

PAPUA NEW GUINEA
MOROBE PROVINCIAL ADMINISTRATION
LAE URBAN LOCAL LEVEL GOVERNMENT

**THE PROJECT FOR THE STUDY
ON LAE-NADZAB URBAN DEVELOPMENT PLAN
IN PAPUA NEW GUINEA**

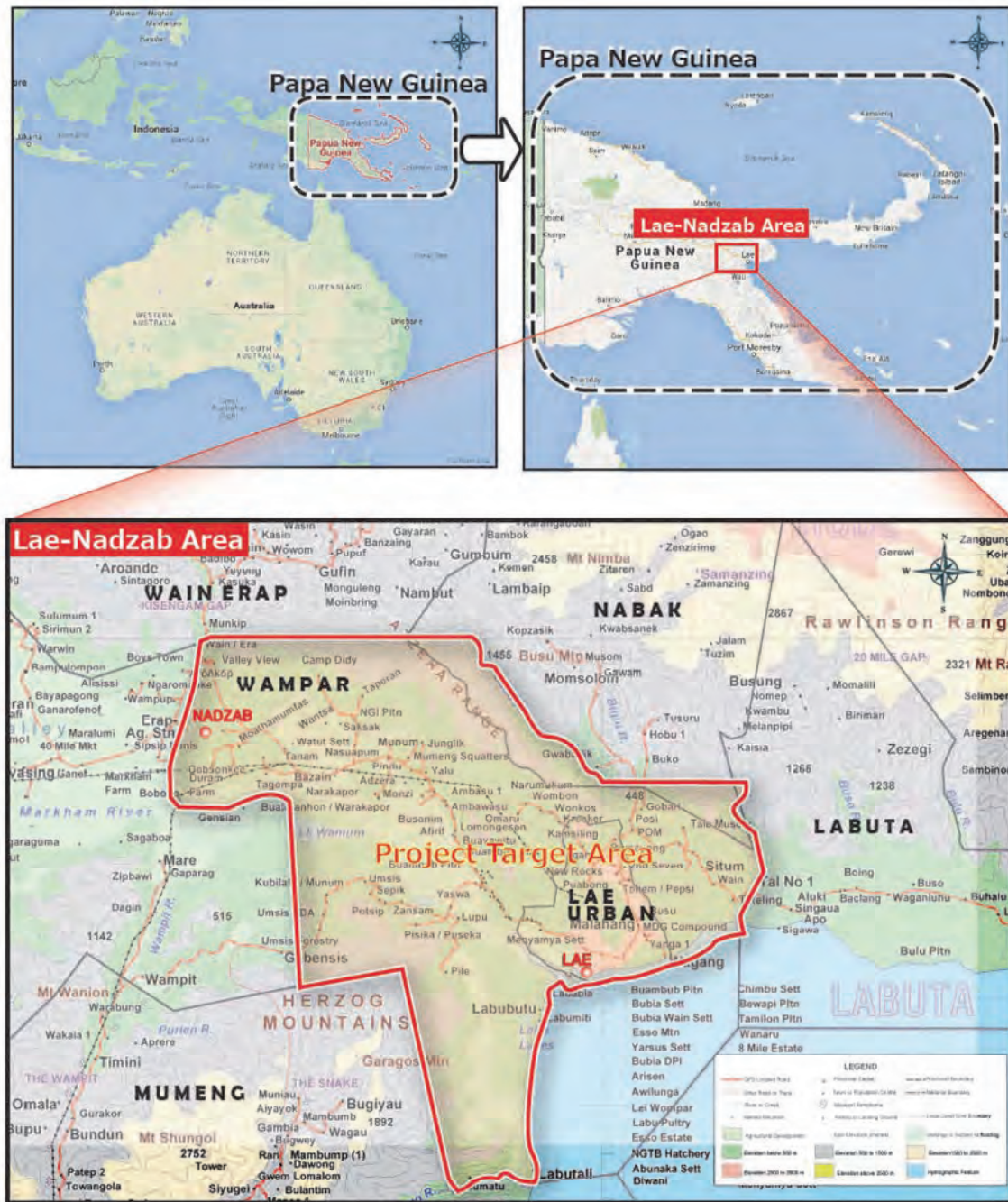
FINAL REPORT

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**JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)**

**YACHIYO ENGINEERING CO., LTD.
KOKUSAI KOGYO CO., LTD.**

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LOCATION MAP OF THE PROJECT AREA

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LIST OF ABBREVIATIONS

Notes	Description
AIDS	Acquired Immune Deficiency Syndrome
ADB	Asian Development Bank
AGR	Average Growth Rate
AAGR	Annual Average Growth Rate
ARAP	Abbreviated Resettlement Action Plan
C&I	Commercial & Industrial Areas
BOD	Biochemical Oxygen Demand
CEPA	Conservation Environment Protection Authority
CHP	Community Health Post
CLT	Customary Land Tenure
COD	Chemical Oxygen Demand
CODEX	Codex: Regulation in Latin (International Food Regulation)
CPI	Consumer Price Index
DDF	Depth Duration Frequency
DEC	Department of Environment and Conservation
DEM	Digital Elevation Model
DLPP	Department Lands and Physical Planning
DMT	District Management Team
DNPN	Department of National Planning and Monitoring
DO	Dissolved Oxygen
DOE	Department of Education
DOH	Department of Health
DOT	Department of Transport
DOW	Department of Works
DPLGA	Department of Provincial and Local Government Affairs
DWTCA	Department of Works, Transport and Civil Aviation
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EQTV	Extended Quality Television
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GIS	Geographic Information System
GOJ	Government of Japan
GOPNG	Government of Papua New Guinea
GRDP	Gross Regional Domestic Product
GRP	Gross Rating Point
HGD	Huon Gulf District
HGDIDP	Huon Gulf District Integrated Development Plan
HIV	Human Immunodeficiency Virus
HOPP	Huon Oil Palm Project
ICDC	Industrial Centre Development Corporation

Notes	Description
id.	idem (the same)
IDF	Rainfall Intensity Duration Frequency
ILG	Incorporated Land Group
IPA	Investment Promotion Authority
IWRM	Integrated Water Resources Management
JICA	Japan International Cooperation Agency
JMP	Joint Monitoring Program
LCD	Litter per Capita per Day
LDDP	Lae District Development Plan
LGA	Local Government Authority
LLG	Local Level Government
LNG	Liquid Natural Gas
LNUDP	Lae Nadzab Urban Development Plan 2005-2015
LULLG	Lae Urban Local Level Government
MC	Management Committee
MDG	Millennium Development Goals
MPA	Morobe Provincial Administration
MPG	Morobe Provincial Government
MPIDP	Morobe Provincial Integrated Development Plan 2014-2018
MS	Magisterial Service
MTDP	Medium Term Development Plan
MZ	Marine Zone
NA, N/A	Not Applicable
NARI	National Agricultural Research Institute
NCDC	National Capital District Commission
ND	National District Road
NDC	National Disaster Committee
NDIDP	Nawaeb District Integrated Development Plan
NDoH	National Department of Health
NEC	National Executive Council
NGO	Non-Governmental Organization
NHC	National Housing Corporation
NI	National Institutional Road
NLDP	National Land Development Programme
NLDT	National Land Development Taskforce
NM	National Main Road
NMB	National Mapping Bureau
NPC	National Planning Committee
NR	National Route
NRI	National Research Institute
NSLUP	National Sustainable Land Use Policy
NUP	National Urbanization Policy
O&M	Operation and Maintenance

Notes	Description
OD	Origin-Destination
OoU	Office of Urbanization
ORD	Office of Rural Development
PCU	Passenger Car Unit
PDLPP	Provincial Division of Land and Physical Planning
p.f.s.	Petrol filling stations
PGK	Papua New Guinean Kina (Local Currency)
PMU	Project Management Unit
PMV	Public Motor Vehicle
PNG	Papua New Guinea
PNGDSP	Papua New Guinea Development Strategic Plan 2010-2030
RAP	Resettlement Action Plan
RBO	River Basin Organization
ROT	Registrar of Title
SAR	Search and Rescue Operations
SBDC	Small Business Development Corporation
SEA	Strategic Environmental Assessment
Sect.	Section
SME	Small and Medium Enterprise
SOP	Standard Operation Procedure
SOPAC	South Pacific Applied Geoscience Commission
SPREP	Secretariat of the Pacific Regional Environment Programme
SRZ	Sustainable Rural Zone
SRZ (A)	Sustainable Rural Zone (agriculture only)
SRZ (F)	Sustainable Rural Zone (forestry only)
SRZ (L)	Sustainable Rural Zone (livestock rearing only)
SS	Suspended Solids
StaRS	Strategy for Responsible Sustainable Development
STP	Sewage Treatment Plant
SZ	Subdivided Zone
ToR	Terms of Reference
TSP	Total suspended particles
UGR	Unit Generation Rate
ULLG	Urban Local Level Government
UNICEF	United Nations Children's Fund
UNITEC	University of Technology, Papua New Guinea
VIP	Ventilated Improved Pit Latrine
WB	World Bank
WHO	World Health Organization
WMD	Waste Management Division
WTP	Water Treatment Plant

PART I

BACKGROUND CONTEXT

INTRODUCTION OF THE PROJECT

Background of the Project

The city of Lae is the provincial capital of Morobe Province, Papua New Guinea (hereinafter referred to as “PNG”), and the second largest city following the national capital of Port Moresby with current population over 200,000 that accounts approximately 3.7% of total PNG population. Lae Port is located at the central area of the city, and has the largest container handling capacity in the country accounting for 46% of total amount in 2010. It is currently under the development of 14m deep port facility by ADB’s assistance to expand the service capacity aiming the development of PNG’s true center of industrial, manufacturing and distribution, and the main port berth construction have just completed in the end of 2014. Nadzab Airport which supported over 300,000 travelers in 2012, on the other hand, is taking a role of domestic hub airport of northern PNG region, and JICA signed a Japanese ODA loan agreement with the government of PNG to develop this Airport for expanded services. The Project Area is neighboring to the Highlands Region where about a half of entire PNG population reside, and the region is one of the largest agricultural production center as well as it is gifted with high potential of natural resources for development. This Highlands Region and Lae city is directly connected with the Highlands Highway which should contribute future industrial development at larger scale.

“Lae-Nadzab Urban Development Plan 2005-2015” (LNUDP) was prepared and approved by the government in 2005 for the nation’s economic and distribution center development in Lae city, Nadzab Airport area and surrounding region (hereinafter referred to as Lae-Nadzab Area). However, major developments planned in LNUDP have not been implemented so far due to disintegrated coordination between publicly financed infrastructure development and the urban development, while private and foreign investments for the regional resource development have been more actively made for effective development. Such circumstance under the regional development could be a major hindrance for infrastructure development in Lae-Nadzab Area.

The PNG government has acknowledged such circumstance in Lae-Nadzab Area, and has requested the Japanese government for Master Plan preparation assistance in August, 2012 in order to set more realistic urban development plan for the region. According to the official request by the PNG government, JICA has dispatched the detailed planning survey team in September, 2014, and the Record of Discussion (RD) has been signed between Japanese and PNG governments on the 15th of December, 2014 in order to initiate the “Project for the Study on Lae-Nadzab Urban Development Plan.”

Purpose of the Project Study

The main objective of the Project is to prepare effective and realistic Urban Master Plan for Lae-Nadzab Area. Lae-Nadzab Area is currently in strong need of more effective and achievable urban development plan which should realize not only the regional growth center development but also the economic and distribution center of the nation. In order to envision the best solution for urban master plan that should be substituting all possible developments proposed in the previous LNUDP, the Project shall review all concerned development plans of the Province and the country as well as current situation of the region and development to identify the problems and issues to come up with the new and appropriate solution to the Region. Land ownership also is the major concern to analyze for better solution to achieve better and more beneficial regional development, because this has been historically a hindrance to make proper development activities in the country.

Through the Project study several survey activities including traffic and origin-destination survey and household interview survey as well as analysis of current development problems and social infrastructure demand are made in order to plan the Lae-Nadzab Area urban development with most possible economic and industrial development utilizing local resources benefitting all regional populations concerned. The Urban Master Plan will be set for the Project target year 2025 with ten (10) year duration, while mid-to-long term development for the year 2050 is also under consideration in line with PNG’s superior development plans. Following the preparation of master plan for the region, priority sub-project should be identified for demand forecast, basic design, development cost estimate, environmental and social consideration as well as preparing the project implementation plan, and Pre-Feasibility Study will be conducted for preparing all these for sub-project.

The main report comprises 22 chapters.

Chapters from 1 to 7 cover background of the Project, reviewing the upper level policy and plans, and present conditions and issues concerning urban development plan.

In Chapter 1, status of Lae-Nadzab Urban Development Area in PNG and necessity of its urban development plan are mentioned. In Chapter 2, natural characteristics including topographic and climatic conditions, in Chapter 3, socioeconomic characteristics, in Chapter 4, social characteristics are stated as a background of the urban development planning. In Chapter 5, current land use and tenure system that are closely related to urban planning are explained. In Chapter 6, present condition of infrastructure and services which concern the urban development in the Project Area and issues to be solved are referred to. In Chapter 7, development directions shown in the upper level policies and plans are studied and summarized.

Chapters from 8 to 16 cover the part for formulation of urban development master plan, the main outcome of the Project.

In Chapter 8, constraints and opportunities for urban development are studied and in Chapter 9 and 10, concept formation for the urban development is made. Urban development vision and development framework are clarified in Chapter 9, and urban structure and patterns are studied in Chapter 10. In Chapter 11, based on the preceding concept formation urban functional allocation are studied to accommodate the economic development direction, and Structure Plan and Zoning Plan as a major component of physical plan are proposed.

Based on the studies so far, in Chapter 12, sectoral projects are formulated, and in Chapter 13, integration of sectoral projects in the urban development master plan is made. In Chapter 14, social environmental assessment are made for each proposed sectoral projects. In chapter 15, projects are programmed based on the implementing strategy under the constraints including financing. In chapter 16, implementing method including capacity building are proposed and selection of priority project is also proposed.

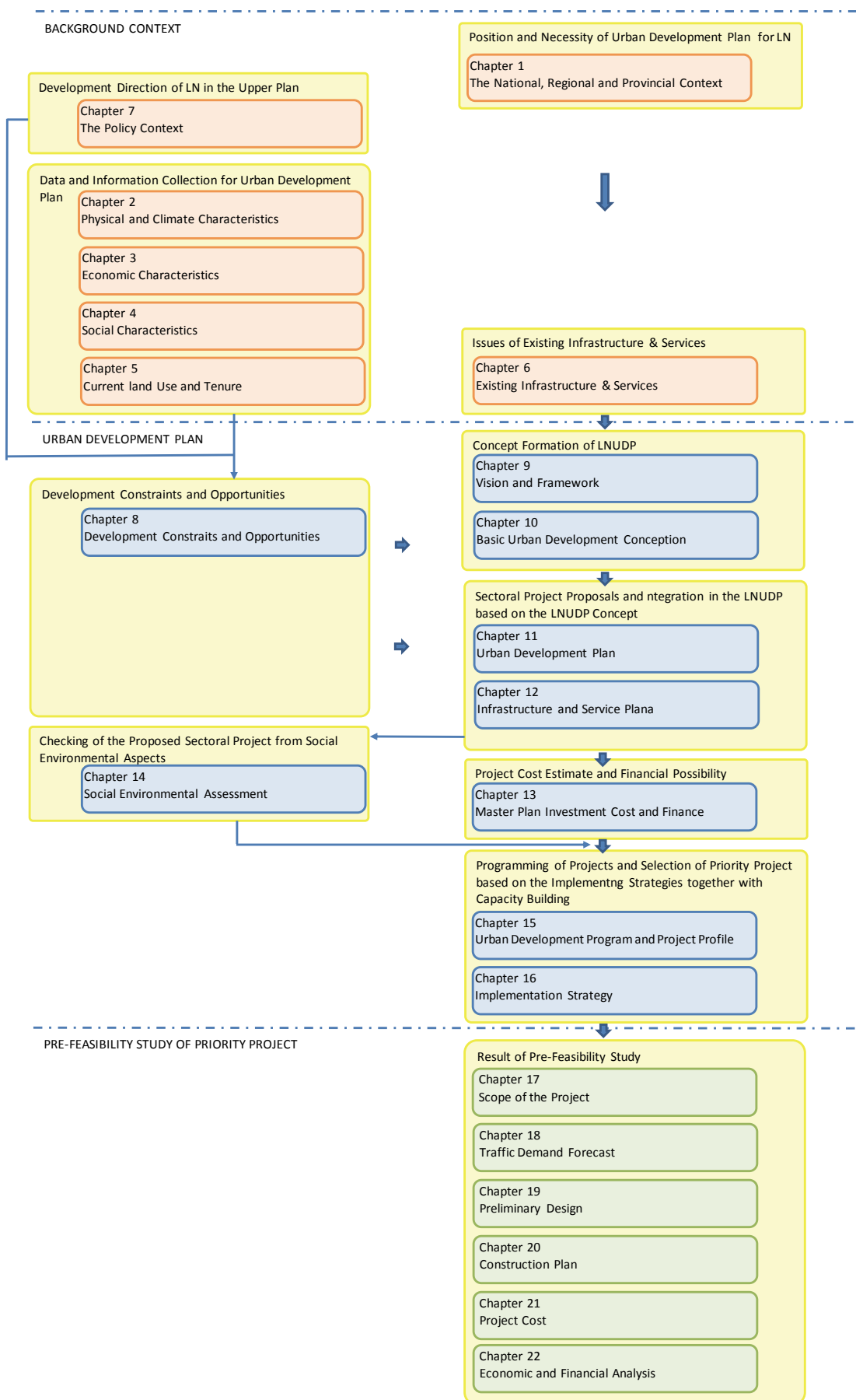
Chapters 17 to Chapter 22 are the pre-feasibility part of the priority project that has strategical importance in Lae-Nadzab Urban Development Plan.

The concept and relationship in the report are also shown in Figure.



Source: JICA Project Team Prepared with Map of Papua New Guinea from Geographic Guide (Nation Map)

Project Area Map



Chapters in this Report

CHAPTER 1 THE NATIONAL, REGIONAL AND PROVINCIAL CONTEXT

1.1 The Location and Status of Lae-Nadzab Area

The area covered by this Project (Lae-Nadzab Area) is situated facing Huon Gulf on the alluvial plains of Markham River and Busu River on the north coast of Papua New Guinea (hereinafter referred to as “PNG”).

The area covered by this plan - the Lae-Nadzab Urban Development Plan - not only includes Lae City but also its surroundings, extending along the Highlands Highway to Nadzab Airport in the west, and the Bunga River and Situm in the east. The area extends to Labu area in the south and the Huon Gulf and the mountains ranges to north form the natural boundaries.

The acreage of the entire Lae-Nadzab area covered by this plan is 1,057 square kilometres and is composed of five local level governments, namely, Lae Urban (LULLG), Ahi Rural, Wampar Rural, Nabak Rural and Labuta Rural Local Level Governments. The area also covers part of three administrative areas of Lae, Huon Gulf and Nawaeb Districts in Morobe Province. Lae City administrated by LULLG is the capital of Morobe Province. Population of the Lae-Nadzab urban development area in 2011 was some 190,000 according to National Population Census (NSO). Out of LLGs composing Lae-Nadzab urban development area, Lae Urban LLG is dominant in terms of population, accounting for 46.8% of the population in Lae-Nadzab Area.

Lae is the second largest city of PNG next to Port Moresby, and the Lae-Nadzab area showed the continuous population expansion as the economy of the area developed.

Port Lae, the largest port in PNG, functions as an import and export port and hub port of the domestic sea transport network among the island country. Accordingly it is regarded as the most important Port in PNG. Nadzab Airport is an inland airport located 32 kilometres northeast of Lae City. The number of annual passengers is second to Port Moresby Airport in PNG. The Airport is expected to be a gateway of not only PNG but also of South Pacific countries under the current Nadzab Airport Improvement Project.

Lae is located at an intersection of corridor roads as well. Out of such corridor roads, Highlands Highway is the spine of the Lae-Nadzab area connecting Lae with Nadzab Airport and further with Highland area in the northwest.

As regional transport network is being established by improvement projects of Lae Port (Lae Tidal Basin Development Project), Nadzab Airport (Nadzab International Airport Development Project) and Highlands Highway (Highlands Highway Improvement Project), a quantum improvement of regional transport potential is expected.

With such an advantageous regional transport network, Lae-Nadzab Area has large economic hinterlands of Morobe, Eastern Highlands, Madang, Chimbu, Western Highlands, Enga, Southern Highlands, Hela and Jiwaka. Especially Highlands, which exports coffee, cocoa, tea and other agricultural produce and imports food, construction materials and machines, industrial goods and other heavy equipment, depends directly on Lae in terms of logistics.

Under such circumstances of regional transport potential and large area of hinterlands, logistic companies, fishery processing factories and food processing factories by both foreign investors and domestic investors are located in Lae. As Lae-Nadzab area is functioning as a base for logistics and industry, further development is expected in this area.

Further as PNG Forestry Research Institute, PNG University of Technology (UNITECH), National Cancer Institute, Lae School of Nursing, and non-governmental organizations are located in Lae-Nadzab area, this area bears the role of educational and cultural centre of PNG.

1.2 The Role of Lae-Nadzab Urban Development Plan

According to major national level plans and policies, such as Papua New Guinea Vision 2050 and Papua New Guinea Development Strategic Plan 2010-2030, Morobe Province, especially Lae-Nadzab area is highly emphasized as the industrial and distribution centre of the entire country. Instead of depending on business activities of Port Moresby (POM), the idea of shifting the actual centre of economic activity to Lae-Nadzab area while retaining POM as a political centre is being considered. Because of its geographic location in the country, Lae Port has already become the largest distributing port of PNG. Lae-Nadzab area has large potential within the Pacific island countries, Oceanian Region, Indonesia as well as Southeast Asian countries for more trading activities in the future. It will also benefit from its geographic position in the domestic economic activities from the island region, highland region and others.

Not only its access to the overseas resources and products, but also local resources, such as agro-products, timbers, mining resources and fishery, should benefit the future industrial and manufacturing development in the region based on not only the domestic but also the international market in the long vision. The Government of PNG (GoPNG) has been stretching expectations more with Lae-Nadzab area to solve economic issues concerning import-oriented market structure and weak production as well as to solve issues of land use and customary land registration processes. Instead of dealing with developed POM region for finding solutions, Lae-Nadzab area should provide more flexible development options with newly set-up urban development guidelines and regulations in order to realise a new economic centre of the country with more sophisticated industrial and distribution system and infrastructure.

ADB's development assistance for the major Tidal Basin Lae-Port development, JICA's assistance for the improvement of existing airport as well as other donors' developments are either on-going or up-coming to the region to speed up the regional development for better economic activities. Thus, setting up a new urban master plan focusing on Lae-Nadzab area development with appropriate regulations and guideline applications for proper land use and utilization is a timely demand fulfilling project for the country, and this master plan and its implementation should be able to showcase the new and effective development for the country as a new model project.

With the current improvement in the province of the economy boosted by the mining industry, Lae is going through a period of increased urban growth with rapid population concentration, thus exerting great demand for residential land with the consequential effect on the provision of urban/city public services.

The existing Lae-Nadzab Urban Development Plan was prepared and approved for implementation in 2005 with the time frame of ten years. According to its assessment however, the implementation of the Plan was not fully executed. With the current rise of the economy of the country and the region, spontaneous developments are spreading fast within the area resulting in exposing the great possibility for future expansion of the city and its urban functions into the outer lying areas of the city.

Under such circumstances, GoPNG decided to review and update the urban development plan for Lae-Nadzab area with an approbation of Morobe Provincial Administration (MPA), Lae Urban Local Level Government (LULLG) and authorities concerned. This Draft Final Report sets forth the expected goals and methodology of the Project.

The purpose of the Project is as follows:

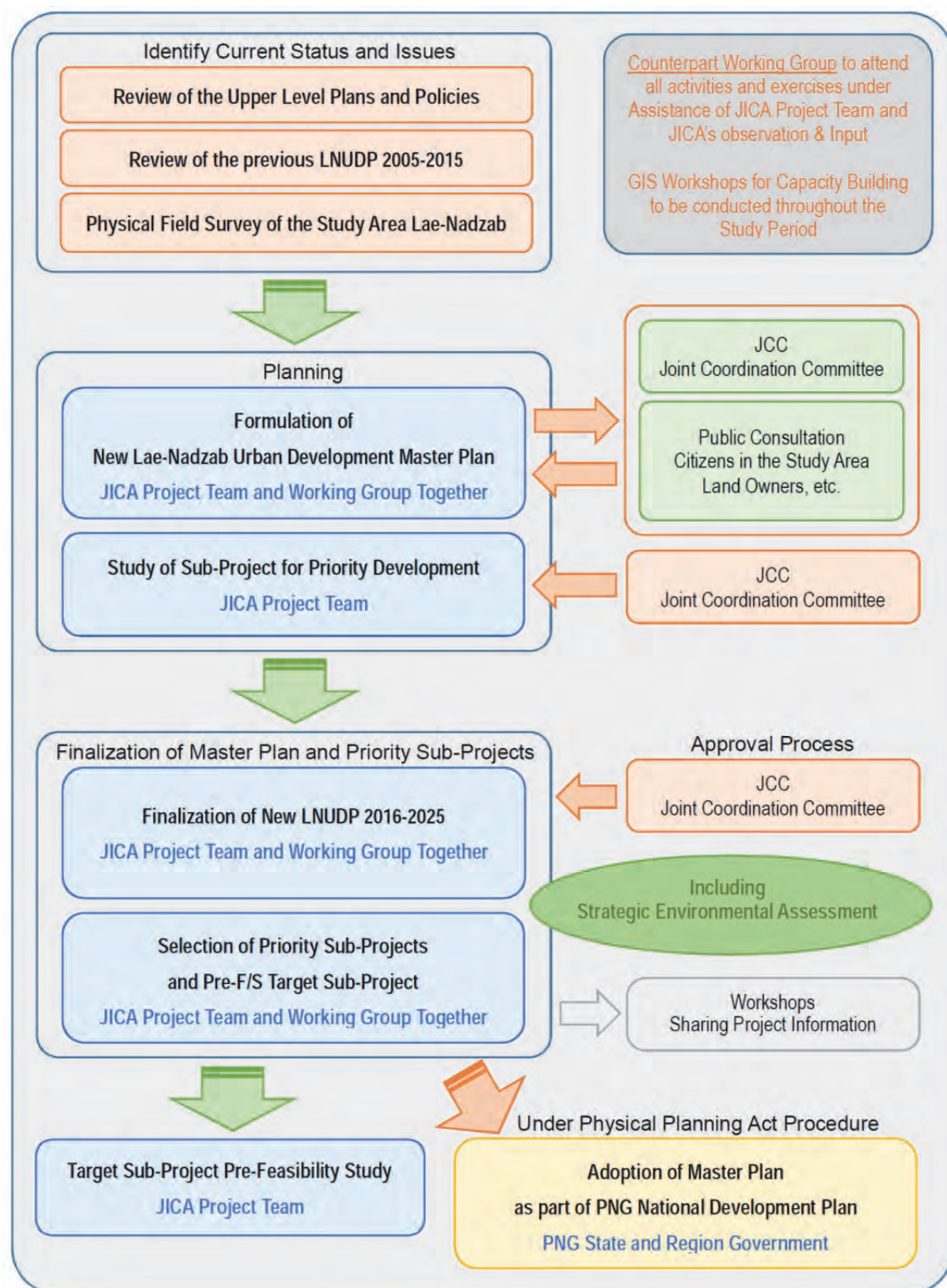
(1) Project purpose

- To promote sustainable long-term economic and social development in Lae-Nadzab Area through formulation of urban development plan and implementation of Pre-Feasibility Study

(2) Outputs of the Project

- Urban development plan for Lae-Nadzab area in 20016-2025
- Pre-Feasibility Study for a prioritized project

The general project work flow is illustrated in the following figure to realize interrelationship among actions and entities.



Source: JICA Project Team

Figure 1.2.1 Project Work Flow

The following figure illustrates the Project Study implementation schedule.

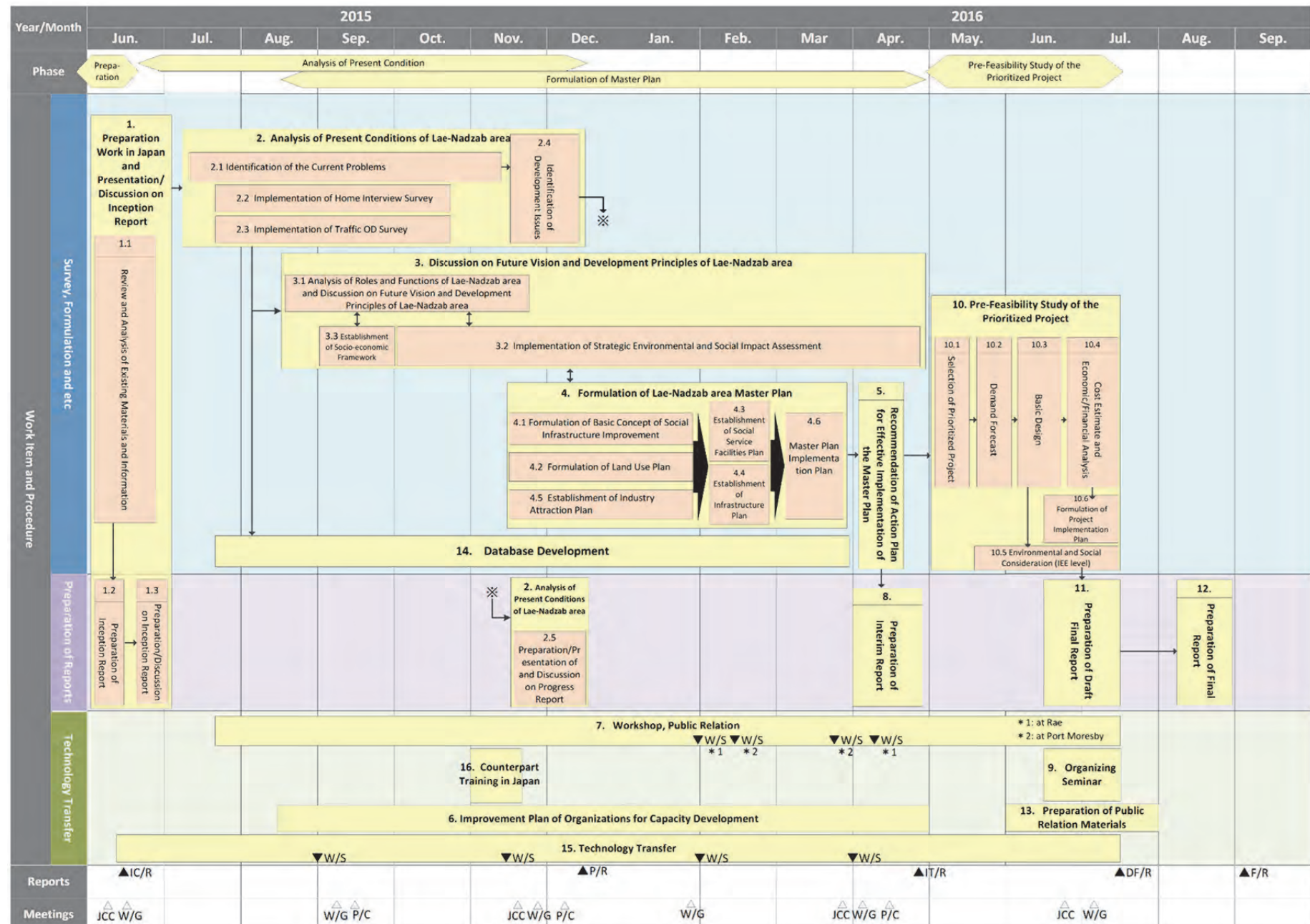


Figure 1.2.2 Project Study Implementation Schedule

CHAPTER 2 PHYSICAL AND CLIMATE CHARACTERISTICS

This Chapter outlines the present conditions of the environment of the Project Area beginning with a brief analysis of the environmental setting of the province. The purpose of this Chapter is to describe the baseline conditions of the Project Area in order to assess potential for natural hazards to enable better understanding of the risks involved that may be factored into the future Lae urban development project design and planning, including that of potential and or likely impacts that may arise from the project intervention to guard against.

Desktop literature reviews and analysis of published spatial data have been undertaken to characterise the environmental elements described below with assessment of topographical constraints, and potential natural hazards.

2.1 General Background

2.1.1 Morobe Province

Morobe Province lies between south latitude 4 degrees 5 minutes and between east longitude 8 degrees 5 minutes and 48 degrees on the north coast of the mainland PNG. The Province shares common borders with West New Britain to the east, Madang Province to the north, Eastern Highlands to the west, Gulf Province to the southwest, Central to the south, and Oro Province to the southeast. It has a total land and maritime area of 34,650 square kilometres comprising of 33,931 square kilometres and 719 square kilometres respectively with a coastline that extends to approximately 402 kilometres from south and southeast to the north and northeast. The coastal and island areas; the inland and mountain areas; and the river, valley, and swamp areas characterise the general geography of the province.

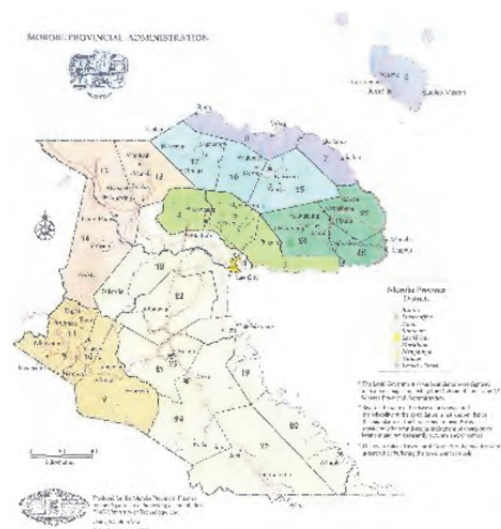
Traditionally, Ahi people are the original traditional landowners of Lae City. The people of Butibum, Hengali, Wagan, Yagan, and Kamkumung villages make up the Ahi landowners (Armitage, 2000). Land ownership within and around Lae City has become a contentious issue and remains so as portions of the customary owned land change hands legally and illegally as Lae City expands and increasing in-migration of outsiders continues. The numerous settlements within and outside of the peripheries of Lae City that make up the landscape of the modern day Lae are a testament to the ongoing land and social problems.

A major part of the province is covered by primary forest. The topography ranges from sea level to over 4000 meter ASL. and generally can be broadly divided into two major divisions, the highlands and the lowlands. The principal lowland areas are in the north – west to south – east separated by the Markham River and Valley, which separates the central highlands from the north coastal highlands and occupy part of the extensive Sepik – Ramu – Markham fault trough. The highlands of the province is a typical feature of the central highlands of PNG characterized by, deep dissections and complex network of drainage channels, giving rise to extremely rugged terrain with steep slopes and high relative relief, high altitudes and



Source: Map of PNG from Geographic Guide (Nation Map)

Figure 2.1.1 Map of PNG and Morobe Province



Source: Morobe Provincial Administration

Figure 2.1.2 Map of Morobe Province showing Districts

broad inter-mountain plains. Tectonic instability is one of the many characteristics of the province, while the combination of heavy rainfall and steep slopes results in unstable soil conditions (MPG).

The vast Markham Valley is dominated by grassland that spans from Lae City westward through Huon Gulf to Kaiapit District dividing the Saruwaged, and Finisterre mountains to the north and the Highlands mountain systems to the south. In the lowlands, the climate is hot and humid with an average temperature of 30 degrees C and a mean annual rainfall of about 2,900 millimetres / year. Wau, Lae, Siassi, parts of Menyamya, Huon Gulf and Finschhafen Districts are some of the wettest areas with up to 5,000 millimetres of rain per year.

The landform classification of the province can be grouped into seven groups namely the mountains, hills, volcanic, plains and plateaus, flood plains, raised coral reefs and littoral and lakes (Bleeker 1989, PNGRIS 2013). Approximately 75 % of the landform is mountainous and at least 15 % is plains and plateaus, Bhunia et al (2012). Land use potential for agriculture development (with various limitations) occurs around the coast to the south, including the Markham Valley floor and the entire coastline of the Huon Peninsular, while the land considered unsuitable for agriculture development is confined to the higher elevations of the province. Dominant soils are Humitropepts, Dystropepts, Troporthepts and Rendolls (Bleeker, 1983).

2.1.2 Project Location and Lae Setting

The city of Lae is situated at the eastern end of the Markham Valley, a large intramontane basin separating the Bismarck Range, part of the Central Ranges, and the Finisterre Sarawaged Range that is part of the northern coastal ranges. The city is located in a coastal plain formed of alluvial fan deposits. It sits on a series of uplifted terraces that effectively are a continuation of the Atzera Range, a NW-SE trending branch of the Sarawaged Range (Buleka et al, 1999). Mount Lunaman, or locally known as Lo'Wamung, a characteristic feature in the city, is an outlier on top of the uplifted terrace, overlooking the Huon Gulf.

The city is low - lying with an average elevation of 20 metres ASL, and a gradient of 5 metres per kilometre from the 30 metre contour to the shoreline, except for the Central Business district and Mount Lunaman, several depositional surfaces with small benches in between, occur in the city area. These include terraces at 35 metres, 30 metres, and 20 metres, the 8 - 15 metres surface in the Didiman fan at Lae airstrip, and the 3 - 5 metre terrace at Stewart Park (Crook and Liu, 1993).

Three major rivers characterise the river system in Lae and the Project area and these are the Markham River in the west of Lae and the Bumbu and Busu Rivers immediately to the east. These rivers combined discharge substantial volume of water, gravel, and sediments into the Huon Gulf annually forming large area of muddy water and plumes which are a prominent feature of the Lae sea water front. These rivers have history of flooding causing considerable damage to the city and the surrounding human settlement and the environs.

The Project area effectively is an extension of the external boundary of the Lae Urban encompassing areas within three Districts namely, Nawaeb, Lae, and Huon Gulf, comprising of a total of 1,057 square kilometres comprising of a population of about 200,000 people.

2.2 Physical Environment

2.2.1 Topographical Constraints

Topography of Morobe Province ranges from sea level to 4,000 metres above sea level and is very much dissected with deep gulley's and gorges including valley basins.

The external boundary of the Project area extends from the existing Lae City boundaries but where topographical issues relating to steep slopes are of limited concern. Any topographical issues of concerns arise from the ridges and foot hills of the Rawlinson Range extending from Situm River to Atzera Range and onto the Markham Valley where landslips are a natural occurrences due to unstable geology and forest clearance enhanced by rainfall.

Identifying and establishing geologically vulnerable locations within the proposed Lae City expansion to avoid or mitigate risks / extreme hazard poses a challenge. This is not only important for urban satellite development but also for the provision of utility services such as water supply, sewerage and waste management including major infrastructure developments that require access to land for their construction and establishment. These potential problems are further compounded by known heavy flooding of the Markham, Bumbu and Busu Rivers experienced, over the years during heavy rains that tend to occasionally cause substantial damages to properties and settlements within the precinct of the city. The recorded past destructions to settlement and properties are testaments that cannot be ignored.

Aside from the physical constraints of the environment more pressing and challenging endeavour for the Project will be dealing with the concerned landowners and stakeholders as the city boundary expansion for urban development, no doubt, will extend onto private / customary owned land areas and properties.

2.2.2 Geology

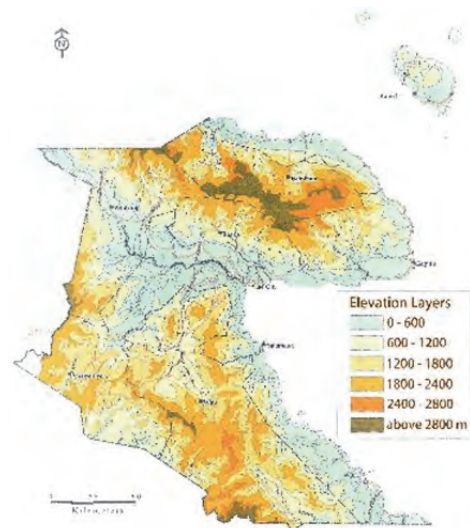
Geologically, Lae is underlain by alluvial fan deposits with mixed and undifferentiated volcanic, sedimentary and metamorphic rocks (PNGRIS, 1999). It is located on a geologically unstable zone where interacting crustal plates cause geological faults and movements that renders the city and the region vulnerable to serious seismic activities. It is located on a geologically unstable region underlain by active crustal plate movement as a result of the interacting Indo-Australian Plate and the Pacific Plate.

Lae City effectively is located on the Pacific Ring of Fire and geologic instability has produced numerous faults and earthquakes. It sits between the larger Indo-Australian Plate and the Pacific Plate on the South Pacific Plate in the Ramu-Markham Fault Zone where the New Guinea Highlands Deforming Zone and South Bismarck tectonic plates are converging.

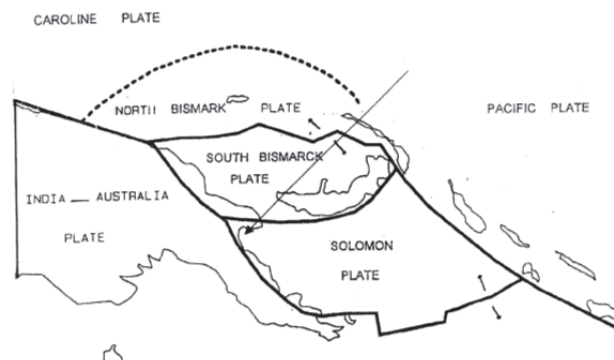
The Ramu-Markham Fault Zone, which follows the northern edge of the Markham Valley, is the active plate boundary between the South Bismarck Plate and tectonostratigraphic terrains within the New Guinea Highlands Deforming Zone. The Ramu-Markham Fault Zone has generated large thrust earthquakes (e.g. 6 April 1999 Mw 6.4, 16 kilometres North of Lae, near Hobu, and 22 November 2007 Mw 6.8, 110 kilometres North of Lae). Figure 2.2.2 Simplified Configuration of the Pacific and Indo-Australian Plates.

2.2.3 Soils

Dominant soil types of Morobe Province are Humitropepts, Dystropepts, Troporthents and Rendolls (Bleeker, 1983). Ningal et al (2007) land use change and population study in Morobe has determined Inceptisols as the dominant soils and cover 54% of the Morobe Province. Classifying the soils into poor, moderate and good categories by analysing the physical and chemical properties, they have determined that 41% of the Morobe Province has soils of good quality and about 53% soils of moderate quality. Much agricultural areas converted to other land use have been made on Mollisols soil type reflecting to an extent the fertility and productivity of the soil composition, and such areas



Source: Morobe Provincial Administration
Figure 2.2.1 Land Elevation Map of Morobe Province



Source: CCOP COAST PLAB, LAE CASE STUDY, 1999
Figure 2.2.2 Seismic Plate Condition of the Country

occur within areas with about 1,000 – 2,500 millimetres rain per year.

According to Morobe Province Resource Database (1997), much of the soil types of the Project area fall within the Soil Classification of Entisols, Inceptisols, and Mollisols which converts into physiographic Soil Group composition of alluvial, swampy alluvial / organic, brown forest / lithiosols, acid brown forest, and humic brown soil types. This is largely influenced by the regular depositional deposit from the Markham, Bumbu, and Busu Rivers over the course of the geological history of the area. In land use potential classification, Lae City and the urban satellite expansion is developed on a very fertile productive land area.

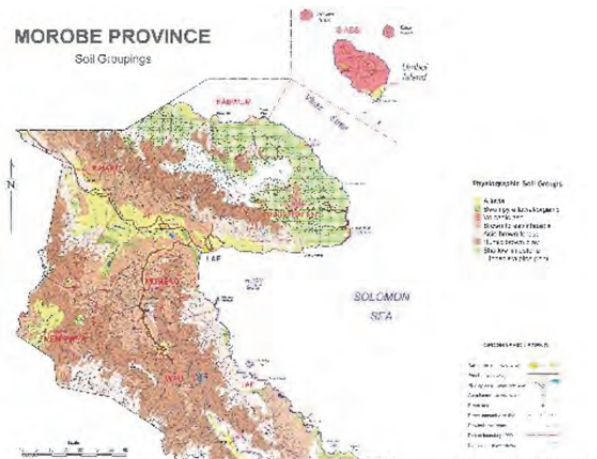
2.2.4 Climate

The climate is tropical equatorial characterized by seasonal wet and dry seasons. The abundance of water gives rise to lush vegetation and vast water related resources. Certain parts of the province have defined wet and dry seasons. Inland areas are generally cooler while the coastal areas are warmer. The city of Lae experiences a humid tropical climate, with an annual precipitation of 4,500 millimetres, evenly distributed through the year, and with an average annual temperature of 27 degrees C, the hottest months are from November to February. There are two pronounced seasons, from December to March the northeast monsoon prevails, and the southeast monsoon from May to October (McAlpine et al., 1983). There are, however, considerable variations in local wind patterns and speeds related to topographic effects.

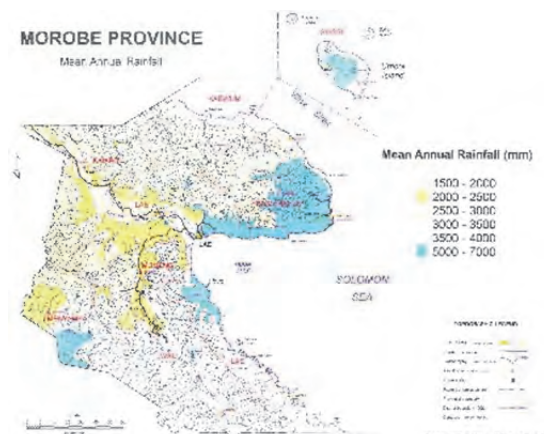
From time to time prolonged dry and wet seasons are experienced that are influenced by global climatic conditions such as El Nino and La Nino. Presently, the country is experiencing severe dry season due to El Nino affecting about 1.3 million people for which a State of Emergency has been declared for the severely affected areas especially in the Highlands region. Morobe Province is neither spared as food gardens are reportedly severely affected particularly taro and banana within the Lae – Markham area requiring food assistance from the Government.

Over six months of dry season has had debilitating effect on food production and water supply. With food production severely affected by the prolonged dry season the people are not only having difficulties making adequate income returns from market sales but are reported to be buying food from market for sustenance. Schools are closed and children sent home due to severe water shortage. This is particularly experienced in the Markham Valley where the prolonged drought is severe.

During the 2015 prolonged drought experienced there was contrasting difference between Lae and the Markham areas where Lae continues to experience rain every now and then while there is hardly any experienced in the Markham area and this is due the varying topographical settings that have a greater influence in the overall climate even within driving distance that separates the two areas, geographically.



Source: Morobe Provincial Administration
Figure 2.2.3 Soil Grouping Map of Morobe Province



Source: Morobe Provincial Administration
Figure 2.2.4 Rainfall Map of Morobe Province

2.2.5 Rainfall

The distribution of rainfall in the province varies and this is largely due to specific relief and aspect that cause local variations in the rainfall amounts. The interior and the coastal areas of the province between Finschafen and Morobe south coast have highest annual rainfall that amounts between 3,000 millimetres and 5,000 millimetres. The remainder of the province receives annual amounts of between 2,500 millimetres and 3,000 millimetres. The coastal section has a reverse pattern, however, with the wettest months being May and August and the driest between January and April. The prolonged dry season due to El Nino effect has had a lot of effect distorting the regular rainfall pattern so far in 2015.

Very heavy rainstorms often lasting more than 24 hours occur in the Lae area. Within the Butibum catchment, since 1972, maximum one-day rainfalls recorded at UNITECH and at Lae airport have ranged from 78 millimetres to over 300 millimetres. In one case 210 millimetres of rain fell in a 6-hour period. These rainstorms are key factors in creating floods in the lower floodplain of the Bumbu River, and affecting Lae.

2.2.6 Temperature

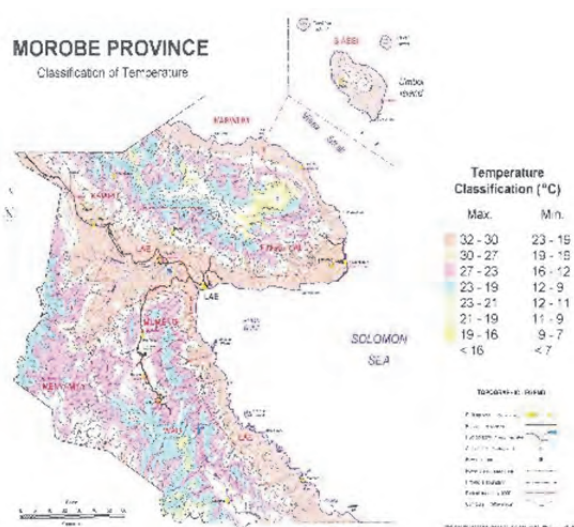
Temperature contrasts, on a seasonal basis, are not large for most areas of the province. It is evident that temperatures are high throughout the year, with average minimum temperatures of lowlands exceeding 20 degrees Celsius. The daily temperature range exceeds the seasonal temperature range. With increase in elevation, the absolute and average temperatures decrease and the seasonal range tends to equal the daily range of temperature. Generally, the temperatures for the province are as follows: coastal areas 26 degrees Celsius and above, inland areas 20-26 degrees Celsius and highland areas from 0-20 degrees Celsius.

2.3 Biological Environment

2.3.1 Vegetation

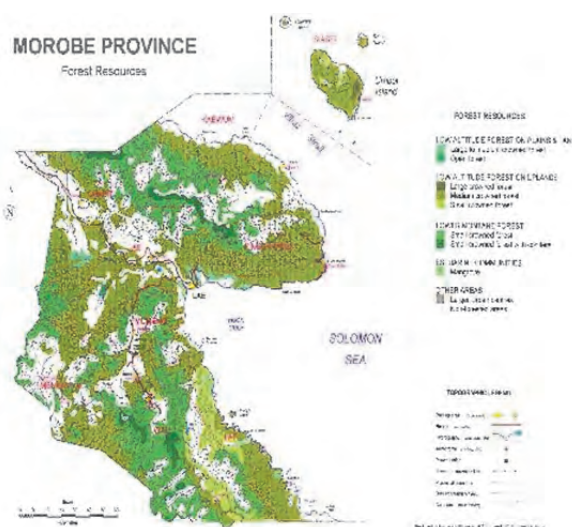
Forest cover is the dominant vegetation in PNG characterised by high tree species diversity reflecting the wide range of climatic, geographical and geological conditions which in turn provide a wide range of diverse forest habitats for other flora and fauna. Johns (1977) classifies vegetation in PNG according to zonal types, primarily based on altitudinal and rainfall where there are twelve categories comprising of mangrove, coastal vegetation, anthropogenic grassland, swamp vegetation, savannah, monsoon forest, lowland tropical rainforest, lower montane forest, mid montane forest, upper montane forest, sub alpine forest grassland, and alpine.

Given Morobe Province's geographical location with its particular geology, topography and climate attributes, the vegetation of the province can be divided into seven groups. The first group is lowland forest and is the predominant vegetation type



Source: Morobe Provincial Administration

Figure 2.2.5 Regional Temperature Map of Morobe Province



Source: Morobe Provincial Administration

Figure 2.3.1 Forest Resource Map of Morobe Province

restricted to deep soils of well-drained river plains and gently sloping alluvial fans. The second group is the lower mountain forest vegetation type located between 900-1,400 metres above sea level. It marks the transition from lowland forest to the upper mountain forest zone. The third vegetation type is the upper mountain forest type located at 3,000 metres above sea level. It is increasingly covered with grassland, and patches of forest becomes more scattered. Grassland is the fourth common vegetation type in lowland areas that are associated with well-defined dry season. Trees are rare. Wooded forest and water swamp is the fifth common vegetation type, which occurs in the lowland flood plains of major rivers, coastal vegetation makes up the sixth and the mangrove forest makes up the seventh most common vegetation in the province.

The natural vegetation within the vicinity of the Project area is quite varied as characterised by medium – crowned lowland hill rainforest such as is noticeable in the Atzera Range, river flood plains covered with medium to small crowned open forest, lowland wet swamp forest to extensive mangrove swamp forest areas spread along the coast and river mouth alluvial flood plains and mudflats. Considerable intact natural forest stand is noticeable within the Atzera and the Rawlinson Ranges with greater prominence in the Labu area in the southeast of the Project area. Otherwise much of the areas extending from the coastal plains to the Situm River, the foot of the Rawlinson Range along the foothills of the Atzera Range, and the extent of the area along the Lae – Nadzab sector comprise of human settlement, agricultural activities, and subsistence farming rendering much of the vegetation being reduced to secondary regrowth.

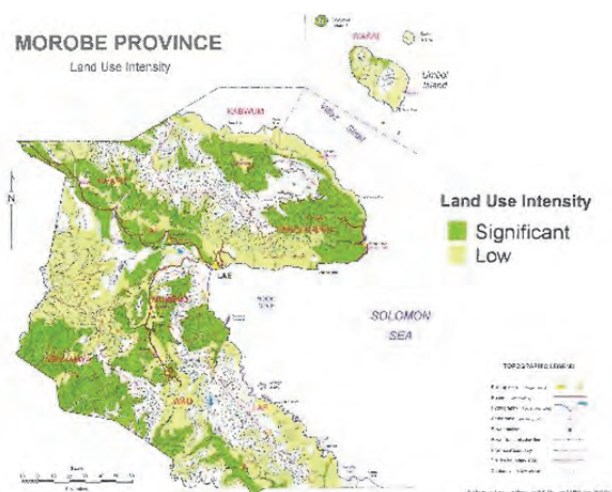
Extensive anthropogenic grassland extends from Lae to Nadzab along the Markham Valley and the surrounding hill sides remain a testament of the past and ongoing men's activities causing permanent change to the surrounding environment and the vegetation.

Analysing the 1956 aerial photos of the surrounding vegetation of Lae City particularly the Atzera hills, Buleka et al (1999) confirmed the forest to be intact but the rate of change in land use activities (at that time) coupled with increasing human population it was determined that the same forest would be cleared between 2000 and 2010.

During June 2015 Lae – Nadzab Project Team reconnaissance trip into the Atzera Range foothills, it was observed that the forest indeed had been reduced to secondary regrowth resulting from logging, subsistence farming, and human settlement establishments. With the rapid increase in the population of Lae City, the chances of any forest recovery in the Atzera hills and the surrounding environment stand no chance. In the study of land use change and population growth in the Morobe Province, Ningal et al (2008) have determined that, “the area under agriculture in the Morobe Province increased by 58% while population almost doubled between 1975 and 2000”, emphasising, “without efforts to improving soil fertility management, improved farming system and increased crop production, the current trend of increasing the agriculture area as a result of human population growth is likely to continue.”

Associated with the land use change and its effect on the forest of the area is the reported hazards experienced thus far that continues to this day, is the problem of forest loss induced land slide threats to peoples' lives and continuing land / rock / debris blockage of culverts, and flooding with debilitating effect on parts of the Lae – Nadzab road.

The general surrounding natural forest habitats within the vicinity of Lae City is basically gone with the exception of the Atzera and Rawlinson Ranges, and the Labu area. However, notable forest



Source: Morobe Provincial Administration

Figure 2.3.2 Land Use Intensity of Morobe Province

conservation habitats occur within Lae City and they are the Lae Botanical Garden and the Rainforest Habitat at UNITECH. The Rainforest Habitat holds cages of live native animals both protected and not protected species. Further northeast from Lae in the Finistera and the Sarawaged mountains is the first nationally declared Yus Conservation Area comprising more than 78,729 hectares protecting the unique plants and animals including the rich diverse habitats that range from the sea level to over 3000 metres asl. Among the many unique and endemic species and critical habitats being conserved are twelve species that are on IUCN List as endangered, threatened or vulnerable. Two mammals on the IUCN List, The Long Beaked Echidna (*Zaglossus bruijni*) and the Matchie's Tree Kangaroo (*Dendrolagus matchiei*) are on critically endangered and endangered categories.

2.3.2 Aquatic

Morobe Province has an abundance of water resources in the form of rivers, lakes and underground water and this is largely as a result of its geology, topographical and climatic setting that effectively influence the hydrological cycle in the Province, Bhunia et al (2012). Markham, Bumbu, and Busu Rivers characterise the major river systems within the immediate vicinity of the project area. "Lae has the fifth highest rainfall place on earth" (Anon).

Bhunia et al (2012) have determined in their study that over 57% of the Morobe Province has potential for groundwater while nearly 43% fall under the zone category showing inequality in the distribution of the groundwater potentiality in the Province highlighting the need for caution and responsible use of this potential water resource. It is cautioned however that quality and chemical composition of the groundwater is an aspect that is not known and needs to be first determined before using it.

The water supply for the City of Lae effectively is supplied from bore water. The fast growing population of Lae City has serious long term implications on the sustainable use of the groundwater supply in the long run requiring putting in place mitigation strategies to ensure maintenance of sustainability, as there are already signs of depletion in some of the groundwater supply pump stations, Betisolo et al (2014). Lack of good water supply, sewerage system and solid waste management remain a serious challenge for the well-developed city of Lae as the second largest city in PNG now and into the future.

Aside from the notable and devastating effects of flooding from the three major rivers (Markham, Bumbu and Bushu) over the years, little is known of any serious long term studies on the hydrometric and water qualities of the rivers, this standard scientific information remains amiss, while it is known that the bulk of Lae City population actually depend on these rivers and other streams and creeks for their livelihood.

Water PNG Limited, a State Owned Enterprise (SOE) is responsible for the Water Resource use and supply in PNG except for the Nation's Capital District, Port Moresby. With the exception of the Igam Army Barracks and the University of Technology, Water PNG Ltd is responsible for Lae City water supply and sanitation. Both the Igam Army Barracks and UNITECH institutions require water use permit from Water PNG.

2.3.3 Coastal Environment

Morobe Province has a 719 square kilometres of maritime area with a stretch of 402 kilometres of coastline. The Lae –Nadzab Urban Development Project area, in part, covers a stretch of the coastline extending from the Situm River in the east to Labu in the southwest that forms part of the Huon Gulf maritime area. Fish form the primary source of protein for the people that live in the villages along the coastline and also for the city residents. Coral reef habitats within the immediate coastline of Lae are absent due to the geology of the seabed but also due to, in part, the influence of the discharge of high volume of sediment from the Markham River.

Among the many variety of marine and brackish water species recorded for the Lae and the surrounding marine area, there are two large reptile species that are both protected by law and they are, the saltwater crocodile (*Crocodylus porosus*) and the leatherback turtle (*Dermochelys coriacea*). Lababia Conservation Area located further southeast from Lae forms part of the Turtle Conservation efforts undertaken along the coastal areas of the Huon Gulf.

Unfortunately, it is noted that, people living in villages along the coastline of the Hun Peninsula are faced with immediate threats from sea level rise. This challenge became obvious during the Project Team's excursion trips to Labu and Wagan villages where the Team witnessed evidence of village shorelines being washed away, with the people expressing their concern and desire to relocate to higher grounds. The Labu village people were blunt about their predicament and intentions requesting urgent attention from the provincial Government. Relocation and resettlement is inevitable for many of these coastal communities along the Huon Gulf in not too distant a future. The Labu people also expressed grave concern about their fishing grounds being taken over by big cargo ships that anchor outside in their traditional fishing water areas waiting to move into berth at the Lae Wharf.

2.4 Lae City and Climate Change

With the increasing modernisation and development expansion of Lae City coupled with the rapidly increasing population, is already putting a lot of stress on the limited land and natural ecosystems that provide buffer against natural disasters (flooding, storm surge, severe storms, landslips and droughts), and provide subsistence for the bulk of the residents through provision of food, drinking water, building material, shelter, and medicines). This is a hard reality that one cannot ignore considering the fact that Lae City is not only vulnerable to serious natural disasters but the bulk of people that make up the city population live either in the surrounding villages or in settlements, and many do not have formal employment. Both Lae City and its residents continue to depend very much on their land and the natural environment for their subsistence and existence. Communities in Markham making it through the recent long severe El Nino drought are a testament to the peoples' resilience and adaptation to their natural environment. "Adaptation to climate change is the challenge of maintaining such ecosystem services in the face of long term climate changes" (TKCP 2012). Relocation and resettlement of the Labu community provide a living example of the people not only battling with the effects of Climate Change related sea level rise but also view the Lae – Nadzab Urban Development Project an opportunity to become actively involved with the hope of realizing their dreams of a better future. Maintenance of the integrity of the ecosystems within and around the around Lae City is critically important. It is noted that, initiatives have already been taken at the Provincial Government level in working together with the Office of Climate Change and the Natural Disaster Office to streamline development policies through integrating Climate Change and Disaster strategies into the Provincial development plans.

2.5 Natural Hazards

The following section provides a brief description of the natural hazards that may occur that could affect the project design and development, and this is done through desktop research analysis and syntheses of technical and nontechnical reports on the geology and the past natural hazard experiences within Lae and the Province.

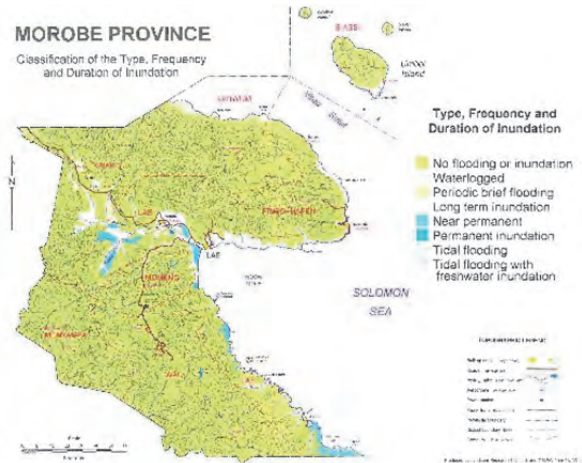
2.5.1 Potential Hazards of Project Area

The Lae – Nadzab Urban Development Project Area is located in a geologically unstable area that warrants careful attention in undertaking future design and planning for city development. The existing geomorphology and topography of the Project Area is a cumulative end result of the many millions of years of the geological instability due to the crustal plate movements that is continuing today directly causing geological and topographical changes in the area and the region with potential to cause devastating destruction.

According to Buleka et al (1999), the principal potential geologic hazards in coastal zones, all of which can cause loss of life and great economic cost in Lae are:

- Earthquakes: episodic ground movements and shaking due to crustal tectonic forces, causing foundation collapse, damage to buildings and infrastructure, and triggering other geologic processes.
- River floods: major discharges of water and sediment, which inundate floodplains, erode bridges, and bury land and buildings with flood debris.

- Landslides: episodic movements of rock and soil that remove, bury, and cause impact damage to settlements, infrastructure and industrial facilities.
- Landslide dam bursts: special types of catastrophic floods caused by breaching of temporary river dams formed from landslide debris, which in turn inundate floodplains, erode bridges, and bury land and buildings with flood debris.
- Coastal erosion: loss of land along the coast and damage to coastal settlements, agriculture, infrastructure and industrial installations.
- Tsunamis: temporary abnormal sea wave conditions which can inundate coastal areas and settlements, causing high-energy impact damage and land loss.
- Submarine slope instabilities: episodic underwater movements of rock and sediment, causing coastal land loss, damage to harbours and wharves, and sea floor installations such as pipelines and cables.



Source: Morobe Provincial Administration

Figure 2.5.1 Inundation Map of Morobe Province

Several geological and plate tectonics studies have been undertaken in Lae by geologists and academics from within and outside of PNG, over the years, and their findings published on the geology and vulnerability of Lae City seem to have reached similar conclusions on the present situation and potential risks in the future.

Wallace et al (2009), in their study of the plate tectonics of the Lae area described their findings as below;

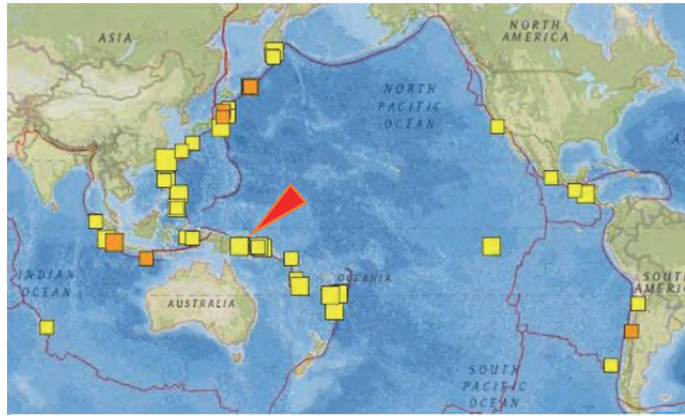
“Previous studies have highlighted the seismic hazards posed to Lae City due to its location in the active plate boundary zone (Ripper and Anton, 1995; Buleka et al., 1999). A seismic zone has been identified (The Lae Seismic Zone) (Kulig et al., 1993), located between the Atzera Range and Situm, which has the potential to generate shallow Mw ~7.0 earthquakes. It is believed that such earthquakes in the Lae region have a return period of 100-110 years and are likely to result in ~1 metre vertical coseismic displacements, as evidenced by mapping and dating of Quaternary sediment profiles in the Lae area (Crook, 1989). Such an event would cause significant damage, not only as a direct result of ground motion from the earthquake, but also from landslides on steep land around the city (e.g. the Atzera Range). A submarine landslide off the Lae coast triggered by seismic energy could also generate a tsunami that would endanger coastal areas and port facilities. This risk is not understated, as there is a steep coastal gradient of unconsolidated alluvium along the Lae coast due to the close proximity of the deep New Britain trench.

The seismic hazard in Lae is further amplified by the very thick alluvial deposits that the city and many of its suburbs are built on. Sedimentary basins amplify seismic energy and the damage from even smaller magnitude earthquakes can be significant.”

According to Buleka et al (1999), “Lae is located in such a seismically active region, basically in a collision between the Australian plate moving north north-eastwards at about 3 cm/year and the Pacific plate moving west southwest at 7 -10 centimetres/year. Smaller plates are sandwiched between these two major plates giving a complex pattern of movement. The interactions between the plates produce regional uplift and subsidence, earthquakes and faults. Lae lies on the northern flank of the Huon Gulf which is believed to be the location of a major thrust fault known as the Markham/Ramu lineament. Across the fault there is uplift to the north and subsidence to the south. On the northern side of the Gulf the 4,000-metre relief Finisterre Mountains, show uplift rates on the order of 3.5 millimetres per year, identified from dating of raised marine terraces (Chappell, 1974, 1983, &

Chappel, Ota and Berryman, 1996). Seismic reflections over the Huon Gulf have indicated the presence of coral platforms at depth and a radiocarbon date from the dredged sample indicated sinking at the rate of 4 millimetres/1,000 years (Galewsky et al, 1996).

“Tectonic uplift is one of the main driving mechanisms for nearly all the geological hazards affecting Lae and its environs. Technically it is not a hazard in its own right except for possibly changing the course of a river following a major earthquake where surface expression of the fault takes place. It is a mechanism that provides the potential for mountain ranges to be denuded, thus a source of sediment for the rivers and flood plains. It is a mechanism that has created mountains in the hinterland of Lae that exceed a height of 4,000 metres and are capable of causing the moisture in clouds to precipitate in the headwaters of the rivers. It is a mechanism that has caused the coastal strip and alluvial fans themselves into defined channels and creating corridors for high energy flooding. Most of the rivers draining the Sarawaget range do not dissipate energy in an overbank flow because they are incised into channels. Without such energy dissipation some rivers have a proven history of flooding of sufficient discharge to destroy bridges almost on the coastline and for carrying boulder sized rocks into the sea itself.”



Source: USGS

Figure 2.5.2 Occurrence of Earthquake in Pacific Region
(Indicates earthquake M4.5 or higher)

2.5.2 Recorded History of Hazards in Lae

A wealth of recorded information on the past experiences of natural disasters and geological events in Lae exist which provide a greater insight into the past as reference points. Sourced from the Buleka et al (1999) study, the information provided below sheds historical context on the potential natural hazards and vulnerability of Lae City.

- About 250 years ago a ground displacement occurred within the city, in the Stewart Park area. Crook and Liu, (1993), report that the area was uplifted by 2 - 3 m. This event is believed to have permanently altered the course of the Butibum River and Didiman creek which is the remaining relic of the Butibum channel.
- In 1913, a magnitude 7.0 earthquake occurred in the Huon Gulf, the tsunami inundating the village of Salamaua (Everingham, 1974).
- In 1922, the International Seismological Centre previously located a magnitude 7.0 earthquake just to the north of Markham Valley.
- Submarine landslides appear to have occurred in 1932, 1971, and 1972, causing coastal land-loss and local tsunamis (Everingham, 1973). In August, 1932 approximately 5 acres of land, a wharf building, some heavy equipment and 100 m of railroad disappeared into the sea.
- In 1966, a magnitude 7.2 earthquake occurred in the Huon Gulf east of Lae, damaging the Madang-Cairns submarine link (SEACOM CABLE).
- In 1968 there are reports of SEACOM submarine cable breaks in the New Britain Trench about 200 kilometres east of Lae. This was attributed to sea floor flows of sediment originating near the mouth of the Markham, considered by some to be mobilized by submarine landslides close to Lae.
- In August 1972 abnormal sea waves with heights of 2.4 metres were caused by underwater landslip near Voco Point.
- In 1977 the Busu Bridge was destroyed by flooding in the Busu catchment

- A 1983 flood, which destroyed parts of the Bumbu valley and parts of the city of Lae, was caused by heavy rainfall due to a stationary high pressure cell over the Coral Sea. The flood was made worse by rapid runoff from the Agora mountains, due to slashing and burning of the natural vegetation for agriculture.
- In 1983 the Busu Bridge was destroyed by flooding in the Busu catchment.
- In 1987 and 1992, magnitude 7 earthquakes occurred northeast of Lae on the north-eastern coast of the Huon Peninsula.
- In 1988 the Kaiapit landslide in the Upper Markham catchment killed 74 people, and destroyed 3 villages.
- On 13th October 1993, a magnitude 7.1 earthquake followed by a whole series of magnitude 7.6 and 5 earthquakes over a three-month period, triggered massive, widespread landslides. 37 people were killed, 2 airstrips damaged, 3 villages
- Destroyed and a further 58 damaged. 8,000 people were evacuated to safety and landslide debris caused rivers to dam. When the dam breached 2 major highway bridges in the Markham- Ramu valley were destroyed.
- A magnitude 6 earthquake caused the breaching of a landslide-dammed lake on the Bura River in 1993.
- Landslide dam burst and destroyed bridges over the Gusap and the Bura rivers in 1993.
- Destruction of a bridge on the Okuk Highway in 1994, cost an estimated \$US40 million in lost coffee exports.
- A landslide dam burst on Boana River in 1996, and the flood and debris washed out two bridges over Busu River.
- While no magnitude 7 earthquakes have occurred at Lae, on many occasions, cracking has occurred in the city and people have been badly scarred by the shaking intensities accompanying magnitudes 5 and 6 earthquakes.

Considering the port at Lae, the “Pacific Island Monthly” 21 September, 1932, article as told by Everingham, (1973), and reproduced below: “At the end of August, about 5 acres of the shore, eastwards of the aerodrome, simply slid into the sea, carrying with it the wharf that had been built for light craft, two or three sheds at the end of the wharf, the large steam crane, and about 100 yards of railway.....”

Lae City certainly has a colourful recorded history relating to natural disasters that warrants taking note of and applying the precautionary principle as a mitigating strategy.

CHAPTER 3 ECONOMIC CHARACTERISTICS

3.1 Economic Overview

Papua New Guinea (hereinafter referred to as “PNG”) is categorized as a lower middle-income country in terms of GDP per capita in current basis as well as purchasing power basis. GDP accounted for US\$1,758, in 2013, according to IMF. However, GINI coefficient is high in PNG (0.51 according to the independent household survey in 1996) and HDI (human development index) ranked 156th out of 180 countries listed. This means income inequality is high in PNG. The World Bank reports that about 35% of population is under poverty line (US\$1.25/day), though we could not observe any street children or homeless people in city streets.

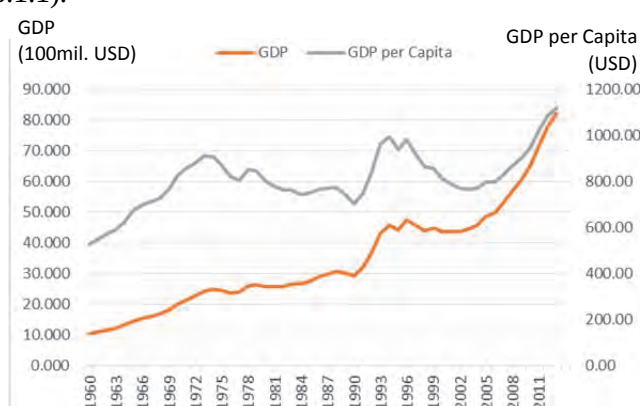
GDP breakdown by industry group is 36.27% primary, 43.97% secondary, and 19.76% tertiary. Population breakdown according to the industry is 72.3%, 3.6% and 22.70% respectively, according to IMF. The economic growth of the country in the decade has been steady reflecting the exploitation of abundant natural resources headed by mining such as LNG, crude oil, gold, copper, and marine resources caught at the world’s eminent fishery area. Balance of Payment¹ since 2010 has been estimated negative because the country relies too much on both imported food and industrial products and to make matters worse, international market price for PNG’s key export products showed a decline in the past five years. Economic data as well as industrial statistical data focusing on Morobe and Lae area has not been generalized yet nor public system to gather such data has not been established. Thus, basic data used for planning new business will be estimated based on the data collected from stakeholders.

PNG has the largest economy among the Pacific island countries, and its gross domestic product (GDP) in 2013 was approximately 8.2 billion USD (based on constant prices in 2000). Petroleum, the production of which started in 1992, has grown to compete with gold and copper as one of the country’s major industries, further boosting the GDP and helping PNG achieve unprecedented economic growth since 2003.

3.1.1 Economic Indicators of the Country

(1) GDP and GDP growth

GDP per capita grew from 768 USD in 2003 to 1,121 USD in 2013 (both based on constant prices in 2000). Moreover, a liquefied natural gas (LNG) project with participation of Japanese enterprises started production in 2014 and GDP is expected to grow even further when exports of LNG are counted (see Figure 3.1.1).



Source: World Bank

Note: The figures are indicated in 2000 constant prices

Figure 3.1.1 Changes in GDP

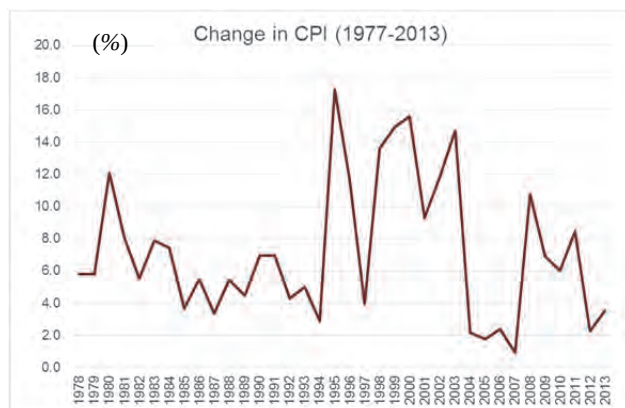
¹ Balance of payments, current account (mil. US\$) :

2012	not available
2010	-633
2005	539

Source: World Statistics Pocketbook | United Nations Statistics Division

(2) Inflation

The inflation rate in PNG at one time exceeded 15% per annum, but it has settled down in recent times and was 2.3% in 2012 and 3.6% in 2013.



Source: Bank of PNG

Figure 3.1.2 Changes in Inflation Rate per Price

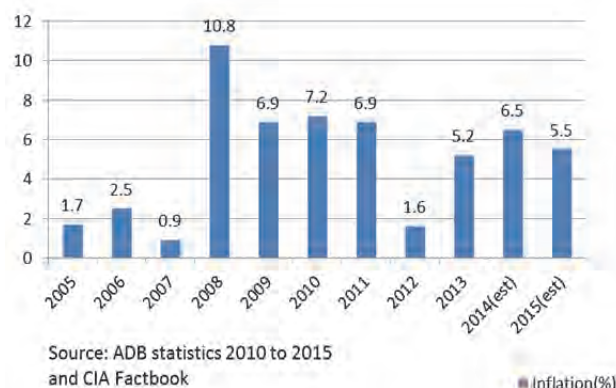


Figure 3.1.3 Inflation (Consumer Price)

As stated above, PNG's economy grows continuously in the decade after 2005. Inflation rates have stayed in prudent ranges despite the fact that strong inflationary pressures have arisen from depreciation of PGK, price hike of imported commodities and public expenditures.

(3) CPI

In concert with the inflation movement, CPI had increased year by year since 2005. CPI value in 2011 reached 40% higher than the base value in 2005.

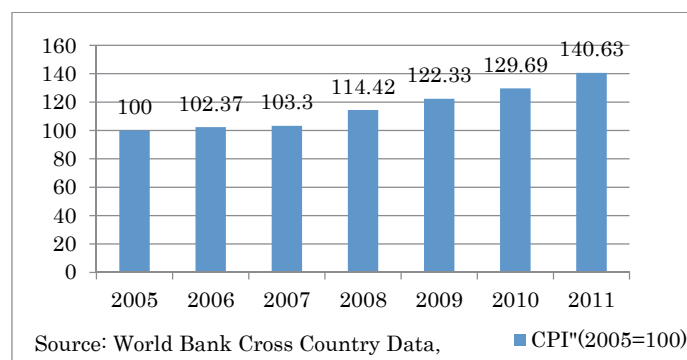


Figure 3.1.4 CPI

(4) Minimum wage and buying power

The fourth Minimum Wages Board (MWB²) was held in 2013 to discuss compensation between minimum wage and consumer prices. After due discussion at the Board, the wage increased by US\$30 cents over the next year. However, it is estimated that about 85% of local workforce is engaged in informal economic activities and only a little number of workforce will be able to enjoy the wage hike. In addition, minimum wage hike has been almost neglected in two decades so that the living standards of workers became depressed, according to the worker's union.

On the contrary to the complaints from the union, the level of minimum wage is higher than in neighbouring market economy countries such as Indonesia, Philippines and Viet Nam. This phenomenon seems to reflect life supporting costs especially for both daily and sundry products dominated by imports.

² Minimum wage board is a sole and responsible body to draft a plan to submit cabinet for minimum wage deliberation.



Figure 3.1.5 Minimum Wage

(5) Workforce and unemployment

There is no definite statistical information about unemployment. This is caused by the PNG's peculiar social condition understood as a subsistence economy.

Generally, demarcation between employment and unemployment can be defined whether a workforce wishes to take part in wage-earning activity or not. However, according to INA (Institute of National Affairs: economy and business activities research organization), workforce migrates between (subsistence economy) villages and cities frequently according to necessity of earning money. In this regard, INA estimates informal workforce would be around 80% and formal workforce which engages in wage-earning activity would be 450,000 as of 2015.

In addition, officials of Department of Labour and Industry Relations (DLIR) during the interview survey, using experience values due to absence of official data, told the JICA team that about 94 to 95% of workforce is involved in informal activities aside from wage employment or income generation. Remaining 5 to 6% is acknowledged as formal workforce that participates in market activities. However, around 30% in informal workforce may be categorized as semi-informal workforce. This is because these workers can participate in market activity if the requirements are met such as menial work or necessity of cash earnings.

Population of PNG is 7.26 mil. as of 2012 according to ADB statistics. Thus, the scale of formal workforce will be 430,000 approximately (using an estimate by the DLIR officials).

Lae Urban District Employment by Sector

As quote from Lae District 5-Year Development Plan 2013-2017, national entities employ only 15% of labour force. Moreover, according to the IPA survey, foreign invested companies employ 56%, citizen entities 28% and national entities 15%. Also, IPA survey of 1996 suggests that total capital investment by foreign entities in Lae was 445 mil. PGK while indigenous capital invests 62.8 mil. PGK. As seen above, an indigenous capital enterprise has not grown up yet in Lae City.

3.1.2 Trade and Investment

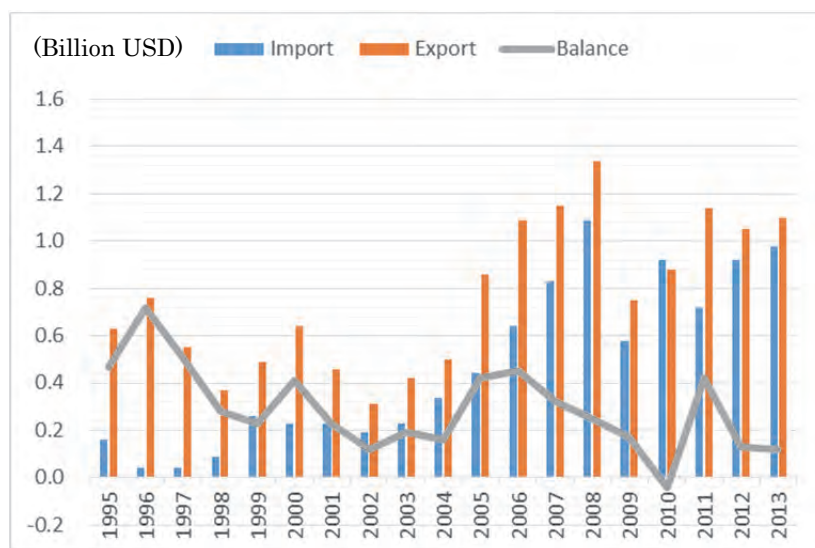
(1) Trade and Trade Balance

PNG's exports were conventionally dominated by gold and copper, however, from the second half of 2012, the country also started exporting nickel and cobalt. In 2014, it also started exporting LNG products, causing the value of exports to jump 1.5 times. As for imports, PNG buys a wide range of finished products ranging from industrial articles to household consumables and processed foods (see Figure 3.1.7 and Figure 3.1.8).

(2) Exports and Imports

Looking at the performance of exports and imports, until the first half of the 2000s, the value of exports greatly exceeded the value of imports although the situation was unstable. From 2005 onwards, except for 2009 when the global financial crisis occurred, both exports and imports displayed steady growth with the real value of exports in 2013 reaching 13,337 mil. PGK and the real value of imports being 12,142 mil. PGK. Having said that, these export and import values still

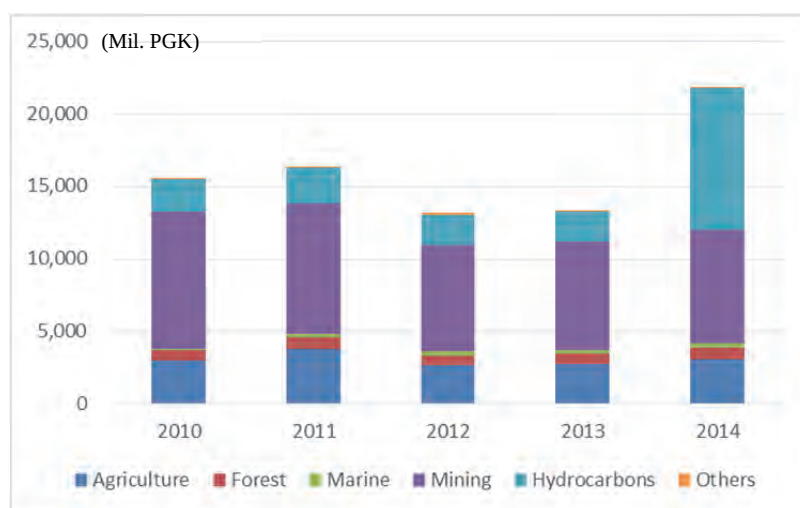
did not reach the record levels of 2008. However, according to estimates for 2014, with exports of LNG getting underway, the value of exports is expected to increase significantly while imports are expected to decrease, thereby generating a large trade surplus (see Figure 3.1.6).



Source: UNCTAD

Figure 3.1.6 Changes in PNG's Exports and Imports

The above figure indicates that trade scale had grown threefold since 2005 in comparison with the previous two decades. In this regard, PNG seemed to join the globalization framework since beginning of 2000. From 2005 to 2012, trade balance shows positive reflecting the favourable exportation. Simultaneously, import has been increasing in correspondence to the necessity of industrialization and upgrading of quality of life. Since 2012 and onward, increase of import caught up with the export and then trade balance became negative in 2013.



Source: Bank of PNG

Figure 3.1.7 Changes in PNG's Export Items

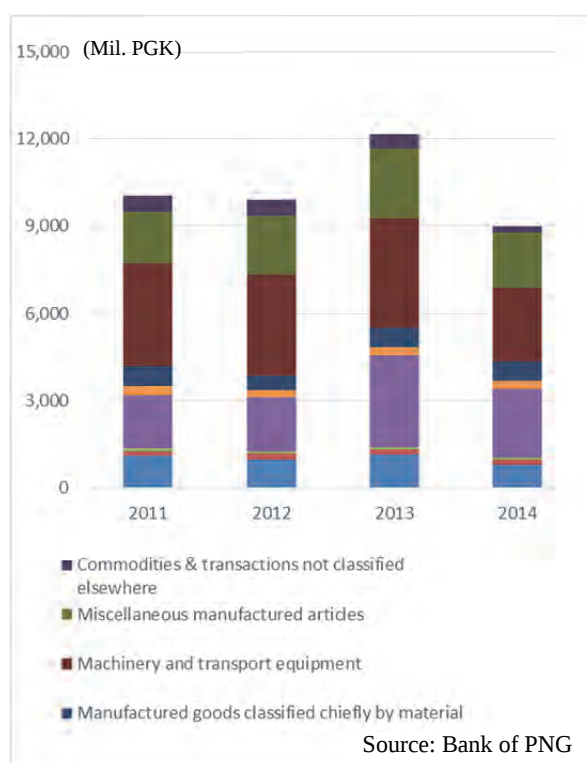


Figure 3.1.8 Changes in PNG's Import Items

1) Export by categories

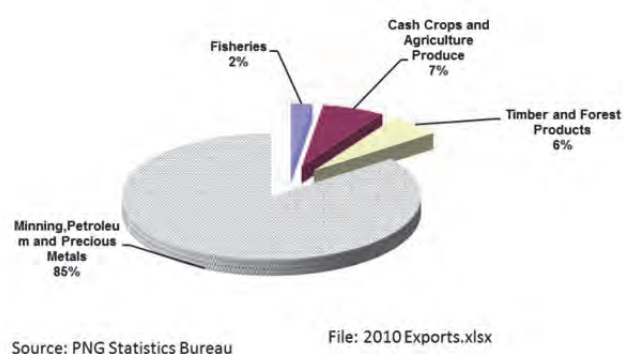


Figure 3.1.9 Most Exported Indicators

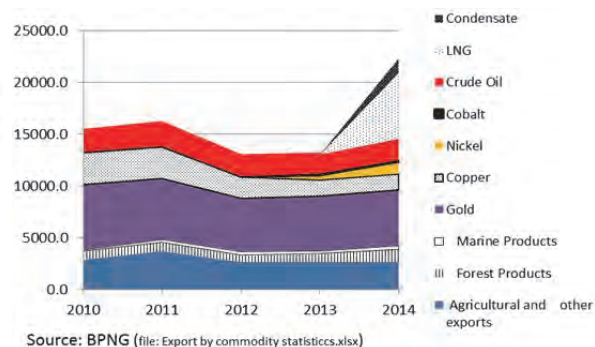


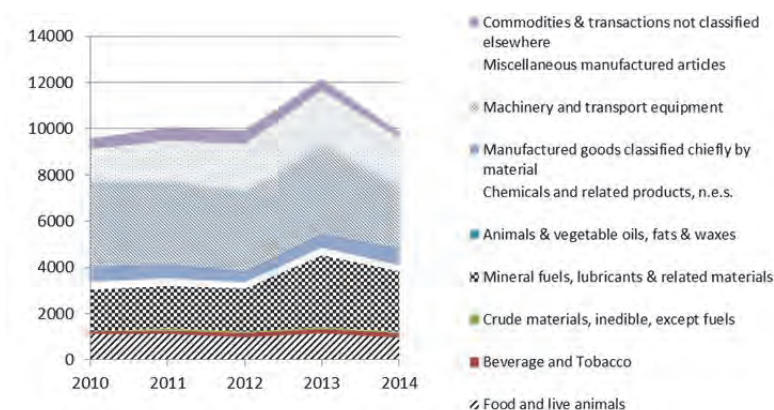
Figure 3.1.10 Exports Classified by Commodity Group (mil. PGK f.o.b.)

As shown in the Figure 3.1.10, about 75% of export in terms of value is borne by resources (mining and petroleum) in 2014. The share of mining and petroleum increased by approximately 20% more than 2013 in response to the start of LNG plant operation. Meanwhile, the value of other commodities has not been increased since 2010.

2) Imports by categories

The following figure shows that machinery and transport equipment and mineral fuels, lubricants & related materials accounted for 50% of total imports. This means the cardinal measures to support industrialization of PNG are fully relying on overseas.

Food and live animals are the fourth largest import item though over 80% of labour force engage in agriculture. Poor performance in agricultural productivity may reflect the high import value of food.

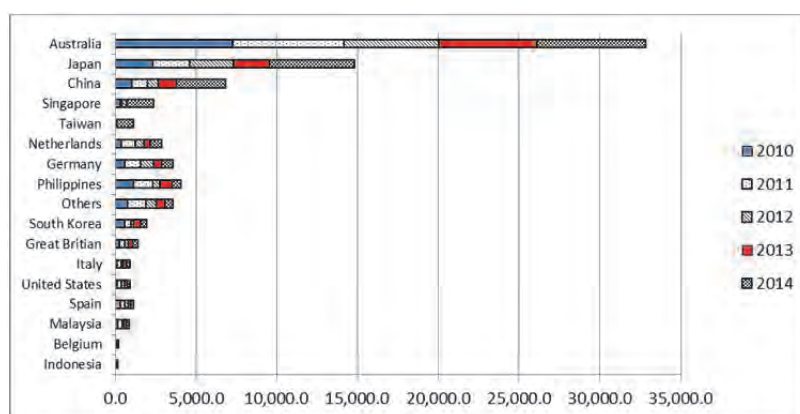


Source: Bank of Papua New Guinea (file: Import Statistics.xlsx)

Figure 3.1.11 Import Classified by Commodity Group (mil. PGK f.o.b.)

3) Export and import countries

Australia and Japan are the first and second largest importers of PNG commodities. China follows these two countries. The two big importers accept more than 50% of the total export of PNG commodities.

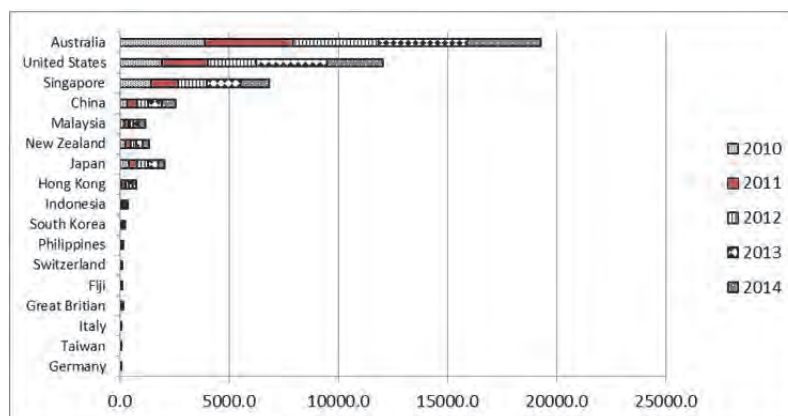


Source: BPNG (file: Export countries.xlsx)

Figure 3.1.12 Countries for Export (mil. PGK)

Australia is the biggest exporter to PNG and accounted for 32% of total exports in 2012, according to Australia & New Zealand Banking Group (PNG) Ltd; ANZ. Japan is the second largest, accounting for 7%, and China followed, accounting for 6% of total exports. Japan is the 7th largest exporter in 2014 but is 5th in terms of accumulation of 5 years' exports since 2010.

As for import destinations, Australia is the largest and accounted for 37% in 2012 according to ANZ. Singapore followed and accounted for 14.1% and Malaysia was the third, accounting for 9.1%.



Source: BPNG (file: Import countries.xlsx)

Figure 3.1.13 Countries for Import (mil. PGK)

Table 3.1.1 Main Trading Partners of PNG

EXPORT

	Amount (Million Kina)					Composition (%)				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
Australia	7,278	6,883	5,868	6,109	6,705	46.6%	42.0%	44.5%	45.8%	31.0%
Japan	2,320	2,273	2,711	2,253	5,283	14.9%	13.9%	20.6%	16.9%	24.4%
China	1,036	985	627	1,155	3,064	6.6%	6.0%	4.8%	8.7%	14.2%
Singapore	307	147	240	74	1,619	2.0%	0.9%	1.8%	0.6%	7.5%
Taiwan	20	35	37	22	999	0.1%	0.2%	0.3%	0.2%	4.6%
Netherlands	398	837	545	382	713	2.6%	5.1%	4.1%	2.9%	3.3%
Germany	615	941	842	503	697	3.9%	5.7%	6.4%	3.8%	3.2%
All Others	3,628	4,285	2,305	2,839	2,548	23.3%	26.2%	17.5%	21.3%	11.8%
Total	15,602	16,386	13,175	13,338	21,627	100.0%	100.0%	100.0%	100.0%	100.0%

IMPORT

	Amount (Million Kina)					Composition (%)				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
Australia	3,919	4,017	3,904	4,090	3,370	41.0%	42.5%	39.4%	33.7%	34.2%
United States	1,938	2,079	2,260	3,217	2,563	20.3%	22.0%	22.8%	26.5%	26.0%
Singapore	1,440	1,235	1,312	1,560	1,305	15.1%	13.1%	13.2%	12.8%	13.3%
China	355	442	526	591	656	3.7%	4.7%	5.3%	4.9%	6.7%
Malaysia	230	181	224	255	297	2.4%	1.9%	2.3%	2.1%	3.0%
New Zealand	253	262	249	285	275	2.7%	2.8%	2.5%	2.3%	2.8%
Japan	441	348	510	487	261	4.6%	3.7%	5.1%	4.0%	2.7%
Hong Kong	100	138	169	179	175	1.0%	1.5%	1.7%	1.5%	1.8%
All Others	880	754	759	1,477	944	9.2%	8.0%	7.7%	12.2%	9.6%
Total	9,556	9,456	9,912	12,142	9,844	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Bank of PNG

(3) Foreign Direct Investment (FDI) Flow

Foreign direct investment to PNG in 2012 was 5.265 billion PGK (approximately 2.879 billion USD), which was the highest level in the past five years. The top investment sectors over the five-year period of 2007-2012 were petroleum and gas (drilling), construction, agriculture, mining & quarrying, and real estate. In 2012, most foreign capital (87%) was invested in the petroleum and mining & quarrying sectors.

In terms of the investment sources, Malaysia, Australia and USA are the leading countries followed by Japan. Investment going into PNG has increased drastically in recent years, reflecting the attractiveness of PNG's high-level economic growth, its long-term political stability, launch of the PNG LNG project, and trust in the foreign investment promotion policies the government has adopted. The main players behind the expansion of investment between 2007 and 2012 were Malaysia, the United States, Australia, Japan and the British Virgin Islands.

Table 3.1.2 Invested Amounts by the Top Five Investor Nations (2007-2012)

Country	Malaysia	United States	Australia	Japan	British Virgin Islands
Amount (mil. PGK)	4,599.4	3,674.5	3,367.0	2,890.3	1,704.0

Source: IPA

1) Nation-wide FDI Inflow

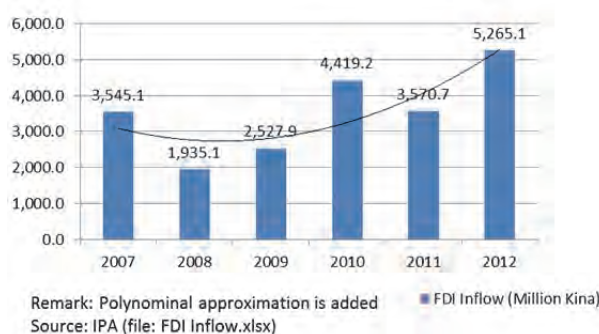


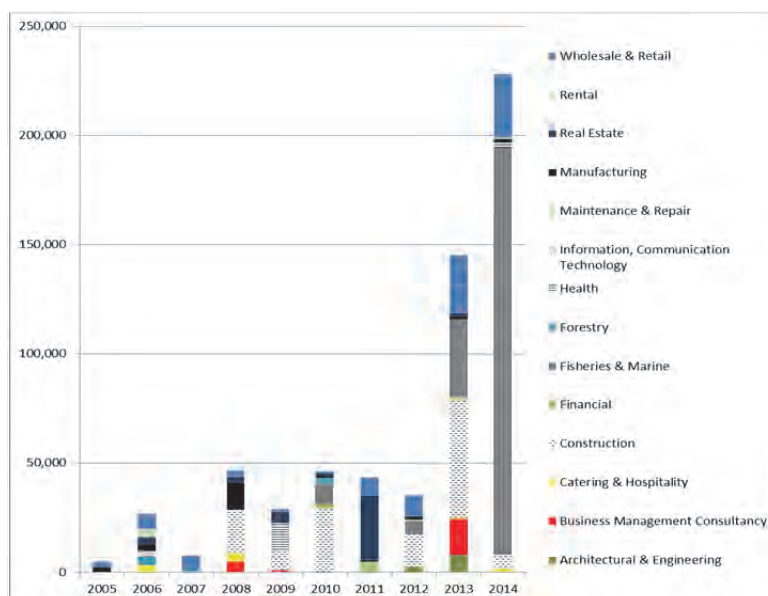
Figure 3.1.14 FDI Inflow (mil. PGK)

As the curving line indicates, FDI inflow has been increasing holistically. Total FDI in 2012 was 5.26 billion PGK (equivalent to US\$2.8 billion, approximately). According to the IPA, FDI has been

focusing in oil and gas, mining, infrastructure construction, and agriculture.

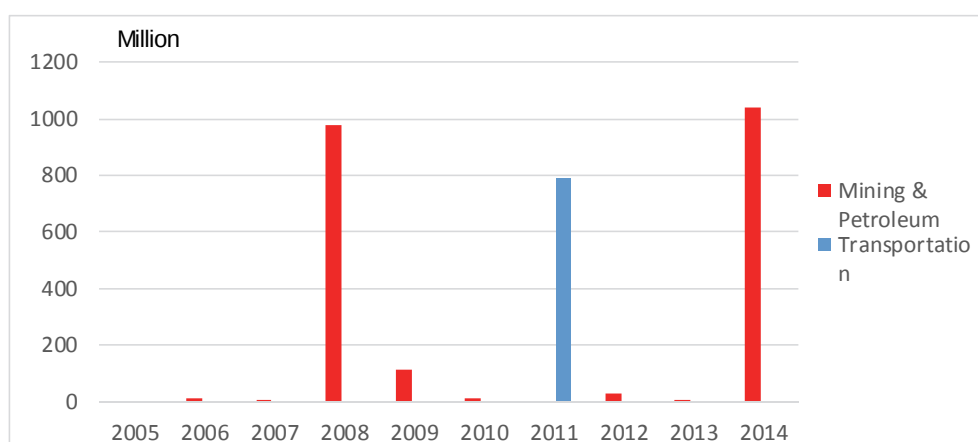
“Doing business of 2015” of the World Bank ranked PNG 133rd out of 189 countries. It is lower than the previous year of 131st and lower than the regional average (East Asia & Pacific rank 92nd). Albeit with such unfavourable business conditions, PNG’s FDI inflow has an upward momentum as shown in the above figure.

2) Proposed Investment by Sector focusing in Morobe Province



Source: IPA Remark: 1,000PGK

Figure 3.1.15 FDI focusing in Morobe Province (I)



Source: IPA

Figure 3.1.16 FDI focusing in Morobe Province (II)

As seen in the previous two figures, scale of FDI inflow to **Mining** sector is outstanding among all FDI to Morobe Province in this decade. According to the PNG Mine Watch, 14th August 2015, FDI inflow to Morobe Province in these years was focusing mainly in Bulolo gold mine.

FDI to **Fishery and Marine** subsector is the most outstanding in non-mining sectors and was prominently active in 2013 and 2014. This is wholly reflected by tuna cannery projects. Following the Fishery and Marine subsector, construction has been booming since 2008. As of 2015, there are six tuna canneries in operation and one tuna cannery under construction in Morobe and Madang Provinces. Madan Province has an advantage in attracting tuna cannery investment due to well-developed fishery port while Morobe has an advantage as an exporting port. In this regard, Morobe Fisheries Management Authority, expecting to boost cannery business, is promoting to develop Wagang fishery port in the southeast of Lae City.

Fishery in PNG and Tuna business

According to IPA investment guide book, PNG has a high potential in terms of fish-culture, processing of tuna, lobster, shrimp and crab. Especially, tuna fishing is PNG's investor-attractive and export-valuable subsector because supply capacity of PNG fisheries zone accounts for about 10% in the world tuna market. PNG Government has licensed foreign investors to catch fish within its coastal economic zone only to those who agreed to start onshore investment in canneries in view of resource control and job creation to citizens. Currently, the government has access agreements with Taiwan, Korea, Philippines and China.

One of the major issues for the canneries is low cost competitiveness of products due to high labour cost and high auxiliary materials. In this regard, these canneries mainly target the local and EU markets. This is because, Economic Partnership Agreement (EPA) lets PNG

Wholesale and retail is the next investment hearty subsector. It is reflecting the increase in demand for daily commodities and foods in correspondence to the urbanization of the city of Lae. Manufacturers of daily and processed food products prospect that the scale of market will expand steadily in the future. Like daily commodities and processed food market, needs of auto parts as well as **Maintenance/Repair** will increase in correspondence to the urbanization. Unfortunately, aftersales market for auto-parts and maintenance shops are not popular in the country nor well developed though these subsectors can be a seed to nurture metal working industry in the future.

Investment to **Construction** became active in 2008 and shrunk in 2014. This investment trend seems to correspond with the construction of LNG even though LNG mine and pipe line route is not connected to Morobe Province. LNG project may have generated a spin-off effect to Morobe Province as well.

As for **Manufacturing**, foreign direct investment in this decade accounted for almost negligible value. It seems that foreign investors may consider manufacturing business in PNG being non-viable. In fact, business environment to start manufacturing firms has various hurdles including requirement of technology license originated in SA (Standards Australia).

3.2 Industry Sector

3.2.1 Development of Major Industries in the Project Area

(1) Mining

1) Manufacturing secondary products

Mining is the irresistible economic driving force of PNG, and various mining projects are under commercial operation all over the country and in Morobe Province as well. The two largest gold mines are the Porgera mine at Enga Province and Lihir mine at New Ireland Province. In Ramu of Madang Province, there was found a world-class scale nickel-cobalt mine, in which the aggregate nickel accounts for 31,000 tones and is going to be operated by Chinese Joint Venture Company in 2016 according to the information from officials of Morobe Province.

At this moment, extracted precious ores, in general, are processed into ingots near the Project site for export but secondary processing to widen marketability has not been touched due to feasibility of the Project. For example, gold is the biggest mineral resource in terms of scale of GDP output in PNG. However, it is not processed to secondary products other than ingot because of scarce demand from local market and unavailability of necessary technology such as forging, casting, powdered metallurgy processing and accessory designing. Fashion accessory making is categorized as labour intensive but does not contribute to employment generation because it is craftsmanship business.

Copper is the second largest mineral resource in PNG. In industry field, copper is widely used because of its metallic and chemical characteristics. Manufacturing these products requires high technology and large investment which PNG cannot tackle in a short period.

2) Mineral Exploration

Commercially viable mines have already started developing or are under the process of extracting now. The government is exploring new mines with the help of foreign experts and developers but no

one can tell that we can start new mining projects when and where. Mining development has not been stipulated due to such unpredictable condition. Moreover, it will contribute to economic development but will not affect its becoming an industrial nation in the future.

(2) Fishery

Fishery is the one of leading industries of PNG next to mining business. The supply capacity of PNG fisheries zone accounts for about 10% in the world tuna market. In this connection, seven tuna canneries are in operation at Morobe Province and adjoining region, Madan Province. These canneries employ more than 30,000 workers in the area. Unfortunately, all these factories depend on foreign capital.

(3) Services

Among proposed investment by sector, construction, financial agents and manufacturing are the top three local investments in 2013 and mining follows. Construction seems booming in correspondence to the progress of urbanization and expansion of economic scale, and the sector will increase year by year. Unfortunately, like other industries, market share is almost dominated by foreign capitals. According to the IPA Lae office, local investment is focusing on the temp industry to dispatch simple labourers to the construction sites. In this regard, construction industry is not developed well.

Business climate of the manufacturing sector will be discussed more in detail in Chapter 10. Manufacturing sector is believed as a big provider to generate employment opportunity.

1) Retailing and wholesaling

Retailing and wholesaling is rapidly growing subsector in correspondence to the growth of consumer market as well as the expansion of the urban population. In the city of Lae, supermarkets have become leisure spots for citizens that can motivate people to participate in market economy and/or consumption life.

Most handle commodities except fresh foods are imports mainly from Australia, Indonesia, Singapore, Malaysia and China. Therefore, these supermarkets are not only retailers but also importers as well.

Retail prices, at a glance, look very expensive for the average income of the citizens. It is thought that an import-dependent market and exclusive market constitution cause this.

2) IT business

All kinds of information and telecommunication system have not well developed throughout the country and those are big constraints to link with the foreign market. Currently, though quality of services is not satisfactory, IT-business frame like mobile subscriber network within the country exists. Like other developing/growing countries, number of mobile telephone subscription is increasing rapidly as shown in the Table 3.2.1. But, IT business such as e-commerce nor e-payment system has not been born yet. It is thought that there are two reasons. One is small number of IT network users other than mobile phone subscribers. Second reason is high communication and internet charges. In this way, internet business environment has not grown up enough yet to start internet business for local market. However, POST PNG project has begun for targeting mainly overseas customers based on the idea generated by Prime Minister Peter O'Neil. A new website which offers PNG's postage stamps to world collectors has begun. This pilot project will be the cusp of e-business of PNG.

The following is the current IT subscription condition of PNG.

The number of fixed telephone subscribers is small in PNG and they are not well networked throughout the country due to geographical and demographic reasons. In this regard, mobile telecommunication systems have rapidly saturated in short period since being introduced to PNG. Mobile penetration was only 0.16% in 2000 and became 38% in 2012 while fixed telephones are 1.2% and 1.94% respectively during the same period, according to the Ministry of Information and Communication Service.

Table 3.2.1 IT subscriptions

Indicators	2000	2005	2008	2009	2010	2011	2012
Fixed telephone subscriptions per 100 inhabitants	1.12	1.05	1.02	1.36	1.77	1.85	1.94
Mobile telephone subscriptions per 100 inhabitants	0.16	1.23	13.35	21.15	27.84	34.22	37.78
Estimated internet users per 100 inhabitants	0.84	1.72	1.15	1.61	1.28	2.00	2.30

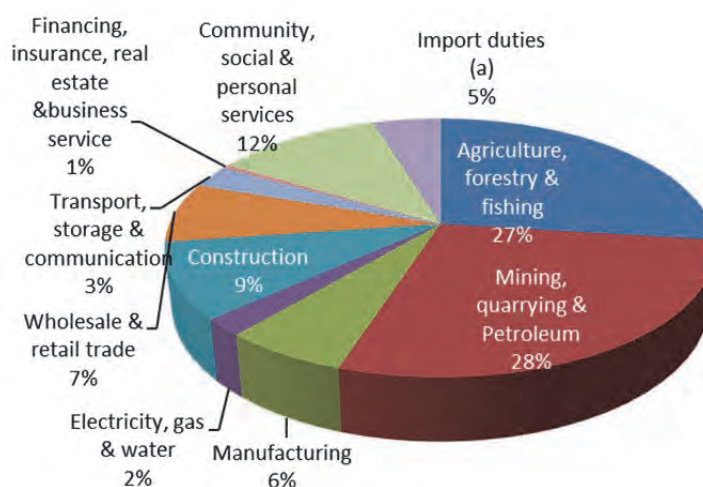
Source: International Telecommunication UNION statistics

As shown in the above table, the rate of mobile phone diffusion has grown rapidly. Telephone subscribers use SNS rather than make telephone calls because of the high calling rates. In addition, internet diffusion ratio accounted only for 2.3% in 2012.

Figure 3.2.1 shows the GDP shares of each industry in PNG. The two sectors of 1) agriculture, forestry & fishing and 2) mining, quarrying & petroleum account for 55%, indicating just how important they are to PNG. Compared to the composition in 2001 shown in Figure 3.2.2, there hasn't been much change and the industrial structure has largely remained unchanged.

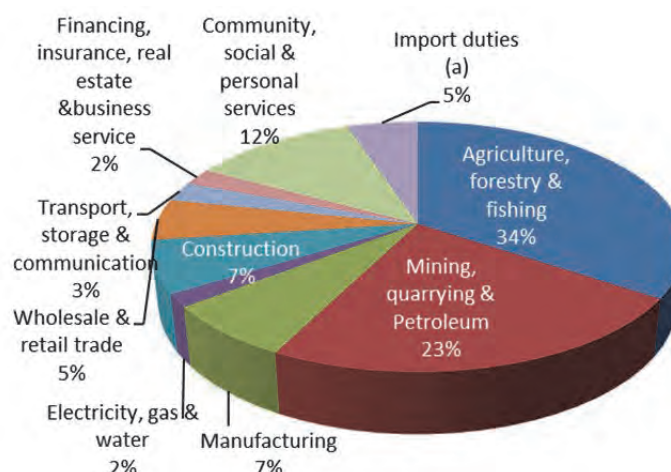
3.2.2 Industrial Structure

Figure 3.2.1 shows the GDP shares of each industry in PNG. The two sectors of 1) agriculture, forestry & fishing and 2) mining, quarrying & petroleum account for 55%, indicating just how important they are to PNG. Compared to the composition in 2001 shown in Figure 3.2.2, there hasn't been much change and the industrial structure has largely remained unchanged.



Source: National Statistical Office

Figure 3.2.1 Composition of GDP by Industry (2011)



Source: National Statistical Office

Figure 3.2.2 Composition of GDP by Industry (2001)

Table 3.2.2 shows the number and ratio of workers by industry. From this, the following characteristics can be gathered about the Project Area .

	Sectors that are small compared to those in whole of PNG.	Sectors that are large compared to those in whole of PNG.
Morobe Province		Mining and quarrying
Project Area	Agriculture, hunting and forestry	Manufacturing, construction, wholesale & retail trade, transport, storage & communications, real estates

Table 3.2.2 Employment Composition in PNG, Morobe Province and the Project Area

	Employment by Industry			Employment Composition (%)		
	Papua New Guinea	Morobe Province	Study Area	Papua New Guinea	Morobe Province	Project Area
Total	3,272,026	296,314	65,288	100.0%	100.0%	100.0%
Agriculture Hunting and Forestry	2,482,609	216,605	26,017	75.9%	73.1%	39.8%
Fishing	17,679	1,028	183	0.5%	0.3%	0.3%
Mining and Quarrying	24,743	7,277	420	0.8%	2.5%	0.6%
Manufacturing	25,243	4,154	3,446	0.8%	1.4%	5.3%
Electricity, Gas, Steam, and Hotwater	3,734	400	309	0.1%	0.1%	0.5%
Construction	64,147	6,407	4,231	2.0%	2.2%	6.5%
Wholesale, Retail, Repair of Motor Vehicle and Personal/Household Goods	359,223	33,464	12,281	11.0%	11.3%	18.8%
Hotel and Restaurants	6,511	522	443	0.2%	0.2%	0.7%
Transport Storage and Communications	38,952	4,059	2,978	1.2%	1.4%	4.6%
Financial Intermediation	4,931	340	300	0.2%	0.1%	0.5%
Real Estates Renting and Business Service Activities	54,830	6,480	5,362	1.7%	2.2%	8.2%
Others	189,424	15,578	9,317	5.8%	5.3%	14.3%

Source: National Statistical Office

Table 3.2.3 shows the composition of employment according to each municipality in the Project Area. In Labuta Rural and Nabak Rural, which are agriculture-based municipalities, almost 90% of workers are engaged in agriculture & forestry and the communities are almost completely self-sufficient. In the intermediate district of Wampar Rural also, agriculture & forestry accounts for almost 70% of employment. As for other features, manufacturing and construction account for high rates in Ahi Rural, and all urban industries such as manufacturing, construction, wholesale & retail trade, transport, real estate and others are prominent in Lae Urban.

Table 3.2.3 Employment Composition of each Municipality in the Project Area

	Employment by Industry			Employment Composition (%)		
	Papua New Guinea	Morobe Province	Study Area	Papua New Guinea	Morobe Province	Project Area
Total	3,272,026	296,314	65,288	100.0%	100.0%	100.0%
Agriculture Hunting and Forestry	2,482,609	216,605	26,017	75.9%	73.1%	39.8%
Fishing	17,679	1,028	183	0.5%	0.3%	0.3%
Mining and Quarrying	24,743	7,277	420	0.8%	2.5%	0.6%
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Real Estates Renting and Business Service	54,830	6,480	5,362	1.7%	2.2%	8.2%
Activities						
Others	189,424	15,578	9,317	5.8%	5.3%	14.3%

Continued.	Employment Composition (%)					
	Study Area	Wampar Rural	Ahi Rural	Lae Urban	Labuta Rural	Nabak Rural
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Agriculture Hunting and Forestry	39.8%	66.8%	35.2%	24.2%	86.9%	89.4%
Fishing	0.3%	0.7%	0.2%	0.1%	0.5%	0.2%
Mining And Quarrying	0.6%	0.5%	0.6%	0.8%	0.1%	0.1%
Manufacturing	5.3%	1.9%	7.4%	6.0%	0.9%	0.9%
Electricity Gas Steam And Hotwater	0.5%	0.1%	0.4%	0.7%	0.1%	0.0%
Construction	6.5%	3.0%	8.9%	7.0%	1.2%	1.0%
Whole sale & Retail Trade Sale & Repair	18.8%	12.7%	20.7%	22.0%	5.3%	5.2%
Motor Vehicle Personal & Household Goods						
Hotel & Restaurants	0.7%	0.2%	0.7%	1.0%	0.0%	0.0%
Transport Storage and Communications	4.6%	2.2%	4.8%	6.1%	0.7%	0.5%
Financial Intermediation	0.5%	0.1%	0.4%	0.8%	0.0%	0.0%
Real Estates Renting and Business Service	8.2%	5.2%	7.2%	11.3%	0.8%	0.2%
Activities						
Public Administration and Defence	2.8%	0.8%	2.2%	4.5%	0.5%	0.2%
Compulsory Social Security						
Education	3.7%	1.6%	3.5%	5.1%	1.4%	1.2%
Health	1.2%	0.3%	1.0%	1.8%	0.5%	0.2%
Other community Social and Personal Service	1.5%	0.5%	1.6%	2.0%	0.1%	0.3%
Activities						
Private Households with Employed Persons	1.2%	0.4%	1.3%	1.7%	0.1%	0.0%
Extra-Territorial Organizations and Bodies	4.0%	2.8%	4.3%	4.8%	0.9%	0.6%

Source: NSO (Note) The "Project Area" shows values for the entire administrative district including the target area.

Table 3.2.4 shows estimated GDP in 2011 in the Project Area. The figures have been obtained through calculating the industry-separate GDP per capita based on the overall GDP of PNG and industry-separate number of workers (see Table 3.1.1) and then multiplying the industry-separate number of workers in Morobe Province and the Project Area. In the Project Area, manufacturing accounts for the highest share of 23%. This is next followed by construction, social services, and mining & quarrying, and the top four sectors account for 69% of the overall GDP.

Table 3.2.4 GDP of the Project Area (2011, Estimates)

	Papua New Guinea				Morobe Province			Project Area		
	GDP (PGK million) (A)	Percent to GDP	Employment (persons) (B)	GDP per capita (PGK) (C) = (A) / (B)	Employment (persons) (D)	GDP (PGK million) (C) * (D)	Percent to GDP	Employment (persons) (E)	GDP (PGK million) (C) * (E)	Percent to GDP
Agriculture, Forestry and Fishing	6,978	27.0%	2,500,288	2,791	217,633	607,351	15.1%	26,200	73,118	7.7%
Mining, Quarrying and Petroleum	7,248	28.0%	24,743	292,926	7,277	2,131,623	53.1%	420	123,103	13.0%
Manufacturing	1,600	6.2%	25,243	63,387	4,154	263,310	6.6%	3,446	218,459	23.0%
Electricity, Gas and Water	542	2.1%	3,734	145,024	400	58,010	1.4%	309	44,766	4.7%
Construction	2,448	9.5%	64,147	38,159	6,407	244,483	6.1%	4,231	161,452	17.0%
Wholesale and Retail Trade	1,945	7.5%	365,734	5,317	33,986	180,718	4.5%	12,724	67,660	7.1%
Transport, Storage and Communication	717	2.8%	38,952	18,416	4,059	74,751	1.9%	2,978	54,848	5.8%
Financing, Insurance, Real Estate and Business Service	136	0.5%	59,761	2,278	6,820	15,533	0.4%	5,662	12,895	1.4%
Community, Social and Personal Services	3,022	11.7%	189,424	15,952	15,578	248,501	6.2%	9,317	148,626	15.6%
Others	1,222	4.7%	-	-	-	189,768	4.7%	-	44,904	4.7%
Total	25,857	100.0%	3,272,026	-	296,314	4,014,050	100.0%	65,288	949,831	100.0%

Source: Prepared by the JICA Study Team based on data from the National Statistical Office.

3.2.3 Overview of Business Climate identified through Interview Survey

Interview survey to 27 leading manufacturing companies registered to Lae Chamber of Commerce was conducted so as to identify business environment as well as the structure of industry at the Project site (refer to the summary table below).

Now, total of 34 companies are listed in LCC in manufacturing sector and thus interview survey covered almost 80% of leading manufacturers of the target site. Over 90% of those are categorized into light industry and 79% are foreign shareholding companies.

Table 3.2.5 Summary of Companies Visited

	COMPANIES	Subsector	Established year	No. of employees	Shareholder country	Market demand	Subcontract out/local procure	Current market	Constraints
1	Company A	Light Industry (food)	1994, 1997(ope ration)	1050 (Peak time=3000)	Foreign	Stable but dominated by imports	No subcontract out	Tuna: foreign, Mackereel: local	High power & water tariff, high manpower cost, security cost
2	Company B	Light Industry (food)	1975	350 (PNG total: 500)	Foreign	Increasing	Package and film	Local	Quality of engineer (esp. electrical)
3	Company C	Light Industry (food)	1939	300	PNG	High demand	Label printing, packaging is done in-house	Local	Power inconsistency and high power tariff
4	Company D	Light Industry (food)	1952	160	Foreign 75% and PNG25%	High demand	Printing is done in Australia. Colgate paper and logistics is local	Local, partly pacific islands	Power inconsistency, sewage, water & power tariff, export & import tariff
5	Company E	Light industry	1987	75 or 25	Foreign	High demand	printing	Local	Power inconsistency, power tariff, internet / telephone connection
6	Company F	Light Industry (food)	1946	100(1000: Whole PNG)	PNG	Stable	Carton box (feeds from local supplier but imported)	Local, Asian countries	Power inconsistency, road condition, quality and number of engineers, management capability
7	Company G	Chemical industry	1972	750 (50 expatriates)	Foreign	High demand but competition become severe	All imports	Local	Exchange rate, inconsistency of power
8	Company H	Light Industry (food)	1970	800 (total in PNG1031)	Foreign 70%, PNG 30%	High demand	only logistics	Local	Road condition
9	Company I	Light industry, construction	1995	70 to 80	Foreign	demand stable but competition becomes severe	No, raw materials :Taiheiyo Cement	Local	High raw material cost, Inconsistency of power
10	Company J	Light Industry (food)	1975	540 (11 expats)	Local and foreign	growing rapidly and increasing by 20%/year	No subcontract, 80% raw materials local, others: Belgium, Aus)	Local	Power inconsistency, road condition, export/import tariff

	COMPANIES	Subsector	Established year	No. of employees	Shareholder country	Market demand	Subcontract out/ local procure	Current market	Constraints
11	Company K	Light Industry	1972	110	Foreign	slightly growing	No subcontract except logistics, Import: cartons & foams import, other auxiliary parts, Local: timber	Local	Power tariff, power inconsistency, exchange rate
12	Company L	Metalworking, construction	1972	260 (8 expats)	Foreign	stable but not increasing	No subcontract out, raw materials import	Local	Exchange rate, less public work project like LNG construction
13	Company M	Light Industry (Chemical)	Not available	87 (5 expats)	Foreign	not available	Container and drum can procure locally, others import	Local	Not available
14	Company N	Metalworking, construction	1972	50	PNG/Foreign joint	High demand but competition become severe	No subcontract but logistics, all import	Local	Exchange rate because of import raw materials
15	Company O	Light Industry (food)	1998	2048	Foreign	Constant but competition is severe	Machinery repairing	98% Europe and Japan	Security
16	Company P	Light Industry	2000	150	Foreign	High demand	Simple repair work	Local	Power inconsistency
17	Company Q	Light industry	1965	Lae: 105 (150 PNG)	Foreign	Increasing	Mechanical, electrical maintenance,	Local	Power inconsistency, exchange rate, road condition
18	Company R	Light Industry	about 30y ago(1985)	106	Foreign 40%, PNG 60%	Decreased after LNG project but almost stable	No subcontract, Raw materials from Malaysia and Australia	Local	Import tariff, Logistics, Inconsistency of utilities
19	Company S	Light Industry	1996	20	Foreign	Stable	No	Local	Exchange rate, security, utilities
20	Company T	Light Industry (food)	1969	692	Australia	Stable	No	Local	Roads, power, water

	COMPANIES	Subsector	Established year	No. of employees	Shareholder country	Market demand	Subcontract out/ local procure	Current market	Constraints
21	Company U	Food processing	1986	361	Australia	Stable	No	Local	Power, water, exchange rate
22	Company V	Light industry, construction	1974	500	Foreign	High demand	No	Local	Land acquisition to expand, customs, logistics
23	Company W	Light Industry	2012	200	Foreign 60%, PNG 40%	High demand	No	Local	Power consistency, slow and unstable network
24	Company X	Light Industry	1986	125	Australia	Stable	No	Local	Power, water, communications
25	Company Y	Light Industry (food)	1977	200	Foreign	High demand	No subcontract out, raw materials import from Aus & Nz, and PNG	Local market and partly Vanuatu and Singapore	Power consistency, water sewage
26	Company Z	Light Industry	1977	120	Foreign	High demand but competition is high	No subcontract out, Local procurement: Carton box Import: steel, ferrous	Local	Power inconsistency, exchange rate, slow public services, competitors lower prices
27	Company AA	Light Industry	1950	1500	Foreign	Steadily increasing	No subcontract out except logistics	Export, Local	Logistics

Source: JICA Project Team

Other important findings through the site survey are enumerated as follows.

(1) General features of industry through the interview survey

- 80% of the companies visited are large scale³ in terms of PNG's definition.
- 75% companies target only local market.
- Majority of companies are categorized as light industry.
- There are no assembling companies.
- Manufacturers targeting after-sales market are not seen.
- Linkage among companies is not functioning.
- Subcontracting is not popular and companies handle almost all processes in-house or rely on imports. In this regards, supporting business is not well developed.
- Local Colgate paper and carton box is comparably welcomed by manufacturers while low quality.
- Tin cans had been manufactured in-house or imported until last year. A new and independent tin can manufacturer started commercial operation last year to provide low price products for food manufacturers freely.
- Local market categorizes as seller's market because single or a few manufactures control it.
- High cost and inconsistent public utility services cause the cost hike for manufacturers.
- Security conditions also cause the cost hike for businesses.
- Manufacturers use imports because there is no local supplier/manufacturer or local supporting materials to meet requirement in terms of cost and quality. This means that supporting business, industrial framework in other words, has not developed in the region.

(2) Industrial development and SME promotion measures

- The government has just launched SME policy and Master Plan in February 2016.
- Small Business Development Corporation (SBDC) was established in 1992 based on SBDC Act in 1990.
- SBDC is the only one public service opened for SME promotion though it is not available in Lae City though Lae is the centre of industry of PNG.
- Definition of SMEs is not statutorily stipulated, thereby meticulous supports are not provided.
- Micro financing program is available to SME to support business start-up and operational expenses. However, as summarized at the end of the Chapter 3⁽ⁱ⁾, microfinance program is not helpful to minor businesses in terms of its condition (amount, interest, collateral, term). Practically, 15 small scale companies out of 15 visited for interview survey did not apply for micro finances due to its condition. NARI, UNITECH, vocational schools are keen to assist new business start-ups as well as to provide technical support. Unfortunately, there is no matching system now.
- Municipal governments have developed industrial parks to promote manufacturers. This promotion measure is a little help to industry since land acquisition has been the most serious constraint for new businesses in PNG.
- Investors are not receiving merits from the industrial park other than availability of land. Utility supply and other practical incentives, which are the standard incentives to attract investors into the estate, are not provided.

³ Definition of SMEs:

There is no definite demarcation duly stipulated by the government. In this regard, the following definition was provided by Lae Chamber of Commerce. Each number indicates employed workers of one company.

Micro: 1-9, Small: 10-49, Medium 50 – 99, Large: 100 <

(3) Public services on industrial development

- On both provincial and city levels, there is no one or no division who can dedicate to industrial development.
- Accordingly, following-up of “Lae-District 5 Year Development Plan 2013-2017” (5year plan) and” Lae-Nadzab Urban Development Plan 2005- 2015” has been left behind the routine work.
- Technically, UNITECH and NARI is the only channel who can support private sectors.

3.2.4 Position of Manufacturing Industry of Lae-Nadzab Area in PNG

The following section summarizes the condition and position of industry in the target Project Area based on the result of survey and, thereby, the future prospects.

(1) Leading industry

Figure 3.2.1 and Figure 3.2.2 of section 3.2 give definite information about economic tow truck in terms of share of GDP. Comparison of the two figures suggests that “mining, quarrying & petroleum” increases its importance in terms of share of GDP. The industry, without any doubt, can contribute significantly to expand PNG’s economy⁴.

Contrarily, manufacturing had lost its market share. Manufacturing is one of the most important industries for a country to assure sustainable development. And Lae-Nadzab region is the home of industry of the country. This means that the region hosts the most important and large manufacturing businesses in the country as partly introduced in Table 3.2.5.

Among various industrial sectors, fishery, agro-based processing, woodworking, light industry including engineering services (maintenance and repair) are the leading and promising ones which have been supporting the name of “home of industry” to Morobe Province. The strength of these subsectors in terms of business environment is as follows.

Fishery is PNG’s leading industry. Majority of high commercial value fish, tuna, are discharged from catch boats at the region and neighbouring city and then, transferred to cannery in the region for processing. As of April 2016, fish cannery employs about 5,000 workers in the region. And the employment scale will be quadruplicate by the end of 2016⁵, Morobe Fishery Authority explained.

According to the interview survey, local market-oriented cannery businesses are suffering from severe market competition with imports. And this is one of the reasons the cannery business is not able to grow properly or is left behind from rapid growth. Nevertheless, exports to Euro-American market from PNG won a certain market share because of the preferential treatment.

North to west sea area of New Britain Island of PNG is believed to be the last rich fishing ground of the world and the share of tuna supply from the ground accounted for about 13% of the world total. From these facts, Lae-Nadzab region is recognized as the most important region of the country in tuna processing today and future as well. Regardless of the circumstances, fish processing business does not well contribute to growth of GDP. As indicated at the foot note, scale of employment of the cannery in the end of 2016 will reach 7% in the whole province.

Agriculture, forestry and fishing is the second largest industry group after mining. Agriculture and forestry is popular all over the country but is not thriving with respect to the number of engaged persons. This phenomenon is the same in Morobe as well. Definitely, GDP per capita of this industry group is about 25 times smaller than the manufacturing group (see Table 3.2.4). Majority of them do farming on a subsistence basis. Commercialization of agriculture is not popular to small scale farmers. Morobe is a fertile region and has a big opportunity to develop food processing

⁴ From the viewpoint of sustainable development of the country, we cannot be so reluctant about the expansion of mining sector. Since, exploration, development, commercial operation and development of supporting industry has been fully relied on foreign investment and no useful technology had been incubated or transferred into PNG. Mining industry in PNG means just prostitution of natural resource until a commodity will be sold out.

⁵ Result of interview at Morobe Fishery Authority

businesses using abundant agricultural crops⁶. It is clearly reported on the International Journal of Innovative Research in Science & Engineering (IJIRSE) ISSN (online) 2347-3207 by UNITEC that fertile arable land extends from north of Yalu region through north edge of Tidal Basin along by Markham River. This arable land will be appropriate to grow rice, the report indicates.

As for the manufacturing industry in Morobe and the Project Area, total number of employment in manufacturing in all of PNG, Morobe Province and the Project Area is 25,243, 4,154 and 3,446⁷ respectively shown in Table 3.2.2. Considering that Morobe Province is the home of industry, the share of employment in Morobe and the Project Area against whole PNG is just 16.4% and 13.6% respectively⁸. However, it seems that more workers are engaging in manufacturing. Number of business establishments in this subsector is much more than what PNG officials estimate. Private businesses are reluctant to register their commercial activity to government. As noted as the home of industry, Morobe Province, especially Lae City boasts of number and variety of manufacturing businesses and it organizes an industrial agglomeration as a whole.

(2) Strength of businesses in Morobe and the Project Area

1) Location of the area

In spite of efforts to evaluate the productivity of target region in comparison with the whole nation, only whole sector-wise GDP and number of employed persons in major areas of the country are obtained as shown in Table 3.2.4. The data in the table suggests only a value of GDP based on the proportional calculation in relation to the scale of employment since specific data provided directly from the target region, Morobe and the Project Area, were not given. In this regard, actual features of industrial strength at Morobe and the Project Area based on GDP per capita were not identified. However, from the logistic point of view, Morobe and the Project Area are strategically located. It is a hub of transportation/distribution connecting with islands, highlands, and overseas. It has the largest sea port in the country and the port is the main entrance of PNG for imports and exports. For this reason, Taiheiyo Cement, Nestle, Colgate and other international branded companies operate in Lae.

For instance, one of large food processing company has two strategic production/supply centres to cover all local market. One is in Lae and another is in Port Moresby. Lae centre can cover 70% of local market and remaining 30% is supplied from Port Moresby. Thus, Lae is in an advantageous location in terms of distribution.

2) Raw materials availability

As discussed in the above clause, the area is advantageous for running manufacturing business in terms of accessibility to raw materials. It is advantageous for obtaining not only local raw materials but also imports as a determinant for manufacturers operating in the area. Especially, biological resources are abundant in the region. Utilizing the business climate especially rich resources, various national brand manufacturers (the most famous in and/or leading company) like Table bird, TRUKAI, Frabel food, Main Land HDS, etc. operate here.

◆ Woods and woodworking

⁶ If developing a commercialization framework like unionization of small farmers and developing efficient crop collection system is attained, productivity of agriculture as well as bridge developing between agriculture and manufacturing (food processing) will be realized and thus spur a momentum of economic growth of the region.

⁷ This statistical number is smaller than actual number of employed persons collected at interview survey. In this regard, it is assumed that employment at cannery may be included in other category such as “Agriculture Hunting and Forestry” or a number of companies seem to have been reluctant to register its commercial operation officially.

⁸ The data in statistics may be sourced from IPA’s business registration. However, there is a significant gap between direct interview survey by JICA survey team and IPA’s. We consider that there are many businesses operating without registering to IPA. The scale of employment in manufacturing industry in Morobe Province may be two times bigger than the statistical data.

For wood processing firms, this is one of the best possible areas. In northwest mountainous area, there are PNG's oldest afforested mountains. And, wide mountain districts from north to west of the Project Area are famous for producing good quality and valuable wood. Wood is delivered to Lae City for primary processing into timbers and so on. There are several timber processing works inside Lae City headed by Timber College under UNITEC. The college provides both academic and commercial services to privates. Not only inland origin logs but also island origin logs and timbers are delivered to the city for initial processing. Majority of timbers and semi-processed wood have been shipped out for export market. There are a few wood working companies manufacturing final products such as furniture and housing exteriors. Biggest company is established by foreign capital and it manufactures for overseas market targeting market taste design. All the process of the company complete in-house so that no economic and technical effect spin-off to the supporting industry.

◆ Agriculture based products

Highland and Lae suburbs are famous for vegetable cultivation and these crops are delivered to nation's second largest market, Lae. Also, Lae citizens are able to enjoy various fruits throughout the year from the adjacent regions. Melon, mango, banana, nuts, sweet potato, jackfruits, and so on are the typical fruits popularly seen in the city. In addition to those commercially available products, there are abundant agro-products produced outside of distribution framework (crop for subsistence). The current constraint for industrialization of agro-products is small scale food processing industry and lack of developing system.

Rice growing is booming in PNG with respect to taste and long lasting shelf life. Rice is almost replacing traditional and daily staple foods such as Sago, Yam and Taro. In addition, post harvesting process can be more easily commercialized than for ordinal staple foods due to long storage life. It will be discussed more in detail at other chapter, however, it will generate big job opportunity to Lae if rice growing and its relating industry are promoted.

Coffee is a second largest agricultural export after oil palm. Coffee production in PNG accounts for around 1% of world total today and Highland province is the production centre of the country. Share of coffee production of the Project Area is not big. It has succeeded in challenging business model by unionizing small farmers into one commercial organization. This business model will be a good example to generate more commercial bodies by utilizing abundant biological resources and involve people who are outside of monetized economy.

◆ Marine products

Papua New Guinea is proud of its abundant aqua fisheries from off-shore sailing fish, inshore bottom fish, invertebrate, brackish water fish, inland and river fish. Among these extensive and valuable fisheries, tuna is the most important export orient item. Lae is the centre of tuna cannery in the country and is expanding its manufacturing scale now. In Malahang industrial park, three foreign capital canneries are going to start commercial operation and are going to employ around 10,000 new workers at new canneries shortly. At the same time, one Japanese dried bonitos (Katsuo-bushi) manufacturer is expecting to invest in the area due to accessibility of quality and cheap raw materials (smoking wood and tuna). All of these are at a comparative advantage to boost and strengthen fishery and its supporting industry derived from the current business environment.

3) Local market

Population of Lae City is expanding year by year and it is increasing its position as an industrial city. Corresponding to the growth, need for new business is growing. Motorization is in progress but supply side is not able to correspond the needs of maintenance, repair and parts supply for after-sales market. Since beginning of 2016, small-scale automotive parts suppliers run by Chinese migrants targeting after-sales market are booming in the suburbs of Lae City. This is the one of significant evidence of growing motorization of the area. The current constraints for enhancing new businesses in the area is lack of public support for both new investment incubation and practical promotion measures.

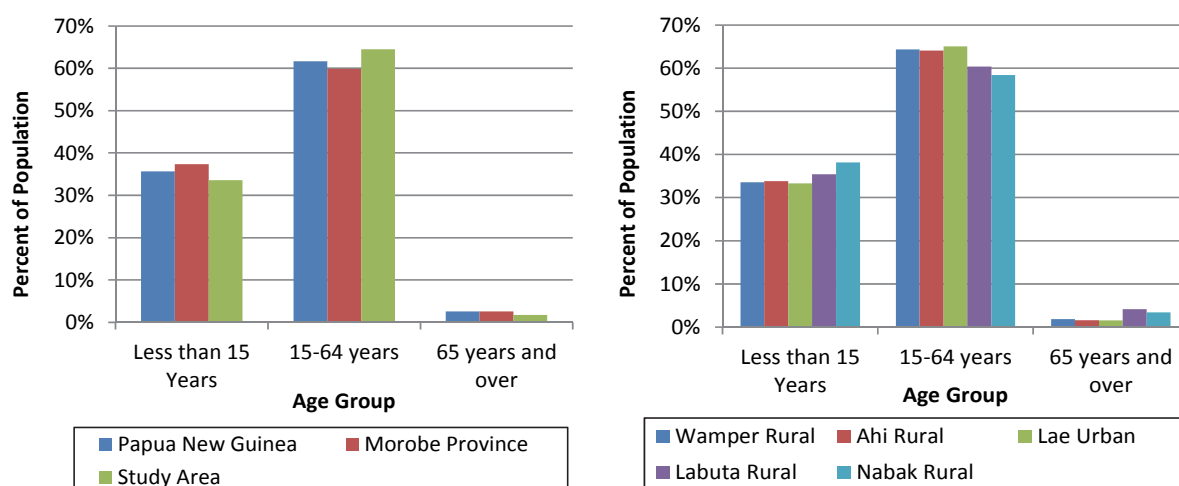
4) Divisional cooperation

Numbers and varieties of business establishment are abundant in the area. Companies in the area have preferable business opportunity than other areas in obtaining market competitiveness in terms of developing inter-business networking. However, subcontracting business and horizontal and vertical labour specialization are not popular in the area nor all over the country. Rather, companies seem to thrive on market monopolization. This business style causes the seller's market (high retailing price) but lowers market competitiveness in the export market. Also, this is one of the important reasons why small-scale businesses do not grow with respect to number of employees, level of skill and financial strength.

Another business climate weakness is lack of practical industrial promotion measures and no official body to administrate or superintendent it. Definitely, there is no special administrative division of industry promotion and no officials who are specializing in industry development.

3.3 Employment

Looking at the age group-separate population of the Project Area in comparison to all of PNG and Morobe Province, as is shown in Figure 3.3.1, the share of population in the so-called productive age group of 15~64 is comparatively high. Moreover, looking at the age group-separate population of each administrative area of local level government (LLG), the share of population in the productive age group is comparatively higher in Lae Urban and two neighbouring municipalities (Ahi Rural and part of Wampar Rural) (combined, these three municipalities are referred to as Lae City in LNUDP 2005-2015). From this it can be noted that the advance of urbanization is triggering a migration of the productive age group population from outlying rural areas to the cities in search of employment opportunities.



Source: National Population Census (National Statistical Office)

Figure 3.3.1 Population Composition by Age Group

Meanwhile, looking at the rate of labour force (employable population; people aged 10 years and over are regarded as the labour force in PNG) according to each LLG, compared to productive age group population shown in Figure 3.3.1, the rate of the labour force is comparatively lower in the three LLGs of advancing urbanization indicated above (see also Table 3.1.1). This is explained by the fact that the large portion of people who are engaged in subsistence farming in the rural areas are also included in the labour force. This also accounts for low unemployment levels in the rural areas. On the other hand, the unemployment rate is high in Lae Urban and Ahi Rural, indicating that many of the people who move to the city from the countryside in search of work are unable to find employment.

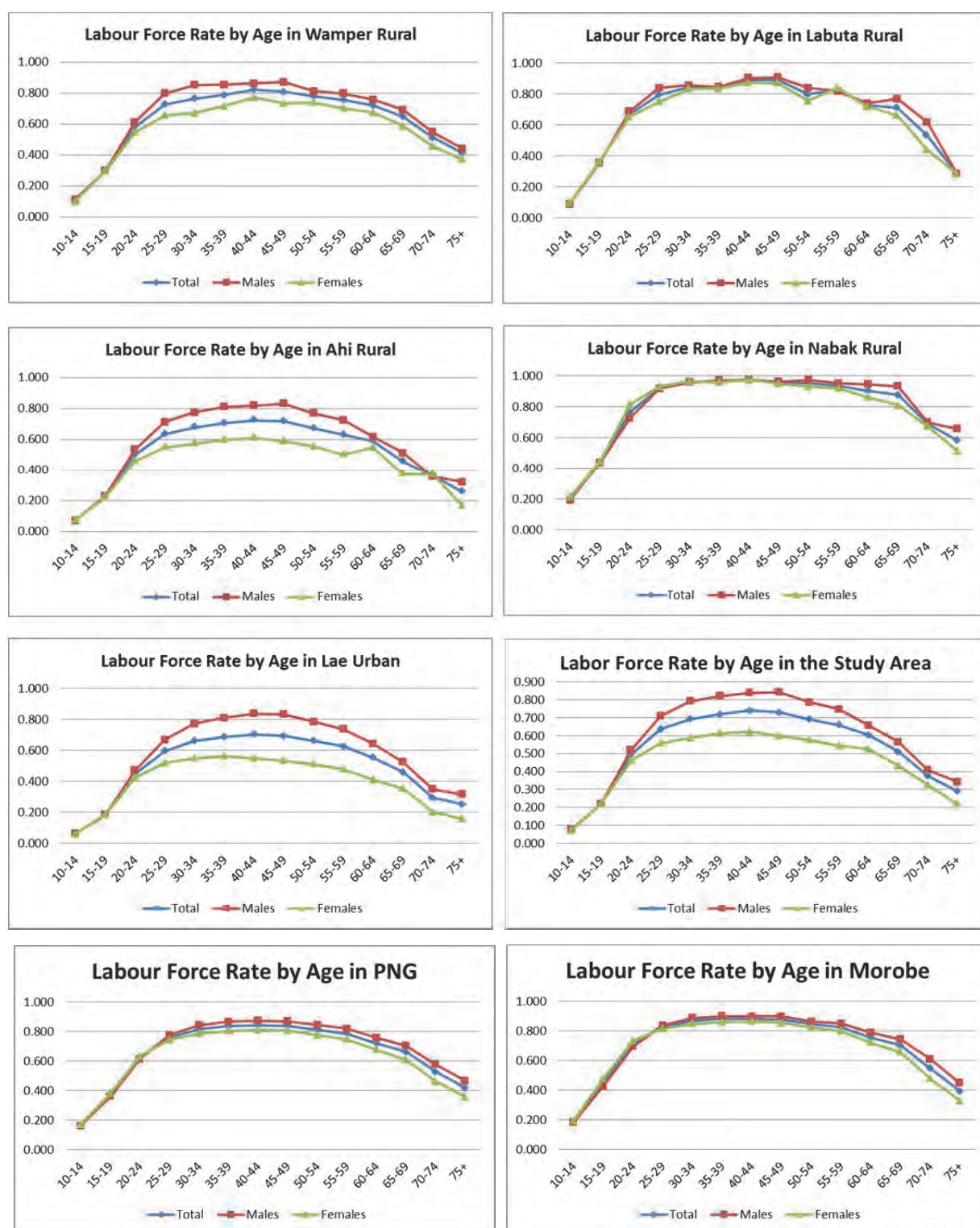
Figure 3.3.2 shows the age-group separate rates of employed population. On comparing the Project Area with PNG and Morobe Province, it can be observed that there is a disparity between males and females in terms of the employment rate. The reason for this can be clearly discerned by taking a look at LLG-separate population trends in the Project Area. In other words, the rural areas (Labuta Rural, Nabak Rural) and urban areas (Lae Urban, Ahi Rural) display clearly different trends. The

overall employment rate is high in the rural areas but low in urban areas, reflecting the fact that more people are engaged in agricultural work in the rural parts. Another point is that gender disparities can be seen in urban areas, with the employment rate lower among females. In cities, where many people are employed in non-agricultural sectors, this is thought to be because there are more employment opportunities for males. Incidentally, Wampar Rural displays intermediate characteristics between the rural areas and urban areas.

Table 3.3.1 Labour Force and Unemployment

	Population Aged 10 Years and Over	Labour Force	Employed	Unemployed	Not Economically Active	Others	Not Stated
Papua New Guinea	5,465,613	3,342,833	3,255,151	87,682	1,928,170	177,738	16,872
Morobe Province	374,044	247,390	243,994	3,396	115,133	11,014	507
Wampar Rural	27,059	16,121	15,345	776	9,756	1,112	70
Ahi Rural	45,767	22,665	20,384	2,281	21,615	1,368	119
Lae Urban	67,318	31,016	27,054	3,962	33,781	2,418	103
Labuta Rural	3,092	1,945	1,920	25	989	154	4
Nabak Rural	401	289	288	1	107	4	1
Total	143,637	72,036	64,991	7,045	66,248	5,056	297
Papua New Guinea	100.0%	61.2%	59.6%	1.6%	35.3%	3.3%	0.3%
Morobe Province	100.0%	66.1%	65.2%	0.9%	30.8%	2.9%	0.1%
Wampar Rural	100.0%	59.6%	56.7%	2.9%	36.1%	4.1%	0.3%
Ahi Rural	100.0%	49.5%	44.5%	5.0%	47.2%	3.0%	0.3%
Lae Urban	100.0%	46.1%	40.2%	5.9%	50.2%	3.6%	0.2%
Labuta Rural	100.0%	62.9%	62.1%	0.8%	32.0%	5.0%	0.1%
Nabak Rural	100.0%	72.1%	71.8%	0.3%	26.8%	0.9%	0.2%
Total	100.0%	50.2%	45.2%	4.9%	46.1%	3.5%	0.2%

Source: National Statistical Office



Source: National Population Census (National Statistical Office)

Figure 3.3.2 Employment Ratio by Age

ⁱ Summary of microfinancing program available for small businesses :

There are two microfinancing sources available in Lae:

1. PNG Microfinance Ltd (PML) is Papua New Guinea's first microfinance institution established in 2004. PML serves customers in the informal sector, small business and is the provider of financial service in many parts of Papua New Guinea. This is a second tier financing service institution under Central Bank of Papua New Guinea. Following is the summary of microfinancing program of PML.

Loan products	Loan condition			
1. General loan	not specified			
2. Fishery loan		Micro	Small	Business
	Amount Min	1,000	51,000	501,000
	(Kina) Max	50,000	500,000	1,500,000
	Term	12-24 m	36 months	84 months
	Interest	6.5%		
3. Tourism loan		Start-up	Successfully managed	Up-scale
	Amount Min	10,000	51,000	201,000
	(Kina) Max	50,000	200,000	500,000
	Term	12 months to 5 years		
	Interest	6.5%		
4. Women in Textile loan	Amount Min	1,000		
	(Kina) Max	100,000		
	Term	3 months to 5 years		
	Interest	6.5%		
5. Co-operatives loan		Pilot	Enterprise	Business
	Amount Min	1,000	20,000	100,000
	(Kina) Max	20,000	100,000	1,000,000
	Term	12 - 36 m	5 years	10 years
	Interest	6.5%		
6. Women in Business loan		Start-up	Grower	
	Amount Min	1,000	100,000	
	(Kina) Max	100,000		
	Term	2 - 15 y	2 - 20 y	
	Interest	6.5%		

2. PNG Microfinancing Ltd (PML).

PML is Papua New Guinea's first microfinance institution established in 2004. PML serves customers in the informal sector, small business and is the provider of financial service in many parts of Papua New Guinea.

Loan products	Loan condition		
1. Micro loan	Amount	Min	1,000
		Max	15,000
	Term	Months	Max. 12
	Collateral	100% of loan amount	
	Interest	% yearly	depend on business cycle
2. Wanbel loan	Women group		
	Amount		300 - 10,000
	Term	Months	12
	Collateral	Cash deposit of 50% equity	
	Interest	% yearly	36
3 SME loan	Amount	Min	15,001
		Max	250,000
	Term	Months	36
	Collateral	Joint liability, 100% of loan	
	Interest	% yearly	24

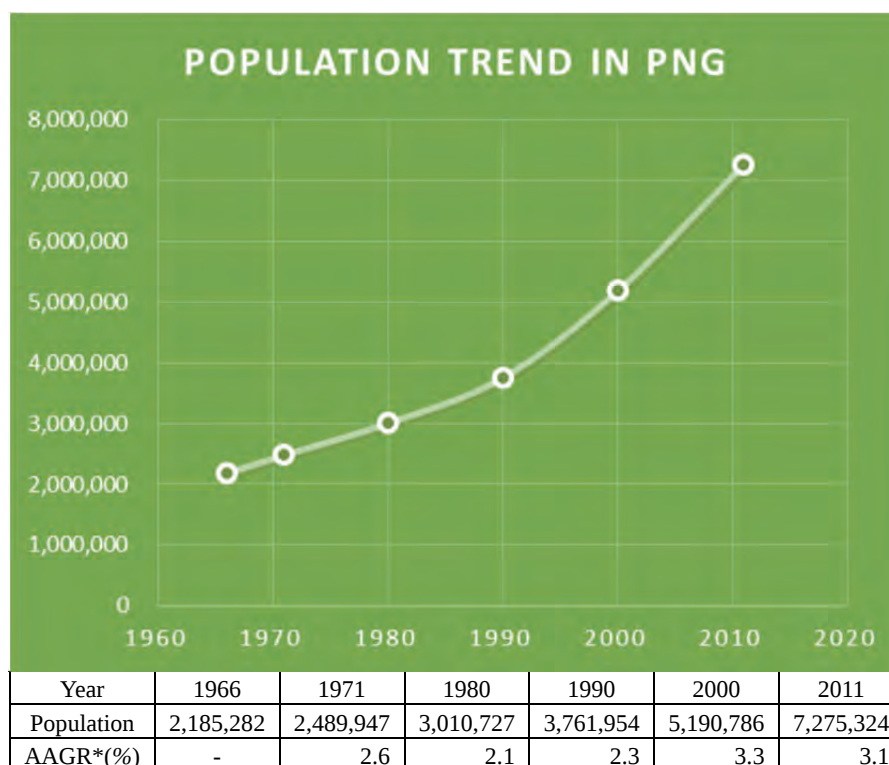
Remark: Wanbel loan is a short to medium term working capital loan to mothers in groups of 4-6 members who are engaged in multiple income generating activities that are already established.

Fund source: IFC

CHAPTER 4 SOCIAL CHARACTERISTICS

4.1 Population

According to the national population census of 2011, the population of PNG is approximately 7.3 million. Looking at changes compared to past censuses, population increased at a rate of around 2% per year up to 1990, but the rate increased to more than 3% from 1990 onwards.



*: Annual Average Growth Rate

Source: Prepared by the Study Team based on national population censuses

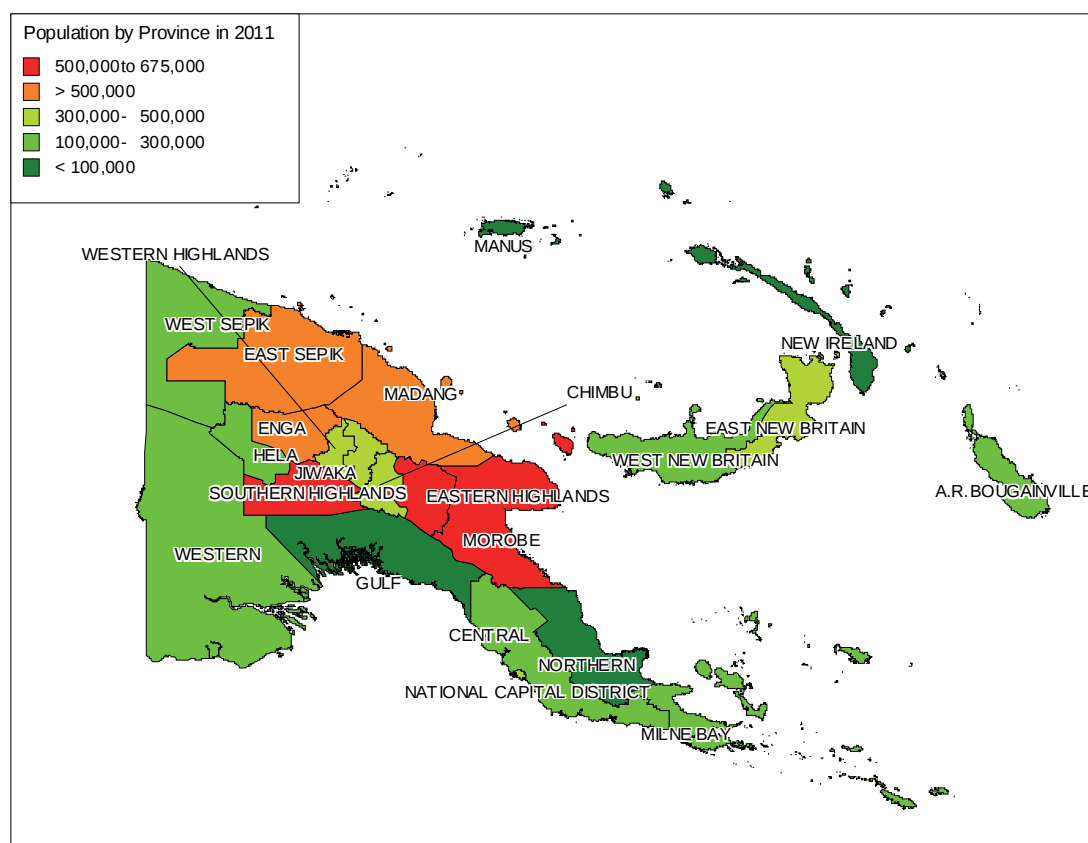
Figure 4.1.1 Changes in Population of PNG

Moreover, according to Table 4.1.1 and Figure 4.1.2, which show the population by province, Morobe Province including the Project Area had a population of approximately 675,000 in 2011, making it the most populous province in the country with approximately 9% of the overall population. Moreover, according to Table 4.1.1 and Figure 4.1.3, which show the rate of population increase after 1980, the rate of increase in Morobe Province is less than the national average, while it is higher in the highlands, islands and National Capital District.

Table 4.1.1 Changes in Population in each Province of PNG

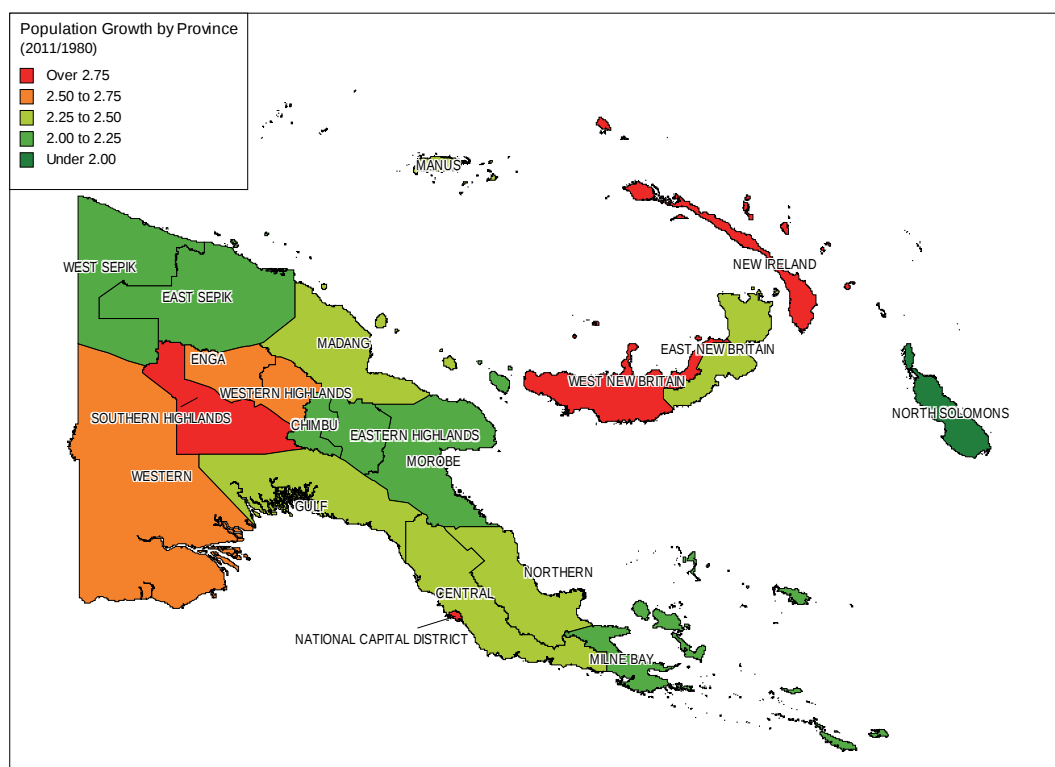
PROVINCE	Population				Annual Average Growth Rate (%)				Share of Each Province (%)			
	1980	1990	2000	2011	1980-1990	1990-2000	2000-2011	1980-2011	1980	1990	2000	2011
Western	78,575	110,420	153,304	201,351	3.5	3.3	2.5	3.1	2.6	2.9	3.0	2.8
Gulf	64,120	68,737	106,898	158,197	0.7	4.5	3.6	3.0	2.1	1.8	2.1	2.2
Central	116,964	141,195	183,983	269,756	1.9	2.7	3.5	2.7	3.9	3.8	3.5	3.7
National Capital District	123,624	195,570	254,158	364,125	4.7	2.7	3.3	3.5	4.1	5.2	4.9	5.0
Milne Bay	127,975	158,780	210,412	276,512	2.2	2.9	2.5	2.5	4.3	4.2	4.1	3.8
Northern	77,442	96,491	133,065	186,309	2.2	3.3	3.1	2.9	2.6	2.6	2.6	2.6
Southern Highlands	236,052	317,437	360,318	510,245	3.0	5.6	3.2	3.8	7.8	8.4	6.9	7.0
Hela	na	na	185,947	249,449	-	5.6	2.7	3.8	-	-	3.6	3.4
Enga	164,534	235,561	295,031	432,045	3.7	2.3	3.5	3.2	5.5	6.3	5.7	5.9
Western Highlands	265,656	336,178	254,227	362,850	2.4	2.7	3.3	3.2	8.8	8.9	4.9	5.0
Jiwaka	na	na	185,798	343,987	-	2.7	5.8	3.2	-	-	3.6	4.7
Chimbu	178,290	183,849	259,703	376,473	0.3	3.5	3.4	2.4	5.9	4.9	5.0	5.2
Easter Highlands	276,726	300,648	432,972	579,825	0.8	3.7	2.7	2.4	9.2	8.0	8.3	8.0
Morobe	310,622	380,117	539,404	674,810	2.0	3.6	2.1	2.5	10.3	10.1	10.4	9.3
Madang	211,069	253,195	365,106	493,906	1.8	3.7	2.8	2.8	7.0	6.7	7.0	6.8
East Sepik	221,890	254,371	343,181	450,530	1.4	3.0	2.5	2.3	7.4	6.8	6.6	6.2
West Sepik	114,192	139,917	185,741	248,411	2.1	2.9	2.7	2.5	3.8	3.7	3.6	3.4
Manus	26,036	32,840	43,387	60,485	2.3	2.8	3.1	2.8	0.9	0.9	0.8	0.8
New Ireland	66,028	86,999	118,350	194,067	2.8	3.1	4.6	3.5	2.2	2.3	2.3	2.7
East New Britain	133,197	185,459	220,133	328,369	3.4	1.7	3.7	3.0	4.4	4.9	4.2	4.5
West New Britain	88,941	130,190	184,508	264,264	3.9	3.5	3.3	3.6	3.0	3.5	3.6	3.6
Atonomous RB	128,794	154,000	175,160	249,358	1.8	1.3	3.3	2.2	4.3	4.1	3.4	3.4
TOTAL	3,010,727	3,761,954	5,190,786	7,275,324	2.3	3.3	3.1	2.9	100.0	100.0	100.0	100.0

Source: National Statistical Office



Source: PNG Census 2011

Figure 4.1.2 PNG Population Distribution (2011 Census)



Source: PNG Census 2011

Figure 4.1.3 Changes in PNG Population (2011/1980)

Moreover, according to Table 4.1.2, which shows the population of the Project Area, it was approximately 190,000 in 2011, accounting for 2.6% of the national population and 28% of the population of Morobe Province. The average rate of increase since 2000 has been 2.4% p.a. Moreover, this area has approximately 30,000 resident households, with each household containing 6.17 people on average, which is far higher than the average household size for Morobe Province as a whole (5.19 people/household). In terms of each LLG, household sizes are large in Ahi Rural, Lae Urban, Nabak Rural and so on. Concerning the reasons why, the main factors are considered to be the existence of urban high-density residential areas (Low Cost Residential) in Ahi Rural and Lae Urban, and the traditional structure of large-family communities in Nabak Rural.

Table 4.1.2 Project Area Population

LLG	Population (persons)			Household (households)			Average Size of Household (persons/household)			Population Density (persons/km ²)	
	2000	2011	AAGR	2000	2011	AAGR	2000	2011	Growth Rate (2000=1.00)	2000	2011
Wampar Rural	24,758	35,861	3.4%	4,392	7,923	5.5%	5.64	4.53	0.80	31.9	46.2
Ahi Rural	40,486	60,326	3.7%	6,601	9,523	3.4%	6.13	6.33	1.03	463.2	690.2
Lae Urban	78,692	88,608	1.1%	11,791	12,378	0.4%	6.67	7.16	1.07	1,813.6	2,042.1
Labuta Rural	2,151	4,100	6.0%	347	788	7.7%	6.20	5.20	0.84	37.1	70.7
Nabak Rural	298	542	5.6%	42	78	5.8%	7.10	6.95	0.98	4.5	8.1
Total	146,385	189,437	2.4%	23,173	30,690	2.6%	6.32	6.17	0.98	141.8	183.5

Source: National Statistical Office

(1) Status of Current Migration in the Project Area

The distribution of birthplaces of local residents in the Project Area of five (5) LLGs has been analysed based on the census data; especially addresses differing from the current living addresses were checked.

- Approximately 40% of population in the Project Area have migrated from other regions, and

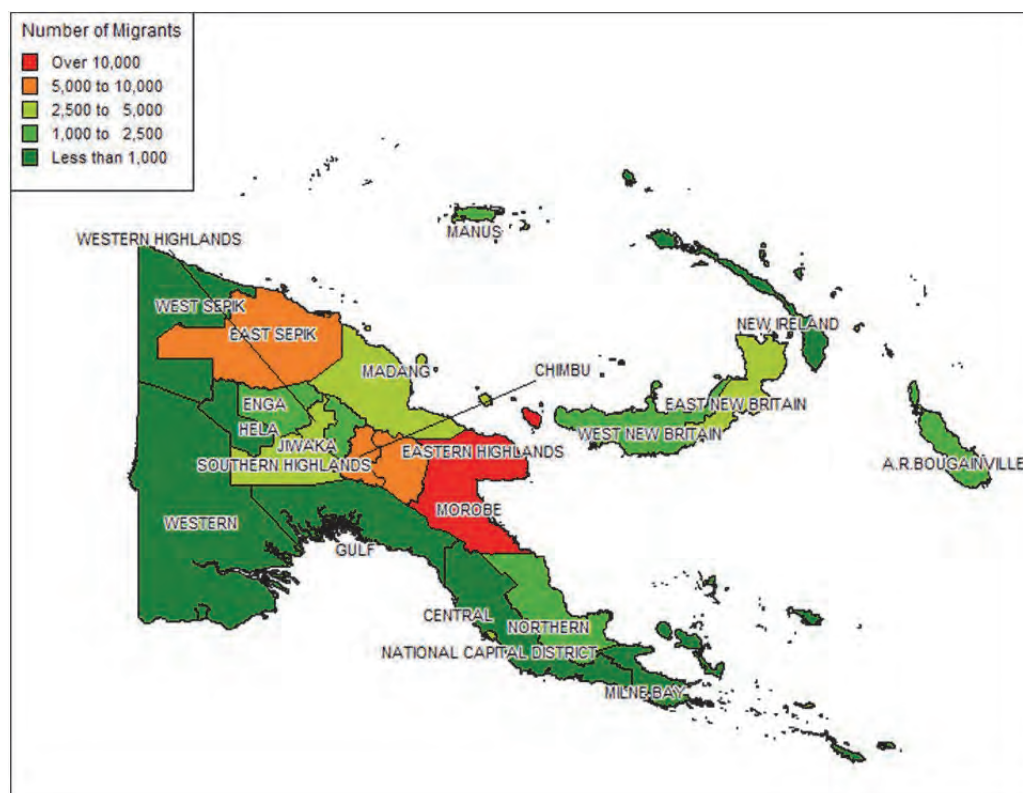
1/3 of the above noted 40% population have migrated originally from other parts of Morobe Province.

- Migration from other regions indicates mainly from the Provinces of Cimubu, Eastern Highlands and East Sepik.

Table 4.1.3 Place of Birth Analysis in the Project Area

Place of Birth (Province)	Type of Migration (Usual Residence or Usual Residence 1 year before)				
	Total	Non-migrant	Within Province	Between Provinces	Not Stated
Total	221,977	134,623	30,132	56,991	231
Western	395	-	-	395	-
Gulf	549	-	-	549	-
Central	825	-	-	825	-
National Capital District	3,591	-	-	3,591	-
Milne Bay	783	-	-	783	-
Northern	1,470	-	-	1,470	-
Southern Highlands	4,095	-	-	4,095	-
Enga	2,419	-	-	2,419	-
Western Highlands	3,861	-	-	3,861	-
Chimbu	7,805	-	-	7,805	-
Eastern Highlands	8,325	-	-	8,325	-
Morobe	164,755	134,623	30,132	-	-
Madang	4,956	-	-	4,956	-
East Sepik	8,303	-	-	8,303	-
West Sepik	895	-	-	895	-
Manus	1,177	-	-	1,177	-
New Ireland	552	-	-	552	-
East New Britain	2,711	-	-	2,711	-
West New Britain	1,278	-	-	1,278	-
AR Bougainville	1,127	-	-	1,127	-
Jiwaka	1,288	-	-	1,288	-
Hela	586	-	-	586	-
Not stated	231	-	-	-	231

Source: national Population Census



Source: National Population Census

Figure 4.1.4 Distribution of Migrants from other Regions

4.2 Social Profile and People's Life

4.2.1 Traditional Social Systems and their Negative Impacts

(1) Wantok System

In PNG, there are more than 800 tribal languages, with speaking populations ranging from a few hundred to tens of thousands, and there are many minority tribal groups. Tribal leaders known as “Big Man” are selected based on personal ability comprising leadership skills, knowledge and negotiating ability, but there is no system of hereditary succession as seen in other countries.

Tribal groups in PNG are called *wantoks* in the sense that the members of a tribe speak the same language. A single *wantok* can range in size from less than a hundred people to many hundreds or thousands, and relations between neighbouring *wantoks* vary from friendly to hostile. *Wantoks* are composed of clans and families. In the narrow sense, *wantoks* comprise only members of certain clans and families, but in the wider sense they include all persons who speak the same language. Ties and the system of mutual aid within *wantoks* are extremely strong, and there are also examples of mutual aid and coexistence between different *wantoks*. For PNG, which does not have a full social security system, the *wantok* system acts as a safety net, however, the system is also negatively exploited in order to secure appointments to important government posts and to unlawfully provide social services and so on. PNG is a nation composed of numerous differing tribal groups based on the *wantok* system, and each “big man” serves with the objective of maximizing the benefits of his own *wantok*. Accordingly, the *wantok* system definitely fosters negative effects, with favouritism and unfair policies sometimes hindering development.

(2) Customary Land System

One major reason given for the lack of development of infrastructure, especially the road network, in PNG is its steep terrain. Road construction is hindered by the central highlands that reach heights of 2,000~3,000 meters, as well as the mountains that jut out towards the coast, and the widespread marshlands in the coastal area. However, in addition to these topographical characteristics, the customary land system of PNG that is based on the *wantok* system is also pointed to. More than 95% of land ownership in PNG is based on the traditional customary system, whereby the clans own land and land is orally passed on from one generation to the next. In other words, the traditional customary system of land ownership is not based on legal systems of land registration and so on. Moreover, because the Government of PNG regulates the purchase and sale of land that is customarily owned, it is necessary to lease such land when constructing roads. In such cases, the government conducts negotiations with the “big man” clan leader who owns the land. Once the negotiations are officially concluded and work starts on construction, abuses sometimes arise whereby members of clans that receive little benefit block roads, demand rent or conduct looting. The government is responding through policies such as establishing a registration system for customary land, purchasing and leasing such land and so on. It can thus be said that the customary land system of PNG is a major impediment to development of infrastructure and acquisition of land for industrial development.

(3) Politics and Governance

The political system in PNG is a parliamentary democracy based on democratic elections. However, since PNG is a conglomeration of numerous tribal groups, the tribes tend to compete in putting forward their own candidates. In the general elections of 2012, more than 3,400 candidates representing 46 political parties vied for 111 parliamentary seats. In such an environment, because election defeats are decided by very small margins, incumbent members of parliament frequently lose their seats in the next elections. Moreover, in cases where candidates do not accept the results, because they can lodge appeals and dispute whether or not election results are valid in a court of law. Sometimes the elected candidates are unable to assume their official duties, because they are involved in legal disputes. Such frailties of the election system are deeply linked to the aforementioned *wantok* system. Everybody knows that selecting members of parliament from tribal groups spawns major interests, and this environment leads to widespread violence during elections and legal disputes following the appointment of elected members. The prime minister is elected by

the members of parliament, while members of the cabinet are appointed from the governing party by the prime minister.

In other words, even though PNG has a political system based on political parties with members of parliament elected in democratic elections, the fact that the country is a conglomeration of minority tribal groups means that it is hard for consistent policies to be implemented; moreover, there is a high turnover of government administrations, making it difficult for consistent infrastructure development policy to be implemented. Looking at fiscal revenue, since this is largely dependent on the mining and quarrying sector, stable revenue can be anticipated so long as the mining and quarrying industry is prosperous, however, since natural resources are finite, there are issues in terms of sustainability. As a result, it is essential that policies be adopted to make effective use of the revenues from the currently prosperous mining and quarrying sector.

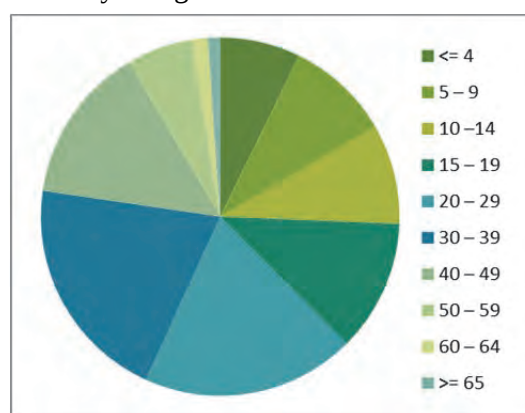
4.2.2 Social Profile and People's Life

The Project Area consists of three districts, namely Huon Gulf District, Nawaeb District and Lae District. There are five Local Level Government (LLG) jurisdictions allocated within the above three Districts. Lae City is the second largest city in the country being considered as the central hub of industrial and trading activities of future PNG. There are over 100 languages spoken historically in Morobe Province, and there are also large number of land owners so-called "Clan" who occupy over 97% of land. While the Provincial government owns only limited and small areas of lands, most people and communities live with traditionally oriented land ownership structure in the region borrowing clans' land to utilize in many ways for their allowed daily use.

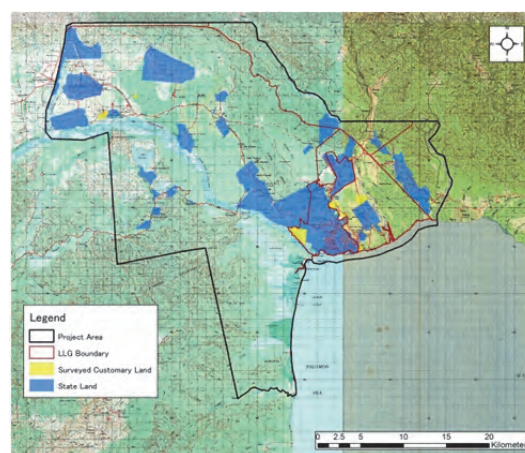
According to the household survey conducted under the Project study, gender proportion in the Project Area indicates slightly larger population of males. The age distribution shows that the ranges of 20~29 and 30~39 have the largest population, followed by the age ranges 40~49 and 15~19. The age range over 60 indicates very small share.

PNG in general has a unique land ownership tradition in its history, so-called customary land owned by clans. There have been so many numbers of tribes as many local languages existed, and the leaders of these tribes in their history have been not only the leaders of communities or villages but also the customary land owners. Clans are powerful in terms of politics and have strong influence on people and communities, and PNG legislation in many cases cannot control this traditional land ownership system. Because of such condition under clans' influence, land acquisition and development have been major issues and facing difficulties in the country as over 97% of land of PNG is owned by them. Neighbouring clans or groups of clans make this situation somewhat more difficult since they are in kinds of coalition against land acquisition and checking activities of each other. As the Figure 4.2.2 illustrates, there are very small amount of state lands available as shown in blue-colour.

The geographical nature between mountain range and Huon Gulf as well as surrounding Pacific Ocean has gifted a variety of agricultural, forestry and fishery potentials in the region, and major products are



Source: JICA Project Team according to Household Survey Result of
Figure 4.2.1 Age Group Distribution in the Project Target Area



Source: JICA Project Team
Figure 4.2.2 State owned Land Distribution

represented by rice, coffee, coconuts, betel nuts from the land and many kinds of fish from the gulf as well as timber production from the mountains. However, there is no strong processing industry for those products in the region except for the fish-can manufacturing industry operated under investment by foreign companies. Besides, mining activities are also strong in the region through history, and several foreign investments have been applied to the gold and copper mining industries for development in the north western side to the Project Area.

Other than working for large plantation production businesses, for instance in the region, most people have been living with daily based informal sector business activities mainly selling small amounts of products harvested from nearby lands or mountains, such as fruit and nuts. The household incomes are not reliably high enough to support children for school enrolment, therefore many children give up attending schools as they have to help family businesses including farming tasks. Many families have or are allowed to use limited areas of land for agro-production while they have limited access to larger markets, thus production amounts are small and sales are limited. Where road network is very poor or does not exist, their living condition is much more severe, for instance in Labu villages, without much options for income, so they have to live based on self-sufficiency.



The types and the made of houses in the region are mainly wooden structure with elevated floor deck for avoiding termite damage as well as moisture from the soil. The roofs are commonly thatched or leaf-covered showing the traditional look. Some families with higher incomes can own the houses with metal sheeted covering of roofs and walls. Most houses, except in Lae City area, are not equipped with toilet facilities or water and power supply in common. In addition, most rural houses do not have rigid partitions among spaces to divide. Therefore, privacy within a family is not well secured.

There is a large issue with land and living places in especially urban area of Lae. People not only in the Project Area but also from Highlands region and others have been migrating to Lae urban area in order for employment as there is not much of job opportunities in rural areas. However, these people and families do not have enough economic background to own a house with land use right, they settle into particular areas in Lae City. Clans, the land owners, are in some sense generous to accept and allow those migrants settle in their property, and this has created quite large low income family informal settlements in the urban area as it is so-called “Squatter Settlement” where higher density of population occurs.

(1) Employment and Industries

The employment trend in the Project Area illustrates that over 25% of rural area population are working in agro-production for their own consumption, and it is followed by informal or temporary employment at over 13%, sales activities at 10%, wholesale and retail trade as well as manufacturing industries at about 7%. When rural areas namely Wampar, Labuta and Nabak LLGs based on the household survey are particularly considered, informal and temporary employment indicates much higher rates, while primary sectors (agriculture, fishery and forestry) and mining sector are higher. Although the employment trend in Lae Urban and Ahi Rural LLGs shows larger shares in primary sector industries, the result shows more options are available in urban area including construction, manufacturing and wholesale/retail industries. There is a large gap in employment opportunities between rural areas and Lae urban area.

- Most working-age population in rural areas work for primary and informal sectors as there is very limited businesses and employment opportunities.
- There are more working opportunities in many sectors in Lae urban area for people to choose.

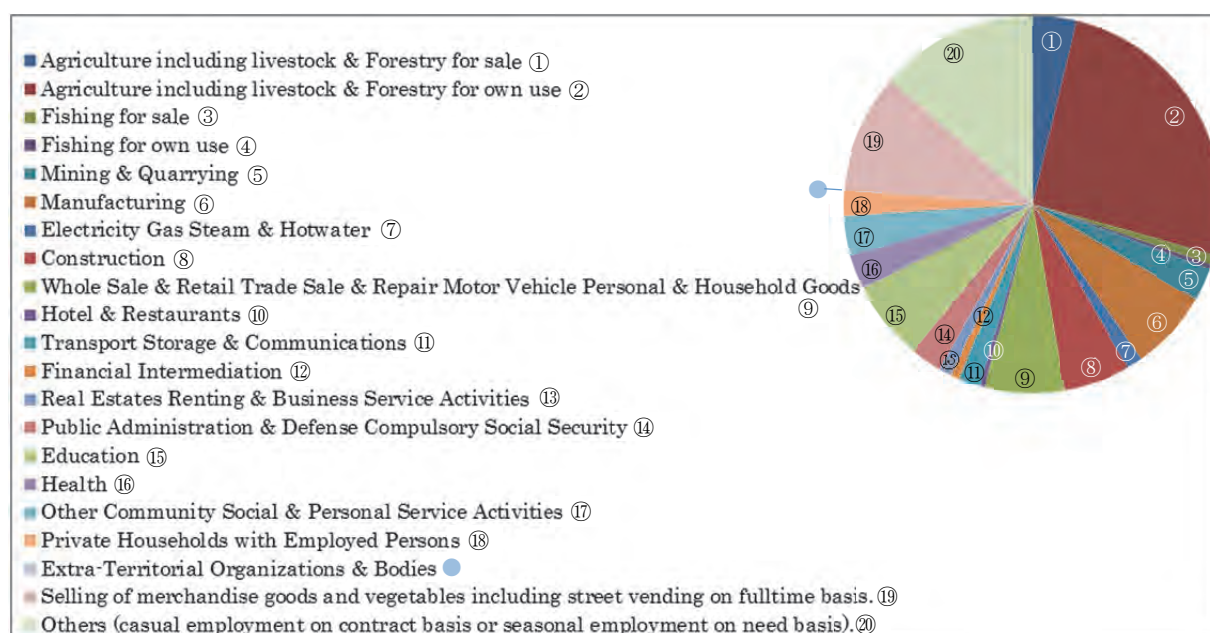
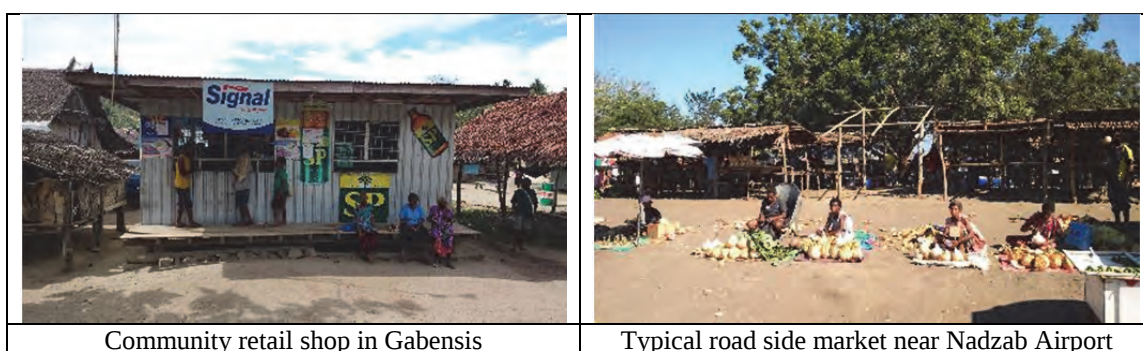


Figure 4.2.3 Proportion of Working Industry (Employment Distribution) in Project Area

As illustrated in Figure 4.2.3 above, primary sectors and small vender industry provide working opportunity in the region while informal sectors are still at the highest options for people.

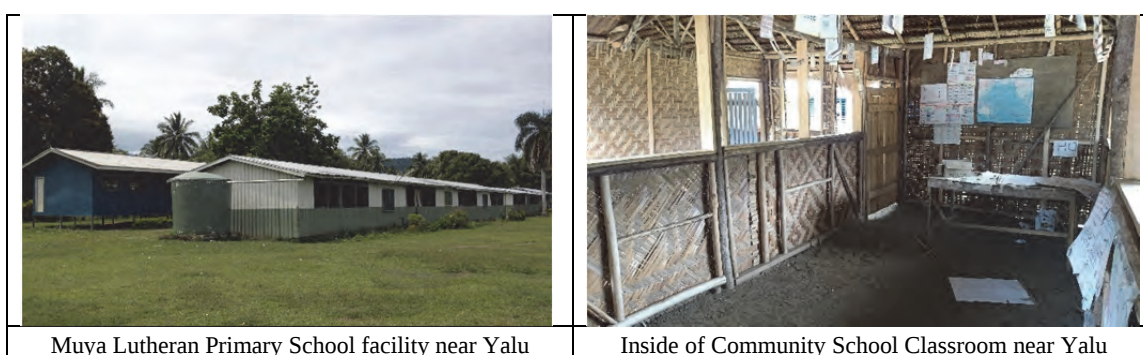
People in rural areas are very willing to sell agro-products, such as beetle nuts, but the markets where they can access are informal markets along roads of the area to which they still have to walk about 2 kilometres or more. The sales income based on such informal market activities is very limited, so only small number of families can manage retail shop businesses in which they sell goods and products brought from the public market, for example in Lae City.



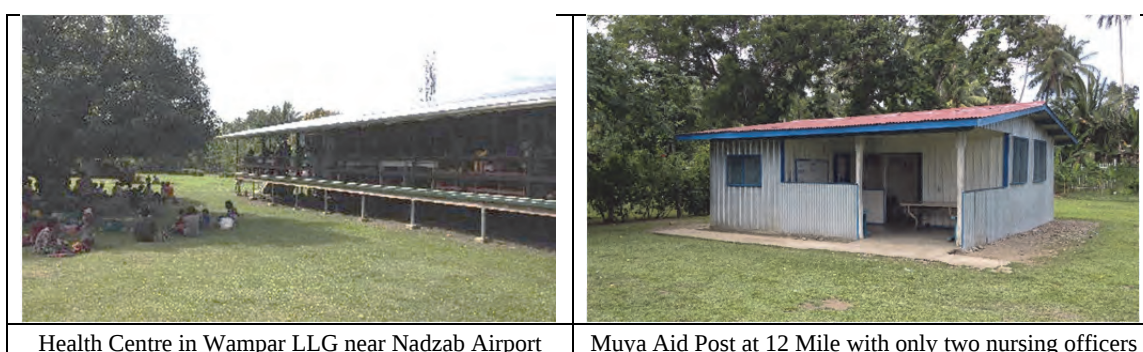
(2) Healthcare and Educational Services

The government has been providing educational and healthcare services to the people and communities, however the degree of services as well as facilities are not meeting with the actual needs and demand of local people.

Based on the national education system, every child has right to enrol schools, but the economically difficult situation in daily lives of many families sets children to discontinue attending school program. These children in fact work or help family to generate incomes rather than attending schools. Elementary and primary schools still have higher enrolment rate, and most schools face classroom shortages and teachers are overloaded. Secondary level education indicates much worse situation to the people, since there are very limited secondary schools in the Project Area mainly concentrated in Lae City area. Students in rural areas, if they wanted, must go for boarding schools or living in urban areas away from their families to attend secondary school, and their families must pay higher expense. Therefore, less than 10% of students can continue study, and only a few percent of students can go to higher education from rural areas due to economic and geographical constraints.



It is a common problem in PNG that localized healthcare services are so limited, and people are struggling with accessing services due to lack of facilities and services. There is a large national level hospital in Lae City, but the service charge is very high and many local people from both rural and urban areas cannot afford such high cost. According to the Provincial Health Department, the number of aid posts and clinics in the region is too small to cover the demand to the services, and some are not fully operational because there are not enough nursing officials or healthcare workers. Most of the facilities are equipped with minimum medicines and service equipment with minimum nursing officers or healthcare workers only, and the service of ambulances is also very limited for emergency patients so that people face high risk of health damage and even fatality.



(3) Security and Crimes

Security issues are not only Lae-Nadzab area's matter but are a nationwide problem. There are some aspects trigger problems among people and communities. Commonly concerned security issues according to the household survey are listed hereafter.

- Conflicts among clans and land-related problems
- Ethnic and tribal conflict

- Problems with drunken people and young people
- Unemployment related problems

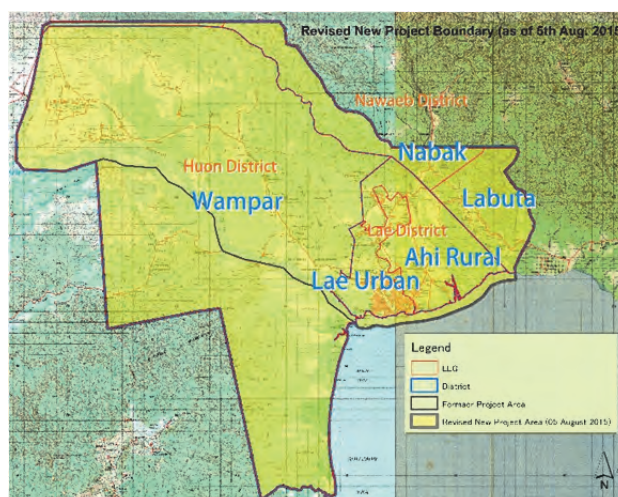
Not only localized community or people's conflicts but also conflicts between people of Morobe and people from other provinces are becoming major issues now, since increasing numbers of people migrate looking for more opportunities of employment and/or markets. They settle in this region and start informal sales activities in the city or along the roads/streets without proper regulation or control by the government. Other than the above listed common issues in the region, carjacking has been another major criminal issue in the region as well as the country. Both urban area and rural areas along major roads are the targets of carjacking criminals. Communities as well as the government are very much aware of the issue, however effective measures have not been taken to diminish carjacking and there is much space to improve certain parts of livelihood.

4.2.3 Household Survey

The purpose of the household survey is to expand understanding of the Project Area as well as to exchange on-site local opinions and concerns that local people and communities should have in terms of their living conditions, environment, livelihood and others. Through the household survey, real voices and information that may not be obtained from official documents such as census data were collected. The analysis of the collected information and data through at-door interviews also support visualization of actual demand and development needs to assist the local people.

The Project household survey was conducted during the second site survey, and total of 1,000 sample families were visited to explain the purpose of the survey and to obtain all interview answers. Total of 427 villages were targeted within 45 Wards in the Project Area in Morobe Province, in particular Huon Gulf, Lae and Nawaeb Districts. There are targeted five LLGs within above noted three Districts, and the distribution of the survey was made as described in the following Table 4.2.1 and Figure 4.2.4.

The sample distribution in each Ward in LLGs is set based on the population ratio of each ward given in National Census 2011 with clarification by the Provincial Statistical Officer. Thus, the numbers of interviewed households in Lae Urban and Ahi Rural LLGs show larger profile, although the area of Wampar LLG is the largest in the Project Area.



Source: JICA Project Team

Figure 4.2.4 District and LLG Boundary Map

Table 4.2.1 Distribution of Surveyed Households in the Project Area

No	LLG Name	Sample Distribution	%	Remarks
1	Nabak	22	2.2	4 Wards included in the survey
2	Labuta	27	2.7	2 Wards included in the survey
3	Ahi Rural	304	30.4	All 17 Wards included
4	Lae Urban	371	37.2	6 Wards included in the survey
5	Wampar	275	27.5	16 Wards included in the survey
	Total	1000	100	

Source: JICA Project Team

Major aspects interviewed are as follows:

- Problems with public and other service facilities, and demand of service facility development
- Difficulties with public services and infrastructure
- Conditions, status and types of living places and houses as well as land or property

- Monthly expense of each family
- Problems with houses, land and basic infrastructure related with the house
- Number of unemployed family members and the reasons
- Source of income for each family and average income amount per month
- Food and eating habit of each family and desire
- Problems with security in their communities and details
- School enrolment status of the family members and reasons for not attending if so
- Expense amount for healthcare services
- Problems with healthcare services
- Vehicle ownership status of each family
- Expense amount for transportation services
- Problems with transportation / public transportation
- Status and problems of electricity services for each family and expense for the power supply
- Status, sources and problems of water supply service including equipment for water use and expense amount for water supply
- Status and problems of sewer services and connection to public sewer system of each family and expense amount for the power supply
- Types of toilet facilities and sanitation problems with each family
- Status of waste collection and recycling program as well as expense or income through the recycling activities
- Status of mobile phone ownership of each family
- Methods or resources for public information gathering or sharing
- Number of each family
- Status of activities with land owned or rented and size of land
- Detail of gardening or farming activities with the land as well as watering and fertilizer use
- Ownership of private vehicles
- Detail information of family members with their sex, occupation, educational background, vocational training, English skills, and
- Trip survey for traffic demand study considering purpose, means of, destination, duration and frequency of trips (minimum three trips)

Each Ward has locally oriented nature and conditions which also influence and control certain development of infrastructure and public services. Lae City, for instance, is more developed with basic infrastructure while families do not have large land for their use as in other rural areas because of urban development concentration. From the population and development concentration point of view, Lae Urban and Ahi Rural LLGs have some different behaviour in answers comparing to the other LLGs.

According to the above listed aspects in questions to the selected families, the following general conditions are identified in each LLG. Traffic demand survey related items are analysed and discussed in particular section of transportation. Data analysis and descriptive charts are attached as Appendix-8 of the report.

4.3 Social Services

4.3.1 Current Condition of Social Service

4.3.1.1 Purpose of Social Service Study

The Project aims at the next ten-year development in Lae-Nadzab Area of Morobe Province, and the Project considers industrial development, especially primary sector, with related food processing and manufacturing industries, as the base of the development. The central government's long-term development plans identify that the Project Area shall become the industrial, manufacturing and distribution centre of the country in the next 30 years. In connection with this national development concept, Lae-Nadzab Area will be highly focused for major developments of industry. The short-term development in the next ten years will gradually appear in the region with the agricultural, fishery and some manufacturing industrial development, and the population in the region should also be increased gradually. When the region is more developed, density in the area will be much higher

expecting further expansion of social services and facilities.

In order to identify the future needs for social service facilities such as schools and healthcare facilities as well as parks and others, the current conditions of such social service facilities should be necessarily understood. According to the study on the current conditions of services, necessary future expansion of the same has to be evaluated.

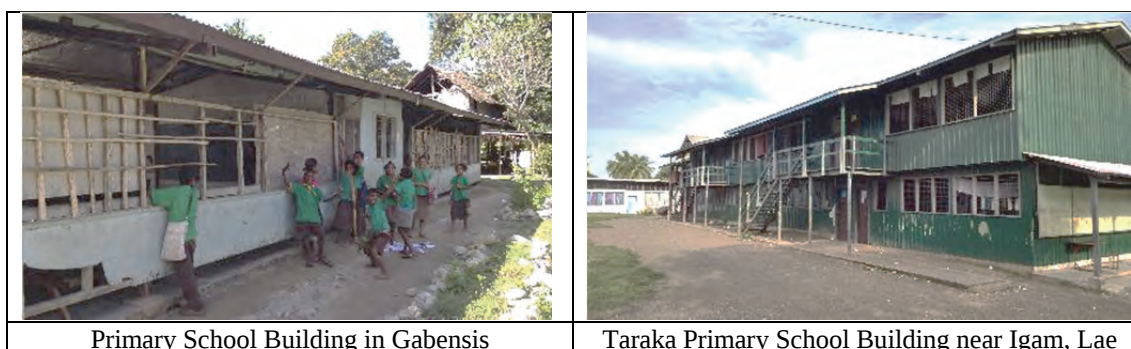
4.3.1.2 Current Condition of Educational Service

Morobe provincial government and Lae LLG make the highest effort to provide equal educational opportunity in the Project Area, however, primary schools (Grade-3 to Grade-8) in the rural areas are not well distributed or located so that the students must walk quite a distance for hours. The primary schools in Lae urban area are located in such a way that the walking distance is shorter between each.

The number of schools as well as classrooms in many schools face shortages in both urban and rural areas, and expansion of facilities is needed. Many schools are not equipped with toilet facilities, such as the schools in Labu area. Some schools are not provided with water and power supply. Because of steep increase of student population, number of teachers is not enough so quality education is threatened.

In the rural areas, there are very limited numbers of secondary and other schools, therefore those students who want to enrol should go mainly for boarding schools. Since such situation sometimes exerts higher economic pressure to the parents, parents often encourage children not to go schools but work or help parents for their family tasks. The service and facility levels are also not standardized among areas and there is need for more equal service quality.

As the Project expects future development in the region, capacity of the current school facilities is inadequate, so there is a large need for expansion or new development of school facilities.

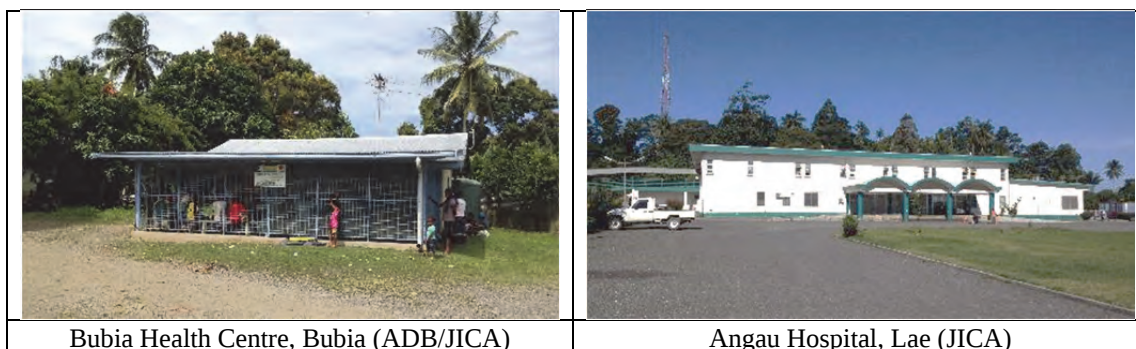


4.3.1.3 Current Condition of Healthcare Service

There is a hierarchy of healthcare facilities in the country, and in most cases in Morobe Province the provided healthcare facilities are aid posts with very limited numbers of nursing officers or healthcare workers to attend patients. The locations of aid posts are another issue that deny many people convenient access to the services. Urban health services are next level facilities above aid posts, however they are only located in largely populated areas. The only facility with capacity and capability of higher medical treatment and adequate number of doctors is Angau Hospital in Lae, but many people do not have access to the treatment services due to the high treatment service costs.

Remote areas, such as Labu, Nadzab and Situm, face difficulties, for instance capacity shortages thus long waiting time for consultation, very little medicine availability and lack of emergency services. Same as educational facilities, there are needs to improve services and facilities at minimum equal quality for people.

As the Project expects future development in the region, the capacity of healthcare facilities and networking as well as number of doctors, nurses and healthcare workers may need to be increased or strengthened.



4.3.1.4 Current Condition of Other Public Services

There are several other publicly operated and serviced facilities in the Project Area, but most of these are not effectively maintained or serviced for communities or for people except some facilities in Lae urban area. Some recreational parks have been established for public services, but operation programs are not well designed so that the use of the facilities is not effective either. Public information service related facilities, such as libraries, are not developed in the region including convenient local or community level government service offices. Therefore, there are greater possibilities to improve public service facilities and services.

(1) Community Centre and Ward House, etc.

Except for town house type government offices of each LLG, there is no standard for facilities, such as community centres and Ward houses, and there are only small numbers of buildings provided by the Provincial administration for community to use, and most communities or villages have small gathering structure providing shading only. There is large needs and demand of effective community gathering facilities for better community activities. Some community structures in Lae urban area indeed have a large catchment area with over 10,000 populations and the size of facility shall definitely be increased for better service. More administrative service offices for convenience are necessary.



(2) Public Facilities, such as Libraries, Sports Fields, Parks and others

There is no publicly operated and maintained library in the Project Area except ones in the schools and universities as well as research institutes and Botanical Garden in Lae City. Including research and information distribution points of view, there are needs for developing libraries and information centres in the region not only for educational purposes but also for business purposes, and these facilities shall provide wide range of information including resources, investment and market for future industrial development. There are several sports facilities and fields, such as Sir Ignatius Kilage Sports Facilities in Lae City near yacht club, but there are not many well developed sports facilities in rural areas. Parks likewise have been developed in Lae urban area for recreational purposes, but people in rural areas do not have such opportunities to access parks. Although there are several public parks in Lae City, some of these are not open for public use normally as they are fenced. Due to lack of good integrated application of urban planning and zoning as well as land use laws and regulations, some of these parks and these land areas have been acquired by private operators for their development, and these public parks are at the threat of uncontrolled private

development.



(3) Police and Others

Police stations are located mainly in Lae urban area except one station in Nadzab at the airport premise. Fire stations are also located in similar arrangement in the region. Accordingly, certain services required by the local people and communities due to any troubles, such as accidents, crimes and fire, cannot be attended immediately. Such kinds of incidents do not happen by scheduled manner, these facilities and services shall be expanded in both number of facilities and number of officials for better public services. Crimes, especially, have been increasing in the region so that the enhancement of police and security services is the mandatory. Through the national development plan of the region, more industries as well as foreign companies and increased population are expected in the Project Area. Therefore, such public safety services are a priority for better as well as reliable living environment in the region.

CHAPTER 5 CURRENT LAND USE AND TENURE

5.1 Land Tenure

Land use control over the customary lands is virtually very hard in PNG. 97% of land in PNG is held under customary ownership for which there is no recorded title. Only the state might acquire customary land from customary owners. At the Land Summit meeting held in Lae in 2005, land reform was discussed and National Land Development Task Force (NLDT) was established. The Incorporated Land Groups registration system was proposed as a one of the proposals by NLDP for activating land use conversion of customary lands.

Before Land Group Incorporation (Amendment) Act 2009, land rights of customary lands were transferred without any documents of area and owners, and many disputes over the land rights occurred. After Land Group Incorporation (Amendment) Act 2009, transferring of land rights can be implemented only after the registration of lands by Land Group Incorporation. This customary land registration requires the steps of identification of clan members who have the right of the customary land, surveying the subject land, verification of the application, and so on. Currently lease-leaseback scheme is devised and utilized in PNG for the owners of any customary land to develop their land for special agricultural or other business projects. Owners of the customary land will be able to participate in the scheme where the Minister for Lands and Physical Planning is satisfied with the identification of owners and their intention to develop the land. Under the Land Act, customary land owners (either in their own name or through incorporated land groups (ILG)) may only dispose of their land to the state. Under the lease-leaseback scheme, the state grants a special agriculture or business “leaseback” to one or more ILGs in their capacity as agent for the customary land owners.

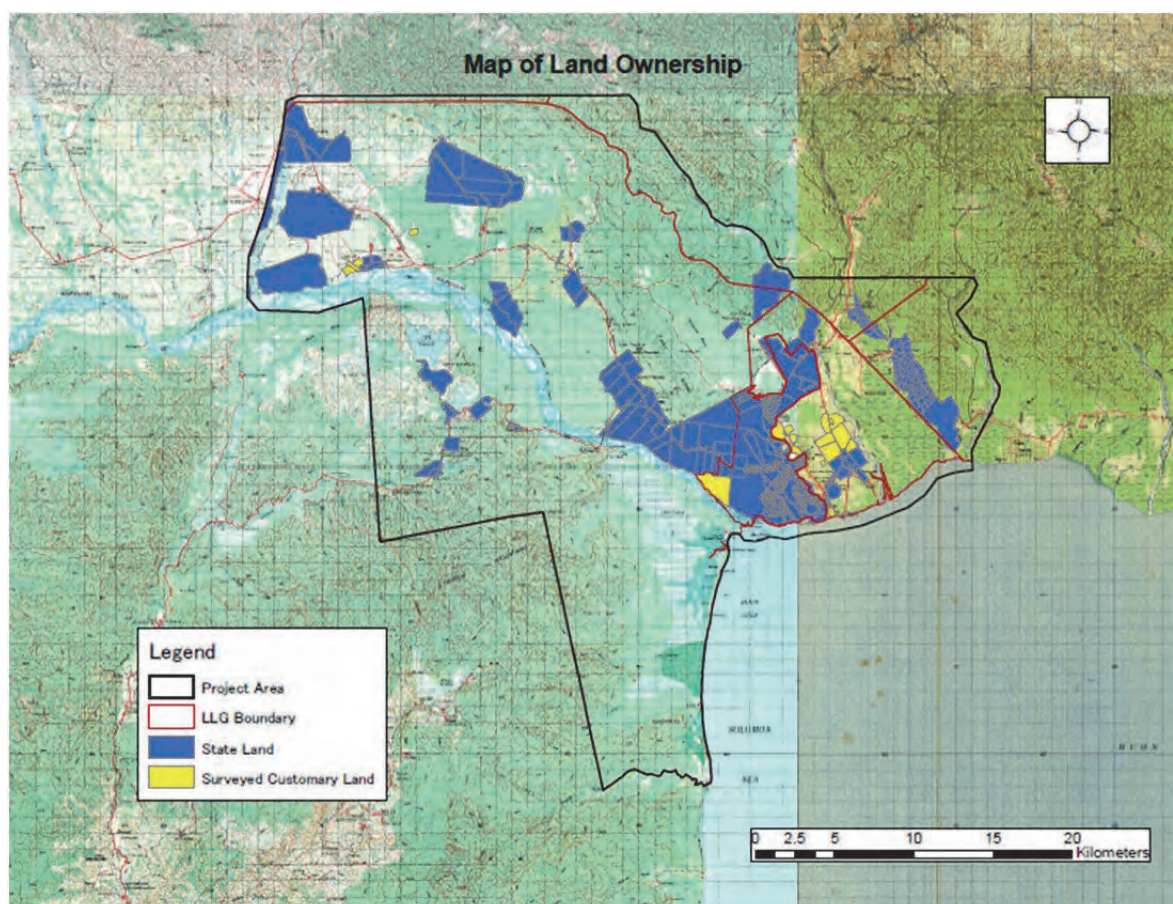
Note: Under the customary laws of PNG, any land belonging to clans may not be sold. In spite of this distinct fact, it is said that the sale of customary land is at an all-time high.

On the other hand, state land is administrated under the Land Act. The Land Act provides the mechanisms by which the state may:

- acquire land (including customary land); and
- grant leases in respect of any land.

In Article 7 of Land Act 1996 it is stipulated that the Minister may, on behalf of the state, acquire (purchase or lease) land by agreement or by compulsory process in accordance with the Land Act. Upon registration, the proprietor is granted indefeasibility of title, similar to the “Torrens” registration of title system adopted in a nearby country under which a land title serves as a certificate of full, indefeasible and valid ownership of land. Most dealings in land are by way of leasehold from state via state leases. A sublease of state lease is permissible and provisions for the registration of subleases exist.

Distribution map of state lands and surveyed customary lands is shown in Figure 5.1.1.



Source: DLPP Lae Regional Office

Figure 5.1.1 State and Customary Lands in the Project Area

Table 5.1.1 State and Customary Lands in the Project Area

State Land (%)	Customary Land		Project Area
	Surveyed (%)	Not Surveyed (%)	
154.85 (14.6)	10.43 (1.0)	891.37 (84.4)	1,056.65 (100.0)

Source: DLPP Lae Regional Office

unit: sq.km

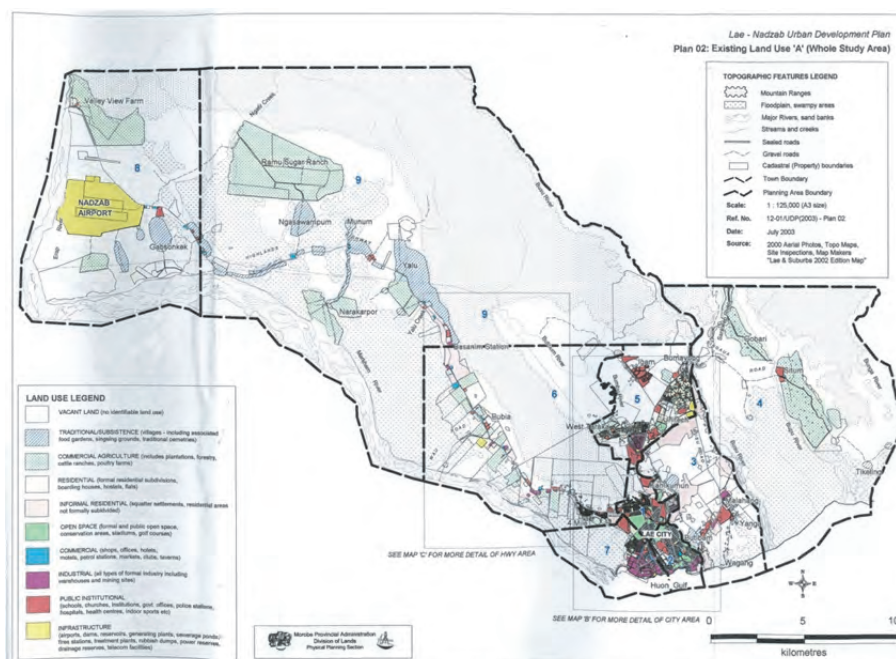
5.2 Land Use

5.2.1 Study of Current Land Use

(1) Current land use in LNUDP 2005-2015

In “LAЕ-NADZAB URBAN DEVELOPMENT PLAN 2005-2015” (LNUDP 2005-2015), the study of current land use was conducted in 2003 for the previous study of proposed urban development planning. The Project Area is largely extended, and land use was determined primarily by the 2000 version of aerial photos and then it was confirmed in field survey.

From the surveyed area of about 74,100 hectares, about 10,300 hectares (about 15%) is used land, in which commercial agriculture accounts for the half. Excluding the commercial agriculture, land use for urban development among the Project Area shares just a small part (about 5,700 hectares: 7.7%) around Lae City.



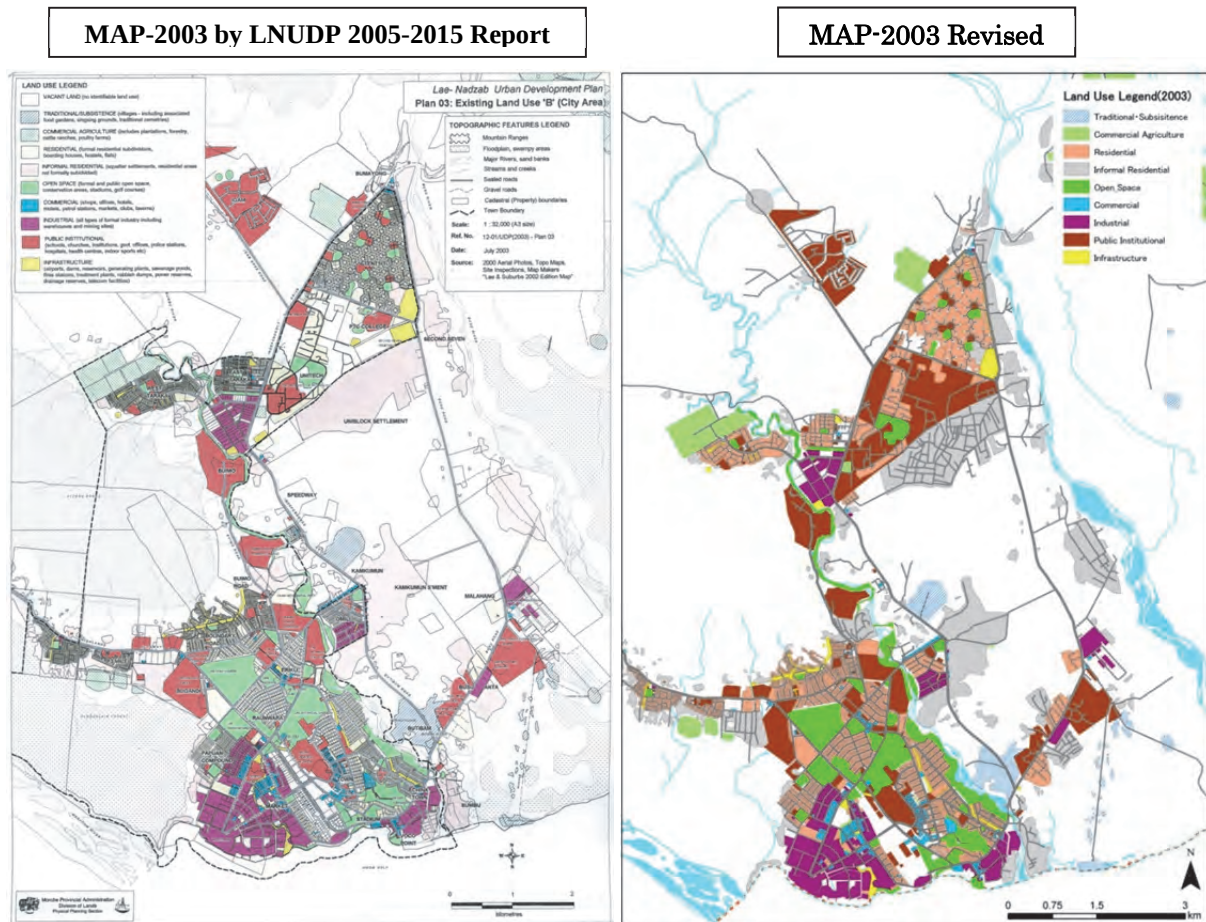
Source: LAE-NADZAB URBAN DEVELOPMENT PLAN 2005-2015
Figure 5.2.1 Current Land Use Map-2003

	No.	Type of Land Use	Approx Area (hectares)	% of entire study area	% of "used land"
Unused	1a	Vacant Land (no identifiable land use and no obvious physical constraints)	20,395	27.5	N/a
	1b	Vacant Land (but subject to physical constraints – mountains, floodplains, rivers, sea)	43,412	58.7	N/a
Total area of Unused Land (hectares)			63,808		
Used	2	Traditional / Subsistence	1,486	2.0	14.4
	3	Commercial Agriculture	4,628	6.2	44.8
	4	Residential (formal)	704	0.9	6.8
	5	Residential (informal – squatter settlements)	1,129	1.5	10.9
	6	Open Space	313	0.4	3
	7	Commercial	92	0.1	1
	8	Industrial	286	0.4	2.8
	9	Public Institutional	557	0.3	5.4
	10	Infrastructure (excluding roads)	1,127	1.5	10.9
Total area of Used Land (hectares)			10,322		
Total area of Study Area (hectares)			74,130 or 741 sq km	100	100

Source: LAE-NADZAB URBAN DEVELOPMENT PLAN 2005-2015
Figure 5.2.2 Land Use Distribution by Current Land Use Map-2003

(2) Obtaining of the prepared data for Current Land Use Map

In order to understand the current situation of land use in Lae-Nadzab Area, firstly the digital data of previous land use map was obtained to examine the LNUDP 2005-2015 Report (considering the results of that study Map-2003 has been updated) which later was revised and since then is regarded as (Revised-Map-2003). The existing land use map of 2015 (Map-2015) prepared based on the Revised-Map-2003 is adopted as the base data for this project. The area in the south of Markham River is also added to this study, and observation of the past aerial photographs to review the existing building layout indicates that no significant new development has taken place over the past 12 years.



Source: LAE-NADZAB URBAN DEVELOPMENT PLAN 2005-2015

Figure 5.2.3 Current Land Use Map-2003 by LNUDP 2005-2015 Report
and Map-2003 Revised in Lae Central Area & Neighbourhood

(3) Conditions for preparing current land use map

1) Land use classification



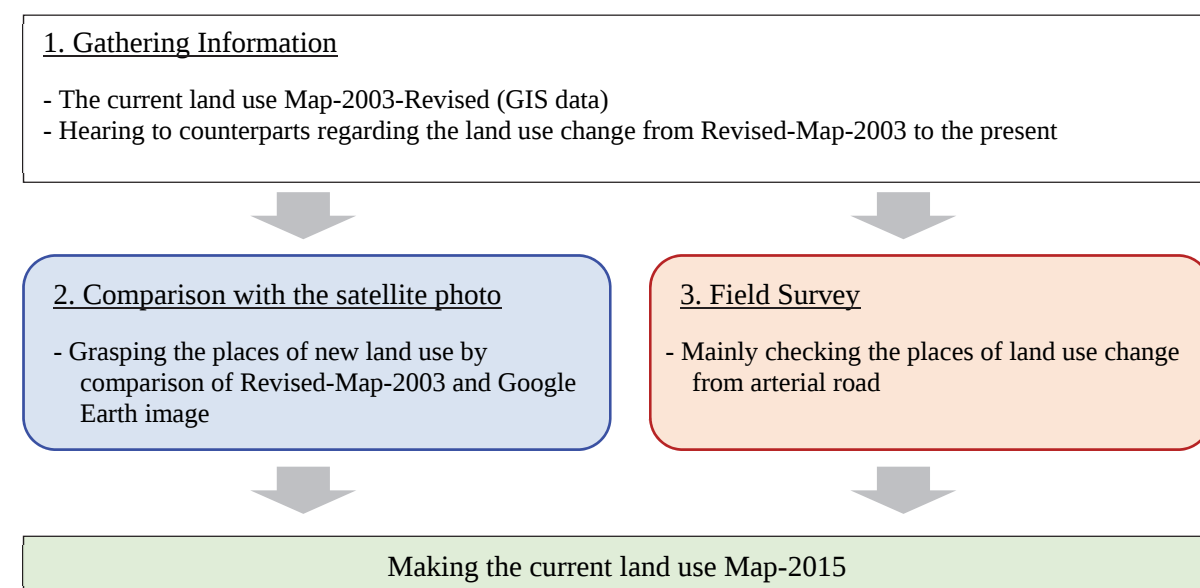
Source: JICA Project Team

Figure 5.2.4 Land Use Classification for Current Land Use Map-2003-Revised and Map-2015

2) Methods and procedures of preparation

For preparing the map, the land use change in Lae-Nadzab Area was evaluated prior to the actual site visit considering the changes from the time the land use map (Revised-Map-2003) was prepared to the present together with satellite photos, such as Google Earth images.

The land use change was then reconfirmed through field survey focusing on the areas where land use has changed. Current Land Use Map 2015 (Map-2015) was prepared by reflecting these changes in the Revised-Map-2003.



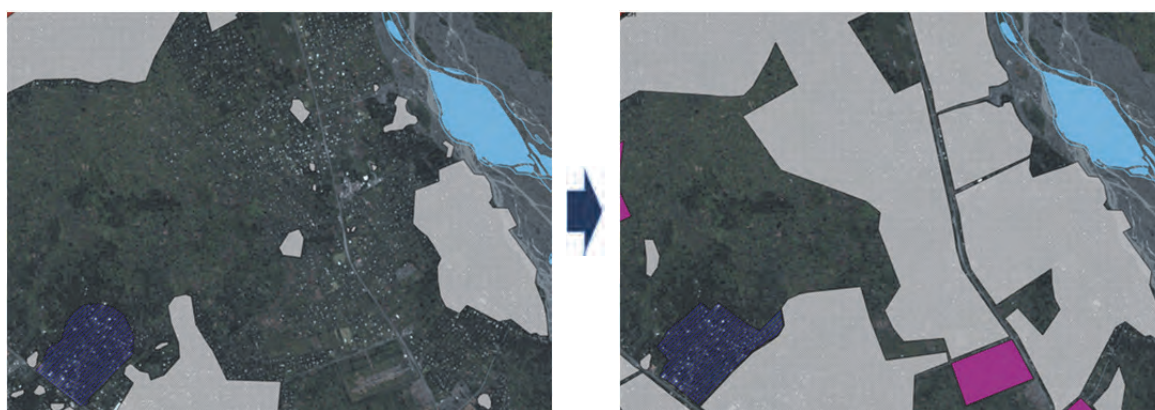
Source: JICA Project Team

Figure 5.2.5 Procedure of Making Current Land Use Map-2015

(4) Understanding of land use change

1) Comparison of current land use map and satellite photo

In the area where land use has changed vastly, the area where land use has changed is recognized so that the change is reflected in the map comparing the data of current land use map (Revised-Map-2003) and satellite photos (Google Earth images). Satellite photos were borrowed to determine the land use changes.



Source: JICA Project Team

Figure 5.2.6 Changing Land Use by Overlaying Google Earth with Revised-Map-2003

2) Overview of the field survey

Field survey was conducted to understand the locations of land use changes. Target area for this current status survey was carried out in three areas: i) Lae Central Area & Neighbourhood, ii) Eastern Area from Lae Central Area, and iii) Western Area from Lae Central Area.

After confirming the locations of land use change, the coordinates were recorded using GPS and used as reference for modifying the map. Counterpart institutions accompanied the field survey, and the land use changes on-site were confirmed together.

Table 5.2.1 Schedule and Area in Field Survey

Study No.	Survey Area	Note
Study 1	Western Area from Lae Central Area	Along Highlands Highway, Southern area from Markham River
Study 2	Nadzab Area, Eastern Area from Lae Central Area	Around Nadzab Airport, Eastern area from the Busu River
Study 3	Lae Central Area & Neighbourhood	In and around Lae Urban LLG

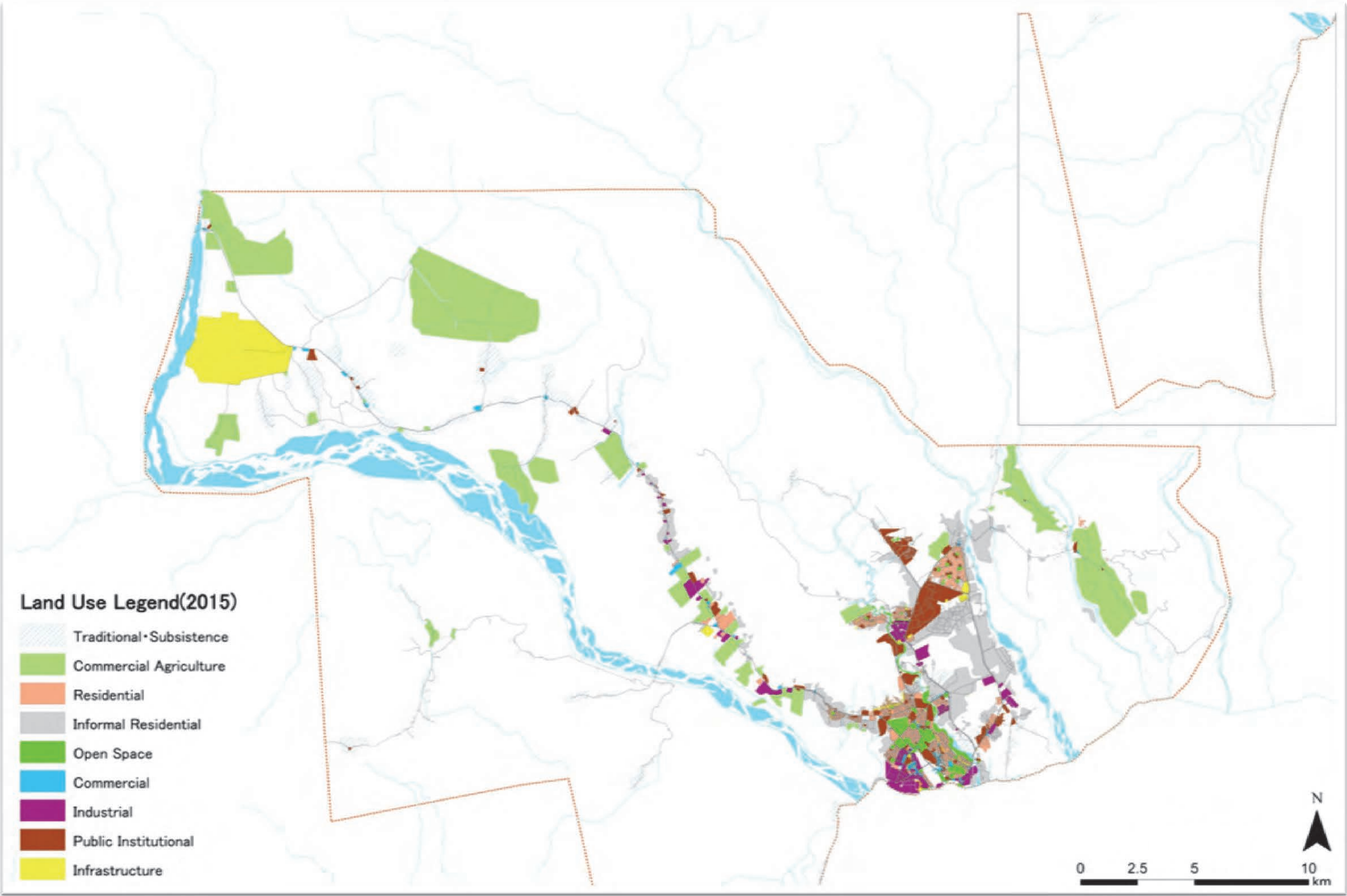
Source: JICA Project Team



Source: JICA Project Team

Figure 5.2.7 Main Survey Route on Site

(5) Current Land Use Map-2015



Source: JICA Project Team

Figure 5.2.8 Current Land Use Map-2015

5.2.2 Land Use Changes from 2003 to 2015

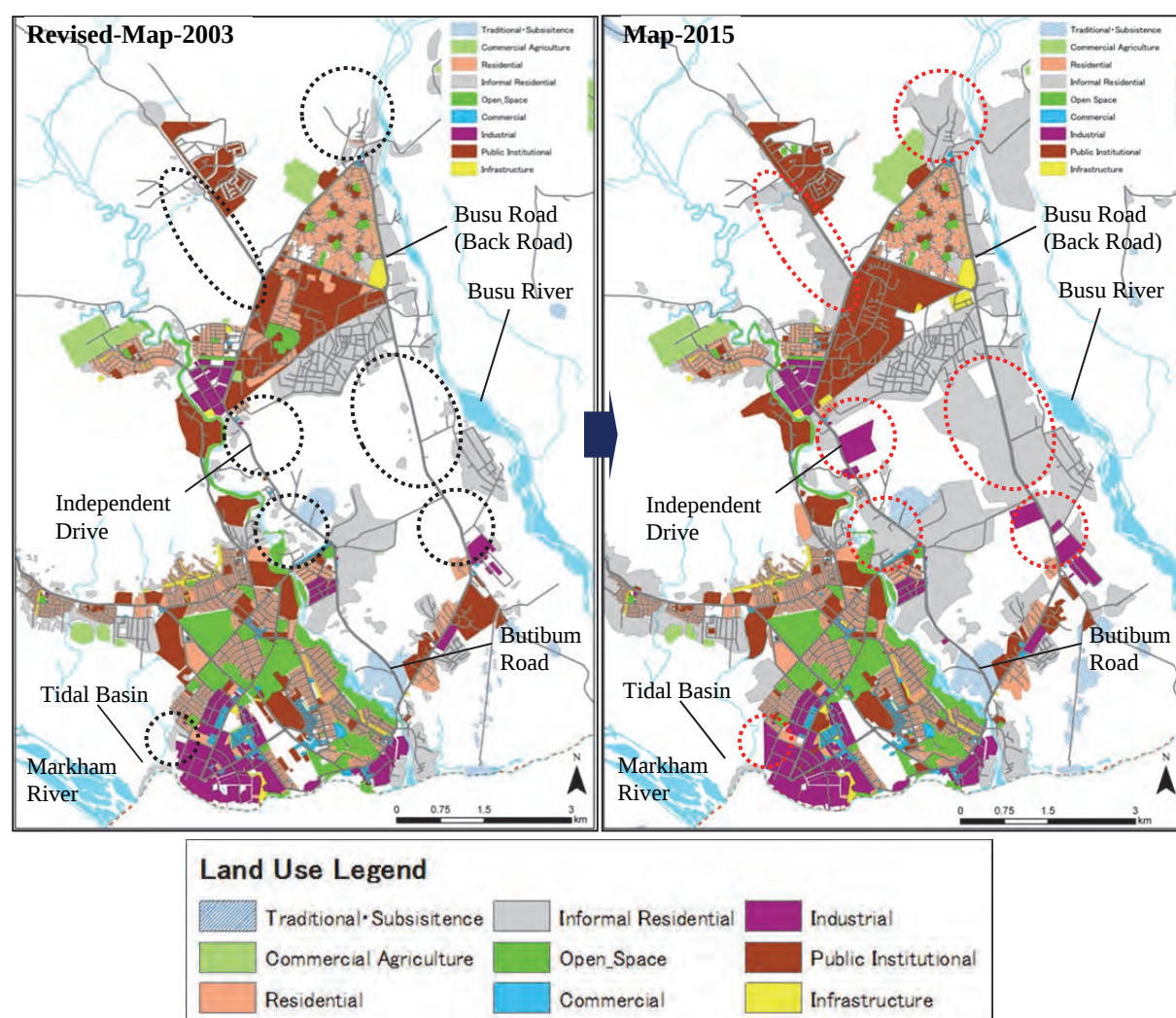
(1) Land use changes

The Project Area was divided into the following four areas, where the current situation of land use for each area is compared: a) Lae Central Area & Neighbourhood (called Lae City), b) South side of Markham River and the Highlands Highway roadside, c) From Yalu to peripheral of Nadzab Airport, and d) East side of the Busu River.

1) Lae City

A new land use has emerged in the north part from Lae Central. Industrial area and informal residential development have expanded along Busu Road (Back Road) and Independent Drive Road. This trend is expected to continue in the future, especially the expansion of informal residential land. It is necessary to examine such changes and incorporate them into the master plan formulation. Such expansion is mainly caused by the population growth and population influx to urban areas.

No major change can be identified in Lae Central. However, some industrial development has expanded in the areas surrounding the port after the development of Lae Tidal Basin (first phase).



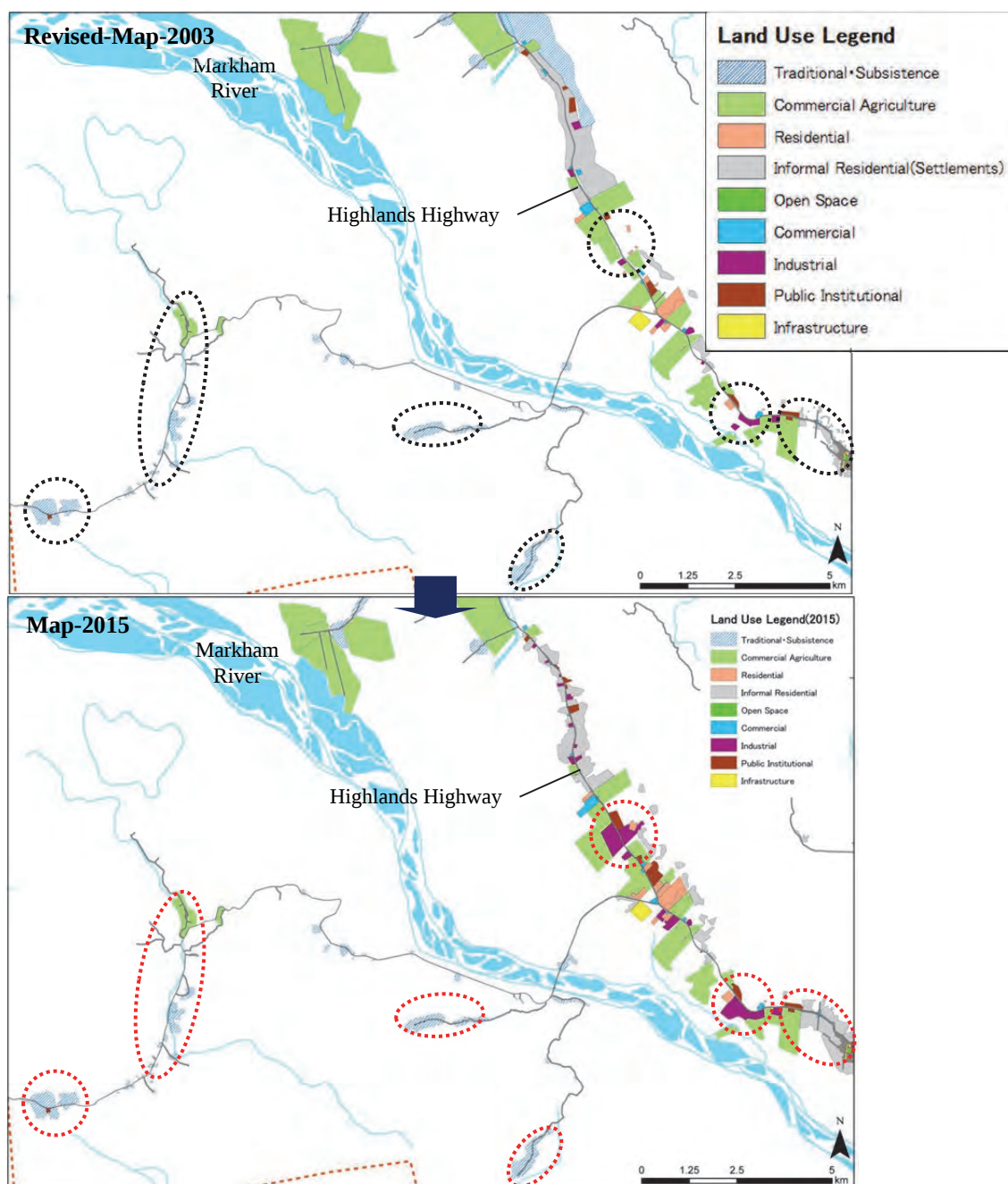
Source: JICA Project Team

Figure 5.2.9 Comparison of Map-2003-Revised and Map-2015
in Lay Central Area & Neighbourhood

2) Highlands Highway roadside, and south side of Markham River

The land is mainly used as commercial agriculture land (such as chicken farm, plantations, etc.) in Highlands Highway roadside during the Revised-Map-2003. Since Highlands Highway is a national highway that connects Lae City and Nadzab airport, land use in 2015 is achieved by some of the roadside industry-based land development. In addition, as for the adjacent part of Lae Central, mainly informal residential lands are expanding.

The traditional villages were confirmed along Wau Road in Markham River southern side which is added in this study. These traditional villages had already existed by the time of the Revised-Map-2003. Therefore, the traditional villages were added to the Revised-Map-2003 and Map-2015.



Source: JICA Project Team

Figure 5.2.10 Comparison of Map-2003-Revised and Map-2015
in Southern Part from Markham River and along Highlands Highway

3) From Yalu to peripheral of Nadzab Airport

According to Revised-Map-2003 the traditional villages had expanded widely in Yalu along Highlands Highway roadside. However, this field survey had revealed that many of those traditional villages had vanished or became very small. Besides, it can be observed that some industrial sites are emerging along the roadside.

In the peripheral of Nadzab Airport there is no major change in land use identified, however commercial agriculture land (pasture) has expanded to the north.

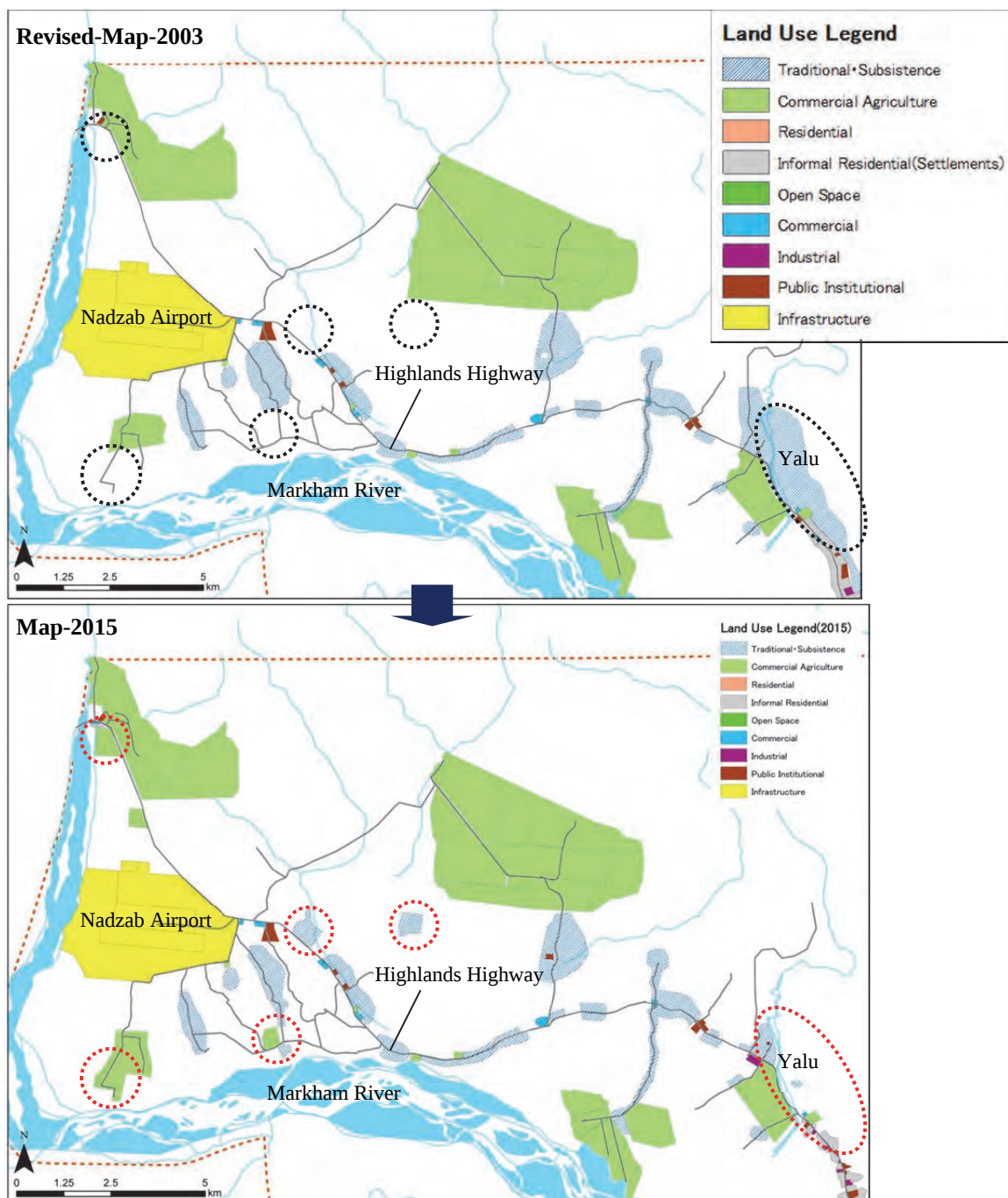
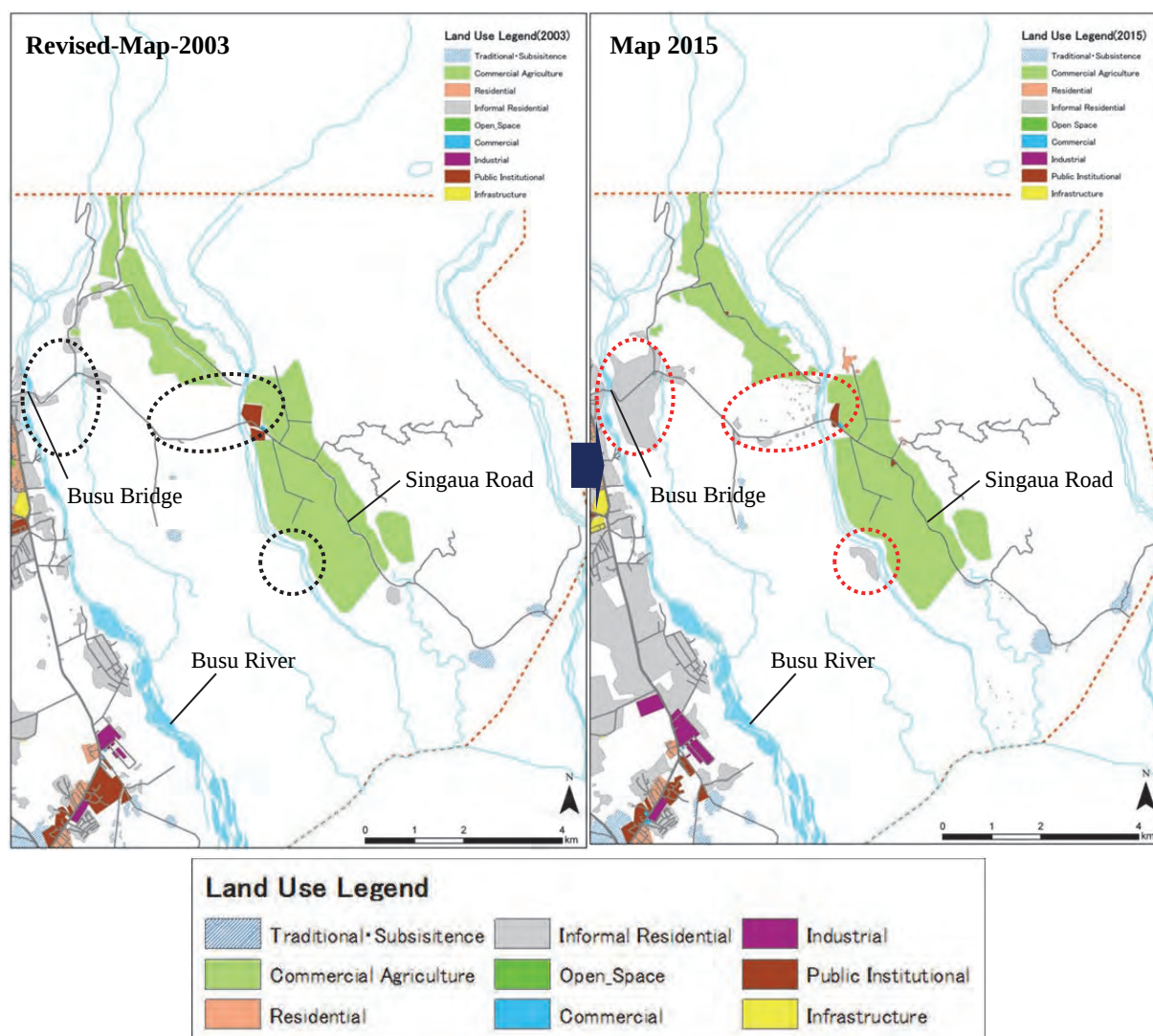


Figure 5.2.11 Comparison of Map-2003-Revised and Map-2015 around Nadzab Airport

4) East Side of the Busu River

There is no major change in agricultural land while informal residential land has expanded along Singaua Road. The population growth and population influx into urban area occur in this area because this area is adjacent to Lae Urban LLG connected by Busu Bridge.



Source: JICA Project Team

Figure 5.2.12 Comparison of Map 2005 and Map 2015 in Eastern Part of the Busu River

(2) Changes of current land use area

1) Scale and area of current land use map

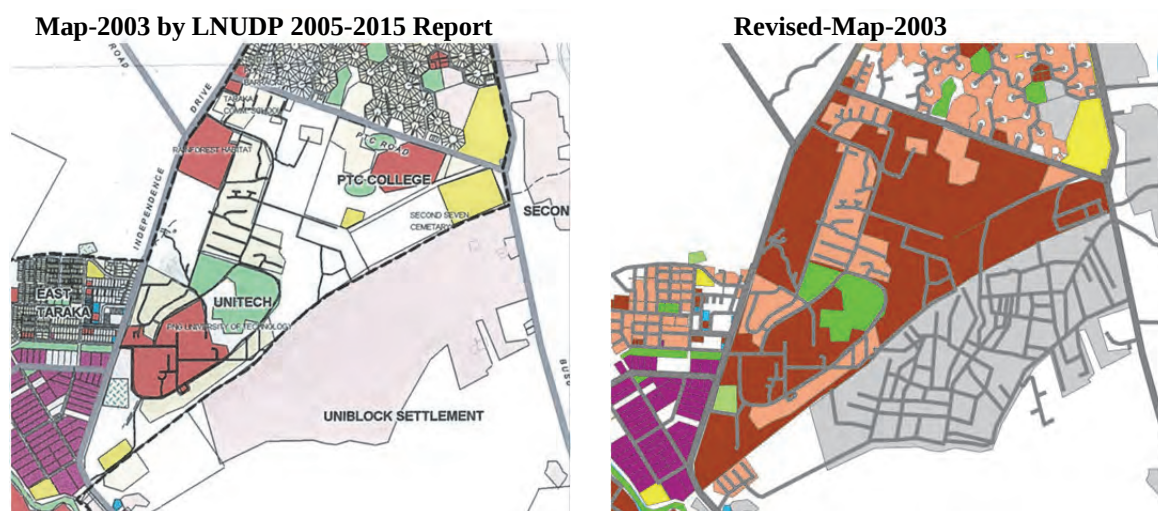
In the current land use study, target planning area is a vast land of about 1,057 square kilometres (about 105,700 hectares). A set of project base maps were prepared in order to identify and confirm these changes during the basic planning stage, and a comparative study was performed on 10- hectare mesh.

2) Comparison of Map-2003 in LNUDP 2005-2015 Report and Map-2003-Revised

Due to the master plan target area expansion in this study, the project target area has increased about 40% from the previous one of LNUDP 2005-2015.

Traditional settlements occupied large area of land in the south side of Markham River which is additionally targeted land. Therefore, traditional settlements of Revised Map-2003 [B] have expanded from Map-2003 [A] during the time of LNUDP 2005-2015 study. When Map-2003 [A]

was prepared, only a part of the land of UNITECH was coloured, and most of the facilities within the campus are also coloured as the university land, resulting in great increase of public facilities land use area in the Revised Map-2003 [B].



Source: LAE-NADZAB URBAN DEVELOPMENT PLAN 2005-2015

Figure 5.2.13 Comparison of Map-2003 by LNUDP 2005-2015 Report and Map-2003-Revised in UNITECH

3) Change from Revised-Map-2003 to Map-2015

a) Residential land use (Residential, Informal Residential, Traditional/Subsistence)

Although not much change is observed in formally developed residential land, informal residential area has expanded almost twice as much in the last 12 years. Most of the expansion of informal residential area has been caused by population growth, and has occurred adjacent to Lae City, because of higher migration and population influx.

This study has confirmed that the expansion of traditional residential land near Yalu is not as large as it is shown in the Revised Map-2003 [B]. The level of information accuracy has improved since the time of Revised Map-2003 [B] preparation, and the revised information illustrates that the actual area of traditional residential land has been greatly reduced. Therefore, the traditional residential land has not changed much from the past.

b) Industrial-based land use (Commercial, Industrial)

No change has been observed in the commercial land, however industrial land has increased about 150ha. More than half of the land increase is identified in and around Lae Urban LLG, and the rest of increased lands are located along the Highlands Highway roadside. Considering the future economic development of PNG, the increase in industrial development land will continue.

c) Public-based land use (Public Institutional, Open Space, Infrastructure)

Through the examination of previous development activities and volumes, only minor changes are identified in public facility land use, such as area increase in Lae Central Area accounting for about 10ha of land. Similarly, there have been very minor changes in open space and urban infrastructure facility land uses including the Nadzab Airport. With regard to the road development, about 8 kilometres of the Highlands Highway has been widened to four lanes slightly increasing the area of urban infrastructure facility land use.

Table 5.2.2 Land Use Area Change in Whole Project Area
from Revised-Map-2003 to Map-2015

Land Use Category	Reference; Map-2003 by LNUDP 2005-2015 Report [A]	Revised-Map-2003 [B] *(Lae Central & Neighbourhood)		Map-2015 [C] *(Lae Central & Neighbourhood)		Note
-Residential	704 ha	680 ha (560 ha)	6% (20%)	690 ha (510 ha)	6% (14%)	
-Informal Residential	1,129 ha	1,120 ha (740 ha)	11% (27%)	2,090 ha (1,530 ha)	18% (42%)	Increase
-Traditional/Subsistence	1,486 ha	1,670 ha (100 ha)	15% (4%)	1,390 ha (160 ha)	12% (4%)	Decrease, [C] is almost same as [A].
-Commercial	92 ha	90 ha (50 ha)	1% (2%)	100 ha (50 ha)	1% (1%)	
-Industrial	286 ha	290 ha (250 ha)	3% (9%)	450 ha (340 ha)	4% (9%)	Increase
-Public Institutional	557 ha	720 ha (630 ha)	7% (23%)	740 ha (640 ha)	6% (18%)	[B] increase from [A].
-Open Space	313 ha	310 ha (300 ha)	3% (11%)	290 ha (280 ha)	3% (8%)	
-Infrastructure	1,127 ha	1,140 ha (70 ha)	11% (2%)	1,150 ha (70 ha)	10% (2%)	Including Nad zab Airport
-Commercial Agriculture	4,628 ha	4,660 ha (50 ha)	43% (2%)	4,620 ha (70 ha)	40% (2%)	
Coloured Area Total	10,322 ha	10,680 ha (2,750 ha)	100% (100%)	11,520 ha (3,650 ha)	100% (100%)	
Project Area	74,130 ha	105,670 ha	-	105,670 ha	-	[B] and [C] are expanded than [A].

* The land use areas are rounded.

Source: JICA Project Team

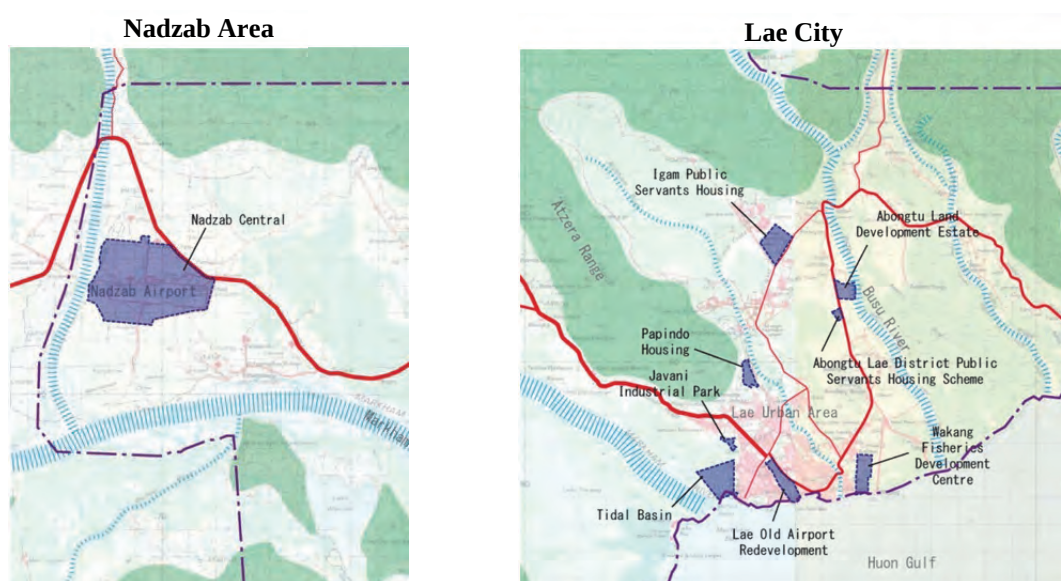
5.2.3 Overview of the Urban Development Projects

Projects of urban development including multiple residential areas and industrial parks have been envisaged and planned aiming for further development in Lae-Nadzab Area.

- Lae Old Airport Redevelopment [plan]: The vacant lot of Lae Airport is located in the heart of Lae Central. Taking advantage of its location, potential and scale, various public facilities, commercial and industrial facilities, transportation facilities and other development complex for the core of urban area are planned.
- Lae Tidal Basin [plan]: In Lae Port which is the largest trading port of PNG, expansion space has become an issue for increase of transportation volume in the future. The plans to build trading port and related facilities have been promoted by utilizing the swamp the west side of the current port including the hinterland. First phase of construction of port facilities has been completed in 2014.
- Javani Industrial Park [plan]: Port-related industrial park development planned in the hinterland of Lae Tidal Basin, and this project is promoted by Morobe Province. Including Tank Farm and rental space with the development area of about 12 hectares.
- Wagang Fisheries Development Centre [envision]: The complex development focusing on fishery port is envisaged in Wagang located in left bank of Bumbu River. Fishing port facilities, industrial facilities and urban areas including housing development are included.
- Abong Lae District Public Servants Housing Scheme and Abongtu Land Development Estate [plan]: Abong Lae District Public Servants Housing Scheme and Abongtu Land Development

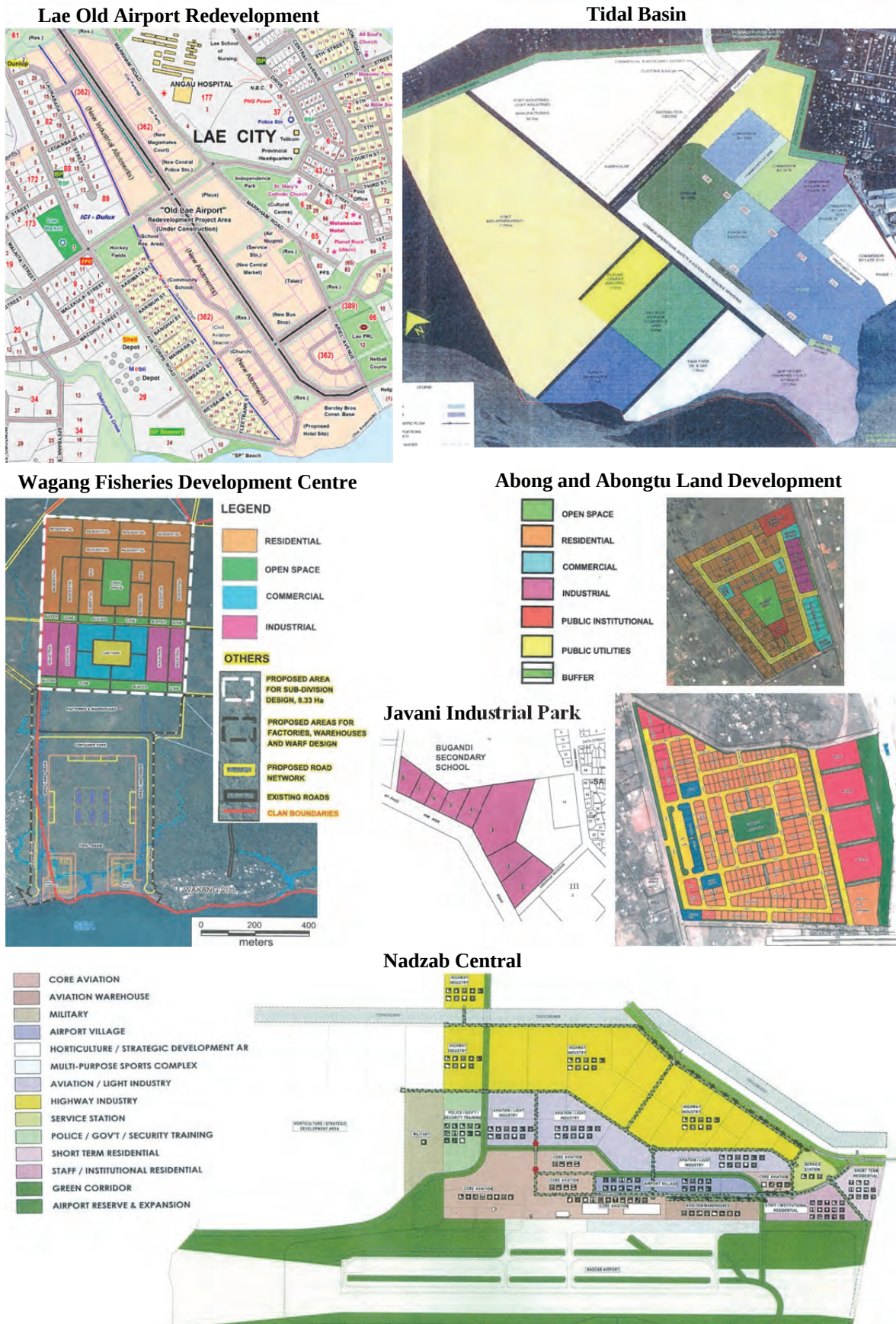
Estate is a residential development in Ahi Rural LLG. This is a PPP project supported by Lae District Administration of Morobe Provincial Government in order to increase the willingness of the land development of the landowners (Ahi tribe). In the development area, commercial and industrial development in addition to residential development along Busu Road has been planned.

- Papindo Housing and Igam Housing [plan]: These are formal residential complex developments within Lae City, where the population growth has been building informal settlement. Recently Papindo Housing development has been promoted.
- Nadzab Central [envision]: Nadzab Central is an industrial park development plan adjacent to the Nadzab Airport (about 1,000 hectares). While supporting the airport function taking advantage of the airport and nearby Highland Highway, it is intended to support the business of Highland and Northern Province. The conception includes airport-related facilities, logistics industry, light industry, plantation, etc.



Source: JICA Project Team

Figure 5.2.14 Urban Development Project in Lae-Nadzab Area



Source: Morobe Province

Figure 5.2.15 Concept Plan of Urban Development Project in Lae-Nadzab Area

5.2.4 Problems and Development Issues Related to Land Use

(1) Problems related to land use

1) Realization of the LNUDP 2005-2015

a) Residential areas that have not been largely realized.

In LNUDP 2005-2015, a structural plan (2005-2015) as policy for development and conservation has been proposed. Four residential locations were selected as future urban development areas (total size of vacant land which can be developed is about 3,000 hectares). They were planned within Lae City, Lae City neighbourhood along Highlands Highway, and north side of Nadzab Airport. Although the targeted planning period has come to an end, majority of future urban development area including residential has not been realized.

b) Industrial land development that has not progressed in hinterland of port.

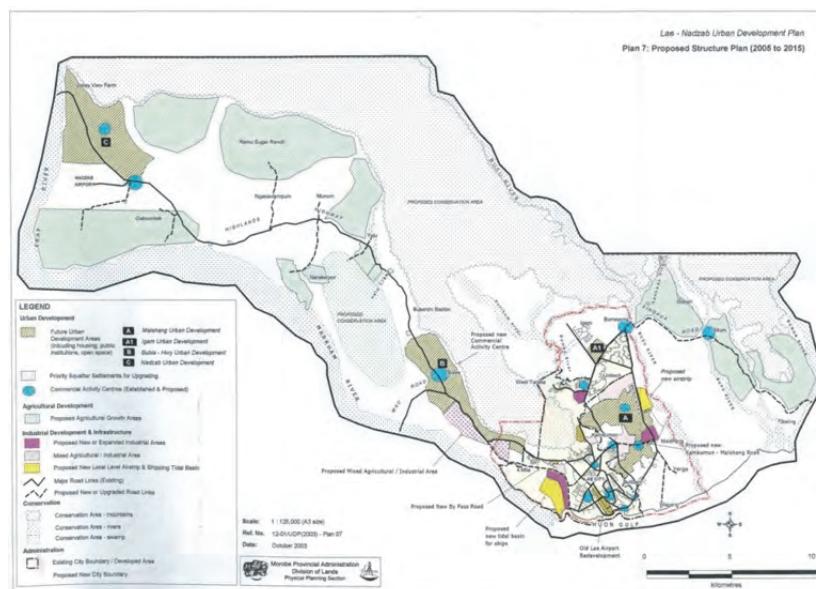
The expansion of industrial land and industrial facilities has progressed gradually in the roadside of Independent Drive and Busu Road in Lae City giving the impression of better realization compared to other land use. However, despite the first phase development of the international port tidal basin, port-related industrial development, such as Javani Industrial Park, planned in the hinterland has not started yet. Thus, future development is expected.

c) Highlands Highway roadside where land use conversion gradually progresses.

In the Highlands Highway roadside, conversion of mainly plantation lands to industrial land gradually progresses in the Lae City periphery where urban area extends. However, there will be some difficulties to implementing as urban developments including residential uses.

d) Old Airport site and Nadzab Airport neighbourhood development do not progress.

Although Lae Old Airport redevelopment is an important project for growth of Lae Central, any development has not been realized. In addition, the runway utilization planned in Busu Road roadside within Lae City also has not been realized. No new development is observed in Nadzab Central, which should utilize Nadzab Airport as a logistic hub and can be expected to become the urban core of Lae-Nadzab Area.



Source: LAE – NADZAB URBAN DEVELOPMENT PLAN 2005-2015

Figure 5.2.16 Proposed Structure Plan (2005 to 2015)

2) Expansion of informal settlement with poor living environment

After independence in PNG, house building by only providing land plots was certified in informal settlement, and informal settlement in Taraka has been provided by the public initiative. However, such policy has been dropped on the way. As a result, massive informal settlements were formed at the foot of Atzera Range, Highlands Highway roadside, on the west side of Ahi Rural LLG and others, and these are still expanding.

The allotment area of these informal settlements is 500-1,500 square metres, and is not necessarily overcrowded. However, these informal residential areas lack basic infrastructure, including paved road and rainwater drainage.

There are problems except the physical planning in the root, for example, informal settlements have become hotbed of conflict and crime between the tribes consisted from *Wantok* society. Therefore, various policies of the government also do not have a greatly effect. The expansion of informal settlement shows that this type of residential area is easily to occur, and it is clear that such expansion cannot be controlled only by the physical planning approach.

3) Lack of land use zoning which enables individuals' establishment

Influence of the Australian city planning has been strongly reflected in urban space of PNG. The strong and energetic vitality of the people seen in Asian and Middle East countries is hardly noticeable in the downtown of Lae, for instance.

Purification of single function land use, for instance, is progressing in Lae City. Places of industrial establishment are limited to the industrial area and targeted large companies, and it is difficult to proceed with using land by the individual efforts for small and medium-sized industries. Individuals are only doing trade by bringing things in open space surrounded by fence, referred to as marketplace. Places for manufacturing and processing are hardly seen. Without exaggeration, such circumstance has influenced indirectly to degrade the means of people's lives.

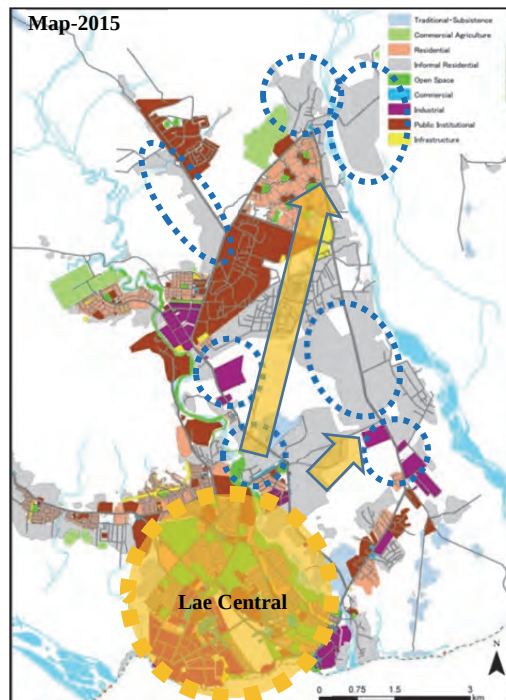
4) Topographical constraint for the urban growth

a) Extension to the northeast direction of Lae City

In terms of the expansion of Lae City by population growth, there is very limited area for development in the elongated permissible area for urbanization along Highlands Highway, which is used as a plantation from long time ago due to existence of wetlands of Markham River and Atzera Branch Range, and not much expansion is expected in the future. Therefore, Lae Central expansion recently has been progressing to the northeast direction in Lae Urban LLG and west of Ahi Rural LLG rather than the western direction to Highlands Highway and Nadzab Airport.

b) Lack of network flexibility

The urban structure mainly relies on only regional trunk road. There are a few alternative routes, such as the Back Road, and these will be greatly affected by the traffic congestion connected with the trunk road and construction activities. There is low flexibility to connect districts with each other causing the risk for sustainable urban development. In addition, there are only two bridges to cross the Butibum River between Lae Central and Ahi Rural, making it is difficult to promote extensive urbanization. The road in Labu in south side of Markham River has not been developed so that the



Source: JICA Project Team

Figure 5.2.17 Expansion Direction of
Lae City from 2003 to 2015

access to Lae Central from Labu is mainly by the coastal transport. The route is sometimes disrupted by Markham River at times of heavy rain.

c) Lack of recreation area

There are open spaces and sports grounds for special events in Lae Central, however, there are very few regional recreation areas for young and old to enjoy at any time. There should be more diverse and multi-purpose recreational areas in the future along with the urban development.

(2) Issues of the urban development in accordance with the land use

1) Issues for urban growth

a) Customary land utilization for urbanization

Most pressing issue for land use is customary land utilization for urbanization. It is considerably difficult to guide the use of and control of customary land. Large tracts of customary land adjacent to Lae City boundary are used for informal settlement or not used for urban functions including factory and public utilities. It is a great issue for urban growth to devise the mechanism so that customary land would be incorporated in implementation of the urban development plan.

b) Secure the expansion of urban area

The development direction has recently expanded towards the northeast from Lae Central rather than the west towards Nadzab Airport to absorb recent significant population growth. Southern side along Highlands Highway has been developed as plantation farmlands and settlements for migrants from the Highlands region. On the other hand, there is a 500-metre wide land use restriction in Atezera Branch Range along the Highlands Highway and the wetland along Markham River. Because of such condition, the areas for development are restricted. The land use conversion has begun recently, and the conversion allowed the land use change from plantation farmlands to industrial lands.

Such proceeding development inhibits urban integration in Lae-Nadzab Area. In order to promote the development of Lae-Nadzab Area, it is required to enhance urban growth with certain developments, such as connecting the Western Highlands region together with a new development of Yalu-Igam Bypass.

c) Formation of ladder road network for the urbanization

Towards the urbanization and development in Lae-Nadzab Area, it is useful to form a network that should be more flexible to connect all the districts. In order to achieve a good development of network in the region, it is effective to form the urban road network organized like a ladder structure to respond to a timely development demand.

d) Setting up the reasonable and feasible attainment target for development

Considering that the past LNUDP 2005-2015 was hardly realized, the cause and problems were sought for analysis. According to the problem seeking and analysis, it is recognized that it is important not to plan with excessive expectations. Reasonable and feasible planning is required for the development in Lae-Nadzab Area.

2) Issues on the improvement of residential environment and Industrial growth

a) Prevention of informal settlement sprawl by providing affordable housing

In Lae-Nadzab Area, currently 130,000 (about 60%) of 210,000 population live in informal settlements. It will continue to expand along with the population growth expected without establishing any prevention means for the future development. These informal settlements are fortunately not overcrowded, and the living environment should be easily improved in the future having such distinctive characteristic, by additional development of basic urban infrastructure facilities.

The improvement of living environment should be prioritized as informal settlements continue to expand in the future. It is effective to introduce affordable housing development schemes.

b) Introducing Mixed Land Use for making strong individual ingenuity

From the industrial development point of view, it is essential to reserve the spaces that can enhance development under the industrial establishment guideline in the physical plan. As the concentration of residents to the town, the commercial and business area tends to expand densely or outward, making it difficult for fixed land use designation to accommodate the urbanization dynamics. There is a need for mixed land use for smooth land use conversion to activate development potential of the private sector.

c) Creation of a variety of recreational areas

In addition to the urban open space developed, there is a need to create a network of recreation places so that people's daily diverse activities can be extended in wider range.