>The diagram illustrates a crosswalk layout on a two-lane road. It shows a hump with width 'W=cm' and a stop line with width 'W=45cm'. A road sign for 'Crosswalk Speed Limit' is positioned above the stop line. The road markings include a center line (W=15cm) and edge lines (W=15cm). The crosswalk itself is marked with a width of 'W=45cm'.</p>
<p>Railway crossings: Railway crossings will be installed at the crossing points with railways. Road markings and road signs shall be installed for safety reasons.</p>	 <p>The diagram shows a road crossing over railway tracks. It features stop lines with a width of 'W=45cm' on both sides of the tracks. Road signs for 'Railway Stop' are placed at the crossing. The road markings include a center line (W=15cm) and edge lines (W=15cm).</p>
<p>Post cones: Post cones (rubber type) for visual guidance purposes will be installed at the front and rear sections of the bridge and at both ends of the box culverts and pipe culverts.</p>	 <p>The technical drawing shows a post cone with a height of 800±10 mm and a diameter of Ø80 mm. It includes a reflection sheet at the top and is secured with two-component epoxy adhesive. The base has a diameter of Ø250 mm. The drawing also shows a top view with a 120-degree angle and a 170 mm diameter.</p>
<p>Road signs: In addition to road signs to be installed at pedestrian crossings and railroad crossings, road signs considered necessary for traffic safety should be installed. Warning signs are installed to alert the presence of a crossing road at the connection between the Typical section and Alternative-2, where the width narrows due to bridges, and in front of the crossing road.</p>	 <p>Three photographs show different road signs: a red octagonal stop sign with Burmese text, a yellow diamond-shaped pedestrian crossing sign, and a yellow diamond-shaped warning sign for a narrow road.</p>
<p>The thickness of sub-base and base course layers: The pavement thickness under the DBST pavement is of 200 mm for base course and 225 mm for sub-base, assuming subgrade CBR of 3% and adapting a cumulative traffic volume of 1.3. The thickness of sub-base and base course layers already constructed in RRIP III are also equal in most sections.</p>	 <p>The cross-section diagram shows a road pavement structure with a total width of 8.0m. It includes a 1.0m wide shoulder on each side. The pavement layers are: DBST (H1=19mm, H2=12.5mm), Base Course (CBR>80) with a thickness of 200mm, and Sub Base (CBR>30) with a thickness of 225mm. The subgrade has a CBR of 3%. The diagram also shows a 3.0% slope and a 2.12% slope. The road width is 6.0m, and the shoulder width is 0.5m. The diagram also shows a 11794 traffic volume and a 3.2m slope.</p>

Source: JICA Survey Team

(4) Policies for Installation and Improvement of Bridges and Culverts

Existing bridges and culverts were surveyed to determine the requirement for repairs and improvements. Survey results will be reflected in the project plan.

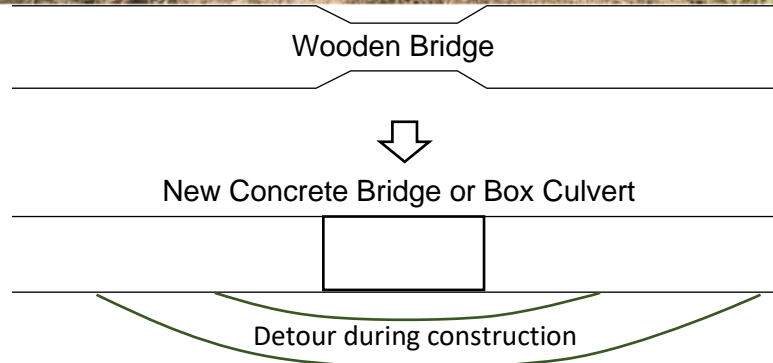
1) Improvement Policy for Bridges

Based on the survey results, no major damage was found on the existing concrete and steel bridges, and although some of the bridges were less than 8.0 m wide, it was determined that there was no need for emergency repair/improvement.

As for the wooden bridges, all bridges were found to be less than 8.0 m wide, and their floor slabs and piers were also made of wood and found to be deteriorated.

Improvement policy

- If the existing bridge is a wooden bridge, it shall be basically replaced, and according to its scale, it shall be changed to box culvert or concrete bridge.
- If the existing bridge is a concrete or steel bridge, "without improvement" shall be used.



Note: Concrete bridges are not improved

Source: JICA Survey Team

Figure 3.4-3 Detour during Construction

2) Improvement Policy for Culvert

Based on the survey results, it was determined that the existing box culvert was cast-in-place concrete, and the pipe culvert was centrifugal reinforced concrete pipe.

Based on the above, improvement policies for the culvert were determined as follows.

Improvement Policy

< Existing Box Culvert >

If the length is more than 8.0 m, it shall be classified as “no improvement”.

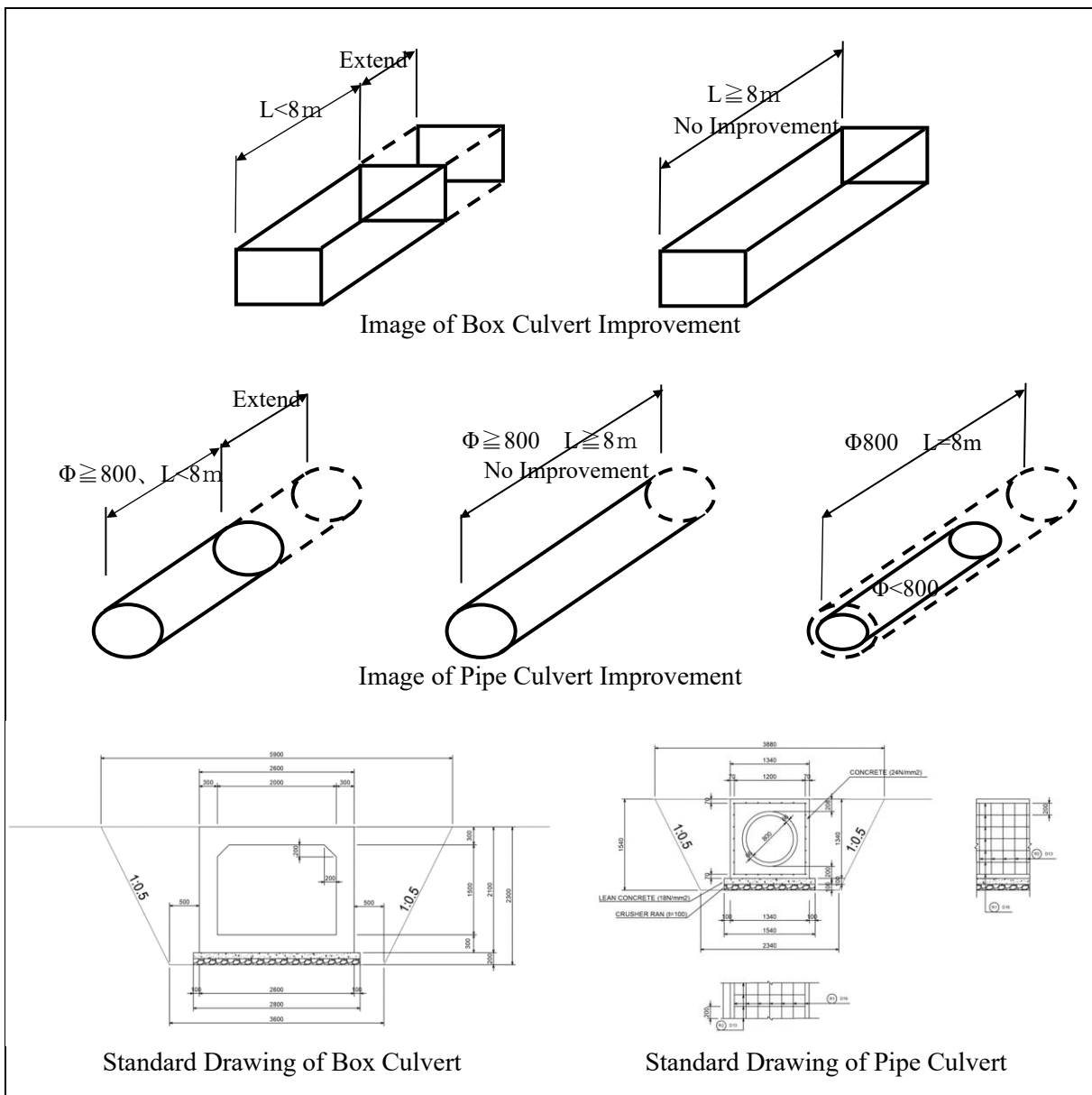
If the length is less than 8.0 m, the length shall be extended to 8.0m with the existing cross-section.

< Existing Pipe Culvert >

If the pipe diameter is $\Phi 800$ or more and the length is 8.0 m or more, it shall be classified as “no improvement”.

If the pipe diameter is $\Phi 800$ or more and the length is less than 8.0 m, the length shall be extended 8.0 m with the existing cross-section.

If the diameter is less than $\Phi 800$, it shall be changed to a $\Phi 800$ pipe.



Source: JICA Survey Team

Figure 3.4-4 Box and Pipe Culvert Improvement Concept and Standard Drawings

(5) Quantity Calculation Policy

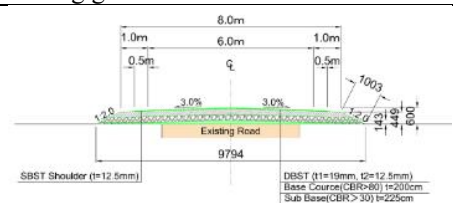
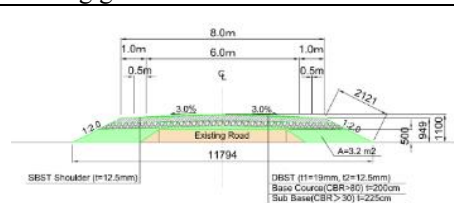
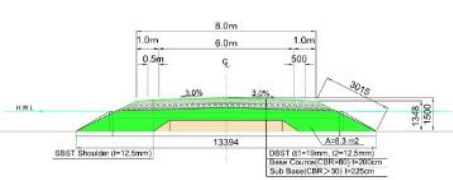
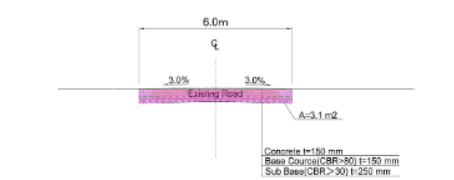
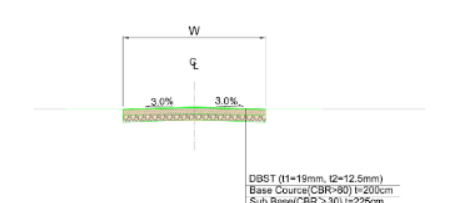
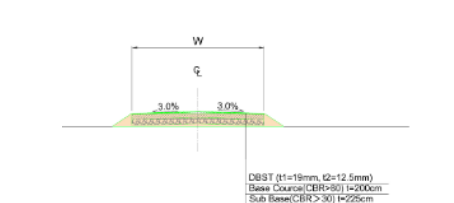
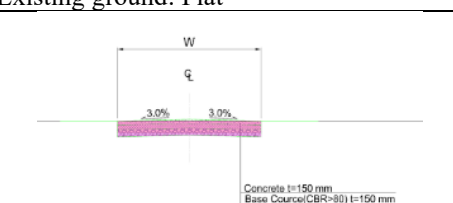
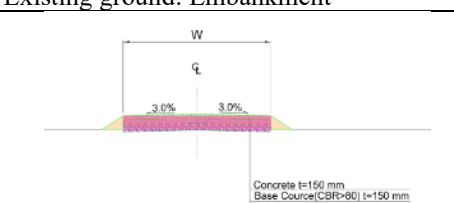
The following quantity calculation policy was adopted to reflect the improvement policy and the policies for installation and improvement of bridges and culverts, which will provide a more precise estimate of the project cost.

- Calculation of quantities for earthwork section

The earthwork classification was established considering that the quantity of embankment is different depending on the improvement classification and the flooded level.

The earthwork classifications were classified into 9 types, A-1 to E, depending on the shape of the existing road as shown below.

Table 3.4-12 Earthwork Classifications

Type of Earthwork	A-1 Type	A-2 Type
Summary	Improvement type: Typical or Alt-1 Flooded level: H.W.L ≤ 50cm Existing ground: Flat	Improvement type: Typical or Alt-1 Flooded level: H.W.L ≤ 50cm Existing ground: Embankment
Image		
Type of Earthwork	B Type	C Type
Summary	Improvement type: Typical or Alt-1 Flooded level: 50 < H.W.L ≤ 150cm	Improvement type: Typical or Alt-1 Flooded level: H.W.L > 150cm
Image		
Type of Earthwork	D-1 Type	D-2 Type
Summary	Improvement type: Alt-2 Flooded level: H ≤ Existing ground Existing ground: Flat	Improvement type: Alt-2 Flooded level: H ≤ Existing ground Existing ground: Embankment
Image		
Type of Earthwork	D-3 Type	D-4 Type
Summary	Improvement type: Alt-2 Flooded level: H > Existing ground Existing ground: Flat	Improvement type: Alt-2 Flooded level: H > Existing ground Existing ground: Embankment
Image		

Type of Earthwork	E Type
Summary	Sliding Section
Image	

Source: JICA Survey Team

- Structure quantity
Calculate the improvement lengths according to improvement policies for bridges, box culverts, and pipe culverts
- Drainage quantity
Calculate the length of earth ditches and U-ditches with covers installed.
- Traffic safety facilities quantity
Calculate the number of crosswalks, railway crossings, and guard posts to be installed

3.4.2 Project Cost

(1) Study on MRD's Cost Estimation

Before starting the cost estimation for the project, the JICA Survey Team surveyed the cost estimation of MRD. Cost estimation for MRD projects is carried out as follows:

- MRD's own fund projects: estimated by MRD Standard Estimation Format (Excel)
- Foreign (ADB, etc.) loan projects: estimated by procured consultants

Features of MRD Standard Estimation are as follows:

- The format is developed by MRD, and it has no relation with MPWT's estimation.
- The format is not applied to foreign loan projects, such as ADB's projects
- The format is meant to be for contracts with PDRD, the Army, and private local contractors
- Cost estimation structure of the format is classified as follows:
 - Material cost
 - Labour cost
 - Miscellaneous (indirect cost, machinery cost, miscellaneous structures' cost)
 - Cost for machine/equipment, operator, fuel, and other related costs are unclear
 - Labor costs are assumed to be as direct hire of farmers, PDRD's employees, or soldiers
 - Contractor's indirect costs (overhead, profit, site office, direct supporting costs) are unclear

(2) Estimate Condition

The cost estimation for the project was executed by JICA Survey Team's own methodology, not MRD's standard cost estimation. Construction Cost and Consultant Cost by the JICA Survey Team were prepared as a base cost basis. The table below shows the estimate condition.

Table 3.4-13 Estimate Condition (Confidential)

(3) Packaging

Confidential

(4) Estimation of Construction/Procurement Costs

Basic unit prices (materials, laborers, machines) were determined by the JICA Survey Team, collecting quotations, and by surveying the "NR5 Improvement Project" and other former projects.

Work performance/progresses were determined by JICA Survey Team, referring to data of MLIT, among other sources in Japan and DPWH (Department of Public Works and Highways) from the Philippines.

Considering the local competitive bidding, the indirect cost was estimated and determined by the JICA Survey Team referring to DPWH percentage and General Requirement items.

The cost of the dispute board was not included in the project cost because MRD will request a local board to settle conflicts.

The package costs (base cost) by each package are shown in Table 3.4-14.

Table 3.4-14 Package Costs (Base Cost) (Confidential)

(5) Estimation of Consultant Cost

Confidential

Table 3.4-15 Consultant Cost (Base Cost) (Confidential)

(6) Project Cost

Base costs of the construction, procurement, land acquisition costs are quoted by the JICA Survey Team. The consultant fee, physical contingency, and price contingency are calculated through JICA Cost Kit. The project cost shown in Table 3.4-16 is posted from JICA's Cost Kit.

Table 3.4-16 Project Cost (Confidential)

3.4.3 Project Implementation Schedule

Table 3.4-17 shows the project implementation schedule.

Table 3.4-17 Project Implementation Schedule (Confidential)

3.4.4 Construction Safety Measures and Traffic Management Plan during Construction

(1) Laws and Standards Applicable to the Construction Sector

The Law on Construction, the main law applicable to the construction sector, was enacted by the House of Representatives at the 3rd Plenary Session on October 7, 2019, and passed by the Senate on October 18, 2019. At the Fourth Extraordinary Meeting, the form and purpose of the meeting were confirmed and approved in its entirety, and the general provisions, as presented by JETRO-Cambodia Construction Law, are as follows:

- Building quality, security, safety, protection of property and welfare of building owners, building users and the public
- Beautiful and good environment for sustainable living to promote public welfare
- Responsibility and efficiency of labour and operations in the construction sector
- Improving investor confidence in the construction sector and promoting an economically and socially efficient real estate market

In addition, there are the following two standards as road-related design standards.

- Road Design Standard 2003: MPWT
- Rural Road Standard 2013: MRD

(2) Construction Safety Measures in Related Businesses

Safety measures for vehicles and pedestrians are required as safety measures in general road construction. Measures for vehicles are shown in the draft traffic management plan in Section 3 below, and measures for pedestrians include the installation of pedestrian passages, separate them from work areas with protective facilities, and installing the necessary signage and lighting facilities.

(3) Traffic Management Plan

Traffic management plans for road construction generally follow the methods described in the next section. Since the traffic volume of both vehicles and pedestrians on the target road is small, it is possible to implement traffic control measures such as detours depending on the situation.

- Alternate traffic on one side during road construction (set up a shelter if necessary)
- Installation of construction notices and traffic warning signs
- Installation of protective fences, safety cones, etc.
- Arrangement of traffic guides
- Installation of security at locations left unattended at night
- Set up detours and regulation/guidance signs when roads are closed

3.5 Procurement Plan

3.5.1 Laws and Standards Related to Procurement

Public Procurement in the Kingdom of Cambodia is governed by the Law on Public Procurement enacted on 14 January 2012. Under Article 3 of the Procurement Law, for the Development Partner (DP) financed projects procurement can follow the procurement guidelines and procedures of the DP as agreed in the Financing Agreement between the Royal Government of Cambodia (RGC) and the DP. This updated Standard Operating Procedures (SOP) on Procurement (referred to as “the Procurement Manual”)¹¹ is issued in compliance with the Law on Public Procurement (2012).

There are five primary procurement methods to procure goods and works under a project. These are:

- (a) International Competitive Bidding (ICB)
- (b) National Competitive Bidding (NCB)
- (c) Shopping (Request for Quotations (RfQ))
- (d) Limited Competitive Bidding (LCB)
- (e) Direct Contracting (DC).

Note: The methods of procurement for works excludes the Limited Competitive Bidding.

The thresholds provided for the different methods of procurement provided in Table 3.5-1 below will apply except where the RGC, represented by the MEF, and the DP have agreed to different thresholds.

This will be indicated in the Procurement Plan. In all cases, the thresholds specified in the approved Procurement Plan will apply.

Table 3.5-1 Indicative Goods Procurement Thresholds

Method	Threshold
International Competitive Bidding	Procurement above US\$1,000,000
Limited International Bidding	Procurement above US\$1,000,000. Only when specified in the project Procurement Plan or with a specific ‘no objection’ from the DP and MEF.
National Competitive Bidding	Procurement above US\$100,000 and up to US\$1,000,000.
Request for Quotations (Shopping) (With Advertising)	Procurement above US\$25,000 and up to US\$100,000.
Request for Quotations (Shopping) (Without Advertising)	Procurement up to US\$25,000.
Direct Contracting	No Threshold. Only when specifically stipulated in the project Procurement Plan or with ‘no objection’ by the DP and MEF on an exceptional basis.

Source: SOP

¹¹ Standard Operating Procedures on Procurement for All Externally Financed Project/Programs in Cambodia Updated Version: December 2019, Ministry of Economy and Finance

Table 3.5-2 Indicative Works Procurement Thresholds

Method	Threshold
International Competitive Bidding	Procurement above US\$3,000,000.
National Competitive Bidding	Procurement above US\$100,000 and up to US\$3,000,000.
Request for Quotations (Shopping) (With Advertising)	Procurement above US\$25,000 and up to US\$100,000.
Request for Quotations (Shopping) (Without Advertising)	Procurement up to US\$25,000.
Direct Contracting	No threshold. Only when stipulated in the project Procurement Plan or with 'no objection' from the DP and MEF on an exceptional basis.

Source: SOP

■ Major Requirement for ICB for Works

- The procurement under the ICB is advertised both nationally and internationally and is open to everyone who purchases the bidding document, referred to as the OCB with international advertising for works.
- The SBDs that are internationally recognized are used for the ICB. A number of DPs require the mandatory use of their SBD for the ICB and where this is the case, their SBD must be used.
- In case of large size or complex works procurement, a prequalification of Contractors is carried out prior to the bidding out the works contract. This is only used for procurement through the ICB.

■ Major Requirement for ICB for Goods

- The procurement under the NCB is nationally advertised in the English and Khmer language newspapers of national circulation and is open to all who purchase the bidding document, referred to as the OCB with national advertising for works.
- The NCB follows the national procedures of the Government and uses the Government national documentation.
- The NCB is generally used when the size of the contract is small and the procurement is unlikely to attract international competition, or when the domestic Contractor can offer better prices.
- However, it can be used for higher value contracts and this will be prescribed in the project Procurement Plan.
- All Bidders, both foreign and national are eligible to bid.
- The normal period for the availability of bidding documents is thirty (30) calendar days.

3.5.2 Review of Procurement Methods for Similar Projects

The procurement methods adopted in RRIP-II and RRIP-III funded by ADB are shown in Table 3.5-4 to Table 3.5-6. Major findings related to the procurement method and bidding results are listed below.

- Procurement method: ICB and NCB are applied to both projects. Open Competitive Bidding (OCB) with Single-Stage One-Envelope Bidding was adopted for all the packages.
- Successful bidder (RRIP-II): In the NCB, seven of the eight packages were awarded to Cambodian contractors, and only one package was awarded to a Chinese contractor. In the ICB, five of the 13 packages were awarded to JVs with Cambodian contractors participating (JV partners were mainly Chinese), four to Chinese contractors alone, two to Cambodian contractors alone, and one to Vietnamese contractors alone, indicating a higher percentage of successful bids by foreign firms than in the NCB (except for one package of unknowns).

- Successful bidder (RRIP-III): All bids for both ICB and NCB were awarded to Cambodian operators (except for one package of unknowns).
- Estimated value and threshold: In RRIP-II, ICB and NCB are clearly distinguished by the aforementioned threshold: USD 3,000,000, while in RRIP-III, two of the four NCB packages exceed the threshold.
- Bid qualification: The bid qualification in RRIP-III is shown in the Table 3.5-3.

Table 3.5-3 Key Qualification for Eligible Bidder in RRIP-III

Procurement method	Contract package	Estimated value	Minimum financial requirement		Minimum experience in similar contract in last years	Key experience	
			Average annual turnover	Financial resources		DBST pavement	Embankment and subgrade
NCB	CW-C1	4.7	4.7	0.6	3.8	148,000 m ² / 5 years	59,000 m ³
NCB	CW-C3	2.0	2.0	0.25	1.6	77,000 m ² / 5 years	28,000 m ³
ICB	CW-D	8.9	6.0	0.8	7.2	290,000 m ² / 10 years	109,000 m ³
ICB	CW-E	9.1	6.1	0.8	7.3	320,000 m ² / 10 years	122,000 m ³

Unit: USD million

Source: SOP edited by JICA Survey Team

Table 3.5-4 Procurement Method Adopted in RRIP-II (1)

Package	Road	Length (km)	Province	Estimated Value (USD)	Awarded Contract Value (USD)	Procurement Method	Advertisement Date (quarter/year)	Date of ADB Approval of Contract Award	Successful Bidder		
1. Awarded and Ongoing Contracts											
1	CW17	1	2.77	Kampong Speu	749,786	685,738	NCB	Q2 / 2020 (07 August 2020)	21-Dec-20	UMV Dev Co.,Ltd JV Ung Sim Sia Const'n Co.,Ltd	Cambodia
2	CW18	2	17.95	Kampong Thom and Tboung	2,317,294	2,159,952	NCB	Q2 / 2020 (07 August 2020)	22-Dec-20	Beng Meng Group Co.,Ltd.	Cambodia
3	CW19	3	29.39	Tboung Khmum	4,113,127	3,754,691	ICB	Q2 / 2020 (14 August 2020)	17-Feb-21	PS-USS Joint Venture	Unknown
4	CW20	3	7.18	Kampong Speu and Kampong	1,150,985	1,050,100	NCB	Q2 / 2020	1-Feb-21	Heng Sambat Co., Ltd. Import Export Transportation and Construction	Cambodia
5	CW3B (L1/L2)	5	61.9	Kampong Speu	4,569,212	4,487,830	NCB	Q4 / 2020 (26 February 2021)		Lot 1: 6 Stars Construction Co., Ltd; lot 2: Ung Sim Sia Construction Co., Ltd	Lot 1: Cambodia Lot 2: Cambodia
6	CW3-B	5	64.2	Kampong Speu	5,920,000	4,486,519	ICB	Q3 / 2017	19-Dec-17	Huong Giang Consultancy Investment and Construction Joint Stock Company	Vietnam
2. Completed Contracts											
7	CW2-A	2	34.8	Takeo	4,290,000	3,111,193	ICB	Q2 / 2016	25-Nov-16	Ung Sim Sia Construction Co., Ltd.. VO. No 1. 273,468.29 (Charge from contingency)	Cambodia
8	CW4-A	3	38.5	Kampong Chhnang	5,220,000	3,058,615	ICB	Q2 / 2016	25-Nov-16	Ung Sim Sia Construction Co., Ltd.. VO. No 1. 267,310.26 (Charge from contingency)	Cambodia
9	CW8		50	Mekong River Island roads and 11 jetties	13,280,000	8,204,258	ICB	Q2 / 2016	8-Dec-16	Joint Venture of Henan Water Construction Group Co., Ltd. and Heng Sambat Co., Ltd. VO No 1. 1,023,418.60 (Charge from contingency) VO No 2. 125,261.36 (Deduct from BOQ insert to contingency)	JV of China & Cambodia
10	CW1	9	193.9	Tboung Khmum	26,060,000	22,230,957	ICB	Q1 / 2016	20-Sep-16	Joint Venture of Xinjiang Beixin Road and Bridge Group Co., Ltd and Beng Meng Group Co., Ltd. VO. No 1. 812,489.39 (Charge from contingency) VO. No 2. 308,932.60 (Charge from contingency)	JV of China & Cambodia

Table 3.5-5 Procurement Method Adopted in RRIP-II (2)

Package		Road	Length (km)	Province	Estimated Value (USD)	Awarded Contract Value (USD)	Procurement Method	Advertisement Date (quarter/year)	Date of ADB Approval of Contract Award	Successful Bidder	
11	CW3-A	3	75.2	Kampong Speu	7,820,000	6,118,674	ICB	Q2 / 2016	25-Nov-16	SBPH Engineering and Cont. Co., Ltd. - Civil Engineering Cont. Corporation No. 1 JSC. VO. No 1 459,356.18 (Charge from contingency)	JV of Cambodia & Unknown
12	CW7-A	1	40	Kampong Thom	4,530,000	4,470,377	ICB	Q2 / 2016	8-Dec-16	Joint Venture of Tan Kim Eng Co., Ltd. and Xinjiang Beixin Road & Bridge Group Co., Ltd. VO. No 1. 193,320.43 (Charge from contingency)	JV of Cambodia & China
13	CW6-A	2	46.5	Siem Reap	5,110,000	5,441,235	ICB	Q2 / 2016	8-Dec-16	Joint Venture of Banteay Srei Engineering & Construction Co., Ltd. and Anhui Shuiian Construction (Cambodia) Co., Ltd. VO. No 1 (Only extension)	Cambodians' JV
14	CW13	1	6.4	Battambang	631,000	470,320	NCB	Q3 / 2017	28-Feb-18	HENG CHHAT Construction Co., Ltd. VO. No 1. 37,109.18 (Charge from contingency) VO No 2. 8,867.90 (Charge from contingency)	Cambodia
15	CW15	2	22.4	Takeo	2,120,000	1,694,649	NCB	Q4 / 2017	28-Feb-18	6 STARS Construction Co., Ltd.	Cambodia
16	CW14	2	22	Kampong	2,350,000	1,912,090	NCB	Q4 / 2017	28-Feb-18	Khmer Décor Construction Co., Ltd.	Cambodia
17	CW7-B	3	73.4	Kampong Thom	8,450,000	6,107,023	ICB	Q3 / 2017	2-Feb-18	Guangdong Provincial Changda Highway Engineering Co., Ltd.	China
18	CW2-B	5	47.2	Takeo	5,150,000	3,753,554	ICB	Q3 / 2017	2-Feb-18	Guangdong Provincial Changda Highway Engineering Co., Ltd	China
19	CW4-B	6	87.8	Kampong Chhnang	8,880,000	7,381,621	ICB	Q3 / 2017	19-Dec-17	Guangdong Provincial Changda Highway Engineering Co., Ltd. VO. No 1. 940,964.85 (Deduct from contingency 436,186.79)	China
20	CW6-B	4	79.7	Siem Reap	7,530,000	6,096,045	ICB	Q3 / 2017	2-Feb-18	Guangdong Provincial Changda Highway Engineering Co., Ltd	China
21	CW16	7	6.82	Tboung Khmum	2,050,762	1,852,228	NCB	Q2 / 2020 (07 August 2020)	10-Dec-20	Heng Sambat Co.,Ltd. ImpExp Transportation & Construction	China

Table 3.5-6 Procurement Method Adopted in RRIP-III

Package		Road	Length (km)	Province	Estimated Value (USD)	Awarded Contract Value (USD)	Procurement Method	Advertising		Date of ADB Approval of Contract Award	Successful Bidder		Bidders
1	CW-A	6	93.65	Kampong Cham	13,000,000	13,997,669	ICB	Q4 / 2019	International	3-Apr-20	Un Sim Sia Construction Co. Ltd.	Cambodia	Unknown
2	CW-B1	2	31.76	Tboung Khmoum	4,660,000	Unknown	ICB	Q1 / 2020	International	8-Jun-20	M.T.A	Unknown	Unknown
3	CW-B2	2	23.79	Tboung Khmoum	Unknown	2,481,668	NCB	27-Jun-18	National	12-Mar-19	Un Sim Sia Construction Co. Ltd.	Cambodia	Unknown
4	CW-C1	2	30.00	Preng Veng	4,700,000	4,362,869	NCB	5-Jun-20	National	18-Dec-20	Banteay Srei Engineering & Construction Co., Ltd.	Cambodia	All bidders were Cambodian.
5	CW-C2	2	28.10	Preng Veng	4,700,000	4,296,786	NCB	5-Jun-20	National	18-Dec-20	Banteay Srei Engineering & Construction Co., Ltd.	Cambodia	All bidders were Cambodian.
6	CW-C3	1	15.10	Preng Veng	2,000,000	1,966,836	NCB	5-Jun-20	National	7-Oct-20	Bore Khmer Construction Development Co., Ltd	Cambodia	All bidders were Cambodian.
7	CW-D	4	57.20	Svay Rieng	8,900,000	8,915,950	ICB	25-Mar-20	International	27-Jul-20	Tan Kim Eng Co., Ltd.	Cambodia	All bidders were Cambodian.
8	CW-E	1	61.23	Kratie	9,100,000	8,914,546	ICB	25-Mar-20	International	10-Aug-20	Beng Meng Group Co.,Ltd	Cambodia	One Chinese and four Cambodian.

3.5.3 Possibility of Participation by Japanese Companies

Interviews were conducted with the contractors of NR5 in Cambodia (Obayashi Corporation, Sumitomo Mitsui Construction, and World Development Industry), which is currently under construction, regarding the possibility of participation by Japanese firms.

Obayashi Corporation, Sumitomo Mitsui Construction, and World Development Industry all indicated that they were not willing to participate in the project, mainly for the following reasons:

- Cambodian firms are expected to participate in this project because it does not require advanced technical capabilities, and Japanese firms will have a low advantage in price competition.
- Since DBST paving has not been done in Japan, Japanese contractors have not accumulated sufficient experience, technology, and know-how related to DBST, and have no particular advantage in terms of technology.

3.5.4 Implementation Capacity of Local Companies

This project consists mainly of DBST pavements, and the bridges/structures are small in scale. Cambodian local firms have sufficient experience in construction of these works, and there are no particular problems in terms of implementation capacity.

3.5.5 Procurement Method

This project falls under the case where "the amount involved in the procurement is so small that foreign firms clearly would not be interested, or that the advantage of ICB would be outweighed by the administrative burden involved" as stated in Article 1.03 of JICA's "Guidelines for Procurement under Japanese ODA Loans."

The Cambodian SOP also states “NCB is normally used when the procurement is unlikely to attract foreign competition and the advantages of approaching the international market are clearly outweighed by the administrative and financial burden involved” and “NCB is generally used when the size of the contract is small or when the domestic Contractor can offer better prices.”

Therefore, in light of the considerations up to the previous section and the development of Cambodian domestic firms, it is considered desirable to apply NCB in this project.

3.5.6 Procurement Package

Through discussions with MRD, a draft procurement package was developed, taking into consideration the following points:

(Confidential)

(Note: the final procurement package will be decided at the detailed design stage based on the construction plan, cost estimation, land acquisition plan for each target road.)

Table 3.5-7 Proposed Package Plan (Confidential)

Figure 3.5-1 Location Map of Proposed Package (Confidential)

3.6 Project Implementation Structure

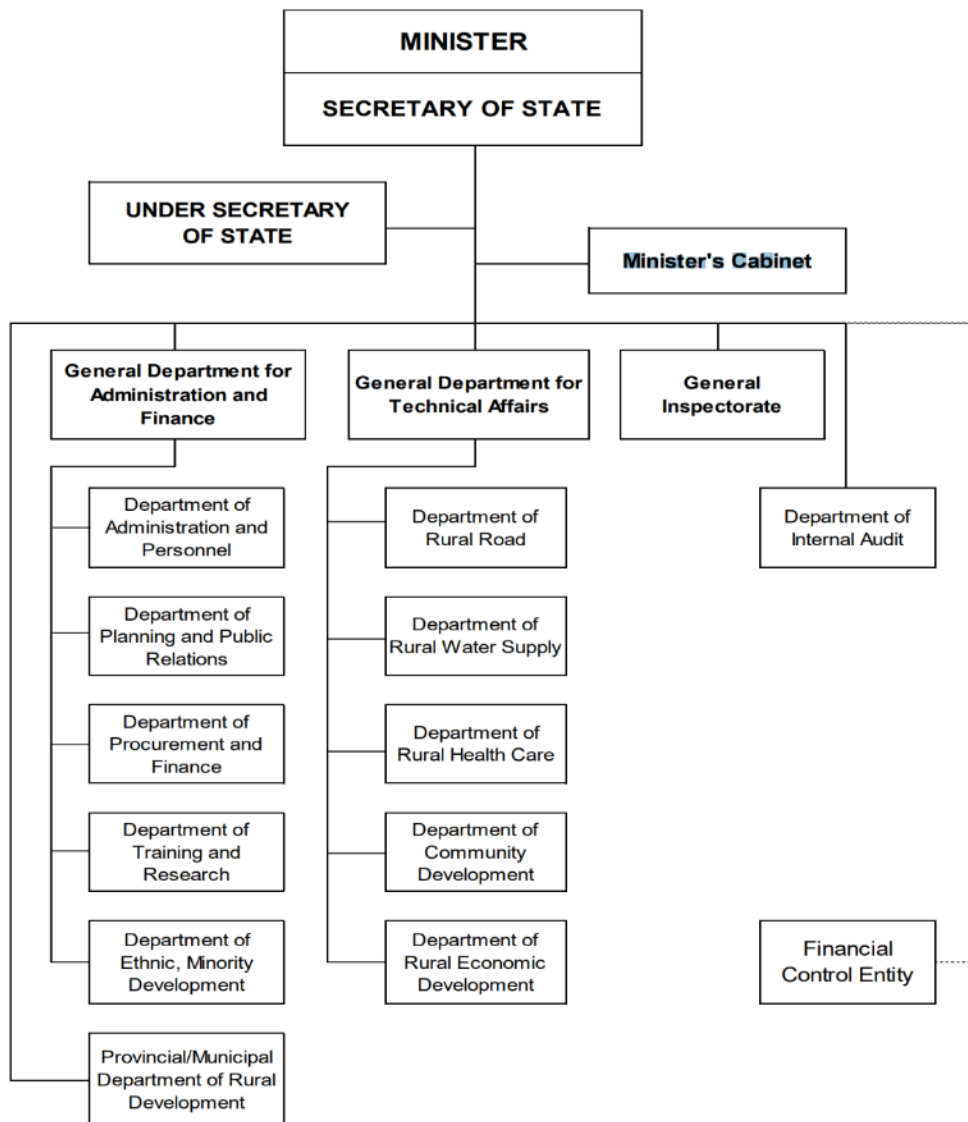
3.6.1 Current Organization System in MRD

The Ministry of Rural Development (MRD) was established by the laws of the Kingdom of Cambodia, promulgated by the Royal Decree No NS/RKM/0196/12 dated 25 January 1996. The overarching goal is defined as “MRD is responsible for promoting the improvement of social and economic conditions in rural areas.”

The Department of Rural Roads (DRR) is responsible for rural road development in MRD, and its primary role is defined as "DRR contributes to this goal by increasing access to rural areas through cost-effective investments in the maintenance and development of rural roads.

The Provincial/Municipal Department of Rural Development (PDRD) has been established as a provincial agency of MRD, and is responsible for the management of on-site engineers and construction equipment, as well as construction supervision.

Figure 3.6-1 to Figure 3.6-3 show the organizational chart of MRD, DRR, and PDRD, and Table 3.6-1 shows the legal status of each organization.



Source: MRD

Figure 3.6-1 Organization Chart of MRD

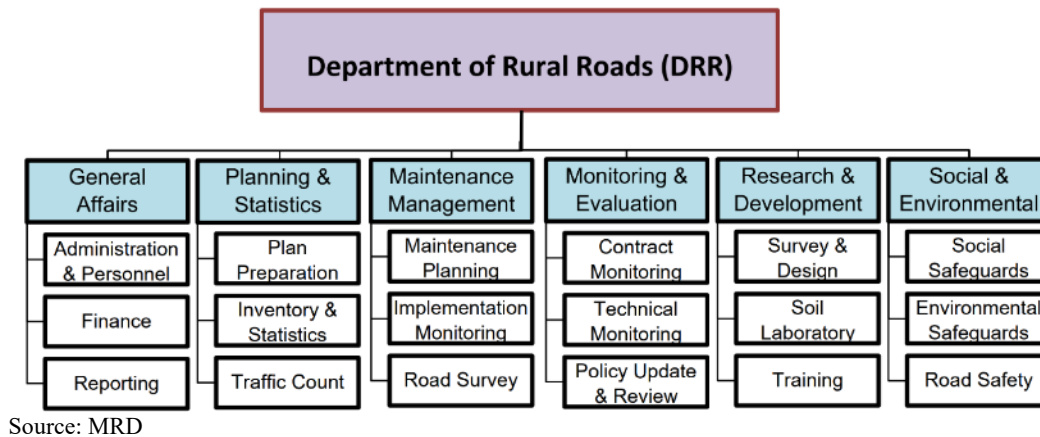


Figure 3.6-2 Organization Chart of DRR

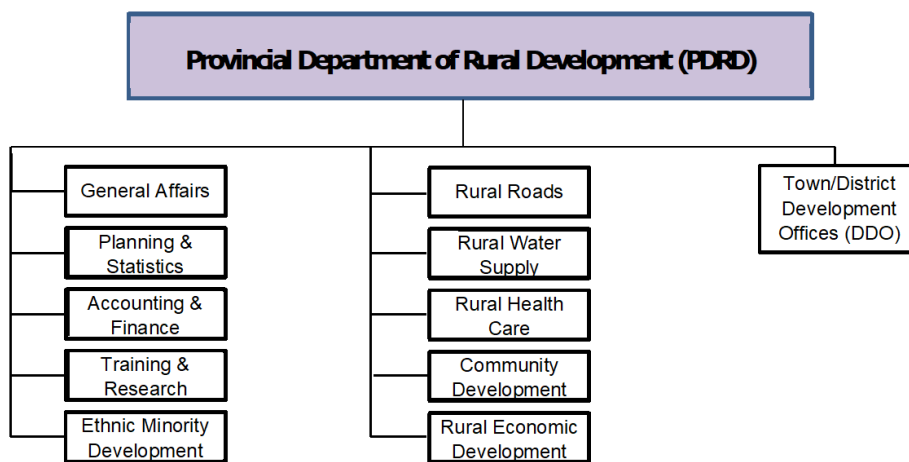


Figure 3.6-3 Organization Chart of PDRD

Table 3.6-1 Duties of MRD, DRR and PDRD

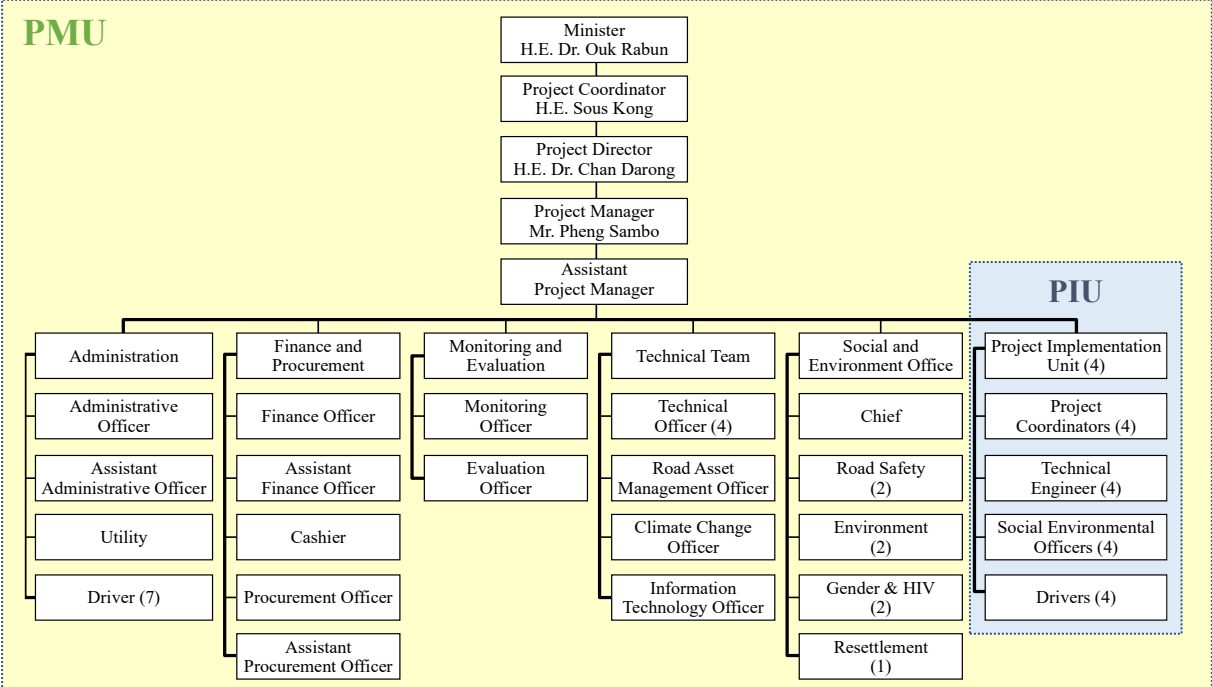
Organization	Main Duties
MRD	<ul style="list-style-type: none"> Rural development policies and strategies Short-, medium- and long-term plans for rural development Reduction of poverty and disparities between rural and urban areas Participate in nation building and development in rural development by level of work activity at the family, village, and commune level Study, research, collect and manage data, statistical information about the situation on socio-economic and cultural in the rural areas Develop human resources through technical training, skills, and knowledge to civil servants of the Ministry, etc.
DRR	<ul style="list-style-type: none"> Prepare plan for the rehabilitation, development, and maintenance of rural roads for the short, medium and long term. Study, research and plan for repair-construction and maintenance of rural roads. Training for civil servants of PDRD rural roads offices and the private sector new methods of repair, construction and maintenance of roads. Monitor and evaluate the implementation of road repair, construction and maintenance projects. Collect, analyze and monitor data of traffic counting of road offices Prepare procedures related to the operation and maintenance of rural roads by the people to ensure sustainable rural development, etc.
PDRD	<ul style="list-style-type: none"> Implement and coordinate on-site activities of the Ministry of Rural Development. Manage on-site engineers and construction equipment

Source: Sub-decree No. 51 ANKr.BK and Prakas on the Organization and Functioning of the Department of Rural Roads

3.6.2 Project Implementation Structure

A project management unit (PMU) and Project Implementation Unit (PIU) will be established in MRD. The PMU will implement, manage, and coordinate project activities to cover the project scope. PIU will be established in each province.

The proposed organization char of the project implementation is shown below.



Source: MRD

Figure 3.6-4 Project Management Unit (PMU) and Project Implementing Unit (PIU)

3.6.3 Technical Support related to Project Implementation

This project consists of the installation of DBST pavement and construction of small bridge and a drainage structures. Although domestic contractors are considered to have sufficient construction experience and technology, it is assumed that there may be cases where consultant support is required for quality, process, and safety control, among other areas.

This has occurred in various projects and should be handled appropriately by consultants.

3.7 Operation and Maintenance Structure

3.7.1 Operation and Maintenance Structure of MRD

(1) Organizational Aspects

The organization of MRD (Ministry of Rural Development), Department of Rural Roads, Provincial Department of Rural Development (PDRD) and the duties of MRD, DRR, and PDRD as described in the Sub-decree and Prakas are shown in Section 3.6.1.

Table 3.7-1 and Table 3.7-2 show the number of the staff in each of the concerned organizations.

In DRR, the staffs of Maintenance Management Section are engaged in rural road operation and maintenance.

Table 3.7-1 Number of Staff of DRR (as of 2019)

Section	No. of Staff
General Affaires	11
Planning and Statistics	8
Maintenance Management	14
Monitoring & Evaluation	18
Research & Development	20
Social Environment	12
Others	13
Total	96

Source: JICA Survey Team

In PDRD, the staffs of Rural Roads sector are engaged in rural road operation and maintenance.

Table 3.7-2 Number of Staff of PDRD (as of 2019)

Sector	Kampong Chhnang	Pursat	BT.B	Banteay Meanchey	25 Provinces
General Affairs	7	3	4	2	
Planning & Statistics	3	2	6	4	
Accounting & Finance	3	3	4	2	
Training and Research	3	4	3	3	
Ethnic Minority Development	-	2	3	1	
Rural Roads	8	2	3	4	
Rural Water Supply	6	1	9	4	
Rural Health Care	5	5	4	2	
Community Development	4	3	5	3	
Rural Economic Development	5	2	5	4	
Town District Development	-	3	16	1	
Total	44	30	60	30	1,118

Source: MRD

Table 3.7-3 shows the equipment owned by PDRD.

Table 3.7-3 Equipment owned by PDRD

Pickup	Kampong Chhnang	Pursat	Battambang	Banteay Meanchey
Pickup (for rural road)	1	1	1	1
Water Sprinkler Car	1			

Source: MRD

Table 3.7-4 shows the equipment owned by DRR.

Table 3.7-4 Equipment owned by DRR

Equipment	No.	Location	Remarks
Motor Graders	4	Kompongthom, Tboung Khmum, Kompong chhnang	Updated on 30 June for the current location
Water track	3	Kompongthom, Tboung Khmum	
Excavator	2	Kompongthom	
Compactors	2	Kompongthom, Tboung Khmum	
Wheel Loaders	1	Kompong chhnang	
Sealcoat Truck	2	Tboung Khmum	

Source: MRD

(2) Financial and Budgetary Aspects: Financial Status, Budget Performance, Outlook for Securing Financial Resources, Financial Sustainability, and Others

Table 3.7-5 shows the maintained road length and budget in 2021 and 2022.

Table 3.7-5 Maintained Road Length and Budget in 2021 and 2022

(2021)

	Type	Length Budget	Kampong Chhnang	Pursat	Battam -bang	Banteay Meanchey	All 25 Provinces
Routine	Laterite & Earth	Total (km)	1,376.9	1,176.0	3,314.7	1,317.7	27,483.6
		Maintained(km)	104.6	94.1	103.6	107.2	2,126
		Budget	MR 805 (\$201,000)	MR 703 (\$175,000)	MR 766 (\$191,000)	MR 770 (\$192,000)	MR 12,899 (\$3,224,000)
	DBST	Total (km)	124.3	211.5	419.1	318.1	4,090.1
		Maintained(km)	116.9	192.4	179.1	62.0	917.8
		Budget	MR 3,687 (\$909,000)	MR 5,515 (\$1,378,000)	MR 5,370 (\$1,342,000)	MR 1,546 (\$386,000)	MR 24,993 (\$6,248,000)
Periodic	Laterite & Earth	Total (km)	1,376.9	1,176.0	3,314.7	1,317.7	27,483.6
		Maintained(km)	23.1	12.9	15.0	14.6	382.0
		Budget	MR 1,759 (\$439,000)	MR 1,054 (\$263,000)	MR 1,154 (\$288,000)	MR 1,056 (\$264,000)	MR 27,491 (\$6,872,000)
	DBST	Total (km)	124.3	211.5	419.1	318.1	4,090.1
		Maintained(km)	3.8	4.3	16.1	0	43.1
		Budget	MR 1,946 (\$486,000)	MR 1,984 (\$496,000)	MR 4,390 (\$1,097,000)	MR 0 (\$ 0.0)	MR 12,760 (\$3,190,000)

(2022)

	Type	Length/ Budget	Kampong Chhnang	Pursat	Battam -bang	Banteay Meanchey	All 25 Provinces
Routine	Laterite	Total(km)	1,376.9	1,176.0	3,314.7	1,317.7	27,483.6
		Maintained(km)	115.3	108.6	124.6	117.0	2,521.0
		Budget	MR 955 (\$238,000)	MR 858 (\$214,000)	MR 978 (\$244,000)	MR 928 (\$232,000)	MR 18 569 (\$4,642,000)
	DBST	Total(km)	165.8	211.5	419.1	318.1	4,090.1
		Maintained(km)	141.5	131.4	110.8	51.1	957.7
		Budget	MR 3,978 (\$994,000)	MR 3,568 (\$896,000)	MR 3,516 (\$879,000)	MR 1,759 (\$439,000)	MR 27 819 (\$6,954,000)
Periodic	Laterite	Total(km)	1,376.9	1,176.0	3,314.7	1,317.7	27,483.6
		Maintained(km)	21.2	10.5	12.0	13.0	323.6
		Budget	MR 1,667 (\$416,000)	MR 958 (\$239,000)	MR 1,097 (\$274,000)	MR 1,004 (\$251,000)	MR 42 826 (\$10,706,000)
	DBST	Total(km)	165.8	211.5	419.1	318.1	4,090.1
		Maintained(km)	0	0	6.3	0	27.89
		Budget	MR 0 (\$ 0.0)	MR 0 (\$ 0.0)	MR 1,880 (\$470,000)	MR 0 (\$ 0.0)	MR 9 927 (\$2,481,000)

Note) MR: Million Riel
Source: JICA Survey Team

Table 3.7-6 is a summary table of the road extension/budget for 2022 by province and the road length/budget for RRCI. The overall maintenance cost in 2022 is US\$24.7, and the proposed maintenance cost US\$5.2 is equivalent to about 22% of the 2022 yearly budget. Since the government budget for the O&M cost for rural roads is being increased according to price increase, the estimated O&M amount is deemed to be affordable.

Table 3.7-6 Road Length and Budget of MRD in 2020 and Road Length and O&M Cost for RRCI

Province	Road Type	Total (2022)				RRCI			
		Length (km)	Routine	Periodic	Sub-total	Length (km)	Routine	Periodic	Sub-total
Kampong Chhnang	Laterite /Earth	1,377	MR 955	MR 1,667	MR 2,622	0.0	MR 0	MR 0	MR 0
			\$ 238,750	\$ 416,750	\$ 655,500		\$ 0	\$ 0	\$ 0
	DBST	166	MR 3,978	MR 0	MR 3,978	122.5	-	-	-
			\$ 994,500	\$ 0	\$ 994,500		\$ 144,000	\$ 1,028,000	\$ 1,172,000
Pursat	Laterite /Earth	1,176	MR 858	MR 958	MR 1,816	0.0	MR 0	MR 0	MR 0
			\$ 214,500	\$ 239,500	\$ 454,000		\$ 0	\$ 0	\$ 0
	DBST	211	MR 3,568	MR 0	MR 3,568	143.1	-	-	-
			\$ 892,000	\$ 0	\$ 892,000		\$ 239,000	\$ 1,200,000	\$ 1,439,000
Battambang	Laterite /Earth	3,315	MR 978	MR 1,097	2,075	0.0	MR 0	MR 0	MR 0
			\$ 244,500	\$ 274,250	\$ 518,750		\$ 0	\$ 0	\$ 0
	DBST	419	MR 3,516	MR 1,880	MR 5,396	129.3	-	-	-
			\$ 879,000	\$ 470,000	\$ 1,349,000		\$ 195,000	\$ 1,086,000	\$ 1,281,000
Banteay Meanchey	Laterite /Earth	1,318	MR 928	MR 1,004	MR 1,932	0.0	MR 0	MR 0	MR 0
			\$ 232,000	\$ 251,000	\$ 483,000		\$ 0	\$ 0	\$ 0
	DBST	318	MR 1,759	MR 0	MR 1,759	134.8	-	-	-
			\$ 439,750	\$ 0	\$ 439,750		\$ 160,000	\$ 1,126,000	\$ 1,286,000
Sub-total (4 Province)	Laterite /Earth	7,186	MR 3,719	MR 4,726	MR 8,445	0.0	MR 0	MR 0	MR 0
			\$ 929,750	\$ 1,181,500	\$ 2,111,250		\$ 0	\$ 0	\$ 0
	DBST	1,114	MR 12,821	MR 1,880	MR 14,701	529.7	-	-	-
			\$ 3,205,250	\$ 470,000	\$ 3,675,250		\$ 738,000	\$ 4,440,000	\$ 5,178,000
Total (25 Province)	Laterite /Earth	27,483	MR 18,569	MR 42,826	MR 61,395				
			\$ 4,642,250	\$ 10,706,500	\$ 15,348,750				
	DBST	4,090	MR 27,819	MR 9,927	MR 37,746				
			\$ 6,954,750	\$ 2,481,750	\$ 9,436,500				

Note) MR: Million Riel

Total \$ 24,785,250

Source: MRD

Table 3.7-7 DRR O & M Budget for Past 10 Years

(Unit: million riel)

Year	Routine	Periodic	Total	Growth Rate
2022	46,388 (\$11,597,000)	52,753 (\$13,188,000)	99,141 (\$24,785,000)	+ 115% (+8.9 % /year)
2021	37,892 (\$9,473,000)	40,251 (\$10,062,000)	78,143 (\$19,535,000)	
2020	39,260 (\$9,815,000)	43,287 (\$10,821,000)	82,548 (\$20,637,000)	
2019	35,345 (\$8,836,000)	34,838 (\$8,709,000)	70,183 (\$17,545,000)	
2018	27,000 (\$6,750,000)	45,000 (\$11,250,000)	72,000 (\$18,000,000)	
2017	17,000 (\$4,250,000)	15,600 (\$3,900,000)	32,600 (\$8,150,000)	
2016	21,000 (\$5,250,000)	49,000 (\$12,250,000)	70,000 (\$17,500,000)	
2015	17,700 (\$4,425,000)	41,300 (\$18,325,000)	59,000 (\$14,750,000)	
2014	13,800 (\$3,450,000)	32,200 (\$8,050,000)	46,000 (\$11,500,000)	
2013	13,800 (\$3,450,000)	32,200 (\$8,050,000)	46,000 (\$11,500,000)	

Source: MRD

Table 3.7-8 shows Routine Maintenance and Periodic Maintenance costs by road: Routine Maintenance consists of (1) Pothole Repair, (2) Grass Cutting, (3) Pipe/Box Culvert Desilting and (4) Side Ditch Desilting. The maintenance cost by item for each road is shown below: Periodic Maintenance is planned as resurfacing once every five years based on the Rural Roads Master Plan (RRMP) published in February 2021. The unit cost of resurfacing is based on the Feasibility Report issued in March 2018.

Table 3.7-8 O&M Cost by Road Per Year (Confidential)**(3) Technical Aspects**

The number of DRR/PDRD office staff is very small, as mentioned above, and the number of technicians is unknown. In addition, experience with DBST is very limited and no guidelines or manuals exist. There is also no plan for training within the Ministry. Equipment for O&M is limited in type and number as mentioned above. MRD has very limited experience in maintaining and managing DBST, and its maintenance capacity is not high. JICA Survey Team could not confirm the content and status of the maintenance of the DBST, although the budget has been allocated to DRR and the maintenance of DBST has been managed by DRR. DRR states that the challenge is to improve PDRD's technical capabilities.

However, the maintenance of agricultural roads (laterite roads) has actually been carried out by PDRD by hiring people living near agricultural roads, in accordance with the "maintenance and management agricultural roads to be carried out by local residents" stipulated in the Prakas. The amount of work required for maintenance and management per length of the project is the same as in the past, and it is thought that maintenance and management can be carried out without any problems by utilizing residents in the surrounding area. The total length of the 529-km project is expected to require 233 workers/day, and 0.44 workers/km is considered to be an easily procurable number of workers.

According to ANUKRET on Maximum Weight of Transport Vehicles Circulating on National Roads of the Kingdom of Cambodia, the maximum vehicle weight of NR5 in Cambodia is 35 tons. A permit from MPWT is required for vehicles over 35 tons to travel on the road. Owners of trucks over the regulated

weight must apply in advance to the MPWT for a permit and obtain one; if they drive without a permit from the MPWT, they will receive only a warning for up to 5% of the regulated weight plus a fine of 100,000 Riel (about \$25) for 5-10%.

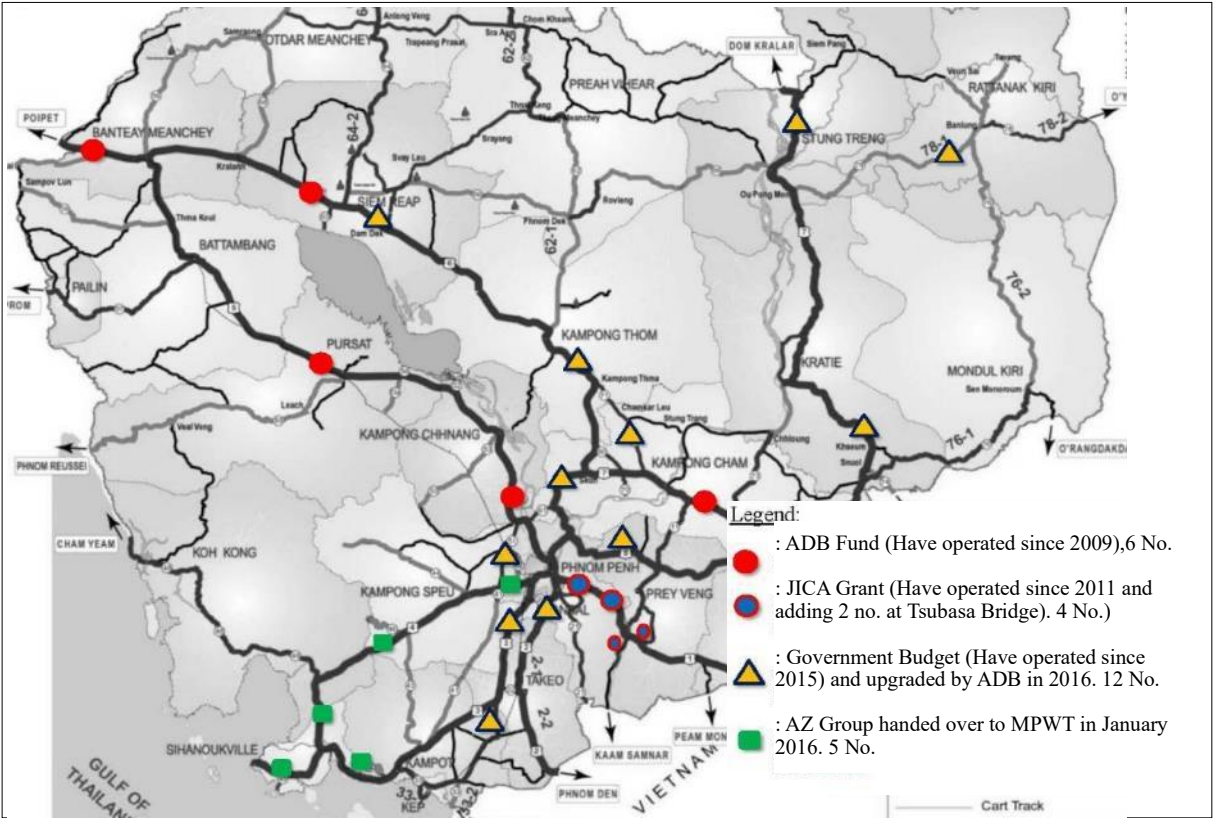
Thereafter, for each additional 10% of weight, a further fine of 100,000 Riel (\$25) will be added.

As of 2018, 27 Weigh Stations (i.e, checkpoints along a highway to inspect vehicular weights) are maintained and operated by MPWT in Cambodia. Of these, one is located on the NR5 at BMC, one at PS, and one at KCH, where overweight vehicles are inspected. MPWT plans to construct 6 more weigh station and step up its crackdown against overloading.

Table 3.7-9 Maximum Vehicle Weight by Number of Axles

Classification	Category A	Category B
Road Name / Section	NR4, 6 and 7 from Skun junction road to the provincial town of Kampong Cham	Other national roads
2 axles	16 tons	16 tons
3 axles	25 tons	20 tons
4 axles	35 tons	30 tons
5 axles	40 tons	35 tons

Source: ANUKRET on Maximum Weight of Transport Vehicles Circulating on National Roads of the Kingdom of Cambodia



AZ Group: AZ Group signed the concession contract for the operation and management of the Phnom Penh-Sihanouville highway in 2001, but the contract was canceled in 2016 and the road and road facilities, including the weigh station, were transferred to MPWT.

Source: Overview of the Transport Infrastructure Sector in the Kingdom of Cambodia

Figure 3.7-1 Weigh Station Location Map

MRD has 9 sets of mobile axle weight testers for overloading of rural roads. They are randomly inspected on rural roads and could be utilized in this project. In addition, the RRIP has height restrictions, and this measure would considerably limit the mixing of large vehicles. Combined with axle-weight inspections, it is expected to be quite effective. The target road parallel to NR5 is threatened by heavy truck traffic that avoids weighing at Weigh Stations. MPWT and MRD need to work together to implement measures to prevent overloading.



Source: JICA Survey Team

Figure 3.7-2 Load Axle Inspection on Rural Roads



Source: JICA Survey Team

Figure 3.7-3 Height-Restricted Gate on a Rural Road improved by RRIP

3.7.2 Review of the Support of the Similar Project

Table 3.7-10 shows a similar project that was implemented by JICA. The said project aimed to strengthen the capacity of the MPWT for road and bridge operation and maintenance, with some guidelines and manuals remaining that could be used in MRD.

Table 3.7-10 Project Outline

Project Title	The Project for Strengthening Capacity for Maintenance of Roads and Bridges
Project Period	April 2015 – March 2018
Overall Goal	Appropriate Maintenance of roads and bridges is managed by MPWT
Project Purpose	Capacity of RID to supervise implementing bodies maintaining roads and bridges are enhanced.
Outputs	(1) The bridge maintenance cycle is established. (2) Road and bridge inspection capacity of RID is enhanced. (3) Road and bridge repair capacity of RID is enhanced. (4) Road and bridge maintenance cycle is introduced to other Department of Public Works and Transport (hereinafter DPWT) and concerning agencies.

Source: JICA Survey Team

Table 3.7-11 Guidelines and Manuals

I. Road Maintenance
<ul style="list-style-type: none"> • Road Maintenance Manual • Guideline for Routine Road Maintenance Using IRI
<ul style="list-style-type: none"> • Road Repair Manual • Guideline for Repairing Defects of Road • Handbook Version
II. Bridge Maintenance
<ul style="list-style-type: none"> • Bridge Inspection Manual • Bridge Inspection Manual • Handbook Version
<ul style="list-style-type: none"> • Bridge Repair Manual • Bridge Repair Manual • Handbook Version
III. Annual Action Plan
<ul style="list-style-type: none"> • Bridge Maintenance Annual Action Plan • 3-Year Bridge Maintenance Strategic Plan

Source: JICA Survey Team

3.7.3 Status of Support from Other Donors

A summary of the other donors' activities is provided in Table 3.7-12.

Table 3.7-12 List of Other Donors

Name	Project Name	Outline				
		Lone /Grant	Target Group	Period	Project Cost	Purpose
ADB	Road Asset Management Project	Lone	MPWT	Apr 2008~ Mar. 2015	52.35 Million USD	Assist in the maintenance of national and state highways, improve maintenance capacity, and strengthen asset management capacity
WB	Cambodia Road Connection Improvement Project	Lone	MPWT /MRD	2020~ 2028	100 Million USD	Improve climate resilient road access to economic and human development facilities in targeted provinces

Source: JICA Survey Team

A summary of the project in Table 3.7-12 is shown below.

(1) Road Asset Management Project (ADB)

- (i) assist the government in periodic maintenance of about 950 km of the national and provincial roads administered by the Ministry of Public Works and Transport (MPWT);
- (ii) help build capacity at MPWT to improve the maintenance and management of its roads network; and
- (iii) provide institutional and management support and training to MPWT to strengthen its road asset management and quality assurance capacity at all levels, and to start a process of privatizing its force account units.

(2) Cambodia Road Connection Improvement Project (WB)

The main components are as follows

- (i) Component 1: Improvement and maintenance of National and Provincial Roads (US\$47.0 million)
 - Improvement and maintenance of National and Provincial Roads (US\$44.0 million)
 - Design and supervision service (US\$30.0 million)
- (ii) Component 2: Improvement and maintenance of Rural Roads (US\$47.0 million)
 - Improvement and maintenance of Rural Roads (US\$44.0 million)
 - Design and supervision service (US\$30.0 million)

The activities of Component 2 are as follows:

- Rural roads will be upgraded from the existing earth and laterite roads to double bituminous surface treatment (DBST) standards
 - Roads will be upgraded with climate resilience measures including improving the capacity of drainage systems and adaptation of bridges to the flooding risks, introducing concrete pavements on flood-prone areas, and other resilience solutions.
 - Road safety will be improved by widening and sealing shoulders, where land is available, through better marking and signage, and introducing traffic calming measures at critical locations.
 - Rural road prioritization for investment will be completed in the first year of project implementation. The rural road prioritization process will be based on geospatial analysis to assess flood vulnerability of the network and road accessibility gains and environmental and social screening.
 - It is estimated that the component will finance 250 km of priority rural roads through Output and Performance-Based Road Contracts (OPBRC) covering both road improvement and maintenance and including performance requirements for improved preservation of road assets, enhanced resilience to climate events, and also service levels during the maintenance phase.
- (iii) Component 3: Institutional development and project management (US\$ 6.0 Million)
 - Institutional development and project management to MPWT (US\$3.0 million)
 - Institutional development and project management to MRD (US\$3.0 million)

The activities of Component 3 are as follows:

- Preparation of the Rural Roads Accessibility Financing Strategy and support for the operationalization of the Rural Roads Asset Management System,

- Road safety awareness activities and road safety assessment of MRD project roads;
- Study on transportation services in rural areas,
- Providing technical assistance for implementation of road side preservation activities, implementing the MRD’s gender mainstreaming action plan and project management support including procurement, FM and audits, environmental and social oversight, overloading control, M&E, training, and incremental operation costs.

(iv) Component 4: Contingency emergency response (US\$0 million)

3.7.4 Issues and Challenges of Operation and Maintenance

(Budget)

Securing maintenance costs is a challenge. Maintenance costs of \$5.18 million/year are required, but the budget for rural road maintenance for all 25 provinces in 2022 is \$24.78 million, and \$5.18 million is equivalent to 21% of the total budget. As mentioned above, the budget is increasing every year, therefore, the JICA Survey Team considers it is possible to secure this funding.

(Organization)

MRD and PDRD have limited experience in DBST maintenance and management, their technical capacity is not sufficient, and no guidelines or manuals exist. In addition, no technical cooperation projects for road maintenance have been implemented and the number of engineers has not been confirmed. Furthermore, although PDRD is the implementing unit for DRR, maintenance has not been carried out using the PDRD organization. PDRD, which is the implementing unit of DRR and has an advantage in rural area, should be educated and PDRD should be responsible for future DBST maintenance and management.

3.7.5 Technical Support related to Operation and Maintenance

In 2018, JICA’s “The Project for Strengthening Capacity for Maintenance of Roads and Bridges” produced guidelines for road repair and maintenance using IRI for the Ministry of Public Works and Transport. Parts that can be utilized for this project should be excerpted or modified as necessary to fit this target road, and guidelines and manuals should be developed and applied to this project.

Both MRD and PDRD have no experience in maintaining and managing DBST and have not received technical assistance for DBST maintenance to date, and both MRD and PDRD are considered to have low capacity. The World Bank’s “Cambodia Road Connection Improvement Project” includes maintenance and management through OPBRC ((Output- and Performance-Based Road Contract: a term-based contracting method that specifies road surface properties, grass height, degree of cleaning of waterways, etc.), but the details are not yet clear.

In collaboration with the “Cambodia Road Connection Improvement Project,” and referring to the relevant documents of “The Project for Strengthening Capacity for Maintenance of Roads and Bridges”, the capacity of MRD and PDRD should be improved through a technical cooperation project. If necessary, OPBRC should also be considered for technical cooperation projects. Since MRD and PDRD have no experience in maintenance and management of DBST and have not provided any technical support for maintenance and management of DBST, MRD and PDRD are considering to develop a guideline and manual for maintenance and management of DBST. Therefore, the capacity of both MRD and PDRD is considered to be low. The “Cambodia Road Connection Improvement Project” includes maintenance and management through OPBRC, but the details are not yet clear. If necessary, OPBRC will also be a target of technical cooperation.

3.7.6 Operation and Maintenance Structure of the Target Projects

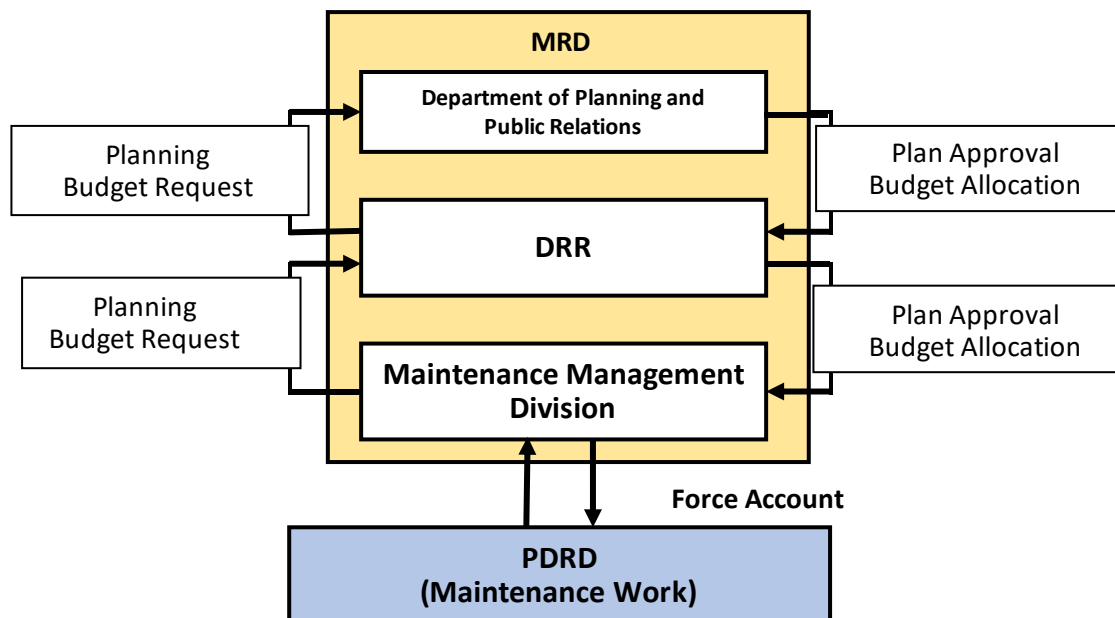
The number of personnel required for routine maintenance is shown in Table 3.7-13. Periodic maintenance is not included because it is not required at all times. The specified manpower is required to maintain the project through force account method.

Table 3.7-13 Number of Manpower required for O&M

Name of Province	Manpower / day
Kampong Chhnang	44
Pursat	81
Battambang	64
Banteay Meanchey	45
Total	233

Source: MRD

The O&M Structure is shown in Figure 3.7-4. Both routine maintenance and periodic maintenance will be conducted by force account method. In addition, since the periodic maintenance plans resurfacing every five years, the capacity and structure of PDRD will be strengthened to be able to resurface all the sections under force account.



Source: JICA Survey Team

Figure 3.7-4 O&M Structure

3.8 Overview of Technical Support

3.8.1 Needs of Technical Support

The consultants in detailed design and construction management should carry out the following technology transfer is an important aspect in design and supervision works:

- Provide the opportunity to the MRD officers and staffs to be involved in the working team of the Consultant during the design, contract administration and supervision works for their capacity building wherever possible.
- If requested by MRD, the Consultant shall brief and demonstrate the survey and design procedure, the construction supervision and contract management process and procedures in small workshops or on site.
- Support capacity building of MRD and its staff with respect to operation maintenance of DBST roads. The Consultant shall prepare a brief manual for the maintenance of DBST roads and provide guidance in the field on implementation methods.
- Assist MRD in conducting traffic safety education and awareness activities for residents.

3.8.2 Accompanying Needs of Technical Support

(1) Road Traffic Safety Program on Rural Road

In Cambodia, road traffic safety measures on NR5 and other trunk roads are an urgent issue, as the number of traffic accidents and traffic casualties are expected to increase along with the growth of traffic volume. In response to this, JICA is working to increase transport capacity and improve transport efficiency while ensuring the safety of local residents and others on NR5, which JICA is supporting through yen loans under the “Project for Improvement of Road Traffic Safety on Trunk Road.” For this purpose, JICA is verifying road traffic safety measures, strengthening the organizational structure and human resource development related to road traffic safety measures, and promoting awareness activities.

JICA Survey Team held a meeting on October 14, 2022 to discuss the technical assistance needs for road traffic safety on rural roads with the “Project for Improvement of Road Traffic Safety on Trunk Road” survey team.

Currently, the “Project for Improvement of Road Traffic Safety on Trunk Road” is mainly focused on helping the MPWT to establish a structure and system for road traffic safety related activities. In order to encourage local residents to develop safe traffic habits, it is necessary to address traffic safety not only on national roads but also in the entire region in the future. Therefore, it is of great importance to engage in future improvement of road traffic safety, including MRD and PDRD, such as identifying the current status of traffic accidents on rural roads and identifying issues, road traffic safety awareness activities at schools along major rural roads," and traffic policing training.

In addition, local residents are currently crossing national roads and driving in the wrong direction on NR5, which is one of the factors of traffic accidents. These issues should be considered from the perspective of the road network, which includes not only national roads but also rural roads. Since many of the roads covered by current project are connected to NR5, it is necessary for the national and rural roads to cooperate and consult with each other when discussing the intersection with NR5 during the detailed design phase to ensure that the shape of the road takes into account road traffic safety in the surrounding area.

The following is a list of key comments from the opinion exchange meeting.

Table 3.8-1 Summary of Discussion with the Survey Team of “Project for Improvement Road Traffic Safety on Trunk Road”

Item	Key Comments from the Discussion
Outline of "Project for Improvement of Road Traffic Safety on Trunk Road"	<ul style="list-style-type: none"> ✓ The target area is limited to NR5 in the "Project for Improvement of Road Traffic Safety on Trunk Road". While the main CP is the MPWT, road traffic safety education and enforcement-related activities are often coordinated with the DPWT (Department of Public Works and Transport) and local police, and there is significant involvement with local organizations. It is also important to consider this on rural roads. ✓ The National Road Safety Committee (NRSC) also plays a secretariat role. The traffic accident data collected includes traffic accidents on rural roads. ✓ Currently, there are many traffic collisions on NR5 when local residents cross the national highway. Tractors and other vehicles driven by local residents cross the national highway at low speed. As a result, collisions with vehicles traveling on the national road occurred frequently when the bypass was in service. ✓ Another road traffic safety issue is that many vehicles drive the wrong way on national roads. ✓ Crossings of national roads and reversals of national roads need to be planned not only for national roads but for the entire road network. Thus, the cooperation of MRD and PDRD will definitely be necessary in the future. ✓ The “Project for Improvement of Road Traffic Safety on Trunk Road” aims to create a structure and system for road traffic safety education and awareness activities. To this end, the project is first targeting schools along NR5, where it is easier to conduct educational activities, and examining how the police and DPWT can efficiently conduct road traffic safety educational activities by engaging with the community. And in the future, the project will target all local residents. ✓ Traffic safety measures should essentially be implemented at the local level. For this purpose, the central government needs to understand the system, so Phase 1 of the project is being conducted for the MPWT.
Future Development of Road Traffic Safety Awareness Activities	<ul style="list-style-type: none"> ✓ In Phase 2, based on the results of Phase 1, the establishment of a system of traffic safety measures in the regions is being considered. The creation of a system that enables cooperation between the central and local governments, and the provision of support for road traffic safety measures and the development of road traffic safety facilities are also being examined. ✓ Since MRD and PDRD need to implement road traffic safety facilities on rural roads, etc., MRD may be incorporated into the project in the future. However, since MRD and PDRD's personnel and budget for rural roads should be small, the issue is whether they can focus on road traffic safety measures. ✓ The users of both national and rural roads are the same. Efforts will be needed in the future to have local residents understand how to ensure road traffic safety in their daily lives, including on rural roads. ✓ The current traffic accident investigation and problem identification being conducted on NR5 should also be conducted on rural roads. ✓ Motorcycle transportation to school for junior high and high school students is a safety hazard. Since many students come to school from long distances, schools are considering the installation of school buses as one of the road traffic safety measures. ✓ Paving rural roads will allow school buses to operate more efficiently, which will lead to road traffic safety on NR5. In addition, terminal transportation in rural areas will be enhanced by using school buses as community buses as well. ✓ In order for local residents to learn safe traffic habits, it should be a whole community effort, not just a national highway.
Road Traffic Safety	<ul style="list-style-type: none"> ✓ There are a number of roads in this target road that connect to NR5. Since

Item	Key Comments from the Discussion
Facilities	<p>the target roads will be paved with DBST, they are likely to become major roads in the region. In addition, the connection with NR5 is highly potential to become a major intersection because of the expected increase in traffic volume.</p> <p>✓ For intersections connecting to target roads, the national government and rural areas should collaborate and discuss the shape of the intersection during the detailed design phase to ensure that road traffic safety is taken into consideration.</p> <p>In conjunction with the "Project for Improvement of Road Traffic Safety on Trunk Road", a plan that will improve road traffic safety in rural areas will be implemented.</p> <p>For example, a traffic signal will be installed at the connection of the target road near the school as a pilot project.</p>

Source: JICA Survey Team

Technical cooperation for traffic safety on rural roads includes traffic safety education for local residents as well as conventional traffic safety facility measures for MRDs and PDRDs, and enhancement of traffic accident data collection and analysis capacity. In addition, by strengthening the organizational structure and human resource development related to traffic safety measures, such as community-based social regulation and control of provincial and district police, and by promoting awareness-raising activities, the project aims to contribute to reducing travel time, increasing transportation capacity, and improving transportation efficiency in the target areas, while ensuring the safety of local residents and others.

Table 3.8-2 Sample PDM (1)

Target	DRR, PDRD of MRD, MOI (provincial and district police)
Project Purpose	Traffic safety is ensured for community residents, and the number of accidents is reduced.
Output	<ul style="list-style-type: none"> ● The capacity of the relevant organizations for research and analysis for road safety are improved. ● The capacity of the relevant organizations for road safety engineering are improved through activities in the project. ● The capacity of the relevant organizations for traffic enforcement are improved through activities in the project. ● Community residents understanding of traffic safety and awareness of traffic accident are improved.

(2) Capacity Development of Rural Road Operation and Maintenance

Sample PDM for the project on strengthening the O&M capacity of rural roads is shown below.

Table 3.8-3 Sample PDM (2)

Target	DRR, PDRD of MRD
Project Purpose	Institutional capacity of MRD on road management is improved.
Output	<ul style="list-style-type: none"> ● Road management strategy is prepared ● Framework for road management including overload control at MRD head office and PDRD offices in sample province(s) is established. ● Road inspection and diagnosis manuals are prepared ● Road Management Data System is established. ● PBC(OPBRC) is introduced in MRD and PDRD

(3) Possibility to Introduce of LBT

LBT (Labor-Based Technology) is funded by the MEF of Cambodia as Cash for Work and is being implemented based on a request from the Village Committee with the goal of preventing out-migration. The LBT is a labor-based construction up to sub-grade body and does not require any difficult skills. The draft PDM of the technical cooperation project is prepared assuming the pavement work is included in the LBT.

Table 3.8-4 Sample PDM (3)

Target Group	PDRD
Project purpose	Capacity on embankment work and pavement work (Sandbag method, Macadam method, etc.) by LBT is improved
Output	<ol style="list-style-type: none"> 1. Capacity on embankment work by LBT is improved 2. LBT pavement methods (Sand Bag or Macadam method) are understood by PDRD and implemented.
Activities	<ol style="list-style-type: none"> 1-1 Basic theory on embankment work is understood by PDRD 1-2 To prepare a construction method plan for embankment work by LBT in accordance with the local available material and equipment. 1-3 To prepare the quality control plan for LBT 1-4 To implement the sub-project of the embankment work by LBT through the construction method and quality control plan
	<ol style="list-style-type: none"> 2-1 Basic theory on pavement work by LBT is understood by PDRD 2-2 To prepare a construction method plan for embankment work by LBT in accordance with the local available material and equipment. 2-3 To prepare the quality control plan for LBT 2-4 To implement the sub-project of the pavement work by LBT through the construction method and quality control plan

Source: JICA Survey Team

CHAPTER 4 ENVIRONMENT AND SOCIAL CONSIDERATION

4.1 Conditions of Environmental and Social Consideration

4.1.1 Overview

(1) Project Outline

On the road sector of Cambodia, JICA has assisted the development of NR5 including the widening, rehabilitation, and development of a bypass road, a trunk road that is part of the Southern Economic Corridor. On the other hand, the development of rural roads along the NR5 has been insufficient. This project foresees the improvement of rural roads on four provinces (Kampong Chhnang, Pursat, Battambang, and Banteay Meanchey) along the NR5, targeting expansion of benefits of NR5, bringing improvements to the living environment, and activation of the local economy.

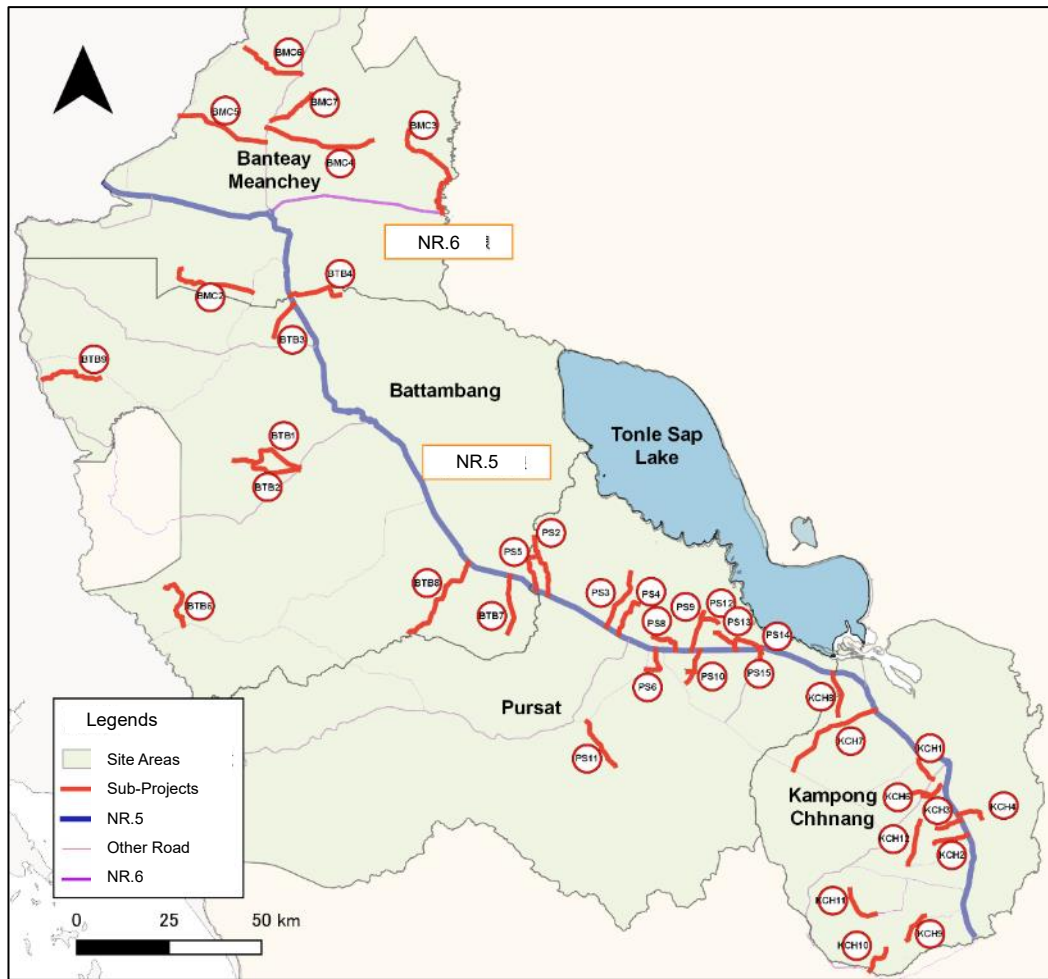
(2) Project Components concerning Environmental and Social Considerations

The sub-projects integrating the project are shown on the table below. Whole sub-projects are normal roads with 2 lanes.

Table 4.1-1 Project Long List

Rank	Target Roads	Provinces	Districts	Rural Road	Existing Condition			Improvement Length by Type (km)				
					Road Length (km)	Carriage way width (m)	R. O. W (m)	Typical (8m)	Alt-1(8m)		Alt-2 (5m)	Total
									Residential land	Cropland		
1	BTB-8	BTB	Moung Russei	NR5 O'Kreat-Ba Sak	18.0	6.0	11.5-13.0	18.0	0.0	0.0	0.0	18.0
2	PS-11	PS	Kandeng	ToulCha- Keo Mory	15.0	6.0	17	11.0	1.0	3.0	0.0	15.0
3	PS-2	PS	Bakan	O'Tapomg-Phum Tanai	18.2	5.0	6.0-13.5	6.8	1.2	8.2	2.0	18.2
4	PS-14	PS	Krakor	Sna Ansa- Arlong Tnaot	10.3	5.0	9.5-10.0	10.3	0.0	0.0	0.0	10.3
5	PS-3	PS	Bakan	Plov Andongkra saing-Tram Pae	17.6	5.0	8.0-19.0	12.0	0.0	5.1	0.5	17.6
6	PS-5	PS	Bakan	Plov Phum Svay Daun Keo-Chrop-Phum Slor Klouk	12.9	5.0	6.5-10.0	0.0	2.5	10.4	0.0	12.9
7	PS-4	PS	Bakan	Phnov-Phiteah Pring	12.2	5.0	8.0-17.0	0.0	10.5	1.2	0.5	12.2
8	KCH-7	KCH	Boribo	Phsar-Kdol Senchey	27.5	8.0	15	27.5	0.0	0.0	0.0	27.5
9	BMC-2	BMC	Mongkol Borei	Plov Balang Chrey	24.1	5.5	15	19.5	2.0	2.6	0.0	24.1
10	BMC-3	BMC	Phnum Srok	Spean Sraeng	24.0	5.0	10.0-11.0	6.0	0.0	11.0	7.0	24.0
11	KCH-10	KCH	Samaki Meanchey	Chrokhnot- Chrok Sdach	8.9	5.0	7.0-13.0	8.0	0.9	0.0	0.0	8.9
12	PS-12	PS	Krakor	Kanchhor-Kampong Pou	5.0	5.0	7.5-14.5	3.4	0.5	1.0	0.1	5.0
13	BTB-6	BTB	Samlaut	Plov 1577 Phum Ochrab-OBoiPaol (Phum Sam Loat)	17.0	6.0	15.5	13.8	0.0	3.2	0.0	17.0
14	PS-13	PS	Krakor	Ou Sandan- Sna Ansa	6.5	5.0	5.5-9.0	0.0	6.0	0.0	0.5	6.5
15	PS-15	PS	Krakor	Arlong Tnaot	3.9	5.0	5.0-7.0	0.0	2.7	0.0	1.2	3.9
16	PS-10	PS	Phnum Kravanh	Son Trae-Chher Tum	11.8	6.0	6.0-14.0	4.0	2.0	5.0	0.8	11.8
17	BTB-1	BTB	Thmar Kaul	NR57-Phum Boeung Krar Sal	15.0	5.0	12.5-17.5	15.0	0.0	0.0	0.0	15.0
18	BMC-6	BMC	Tmar Puok	Plov Sre L'or	18.6	5.0	10.0-19.0	11.4	0.0	6.9	0.3	18.6
19	KCH-4	KCH	Rolea B'ier	NR5-Prek Sala	8.2	5.0	8.5-14.0	5.3	1.1	1.8	0.0	8.2
20	BTB-2	BTB	Thmar Kaul	Sneung NR.57-Beoung Praey	18.2	6.0	15	5.8	0.0	12.4	0.0	18.2
21	BTB-9	BTB	Kamrieng	NR59-Phum O' Teuk tla	18.2	6.0	15.0-18.0	18.2	0.0	0.0	0.0	18.2
22	BTB-4	BTB	Thmar Kaul	NR5 (Phasar O'Nhor)-Phum Poa Ta Sek	16.1	6.0	8.0-14.0	0.0	4.0	12.1	0.0	16.1
23	KCH-1	KCH	Rolea B'ier	Srang Kpuos-Kol Kup	4.3	10.0	27	4.3	0.0	0.0	0.0	4.3
24	BMC-5	BMC	Svay Chek	Plov Tae Hang	25.0	6.0	10	0.0	0.0	25.0	0.0	25.0
25	KCH-12	KCH	Teuk Phos	Tbeng Kpous-Ronak	12.4	5.0	10.5-21.5	12.4	0.0	0.0	0.0	12.4
26	PS-8	PS	Krakor	Rotus	8.8	6.0	10.0-12.0	8.8	0.0	0.0	0.0	8.8
27	PS-6	PS	Krong Pursat	Plov Wat Toul V eng	9.7	5.0	9	9.7	0.0	0.0	0.0	9.7
28	KCH-3	KCH	Rolea B'ier	NR5-Damnak Kei	7.1	5.0	14.5	3.8	0.0	3.3	0.0	7.1
29	PS-9	PS	Krakor	Tbaeng Chrum-Raa Toteng Thngai	11.2	8.0	11.0-20.0	11.2	0.0	0.0	0.0	11.2
30	KCH-8	KCH	Boribo	Trapaing Chan-Teuk Chreaop	12.2	8.0	18	12.2	0.0	0.0	0.0	12.2
31	BMC-7	BMC	Svay Chek, Tmar Puok	Rotus-Phum Tmey	14.1	6.0	7.0-13.0	4.5	0.6	9.0	0.0	14.1
32	KCH-9	KCH	Samaki Meanchey	Meanok-Trapaing Mtes	8.8	5.0	17	8.8	0.0	0.0	0.0	8.8
33	BMC-4	BMC	Phnum Srok	Ta Phou	29.0	5.0	11.5-15.5	29.0	0.0	0.0	0.0	29.0
34	BTB-3	BTB	Thmar Kaul	NR5 Phum Beoung Prieng-Wat Roung Chrey	10.6	6.0	8.0-10.0	0.0	0.0	10.1	0.5	10.6
35	KCH-6	KCH	Rolea B'ier	Phum Thmey-Trapaing Kravan	11.3	5.0	7.5-10.0	9.9	0.1	1.3	0.0	11.3
36	BTB-7	BTB	Moung Russei	NR5 Rar Cham Heang-Khum Muk Rar	16.2	4.0	10.0-13.0	16.2	0.0	0.0	0.0	16.2
37	KCH-11	KCH	Samaki Meanchey	Srae Sar- Ksach Sor	12.7	6.0	15.0-20.0	12.7	0.0	0.0	0.0	12.7
38	KCH-2	KCH	Rolea B'ier	Kosomak-O'Loy	9.1	5.0	8.5-17.0	8.6	0.5	0.0	0.0	9.1

Source: JICA Survey Team



Source: JICA Survey Team

Figure 4.1-1 Project Site Areas

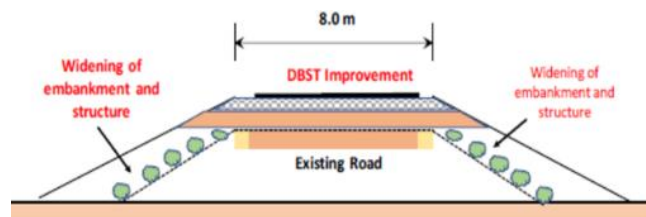
1) Details of the Project

In this project, the existing roads are improved to eliminate deficiencies of the existing rural roads, such as unpaved surfaces, flooding, and unsuitable road alignments.

Table 4.1-2 Improvement Items for the Sub-Projects

Common Matters of Improvements	Matters based on Regional Characteristics
<ul style="list-style-type: none"> Secure the standard crossing width of 8.0 m (excluding areas where widening is difficult) Cover existing roads with DBST pavement Cover 0.5 m of road shoulders with SBST pavement (both sides) Install safety facilities 	<ul style="list-style-type: none"> Widening of the existing road Raising the level of flooded areas Minor improvement of vertical alignment (elimination of flooding) Minor improvement of horizontal alignment (improvement of curvature)

Source: JICA Survey Team



Source: JICA Survey Team

Figure 4.1-2 Example of Improvements

The project will require the supply of materials from quarries and borrow pits. There is a possibility that the implementation of the project will have an environmental impact during construction. After the project is implemented, there may be impacts due to an increase in traffic volume and travel speed.

It should be noted that land acquisition is planned to be kept to a minimum during the implementation of this project, and there will be no resettlement of residents. In addition, other inseparable projects and projects related to derivative/secondary impacts, as well as cumulative impacts related to this project are not assumed.

(3) Reason for which Environmental Assessment and Plans of Sub-Projects and/or Components Cannot be Prepared Before Project Approval

This project is implemented as a sector loan project. EIA/IEE study cannot be implemented for each project since the sub-projects to be implemented have not been selected at the time of L/A. EIA/IEE survey will be carried out after the executing agency decides on the implemented sub-projects after the L/A.

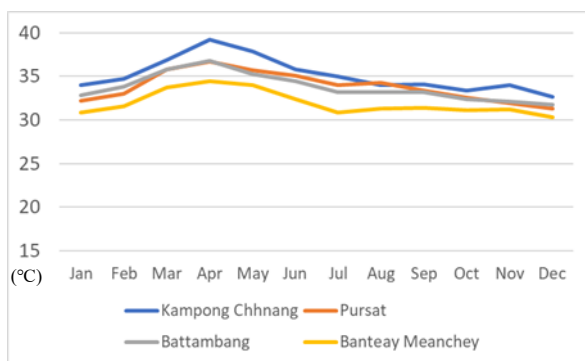
4.1.2 Environmental and Social Baselines

(1) Climate

Cambodia has a tropical monsoon climate with two seasons, dry and rainy season. The dry season takes place from November to April, with the coolest temperatures registering from November to January and warmer temperatures being recorded on February to April. The rainy season takes place from May to October.

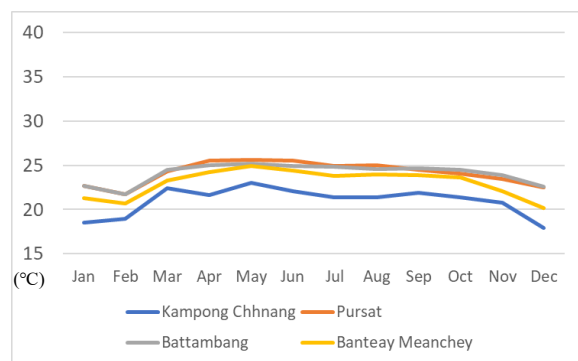
1) Temperature

Average monthly maximum and minimum temperatures for the four target provinces are shown below. The monthly maximum temperatures range from 32°C to 35°C, while the monthly minimum temperatures are around 21°C to 24°C.



Source: MOWRAM

Figure 4.1-3 Average Monthly Maximum Temperatures of 4 Provinces (2016-2018)

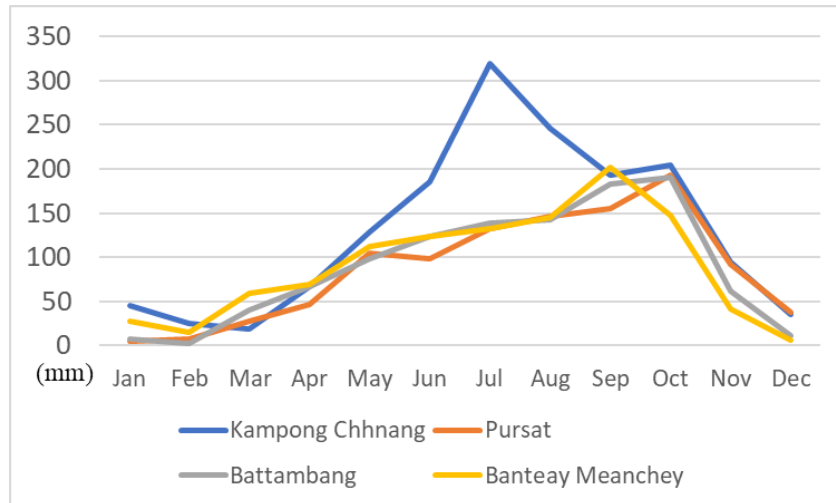


Source: MOWRAM

Figure 4.1-4 Average Monthly Minimum Temperatures of 4 Provinces (2016-2018)

2) Precipitation

Precipitation amounts for the four target provinces are shown in Figure 4.1-5. Kampong Chhnang has an average annual precipitation exceeding 1,500 mm, which differentiates it from the other provinces (1,000 mm to 1,100 mm).

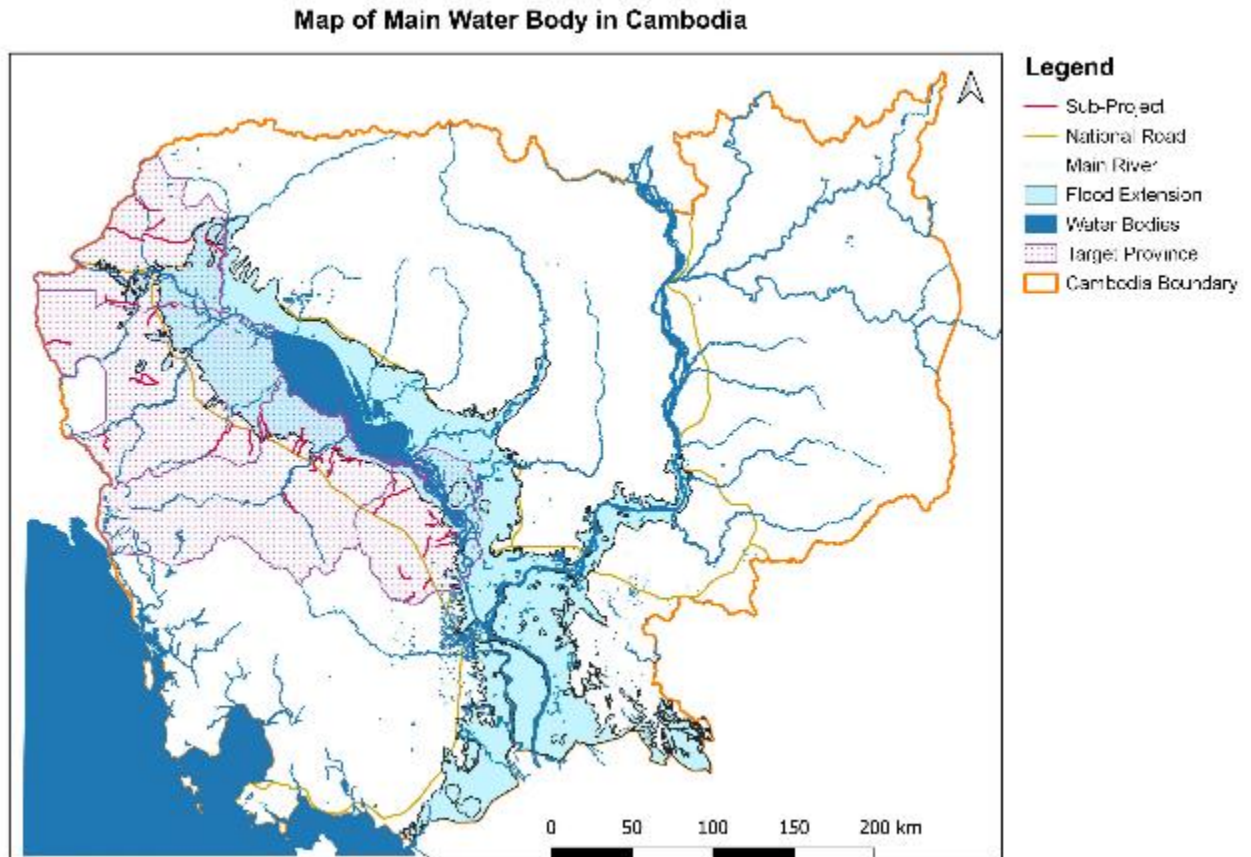


Source: MOWRAM

Figure 4.1-5 Average Monthly Precipitation of 4 Provinces (2014-2018)

(2) Water Systems

Cambodia has two major water systems: the Mekong River and the Tonle Sap Lake. The Mekong River and its tributaries form one of the largest water systems in the world. On the other hand, the Tonle Sap Lake system, accounts for more than half of the water volume during the rainy season and is the most important water system in Cambodia.



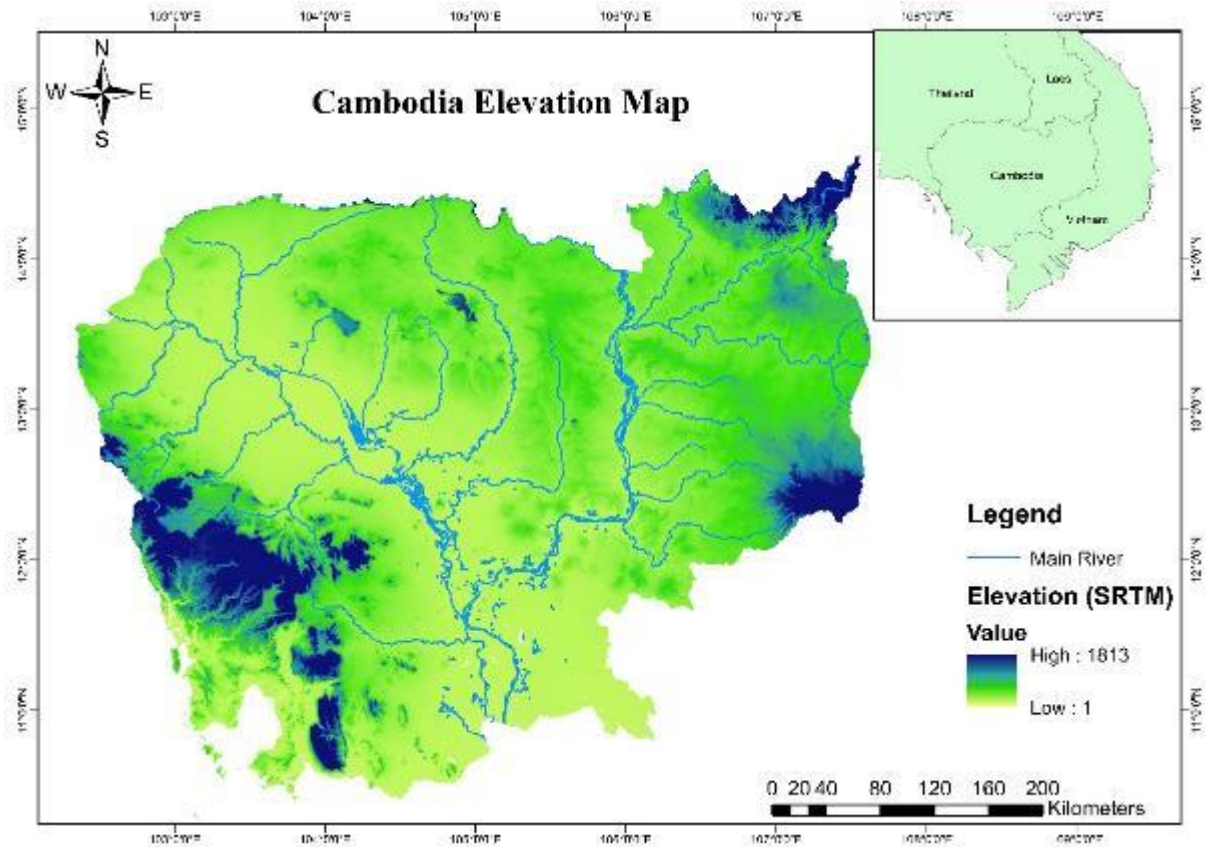
Source: Open Development Cambodia (ODC)

Figure 4.1-6 Water Systems around the Project Sites

(3) Topography and Geology

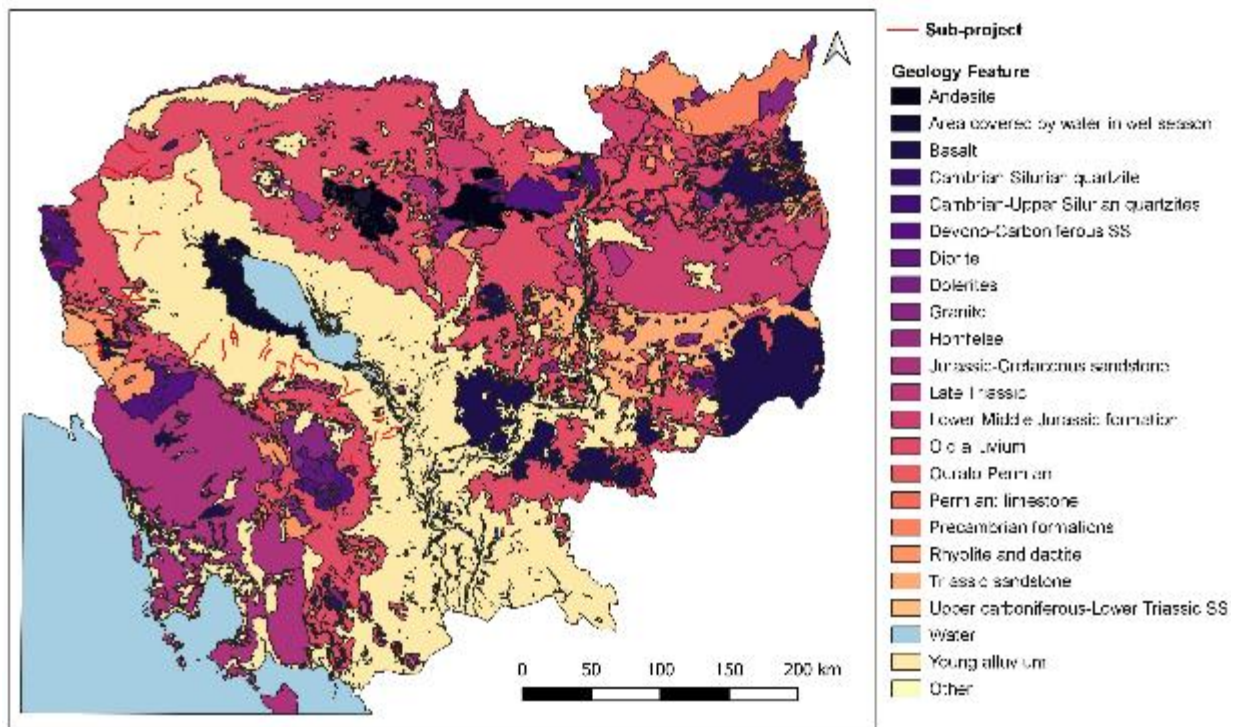
Cambodia has three topographic features: central plains, highlands, and mountains. Around Tonle Sap Lake, there are vast plains with an elevation range of 5 to 10 meters above sea level. The Cardamom and Elephant Mountains extend from the West to the Southwest of the country, while Northern and Eastern borders are bordered by the Dangrek Mountains.

Elevations across the country range from 1 m to 1,813 m, with average elevations of 15 m, 39 m, 17 m, and 29 m in Banteay Meanchey, Battambang, Pursat, and Kampong Chhnang provinces respectively. Most of the Project is in the flatlands around Tonle Sap Lake. However, some sub-projects, such as BTB-06 and PS-11, are located in higher elevations within the Cardamom and Kravanh Mountains.



Source: JICA Survey Team

Figure 4.1-7 Topography of Cambodia



Source: Atlas Data, 2006

Figure 4.1-8 Geology of Cambodia

(4) Air Quality

"Sub-Decree No: 42 ANRK BK on Air Pollution Control and Noise Disturbance", enacted in July 2000, stipulates that the environment and health will be protected from air pollution and noise through monitoring and mitigation measures. All mobile and stationary sources of air pollution and noise are covered by this decree.

Table 4.1-3 Standards of Air Quality of Cambodia (comparison with IFC Guidelines)

Parameter	Unit	MoE standard*				IFC standard**			
		1 Hour	8 Hours	24 Hours	1 Year	1 Hour	8 Hours	24 Hours	1 Year
CO	mg/m ³	40	20	-	-	-	-	-	-
NO ₂		0.3	-	0.1	-	0.2	-	-	0.04
SO ₂		0.5	-	0.3	0.1	-	-	0.02	-
O ₃		0.2	-	-	-	-	0.1	-	-
Pb		-	-	0.005	-	-	-	-	-
TSP		-	-	0.33	0.1	-	-	-	-
PM ₁₀		-	-	0.05	-			0.05	0.02
PM _{2.5}		-	-	0.025	-			0.025	0.01

*Declaration on Uses of Term of Reference for Establishment of Factory and Handicraft (2018),

** IFC (2007). Environmental, Health, and Safety (EHS) Guideline: Noise Management (for Residential, institutional, educational)

(5) Noise and Vibration

Standards of noise are shown on the below table.

Table 4.1-4 Vehicles Noise Standards

No.	Category of Vehicle	Maximum Noise Level Permitted (dB(A))*
1	Motorcycle (cylinder capacity [CC] of engine not exceeding 125cm ³)	85
2	Motorcycle (CC of the engine exceeding 125cm ³)	90
3	Motorized tricycles	90
4	Car, taxi, passenger vehicle for carriage of less than 12 passengers	80
5	Passenger vehicle for carriage of more than 12 passengers	85
6	Truck (permitted maximum weight does not exceed 3.5 tones)	85
7	Truck (permitted maximum weight exceeding 3.5 tones)	88
8	Truck engine is more than 150 KW	89
9	Tractor or any other truck not classified elsewhere on this table	91

Source: *Declaration on Uses of Term of Reference for Establishment of Factory and Handicraft (2018)

Table 4.1-5 Ambient Noise (dB(A)) Standards

No.	Area	MoE standard*			IFC standard**	
		From 6:00 AM to 18:00	From 18:00 to 22:00	From 22:00 to 6:00 AM	From 7:00 AM to 22:00	From 22:00 to 7:00 AM
1	Quiet area: Hospital Libraries School Kindergarten	45	40	35	55	45
2	Residential area: Hotels Administration offices House	60	50	45		
3	Commercial and service areas and mix	70	65	50	70	70
4	Small industrial industries intermingling residential areas	75	70	50		

Source: *Declaration on Uses of Term of Reference for Establishment of Factory and Handicraft (2018),** IFC (2007). Environmental, Health, and Safety (EHS) Guideline: Noise Management (for Residential, institutional, educational)

Standards or regulation for vibration are not established.

(6) Water Quality

“Sub-Decree No: 27 ANRK BK on Water Pollution Control”, enacted in April 1999, stipulates that the Ministry of Environment (MOE) is responsible for monitoring water quality, inspecting, and reporting on pollution activities. Additionally, companies and organizations discharging or transporting wastewater must be licensed by the MOE.

Table 4.1-6 Surface Water Quality Standards

No.	Surface Water Quality Parameters	Unit	Standard*
1	Temperature	°C	<45
2	pH	-	6-9
3	Total Suspended Solid (TSS)	mg/l	<120
4	Dissolved Oxygen (DO)	mg/l	>1
5	Biochemical Oxygen Demand (BOD5)	mg/l	<80
6	Chemical Oxygen Demand (COD)	mg/l	<100
7	Total Nitrogen (TN)	mg/l	<6
8	Total Phosphorus (TP)	mg/l	<5
9	Total Dissolved Solid (TDS)	mg/l	<2000
10	Oil or Grease	mg/l	<15
11	Detergent	mg/l	<15
12	Sulfate (SO4)	mg/l	<500
13	Arsenic (As)	mg/l	<1
14	Iron (Fe)	mg/l	<20
15	Mercury (Hg)	mg/l	<0.05
16	Total Coliform	mg/l	<1000

Source: *Declaration on Uses of Term of Reference for Establishment of Factory and Handicraft, MoE (2018)

Table 4.1-7 Underground Water Quality Standards

No.	Parameter	Unit	Standards
1	pH	-	6.5-8.5
2	Turbidity	NTU	<5
3	Electrode Conductivity (EC)	NTU	500-1500
4	Total Dissolved Solid (TDS)	mg/l	<800
5	Total Hardness (CaCO ₃)	mg/l	<300
6	Chloride (Cl)	mg/l	<250
7	Fluoride (F)	mg/l	<1.5
8	Nitrate (NO ₃)	mg/l	<50
9	Sulfate (SO ₄)	mg/l	<250
10	Iron (Fe)	mg/l	<0.3
11	Arsenic (As)	mg/l	<0.05
12	Mercury (Hg)	mg/l	<0.001
13	Chromium (Cr)	mg/l	<0.05
14	Manganese (Mn)	mg/l	<0.1
15	Aluminum (Al)	mg/l	<0.2
16	Benzene (C ₆ H ₆)	mg/l	<0.01
17	Cadmium (Cd)	mg/l	<0.003
18	Total Coliform	MPN/100ml	0
19	E-Coli	MPN/100ml	0

Source: *Declaration on Uses of Term of Reference for Establishment of Factory and Handicraft, Ministry of Environment (2018)

(7) Ecosystem

Cambodia is a country rich in nature, and important ecosystems have been established as protected areas. Major protected areas in the vicinity of the project site are listed in the below table.

Table 4.1-8 Major Protected Areas around Sub-Projects

Parks/Wildlife Reserves/ Conservation Areas	Location	Physiographic Region	Park Area (ha)	Forest Cover Area (ha)	Characteristic Features
B. Wildlife Sanctuaries					
Aural Sanctuary, Sanctuary	Koh Kong Pursat, Kampong Chhnang, Kampong Speu, Pursat	Mountain-Coastal/ Tonle Sap	253.7	191,230	Highest mountain in Cambodia (5,810 ft) Vegetation ranging from dry dipterocarps to medium altitude evergreen forest; larger parts are botanically not described Wildlife includes tiger, bunting and gaur endangered Eld's deer

Parks/Wildlife Reserves/ Conservation Areas	Location	Physiographic Region	Park Area (ha)	Forest Cover Area (ha)	Characteristic Features
Roiem Daun Sam Sanctuary	Battambang, Banteay Meanchey	Tonle Sap	178.8	2,499	<ul style="list-style-type: none"> Lowland evergreen and semi-evergreen forest, Unknown condition; no forest exists across the Thai border Wildlife possibly includes pileated gibbon (endangered primate)
C. Protected Land Scape					
Banteay Chhmar	Banteay Meanchey Oddar Meanchey	Tonle Sap	81.2	8,010	Archaeological and cultural sites, including an important temple site
D. Multiple Use Management Area					
Samlaut	Battambang Pailin	Tonle Sap	60	46,619	<ul style="list-style-type: none"> Evergreen forest, watershed of Battambang River Exploited by mining, operations causing severe erosion and increased sedimentation of the river, flowing in to the Tonle Sap Lake
Tonle Sap	Kampong Chhnang Kampong Thom Siem Reap Battambang, Pursat	Tonle Sap	316.2	220,859	Long standing reserve and ichthyological reserve; biological, hydrological, and cultural/economic importance

Source: Ministry of Environment

Table 4.1-9 Major Wetlands in Pursat and Kampong Chhnang

Identified Wetlands	Location	Province/ Municipality	Elevation Average(m)	Area (ha)			Wetland Types	Soil Types
				Water Surface	Marsh	Total		
A. Fresh Wetlands								
O Chang Rung Lake	About 25 km N of Pursat Provincial town	Pursat	15.3	11,500	43,500	55,000	Lakes, flooded forest, marshes, and rice fields	Grey hydromorphic and mud
Boeung Chhamar	About 23 km N of Phnom Krakor	Pursat	24	20,000	13,000	33,300	Forest, rice field, and marshes	Lacustrine alluvial

Identified Wetlands	Location	Province/Municipality	Elevation Average(m)	Area (ha)			Wetland Types	Soil Types
				Water Surface	Marsh	Total		
Boeung Veal Pok	10 km from Kampong Chhnang provincial town	Kampong Chhnang	198	20,000	36,000	56,000		Acid lithosol and Lacustrine alluvial

Source: Ministry of Environment

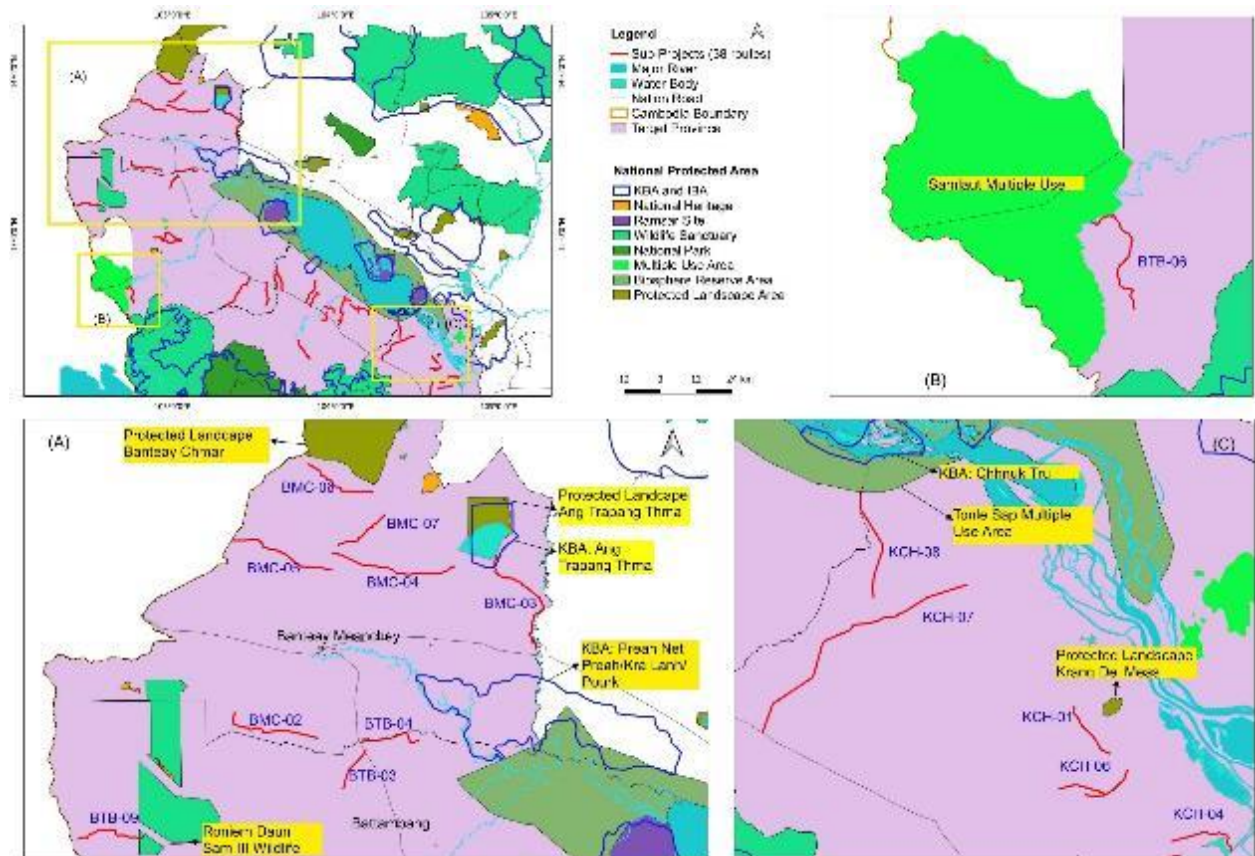
Six routes of the sub-projects (BMC-3, BMC-4, BMC-6, BTB-6, BTB-9, KCH-1, and KCH-8) are located near national protected areas, KBAs, and IBAs. Among these, a portion of BMC-3 was confirmed to be within a protected area. However, since a section within the projected area of BMC-3 has been already developed, the part was excluded from the project.

Table 4.1-10 Sub-Projects near Protected Areas

Details on Protected Areas near Sub-Projects						
Sub-Project	Category	Type	Name	IUCN management category IBA Criteria *1	Vulnerable species (IUCN) *2	Summary
BMC-3	National designation	Protected Landscape	Ang Trapeang Thmor	VI (Landscape protection area)	CR3 EN9 VU16	Touches the border of protected landscape and crosses the KBA
	KBA		Ang Trapeang Thmor			
BMC-4	National designation	Protected Landscape	Ang Trapeang Thmor			Located about 4 km to KBA and 4.4 km to protected landscape
BMC-6	National designation	Protected Landscape	Banteay Chhmar			Located about 1.8 km close to Banteay Chhmar
BTB-6	National designation	Multiple Use Area	Samlaut	VI (Resource Conservation Areas)	CR2 EN6 VU19	Closest point to multiple use area is located at 130 m
BTB-9	National designation (Has been dissolved)	Wildlife sanctuary	Roniem Daun Sam III			10 km-section located inside Roniem Daun Sam III wildlife sanctuary
KCH-1	National designation	Protected Landscape	Krang Dei Meas			2.5 km to Phnom Krang Dei Meas protected landscape

Details on Protected Areas near Sub-Projects						
Sub-Project	Category	Type	Name	IUCN management category IBA Criteria *1	Vulnerable species (IUCN) *2	Summary
	12					
KCH-8	National designation	Multiple Use Area	Tonle Sap (Biosphere Reserve)	VI(Resource Conservation Areas)	CR3 EN9 VU16	Close to multiple use area, at a distance of 350 m
	KBA		Chhnuk Tru			Closest point is at 3.4 km

Source: Ministry of Environment



Source: MoE-2017, ODC-2013

Figure 4.1-9 Protected Areas near Sub-Projects

¹² Sub-decree No. 61 on the establishment of Phnom Krang Dei Meas protected landscape area (2019)

(8) Historical Heritage

There are many important historical sites in Cambodia, including World Heritage sites. The following is a list of important historical sites in the vicinity of the project site. Note that Kangva Hill Ancient, which is on the boundary between PS and KCH is located close to KCH-8. However, due to the separation distance of about 5 km, no negative impact is expected to occur.

BMC

- Tepkaosa Snay Archaeological Site dates to the Iron age¹³
- The Archeological Complex of Banteay Chhmar was an ancient site in the Angkorian period (802-1432)¹⁴

BTB

- Laang Spean is a prehistoric cave site on top of a limestone hill¹⁵

PS

- The ancient Buddhist carving being discovered in Kangva Hill

KCH

- Ancient city of Oudong was the capital of the post-Angkorian period, from the 17th to the 19th century.¹⁶
- Samrong Sen village is where the archaeological site is situated.¹⁷



Source: UNESCO

Figure 4.1-10 Archeological or Cultural Sites near Sub-Projects

¹³ Archaeology and Archaeozoology of Phum Snay: A Late Prehistoric Cemetery in Northwestern Cambodia

¹⁴ <https://web.archive.org/web/20210122224704/http://whc.unesco.org/en/tentativelists/6456>

¹⁵ <https://www.jstor.org/stable/40386114>

¹⁶ <https://whc.unesco.org/en/tentativelists/6459/>

¹⁷ A study of polished stone tools from Samrong Sen, Cambodia: the French Museum collections"

(9) Ethnic Minority/Indigenous Peoples

The Government of Cambodia (GOC) defines "indigenous peoples" as people who have their own language, culture, traditions, and customs different from those of the Khmer people¹⁸. Currently, there are 22 identified indigenous peoples known as "Hill Tribes"¹⁹. Many of them are living in remote areas.

The table below lists the indigenous peoples/minorities living in the four target provinces of Kampong Chhnang, Battambang, Banteay Meanchey, and Pursat²⁰.

Table 4.1-11 Ethnic Minority/Indigenous Peoples near Sub-Projects

Province	Ethnic Minority Group
Battambang	Jarai, Stieng, and Ja'ong
Pursat	Jarai, and Poar
Banteay Meanchey	Jarai
Kampong Chhnang	Jarai

Source: Final Draft Report of Census of Indigenous Peoples in Cambodia, Ministry of Planning, 2018.

No such indigenous/minority residential areas have been identified in the vicinity of the project site. On the other hand, there are many indigenous peoples who have migrated from their original areas of residence to more developed areas due to work, education, marriage, etc. There are several villages around the project site that are believed to be inhabited by indigenous peoples. However, these indigenous peoples speak Khmer and are well assimilated into the areas to which they have been relocated. Worldbank OP4.10 Indigenous Peoples does not meet the definition of indigenous peoples, particularly in terms of attachment to and dependence on the land and its resources (b below) and use of their own language (d below).

Definition of indigenous peoples on Worldbank OP4.10 – Indigenous Peoples

- (a) self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;
- (b) collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;
- (c) customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and
- (d) an indigenous language, often different from the official language of the country or region.

(10) Socioeconomic Conditions

See "2.1.3 Social Conditions"

¹⁸ National Policy for the Development of Indigenous Peoples, 2009

¹⁹ National Report on Demographic and Socio-economic Status of IPs in Cambodia, CIPO, 2013

²⁰ Final Draft Report of Census of Indigenous Peoples in Cambodia, MoP, 2018

4.1.3 Assessment of Legal Framework and Institutional Capacity

(1) Legal System for Environmental Assessment and Environmental Management

In 1996, the “Law on Environment Protection and Natural Resources Management” was enacted, followed in 1999 by enactment of the “Sub-Decree on Environmental Impact Assessment Process”, stipulating projects and a public participation process that required the submission of an EIA report. Since then, it has been implemented based on the following guidelines and laws related to EIA.

- The Prakas (Declaration) on General Guidelines for Conducting Initial and Full Environmental Impact Assessment Reports (2009)
- The Joint Prakas (Declaration) on the Establishment of Service fee for Reviewing report of EIA and Monitoring the Project implementation (2000 and 2012)

In 2020, “Prakas No. 021 on the Classification of Environmental Impact Assessment for Development Projects” was enacted. As a result, three necessary procedures were established according to the type and scale of the project/business.

Environmental Management Contract (EMC)

Procedures for projects that have a minor impact on the environment and society. The preparation and submission of an Environmental Management Project (EMP) is required.

Initial Environmental Impact Assessment (IEIA)

The submission of an IEIA report is required for projects that have a moderate impact on the environment and society.

Full Environmental Impact Assessment (Full EIA)

The submission of a full EIA report is required for projects that have a significant impact on the environment and society.

(2) Objectives and Policies for Preparation and Implementation of Sub-Projects

Rehabilitation of roads with a length of less than 30 km is foreseen within some of the sub-projects of this project. In accordance with Prakas No. 021, EMC procedures are required for road construction of 10 km or more and with a total length of less than 30 km. Therefore, 26 routes among sub-projects are expected to fall under this category.

In Cambodia's EIA system, regarding IEIA and Full EIA, the “General Guidelines for Conducting Initial and Full Environmental Impact Assessment Reports” describes the contents to be implemented in the assessment and prescribes guidelines for public consultations. Within this framework, only in the case of EMC, public consultations and information disclosure are not required. Furthermore, implementation of the sub-projects must additionally comply with JICA Guidelines for Environmental and Social Considerations, January 2022 (hereinafter referred to as JICA GL). Therefore, in order to comply with both frameworks, it will be necessary to conduct public consultations.

Under Cambodia's EIA system, road projects of less than 10 km do not require environmental impact assessments or permits. However, because it is expected to be classified as Category B within JICA GL, a survey equivalent to EMC is requested to be conducted to avoid or minimize negative impacts.

(3) Adequacy of the Executing Agency's Institutional Capacity in Implementing National Laws and JICA Requirements

The implementing agency, MRD, has established a section for environmental and social considerations in the Department of Rural Roads (DRR), which has jurisdiction over this project. In addition, the Project Management Unit (PMU), which will be established in conjunction with the implementation of the project, will also have a section for environmental and social considerations, and thus organizational support for environmental and social considerations for the project is possible.

On the other hand, MRD has no experience in implementing JICA-supported projects. Consequently, MRD currently has no experience in assessing environmental and social considerations in line with JICA GL, nor does it have sufficient understanding of the contents of such considerations. In the D/D phase after the selection of the project, MRD will conduct an EIA and other environmental studies, as well as RAP studies. For the implementation of the environmental and social considerations, following supports are desired.

- Environmental and Social Considerations:

MRD has experience in conducting environmental procedures in line with Cambodia's EIA system in the course of implementing other projects. On the other hand, MRD has no experience in JICA projects, and therefore, it is desired that D/D consultants provide sufficient support to address the gap between the legal system of Cambodia and JICA GL. In particular, proper explanation to MRD is required for matters that fall outside of the EIA system but are essential for JICA GL. (i.e., implementation of public consultation for EMC-eligible projects, and implementation of EMC-equivalent studies for sub-projects that do not require EMC).

- Land acquisition and involuntary resettlement:

In the same way as with environmental and social considerations, adequate support is desired from D/D consultants.

- Employment of consultants:

MRD has hired specialized consultants for past projects. The project needs to conduct the survey in line with JICA GL and, given that MRD has no experience in JICA projects, it is strongly recommended that the survey be conducted by a consultant with experience in surveying multiple JICA projects. Although MRD provided the JICA Survey Team with a list of consultants it had hired in the past, none were identified to have experience in JICA projects.

4.1.4 Anticipated Environmental Impacts

(1) Project Characteristics on the Environmental and Social Considerations

Since this project is an improvement project for existing rural roads, the scale of construction of each sub-project is small. Land modification is minimal, and resettlement is not required.

(2) Draft Scoping and Prediction of Environmental and Social Impacts

A scoping was conducted based on the JICA GL for the expected environmental and social impacts of this project.

Table 4.1-12 Draft Scoping and Prediction of Environmental and Social Impacts

Classification	No.	Impact Items	Before/during Construction	On Operation	Prediction of Impacts
Pollution Control	1	Air Pollution	✓	✓	<p>During Construction:</p> <ul style="list-style-type: none"> Exhaust gas is expected to be generated from construction work and the operation of construction machinery. <p>On Operation:</p> <ul style="list-style-type: none"> This project will not change traffic volume for the entire region: Roadside air pollution may occur due to the shift of traffic to the improved roads. However, it is also expected that pollutant emissions will decrease due to the increased travel speeds resulting from the improvement. The generation of roadside dust is greatly reduced.
	2	Water Quality	✓		<p>During Construction:</p> <ul style="list-style-type: none"> Turbid water from construction work may flow into the river. <p>On Operation:</p> <ul style="list-style-type: none"> Since this project is a road improvement project, it is not expected to cause water pollution during operation.
	3	Waste	✓		<p>During Construction:</p> <ul style="list-style-type: none"> This project is an improvement project for existing roads, a significant amount of waste is not expected to be generated during construction. However, demolition of existing structures or activities of construction workers may generate waste. <p>On Operation:</p> <ul style="list-style-type: none"> No waste is expected from road use.
	4	Soil Contamination			<p>During Construction:</p> <ul style="list-style-type: none"> This project is an improvement project for existing roads, there are no factors that cause soil contamination. <p>On Operation:</p> <ul style="list-style-type: none"> There are no factors that cause soil contamination due to the operation of this project.
	5	Noise and Vibration	✓	✓	<p>During Construction:</p> <ul style="list-style-type: none"> Noise generated by construction work may affect neighboring residential areas. <p>On Operation:</p> <ul style="list-style-type: none"> Traffic noise may affect roadside residential areas.
	6	Ground subsidence			<p>During Construction:</p> <ul style="list-style-type: none"> This project is an improvement project of the existing road, there is no possibility of causing land subsidence. <p>On Operation:</p> <ul style="list-style-type: none"> This project is a general road, it is not foreseen for the load on the road to cause land subsidence.
	7	Odor			<p>During Construction:</p> <ul style="list-style-type: none"> No odorous materials or equipment are used in the construction work, therefore no strong odors are expected. <p>On Operation:</p> <ul style="list-style-type: none"> There are no projects that generate strong odors after operation.
	8	Sediment			<p>During Construction:</p> <ul style="list-style-type: none"> Since there is no direct construction activity on the surrounding rivers, the diffusion of sediment from these rivers is not expected. <p>On Operation:</p> <ul style="list-style-type: none"> There are no factors that affect the bottom sediment.

Classification	No.	Impact Items	Before/during Construction	On Operation	Prediction of Impacts
Natural Environment	9	Protected Area			<p>During Construction:</p> <ul style="list-style-type: none"> • Three sub-projects are located in the vicinity of the protected area. However, the projects are implemented almost entirely within the existing road, and furthermore, the scale of the construction work is small, with the nearest one separated by a sufficient distance of 50 to 100 meters across National Highway No.5. Therefore, the negative impacts of the construction work are small. <p>On Operation:</p> <ul style="list-style-type: none"> • No factors are expected to affect the protected area due to the improved road.
	10	Ecosystem			<p>During Construction:</p> <ul style="list-style-type: none"> • This project is an improvement project for existing roads and will not cause loss of the ecosystem. In addition, the negative impacts on the surrounding ecosystem are expected to be negligible as the construction work will be small scale. <p>On Operation:</p> <ul style="list-style-type: none"> • This project is an improvement of the existing road, and it is not expected that the improved road will have an impact on flora, fauna, and ecosystems.
	11	Hydrology			<p>During Construction • On Operation:</p> <ul style="list-style-type: none"> • The structures of this project will not interfere with the water flow of rivers
	12	Geographical features			<p>During Construction:</p> <ul style="list-style-type: none"> • This project is an improvement project of the existing road, there is no possibility of affecting the topography. <p>On Operation:</p> <ul style="list-style-type: none"> • Since this project is a road project, it is not expected that the project contents will affect the topography and geology during operation.
Social Environment	13	Land Acquisition and Involuntary Resettlement	✓		<p>Before Construction:</p> <ul style="list-style-type: none"> • Land acquisition and removal of structures are foreseen. On the other hand, involuntary resettlement including illegal residents is not expected. <p>On Operation:</p> <ul style="list-style-type: none"> • No additional resettlement or land acquisition is expected for the implementation of the project.
	14	Poor			<p>Before Construction:</p> <ul style="list-style-type: none"> • Since there will be no resettlement, impact on the poor is not expected. <p>During Construction/On Operation:</p> <ul style="list-style-type: none"> • The improvement of convenience through this project may have a positive impact on the economic situation of the poor.
	15	Ethnic minorities and indigenous peoples			<p>Before/During Construction/On Operation:</p> <ul style="list-style-type: none"> • The project sites are not inhabited by ethnic minorities and indigenous peoples.
	16	Local economies, such as employment, livelihood, etc.			<p>Before Construction:</p> <ul style="list-style-type: none"> • The scale of land acquisition is small and there is no possibility of lowering the livelihood of the affected people. <p>During Construction:</p> <ul style="list-style-type: none"> • A positive impact is expected as the construction work will create new jobs in the area. <p>On Operation:</p> <ul style="list-style-type: none"> • Shorter travel times and travel speed improvements are expected to contribute to the local economy. • Roadside development can positively affect lives, livelihoods, and communities.
	17	Land use and utilization of local resources			<p>During Construction/On Operation:</p> <ul style="list-style-type: none"> • This project is an improvement of existing roads and will not affect land use or use of local resources.
	18	Water usage			<p>During Construction/On Operation:</p> <ul style="list-style-type: none"> • This project is an improvement of existing roads and will not affect water use.

Classification	No.	Impact Items	Before/during Construction	On Operation	Prediction of Impacts
	19	Existing social infrastructures and services			During Construction/On Operation: • This project is an improvement of existing roads and will not affect existing social infrastructure and social services.
	20	Social structure such as social capital and local decision-making institutions			During Construction/On Operation: • This project is an improvement of existing roads and will not affect social institutions, such as social capital and local decision-making bodies.
	21	Misdistribution of benefits and damages			During Construction/On Operation: • Since this project is an improvement of existing roads, there is no possibility that uneven distribution of damage and benefits will occur.
	22	Local conflicts of interest			During Construction/On Operation: • As this project is an improvement of existing roads, there is no possibility of conflicts of interest occurring within the region.
	23	Cultural heritage			During Construction/On Operation: • This project is an improvement of existing roads, and there is no possibility of affecting cultural heritage. However, there is a need to confirm this aspect in the environmental survey after the project decision. If impacts are foreseen, appropriate mitigation measures are required.
	24	Landscape			During Construction/On Operation: • This project is an improvement project of existing roads, and there is no possibility of affecting the surrounding scenery.
	25	Gender			During Construction: • Employment created by construction work may have a positive impact on women's economic activity. On Operation: • This project is a project to improve the existing road, no impact on women's activities is expected.
	26	Children's rights			During Construction/On Operation: • This project is an improvement project of the existing road, negative impact on children's rights is not expected.
	27	Infectious diseases such as HIV/AIDS	✓		During Construction: • There is a risk of HIV/AIDS transmission among construction workers and related local businesses. On Operation: • This project is a project to improve existing roads, it is not expected that this project will increase the number of infectious diseases.
28	Working conditions	✓		During Construction: • There is a working risk to construction workers. On Operation: • No significant negative impact on the working environment is expected in the maintenance work of this project.	
Others	29	Accidents	✓	✓	During Construction: • There is a risk of accidents involving construction workers. On Operation: • Higher vehicle speeds may increase traffic accidents. • It is expected that the reduction of traffic volume on the existing road will contribute to the reduction of accidents.
	30	Trans-boundary impacts or climate change	✓		During Construction: • Construction work will generate CO ₂ emissions. On Operation: • CO ₂ emissions may be reduced as vehicle speed increases.

Source: JICA Survey Team

(3) Policies for Survey on Environmental and Social Considerations

Survey items and methods related to environmental and social considerations are shown in the table below.

Table 4.1-13 Draft Policies of Survey Items and Measures

	Items	Survey Items	Survey Measures
Pollution Control	Air Pollution	<ul style="list-style-type: none"> Environmental standards (Cambodia, IFC) Air quality baselines Construction machinery, construction methods foreseen on construction plan 	<ul style="list-style-type: none"> Review of existing materials Review of construction plan Review of traffic volume estimation
	Water Quality	<ul style="list-style-type: none"> Environmental standards Baselines of water quality of rivers around the Project site Construction methods 	<ul style="list-style-type: none"> Review of existing materials Field survey of water quality (visual inspection) Review of construction plan
	Waste	<ul style="list-style-type: none"> Laws and regulation of waste management Volume of estimated waste (demolition of existing structures, and construction activities) Construction methods 	<ul style="list-style-type: none"> Review of existing materials Field survey of structures along the sub-projects Review of construction plan
	Noise and Vibration	<ul style="list-style-type: none"> Environmental standards (Cambodia, IFC) Noise sources around the project site Location of hospitals, school and religious facilities which require high considerations Construction machinery, construction methods on construction plan Project plan 	<ul style="list-style-type: none"> Review of existing materials Field survey of noise sources (visual inspection) Review of maps Review of construction plan Review of project plan
Social Environment	Land Acquisition and Involuntary Resettlement	<ul style="list-style-type: none"> Affected areas based on Detail Design Livelihoods of affected persons Opinions and comments of affected persons 	<ul style="list-style-type: none"> Review of project scope Socioeconomic survey in RAP survey Conduction of stakeholder meetings and individual interviews
	Infectious diseases such as HIV/AIDS	<ul style="list-style-type: none"> Status of HIV/AIDS in Cambodia Scale of construction activities of the project 	<ul style="list-style-type: none"> Review of existing materials Review of construction plan Review of existing materials
	Working conditions	<ul style="list-style-type: none"> Expected status of working conditions 	<ul style="list-style-type: none"> Review of construction plan
	Accidents	<ul style="list-style-type: none"> Expected status of working conditions Safety plan of construction plan Road safety management of the project 	<ul style="list-style-type: none"> Review of construction plan Review of road safety foreseen in the project
Others	Trans-boundary impacts or climate change	<ul style="list-style-type: none"> Policies and legal framework on reduction of greenhouse gasses in Cambodia Construction plan, construction machinery which emits greenhouse gasses 	<ul style="list-style-type: none"> Review for existing materials Review of construction plan Review of ROW of the Project, field reconnaissance Estimation of reduction in emissions of greenhouse gasses due to the project

Source: JICA Survey Team

(4) Mitigation Measures against Major Negative Impacts

Based on information which is found as of now, expected mitigation measures against major negative impacts are shown on the below table.

Table 4.1-14 Mitigation Measures during Construction

	Item	Mitigation Measures	Costs	Responsibility
1	Air Pollution	<ul style="list-style-type: none"> • Continuous watering at construction sites to reduce dust generation • Appropriate and continuous maintenance of construction machinery to control emission gas • Formulation of a construction management plan to reduce the number of construction machines in operation and operating hours • Avoid unnecessary idling of machinery 	Included in construction cost	Contractor (Supervised by MRD)
2	Water Quality	<ul style="list-style-type: none"> • Protection of temporary soil placing 	Included in construction cost	Contractor (Supervised by MRD)
3	Waste	<ul style="list-style-type: none"> • Appropriate waste management (reduction and proper disposal) • Training for construction workers 	Included in construction cost	Contractor (Supervised by MRD)
5	Noise and Vibration	<ul style="list-style-type: none"> • Appropriate and continuous maintenance of construction machinery to suppress noise generation • Formulation of a construction management plan to reduce the operation time of construction machinery • Monitoring of construction noise • Continuous information sharing with the community 	Included in construction cost	Contractor (Supervised by MRD)
13	Land Acquisition and Involuntary Resettlement	<ul style="list-style-type: none"> • Appropriate implementation of land acquisition based on the resettlement plan 	Included in RAP cost	MRD
27	Infectious diseases such as HIV/AIDS	<ul style="list-style-type: none"> • Compliance with occupational health and safety standards • Implementation of education and information dissemination activities for construction workers to prevent infectious diseases 	Included in construction cost	Contractor (Supervised by MRD)
28	Working conditions	See “Infectious diseases such as HIV/AIDS” and “Accidents”	Included in construction cost	Contractor (Supervised by MRD)
29	Accidents	<ul style="list-style-type: none"> • Adherence to safety and health measures based on occupational safety and health standards • Examination of safety measures on the sub-projects 	Included in construction cost	Contractor (Supervised by MRD)
30	Trans-boundary impacts or climate change	<ul style="list-style-type: none"> • Reduce the number of construction machines in operation and operating hours through construction plans • Appropriate and continuous maintenance of construction machinery • Avoid idling of machinery 	Included in construction cost	Contractor (Supervised by MRD)

Source: JICA Survey Team

Table 4.1-15 Mitigation Measures on Operation

No	Item	Mitigation Measures	Costs	Responsibility
1	Air Pollution	• Since the negative impacts are expected to be extremely small, no special mitigation measures are required. However, it should be confirmed through monitoring.	MRD	MRD
5	Noise and Vibration	• Monitoring of roadside noise	MRD	MRD
29	Accidents	• Monitoring of safety facilities on the sub-projects	MRD	MRD

Source: JICA Survey Team

4.1.5 Environmental Assessment for Sub-projects and /or Components

(1) Screening for Sub-Project Selection in this Study

Projects that fall under Category A of JICA GL are excluded from this project.

There are some protected areas established by GOC in the vicinity of this project, including KBA and IBA. Sub-projects within and adjacent to these protected areas are likely to be classified as Category A. The location of protected areas was confirmed by checking related materials and consulting with the executing agency.

From this result, sub-projects that are expected to be in/around sensitive areas, including protected areas, were excluded. Two sub-projects, BTB6 and KCH8, were identified to be close to protected areas (Salmout and Tonle Sap) and BMC3 was found to be located at a distance of about 10 km away from a protected area. However, these three sub-projects are deemed to not be located in "critical habitats" (FAQ for JICA GL), details are described in 3.3.4.

Regarding settlements of indigenous peoples, it was confirmed that the sub-projects were not located within settlements of indigenous peoples, based on related materials and consultations with the executing agency.

(2) Preparation of Environmental Assessment and Environmental Management Plan

After the start of D/D, according to the scale of sub-projects, EMC procedures are to be taken based on the Cambodian EIA system. In principle, the EMC procedures require the submission of an EMP (Environmental Management Plan), which is prepared by the executing agency, excepted urgent and specialized projects decided by the Cambodian Government. The preparation of the EMP is basically consist of a desktop study, and is conducted by EIA consultants contracted by the executing agency. The EMP includes items required by JICA GL, such as the Environmental Monitoring Plan. The EMP is prepared roughly in two months.

Sub-projects with a length of less than 10 km are not covered by the system, but in order to ensure the avoidance and reduction of negative impacts, a survey equivalent to EMC should be carried out and confirmed.

(3) Environmental Criteria for Sub-Project Selection

The order of priority of sub-projects was examined in this survey. In the view of the environment and society, the project content is the same, and there are no major differences from the perspective of the surrounding environment. It is recommended to select the order of priority based on the following viewpoints.

- Road length: Sub-projects with long road extensions are expected to have a large impact on the environment and society.
- Quantity of construction: It is expected that sub-projects with small construction quantity will have less environmental impacts such as air quality and noise.
- Population along the roads: It is expected that sub-projects with large population along the road will contribute to social benefits.

In case resettlement is expected to occur in the sub-projects, resettlement will be avoided by reducing the scope of the sub-projects.

4.1.6 Consultation, Information Disclosure, and Grievance Redress Mechanism

(1) Method of Consultation with Stakeholders

Under Cambodia's EIA system, public consultations with stakeholders including residents are required for projects that require Full EIA. Although, public consultations are not required in the EMC procedures for this project, in order to satisfy JICA GL, public consultations will be held. Also, for sub-projects (roads of 10 km or less) for which EMC is not required, public consultation will be also held. The public consultations will be held twice for each area, before the implementation of the EMC study and after the preparation of the EMP. On the public consultations, consents of stakeholders should be acquired.

(2) Information Disclosure

In Cambodia's EIA system, public consultation is regarded as a means of information disclosure of projects. However, although public consultation is essential for large scale projects which require full EIA, it is not essential for medium or small projects corresponding the EIEA or EMC. Therefore, there are no opportunity of information disclosure for the medium or small projects. To address the gap between the EIA system of Cambodia and JICA GL, public consultations will be carried out in this project as means of information disclosure. Results of monitoring of sub-projects will be disclosed by MRD on their website. And JICA will also disclose it on the website of JICA.

(3) Grievance Redress Mechanism (GRM)

The Social and Environmental Section of the PMU, which will be established under this project, will be in charge of handling complaints related to the environment and society. Details of the grievance redress mechanism are described in the Resettlement Policy Framework.

4.1.7 Institutional Arrangement and Responsibilities

(1) Role of MRD

During the detailed design phase, in principle, MRD needs to carry out the EMC procedures. MRD is responsible for conducting EMC procedures from EMP preparation. MRD will hire a professional consultant to assist with the EMC procedures. Since MRD has no experience with JICA projects, it is strongly recommended that the professional consultants have experience in JICA projects in order to conduct studies in line with the JICA Environmental and Social Guidelines.

MRD regularly reports to JICA on the progress and content of environmental and social considerations.

EMP should be prepared for all sub-projects, including sub-projects which length is equal and less than 10 km.

(2) Role of JICA

Based on the report submitted from MRD during the detail design phase, the status of implementation of environmental and social considerations for each sub-project will be confirmed by JICA. Main items which should be confirmed are listed below.

- Progress of EMP study and EMC procedure
- Prediction of negative impacts on environmental and social conditions
- Mitigation measures against the negative impacts
- Monitoring measures

If there are any issues regarding the confirmed items, JICA will give necessary instructions.

4.1.8 Monitoring and Reporting

Monitoring, developed in the EMP, will be conducted during construction by contractors (or C/S

consultant). Results are to be reported to the Social & Environmental Section of the PMU for their revision. Once the results have been reviewed, the monitoring reports are to be submitted to JICA. Outlines of Monitoring Plan and Monitoring Report are shown on the below Tables.

Table 4.1-16 Monitoring Plan During/Before Construction

No	Items	Monitoring Method	Locations	Frequency	Cost	Responsibility
1	Air Pollution	Confirmation of environmental measures in construction plans	-	Before commencement of construction	Included in consultant fee	Consultant (MRD)
		On-site confirmation of the implementation status of environmental measures in construction work	Each construction site	During construction	Included in consultant fee	Consultant (MRD)
2	Water Quality	Confirmation of environmental measures in construction plans	-	Once before commencement of construction	Included in consultant fee	Consultant (MRD)
		On-site confirmation of the implementation status of environmental measures in construction work	Each construction site	During construction	Included in consultant fee	Consultant (MRD)
3	Waste	Confirmation of environmental measures in construction plans	-	Once before commencement of construction	Included in consultant fee	Consultant (MRD)
		On-site confirmation of the implementation status of environmental measures in construction work	Each construction site	During construction	Included in consultant fee	Consultant (MRD)
5	Noise and Vibration	Confirmation of environmental measures in construction plans	-	Once before commencement of construction	Included in consultant fee	Consultant (MRD)
		On-site confirmation of the implementation status of environmental measures in construction work	Each construction site	During construction	Included in consultant fee	Consultant (MRD)
14	Land Acquisition and Involuntary Resettlement	Confirmation of implementation records of land acquisition and resettlement	-	During the period of land acquisition and resettlement	RAP	Consultant (MRD)
27	Infectious diseases such as HIV/AIDS	Confirmation of construction safety plan	-	Before commencement of construction	Included in consultant fee	Consultant (MRD)
		Confirmation of construction records • Implementation status of construction safety plan	Each construction site	During construction	Included in consultant fee	Consultant (MRD)
28	Working conditions	See "Infectious diseases such as HIV/AIDS".				
29	Accidents	Confirmation of construction safety plan	-	Before commencement of construction	Included in consultant fee	Consultant (MRD)

No	Items	Monitoring Method	Locations	Frequency	Cost	Responsibility
		Confirmation of records of construction •Implementation status of construction safety plan	Each construction site	During construction	Included in consultant fee	Consultant (MRD)
30	Trans-border impacts or climate change	•Maintenance of construction machinery •Confirmation of records of construction •Maintenance status of construction machinery •Construction machinery operation status, fuel consumption	Each construction site	During construction	Included in consultant fee	Consultant (MRD)

Source: JICA Survey Team

Table 4.1-17 Monitoring Plan on Operation

No	Items	Monitoring Method	Locations	Frequency	Cost	Responsibility
1	Air Pollution	Field survey (visual inspection)	Roadside	Once per year during after two years of completion of the projects	Included in consultant fee	MRD (committed to consultant)
5	Noise and Vibration	Field survey (visual inspection)	Roadside	Once per year during after two years of completion of the projects	Included in consultant fee	MRD (committed to consultant)
29	Accidents	Monitoring of safety facilities on the sub-projects	MRD	Once per year during after two years of completion of the projects	Included in consultant fee	MRD (committed to consultant)

Source: JICA Survey Team

Table 4.1-18 Monitoring Report

	During construction	On operation
Preparation of Monitoring Report	Contractor	MRD (executing agency)
Contents	<ul style="list-style-type: none"> • Progress and results of construction work • Monitoring results • Implementation status of mitigation measures • Issues to be addressed • Others 	<ul style="list-style-type: none"> • Performance of the project • Monitoring results • Implementation status of mitigation measures • Issues to be addressed • Others
Frequency of Submission	Four times/year during the construction period	Once per year
Destination of Report	JICA	JICA
Preparation of Monitoring Report	MRD/Consultant The monitoring reports of environmental and social considerations will be submitted along with the Project Status Reports (PSR).	MRD/Consultant

Source: JICA Survey Team

During the detailed design (D/D) phase, monitoring forms for each sub-project will be prepared by D/D consultants.

4.1.9 Preparation of Environmental and Social Management System Check List

The Environmental and Social Management System (ESMS) was prepared for this project.

Table 4.1-19 Checklist for ESMS of Executing Agency

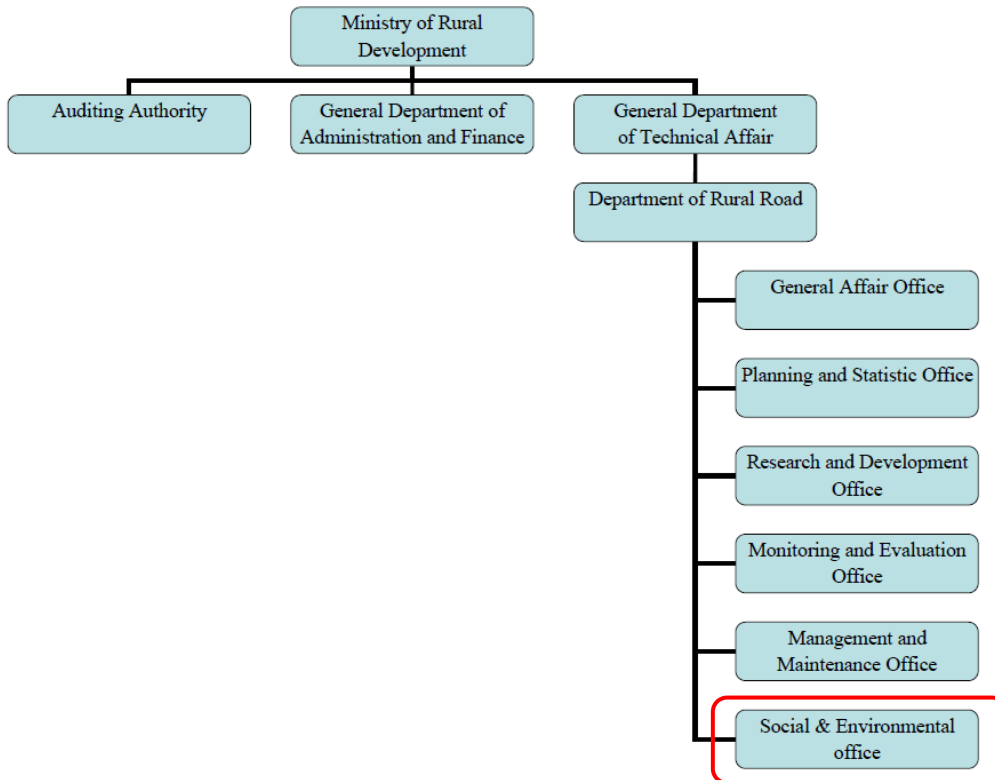
No.	Questions (English)	Answer	Improvement Plan
1. Policy			
(1)	Does the executing agency have any formal environmental or social policy or procedures? If yes, please describe them and provide appropriate documentation. If no, does the executing agency have any plan to set such policy or procedures?	MRD (Ministry of Rural Development) does not have any formal environmental and social policy or procedures. As of now MRD has no plan of formulating these policy or procedures. MRD is implementing their projects under environmental policy and law including EIA system and JICA Guidelines.	For this project, there is no need for special policy or procedures of environmental and social considerations. The project will be implemented under the EIA system of Cambodia and JICA Guidelines.
(2)	Are there any types of projects in which the executing agency will not take part due to the environmental and social risks? (e.g., projects involving handling of hazardous wastes or endangered plants or animals).	There is no restriction on the project scope of MRD. For the implementation of projects which cause significant negative impacts, the projects will be implemented with appropriate mitigation measures.	None for this project.
2. Procedures			
(3)	Does the executing agency have any environmental and social procedures such as screening, categorization and environmental review? If yes, please describe.	Projects of MRD are implemented under the Law on Environmental Protection and Natural Resources Management, 1996, including EIA procedures. There are no individual law systems of MRD such as screening methods and environmental reviews.	None.
(4)	Please describe how you ensure that your sub-projects are operated in compliance with the national laws and regulations and applicable JICA's requirements.	MRD will implement the project under the environmental laws and JICA Guidelines, with support of JICA. MRD hopes supports of consultants who have experiences of JICA projects.	On each phase after L/A, JICA will assist the implementation of the environmental and social considerations by assignment of environmental & social specialists.
(5)	How are environmental considerations taken into account in the credit review and approval process for project loans or equity investments? (For financial intermediary only)	-	-
(6)	How are environmental issues taken into account in deciding whether offer or extend commercial credit, working capital finance, trade finance, payment services and other financial services to a company? (For financial intermediary only)	-	-
3. Organization and Staff			

No.	Questions (English)	Answer	Improvement Plan
(7)	Please provide us with the organization chart of the executing agency's Environmental and Social Management System (ESMS).	Under Department of Rural Road (DRR), there is Social & Environmental Office. Organization chart is attached. During the project implementation, S&E Office will handle the ESMS.	None.
(8)	Who is responsible for environmental and social management within the executing agency? (name/role and title)	The S&E section of the PMU has responsibility. Responsible person: Mr. CHHUN Chamroeun (SEO Officer)	None.
(9)	Are there any staff with training for environmental and social considerations in the executing agency? If so, describe.	Staff members are getting training and experiences through the project implementation.	In future, technical assistance for E&S is preferable.
(10)	Are there any technical staff with an engineering/industry background responsible for technical analysis of credit proposals?	Yes. There are engineering staff in the related sections of MRD.	None.
(11)	What experience, if any, does the executing agency have of hiring or dealing with environmental consultants?	Environmental consultants have been hired for EMC (EIA) study and procedures of projects.	For this project, hiring of environmental consultants who have experiences of JICA projects is desirable because MRD has limited experiences of JICA projects.
(12)	What was the budget allocated to the ESMS and its implementation during a year? Please provide budget details including staff costs and training as well as any actual costs.	Budget is allocated under each project. Therefore, there are no fixed costs.	None.
4. Monitoring and Reporting			
(13)	Does PMU receive environmental and social monitoring reports from contractors?	Yes.	None.
(14)	Please describe how PMU monitor the contractors of the sub-projects and social and environmental performance of the sub-projects?	S&E section of PMU has responsibility for monitoring and reporting to the PMU management.	None.
(15)	Is there an internal process of PMU to report on social and environmental issues to senior management of MRD?	Yes.	None.
(16)	Does MRD prepare any social and environmental reports: <ul style="list-style-type: none"> • For other multilateral agencies or other stakeholders • E&S reporting in the Annual Report 	Yes. MRD prepares reports for each project.	MRD will prepare EMP based on Cambodia EIA system and JICA Guidelines for each sub-project. According to the EMPs, MRD conducts monitoring. Before/during the implementation of the sub-projects, the EMPs and monitoring reports will be disclosed on MRD's website and offices of PDRD.
5. Experience			
(17)	Has the executing agency signed any national or international agreements or	<u>1.International Agreement</u> a. United Nations	None.

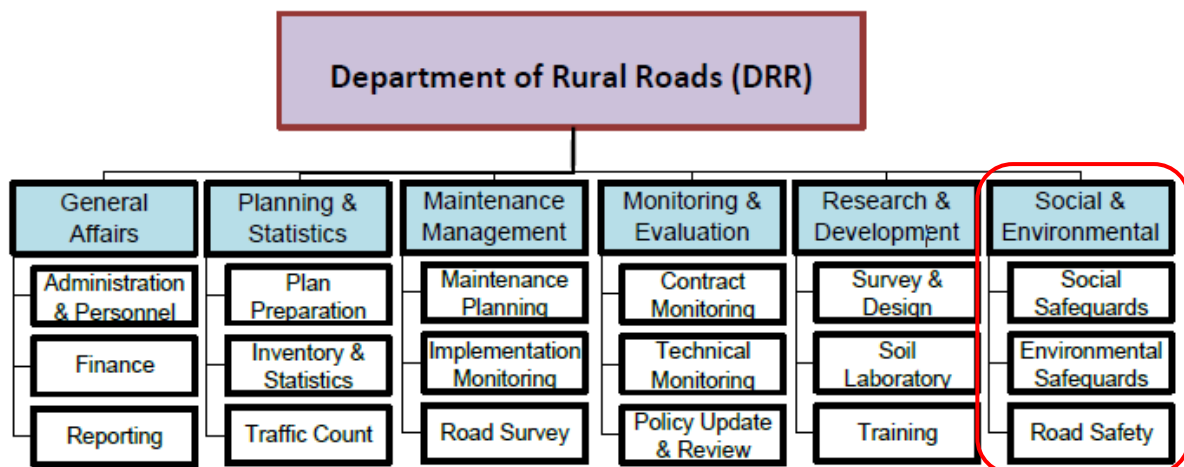
No.	Questions (English)	Answer	Improvement Plan
	<p>declarations concerning environmental issues?</p>	<p>Educational, Scientific and Cultural Organization (UNESCO) World Heritage Convention, 1991 b. Convention on Biodiversity, 1995 c. United Nations Framework Convention on Climate Change (UNFCCC), 1995 d. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1997; e. UNESCO Network of Biosphere Reserves in 1997 f. Ramsar Convention on Wetlands of International Importance, especially as Waterfowl Habitat, 1999 g. Basel Convention on the Control of Trans-boundary Movements of the Hazardous Wastes and Their Disposal, 2001 h. Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol on Substances that Deplete the Ozone Layer, 2001.</p> <p><u>2. Regional Agreement</u> a. Association of Southeast Asian Nations (ASEAN) agreements: (i) on Trans-boundary Haze Pollution in 2006 b. Disaster Management and Emergency Response in 2009 c. Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin (or the Mekong Agreement) in April 1995.</p>	
(18)	<p>Has the executing agency ever received any criticism of its environmental record? If so, what was the criticism?</p>	<p>No, there was no major criticism. On each project implementation, there were small grievances such as dust due to construction activities.</p>	<p>Grievance mechanism in the PMU should be examined sufficiently.</p>
(19)	<p>Does the executing agency carry out environmental audits of its properties to analyze health and safety issues, waste disposal, etc?</p>	<p>No.</p>	<p>None.</p>
(20)	<p>Please state any difficulties and/or constrains related to the implementation of the ESMS.</p>	<p>None.</p>	<p>None.</p>
<p>6. Need of Capacity Development and Improvement Plan</p>			

No.	Questions (English)	Answer	Improvement Plan
	<p>The implementing agency (MRD) has a section for environmental and social considerations in the Department of Rural Roads (DRR), which has jurisdiction over this project. In addition, the Project Management Unit (PMU), which has been established in conjunction with the implementation of the Project, has a section for environmental and social considerations, and thus organizational support for environmental and social considerations for the Project is possible. On the other hand, MRD has no experience in implementing JICA-supported projects. Therefore, MRD has no experience in environmental and social considerations in line with JICA GL, nor does it have sufficient understanding of the contents of JICA GL. In the D/D phase after the selection of the sub-projects, MRD will conduct an EIA and other environmental studies, as well as RAP studies. For the implementation of the environmental and social considerations, following supports are desired:</p> <ul style="list-style-type: none"> • Environmental and Social Considerations: MRD has experience in proceeding environmental procedures in line with Cambodia's EIA system in the course of implementing other projects. On the other hand, MRD has no experience in JICA projects, and therefore, it is desired that D/D consultants provide sufficient support to fill the gap between the legal system of Cambodia and JICA GL. In particular, sufficient explanation for MRD is required for matters that fall outside of the EIA system but are essential for JICA GL. (i.e., implementation of public consultation for EMC-eligible projects, and implementation of EMC-equivalent studies for sub-projects that do not require EMC); • Land acquisition and involuntary resettlement: As same as environmental and social considerations, adequate support is desired from D/D consultants; and • Employment of consultants: MRD has hired specialized consultants for the past projects. The project needs to conduct the survey in line with JICA GL, given that MRD has no experience in JICA projects, it is strongly recommended that the survey be conducted by a consultant with experience in surveying multiple JICA projects. 		

Source: JICA Survey Team



Source: MRD



Source: MRD

Figure 4.1-11 Organization Chart of MRD and DRR

A Project Management Unit (PMU) will be established for each project. The PMU also includes a social and environmental (S&E) section. The S&E section of the PMU directly manages ESC on each project.

4.2 Preparation of Resettlement Policy Framework

It is planned that ARAP will be prepared in the D/D stage, after target roads have been determined. The Resettlement Policy Framework was prepared during this study.

Table 4.2-1 Resettlement Policy Framework

	Element	Description
1	A brief description of the project and components for which land acquisition and resettlement are required, and an explanation why ARAP cannot be prepared by project appraisal	<ul style="list-style-type: none"> ✓ <u>Project type</u>: Road Improvement Project (total:38 roads, around 530km), (Target road for ARAP: 23 roads, 168.2km) ✓ <u>Target area</u>: Along National Road No.5 in, Banteay Meanchey, Battambang, Pursat, and Kampong Chhnang (4 provinces) ✓ <u>Current Situation</u>: Even though Target roads are selected, still not decided which road will be candidate finally. ARAP will be conducted during detailed design stage. So far, only land acquisition is expected for this project. Resettlement is not expected for this project.
2	Principals and objectives governing resettlement preparation and implementation	<p>Principals and objectives of this framework are line with relevant laws and decree in Cambodia.</p> <ul style="list-style-type: none"> ✓ Constitution of the Kingdom of Cambodia (1993) ✓ Land Law (2001) ✓ Expropriation Law (2010) <p>For externally funded projects, there is the guideline named:</p> <ul style="list-style-type: none"> ✓ <u>Sub-Decree No.22 ANK/BK: Land Acquisition and Involuntary Resettlement -Standard Operating Procedures for Externally Financed Projects in Cambodia (2018)</u> <p>In addition to the above, this project will refer to the following frameworks:</p> <ul style="list-style-type: none"> ✓ JICA Guidelines for Environmental and Social Considerations (2022) ✓ The World Bank Environmental and Social Framework (2017)
3	A description of the process for preparing and approving resettlement plans	<ol style="list-style-type: none"> 1. Preparing Basic Resettlement Plan or Resettlement Framework (in case of sub projects cannot be prepared before appraisal) by Executing Agency (EA/MRD); 2. Preparing Detailed Resettlement Plan by General Department of Resettlement (GDR) in Ministry of Economic and Finance (MEF); 3. Updated Detailed Resettlement Plan; 4. <u>Approved by Inter-Ministerial Resettlement Committee (IRC)</u>; 5. Implementation of Detailed Resettlement Plan (DRP); 6. Monitoring and Evaluation (Internal and External); <p>The Process is shown in Figure-1 below. <i>Source: Land Acquisition and Involuntary Resettlement –Standard Operating Procedures for Externally Financed Projects in Cambodia (LA-IR/SOP 2018)</i></p>
4	Estimated population displacement and likely category of displaced persons, to the extent feasible	<p>Estimated number of affected people is unknown at this stage because candidate target roads are not finalized yet nor Socio Economic Survey has not been started. Cut-off date should be the commencement date of the population census survey. Among 38 roads, total amount of affected roads is 23, and total affected length is around 168.2km as of October 2022.</p> <ul style="list-style-type: none"> ✓ Kampong Chhnang: 5 roads, 9km

	Element	Description
		<ul style="list-style-type: none"> ✓ Pursat: 9 roads, 60.3km ✓ Battambang: 4 roads, 41.8km ✓ Banteay Meanchey: 5 roads, 57.1km <p>Detailed information about affected roads are shown in Table-2.</p>
5	Eligibility criteria for defining various category of displaced persons	<p>The following criteria will be confirmed at the next stage:</p> <ul style="list-style-type: none"> ✓ <u>Displaced Person</u>: Those who will lose whole or part of their physical and nonphysical assets including home, lands, building/structures, commercial properties, crops, resources, tenancy, subsistence, income earning opportunities, communities, and social and cultural networks. The loss can be temporary or permanent. ✓ <u>Poor and Vulnerable Persons/Groups</u>: Those who are perceived to be more vulnerable than others such as poor affected persons headed by single mothers, elderly people, orphaned children, disabled people among others. ✓ <u>Indigenous People</u>: Those who have traditional collective ownership of land granted by the Royal Government of Cambodia (RGC). It is not expected that indigenous people would be affected by this project. <p><i>Source: LA-IR/SOP 2018</i></p>
6	A legal framework reviewing the fit between borrower laws and regulations and JICA requirements and measures proposed to bridge any gaps between them	<p>Although Constitution and laws related to the land acquisition are enacted in Cambodia, there are some gaps between related laws in Cambodia and guideline of Development Partners (DPs) including JICA Guideline.</p> <p>Standard Operating Procedures (LA-IR/SOP 2018) Manual reflects Cambodia's laws and regulations relating to the acquisition of land and the involuntary resettlement of affected persons and the safeguard policies and procedures of DPs as applied to public infrastructure investment projects. Where appropriate, the SOP includes references to international good practices in resettlement planning, implementation, monitoring and reporting.</p>
7	Method of valuing affected assets	<p><Basic Resettlement Plan preparation stage by MRD></p> <ul style="list-style-type: none"> ✓ Identify entitlements, eligibility, and resettlement assistance (including an Entitlement Matrix). ✓ Initial Cost Estimate (where required) <p><Detailed Resettlement Plan preparation stage by GDR and IRC></p> <ul style="list-style-type: none"> ✓ Detailed Measurement survey (DMS): Demarcation of Land and DMS (100% household survey, 100% Inventory of Loss/IOL and Full Census through DMS Questionnaire) ✓ Carry out Replacement Cost Study (RCS) to determine the prevailing market rates for replacing loss assets. ✓ Update the Entitlement Matrix to show the full and complete compensation package that will be made available to the APs. ✓ Formulation of budget <p><i>Source: LA-IR/SOP 2018</i></p>
8	Original procedures for delivery of entitlements	<p>The following types of displaced persons shall be eligible to compensation, but compensation would vary depending on their</p>

	Element	Description
	including for projects involving private sector intermediaries, the responsible of the financial intermediary, the government, and the private developer	<p>situation:</p> <ul style="list-style-type: none"> ✓ Legal owners and holders of title or rights to land, including customary rights. ✓ Tenants and leaseholders, including employees, workers and hawkers. ✓ Those who have no formal title or rights to the land (illegal occupiers) who are engaged in farming or businesses. ✓ Poor and vulnerable groups. <p>The Entitlement Matrix defines the main types of impact/losses for different types of assets for different categories of displaced persons and their entitlement to compensation. These impacts/losses of assets shall include:</p> <ul style="list-style-type: none"> ✓ Loss of land (productive/agricultural, residential and commercial) ✓ Loss of use of land (standing and perennial crops, fruit trees, businesses) ✓ Loss of structures (residential, commercial and other structures) ✓ Loss of income or livelihood (loss of income during transition period, permanent loss of source of livelihood) ✓ The compensation shall be provided at replacement price (market value not taking in consideration of depreciation with addition of administrative cost (i.e. registration fee)). The livelihood recovery should be realized through the compensation. <p><i>Source: LA-IR/SOP 2018</i></p>
9	A description of the implementation process, linking resettlement implementation to civil works	<p>The actual payments are made in a public place by the Provincial Resettlement Sub Committee (PRSC-WG) in close collaboration with Inter-ministerial Resettlement Committee (IRC-WG). The Provincial Department of Economy and Finance (PDEF) plays a key role as part of the PRSC-WG in the disbursement of payments. The Department of Internal Monitoring and Data Management (DIMDM) is responsible for oversight and verification of the payment process. The PRSC-WG will inform the commune or the village office on the schedule dates for the commencement of the payments at least 3 days in advance. A notice will be placed at the Commune and Village office and community hall, if any, at the same time.</p> <p>The commune and village office will make best efforts to inform the APs about the schedule dates for commencement of payments. On the date for the payments, a public consultation meeting will be conducted to explain the procedures that will be followed prior to the commencement of the payment to each individual AP</p> <p><i>Source: LA-IR/SOP 2018</i></p> <hr/> <p>Compensation payments are made at least 30 days before construction starts in case of Preparatory Survey for National Road No.5 Improvement Project (South Section)</p> <p><i>Source: Final Resettlement Planning for Preparatory Survey for National Road No.5 Improvement Project (South Section) 2013/8</i></p>
10	Description of Grievance	<Resettlement Framework: RF Stage>

	Element	Description
	Redress Mechanism: GRM	<p>✓ Discuss measures to establish grievance redress mechanisms at the local level; and outline the composition, areas of jurisdiction, consultation arrangements, record keeping, and information dissemination methods of the mechanism.</p> <p><Basic Resettlement Plan: BRP Stage></p> <p>✓ Describe (i) the project grievance redress mechanism; (ii) the establishment of the Provincial Grievance Redress Committee: PGRC; and (iii) the Guidelines for receiving, recording, handling and decision-making process</p> <p><Detailed Resettlement Plan: DRP Stage></p> <p>✓ Describe legal framework for Grievance Redress (same as described in Resettlement Framework: RF/BRP)</p> <p>✓ Describe the mechanism for grievance redress for the Project (same as the description in RF/BRP)</p> <p>✓ Describe the composition of the Provincial Grievance Redress Committee (same as the description in RF/BRP)</p> <p>✓ Mention Guidelines for GRM Procedures</p> <p><Note></p> <p>➤ Related Organization: Commune/District Office, General Department of Resettlement: GDR, Provincial Grievance Redress Committee: PGRC</p> <p>➤ APs who wants to redress grievance can contact related organization directory (meet, by phone etc.) or by email, letter,</p> <p>Flowchart of GRM is shown as Figure-2 below.</p> <p><i>Source: LA-IR/SOP 2018</i></p>
11	A description of the arrangements for funding resettlement, including the preparation and review of cost estimates, the flow of fund, and contingency arrangements	<p><Budget Preparation></p> <p>The preparation of the budget estimates must capture all aspects of resettlement costs related to <u>the planning, preparation and implementation of the resettlement plans, acquisition and development of resettlement sites, management and administration, supervision and monitoring and contingencies</u>. The budget must be prepared during the preparation of the DRP and approval sought from MEF soon after the DRP is approved by the IRC and the DP, where required.</p> <p><Budget Disbursement and Payment></p> <p>✓ The GDR is responsible for financial management functions, including budgeting, financial accounting, financial reporting and auditing for the expenditures for Land Acquisition.</p> <p>✓ The MEF is responsible for the operations and maintenance of both of the designated accounts.</p> <p>✓ The General Affairs Department (GAD) will be responsible for managing the project designated account and flow of funds</p> <p>✓ The GDR is responsible for setting out the detailed procedures for the payment of compensation to Affected Persons: APs and to ensure that these are made in accordance with the signed individual contracts.</p> <p>✓ The GAD will maintain a database on all payments to the APs and</p>

	Element	Description
		<p>keep all supporting documentation in its custody. Detailed procedure is described in LA/IR/SOP and Flowchart of Budget Disbursement is shown as Figure-3. <i>Source: LA-IR/SOP 2018</i></p>
12	<p>A description of mechanisms for consultations with participants of displaced persons in planning, implementation and monitoring</p>	<p><Project Preparation/Feasibility Stage> <ul style="list-style-type: none"> ✓ Public information sharing prior to the Sample Social-Economic Surveys (SESs) (Information Brochure etc.) ✓ Information dissemination and consultation with individual APs during sample size SESs (General provisions of compensation policy, Explain eligibility criteria etc.) <p>< Details Detailed Design/Land Demarcation Stage> <ul style="list-style-type: none"> ✓ Information dissemination to local authorities after approval of BRP/RF (Post RF/BRP in Khmer language at Commune Office) ✓ Consultation with AHs at community/commune level (Census, SESs and IOL, DMS, Questionnaire etc.) <p><Implementation> <ul style="list-style-type: none"> ✓ Contract Signing for Compensation Package (After Approval of the DRP, the DRP is disclosed to public) ✓ House to House Consultation (The Draft Contract for Compensation Package is discussed with the individual Affected Households: AHs, Discuss final IOL etc.) ✓ Consultation with APs during Payment/Disbursement of Compensation (including GRM guidance) <p><i>Source: LA-IR/SOP 2018</i></p> </p></p></p>
13	<p>Arrangements for monitoring by implementation agency and if required, independent monitors</p>	<p>While the MRD is responsible for monitoring the implementation of the project, the responsibility for monitoring and reporting on the implementation of the Land Acquisition activities is mandated to GDR. <Internal Monitoring> The primary responsibility for gathering the data and information on the progress of the Land Acquisition from the field rests with IRC-WG and the PRSC-WG which will submit monthly reports to the responsible GDR. GDR will compile the field reports and prepare a consolidated report for the Project on a monthly basis. The report will be submitted to the DIMDM which is responsible for Internal Monitoring. The responsibility of the DIMDM is to (i) review the monthly progress reports, including fielding its own missions to verify the progress and the validity of the data and information, if deemed necessary; and (ii) compile quarterly monitoring report for submission to the Director General of GDR. After the quarterly report is endorsed by the GDR, it will be submitted to the DPs, where required. <External Monitoring> For projects with significant involuntary resettlement impacts and large-scale resettlement exceeding 200 displaced persons, the GDR will recruit a qualified and experienced local external agency (a local</p>

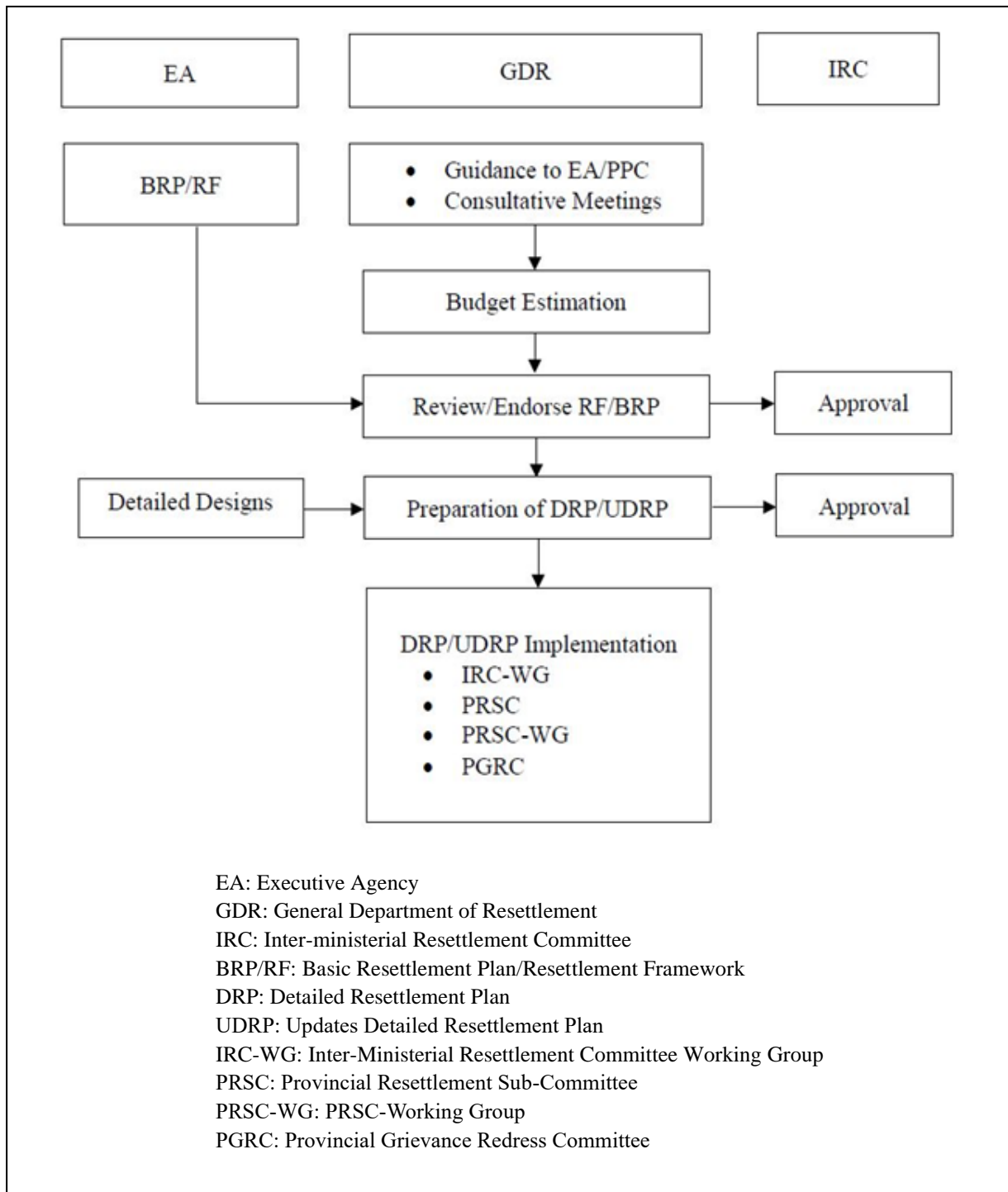
	Element	Description
		<p>firm or an individual) to verify the internal monitoring reports.</p> <p><Note></p> <ul style="list-style-type: none"> ✓ Large scale resettlement which is expected over 200 displaced persons is not expect if this project. ✓ Monitoring form will be prepared during Detailed Design stage. <p><i>Source: LA-IR/SOP 2018</i></p>

Source: JICA Survey Team

Table 4.2-2 Affected Road Length by Target Road

Route No.	Total Length	Affected Area		Total Affected Land
		Residential Land	Cropland	
unit	km	km	km	km
KCH-1	4.3			0.0
KCH-2	8.6	0.5		0.5
KCH-3	3.8		3.3	3.3
KCH-4	5.3	1.1	1.8	2.9
KCH-6	9.9	0.1	1.3	1.4
KCH-7	27.5			0.0
KCH-8	12.2			0.0
KCH-9	8.8			0.0
KCH-10	8	0.9		0.9
KCH-11	12.7			0.0
KCH-12	12.4			0.0
Subtotal	113.5	2.6	6.4	9.0
PS-2	6.8	1.2	8.2	9.4
PS-3	12		5.1	5.1
PS-4		10.5	1.2	11.7
PS-5		2.5	10.4	12.9
PS-6	9.7			0.0
PS-8	8.8			0.0
PS-9	11.2			0.0
PS-10	4	2.0	5.0	7.0
PS-11	11	1.0	3.0	4.0
PS-12	3.4	0.5	1.0	1.5
PS-13		6.0		6.0
PS-14	10.3			0.0
PS-15		2.7		2.7
Subtotal	77.2	26.4	33.9	60.3
BTB-1	15			0.0
BTB-2	5.8		12.4	12.4
BTB-3			10.1	10.1
BTB-4		4.0	12.1	16.1
BTB-6	13.8		3.2	3.2
BTB-7	16.2			0.0
BTB-8	18			0.0
BTB-9	18.2			0.0
Subtotal	87	4.0	37.8	41.8
BMC-2	19.5	2.0	2.6	4.6
BMC-3	6		11.0	11.0
BMC-4	29			0.0
BMC-5			25.0	25.0
BMC-6	11.4		6.9	6.9
BMC-7	4.5	0.6	9.0	9.6
Subtotal	70.4	2.6	54.5	57.1
Total	348.1	35.6	132.6	168.2

Source: JICA Survey Team

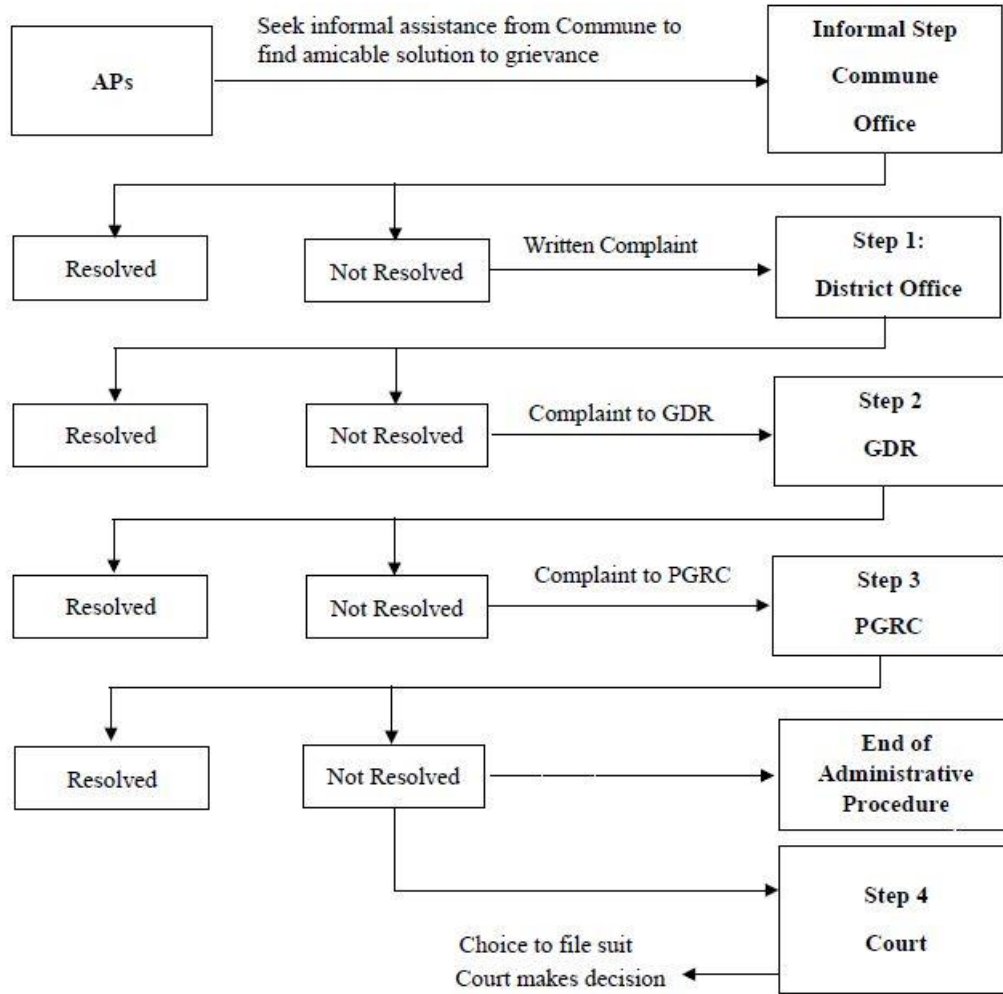


Source: JICA Survey Team

Figure 4.2-1 Process for Preparing and Approving Resettlement Plans

Guidelines for Grievance Redress Mechanism

Flow Chart 1: Procedures of Grievance Redress Mechanism

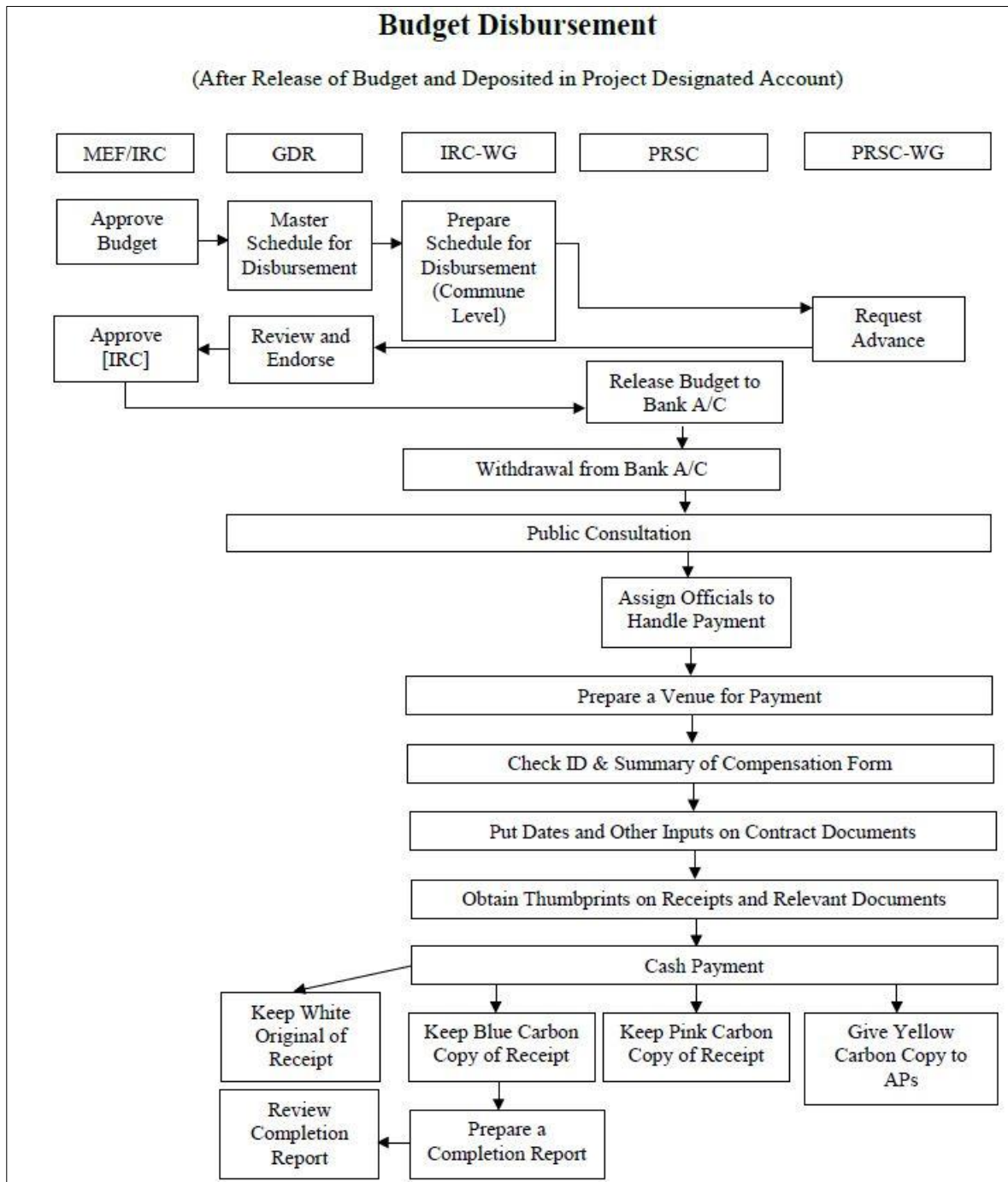


Note: In case of Group Complaint, GRM process starts at step 2

The Flowchart shows the process flow for the grievance redress mechanism. Step 1 to 3 comprise of the administrative procedures while Step 4 is the judicial process under which any complainant can file a suit in the relevant courts at any time. The procedures follow a two-phased approach to redress grievances. In the first phase, the aggrieved AP seeks assistance at the commune level to resolve the grievance under an informal process. This is followed by a 3-step formal second phase when a solution is not found during the first phase.

Source: JICA Survey Team

Figure 4.2-2 Process Flow for Grievance Redress Mechanism (GRM)



Source: JICA Survey Team

Figure 4.2-3 Budget Disbursement

CHAPTER 5 PROJECT EVALUATION AND POINTS TO CONSIDER

5.1 Consideration of Project Effects

5.1.1 Quantitative Effects

(1) Operation and Project Effects

For the evaluation of operation and project effects, the year 2029 is used as the evaluation year and the target value were calculated, since the evaluation of operation and project effects are to be conducted two years after the completion of the project in principle for financial cooperation projects (referring the JICA Project Evaluation Handbook (Ver. 2.0), p. 39).

1) Annual Average Daily Traffic Volume

The Annual Average Daily Traffic Volume (AADT; PCU/day) are calculated based on the results of the traffic survey conducted in 2022. JICA Survey Team calculated the target value for AADT in 2029 using the results of the traffic demand forecasts. Table 5.1-1 shows the AADT (PCU/day) for 2022 and 2029.

Table 5.1-1 Project Effect for AADT in 2022 and 2029

#	Target Roads	2022	2029
		Annual Average Daily Traffic Volume (AADT)	Annual Average Daily Traffic Volume (AADT)
		(PCU/Day)	(PCU/Day)
1	KCH1	1,148	2,108
2	KCH2	317	534
3	KCH3	729	1,227
4	KCH4	1,176	1,980
5	KCH6	311	500
6	KCH7	573	1,052
7	KCH8	587	987
8	KCH9	455	765
9	KCH10	326	549
10	KCH11	238	401
11	KCH12	427	718
12	PS2	1,457	2,790
13	PS3	470	900
14	PS4	462	885
15	PS5	1,152	2,207
16	PS6	1,044	2,000
17	PS8	993	1,901
18	PS9	395	756
19	PS10	1,307	2,504
20	PS11	1,911	3,659
21	PS12	505	887
22	PS13	508	973
23	PS14	421	806
24	PS15	214	376
25	BTB1	712	1,240
26	BTB2	728	1,269
27	BTB3	126	220
28	BTB4	903	1,501
29	BTB6	1,270	2,414
30	BTB7	593	1,127
31	BTB8	1,805	3,430
32	BTB9	747	1,242

#	Target Roads	2022	2029
		Annual Average Daily Traffic Volume (AADT)	Annual Average Daily Traffic Volume (AADT)
		(PCU/Day)	(PCU/Day)
33	BMC2	1,708	2,990
34	BMC3	1,478	2,824
35	BMC4	835	1,595
36	BMC5	623	1,191
37	BMC6	541	947
38	BMC7	388	679
	Total	29,585	54,137

Source: JICA Survey Team

The AADT (PCU/Day) is 29,585 (PCU/Day) in 2022 and 54,137 (PCU/Day) in 2029 on all 38 roads.

2) Travel Time to One-digit National Roads

JICA Survey Team estimated the travel speed per road category and road condition using the results of the travel speed survey. Furthermore, access times from the rural roads to one-digit national road were calculated for sunny day and rainy weather, respectively. The calculation method is as follows:

(Sunny weather)

- Travel speeds are set as follows based on the results of the travel speed survey by road categories and road conditions.

Table 5.1-2 Average Travel Speed Per Road Categories

Road Categories	Road Conditions	Average Speed
		(km/h)
Two-digit National Roads	Paved	48.1
Provincial Roads	Paved	49.3
Target Roads	Good	29.8
	Poor	20.8
	Very Poor	15.7
	Rainy weather	11.8
Paved rural roads	Paved	40.1
Unpaved rural roads	unpaved*	22.0

Source: JICA Survey Team

*Unpaved rural roads are calculated average of travel speed of good, poor and very poor.

- Travel speed is measured from the farthest point of access to the national road on the target roads.
- Paved rural roads are passed when accessing to one-digit national roads.
- Passing through unpaved roads that provide access to one-digit national road by the shortest route is allowed if there are no paved roads road in the vicinity.

(Rainy weather)

- JICA Survey Team set 11.8 km/hour as the average travel speed in rainy weather based on results of travel speed survey.
- Travel speed is measured from the farthest point of access to the national road on the target roads.
- Paved rural roads are passed when accessing to one-digit national roads.
- Passing through unpaved roads that provide access to one-digit national road by the shortest route

is allowed if there is no paved roads road in the vicinity.

Travel speeds for the rural roads after improvement were calculated using travel speed results for rural roads already paved with DBST. Table 5.1-3 shows the access times to the one-digit national roads in 2022 (in rainy weather and sunny day) and in 2029.

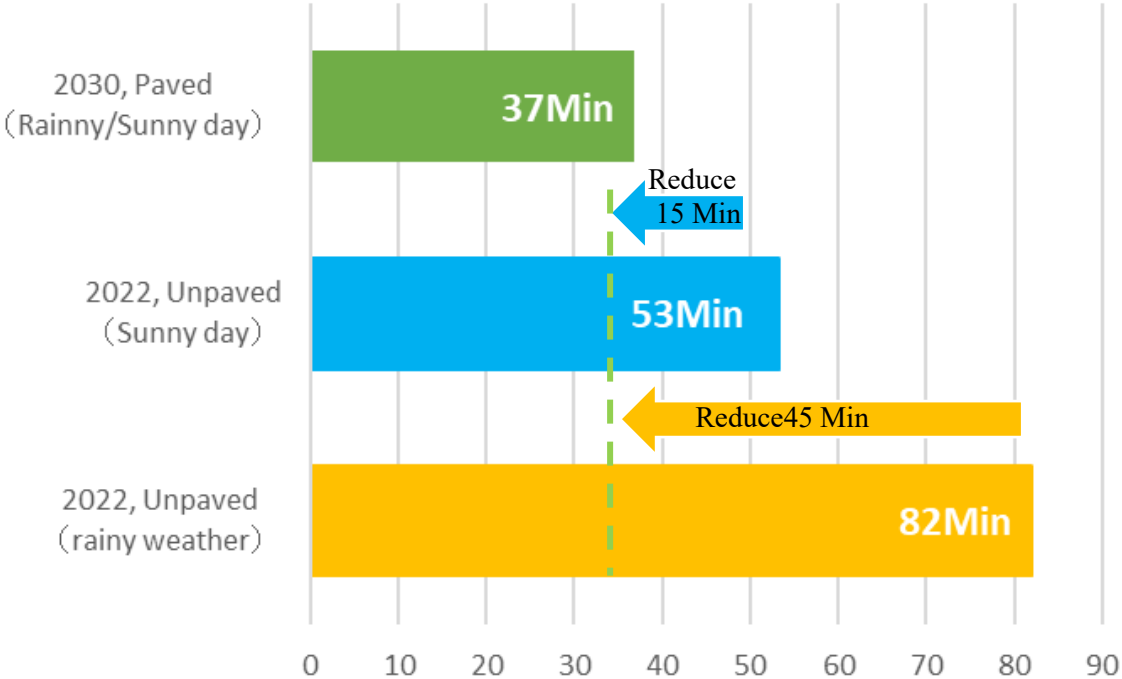
Table 5.1-3 Travel Time to One-digit National Roads

#	Target Road	Before Improvement		After Improvement
		2022	2022	2029
		Average Travel Time to One-digit National Roads (Rainy Weather)	Average Travel Time to One-digit National Roads (Sunny Day)	Average Travel Time to One-digit National Roads (Rainy Weather/ Sunny Day)
		(Min)	(Min)	(Min)
1	KCH1	18.9	12.2	11.0
2	KCH2	46.2	26.5	13.6
3	KCH3	36.0	14.3	10.6
4	KCH4	41.6	16.5	12.3
5	KCH6	31.1	20.4	18.6
6	KCH7	142.6	82.9	44.1
7	KCH8	61.9	24.5	18.2
8	KCH9	62.6	43.5	31.1
9	KCH10	86.1	66.8	54.2
10	KCH11	95.4	56.5	49.9
11	KCH12	109.5	94.0	65.1
12	PS2	92.4	52.9	27.2
13	PS3	89.3	35.4	26.3
14	PS4	61.9	35.5	18.2
15	PS5	65.5	49.3	19.3
16	PS6	29.9	11.9	8.8
17	PS8	22.3	8.9	6.6
18	PS9	56.8	22.5	16.7
19	PS10	49.7	19.7	14.7
20	PS11	109.8	77.2	56.0
21	PS12	43.7	28.4	25.8
22	PS13	12.0	6.5	5.5
23	PS14	28.9	16.6	8.5
24	PS15	13.7	5.4	4.0
25	BTB1	105.2	59.2	51.5
26	BTB2	122.9	83.5	57.8
27	BTB3	53.8	40.6	15.8
28	BTB4	81.7	61.6	24.1
29	BTB6	198.0	168.1	137.1
30	BTB7	82.2	62.0	24.2
31	BTB8	107.8	68.8	43.4
32	BTB9	169.2	149.5	136.6
33	BMC2	141.6	89.3	55.3
34	BMC3	121.8	48.3	35.9
35	BMC4	99.9	55.5	48.0
36	BMC5	171.5	108.6	67.7
37	BMC6	146.8	123.5	80.2
38	BMC7	105.2	74.7	54.7
Total		3115.7	2021.4	1398.8
Average		82.0	53.2	36.8

Source: JICA Survey Team

When the rural roads are paved, the average access time to the one-digit national roads will be reduced by approximately 45 minutes compared to rainy weather conditions. In addition, the average access time

to one-digit national roads will be reduced by 16 minutes compared to sunny weather conditions. The road improvements will reduce access time to one-digit national roads by approximately 623 minutes for all target roads in total. In addition, the total time for all target roads will be reduced by approximately 1,717 minutes due to the deteriorated travelability of unpaved roads during rainy weather.



Source: JICA Survey Team

Figure 5.1-1 Average Travel Time to One-digit National Roads

3) Annual Traffic Impassibility Dates due to Flooding (Day/Year)

JICA Survey Team calculated the annual traffic impassibility date due to flooding (days/year) based on the results of the flood condition survey, water level of Tonle Sap Lake, and the risk of river flooding. Annual traffic impassibility dates due to flooding (days/year) in 2022 and 2029 are shown in Table 5.1-4.

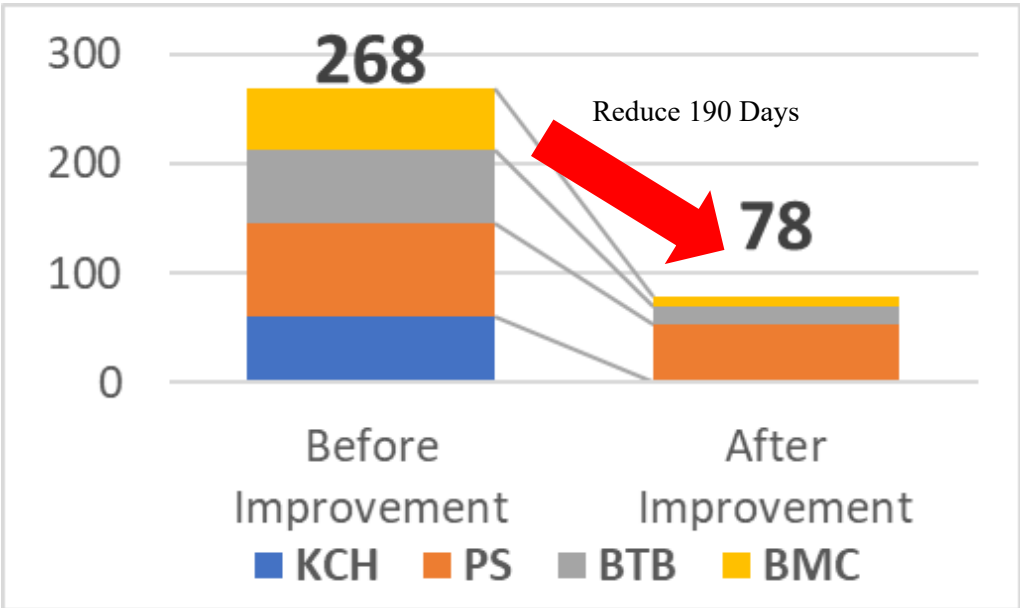
Table 5.1-4 Annual Traffic Impassibility Date Due to Flooding (days/year)

#	Target Roads	Before Improvement	After Improvement
		2022	2029
		Annual Traffic Impassibility Dates due to Flooding (Days/Year)	Annual Traffic Impassibility Dates due to Flooding (Days/Year)
1	KCH1	3	0
2	KCH2	32	0
3	KCH3	6	0
4	KCH4	3	0
5	KCH6	4	0
6	KCH7	0	0
7	KCH8	3	0
8	KCH9	3	0
9	KCH10	3	0
10	KCH11	3	0
11	KCH12	0	0
12	PS2	26	24
13	PS3	6	4
14	PS4	3	1

#	Target Roads	Before Improvement	After Improvement
		2022	2029
		Annual Traffic Impassability Dates due to Flooding (Days/Year)	Annual Traffic Impassability Dates due to Flooding (Days/Year)
15	PS5	26	24
16	PS6	3	0
17	PS8	3	0
18	PS9	3	0
19	PS10	4	0
20	PS11	3	0
21	PS12	3	1
22	PS13	3	0
23	PS14	3	0
24	PS15	0	0
25	BTB1	3	0
26	BTB2	3	0
27	BTB3	3	1
28	BTB4	3	0
29	BTB6	3	0
30	BTB7	32	0
31	BTB8	17	15
32	BTB9	3	0
33	BMC2	22	0
34	BMC3	9	7
35	BMC4	9	0
36	BMC5	9	0
37	BMC6	3	1
38	BMC7	3	0
Total		268	78

Source: JICA Survey Team

After the road improvement, annual traffic impassability date due to flooding (days/year) for all of rural roads will decrease from 268 days/year to 78 days/year, reducing 190 days/year of impassable days. Quality of life for residents across the rural road will be greatly improved such as access to medical center and educational opportunities.



Source: JICA Survey Team

Figure 5.1-2 Reducing Annual Traffic Impassability Date Due to Flooding (days/year)

(2) Other Effectiveness Indicators

1) Number of Isolated Villages Due to Flooding

JICA Survey Team calculated the number of isolated villages due to flooding based on the following conditions.

- The number of isolated villages due to flooding was calculated using the village center data (GIS data) received from MRD, improvement policy based on results of the flood condition survey, the water level of Tonle Sap Lake, and the risk of river flooding.
- In rural roads that are not directly connected to one-digit national roads, possibility of passing through of provincial roads and two-digit national roads during flooding was confirmed and calculated based on the 2013 inundation area data and interview for MRD.

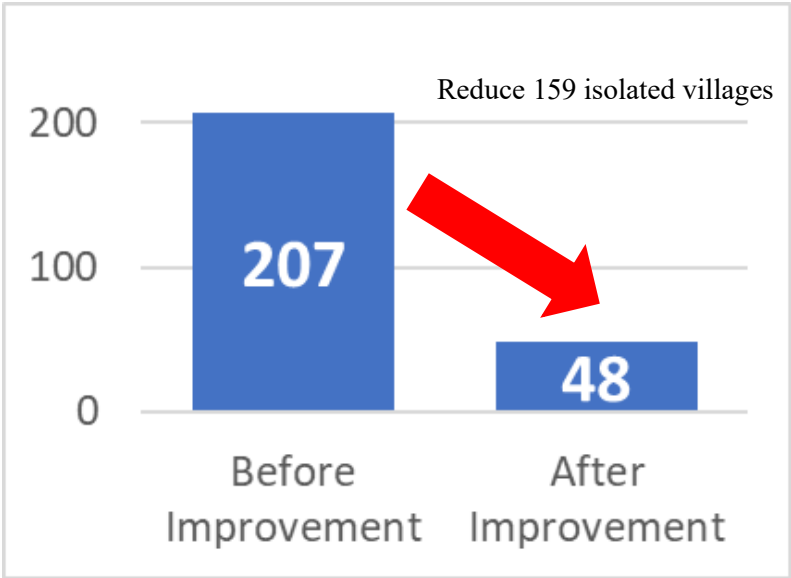
The number of isolated villages due to flooding in 2022 and 2029 is shown in Table 5.1-5.

Table 5.1-5 Number of Isolated Villages Due to Flooding

#	Target Road	Before Improvement	After Improvement
		2022	2029
1	KCH1	4	0
2	KCH2	4	0
3	KCH3	5	0
4	KCH4	4	0
5	KCH6	8	0
6	KCH7	0	0
7	KCH8	6	0
8	KCH9	2	0
9	KCH10	8	0
10	KCH11	2	0
11	KCH12	6	0
12	PS2	11	11
13	PS3	6	6
14	PS4	10	10
15	PS5	4	0
16	PS6	6	0
17	PS8	6	0
18	PS9	5	0
19	PS10	6	0
20	PS11	4	0
21	PS12	5	0
22	PS13	6	0
23	PS14	6	0
24	PS15	5	0
25	BTB1	4	0
26	BTB2	2	0
27	BTB3	1	1
28	BTB4	2	0
29	BTB6	6	0
30	BTB7	2	0
31	BTB8	4	1
32	BTB9	8	0
33	BMC2	4	0
34	BMC3	22	15
35	BMC4	9	0
36	BMC5	3	0
37	BMC6	4	4
38	BMC7	7	0
Total		207	48

Source: JICA Survey Team

The number of isolated villages due to flooding will decrease from 207 to 48, reducing 159 isolated villages due to flooding. The decrease in the number of isolated villages enables emergency transport during floods. Food and daily commodities will be stably available for purchasing.



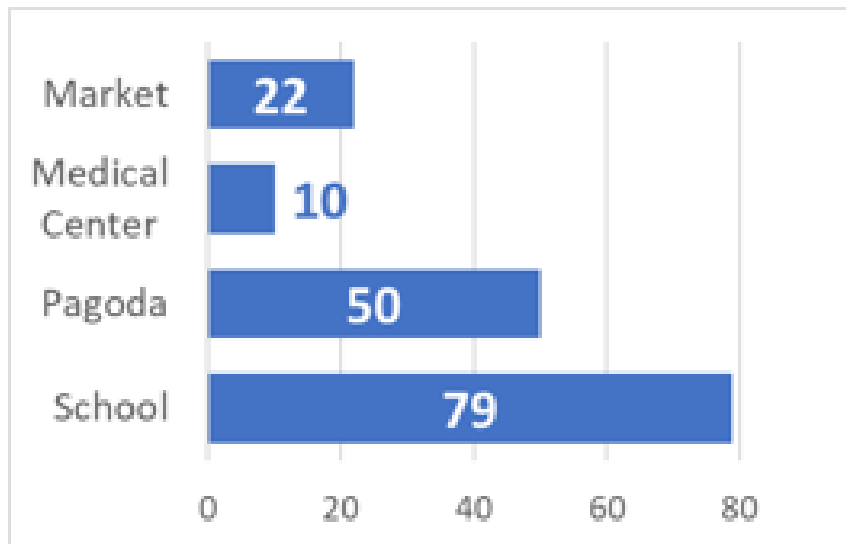
Source: JICA Survey Team

Figure 5.1-3 Number of Isolated Villages Due to Flooding

5.1.2 Qualitative Effects

(1) Improvement for Accessibility to Important Facilities

There are 161 important facilities (schools, pagodas, hospitals, markets) located along the rural roads. Road improvement contribute accessibility to important facilities.

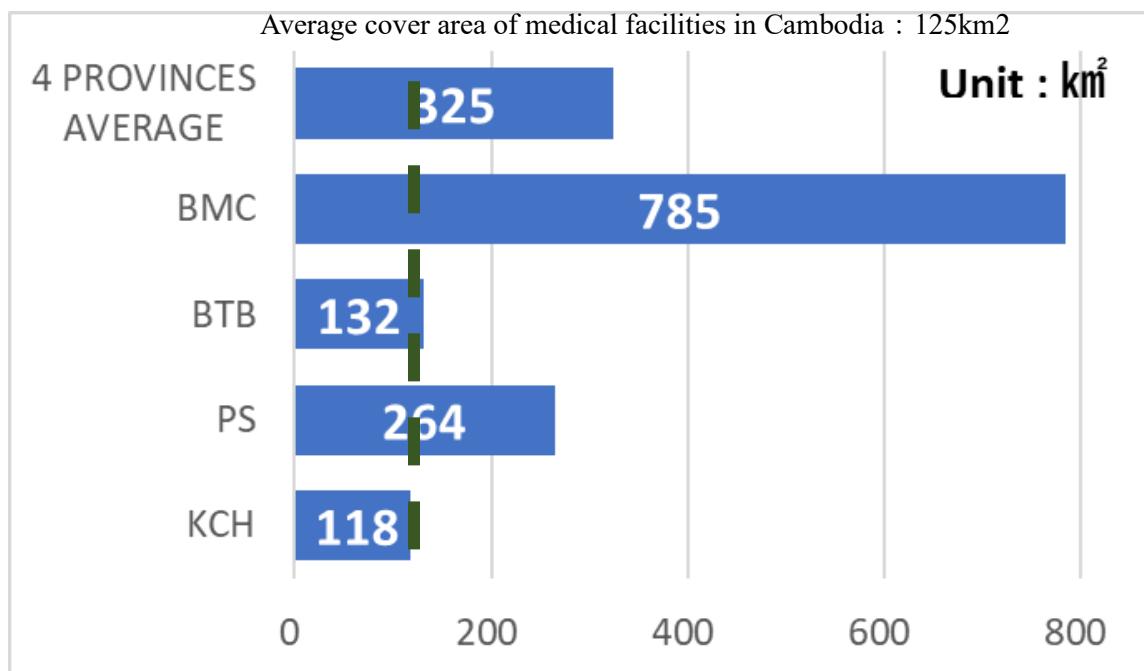


Source: JICA Survey Team

Figure 5.1-4 Improvement for Accessibility to Important Facilities

(2) Improvement for Accessibility to Medical Facilities

The coverage area for medical facilities in the target area is 325 km². The average coverage area of medical facilities in Cambodia is 125 km². The cover area of medical facilities in target area is larger than average cover area of medical facilities in Cambodia. Road improvement contributes to the accessibility of medical facilities.



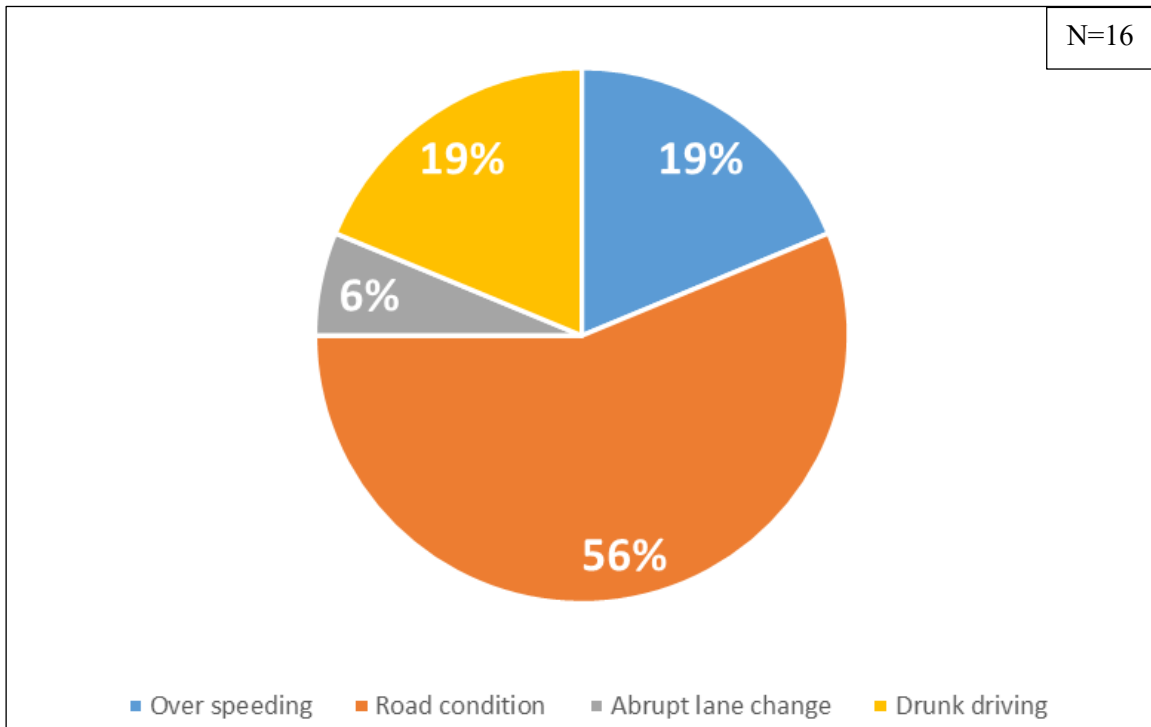
Source: JICA Survey Team

Figure 5.1-5 Coverage Area of Medical Facilities in the Target Area

(3) Road Traffic Accidents

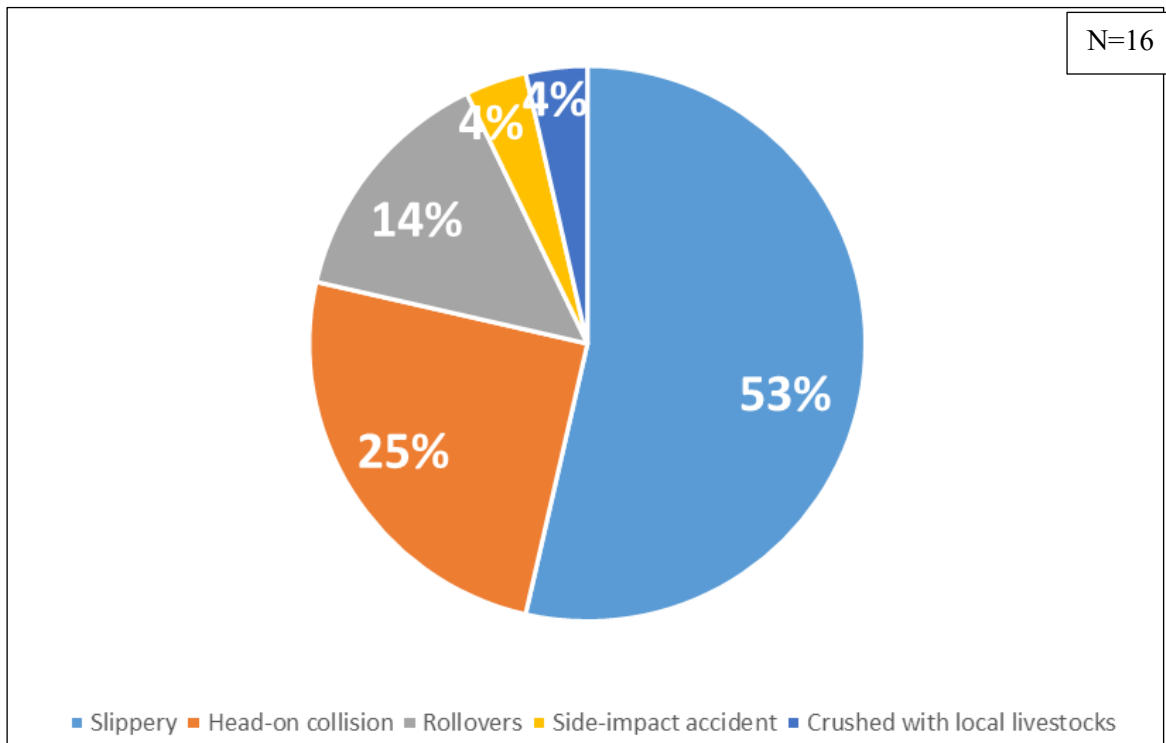
1) Result of Interview for Road Traffic Accidents

JICA Survey Team conducted interviews to commune police at target roads. Interview results are shown below.



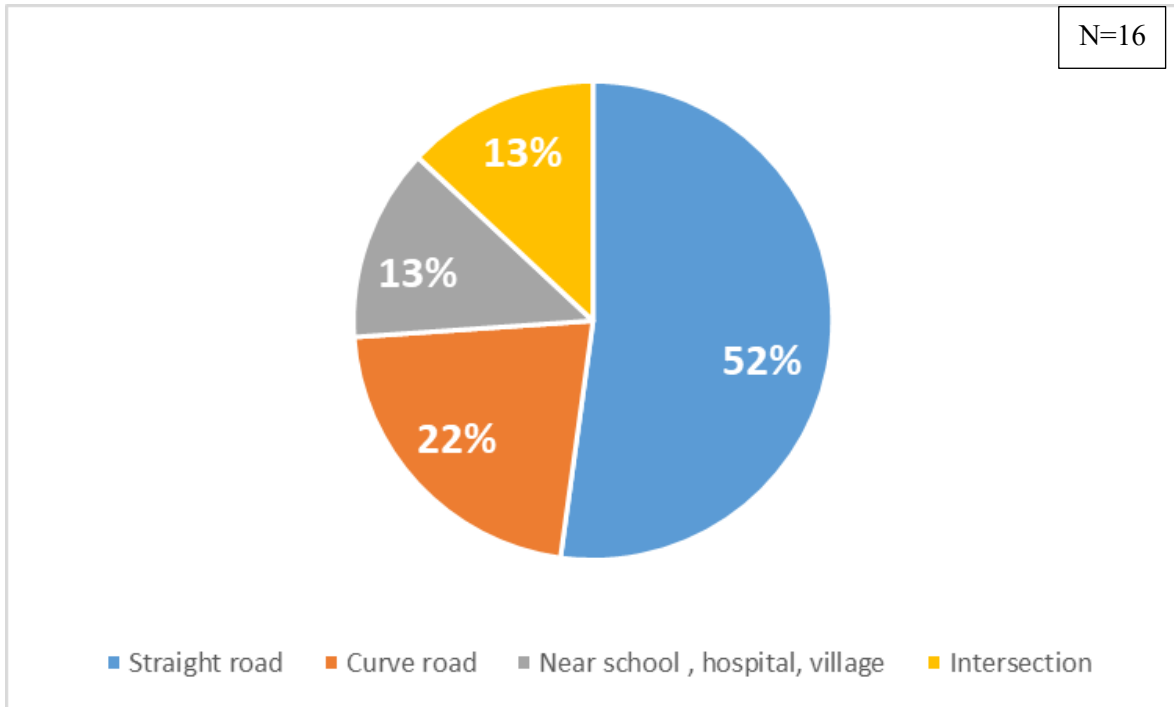
Source: JICA Survey Team

Figure 5.1-6 Causes of Road Traffic Accidents in Target Roads



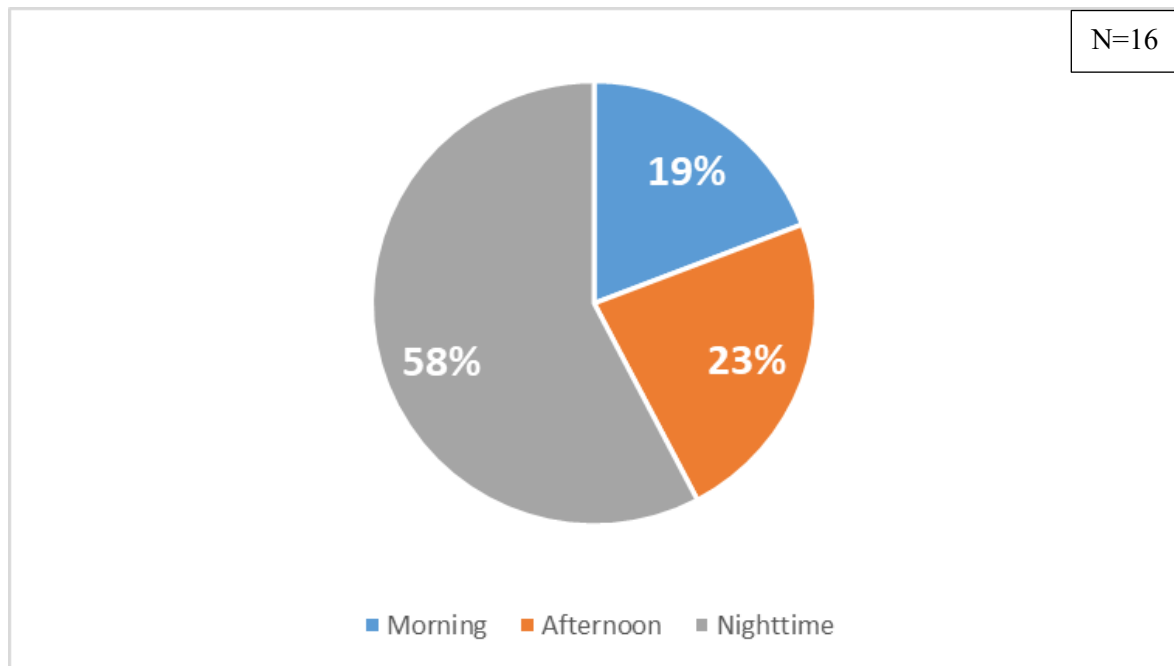
Source: JICA Survey Team

Figure 5.1-7 Types of Road Traffic Accidents



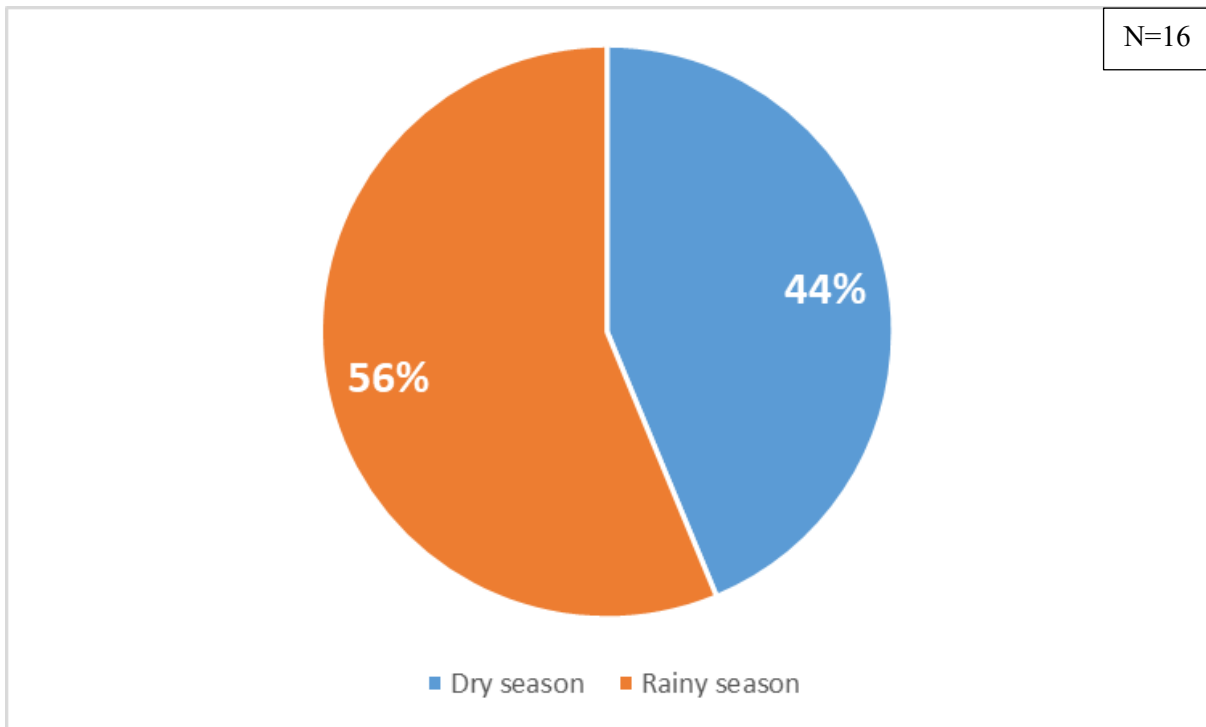
Source: JICA Survey Team

Figure 5.1-8 Road Types of Traffic Accidents



Source: JICA Survey Team

Figure 5.1-9 Time when Road Traffic Accidents Occur



Source: JICA Survey Team

Figure 5.1-10 Seasons when Road Traffic Accidents Occur

Road traffic accidents caused by road conditions account for 56% as the main cause of road traffic accidents. There are many accidents that slip and rollover while driving on muddy roads and dusty roads. In addition, many road traffic accidents occur at night because driver cannot confirm the roads conditions in dark. More road traffic accidents occur during the rainy season than in the dry season.

2) Qualitative Effect for Road Traffic Accidents

According to the result of interview, many slips are caused by road conditions. The road traffic accidents due to slips will be greatly reduced after improvement of rural roads. On the other hand, accidents due to over speeding will increase after improvement. It is necessary to install traffic safety facilities such as road signs, bumps and crosswalks to prevent accidents for over speeding.

5.2 Synergy with Rural Roads and National Road 5

5.2.1 Quantitative Effects

(1) Improvement for Accessibility to Provincial Center

JICA Survey Team calculated the extension of to which improvements to rural roads and NR5 would expand the travel area and increase the number of people interacting between rural areas and capital area. The analysis method is as follows.

Method of Analysis	
•	Set each provincial centers as destination because administrative and economic center
•	The commuting time to the commune center was set as one hour, since the MRD indicated that the commuting time to the commune center was about one hour.
•	The road network consists of one-digit national roads, two-digit national roads, provincial roads, targeted roads, rural roads paved by other donors, and roads for access to provincial government buildings.
•	Passing through unpaved roads that provides access to one-digit national road by the shortest route is allowed if there is no paved roads road in the vicinity.
•	Network created and time-area analysis conducted using speeds before and after improvement.
•	Population is calculated based on the 2019 Population Census.

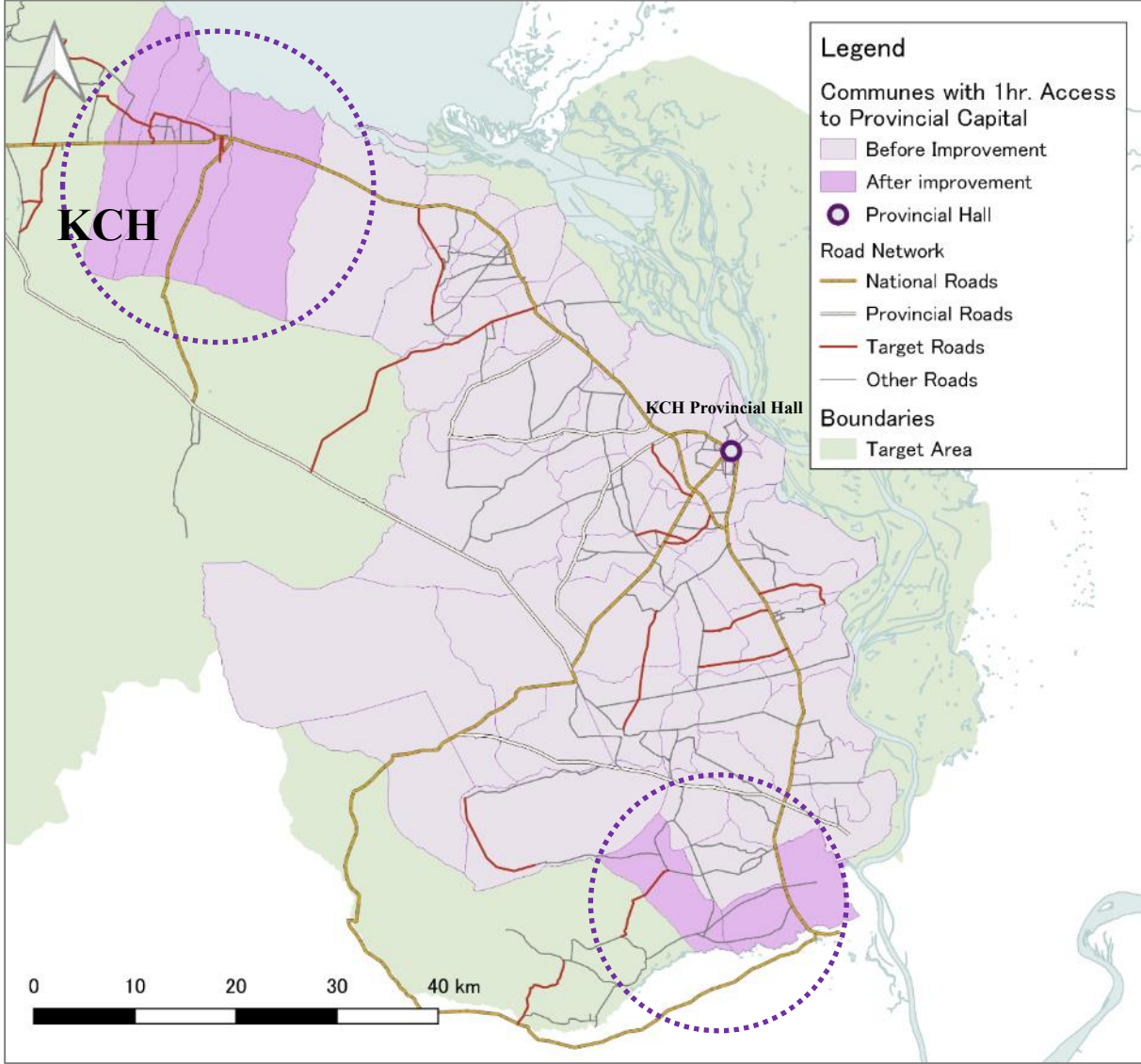
Table 5.2-1 Average Travel Speed per Road Categories

Road Categories	Road Conditions	Before Improvement	After Improvement
		Average Speed (km/h)	Average Speed (km/h)
National Road 5 (NR5)	Paved	53.9	80.0
Two-digit National Roads	Paved	48.1	48.1
Provincial Roads	Paved	49.3	49.3
Target Roads	Good	29.8	40.1
	Poor	20.8	
	Very Poor	15.7	
Paved rural roads	Paved	40.1	40.1
Unpaved rural roads	-	22.0	22.0

Source: JICA Survey Team

The results for the accessible areas within one hour for each province that were calculated using the above analysis method are shown in Figure 5.2-1 to Figure 5.2-4.

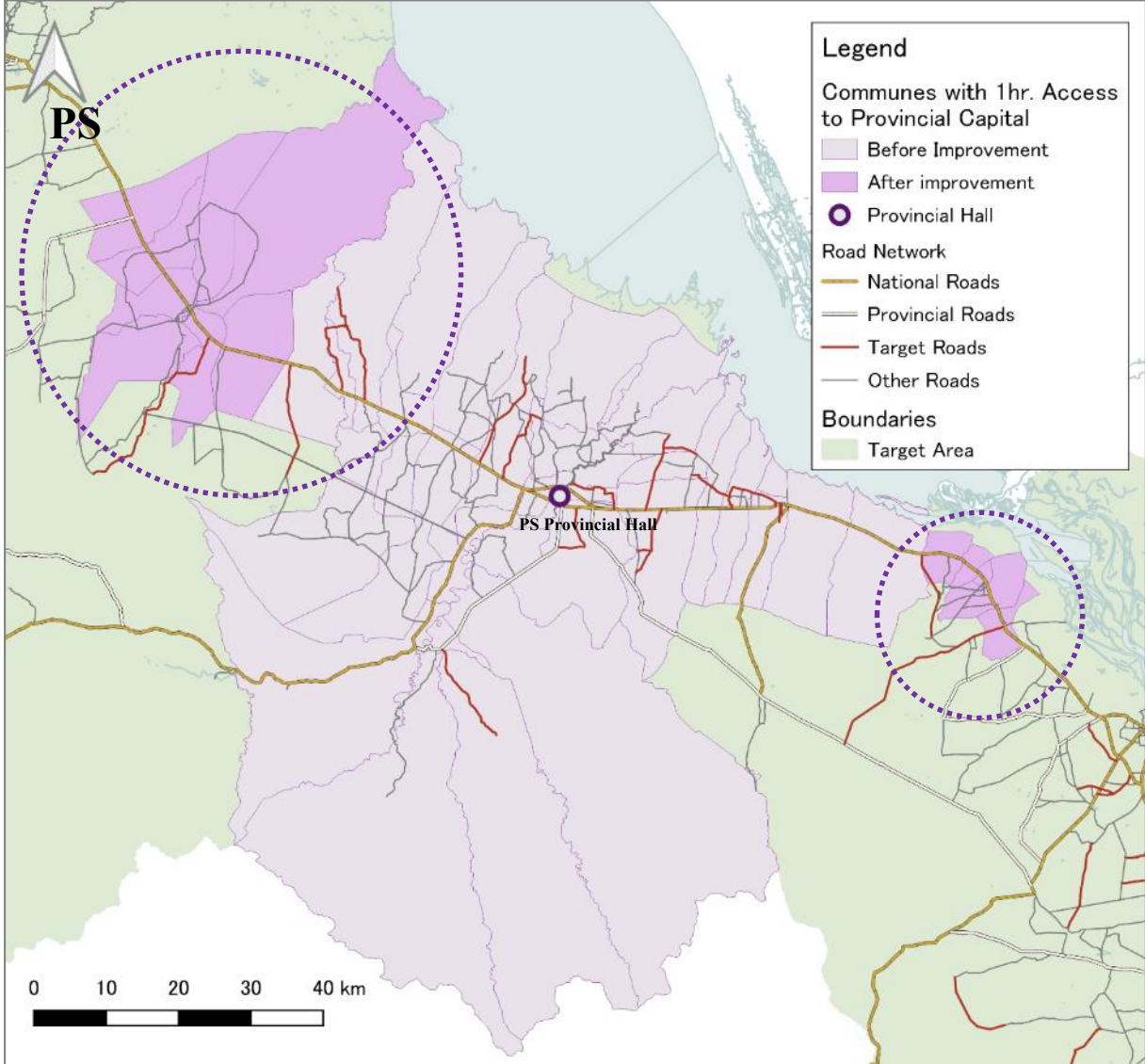
Figure 5.2-1 shows the communes with access to the KCH provincial capital within one hour before and after improvement.



Source: JICA Survey Team

Figure 5.2-1 Number of Communes to Access Provincial Center within 1hr in KCH

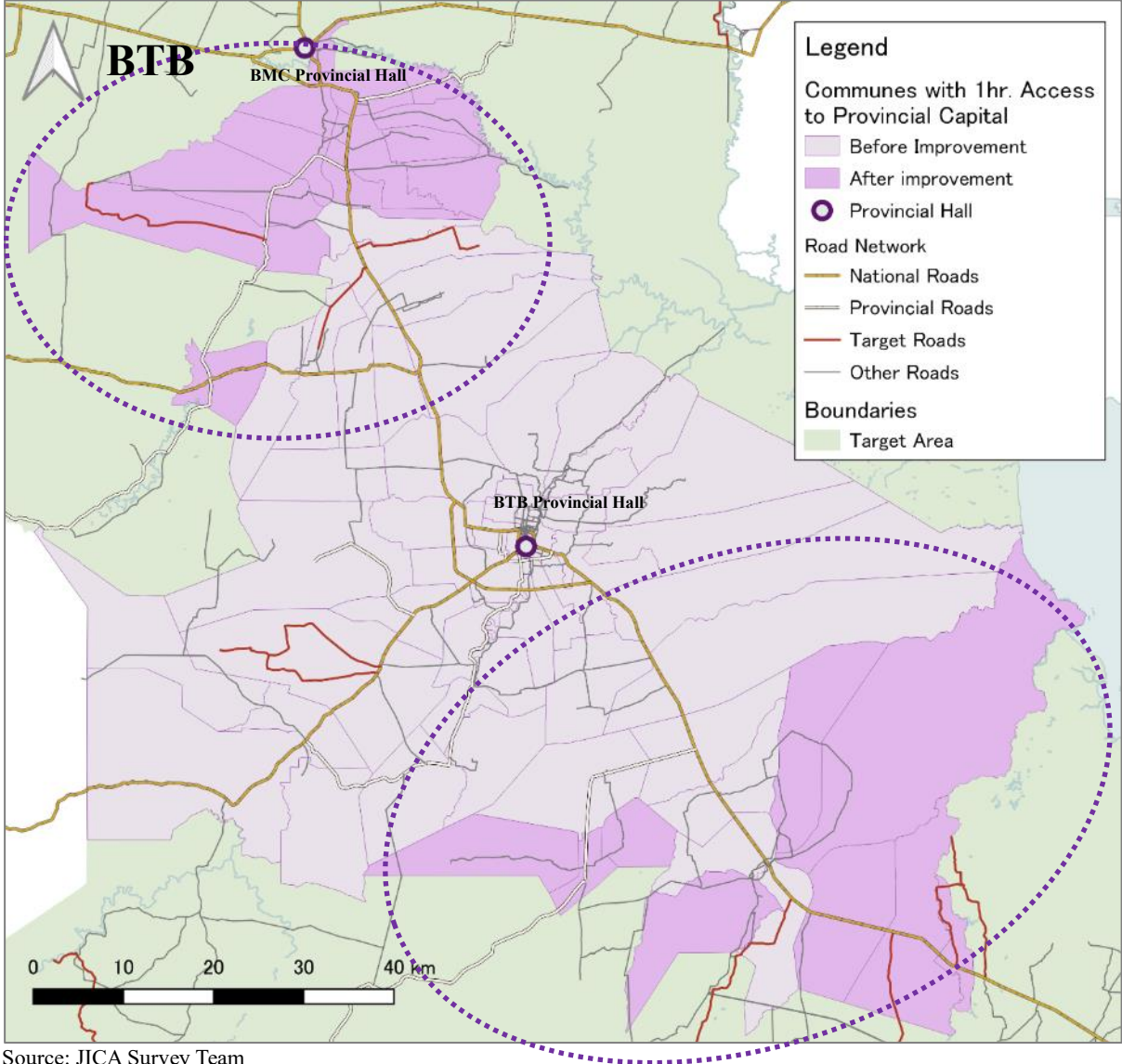
Figure 5.2-2 shows the communes with access to the PS provincial capital within one hour before and after improvement.



Source: JICA Survey Team

Figure 5.2-2 Number of Communes to Access Provincial Center within 1hr in PS

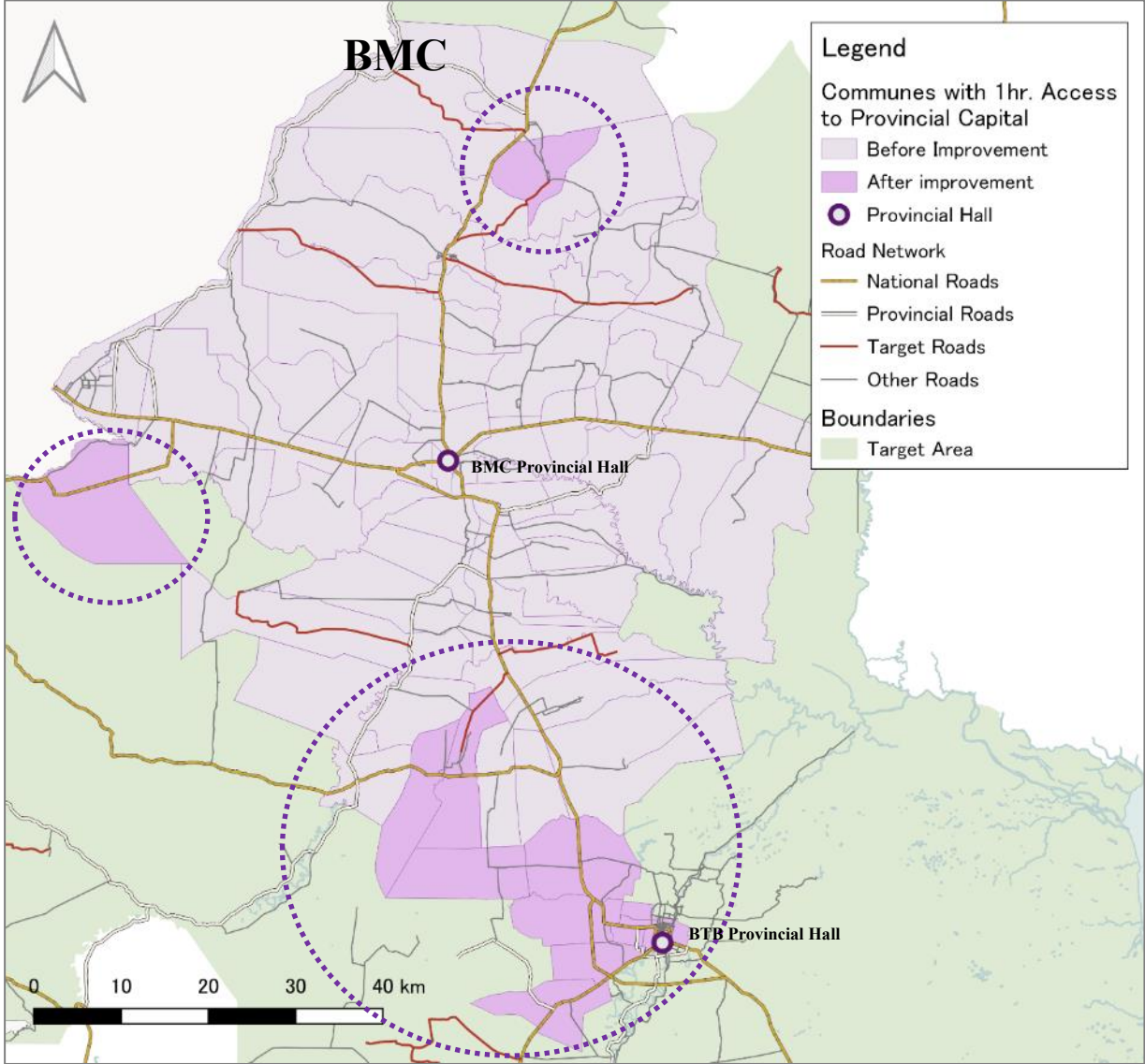
Figure 5.2-3 shows the communes with access to the BTB provincial capital within one hour before and after improvement.



Source: JICA Survey Team

Figure 5.2-3 Number of Communes to Access Provincial Center within 1hr in BTB

Figure 5.2-4 shows the communes with access to the BMC provincial capital within one hour before and after improvement.



Source: JICA Survey Team

Figure 5.2-4 Number of Communes to Access Provincial Center within 1hr in BMC

Table 5.2-2 Number of Communes and Population to Access Provincial Center within 1hr

Province	Commune			Population		
	Before Improvement	After Improvement	Differentiation	Before Improvement	After Improvement	Differentiation
KCH	46	54	8	360,750	428,747	67,997
PS	42	56	14	373,261	499,484	126,223
BTB	54	76	22	595,705	873,813	278,108
BMC	56	70	14	794,066	964,588	170,522
Cumulative Total	198	256	58	2,123,782	2,766,632	642,850

The improvement of the rural roads and NR 5 will expand the travel area and increase the number of communes accessible within one hour to the provincial center. The cumulative total number of communes will increase from 198 to 256. In addition, the population who can access the provincial center within one hour will increase by approximately 640,000, from approximately 2.13 million to 2.77

million. The road improvement will expand the area of travel and contribute to the revitalization of the local economy by increasing the number of people interacting between the rural areas and the provincial area, increasing employment opportunities on rural roads, and increasing the number of places where agricultural products can be sold.

(2) Improvement of Accessibility to Referral Hospitals

JICA Survey Team calculated improvement for accessibility to referral hospital based on improvements to rural roads and NR5 would increase the number of saved lives by expanding travel area to the referral hospital. The analysis method is as follows.

- Method of Analysis
- Find the access time to the referential hospitals in the target area.
 - Based on the Golden Hour Principle, 50% of patients can be saved in 30 minutes after massive bleeding, and the time required is set as 30 minutes from the referral hospital to the commune center.
 - The road network was set same as the accessibility to provincial center.
 - Population was calculated based on accessibility to the provincial capital.

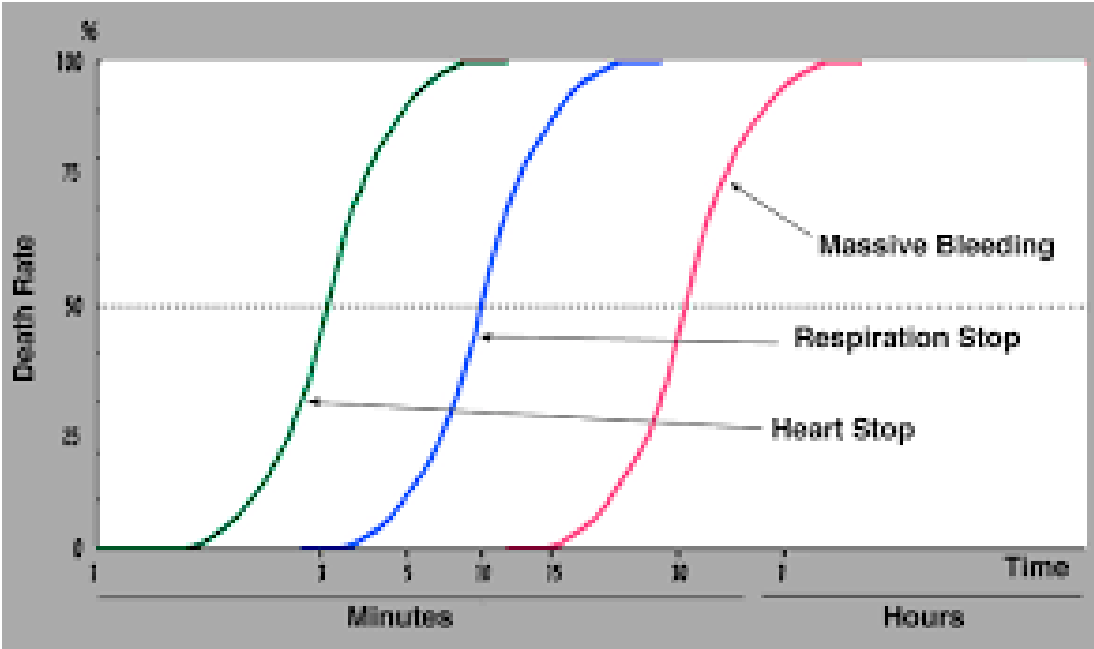
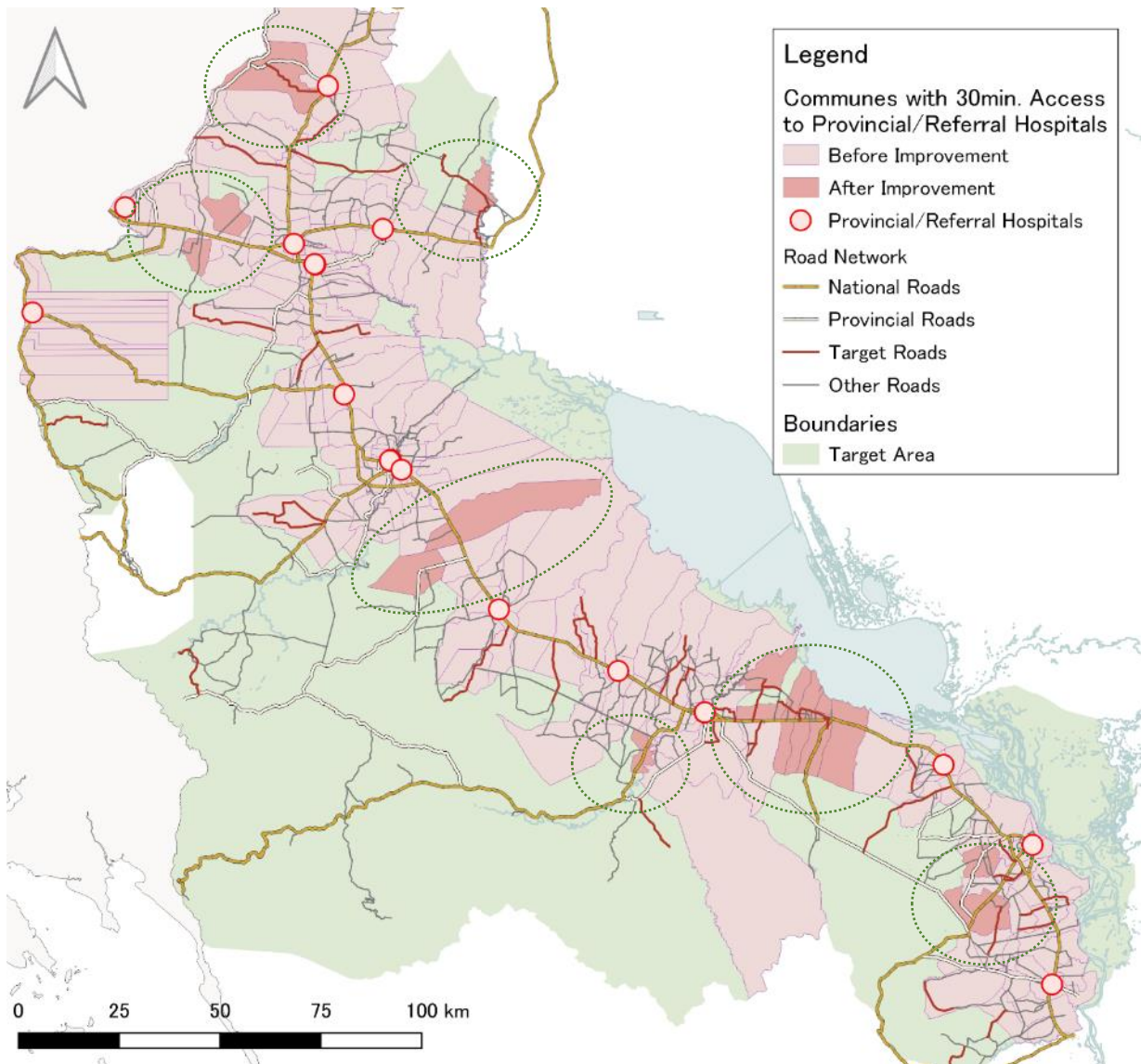


Figure 5.2-5 Golden Hour Principle



Source: JICA Survey Team

Figure 5.2-6 Number of Communes to Access Referral Hospitals within 30min in the Target Area

Table 5.2-3 Number of Communes and Population to Access Referral Hospitals within 30min

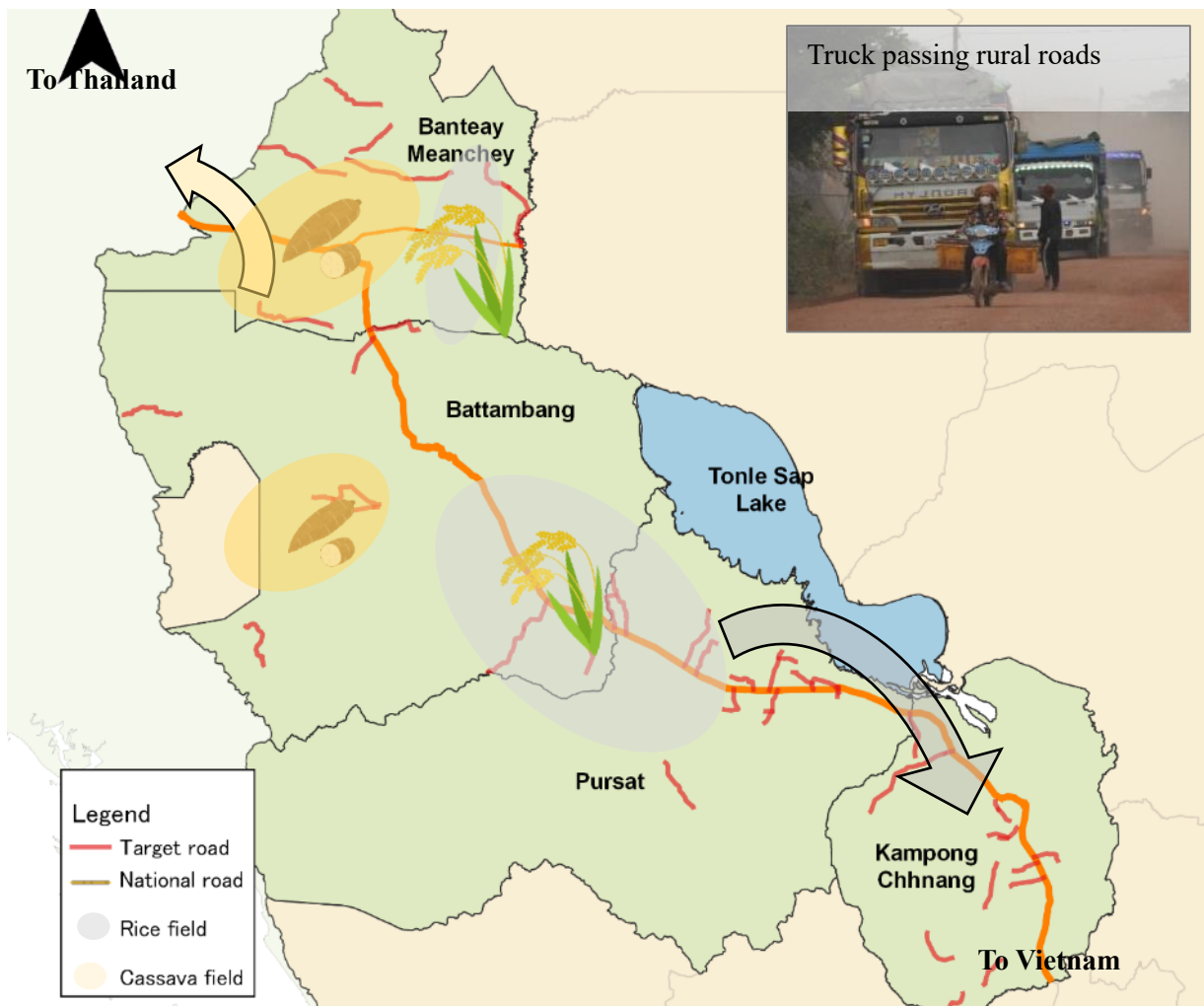
	Commune			Population		
	Before Improvement	After Improvement	Differentiation	Before Improvement	After Improvement	Differentiation
Target area	176	191	15	1,910,004	2,030,574	120,570

The improvement of rural road and NR5 will improve accessibility to referral hospitals and increase the number of communes accessible to referral hospitals within 30 minutes. The number of commune increase from 176 to 191. In addition, the number of population with access to a referral hospital within 30 minutes will increase by approximately 120,000, from approximately 1.9 million to 2.03 million. The improved accessibility to referral hospitals will save more lives.

5.2.2 Qualitative Effects

(1) Improving Transportation for Agricultural Products

The target area produces about 30% of Cambodia's rice and is a major rice and cassava production area. Many trucks pass the target roads during the harvest season. Since trucks load agricultural products on rural roads, the improvement of rural roads contribute improvement for transportation efficiency of agricultural products. According to interviews, rice is transported to Vietnam and cassava to Thailand, and the improvement of roads is expected to shorten transportation time.



Source: JICA Survey Team

Figure 5.2-7 Transportation for Agricultural Products

(2) Road Traffic Accidents

Since the median strip continues for long distance on NR5 after the improvement. JICA Survey Team confirmed through interview that vehicle coming out from the rural roads to NR5 run in the opposite direction and run up to where they can cross the median strip. Therefore, head-on collision may occur. In order to prevent to run opposite direction, police should strengthen traffic control and enhance traffic road education for road users.

5.3 Economic Evaluation

(1) Objectives of Economic Evaluation

The economic evaluation is to evaluate a project from the view of national economy by comparing economic benefits and economical costs through the project life.

(2) Measures of Economic Evaluation

1) Economic Benefit

Economic benefits of this project are defined as a Vehicle Operation Cost (VOC) and Travel Time Cost (TTC). These benefits are calculated by subtracting the total costs of VOC and TTC of “With Project Case” from those of “Without Project Case”.

2) Conversion from Market Price to Economic Price

The economic evaluation is done in economic price in order to evaluate a project from the view of national economy. Economic price can be converted from market price, and the economic price means (a) truly used for the project and (b) true price of the resources and outputs. Above mentioned (a) is to subtract taxes, interests, subsidies, etc. because they are transfers of incomes in the view of national economy. Also (b) is to correct distortions of market prices such as a gap between internal prices and world prices of resources and services. Generally, Standard Conversion Factor (SCF) is used to correct those distortions.

3) Discounting

The total costs and benefits of a project can be added up over the long time of project life; however, project investment, which is the main part of a project cost, is done in the early time of the project. Conventionally, resources used up or generated in earlier years value higher than that in later years. Therefore, a discount rate is applied to the resources and benefits in different years to convert them to present values. In this study, the opportunity cost of capital is applied for the discount rate.

4) Opportunity Cost of Capital

Theoretically, the opportunity cost of capital can be understood as “the marginal Economic Internal Rate of Return (EIRR): the lowest EIRR of the projects which are accepted under the budget constraint of a nation.” However, this ratio is difficult to figure out actually, hence International Donors generally use 10-12% as the discount rate.

5) Evaluation Indices

Economical Internal Rate of Return (EIRR), Net Present Value (NPV) and Benefit Cost Ratio (BCR) are applied as evaluation indices and calculated.

(3) Find Standard Conversion Factor (SCF)

SCF is an index that shows the extent to which the prices of domestic goods and services are distorted by non-perfectly competitive market factors such as tariffs, subsidies, and other import volume restrictions, and converts market prices into economic prices. It is used as a coefficient when the five-year average SCF is 0.93.

Table 5.3-1 Find Standard Conversion Factor

	US\$ million				
	2016	2017	2018	2019	2020
(1) Import value (CIF price)	14119.4	15501.6	18806.5	22241.6	21049.9
(2) Export value (FOB price)	10272.9	11223.6	12962.7	14986.7	17456.7
(3) Import duties	1983.3	1959.9	2347.5	2890.5	2512.6
(4) Export duties	5.2	6.3	7.1	6.5	5.7
SCF	0.9	0.9	0.9	0.9	0.9
				Average	0.93

Source: JICA Survey Team based on key indicators for Asia and the Pacific 2021

(4) Assumptions for Economic Evaluation

- Project life: 30 years (from 2023 to 2052)
- Since the project will start in 2023, the base year is set as 2023
- Opportunity cost of capital (Discount rate): 12%
- Standard conversion factor (SCF): 0.93
- Residual value²¹: Nothing

(5) Unit Cost for Benefit Calculation

JICA Survey Team used Travel Time Cost (TTC) savings and Vehicle Operation Cost (VOC) savings as benefit. JICA Survey Team calculate basic units of travel time cost and vehicle operation cost referring to the report of the JICA Study titled “Preparatory Survey for Phnom Penh-Bavet Expressway Development Project in the Kingdom of Cambodia” and adjusted the values to the base year using the Consumer Price Index (CPI).

The basic unit of travel time cost and basic unit of vehicle operation cost are shown below.

Table 5.3-2 Travel Time Cost

(Unit: USD/hour)		
Motorcycle	Car	Truck
1.21	12.35	36.00

Table 5.3-3 Vehicle Operation Cost

Speed (km/h)	(Unit: USD/km)		
	2023		
	Motorcycle	Car	Truck
10	0.056	0.262	0.557
20	0.052	0.222	0.489
30	0.049	0.207	0.450
40	0.048	0.201	0.430
50	0.048	0.201	0.427
60	0.048	0.201	0.425

(6) Result of Economic Analysis

Confidential

Table 5.3-4 Table for EIRR (Confidential)

Table 5.3-5 Result of Economic Analysis (Confidential)

²¹ Residual value is the value of the existing facilities and equipment (remaining fixed assets) at the end of project life.

(7) Result of Sensitivity Analysis

Confidential

Table 5.3-6 Result of Sensitivity Analysis (Confidential)

5.4 Effects of Adaption to Climate Change

5.4.1 Adaptation with Cambodia's Updated Nationally Determined Contribution 2020

Table 5.4-1 summarizes the proposed adaptation actions subdivided by sectors and the corresponding lead ministry in Cambodia's Updated Nationally Determined Contribution 2020.

The focus sectors in line with the vulnerability of the country are the following:

- Agriculture, including agrobusiness, animal health and production, agriculture / energy, and agriculture / gender (17 actions)
- Coastal zones (2 actions)
- Energy (2 actions)
- Human health (5 actions)
- Industry (1 action)
- Infrastructure – including roads, buildings, and urban land use planning (15 actions)
- Livelihoods, poverty, and biodiversity (7 actions)
- Tourism (3 actions)
- Water resources (6 actions)

In the Infrastructure sector, the rural road rehabilitation / improvement project conducted by MRD is included.

Table 5.4-1 The Proposed Adaptation actions

	Adaptation action	Sector / Sub sector	Ministry
39	Strengthening Climate Resilient Cities	Infrastructure - Land use planning	NCDD
40	Develop national road construction and maintenance design standards for national and provincial roads, considering climate change impacts, including developing an M&E framework for climate proofing and low-carbon technology roads	Infrastructure - Roads	MPWT
41	Repair and rehabilitate existing road infrastructure and ensure effective operation and maintenance systems, considering climate change impact	Infrastructure - Roads	MPWT
42	Rural road rehabilitation and improvement for climate change resilience	Infrastructure - Roads	MRD
43	Develop and annually update national and subnational multi-hazard and climate risk assessments, including the identification of the most vulnerable communities	Livelihoods, poverty and biodiversity	NCDM
44	National end-to-end early warning systems with focus on effective dissemination to populations at risk	Livelihoods, poverty and biodiversity	NCDM
45	Implement community-based disaster and climate risk management programs	Livelihoods, poverty and biodiversity	NCDM
46	Building resilience of biodiversity conservation and restoration to adapt to climate change	Livelihoods, poverty and biodiversity	MOE

Source: Cambodia's Updated Nationally Determined Contribution 2020

5.4.2 Future Climate Risk Analysis

Based on JICA Climate-FIT (adaptation), Survey team prepared a Climate Risk Matrix which is shown below.

Table 5.4-2 Climate Risk Matrix

	Hazard					Vulnerability •Historical and Current Efforts against the impacts occurred and actions to address them •Planned initiatives	Climate Risk (Selected risks to manage)	Potential Adaption Options
	H1 Flood	H2 Torrential rain	H3 Drought	H4 Slight rain	H5 Storm			
Current status of hazard occurrence	++	++	+	+	+	Count		
Prospects for the future of the Hazard	↗	↗	→	→	→			
E1 Road pavement	3 ↗ • Periodic flooding, such as around Tonle Sap Lake, makes it difficult to pass through. • Muddy road surfaces are causing obstructions to traffic.	3 ↗ • Muddy road surfaces are causing obstructions to traffic.	2 → • The Mekong River has been experiencing a decrease in flow and the occurrence of El Niño phenomenon has resulted in a large number of these events in recent years. • On unpaved roads, dust generation is severe.	2 → • The Mekong River has been experiencing a decrease in flow and the occurrence of El Niño phenomenon has resulted in a large number of these events in recent years. • On unpaved roads, dust generation is severe.	0 • No impact on road pavement is anticipated.	• Since the road surface and base course are made of soil, they are damaged easily due to flooding. Because the road surface is made of soil, the surface soil is easily eroded when it dries out. • No drastic measures have been implemented to prevent dust generation during the dry season. • Water sprinkling has been implemented by the government and	• Muddy road surfaces will reduce travel performance and cause road closures. • Dust will reduce visibility, which will reduce travel performance and increase the number of traffic accidents.	• DBST pavement will be paved for target roads in areas that are expected to be inundated by less than 150 cm of high water. • Concrete pavement will be paved for target roads in areas that are expected to be inundated by more than 150 cm of high water.
E2 Installation/improvement of drainage	0 ↗ • Roads with inadequately maintained drainage facilities have clogged drainage pipes during rainfall, resulting in poor drainage.	0 ↗ • Roads with inadequately maintained drainage facilities have clogged drainage pipes during rainfall, resulting in poor drainage.	0 • No impact on drains is anticipated.	0 • No impact on drains is anticipated.	0 • fallen leaves and branches clog drainage facilities.	• Many roads have inadequate maintenance of drainage facilities. • Many drainage pipes are small in diameter, making it difficult to maintain drainage facilities (e.g., cleaning).	• Poor drainage makes roads more susceptible to flooding and road closures more likely to occur.	• Target roads, which are located in areas that are expected that Inundation of 50 cm to 150 cm water level is occurred, will be improved or newly installed drainage facilities, because there is a possibility to have poor drainage on both sides of the road in the event of flooding. • Existing drainage pipes with a diameter of less than 80 cm should be replaced with drainage pipes with a diameter of 80 cm or more, which can be cleaned by a person. • Establishing a system and structure to ensure adequate maintenance and management of drainage facilities.
E3 Improvement of bridges and culvert	0 ↗ • Rising and flooding rivers and irrigation canals have washed away some aging wooden bridges.	0 ↗ • Rising and flooding rivers and irrigation canals have washed away some aging wooden bridges.	0 • There is no climate change-related impact on wooden bridges, although they are showing signs of aging.	0 • There is no climate change-related impact on wooden bridges, although they are showing signs of aging.	0 • There is no climate change-related impact on wooden bridges, although they are showing signs of aging.	• Wooden bridges are deteriorating. • Routine maintenance of wooden bridges is not being performed.	• Damage to the wooden bridge causes road closures and accidents.	• Replacement of existing wooden bridge • Establish of a system to ensure that bridge maintenance can be fully implemented
E4 Instillation of traffic safety facilities	0 • No impact of climate change on road safety facilities is anticipated.	0 • No impact of climate change on road safety facilities is anticipated.	0 • No impact of climate change on road safety facilities is anticipated.	0 • No impact of climate change on road safety facilities is anticipated.	0 • No impact of climate change on road safety facilities is anticipated.	-	0	
E5 Widening of road	0 • No climate change impacts are anticipated.	0 • No climate change impacts are anticipated.	0 • No climate change impacts are anticipated.	0 • No climate change impacts are anticipated.	0 • No climate change impacts are anticipated.	-	0	
E6 Raising of road height	3 ↗ • Periodic flooding, such as around Tonle Sap Lake, is making it difficult to pass through. • The road surface and roadbed have deteriorated due to flooding.	3 ↗ • Periodic flooding, such as around Tonle Sap Lake, is making it difficult to pass through. • The road surface and roadbed have deteriorated due to flooding.	0 • No drought impacts are expected at the current road surface elevation.	0 • No drought impacts are expected at the current road surface elevation.	0 • No drought impacts are expected at the current road surface elevation.	• The road surface elevation is low in relation to flooding. • Since the road surface and base course are made of soil, they are damaged easily due to flooding.	• Flooding causes deterioration of the roadbed and road surface.	• Raise the height of roads for which sufficient land for raising can be secured. • Target roads which are located in areas that are expected to be inundated by water levels of less than 50 cm will be raised by 50 cm. • Target roads, which are located in areas that are expected that Inundation of 50 cm to 150 cm water level is occurred, will be raised by 150 cm.
E7 Improvement of alignment, velocity control measures	0 • Flooding impacts are not expected with the current road alignment.	0 • Flooding impacts are not expected with the current road alignment.	0 • Flooding impacts are not expected with the current road alignment.	0 • Flooding impacts are not expected with the current road alignment.	0 • Flooding impacts are not expected with the current road alignment.	-	0	
Counting	6	6	2	2	0			

Source: Based on JICA Climate-FIT (adaptation),

Basis for climate hazard

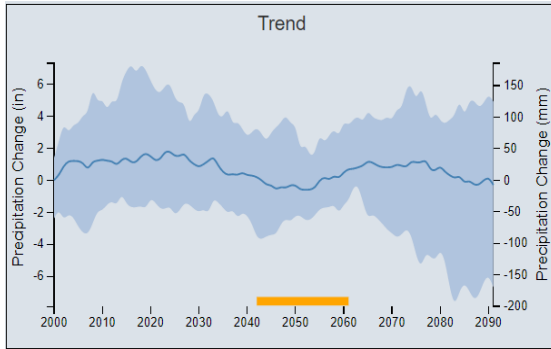
In the followings climate hazards in Cambodia are listed.

H1:	
H3:	DFR2.1.2 (2),
H4:	Cambodia's Updated Nationally Determined Contribution (NDC) 3. Adaptation Contribution
H5:	
H2:	DFR2.1.2 (2)

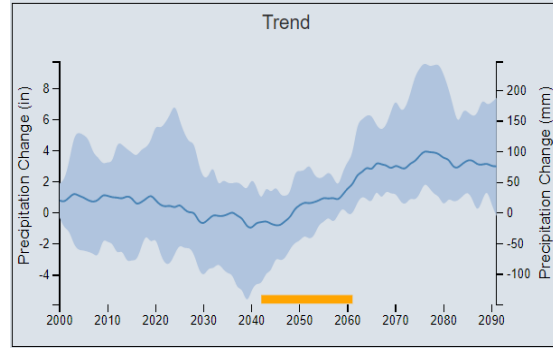
Projected Future Rainfall under RCP Scenario

Over the span of the next 50 years, little or no change in precipitation is projected under RCP 2.6 and RCP 6.0. On the other hand, RCP4.5 and RCP8.5 are projected to increase rainfall by 50 to 100 mm per year.

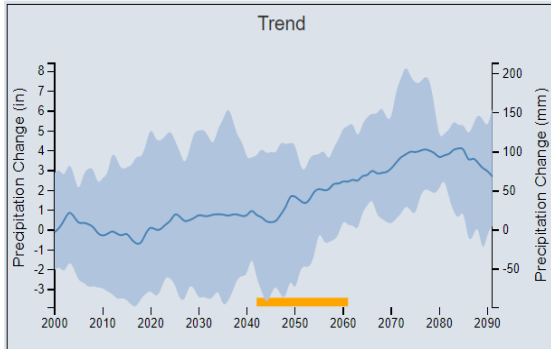
RCP2.6



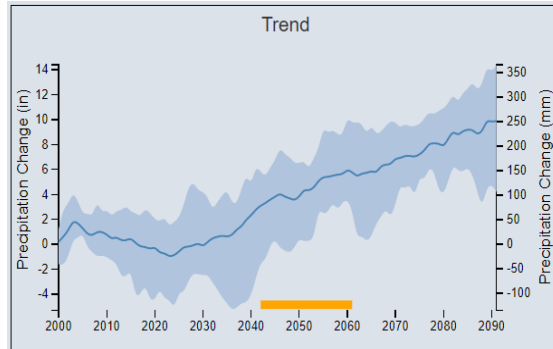
RCP6.0



RCP4.5



RCP8.5



Source: JICA Survey Team

Figure 5.4-1 Basis for Climate Hazard

5.5 Consideration of Gender Mainstreaming and Poverty Reduction Measure

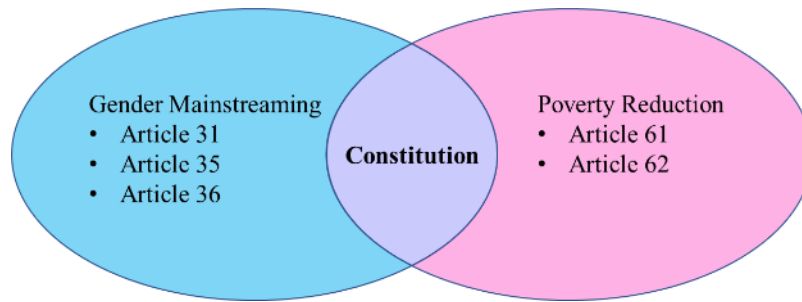
5.5.1 Legal and Institutional Frameworks

The Kingdom of Cambodia has a constitution as the supreme law, RS, and Neary Rattanak as national guidelines for all ministries and sub-national institutions to guide them in developing their own gender mainstreaming.

The specific guidelines, conditions, and modalities for gender mainstreaming in civil construction works of government rural road projects have not been specified or fixed in the contractors' agreements. Only projects supported by development partners such as ADB and WB have clearly defined and stated the terms/conditions of the contractor's agreement for compliance with gender mainstreaming.

(1) Constitution

There are a few articles on promoting gender and poverty reduction in constitution as stated below.



Source: JICA Survey Team

Figure 5.5-1 Articles highlighted on Gender Mainstreaming and Poverty Reduction in the Constitution

Gender Mainstreaming

Article 31: “The Kingdom of Cambodia recognizes and respects human rights as stipulated in the United Nations Charter, the Universal Declaration of Human rights and the covenants and conventions related to human rights, women’s rights, and children’s rights. Khmer citizens shall be equal before the law, enjoying the same rights, and freedom and obligations regardless of race, color, sex, language”

Article 35: “Khmer citizens of either sex shall have the right to participate actively in the political, economic, social, and cultural life of the nation. All requests from citizens shall be thoroughly considered and resolved by institutions of the state.”

Article 36: “Khmer citizens of either sex shall enjoy the right to choose any employment according to their ability and the needs of the society. Khmer citizens of either sex shall receive equal pay for the same work. Housework shall have the same value as work outside the home. Khmer citizens of either sex shall have the right to obtain social security and other social benefits as determined by law. Khmer citizens of either sex shall have the right to form and be members of trade unions. The organization and functioning of trade unions shall be determined by law.”

Poverty Reduction

Article 61: “The State shall promote economic development in all sectors and particularly in remote areas, especially in agriculture, handicrafts, and industry, with attention to policies on water, electricity, roads, and means of transportation, modern technology, and credit systems.”

Article 62: “The State shall pay attention to and help improve the means of production, protect the price of products for farmers and crafters and find marketplaces for them to sell their products.”

(2) Rectangular Strategy

Gender Mainstreaming

RS-IV, Rectangle 1: Human Resource Development, Side 4: Improving Gender Equity and the Social Protection²²: “*The Royal Government’s strategic goal is to strengthen gender equity and social protection to enhance social-economic situation and strengthen women’s role in the society who are the backbone of the economy and society ...*

The Government acknowledges the challenges such as discrimination against women; however, work and family burdens are still a barrier for women to involve in education, the economic, social, and political sector, etc. To address the challenges of promoting gender, the Royal Government mainly focuses on:

- Further promoting women’s role in society through enhancing their capacity and the proportion of women within the leadership roles at both national and sub-national levels, in ministries-institutions both in political and technical positions.
- Updating and implementing Neary Rattanak Strategic Plan by continuing to mainstream gender in the development policies and plans in all sectors and at all levels.

Poverty Reduction

RGC aimed to achieve poverty reduction below 10%²³ and also put effort into promoting the rural development to be more vibrant by further investing in rural roads, small-scale irrigation systems, expanding the coverage of electricity, water, and sanitation accessibility to promote the livelihood of people²⁴. For promoting gender and poverty reduction, the Royal Government mainly focuses on²⁵:

- Pushing for the implementation of the National Social Protection Policy Framework 2016-2025; especially, by putting in place the occupational risk scheme for civil servants and pension scheme for workers-employees covered by labor law, reforming the pension scheme for civil servants, integrating the social security operators ...
- Preparing the legal framework and supporting infrastructure in order to implement the new social assistance programs, widen the coverage of existing programs to provide better support to the poor and vulnerable groups, and put in place new social security schemes while expanding the coverage of existing ones to provide social protection service to every citizen.

(3) Neary Rattanak

According to RS-IV, the Ministry of Women’s Affairs (MoWA), mandated with guiding/leading the promotion of gender equality and monitoring the implementation of gender mainstreaming and women’s empowerment, formulated, and updated the Neary Rattanak Strategic Plan. It builds on the progress of Neary Rattanak IV (2014-2018) and it is linked to the principles of CEDAW²⁶, the rule of law, national policies, government reforms and sectoral frameworks, as well as the 2030 Agenda for Sustainable Development to ensure that no one is left behind.

Neary Rattanak V (2019-2023) focuses on promoting gender mainstreaming in policies, strategic plans, and development programs across all sectors and at all levels, especially in key strategic areas related to

²² RS-IV, Rectangle 1: Human Resource Development, Side 4: Improving Gender Equity and Social Protection, Page #25

²³ RS - IV, 3rd strategic goal, Page #10

²⁴ RS - IV, Rectangular IV: Inclusive and Sustainable Development; Side I: Promotion of Agriculture Sector and Rural Development. In the Sixth Legislature of the National Assembly, the Royal Government will focus on: “bullet no. 10: Continuing to promote the rural development to be more vibrant by further investing in rural roads, small-scale irrigation system....”

²⁵ RS - IV, Rectangular 1: Human Resource Development, side 4: Improving Gender Equity and Social Protection, Page #26

²⁶ Convention on the Elimination of All Forms of Discrimination Against Women, <https://www.ohchr.org/en/treaty-bodies/cedaw>

the economy, education, health, legal protection, governance, and climate change.

The five-year strategic plan for strengthening gender mainstreaming and women's empowerment is supported by an institutional support strategy that concentrates on capacity development and efficiency programs, which are key factors for achieving Neary Rattanak V's approaches and targets. To achieve the Government's strategic goal, Neary Rattanak V focuses on²⁷:

- Expand research and assessment programs on gender and formulate and coordinate in order to implement the first National Policy on Gender Equality and sectoral programs
- Promote and facilitate gender mainstreaming within the sectoral framework of strategic plans and national programs, including the Public Administration Reform (PAR) program, the Decentralization and Deconcentration (D&D) program, and the Public Financial Management Reform Program (PFMRP)
- Strengthen the capacity of gender mainstreaming mechanisms at all levels, including the Gender Mainstreaming Action Group (GMAG) in different sectors, the Technical Working Group on Gender (TWG-G), the Women and Children's Consultative Committees (WCCC) at the Capital, Provincial, Municipal, District and Khan, the Communes Committee for Women and Children (CCWC) at the Commune/Sangkat and relevant stakeholders
- Strengthen systems and mechanisms for monitoring and evaluating gender mainstreaming and women's empowerment in the different sectors
- Promote public awareness and support for the promotion of gender equality, including the implementation of programs on public behavior change and overcoming negative gender stereotypes in society that discriminate against women and girls in all forms
- Promote new initiatives, lessons learned, and best practices on the implementation of gender mainstreaming in policies, programs, and sectors, as well as strengthen the knowledge of management and sharing.

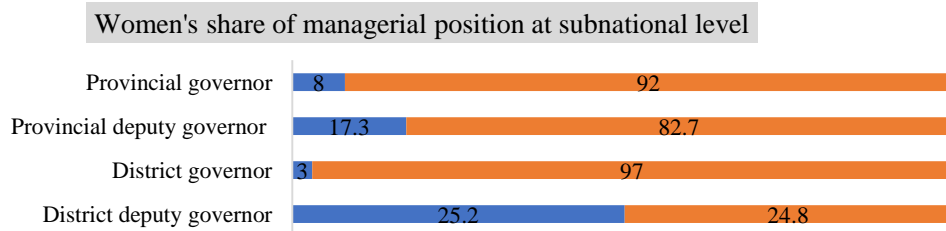
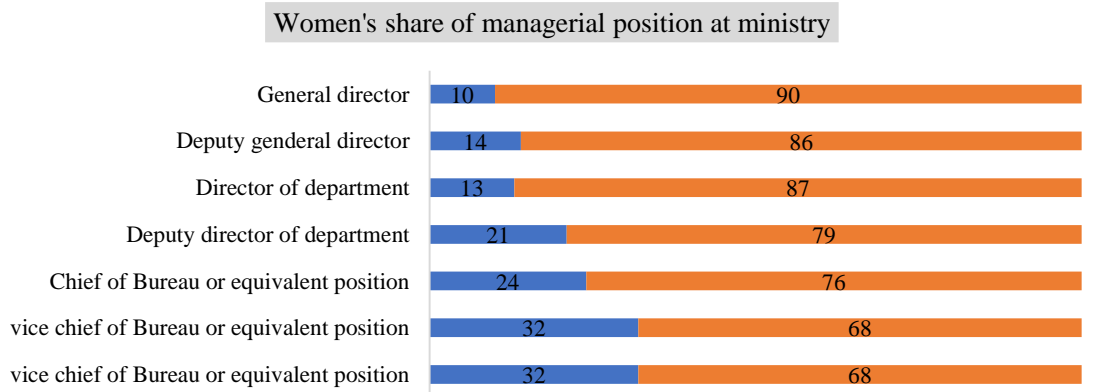
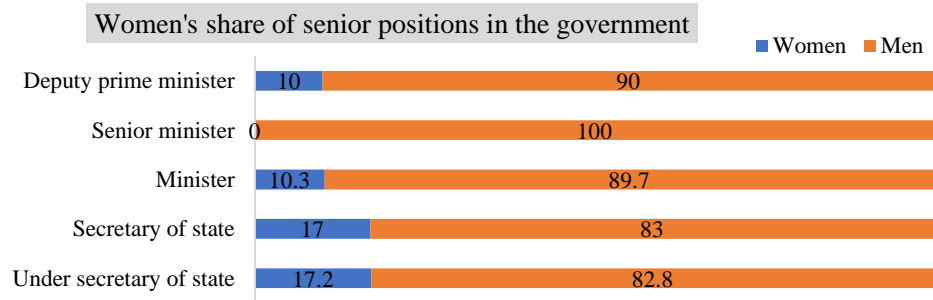
The strategy has imposed empowerment of women in decision-making by increasing the recruitment of female candidates to 50% and expanding the working retirement age of female civil servants to the age of 60, and the intention to promote at least one woman to a position of leadership and management in line ministries and Sub-National Administrations (SNAs).

As a result, in 2021, there were women holding positions in the government and managerial positions at the national and sub-national levels (Figure 5.5-2). In the government, 10% of deputy prime ministers are women. While there are some women in other senior government official positions, it is still lacking compared to men who hold over 80% of overall positions.

At the national level, more women could be seen working in various positions from the vice chief of the bureau to general directors at 19% overall. More women occupied low-level positions and it decreased at higher levels.

At the sub-national level, there are very few percentages of women holding the head position of the governor (8% of provincial governors and 3% of district governors). More women become deputy governors (province and district); however, there is a high disparity of position share as to date, men are still dominant in every position.

²⁷ Neary Rattanak V (2019-2023), Page #-3 and #7



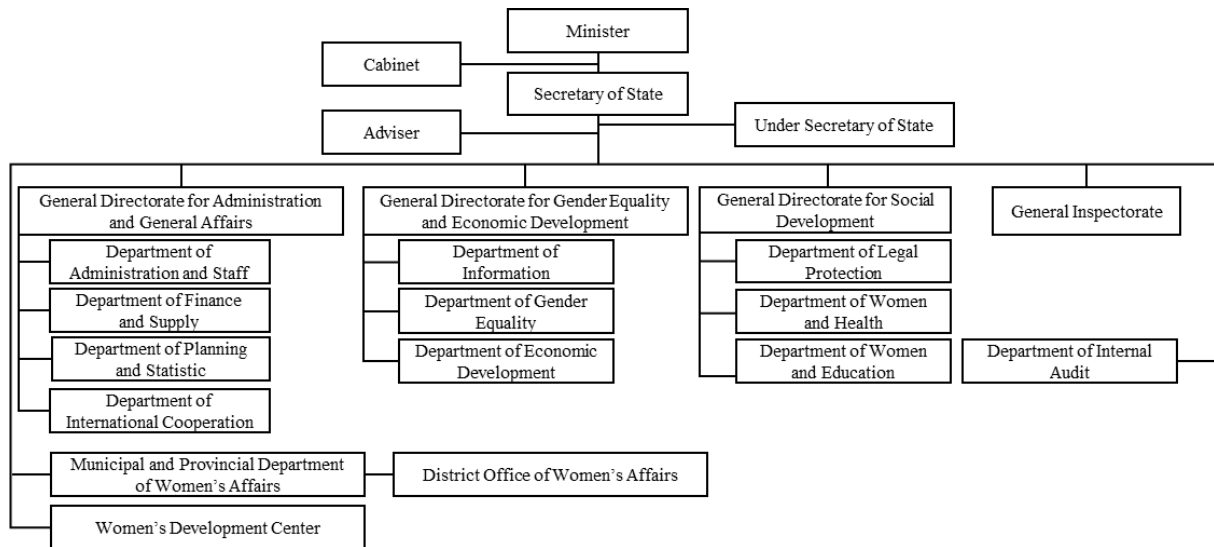
Source: MoWA

Figure 5.5-2 Women's Share of Position at Government, National, and Subnational Level²⁸

²⁸ Key gender statistic as of October 2021, MoWA

(4) Ministry of Woman Affairs

The Ministry of Women’s Affairs (MoWA) was created in 1993 to be responsible for woman-related issues and needs. On behalf of RGC, MoWA is responsible for gender issues and provides a channel through women’s voices that can be heard and enables the development of a broad gender mainstreaming program.



Source: MoWA

Figure 5.5-3 Organization Chart of Ministry of Women’s Affairs²⁹

MoWA prepared Neary Rattanak, the five-year strategic plan, to guide national and sub-national gender and development plans in Cambodia. As the national institutional mechanism for gender mainstreaming, MoWA publishes numerous strategies to promote women's economic empowerment and decision-making and to eliminate all forms of discrimination against women. At the national level, the RGC and MoWA have also established gender mainstreaming working groups within line ministries, which are primarily responsible for preparing gender mainstreaming plans. Similarly, they have established Women's Development Centers (WDCs) at the sub-national level to provide vocational training, focusing on skills such as weaving, manufacturing, handicrafts, hairdressing, tailoring and food processing.

Other commitments from MoWA for gender mainstreaming contain the initializing Australia-Cambodia Cooperation for Equitable Sustainable Services (ACCESS)³⁰, which is the program that strengthen the sustainability, quality, and environment of services for people with disabilities and women affected by gender-based violence, cooperating with Union Aid Abroad-APHEDA³¹. This cooperation focuses on the implementation of the project on Women Workers and Decent Work to enhance the equality of women workers in Cambodia, promote Youth Leadership Lab for Gender Equality Program³², enable youth in Higher education and public institution to become the prominent leader, promote gender equality, and eliminate discrimination against woman in the family, community, and society.

At MoWA, approximately 80% of civil servants are women (Figure 5.5-4). This percentage shows MoWA's commitment to being a model as the only government institution with the highest number of women in positions. The presence of women in the leadership of the institution would allow for a better understanding of the demands and problems faced by women's groups and better planning for gender mainstreaming and advocacy in the country.

²⁹ MoWA, <https://www.mowa.gov.kh/en/organization-chart>.

³⁰ Australia-Cambodia Cooperation for Equitable Sustainable Services, <https://accesscambodia.org/>

³¹ Union Aid Abroad-APHEDA, <https://www.apheda.org.au/women-workers-rights-cambodia/>

³² Youth Leadership Lab for Gender Equality Program, MoWA, <https://www.mowa.gov.kh/detail/category/youth-leadership-lab-gender-equality-kh>

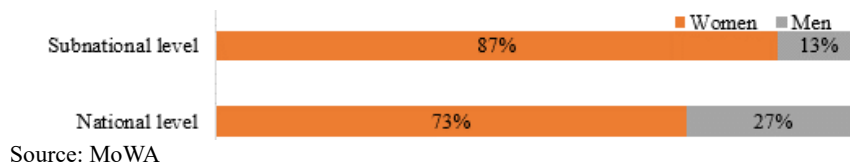


Figure 5.5-4 MoWA Officers' Share³³

5.5.2 Gender and Poverty Reduction Perspectives in Other Donor Projects

(1) Asia Development Bank: ADB

1) Gender Mainstreaming

ADB's gender and development policy³⁴ will embrace mainstreaming where key elements will include gender sensitivity, gender analysis, gender planning, integration, and agenda setting. ADB provides assistance to its developing member countries in the areas of policy support, capacity building, gender and development awareness (GAD), facilitating gender analysis of proposed projects, and ensuring that gender issues are taken into account at all appropriate stages of the project cycle through workshops and training seminars. ADB has also published a strategy to accelerate progress on gender equality (2019-2024)³⁵ by: (1) increasing women's economic empowerment; (2) strengthening gender equality in human resource development; (3) strengthening gender equality in decision making and leadership; (4) reducing women's time poverty and drudgery; and (5) building women's resilience to external shocks.

ADB plays an important role as a development partner of the RGC. In the rural roads sector, ADB has supported many projects such as the Road Network Improvement Project (Phase 1-2), the Rural Roads Improvement Project (I-III) and the Greater Mekong Subregion Corridor Cities Development Project II (GMS2). In all these projects, there are worker and gender action plans that ensure women's participation in all stages of the project. The contractor must hire unskilled workers from local communities, at least 20-40% of whom are women. In community-based road safety campaigns, at least 50% of facilitators should be female³⁶.

2) Poverty Reduction

The poverty reduction strategy of ADB is based on pro-poor sustainable economic growth, inclusive social development, and good governance. To succeed in reducing poverty requires policies that simultaneously strengthen all three pillars, the weight of which varies depending on the country's origin³⁷.



Source: JICA Survey Team

Figure 5.5-5 Three Pillars of ADB's Poverty Reduction Framework

³³ Statistic of civil servant of all ministry 2019, Ministry of Civil Services.

³⁴ ADB (2003), Gender and Development. <https://www.adb.org/sites/default/files/institutional-document/32035/gender-policy.pdf>

³⁵ ADB (2019), Strategy 2030 operational plan for priority 2-Accelerating progress in gender equality, 2019-2024. <https://www.adb.org/sites/default/files/institutional-document/495956/strategy-2030-op2-gender-equality.pdf>

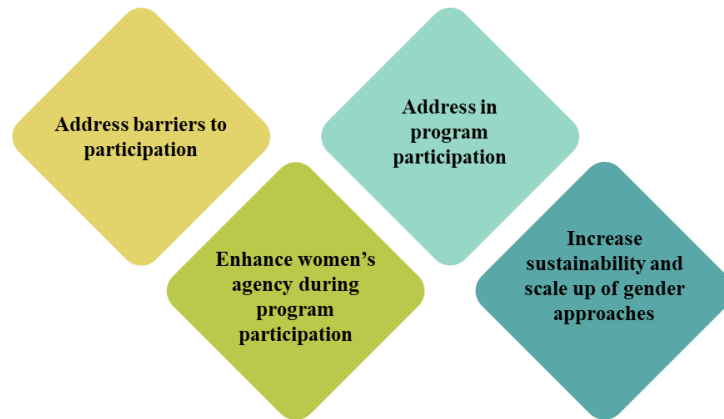
³⁶ Rural Road Improvement Project I-III, Labor, and Gender Action Plan

³⁷ ADB (2004), Enhancing the Fight against Poverty in Asia and the Pacific: The Poverty Reduction Strategy of the Asian Development Bank. <https://www.adb.org/documents/enhancing-fight-against-poverty-asia-and-pacific-poverty-reduction-strategy-asian>

(2) World Bank: WB

1) Gender Mainstreaming

Gender mainstreaming in World Bank (WB) transport projects have focused on women's participation in construction, rehabilitation, maintenance, and management of transport infrastructure that could help expanding their life choices and their capacity to better support their families and more actively participate in communities and societies. The key factors to enhance women participation in rural road project include (Figure 5.5-6)³⁸:



Source: JICA Survey Team

Figure 5.5-6 Strategies to Foster Women's Participation in Rural Road Work

- *Address barrier to participation:* Gender-neutral recruitment is not effective enough to increase women's participation because women are not normally as physically mobile as men, so they are unlikely to obtain information as it is available mostly at the village or district center or at construction sites. More gender-sensitive recruitment strategies should be implemented through public campaigns involving multiple channels of communication about recruitment procedures and a clear message that women are welcome. Childcare tasks are also a burden for women. By addressing this issue and taking positive action through the setting of recruitment quotas for women as well as the integration of gender components into gender equality contractors in access to employment and salary levels, women should be able to participate more in rural road construction work.
- *Address in program participation:* Women are more vulnerable than men under difficult working conditions. This problem must be addressed by providing safe and separate sanitation facilities for women and the project site. The tasks should be sensitized, and the operations manual should be carefully reviewed and modified to give women the opportunity to perform a variety of tasks. Provide measures to ensure that women workers are protected from discrimination and all forms of violence.
- *Enhance women's agency during program participation:* Women workers should be provided with opportunities for technical and life skills training while employed, as this allows them to take on greater challenges and better paying jobs. Projects should consider creating a "safe space" where women can meet regularly to meet with peers, consult with mentors, build skills, address personal issues, and develop leadership training.
- *Increase sustainability and scale-up of gender approach:* Projects should introduce measures to institutionalize women's participation in staffing and leadership positions to address the risks to the

³⁸World Bank Group (2015), Roads to agency: effects of enhancing women's participation in rural roads projects on women's agency. <http://documents.worldbank.org/curated/en/666721468185041902/Roads-to-agency-effects-of-enhancing-women-s-participation-in-rural-roads-projects-on-women-s-agency-a-comparative-assessment-of-rural-transport-projects-in-Argentina-Nicaragua-and-Peru>

continuity of women's increased participation in roadwork. Strategies should be designed for participants, such as providing women with training in financial literacy, job search and business development skills, and access to credit, to improve participants' chances of obtaining permanent employment or becoming self-employed after the project ends.

5.5.3 Gender and Poverty Reduction Perspective in MRD/PDRD

(1) Ministry of Rural Development: MRD

MRD was established by the laws of the Kingdom of Cambodia. Promulgated by Royal Kram No. NS / RKAM / 0196/12, dated January 25, 1996. The Royal Government of Cambodia has assigned the MRD to lead and manage the rural development sector of the Kingdom of Cambodia.

MRD is fully committed to the promotion of gender equality and women's empowerment, which is highlighted in the RS-IV, National Strategic Development Plan updated 2019-2023, and the Cambodian Sustainable Development Goal 2016-2030.

1) Gender Mainstreaming

MRD has updated the Gender Mainstreaming Strategic Plan 2019-2023 to address the remaining issues in previous strategic plans: 2012-2018. The strategy is defined in line with the government's mandate to eliminate gender inequality in the rural development sectors and to promote human rights and poverty reduction, particularly related to the promotion of the livelihood of women and their families. The Gender Working Group (GWG) at the Provincial Department of Rural Development (PDRD) was established in 2006 to facilitate and promote gender mainstreaming at the sub-national level.

MRD's Gender Mainstreaming Strategic Plan 2019-2023 incorporates five strategies to accelerate the realization of gender equality and increase the awareness and understanding of gender.

According to the MRD Administration Department, the total percentage of overall female civil servants was only 18%, which was a small number compared to male civil servants (82%) in 2011. As shown in Figure 5.5-7 below, the total percentage of female civil servants increased from 18% to 25% in 2018; however, this was still a limitation of the women who were employed at the MRD and was also below the required female employment target, which limited at least 30% of the required women. Furthermore, this growing number was still a small number compared to the male staff (75%) in 2018. More women were in leadership positions, from deputy executive director to vice office manager.

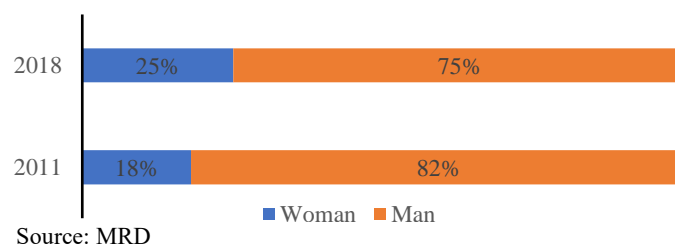
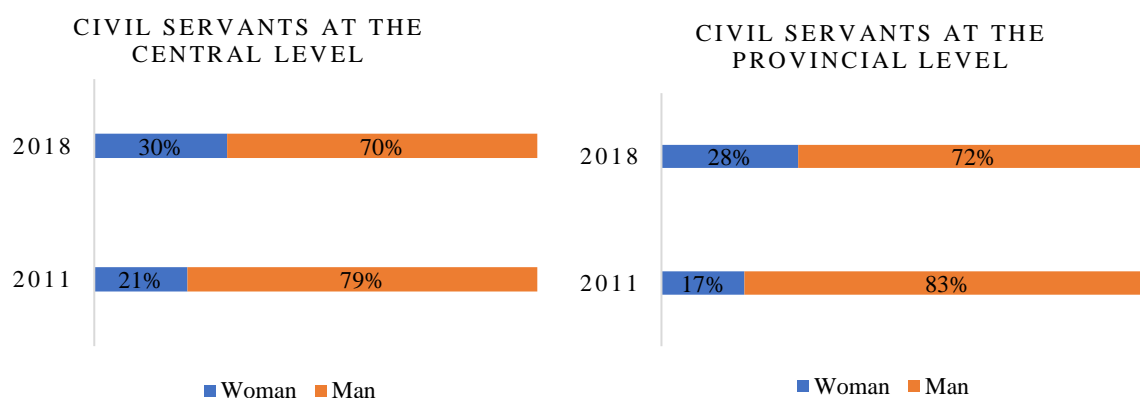


Figure 5.5-7 The Percentage of Employment Status of MRD

As shown in Figure 5.5-8, the percentage of female officials at the central level augmented noticeably from 21% to 30% in 2018, which achieved the target employment of choosing female civil servants. It reflected the effort of the senior leadership of MRD that try to promote gender mainstreaming in office. In addition, at the provincial level, the representative female officials have been raised significantly from 17% to 28% in 2018.



Source: MRD

Figure 5.5-8 Percentage of Employment Status at the Central Level and PDRD39

As a result of MRD's Gender Mainstreaming Strategic Plan, 2019-2023, female officers have built their capacity through trainings, workshops, and study tours. According to the Department of Training and Research on Capacity Building and Human Resource Development, female participants in training sessions increased from 17% in 2010 to 22% in 2018, from 13% to 18% for the workshop, and from 10% to 19% study tours. However, progress has not yet been successful against the 50% target that was set by MRD for women's capacity building. For this outcome, it has been shown that women have been involved in family responsibilities that hinder their participation. Women do not prefer activities that take place far from their homes, which prevents them from participating in certain trainings, workshops or study tours.

GMSP's 2019-2023 goal is to accelerate the realization of gender equality in the rural development sectors. To achieve the goal, MRD will implement the following strategies:

- **Strategy 1: strengthening the capacity of the gender networks at all levels in MRD:** revised the GMAG with membership from all departments and relevant institutions and has established GWGs at the municipal and provincial level. Result: gender network show that their capacity and understanding about gender has increased,
- **Strategy 2: mainstream gender into laws, policies, strategies, and programs in the rural development sectors:** GMAG successfully mainstreamed gender into laws, policies, strategies, and programs in the rural development sectors. As a result, the national budget is allocated budget for the implementation of GMSP
- **Strategy 3: promote gender equality in the ministry and in decision-making positions:** remarkable progress has been made in increasing the degree of women's representation in ministry at the central and sub-national levels and in the number of women in decision-making positions. However, the increase in the rate has remained low than expected, and this requires further attention from the current mandate of the RGC,
- **Strategy 4: increase gender mainstreaming in the rural development sectors:** MRD has been promoting gender equality throughout its sector, covering community development, rural water supply, rural health care, rural infrastructure development, rural economic development, the development of ethnic minorities, and the training in basic skills,
- **Strategy 5: promotion collaboration between the GMAG and the project implementation unit (PIU) with financial support from development partners:** in many cases, the GMAG is not well informed about the extent to which each project has aligned its action plan with the GMAP, and the extent to which gender has been mainstreamed with each project.

³⁹ Gender Mainstreaming Strategic Plan in the Ministry of Rural Development Update 2019-2023, Page #10

The GMSP also aimed to promote women in decision-making positions between 40% to 50%⁴⁰ which expanded the opportunities for capable women to participate in the development direction of communities.

2) Poverty Reduction

The goal of the MRD's **Rural Development Policy (2019-2023)** is to promote the development of rural areas for social, economic, and cultural well-being and a good quality of life. Efforts will improve the quality and resiliency of the rural road infrastructure network and ensure a sustainable rural economy and harmonious community development⁴¹.

(2) Provincial Department of Rural Development: PDRD

1) Gender Mainstreaming

The section on gender mainstreaming focuses on the general status of gender in the project areas, government mechanisms, current practices, and women's participation in community development.

Based on interviews with PDRD representatives in the four provinces and following the MRD's gender mainstreaming strategic plan, JICA Survey Team observed that widely distributed and the promotion of gender awareness was found through various efforts among both department staff and their local communities. Somehow, other mainstreaming mechanisms such as the constitution, RS-IV and Neary Rattanak have limited made known to all staff. Some officers are informed of the Neary Rattanak policy by MoWA, especially among technical staff. It should be noted that the Gender Working Group (GWG) has been established at the municipal and provincial levels, which could strengthen and mainstream gender in the institution and its work at the national and sub-national levels.

The majority of PDRD staff is still male dominated. The overall percentage of female staff (Figure 5.5-9) is still about 24.3% (a national average of 28%), which is still low compared to the target of 33% to be achieved by 2023. Among the staff, most women are in administrative positions, and most are only in office manager positions. The number of women in positions of office manager or above is still limited. In addition, very few women work as technical officers in the PDRD, and it is common for some provincial departments to have no female engineers in some offices. The interview suggested that the ministry also provides opportunities for women to be recruited into engineering positions, but there has not been much change because the engineering sector in the country is still dominated by men even the number of engineering student women is increased in last 5 years. In addition, many people still prefer to work in the capital or in a secondary city where a variety of jobs are available, and the standard of living is better than in the province.

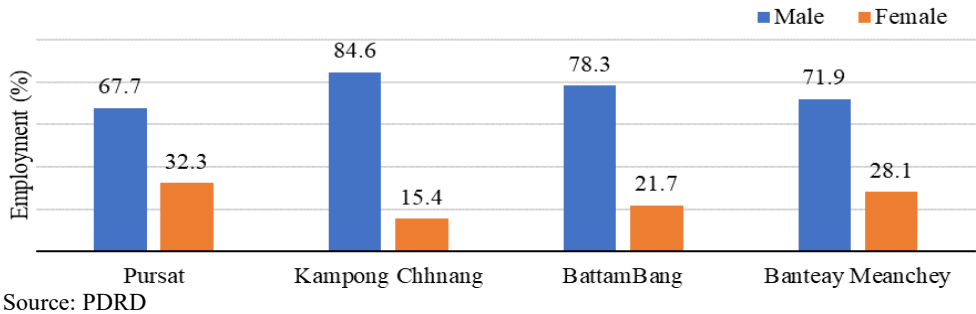


Figure 5.5-9 Status of PDRD Officers

There are many collaborative projects between the RCG and development partners under the management of the MRD. The ADB and WB are two development partners that actively support and

⁴⁰ Gender Mainstreaming Strategic Plan in the Ministry of Rural Development Update 2019-2023, Page #30
⁴¹ Rural Development Policy 2019-2023, Page #10

mainstream gender in all their collaborative projects. Other development agencies such as JICA, French Development Agency (AFD), World Food Programme (WFP), and Korea International Cooperation Agency (KOICA) implement gender-related policies or provide direct support to gender issues in the country as gender mainstreaming. Almost all of the projects in which they participate require the presence of women on project committees and the recruitment of unskilled women workers. In some cases, the contractor is required to employ up to 40% women among unskilled workers, if possible. Labor selection should be from the communities surrounding the project, in order to create jobs and benefits for these communities. Attention to gender issues also applies during construction. Men and women must receive equal pay when performing the same tasks. Training is required for staff and workers, including occupational health and safety protection, while basic and necessary PPE is provided. All types of facilities must be segregated between men and women so that they can feel safe and protected. Tasks that unskilled female workers can participate in during construction work include rebar installation, grass collection, concrete curing, traffic control, cooking, hygiene, etc.

2) Poverty Reduction

The country's poverty reduction effort is strongly linked to the development of rural areas where 61% of Cambodian citizens reside⁴². PDRD, as the professional at provincial level of MRD, has overseen many of the RGC's efforts to improve the rural economy by introducing numerous projects funded of the national budget and in collaboration with development partners.

Each year, the ministry allocates a budget to build many rural infrastructures. Rural roads are one of the key elements in improving rural livelihoods. Many roads have been built, maintained, and improved each year, making the transportation of goods and people easier and less time and resource consuming. While rural water supply and sanitation infrastructure in rural communities as part of the national development goal on water security, which is to provide a safe and reliable source of water for the use and consumption of every citizen.

In addition to the available health centers, the PDRD has promoted many campaigns to improve health and hygiene in rural communities, such as the campaign to end open defecation, and the effort to promote hygiene and health for women and girls, especially menstrual hygiene.

According to the interview, PDRD runs a free training center for the public on technical skills, including mechanics, cooking, language, and other life skills, so that they can use the knowledge gained to earn more income for the family. However, there is a critical problem for some trainees as they do not have enough funds to start a business after the training. The success of the program could be improved by making funds available to the trainees; thus, they have the opportunity to use the skills acquired during the training to improve their live.

5.5.4 Constraints and Countermeasure in Project Planning

(1) Focus Group Discussions

Focus group discussions (FGDs) were conducted in late May 2022 with a total of 192 villagers in 8 different sessions. The purpose of the discussion was to understand the issues faced by women and the poor in rural areas and to discuss ways to address them. The interview was organized at the pagoda and community gathering places following the arrangement and approval date from the commune leaders. The key information for FGD list in Table 5.5-1. The FGD sessions were dominated by women with 97 participants or 54% of the total participants.

⁴² Cambodia Socio-Economic Survey 2019/20, chapter 2.

Table 5.5-1 Key information of FGD

Provinces	Road Lines No.	District name	Commune name	Venue and Date	Participant		
					Total	Female	
						#	%
Kampong Chhnang	KCH-2	Rolea Bi'er	Cheung Kreav	<ul style="list-style-type: none"> Mosque in Knach Kokoh village May 23, 2022 	22	10	45%
	KCH-6	Rolea Bi'er	Chrey Bak	<ul style="list-style-type: none"> Gathering hall in Kley village May 23, 2022 	21	14	67%
Pursat	PS-13	Krakor	Ou Sandan	<ul style="list-style-type: none"> Putharangsey pagoda in Puttreang village May 24, 2022 	14	7	50%
	PS-14	Krakor	Sna Ansa	<ul style="list-style-type: none"> Villager's house in Chi Ches village May 24, 2022 	22	19	86%
Battambang	BTB-3	Thma Kaul	Rung Chrey	<ul style="list-style-type: none"> Preah Punlea pagoda in Preah Ponlea village May 25, 2022 	41	13	32%
	BTB-4	Thma Kaul	Boeng Pring	<ul style="list-style-type: none"> Poy Ta Sek pagoda in Poy Ta Sek village May 25, 2022 	17	7	41%
Banteay Meanchey	BMC-6	Svay Chek	Treas	<ul style="list-style-type: none"> Gathering hall in Ou KorKoh village May 26, 2022 	16	11	69%
	BMC-7	Thma Puok	Kouk Romiet	<ul style="list-style-type: none"> Srae L'a pagoda in Srae L'a village May 26, 2022 	39	16	41%
Total					192	97	
Average of female participation in the survey							54%

Source : JICA Survey Team

1) Gender Mainstreaming

At the local level, the gender situation has improved over the past decades. Girls and boys have equal opportunities to go to school and, with the exception of the elderly, most people can at least read to receive more information from signs or information sources, while more than half of those able to read and write.

Local people affirmed their participation in village or commune meetings. Normally, when the meeting is held in their village, more than 60% of the participants are women because they do not have to travel far from their homes. However, the trend for women participation decreases in high-level meetings at communes, being of 40%.

Men usually perform their various tasks away from the field or home, so more women than men stay at home to care for children and perform household chores. However, there are exceptions where men participate more than women, such as in special economic zones or factories located in the area where most of the recruitment of factory workers is aimed at groups of women, as is the case in Krakor district, Pursat province. In this regard, more men than women stay at home and do housework or other work near the village. According to data obtained from interviews with local officials, when it comes to a meeting involving travel away from home or a meeting at the decision-making level, men occupy a higher percentage than their counterparts.

For infrastructure development, particularly rural road construction, if the projects do not require the employment of unskilled labor, there is no requirement for contractors to employ women in their projects and normally no female employment is seen. However, some participants have experience working in rural road construction if the projects require more labor for the construction of a concrete structure or light work such as traffic control and other road maintenance tasks. The employment of women is also

avored to handle hygiene and food preparation in the labor camps.

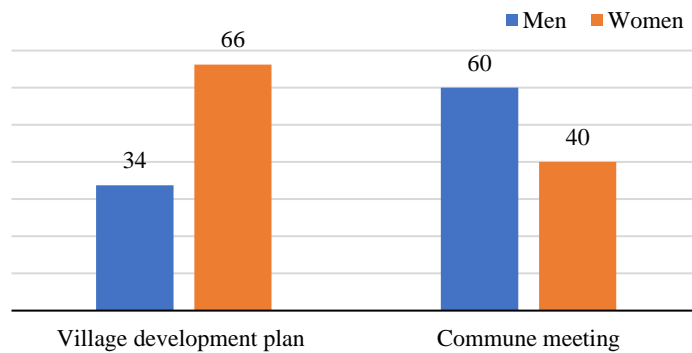


Figure 5.5-10 Percentage by Sex of Community Meeting Participation (FGD)



(a) Ou KorKoh village Treas commune, Svay Chek district



(b) Srae L'a village, Kouk Romiet commune, Thma Puok district

Figure 5.5-11 Activities during FGD with Local People

2) Poverty Reduction

People in the project areas believe that infrastructure development in their communities would improve their livelihoods. Road construction is their strongest desire because they believe that with better road infrastructure, they could increase their income from agricultural production, benefit their children going to school, and be able to use public services more efficiently. They also receive government assistance, especially for poor households (people with ID-Poor cards) and, in some areas, financial assistance for elderly groups who have no dependent relatives. Some villagers who have received capacity training have seen their standard of living improve as they have initiated activities that they would never have been able to do before. However, the number of projects, the number of trainees, and the duration of the project are limited, while some people do not have sufficient financial resources to support their business idea, which reduces the success rate of previous projects.

(2) Constraints

Based on the results of the key informant interviews and FGDs, the common issues that frequently arise during project implementation and affect people in the project area, particularly women and the poor, are described below:

- 1) It will affect people's income, especially women who work as *street vendors*. Most of the time, female-headed households or housewives sell products on the street or in front of their houses in order to earn more money, so when the road is built, they will face problems such as:
 - They are required to temporarily stop selling their products or move to the agreed upon location, which may be far from their previous location

- When roads are blocked for construction near the market area, it causes traffic jams and makes difficult for people to access waste of time
 - For example, many people, usually women, in Kampong Chhnang province said that their income depended mainly on selling handicraft products by engine-cart or motor-trailer; therefore, when rural road construction is prolonged, they cannot easily access their vehicle to sell their products, or they have to suspend their sales for a period in according to the project construction in place.
- 2) Traffic matters always happen during road restoration/construction as described below:
- The situation is certainly complicated for people accessing social services such as hospitals, schools, markets, and others, as it is difficult for them to move around due to the slippery road and the many small holes along the newly dug road.
 - As they have to change their driving on the detour road after the normal roads are closed, they may encounter an unexpected safety issue.
 - The majority of people have complained about the dust in their homes over a long period of time, which could affect their health
 - People are concerned about traffic accidents that sometimes occur during the day and night. According to the responses of the interviewees, previous construction did not provide adequate traffic signs and lights; thus, people accidentally fell into dug holes because they could not clearly see the traffic signs and lights, and sometimes motorcycles crashed during construction.
 - During the rainy season, when construction was not completed, it would be difficult for people to drive, especially students going to school, women wanting to access their goods at the market, and those wanting to access the hospital urgently
 - When the constructed activities started, the noise from the construction machineries and trucks very noisy and disturbed the people who have resident around the construction place.
- 3) People complained about the effect on the right of way, the trees, the fruit trees, agricultural land, and the fences next to the construction road that was damaged or removed without any compensation. Compensation for the damaged fruit tree and fences should be provided in according to the market price.
- 4) People have some concerns related to floods crossing roads during development, since sometimes they have caused damage to the rice fields.
- The flood crossing the road caused farmers to not be able to transport their agricultural products to the market
 - There were no temporarily built flood protection structures and drainage systems that could release and prevent water from flooding.
- 5) Construction has damaged the potable water pipeline along the road, causing water disruption for people in the project area. Water pollution from the construction activities, especially during the rainy day/season, high turbidity, or spilling oil/grease from construction site flow into water source (open well/pond) and rice field.

(3) Countermeasure

The following table summarizes the opinions of stakeholders regarding each of the constraints and countermeasures to address them.

Table 5.5-2 Constraints and Countermeasure from Key Stakeholders

Constraints	Mitigation Suggested from Key Stakeholders		
	PDRD	Local Authorities	FGDs
• Loss income for street vendors	• Prepare a moving plan and provide the suitable place nearby	• Prepare a moving plan and provide the suitable	• Announce the information about the construction

Constraints	Mitigation Suggested from Key Stakeholders		
	PDRD	Local Authorities	FGDs
	the market for street vendors	place nearby the market for street vendors, <ul style="list-style-type: none"> • Notice in advance before construction take place, • Temporary livelihood restoration to affected people/vendor should be considered 	schedule to them before the activities start <ul style="list-style-type: none"> • required to temporarily stop selling their products
<ul style="list-style-type: none"> • Traffic Matters 	<ul style="list-style-type: none"> • Cooperate well with LA/CCs/VCs for rural road inspections to ensure having the proper traffic signs 	<ul style="list-style-type: none"> • Should provide traffic facilitator, sufficient traffic signs, and properly detour roads in some required places 	<ul style="list-style-type: none"> • Sufficient provide traffic sign in construction site, and the project driver should obey the traffic law
<ul style="list-style-type: none"> • Dust 	<ul style="list-style-type: none"> • Cooperate with construction company/contractor to watering the road frequently 	<ul style="list-style-type: none"> • The construction company/contractor should do regularly watering the road during the dry day 	<ul style="list-style-type: none"> • Speed up the construction work • Regularly watering the road during the dry day
<ul style="list-style-type: none"> • The effect on the right of way, the trees, the fruit trees, agricultural land, and the fence next to the construction road 	<ul style="list-style-type: none"> • Work with the development partner related to land procurement and impacts inventories 	<ul style="list-style-type: none"> • Will conduct consultation with affected households to seek for their cooperation 	<ul style="list-style-type: none"> • Compensation to the damaged fruit tree and fences should be provided in according to the market price
<ul style="list-style-type: none"> • The floods over the road and rice fields 	<ul style="list-style-type: none"> • Will facilitate with constructor to build the temporarily overflow water infrastructure 	<ul style="list-style-type: none"> • Work closely with PDRD and contractors to find the solution 	<ul style="list-style-type: none"> • Install drainage along the road rather than digging as the big pool/stream in front of houses • Request to construction contractors to provide the temporary flood protection structures

Source: JICA Survey Team

5.5.5 Recommendation for Implementation of Road Projects

The assessment results confirmed the mechanisms, such as the supreme law, strategies, and policies for gender promotion, that are being developed with the main goal of contributing to poverty reduction.

As recommended, to promote gender and reduce the poverty of people related to the rural road projects, the projects should consider including several terms and conditions to the construction company as listed below:

- At least 25%⁴³ of unskilled female employment need to include in rural road construction within government project as this will create more job opportunities for women and the poor
- Ensure an equal payment for the same work for unskilled female laborers
- Ensure that female laborers receive the training related to work safety and health protection at the construction site
- Provide skill improvement training to unskilled female laborers, so they could easily get jobs after the project ended with a higher salary
- Contractor company should consider hiring local female laborers, as most of the sub-contractors have their own teamwork
- Provide side-drains and flood protection structures in case needed along the rural road in order to keep the roads maintained and prevent flooding over the village and rice fields
- Set clear information and give a notice about the construction starts in advance, so people could well prepare themselves and their properties that could be affected during road excavation
- Finally, when rural roads are completely constructed, villagers suggest to authorities to control the overloaded trucks which easily leads to damaging the roads.

⁴³ 25%, this number is set based on experiences from ADB projects, GMS1, GMS2. There is difficulty in finding female laborers due to low labor rate compared to others sectors and less women interested in working as construction workers.

5.6 Points to Note in Implementing Candidate Projects

5.6.1 Points to Note during Project Implementation

(1) Delays Due to the Spread of COVID-19

Currently, the impact of COVID-19 related measures on construction work in Cambodia is not seen much, but if the spread of infection spreads in the future, there is a possibility that the construction will be affected. Although, there are few cases where delays have occurred at present, and this factor will not be considered it at the moment.

(2) Delays Due to Flooding

Floods are likely to occur in the period from August to October when precipitation increases. Since construction is planned to be suspended during the rainy season, construction delays due to flooding will not be considered.

(3) Delays Due to Government Implementation Items

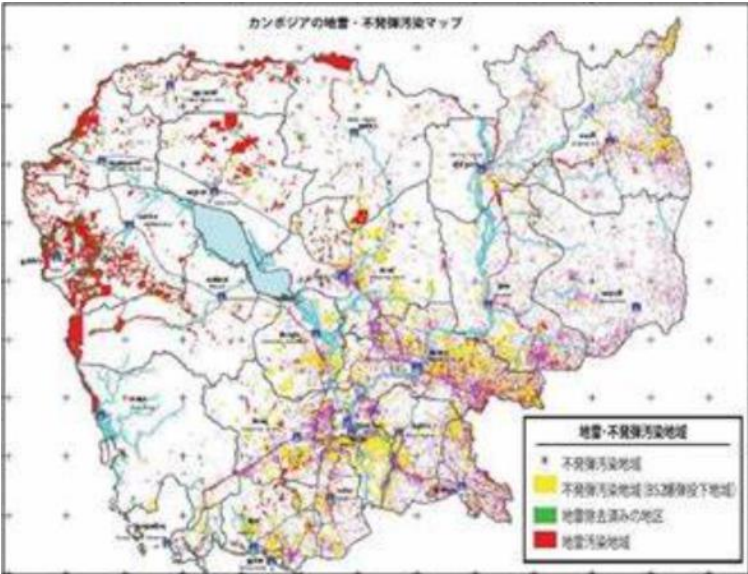
Since the target roads are existing rural roads, there are almost no infrastructure facilities, such as water and gas, and most of the utility poles are built outside the road site.

Under these circumstances, it is considered that there will be almost no impact of construction delays on items borne by the recipient government.

(4) Delays Due to Mines/UXO

In Cambodia, landmines have been located near the border with Thailand in the North and Western part of the country. Additionally, unexploded ordnance (UXO) has been traced near the border with Vietnam in the South and East.

Although the project site is also mainly within a mine-contaminated area, since the construction site is on the existing road it is considered to represent less of a danger. Additionally, it is considered that the disposal of landmines and UXO has progressed to some extent. Furthermore, even if unexploded ordnance is discovered, it is assumed that there will be almost no impact on construction delays, due to the construction area being wide and thus allowing to work in areas that will not be affected. Figure 5.6-1 below shows the pollution map of landmines and unexploded ordnance.



Source: CNAC (Cambodian Mine Action Centre)

Figure 5.6-1 Mine/UXO Contamination Map

(5) Points to Note about Selection of Additional Target Roads in Detail Design

Additional target roads in the detail design stage (after L/A) will be selected by the same prioritization method which is described in Section 3.3.

5.6.2 Points to Note after the Implementation

(1) Non-Implementation of Maintenance

Maintenance should be performed on a regular basis to keep maintenance costs down. If left unattended for a long period of time, significant costs will be incurred to bring the road back to the required performance. The PBC described here is Performance-Based Contract, which is equivalent to the Output and Performance-Based Road Contract (OPBRC) that WB plans to implement.

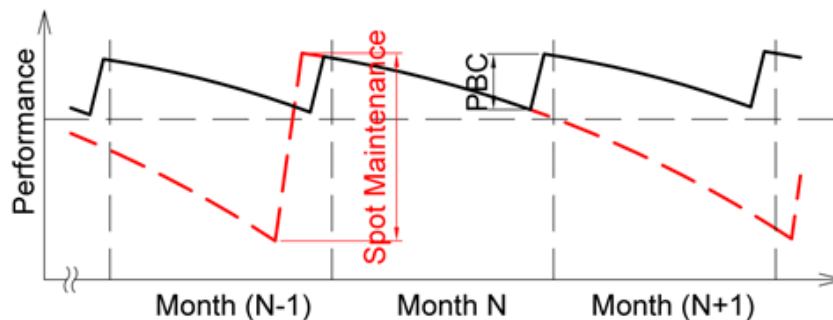


Figure 5.6-2 Comparison of Service Level between PBC & Spot Maintenance

(2) Increase of Traffic Accident due to Exceeding Travel Speed

In the Summary Report of Road Crashes and Casualties in Cambodia 2019, it is noted that the number of deaths due to road crashes doubled between 2009 and 2019. In addition, speeding is the second most common cause of death, with drunk driving being the second most common cause. If roads are improved in the future and some measures are not taken to reduce speed, driving speeds will increase and traffic accidents will likely increase. In addition, this report describes an attempt to reduce the number of fatalities from traffic accidents by half by formulating a "National Road Safety Policy and Action Plan 2011-2020" for national roads, and similar attempts should be made for the roads covered here. In addition, the following activities are included in Component 3 of the WB's Cambodia Road Connection Improvement Project (2020-2028).

1. Road safety awareness activities and road safety assessment of MRD project roads
2. Study on transportation services in rural areas

(3) Overloaded Truck

Since the pavement type is DBST, the entry of overloaded vehicles will accelerate surface damage, and MRD needs to make effective use of its axle-weighing equipment and cooperate with the police and MOWT for O&M. Though overloading measures are mentioned in Component 3 of the WB's Cambodia Road Connection Improvement Project (2020-2028), the actual activities are not yet known.

CHAPTER 6 CONCLUSION

This chapter describes the key issues and proposed support measures that should be considered. Based on the information obtained from the survey, it is necessary to consider appropriate support for the development of rural roads in the target region. The key issues identified in this survey are as follows

✓ **Methodology for additional study of target roads in the detailed design phase**

When new target roads are considered to be added in the detailed design phase (after the L/A is signed), they should be prioritized the same process as in this survey. Rural roads which overlap with roads improved by other donors, or which are expected to have a significant impact on the environment and society (Category A under JICA's Environmental and Social Consideration Guidelines or routes where JICA cannot cooperate) should be considered for exclusion from target roads or change of target section.

✓ **Conducting topography survey**

Since the road planning for this project was conducted using satellite images, detailed topography information was not reflected in the road planning. Therefore, topographic survey around the target roads should be conducted before detailed road design in order to reflect the detailed topographic conditions in the road design and to prepare highly accurate cost estimation.

✓ **Conducting geological surveys**

The existing bridges which are deemed to be replaced in this project have not been planned in their structural form, since it should be planned based on a study of the local geological conditions. Thus, it is necessary to conduct a boring survey around the planned pier location of the target bridges at the detailed design stage and to prepare materials for a detailed structural survey.

✓ **Determination of pavement thickness**

The thickness of sub-base and base course layers was determined based on MRD's own design standard and the results of the RRIP project. Therefore, CBR tests should be conducted on the target roads to confirm the design CBR at the detail design stage, and based on the CBR test result, Consultant should consider the thickness of sub-base and base course layers.

✓ **Embankment material**

In this project, a high percentage of the embankment material will be placed on top of the existing road. Thus, most of the embankment material is purchased soil. Therefore, it is necessary to examine the soil removal site to be purchased, and to prepare accurate cost estimation data.

✓ **JICA Guidelines for Environmental and Social Considerations**

Since MRD has no experience with JICA projects, it is difficult to follow the JICA Guidelines for Environmental and Social Considerations. In order to complement this issue, the following support is necessary.

D/D consultants should let MRD fully understand the environmental and social considerations in line with JICA guidelines.

The local expert consultant who will conduct the environmental and social considerations surveys should be commissioned to a consultant who has a lot of experience in conducting many surveys in the past JICA projects.

✓ **Possibility to Introduce LBT**

LBT will create job opportunities in the target area. Thus, it is expected to improve the income disparity between urban and rural areas and to contribute to the reduction of poverty in rural areas. The improvement of rural roads, where the transportation of equipment is costly, is a project where the advantages of LBT can be utilized. Since the filling up the ground does not require difficult skills, it is relatively easy to construct by human labor, but a certain level of skill is required for

pavement work. In the future, it is necessary to consider the introduction of LBTs with a view to implementing pavement work by LBT.

✓ **Road traffic safety**

As the pavement of rural roads is improved, there is a concern that traffic accidents due to excessive speed will increase. In addition, forced crossing of NR5 and reversing on NR5 are one of the main causes of traffic accidents. The countermeasure of these traffic accidents should be considered not only on national roads, but also on the entire road network, including rural roads. The target roads in this study are likely to be major intersections on NR5, because they will be paved with DBST and become trunk roads in the region, which is expected to increase traffic volumes. The intersections with the target roads should be discussed in cooperation with the national and rural governments during the detail design phase, and it should be designed with road traffic safety in mind. It is also desirable to implement a plan to improve road traffic safety in rural areas in cooperation with the "Project for Improvement of Road Traffic Safety on Trunk Roads". For example, a traffic light could be installed as a pilot project at the junction of the target road near the school.

✓ **Measuring Operation and Project Effects in Ex Post Evaluation**

The sub-projects proposed in this survey have a possibility to change after the L/A is signed. Therefore, Operation and Project Effects at the time of ex-post evaluation are calculated as shown in the table below.

Item	Calculation Policy
Selection of target roads	<ul style="list-style-type: none"> • The province-by-province long list is divided into three groups, from the top to the bottom, and classified into three groups: high priority, middle priority, and low priority. • A road from each of the three groups will be selected per province, for a total of 12 post-evaluation measurement roads. • When selecting roads, "roadside conditions" and "inundated areas" should be taken into consideration so that roads with a variety of characteristics are selected.
Daily Traffic Volume	<ul style="list-style-type: none"> • Traffic volume survey will be conducted on the 12 selected roads above to measure the Annual Average Daily Traffic Volume.
Measuring accessibility to single-digit NR	<ul style="list-style-type: none"> • Travel speed survey will be conducted on the 12 selected roads above to measure the travel time to reach one-digit national road.
Number of date of Road closure in a year	<ul style="list-style-type: none"> • Confirm with PDRD the number of road closure dates in a year of the ex-post evaluation for the 12 selected roads. • If there is no record about road closure on the selected target roads in the PDRD, the same method as in this survey will be adopted. (Source: 5-1-1)
1-hour radius from the capital and 30-minutes radius from Referral Hospital	<ul style="list-style-type: none"> • The average travel speeds for the 12 selected roads will be used as the travel speeds for all target roads. The travel time from the provincial capital or referral hospital to each commune is then estimated. The same methodology as in this survey will be used. (Source: 5-1-3)

Source: JICA Survey Team