Ministry of Regional Development, Building, Housing and Public Works (MAHTP)
Government of the Republic of Madagascar

The Project on Master Plan Formulation for Economic Axis of TaToM (Antananarivo-Toamasina, Madagasikara)

TaToM

Final Report
Main Text: Volume 2

October 2019

Japan International Cooperation Agency (JICA)

Oriental Consultants Global Co., Ltd.
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List of Abbreviations

ABBREVIATION	ENGLISH	FRENCH
3P	Public-Private Partnership	-
3R	Reduce, Re-use, Recycle	-
AAAC	All Aluminium Alloy Conductor	-
ACSR	Aluminium Conductor Steel-Reinforced	-
ADEMA	Airport of Madagascar	Aeroport de Madagascar
ADER	Rural Electrification Development Agency	Agencede Developpement de l'Electrification Rurale
ADP	Airport of Paris	Aeroport de Paris
AFD	French Development Agency	Agence Francaise de Developpement
AfDB	African Development Bank	Banque Africaine de Developpement
AGOA	African Growth and Opportunity Act	La loi sur la croissance et les opportunités économiques en Afrique
APIPA	Authority for the flood protection of the plain of Antananarivo	Autorité pour la Protection contre les Inondations de la Plaine d'Antananarivo
ARR	Arrondissement	Arrondissement
ARTEC	Authority of Communication Technology Regulatory	Autorite de Regulation des Technologies de Communication
ATT	Agency of Land Transport	Agence des Transports Terrestres
BCC	Bureau Control Command	Bureau de Controle et de Commande
BF	Public Water Connection	Borne Fontaine
BFPS	Public and Social Water Connection	Borne Fontaine Publique et Sociale
BL	Laundry Facility	Bassin Lavoir
BNGRC	Bureau of Disaster Risk Management	Bureau National de Gestion des Risques et des Catastrophes
BP	Private Connection	Branchement Particulier
BPOR	Regional Objective Budget Program	Budget Programme par Objectif par Région
BRGRC	Regional office of BNGRC	Bureau Régional du BNGRC
CCA	Climate Change Adaptation	-
CCGRC	Risk and Disaster Management Commune Committee	Comité Communal de Gestion des Risques et Catastrophes
CEG	General Secondary School	College d'Enseignement General
CHRD	District Reference Hospital Centre	Centre Hospitalier de Reference de District
CHRR	Regional Reference Hospital Centre	Centre Hospitalier de Reference Regional
CHU	University Hospital Centre	Centre Hospitalier Universitaire
CIRAD	Agricultural Research Centre for International Development	Centre de Coopération Internationale en Recherche Agronomique pour le Développement

ABBREVIATION	ENGLISH	FRENCH
CISCO	School District	Circonscription Scolaire
CLGRC	Risk an Disaster Management Local Committee	Comité Local de Gestion des Risques et Catastrophes
CNTEMAD	National Distance Learning Centre of Madagascar	Centre National de Tele-Enseignement de Madagascar
COMESA	Common Market for Eastern and Southern Africa	Marche Commun pour l'Afrique de l'Est et Austral
CPGU	Emergency Prevention and Management Unit	Cellule de Prévention et de Gestion des Urgences
CREAM	Research, Study and Support Center for Economic Analysis of Madagascar	Centre de Recherches d'Etudes et d'Appui à L'Analyse Economique de Madagascar
CROU	Emergency Operation Regional Unit	Cellule Régionale des Opérations d'Urgence
CSB	Basic Health Centre	Centre de Sante de Base
CTMM	Monetics Processing Service of Madagascar	-
CUA	Urban Commune of Antananarivo	Commune Urbaine d'Antananarivo
CUT	Urban Commune of Toamasina	Commune Urbaine de Toamasina
DGATE	Direction of Territorial Planning and Equipment	Direction Générale de l'Amenagement du Territoire et de l'Equipement
DGEAH	General Directorate of Water Management, Sanitation and Hygiene	Direction Générale de la Gestion de l'Eau, de l'Assainissement et de l'Hygiène
DGEHU	General Directorate of Hospitals and Universities	Direction Generale des Hopitaux Universitaires
DGM	General Directorate of Meteorology	Direction Générale de la Météorologie
DGRE	Directorate of Water Resources Management	Direction Générale de la Gestion de Ressources en Eau
DHS	Demographic and Health Survey	-
DPS	Directorate of Strategic Planning	Direction de la Planification Stratégique
DREN	Regional Directorate of Education	Direction Regionale de l'Education
DRM	Disaster and Risk Management	-
DRR	Disaster Risk Reduction	-
DTM data	Digital Terrain Model	-
DTOA	Technical Directorate of Water in Antananarivo	Direction Technique de l'Eau à Antananarivo
EDBM	Economic Development Board of Madagascar	-
EDSMD	Demographic and Health Survey of Madagascar	Enquête Démographique et de Santé de Madagascar
EIB	European Investment Bank	-

ABBREVIATION	ENGLISH	FRENCH
ENELEC	Electric Energy	Energie Electrique
ENI	National School of Information	Ecole Nationale d'Informatique
EPP	Public Primary School	Ecole Primaire Publique
EPZ	Export Processing Zones	-
ESPA	Polytechnic University of Antananarivo	Ecole Superieur Polytechnique d'Antananarivo
ESTI	ICT College	Ecole Supérieure des Technologies de l'information
EU	European Union	-
FAO	Food and Agriculture Organization	-
FKT	Fokontany	Fokontany
FPMH	Drilling using human-operated pump	Forage a pompe a motricite humaine
FTA	Free Trade Area	-
FZE	Free Zone Enterprises	-
GDP	Gross Domestic Product	-
GIS	Geographic Information System	-
GIZ	German Development Cooperation	-
GOTICOM	ICT Operators Group	Groupement des Opérateurs des Technologies de l'Information et de la Communication
GRDP	Gross Regional Domestic Products	-
GRIMA (projet)	Inundation and landslide risk management in Antananarivo	Gestion des Risques d'Inondation et de Mouvement de terrain à Antananarivo
GSM	Global System for Mobile commucations	-
HV	High Voltage	-
IAC	Information Access Center	-
ICT	Information and Communication Technology	-
IEC	Information, Education and Communication	-
IMF	International Monetary Fund	-
INSTAT	National Institute for Statistics	Institut National de la Statistique
IOGA	Institute and Observatory of Geophysics of Antananarivo	Institut d'Observation Geophysique d'Antananarivo
IORA	Indian Ocean Rim Association	-
ITU	International Telecommunication Union	-
JICA	Japan International Cooperation Agency	-
LCPDP	Least Cost Power Development Plan	-

ABBREVIATION	ENGLISH	FRENCH
LDI	Act on Industrial Developpement	Loi sur le Développement Industriel
LION	Lower Indian Ocean Network	-
LSC	Local Steering Committee	-
LV	Low Voltage	-
M2PATE	Ministry attached to the Presidency in charge of Presidential Projects, Planning and Equipment	Minitère aupres de la Presidence en charge des Projets Presidentiels, de l'Amenagement du Territoire et de l'Equipement
MEEH	Ministry of Water, Energy and Hydrocarbons	Ministère de l'Eau, de l'Energie et des Hydrocarbures
MEN	Ministry of National Education	Ministère de l'Education Nationale
METFP	Ministry of Employment, Technical Education and Vocational Training	Ministère de l'Enseignement Technique et de la Formation Professionnelle
MID	Ministry of the Interior and Decentral	Ministère de l'Intérieur et de la Décentralisation
MINESUP	Ministry of Higher Education and Research	Ministère de l'Enseignement Superieure et de des Recherches Scientifiques
MPTDN	Ministry of Posts, Telecommunication and Digital Development	Ministère des Postes, des Télécommunications et du Développement Numérique
MSP	Ministry of Public Health	Ministère de la Sante Publique
MTM	Ministry of Transports and Meteorology	Le Ministère des Transports et de la Météorologie
MV	Medium Voltage	-
MW	Mega Watt	-
NEPAD	New Partnership for Africa's Development	Nouveau partenariat pour le développement de l'Afrique
NGO	Non-Governmental Organization	-
NHP	National Housing Policy	
NPE	New Energy Policy	Nouvelle Politique de l'Energie
NR	National Road	-
NRI	Network Readiness Index	-
NRW	Non-Revenue Water	
NSC	National Steering Committee	-
NSPS	National Sanitation Policy and Strategy	-
ODA	Official Development Assistance	
OPEC	Organization of the Petroleum Exporting Countries	Organisation des Pays Exportateurs de Petrole
ORE	Electricity Regulatory Office	Office de Regulation de l'Electricite
PAGOSE	Electricity Sector Governance and Operational Improvement Project	Projet d'Amelioration de la Gouvernance et des Operations dans le Secteur de l'Electricite
PCD	Communal Development Plan	Plan Communal de Développement

ABBREVIATION	ENGLISH	FRENCH
PDDE	Economic Development Master Plan	Plan Directeur de Developpement Economique
PDSS	Health Sector Development Plan	Plan de Developpement du Secteur Sante
PF	Family Planning	Planning Familial
PGE	General Policy of the State	Politique Générale de l'Etat
PIAA	Integrated Sanitation Program of Antananarivo	Programme Intégré d'Assainissement d'Antananarivo
PLOF	Local Plan of Forest Occupation	Plan Local d'Occupation Forestière
PNAEPA	National Program of Access to Drinking Water and Sanitation	Programme National d'Accès à l'Eau Potable et à l'Assainissement
PND	National Development Plan	Plan National de Developpement
PPMH	Wells with Human-operated Pump	Puit avec Pompe à Motricité Humaine
PPP	Public Private Partnership	-
PRD	Plan Régional de Développement	Regional Development Plan
PRODUIR	Integrated urban development and resilience project	PROjet de Développement Urbain Intégré et de Résilience
Project TaToM	The Project on Master Plan Formulation for Economic Axis of TaToM (Antananarivo-Toamasina, Madagasikara)	-
PRSP	Regional Directorate of Public Health	Direction Regionale de la Sante Publique
PSAEP	Agricultural, Livestock and Fisheries Sector Program	Programme Sectoriel Agricole, Elevage et Pêche
PSE	Education Sector Plan	Plan Sectoriel de l'Education
PUDé	Detailed Urban Plan	Plan d'Urbanisme Détaillé
PUDi	Urban Master Plan	Plan d'Urbanisme Directeur
PUPIRV	Infrastructure Preservation and Vulnerability Reduction Emergency Project	Projet d'Urgence pour la Préservation des Infrastructures et la Réduction de la Vulnérabilité
PVC	PolyVinyl Chloride	-
RC	Reinforced Concrete	-
RECs	Regional Economic Communities	Communautes Economiques Regionales
RI	Regional Interconnection	-
RIA	Interconnected Network of Antananarivo	Reseau Interconnecte d'Antananarivo
RIT	Regional Interconnection system	Systeme d'Interconnection Regionale
ROM	Revenue from Household Waste	Redevance sur les Ordures Menageres
ROW	Right of Way	
SADC	Southern African Development Community	Communaute de Developpement de l'Afrique Australe

ABBREVIATION	ENGLISH	FRENCH
SAIC	Intercommunal Land Use Plan	Schema d'Amenagement Inter Communal
SAMVA	Autonomous Department for Maintenance of Antananarivo	Service Autonome de Maintenance de la Ville d' Antananarivo
SASM	Madagascar Sugar Farming Society	Societe Agricole Sucriere de Madagascar
SDAU	Urban sanitation master plan	Schéma Directeur d'Assainissement Urbain
SEA	Strategic Environmental Assessment	-
SEZ	Special Economic Zone	-
SIM	Union of Industries of Madagascar	Syndicat des Industries de Madagascar
SMS	Short Message Service	-
SNGRC	National Strategy for Disaster Risk Management	Stratégie Nationale de Gestion des Risques et des Catastrophes
SPAT	Toamasina Autonomous Port Authority	Societe du Port àa gestion Autonome de Toamasina
SWM	Solid Waste Management	-
TELMA	Telecom Malagasy	-
TVTE	Technical and Vocational Education and Training	-
TWG	Technical Working Group	-
USD	United State Dollar	-
WB	World Bank	-
WHO	World Health Organization	-
WSUP	Water and Sanitation for the Urban Poor	-
WTP	Water Treatment Plants	-
WUA	Water Users Associations	-
ZAP	Educational Administrative Area	Zone Administrative Pedagogique

ABBREVIATION	ENGLISH	MALAGASY
JIRAMA	Malagasy Water and Electricity	Jiro sy Rano Malagasy
FIVMPAMA	Group of Malagasy Employer	Fivondronan'ny mpandraharaha malagasy
SIRAMA	Sugar Industry of Madagascar	Siramamy Malagasy

PART IV

REVISED PUDI FOR TOAMASINA AGGLOMERATION

Chapter 14 Present Situation and Challenges on Urban Development and Housing Development in Toamasina Agglomeration

14.1 Present Situation on Urban Development in Toamasina Agglomeration

14.1.1 Spatial Analysis on Urban Development of Toamasina Agglomeration

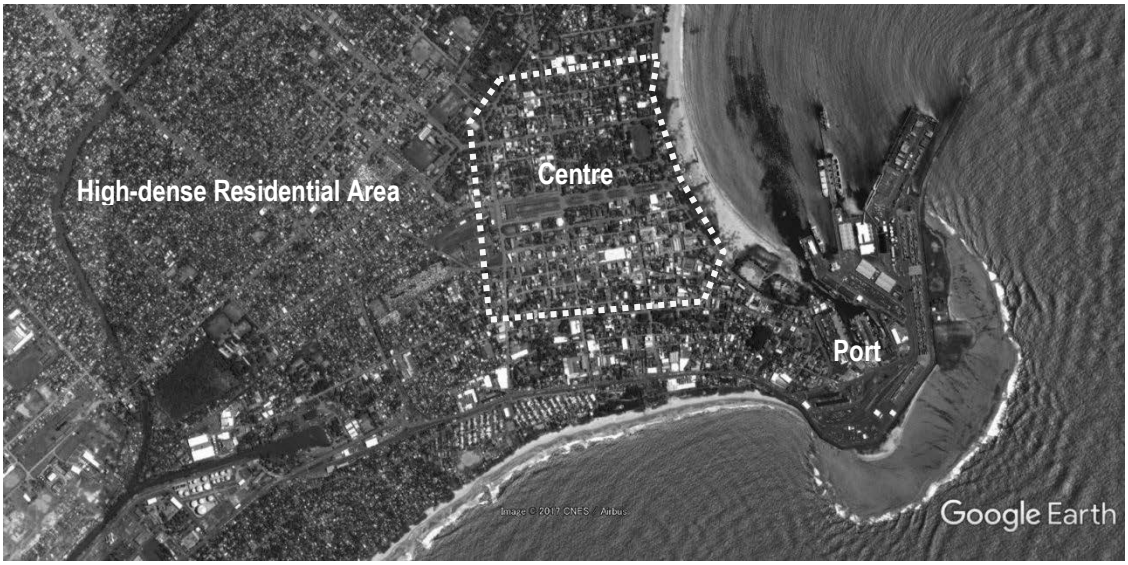
An urban structure for Toamasina Agglomeration is required for defining the future direction of urban development. It is related to the other sectoral strategies which are described in the later chapters. The following items for spatial analyses are examined in order to formulate a future urban structure.

(1) Present Spatial Characteristics of Toamasina Agglomeration

1) City Centre and Sub-Centres of Toamasina Agglomeration

The Toamasina Port is located on the east edge of the city, and near it is the urban centre. The urban centre is organised by a grid system, and in the middle of it is the Independent Avenue. The city hall of CUT is located in the avenue, at the west end, and there is the Toamasina Railway Station just behind the city hall. Length of the Independence Avenue is 800 m toward east up to the coast. The commercial, business, administrative, and public functions are concentrated in this area.

The urbanised areas are still compact and these have developed around the port within approximately 5-7 km distance. Within the urbanised areas, there are no other urban centre, although some commercial activities are found along the National Roads 2 and 5 where density of the residential area is high.



Source: Google Earth

Figure 14.1.1 City Centre of Toamasina Agglomeration

2) Urban Expansion and Sub-urbanisation in Toamasina Agglomeration

Although urban growth in Toamasina Agglomeration is not as rapid as in Antananarivo Agglomeration, the population in the former has been continuously increasing. Urbanised areas are expanding towards surrounding areas of the centre of Toamasina. Figure 14.1.2 shows the present urbanised areas in Toamasina Agglomeration.

Dense residential areas have been built around the centre, and urbanised areas have developed in undulating plain land in the east of the NR2, but both do not extend to the west of the NR2. In the south, the factory of Ambatovy is located. Urbanised areas are developing towards this direction, but not reaching the factory site. In the north, Toamasina Airport is located, and urbanisation can be seen around it.

Due to land ownership, urbanisation has been happening randomly. Reason is not only due to unclear land ownership, but also it is said that there are land owners who own large plots of lands, hence residential buildings cannot be built on those lands. Consequently, many residential buildings have been built illegally on public lands. These land issues result to unorganised urbanisation.

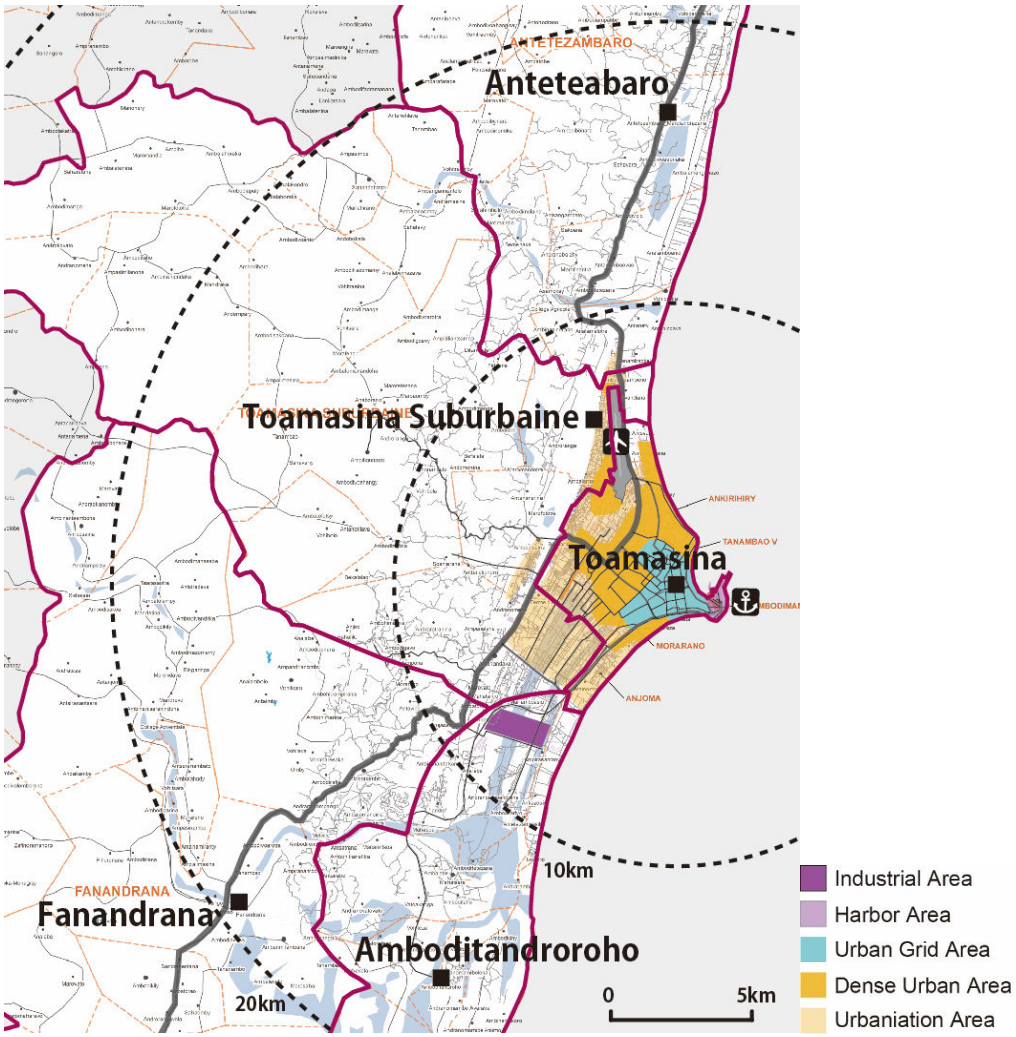
At present, the port expansion project is ongoing and more urbanisation of residential areas as well as industrial development are expected. Expansion of urbanised areas is foreseen to be an issue, and suitable land for this imminent expansion should be found with proper arrangement of installations of roads and infrastructure.

3) Mono-Centric Urban Structure and Poorly Developed Suburban Centres in Toamasina Agglomeration

Toamasina Agglomeration is composed of 5 communes that include Toamasina Urban Commune (CUT). While most areas within CUT are urbanised already, urbanised areas of the other communes are found only around CUT. And although these communes have communal capital towns, they cannot be considered as suburban centres of the agglomeration; they are still small towns and no urban activities are concentrated. In other words, there are gaps between CUA and the other communal capital towns. Only the city hall of suburban commune of Toamasina is located in the urbanised area of the agglomeration. Figure 14.1.2 shows the 5 communes and the location of their respective communal capitals.

The port and the refinery of Ambatovy are remarkable in the urban condition of Toamasina. In consideration of future expansion of industrial activities, urban structure should be organised with those industries.

In order to maximise the potential of the port expansion, a new urban structure should be introduced for the agglomeration with considered suburban centres, industrial or logistic areas, and road networks. This will be a good opportunity to set up a new urban structure before actual urban expansion happens.



Source: JICA Study Team

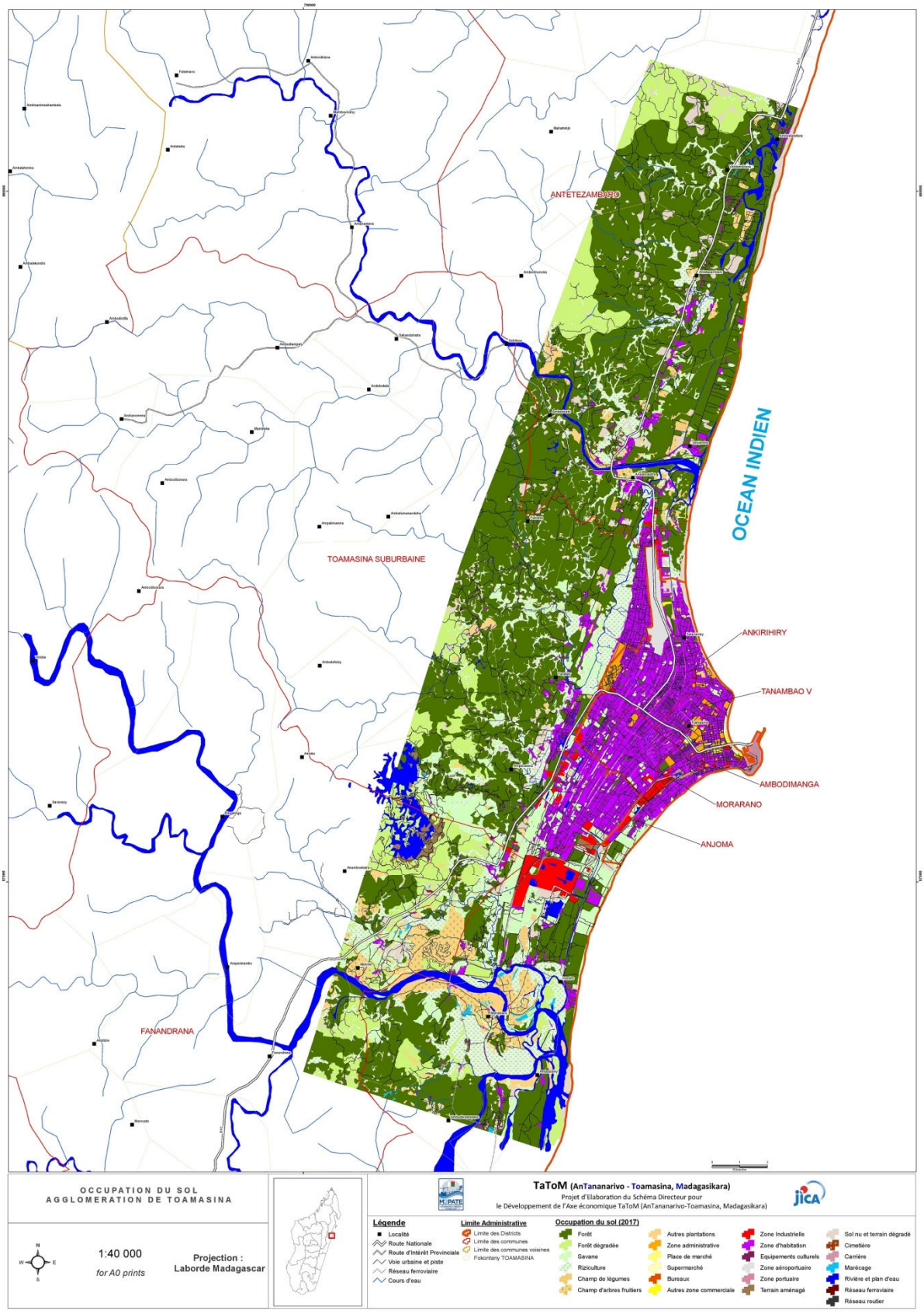
Figure 14.1.2 Urbanised Areas in Toamasina Agglomeration in 2017

(2) Existing Land Use Distribution in Toamasina Agglomeration

A present land use map of Toamasina Agglomeration is prepared by using satellite imageries taken in 2016 as shown in Figure 14.1.3, and proportion of each land use categories is shown in Table 14.1.1. The land use map is prepared for limited areas of Toamasina Agglomeration, containing whole part of CUT, and only some parts of Toamasina Suburbaine Commune, Antezambaro Commune, Fanandrana Commune, and Ambiditandororoho Commune.

Urbanised areas are compact and is concentrated within CUT and some parts of Toamasina Suburbaine Commune. The port located at the eastern edge, and the urbanised areas are developed from the area around the port to north, west, and south. While the urbanised areas within CUT is 22 km^2, which is 72% of the total CUT area, only 10% of lands are used for urbanisation in the land use survey area. Lands outside the urbanised area are composed of grasslands, forest, and few cultivated lands. Even lands beyond the land use survey area are also occupied by forests.

There are 400 ha of lands utilised for industrial purposes, and they are found in the southern part of the urbanised area.



Source: JICA Study Team by Interpreting Satellite Imageries taken in 2016

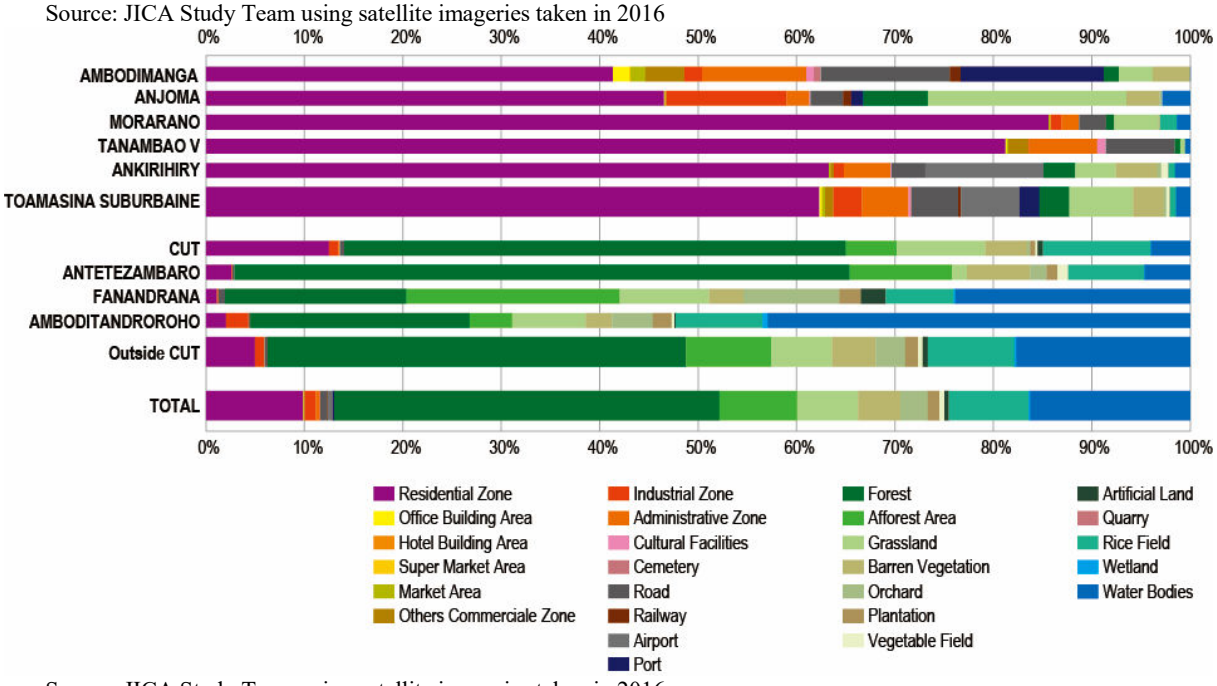
Figure 14.1.3 Present Land Use Map of Toamasina Agglomeration in 2016

Table 14.1.1 Present Land Use in Toamasina Agglomeration

Land Use Category	CUT (Toamasina I District)		Other Communes * (Part of Toamasina II District)		TOTAL*	
Residential Zone	1,935.10	62.4%	1,630.60	5.0%	3,565.60	9.9%
Office Building Area	7.1	0.2%	0	0.0%	7.1	0.0%
Hotel Building Area	0	0.0%	0	0.0%	0	0.0%
Super Market Area	0.5	0.0%	0	0.0%	0.5	0.0%
Market Area	9.5	0.3%	0	0.0%	9.5	0.0%
Other Commerciale Zone	25.4	0.8%	0	0.0%	25.4	0.1%
Industrial Zone	90.1	2.9%	310.9	0.9%	400.9	1.1%
Administrative Zone	147.5	4.8%	14.2	0.0%	161.7	0.4%
Cultural Facilities	6.5	0.2%	0	0.0%	6.5	0.0%
Road	147.3	4.7%	98	0.3%	245.3	0.7%
Railway	8.6	0.3%	9.9	0.0%	18.5	0.1%
Airport	184.3	5.9%	0.8	0.0%	185.2	0.5%
Port	63.5	2.0%	0	0.0%	63.5	0.2%
Urbanised Area	***2,625.4***	***84.6%***	***2,064.4***	***6.3%***	***4,689.7***	***13.0%***
Cemetery	2.8	0.1%	0	0.0%	2.8	0.0%
Forest	93.2	3.0%	13,973.9	42.5%	14,067.2	39.1%
Afforest Area	0	0.0%	2,849.0	8.7%	2,849.0	7.9%
Grassland	201.6	6.5%	2,020.6	6.1%	2,222.2	6.2%
Barren Vegetation	96.7	3.1%	1,453.3	4.4%	1,550.1	4.3%
Orchard	7.9	0.3%	987.9	3.0%	995.8	2.8%
Plantation	0	0.0%	428.2	1.3%	428.2	1.2%
Vegetable Field	11.5	0.4%	164	0.5%	175.5	0.5%
Artificial Land	0	0.0%	161.1	0.5%	161.1	0.4%
Quarry	0	0.0%	0	0.0%	0	0.0%
Rice Field	18.7	0.6%	2,897.00	8.8%	2,915.70	8.1%
Wetland	0	0.0%	63.1	0.2%	63.1	0.2%
Water Bodies	45.4	1.5%	5,805.1	17.7%	5,850.6	16.3%
TOTAL	3,103.2	100.0%	32,867.6	100.0%	35,971.0	100.0%

Note: * The land use survey does not cover the entire areas of the Toamasina Agglomeration (the 5 communes). The survey area comprised of CUT, part of Toamasina Suburbaine, part of Antetezambaro, part of Fanandrana, and part of Amboditandroroho.

Source: JICA Study Team using satellite imageries taken in 2016

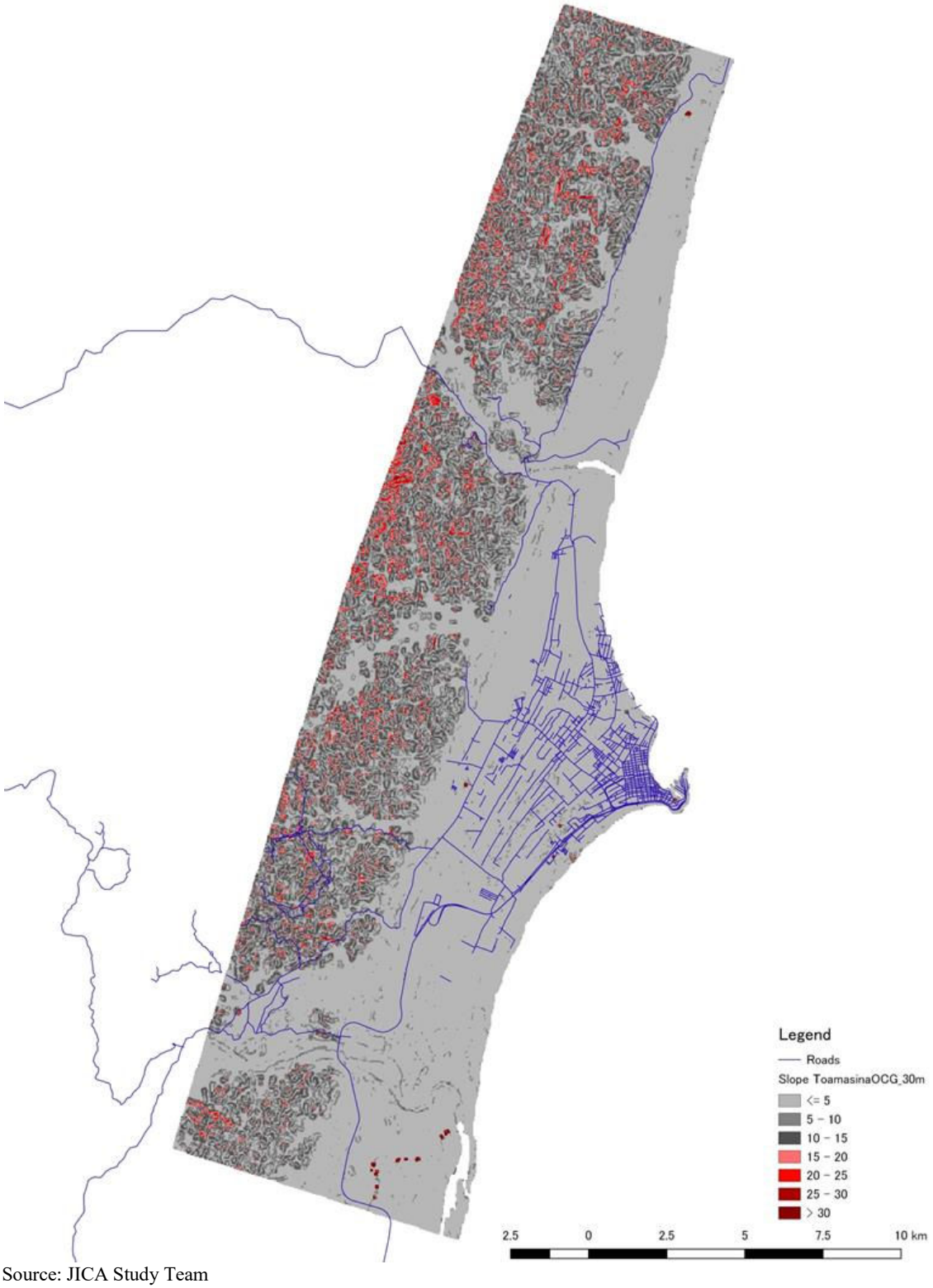


Source: JICA Study Team using satellite imageries taken in 2016

Figure 14.1.4 Proportions of Land Use in Toamasina Agglomeration

(3) Analysis for Sloped Lands

Toamasina Agglomeration has a unique topography, which is composed of undulated plain lands along the coastal side and hills on the west side. The boundary between these two topographical features is clearly seen as a straight line from south to north. In the hilly area, slopes are relatively steep that are not suitable for urbanisation.



Source: JICA Study Team

Figure 14.1.5 Slopes in Toamasina Agglomeration

14.1.2 Characteristics and Problems on Urban Development of Toamasina Agglomeration

The overall issues on Toamasina Agglomeration are identified as follows:

In CUT, basic infrastructure (e.g., for power and water supply), and services such as garbage collection, education facilities are significantly lacking while population and urban functions are over concentrated in this area.

- CUT is already overpopulated and the population densities in some fokontany are extremely high, reaching 500 to 800 persons per hectare. The concentration of urban functions further accelerates the population growth in CUT. On the other hand, development of basic infrastructure and services (e.g., power and water supply) cannot catch up with the population growth. There is a significant gap between the supply and the demand for basic infrastructure and services in CUT.

It is difficult to promote development of economic sectors because of inadequate infrastructure, such as for power and water supply.

- The shortage of infrastructure does not only affect people's quality of life, but also impede development of economic sectors, since it discourages the coming in of new investments and industries in Toamasina Agglomeration. The provision of such infrastructure is indispensable to develop economic sectors in Toamasina Agglomeration.

Because urbanisation has been progressing in low-lying areas and maintenance of the drainage infrastructure has been insufficient, rainwater flooding occurs almost every year.

- Toamasina Agglomeration is located in a frequent cyclone route. The urbanisation has been progressing in low-lying areas, drainage is filled by sedimentation and solid waste; it is not also functioning well due to lack of maintenance. As a result, Toamasina Agglomeration suffers from damages caused by rainwater flooding almost every year.

Public transport is not well developed.

- Public transport, such as bus system, is not operational in Toamasina. Only rickshaws and tricycles are the available public transport for daily movement within the city. The mobility in the city is constrained by a lack of public transport, and these vehicles become one of causes of traffic congestion in busy streets.

There are not enough hospitals, educational facilities, and recreation facilities for middle-income people.

- In Toamasina Agglomeration, international corporations (e.g., Ambatovy) which employ expatriates and professionals are already located. However, there are no facilities offering services to these middle-income people, such as hospitals for advanced medical services, international schools, or leisure and entertainment facilities in Toamasina. The professionals and management class working for those firms are more likely to choose staying in Antananarivo, not in Toamasina.

It takes 8 hours by passenger car or 2 days by cargo freight to travel 350 km distance on NR No. 2 from Antananarivo, the capital of the country as well as the centre of the economy.

- Currently, traveling 350 km distance from Toamasina to Antananarivo takes 8 hours by passenger car or 2 days by cargo freight. This traveling time should be shortened to strengthen economic activities in Toamasina.

As a result, the function of the Port of Toamasina (the primary major port of Madagascar), is not fully utilised for the development of economic sectors in Toamasina Agglomeration.

- The expansion of the Port of Toamasina can bring about a significant opportunity to develop industries and other economic sectors in Toamasina Agglomeration. However, the issues mentioned above would hinder Toamasina Agglomeration from taking advantage of the expansion of Toamasina Port.

14.2 Present Situation on Housing Development in Toamasina Agglomeration

14.2.1 Housing Situation in Toamasina Agglomeration

(1) Current Situation of Housing in Urban Commune of Toamasina

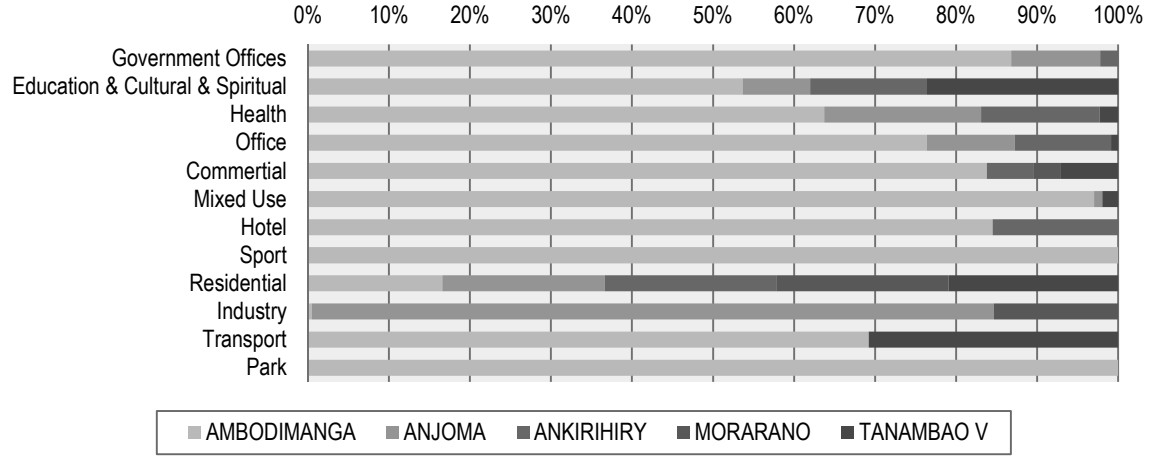
1) Current Situation of Buildings in CUT[1]

As of 2016, there are 64,767 buildings in CUT, most of which are used for residential purposes, as presented in Table 14.2.1. Residential buildings account for nearly 95% or more in four arrondissements except Ambodimanga. The buildings for business, commercial, and mixed use, and transport facilities for the Port of Toamasina are concentrated in Ambodimanga. A number of commercial facilities are found in Ankirihiry also. Most industrial facilities are located in Anjoma and Mararao, while the majority of educational, cultural and spiritual facilities are found in Ankirihiry, Amboddimanga, and Tanambao V. (See Figure14.2.1)

Table 14.2.1 No. of Buildings in CUT by Arrondissement and by Use

Arrondissement	Govern-ment Offices	Education, Cultural & Spiritual	Health	Office	Com-mercial	Mixed Use	Hotel	Sport	Residential	Industry	Transport	Park	Total
AMBODIMANGA	173	167	24	154	375	344	18	9	4,859	2	144	41	6,310
ANJOMA	27	32	9	27	0	4	0	0	7,238	454	0	0	7,791
ANKIRIHIRY	20	204	25	109	118	2	15	0	28,180	0	0	0	28,673
MORARANO	0	0	0	0	34	0	0	0	14,505	156	0	0	14,695
TANAMBAO V	0	85	1	2	37	8	0	0	7,091	0	74	0	7,298
Total	**220**	**488**	**59**	**292**	**564**	**358**	**33**	**9**	**61,873**	**612**	**218**	**41**	**64,767**

Source: JICA Study Team



Source: JICA Study Team

Figure14.2.1 Existing Buildings in CUT by Use

[1] Because the building data of four rural communes are not complete, the analysis is conducted for CUT only.

2) Residential Building Density in CUT

The density of residential buildings is estimated by arrondissement and fokontany as shown in Table 14.2.2 and Figure 14.2.2. The commune average number of residential buildings is 28 per ha. With the highest number of 41 residential buildings per ha, Tanambao V is most congested, while Ambodimanga is the smallest of 20 buildings per ha, followed by Anjoma.

The fokontany with high density of residential buildings are found in the eastern side of the Pangalanes Canal, in Morarano and Tambao V where the building density exceeds more than 70 buildings per ha. The high building density fokontany are also identified in Ambodimanga, Anjoma and Ankirihiry.

Table 14.2.2 No. of Fokontany by Level of Residential Building Density (No. / Ha) in CUT

Arrondissement	Popu-lation	Persons / ha	Residential Bld. /ha	No. of Fokontany						Share (%) of Fokontany					
				Residential Building Density per ha						Residential Building Density per ha					
				< 25	25-40	40-50	50-60	60 <	Total	< 25	25-40	40-50	50-60	60 <	Total
AMBODIMANGA	19,338	49	20	6	5	2	4	2	19	31.6%	26.3%	10.5%	21.1%	10.5%	100.0%
ANJOMA	43,565	86	23	2	4	9	3	3	21	9.5%	19.0%	42.9%	14.3%	14.3%	100.0%
ANKIRIHIRY	114,751	75	26	6	5	11	13	3	38	15.8%	13.2%	28.9%	34.2%	7.9%	100.0%
MORARANO	86,077	182	34	2	4	5	4	11	26	7.7%	15.4%	19.2%	15.4%	42.3%	100.0%
TANAMBAO V	62,555	335	41	2	7	3	13	9	34	5.9%	20.6%	8.8%	38.2%	26.5%	100.0%
Total	**326,286**	**105**	**28**	**18**	**25**	**30**	**37**	**28**	**138**	**13.0%**	**18.1%**	**21.7%**	**26.8%**	**20.3%**	**100.0%**

Source: JICA Study Team

Source: JICA Study Team

Figure 14.2.2 Residential Building Density (No. of Building / ha) by Fokontany

3) Average Footprint Size of Residential Buildings in CUT

The average footprint size of residential buildings is estimated per arrondissement and fokontany, as presented in Table 14.2.3 and Figure 14.2.3. The average footprint size of residential buildings in CUT is 60 m^2, which is almost the same size as the one of CUA, 62 m^2. Reflecting the high

density of residential buildings per ha, the footprint size in Morarano is the smallest of 45 m^2. Similarly, the largest size of 96 m^2 is found in Ambodimanga.

The fokontany with very small footprint size of residential buildings are mostly found in Morarano, along the Pangalanes Canal. The footprint size of some fokontany in the south eastern bank of the Canal in Tambao V and between the railway and the seashore in Anjoma are less than 40 m^2. On the other hand, the fokontany with the large size of footprint over 120 m^2 are found Ambodimanga.

Table 14.2.3 No. of Fokontany by Average Footprint Size (m^2) of Residential Buildings in CUT

Arrondissement	Popu-lation	Persons/ ha	Average Footprint Size (m^2)	No. of Fokontany						Share (%) of Fokontany					
				Average Footprint (m2)						Average Footprint (m2)					
				< 40	40-50	50-60	60-70	70 <	Total	< 40	40-50	50-60	60-70	70 <	Total
AMBODIMANGA	19,338	49	95.9		3	1	3	12	19	0.0%	15.8%	5.3%	15.8%	63.2%	100.0%
ANJOMA	43,565	86	61.7	3	5	4	2	7	21	14.3%	23.8%	19.0%	9.5%	33.3%	100.0%
ANKIRIHIRY	114,751	75	60.5		11	11	9	7	38	0.0%	28.9%	28.9%	23.7%	18.4%	100.0%
MORARANO	86,077	182	44.9	5	11	6	4		26	19.2%	42.3%	23.1%	15.4%	0.0%	100.0%
TANAMBAO V	62,555	335	59.0	1	16	5	2	10	34	2.9%	47.1%	14.7%	5.9%	29.4%	100.0%
Total	**326,286**	**105**	**59.6**	**9**	**46**	**27**	**20**	**36**	**138**	**6.5%**	**33.3%**	**19.6%**	**14.5%**	**26.1%**	**100.0%**

Source: JICA Study Team

Source: JICA Study Team

Figure 14.2.3 Average Footprint of Residential Buildings by Fokontany

(2) Toamasina Suburbaine Rural Commune

The urban area of Toamasina has been expanded into Toamasina Suburbaine, especially in the two fokontany of Ambodisaina and Ambalamansy that have a border with CUT. The new migrants came from rural and mountainous areas, looking for better living environment and opportunities. With the population growth and urbanization, however, development has been occurring without building permits and sufficient basic infrastructure, for example, in the area along the National Road No. 5. The commune reported that the industrial area and public owned lands are occupied

by the people and now accommodate about 7,000 residents. The fact that some owners have large plots of land makes difficult to obtain building permits and develop the public infrastructure and facilities. Such case is also reported in CUT as well. Some issue related to industrial development is reported in the area adjacent to the industrial area.

Therefore, it is necessary to improve the living environment of the settlements experiencing the population growth by developing basic infrastructure such as water and power supply. Meanwhile, since the population growth will be continued in Suburban Toamasina in the future, development of residential areas and improvement of basic infrastructure and public facilities are also necessary to meet the needs of the future residents.

(3) Rural Communes of Amboditandroroho, Antetezambaro, and Fanandrana

In the three rural communes, population is growing in the fokontany near CUT and along the National Roads. In Amboditandroroho, the Fokontany of Ambokarivo along the National Road No. 2 is experiencing sprawling of Toamasina. The area has been developing without development licence and infrastructure. The commune also reported that the unknown land tenure constrains not only development of individual housing but also public facilities such as schools. The commune cannot process the building permit because large plots of land in the commune are owned by unknown but small number of people. Due to the isolation by the canal and river, the expansion of the coverage of basic infrastructure, such as water and power supply is a critical issue for the commune.

In the two communes of Antetezambaro, and Fanandrana, development has been occurring along the National Road No. 2 and No. 5. Similar to the other communes, the issues include development without a building permit and lack of basic infrastructure, such as supply and power supply.

14.2.2 Characteristics and Problems on Housing and Informal Settlements in Toamasina Agglomeration

The issues related to housing and settlements in Toamasina Agglomeration are discussed in accordance with the urbanized area of CUT, suburban areas, and rural areas. Mainly three issues identified for these areas include decongestion of the urban centre, and development of residential areas in suburban, and development of settlement centres.

At first, issues identified in the urbanized areas of CUT include the congested urban areas, lack of basic infrastructure and public facilities, and the quality of housing stock. In CUT, two arrondissements, Morarano and Tanambao V, are identified as highly congested area without sufficient basic infrastructure. In particular, fokontany along the Pangalanes Canal of the two arrondissements have very high population density of more than 300 persons per ha, high building density of 70 per ha, and small footprint size of residential buildings. Moreover, basic infrastructure such as roads, water and power supply, sanitation and hygiene equipment, park and open space, garbage collection, schools, and street lights, are not sufficient and can negatively affect health of the residents. It should be also pointed out that these fokontany are also prone to inundation and flooding during cyclones and heavy rain fall. These areas and other areas with similar settlement conditions, such as some fokontany in Ankirihiry and Anjoma should be improved, by reducing the population density while developing basic infrastructure.

Hence, it is important for the suburbanized areas of CUT to prepare for future urbanization and develop residential areas with adequate basic infrastructure. The fokontany of Toamasina Suburbaine Commune facing CUT are experiencing influx of population, some of who occupy the land and develop dwelling without permits. It is no doubt that this trend in the suburban areas of CUT will not only continue but also be accelerated in future, along with development of the agglomeration and expansion of port activities. Thus, a strategic approach and well considered plan should be prepared in advance to develop residential areas with good living environment and basic infrastructure and facilities. In particular, it is necessary to consider how to develop large

plots by addressing the issue of ambiguous land tenure, in order to accept both the future population growth and the population from CUT for the decongestion.

Despite the congested urban centre development in CUT, in 2018, only 25 % of the population in the agglomeration reside in the four communes. This would be partly attributed to the lack of basic infrastructure and facilities, such as water supply, schools and health clinics, in addition to insufficient employment opportunities in the rural communes. For example, currently there is no high school outside CUT and Toamasina Suburbaine.

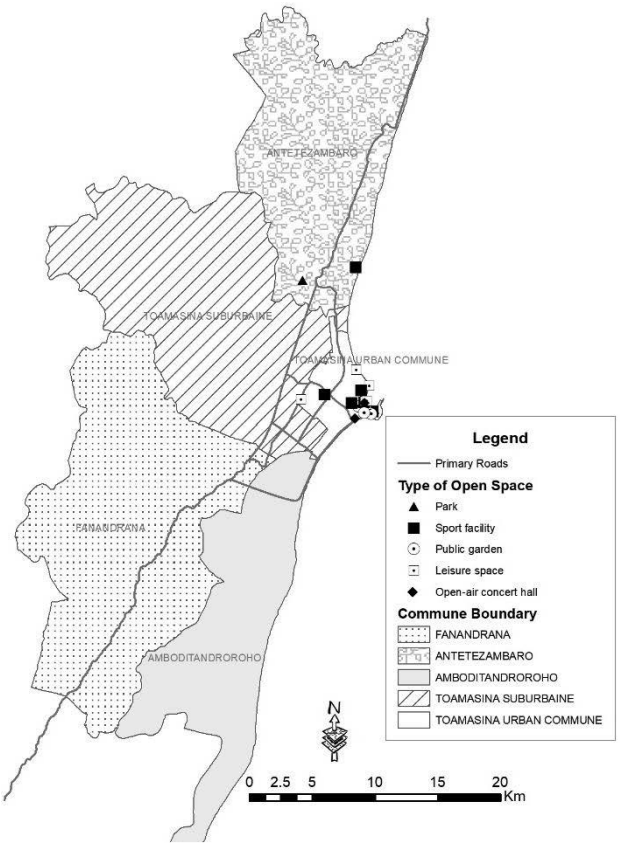
14.3 Present Situation on Open Space in Toamasina Agglomeration

14.3.1 Situation on Open Space in Toamasina Agglomeration

Although there are still plenty of lands left in the surrounding communes, as the urbanisation pressure emerges, unoccupied lands are slowly vanishing in the central areas of CUT.

In addition the number of existing facilities in Toamasina Agglomeration currently recognised as open space is limited. Meanwhile outside CUT, there are only two facilities recognised as open space (See Figure 14.4.1).

In the future, the population of Toamasina Agglomeration will be increasing less in CUT and more outside CUT. Therefore, it is urgently needed to preserve lands where the future population can relax and enjoy the environment.



Source: JICA Study Team

Figure 14.3.1 Location of Existing Open Spaces in Toamasina Agglomeration

14.3.2 Characteristics and Problem on Open Space in Toamasina Agglomeration

(1) Lack of Open Space Facilities in Toamasina Agglomeration

At present, the number of open space facilities such as parks and sports facilities in Toamasina Agglomeration is limited, and unoccupied lands play a role of urban parks and sports ground.

However, as the population of Toamasina Agglomeration continues to grow, and unoccupied land will disappear increasingly, the necessity for such facilities will increase in the future. In addition, remaining non-urbanised areas in CUT, as much as possible, should play the role of protecting the city from losing its urban function.

(2) Necessity of Urban Parks

Urban parks should provide not only recreation space. They should also provide places supporting healthy urban life. As the population increase and the lifestyle shifts from rural to urban, the role of urban parks would become more critical.

CUT will continue to attract more people and businesses, and it is assumed that the daytime population will increase rapidly.

14.4 Review of Existing Urban Development Plans and Ideas for Toamasina Agglomeration

14.4.1 Urban Structure proposed in the Existing PUDi

PUDi 2004 was developed to restrict informal settlements and promote spatial development of the city. In the planning history, the old PUDi of Toamasina was made in 1952. Since the 70s, spontaneous urbanisation has gone beyond the boundaries of PUDi 1952. This unorganised development was mainly due to the absence of proper planning control. PUDi 2004 pointed out the lack of long-term clear spatial planning vision, land tenure management, strategic direction on economic development, infrastructure and facilities, and environmental management. To overcome the situation, PUDi 2004 was formulated with the long-term planning horizon to 2023 and beyond.

(1) Major Strategies

The major strategies in PUDi 2004 are summarised below.

Table 14.4.1 Major Strategies in PUDi 2004 of Toamasina Agglomeration

Strategies	Description
Rehabilitation and improvement of roads	Main focus was given to establish road network through improvement of existing roads and creation of new roads.
Improvement of the port	The port has functioned as an international gate for trade from/to the world. To strengthen the port function, proper management measures should be put in place. To identify the special areas for port activities for effective operation To rehabilitate the existing port and reinforce equipment To improve access roads to the port To develop and revitalise the industrial zone around the port. To redevelop the area located in the east of Boulevard de l'Ivondro between Cité Canada, and the existing harbour area.
Major strategies by area of theme	City Centre and Development Poles To preserve and rehabilitate the city centre and create new development poles To maintain the current industries and extend new industries To utilise land of the military and integrate the Bazar for urban development. Residential Areas To extend residential areas with proper infrastructure in the peripheries To reduce density of the existing high-dense area and develop resettlement zones To improve informal settlements and develop social housing Public Facilities and Spaces To improve the existing public spaces/facilities and allocate public spaces/facilities in the extension areas such as markets To implement and develop public spaces such as the coast, Pangalanes Canal, and the Canal du Nord, and improve accessibility to coastal areas To increase green space and landscape by recovery of the open spaces and by development of Pangalanes Canal To recover the right-of-ways for better functioning of the infrastructures (roads, railways, pipelines, and perimeter of security around industrial zones) Environment

	To keep the cleanliness of the sea and the canals, and protect sensitive areas. To introduce storm water reservoir wherever possible, and water management system Others To rehabilitate communal and administrative buildings To develop tourist areas inside and outside of the city.

Source: PUDi 2004 for Toamasina Agglomeration

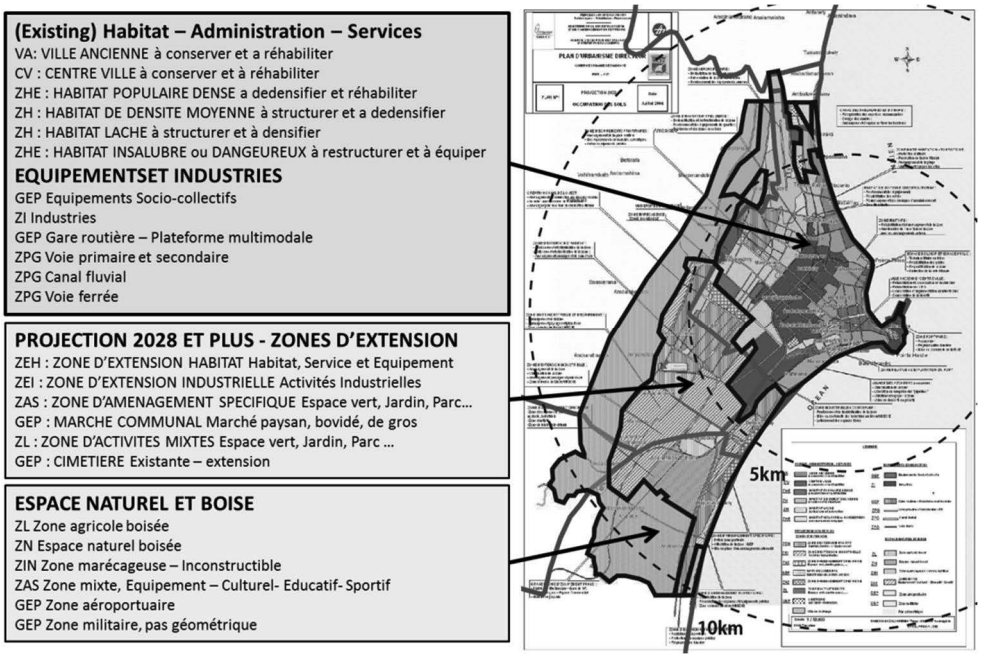
(2) Land Use Zoning and Regulations of PUDi 2004 for Toamasina Agglomeration

The land use zoning plan of PUDi 2004 is shown in Figure 14.4.1. The proposed zones are classified into 3 types as follows:

Table 14.4.2 Land Use Zoning System in PUDi 2004 of Toamasina Agglomeration

Land Use Type	Description
Existing Urbanised Areas	On the existing urbanised areas at 2004, several types of zones were proposed. The centre of the city: "Ancient City" and "City Centre" Several residential zones are identified by different types of density and characteristics. An industrial zone and some other areas dedicated for infrastructures
Expansion Areas	In the southern part of the existing urbanised areas, some expansion areas were proposed. An extension zone for residential and industry usage Other zones for public spaces, market, cemetery and mixed use.
Nature and Forest Areas	Several greenery areas are identified for surrounding areas of the existing urbanised areas and the identified expansion areas. It contains agricultural zone, wooded and forest areas, etc. In addition, some other areas, such as culture, military, were identified.

Source: PUDi 2004 for Toamasina Agglomeration



Source: PUDi 2004 for Toamasina Agglomeration (edited by the JICA Study Team)

Figure 14.4.1 Land Use Zoning of Toamasina Agglomeration in PUDi 2004

(3) Observations

Although the PUDi 2004 was formulated for the purpose of controlling and formalizing the urbanised conditions of the city and its surrounding areas, it was difficult to implement the PUDi either by the communes or by the Ministry. Problems of the PUDi are summarised as follows:

- Non-utilisation of accurate base maps for PUDi: It negatively affected the zoning maps and building permission. For instance, boundaries of the zoning do not correspond to actual ground physical condition. Therefore, it is difficult to read and use them correctly.
- Administrative boundaries are not clear.

- Inconsistency between the actual ground conditions and the contents of the PUDi: Land use zoning and regulations do not respond to accurate ground physical situation so that proper land use and development control are not possible.
- Insufficient coordination between the communes and relevant government agencies
- No reflection of sectorial infrastructure development plans was made on PUDi.
- There is no implementation mechanism for infrastructure development mentioned in PUDi.

14.4.2 Presidential Projects Office's Development Ideas for Antananarivo Agglomeration

M2PATE revealed a map of proposed projects and development policies for Toamasina Agglomeration in 2018. These ideas have been incorporated as presidential projects and the map has been revised in February 2019. See Figure 14.4.2. Total of 22 projects and target areas for future development are shown on this map. These 22 projects are as listed below.

- 1 Port Expansion Project
- 2 Port Project for Developing Quay for RORO Ships and Passenger Ships
- 3 Port Project for Port Building
- 4 Beach Front Project MAIAMI
- 5 Gymnasium
- 6 Barikadimy Stadium
- 7 North Coast Road + NR2 Link Road
- 8 North Wholesale Market
- 9 North Bus Terminal
- 10 Airport Project (ADEMA)
- 11 Bypass between NR2 and NR5
- 12 Industrial Pole in Tsarakofafa
- 13 Widening of Tsarakofafa Road to 4-lane Road
- 14 Truck Terminal Development and Establishment of Logistic and Commercial Platform
- 15 Dry Port
- 16 South Wholesale Market
- 17 South Bus Terminal
- 18 Volobe Hydroelectric Power Plant
- 19 Industrial SEZ
- 20 South Coastal Road
- 21Burst Port
- 22 Port Project for Mineral Quay and Oil Quay

Source : DGPP, 2019, «Projets structurants et valorisation des nouveaux pôles des grandes villes Toamasina »

Figure 14.4.2 Proposed Presidential Projects for Toamasina Agglomeration

14.5 Review of Past Informal Settlement Improvement Project in Toamasina Agglomeration

Toamasina Neighbourhood Development Project (PAQT: *Projet d'aménagement des quartiers de Toamasina*) was conducted by the West Coast Territory (TCO) and Le Port, Reunion from February 2013 to March 2014, in order to improve living and housing conditions of the congested area in CUT. The components of the project were to conduct comprehensive analysis of the project area, to identify the issues of the area, to propose a programme and development plan for coming 15 years, and to develop a consultative mechanism for the residents and stakeholder involvement for a pilot project for redevelopment. The project area includes seven fokontany adjacent to the Pangalanes Canal in Tanambao V, covering 65 ha with 19,000 population.

PAQT conducted the household survey in 2013 and interviewed 421 households.

1) Socio-Economic Characteristics

- Population: 19,706
- Size of households: 4.3 persons
- Length of Residence: 77% of the respondents are born or settled in Toamasina for more than 10 years; 51% live in the current fokontany for more 10 years. However, 35% of the population has been living there for less than 5 years including 26% having stayed only two years or less.
- Employment: Executives (14%), Workers (20%), Craftsmen/traders (28%), travellers/day labours (11%), economically inactive (21%), and retired (5%). 46% of households are wage labours. Inactive (21%) and underemployment (11%).
- Monthly Income (Ariary): 1-56,000 (4%), 56001-199,999 (37%), 200,000-50,000 (45%), and over 500,000 (14%)
- Average Monthly Expenditure: 250,348 Ariary
- Property: television (86.5%); refrigerator (30.4%); gas or electric stove (8.8%); internet connection (5.9%)
- 92% of respondents said they did not play a role in the neighbourhood activities.

2) Basic Infrastructure and Services

- Water Supply
  - JIRAMA Connection (12.1%); Borne Fountain (standpipes) (38.7%); Hand Pump (92.4%)
  - Standpipes: 1 BF / 940 dwellings (Standard in PUDi 2004: 1 BF / 200 dwellings)
  - Water is taken from well, not from standpipes, because they are not many or non-functional, and the cost of using water form well is free of charge.
  - Health problems caused by the quality of water and hygiene are reported, since water is contaminated and not treated before used. The WHO standard for toilet facilities, which mandates that a toilet should be placed 30 meter away from a well, is not respected.
- Power Supply
  - Connected Dwellings (45%), Collective Connection (45%)
- Garbage Collection
  - 50% of the waste are collected by kalesy (minimum 1 time / week) but dumped to the channels or vacant plot. 25% burned on site; 10% thrown into the canal.
- Toilet
  - Shared toilet: 66%
  - Septic tank: 52%
- Mean of transport
  - 37% own at least one bike; 27% at least one moped; and 4% has a car

- School
  - No public primary school in the fokontany.

3) Land and Housings

- Land Use:
  - Current: Residential are: 46. 5ha; Open space: 6.2ha (+ 5.5h channel)
  - PUDi 2004 recommendation: Residential: 28.1 ha (53%); Facilities and Commercial: 5.8 ha (11%); Open space: 19.1 ha (36%)
- Density:
  - Density of Gross Population: 374
  - Gross Building Density (DBB): 0.28
  - Footprint Coefficient: 0.32
  - Net Density of Total Floor Area: 0.36
- Dwellings:
  - Average size: between 26 m^2 (national average) and 33 m^2 (27 qualitative interviews).
  - Average size of the parcels (27 surveyed households): 290 m^2. (The regulations on the construction in Toamasina impose a plot of a minimum of 175 m^2 and 10 m front of street to be able to build.) However, 64% of plots have multiple dwellings and 81% of parcels are shared by several households.
  - 3.8 households per plot on average
  - 30% of the owners have tenants
  - Hard structure (e.g. concrete): 10%, Semi-hard: 44%; Precarious: 46% (among surveyed 421 households.)
  - Degraded buildings (26%); building in middle state (48%); good or new condition (26%
  - Only 9% of buildings have more than one floor: the average number of levels is 1.13.
  - Rooms per Housing: 2.5 rooms on average
  - 1 room (29%); 2 rooms (34%); 3 rooms (13%); 4 rooms (17%); more than 4 rooms (7%)
  - 91% on the ground floor
  - 27% of households reported having flood problems.
  - The majority of buildings were built in the 1970s.
- Housing and Land Ownership
  - Owners (48%), tenants (39%), occupants free of charge (13%)
  - National average in urban areas: owners (69.5%), tenants (20.9%), occupants free of charge (6.7%), temporary occupancy (1.5%) (EPM INSTAT 2010).
  - 53% of the households have their land free of charge (inheritance or de facto occupation) and 46.3% bought it.
  - The funding used for housing construction or purchase was mainly households' own funds (25% of the respondents). Very few people have resorted to micro-credit or bank loan.
  - Tenants pay an average of AR 70,000 per month for housing.

4) Priority of the Households

The dissatisfaction with the neighbourhood conditions and priorities for development identified in the household survey are presented in Table 14.5.1 and Table 14.5.2.

Table 14.5.1 Dissatisfaction of the Neighbourhood Condition in Tanambao V, CUT

Items	%
Environment, green spaces and public spaces	96%
Culture, art, leisure, sports	86%
Collective equipment (health, education, administration)	74%
Road	70%
Markets, businesses, services	68%
Security	61%

Source: Projet d'aménagement des quartiers de Toamasina (PAQT). Étude Pré-opérationnelle. Phase 2 Diagnostic social urbain. Les enjeux de la requalification urbaine. Rapport final. Gret - ATW geosystems, November 2013

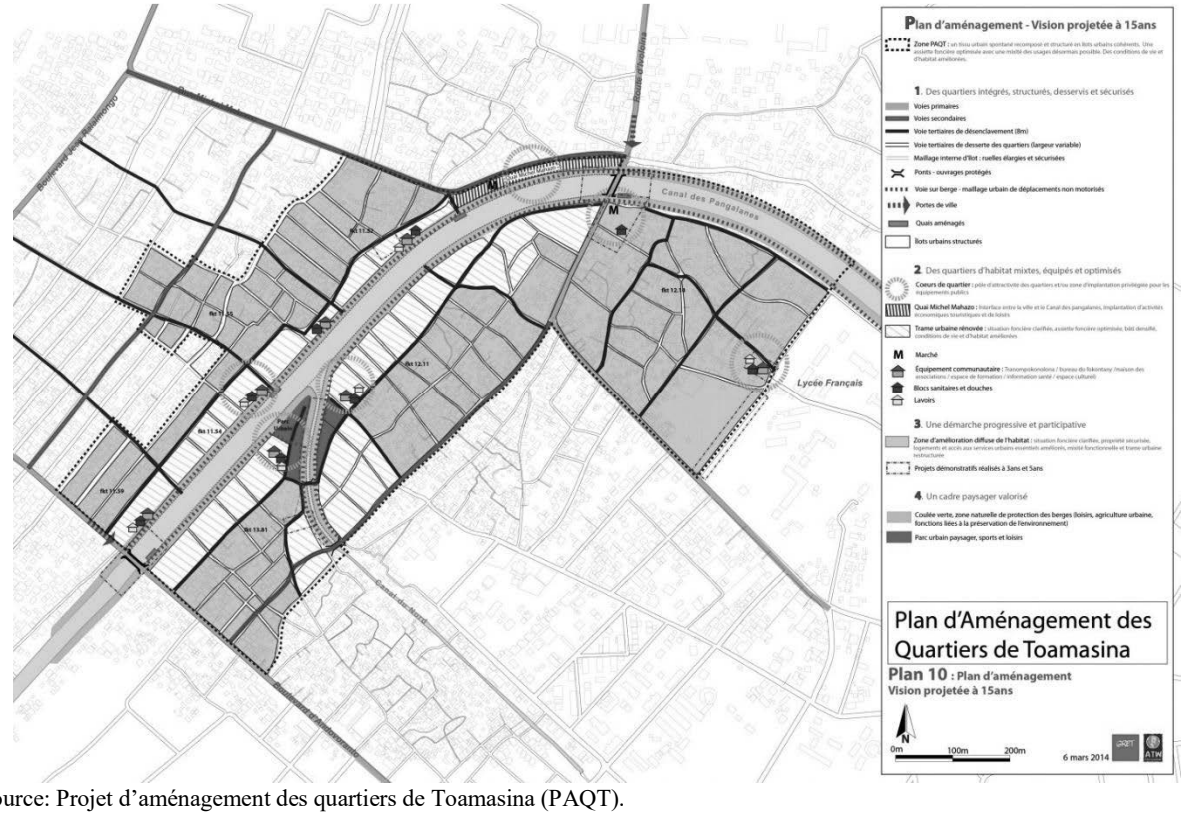
Table 14.5.2 Priorities of the Households* in Tanambao V, CUT

Household Priority	% in the First Choice
Widening of the roads	24.7%
Public lighting	16.2%
Connection to electricity	11.4%
Equipment in sanitary blocks	10.9%
Water connection	10.5%
Development of employment and income-generating activities	5.9%
Construction Tranompokonolona / meeting room	4.8%
Garbage collection service	4.3%
Construction of health centers	2.6%
Improvement of the Pangalanes Canal	1.4%
Market construction	1.4%

*Survey Sample: 421 households - weighting on 3 choices
Source: Projet d'aménagement des quartiers de Toamasina (PAQT). Étude Pré-opérationnelle. Phase 2 Diagnostic social urbain. Les enjeux de la requalification urbaine. Rapport final. Gret - ATW geosystems, November 2013

5) Development Plan

The project proposed for the neighbourhood improvement for coming 15 years as presented in Figure 14.5.1. In total, 33 projects are proposed, including the projects related to the Pangalanes Canal, roads, park development, public lightning, water supply, waste management, sanitation and hygiene, housing, micro-credits, etc.



Source: Projet d'aménagement des quartiers de Toamasina (PAQT).

Figure 14.5.1 Proposed Development Plan in PAQT for Taomasina

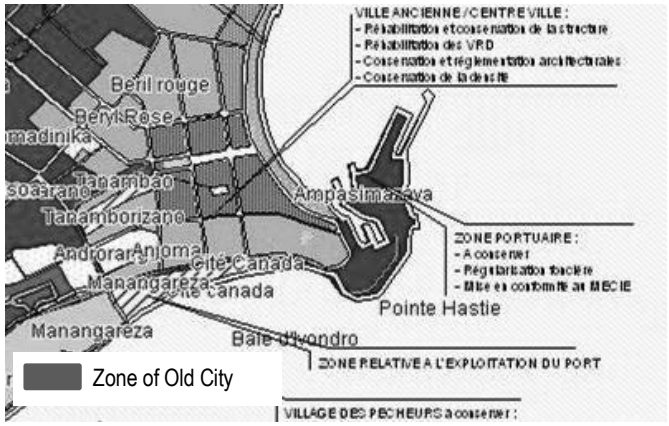
The plan aims to decongest the area by lowering the population density and to develop basic infrastructure and public facilities. The population density of over 150 persons per ha is proposed for the high density mixed use area (yellow shaded area) along the Pangalanes Canal, while the density of 100 to 150 persons per ha is suggested for the area to be decongested.

14.6 Review of Heritage Preservation Regulation for Toamasina Agglomeration and Issues on Heritage Preservation

The area to be preserved in Toamasina is stipulated in the PUDi 2004 for Toamasina section VIII, 1 Old Area to be Preserved. This zone "Zone of Old City" is where the City of Toamasina was originated, and where the historical buildings and monuments need special attention such as protection, rehabilitation and restoration.

In the PUDi it is stated as follows:

This area is area of medium density. In this area, the urbanized centre whose architectural aspects and roadways structure must be preserved to keep the image of the city aesthetic. Therefore, the existing infrastructures such as railway station, Hotel de Ville (City Hall), Independence Avenue and the different administrative buildings must be preserved.



Source: PUDi 2004, Toamasina

Figure 14.6.1 Zoning Map of Toamasina

Although the zoning regulation designates the area to be preserved, there is not list of the heritage to be preserved specifically on a map for Toamasina.

The buildings, avenue, and park shown in the figure below are proposed by the Urban Planning Group of Toamasina Agglomeration[2] for preservation. Some of them are located outside the Zone of Old City. It would be preferable to officially designate and list those heritage buildings, avenue and park in an official document.

[2] Note: The proposal were made at the Toamasina Urban Group Meeting held on 3rd October, 2018.

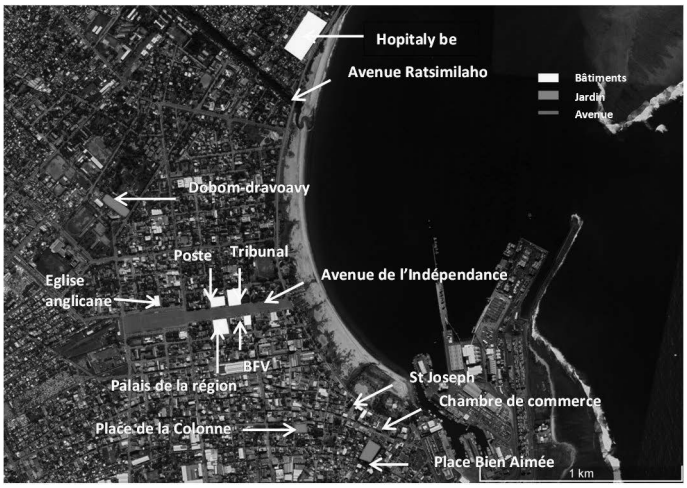


Figure 14.6.2 Preservation Area in Toamasina proposed by Toamasina Urban Group

Chapter 15 Future Vision, Growth Scenarios, and Socio-Economic Framework for Toamasina Agglomeration

15.1 Future Vision for Toamasina Agglomeration

A future vision for Toamasina Agglomeration in 2033 is set as follows:

Statement of Future Vision:

Based on its enhanced gateway function to the sea or its strengthened gateway function from the sea, Toamasina Agglomeration will be a thriving industrial hub and major tourist destination in the Indian Ocean, around the international Port of Toamasina, with a healthy lifestyle and beauty of Pangalanges Canal along with coastal and mountainous landscapes enjoyed by the residents and tourists as well.

This vision statement corresponds to the selected scenario for the overall TaToM, which aims for development not only of existing economic sectors (e.g., primary commodities production and textile industry) but also of new economic sectors (light industries among others) in both Toamasina and Antananarivo Agglomerations, as discussed in Section 3.4. The development of economic sectors of both agglomerations would drive not only the economies of the two agglomerations, but also Madagascar's economy as a whole.

Guided by the vision statement, the goals for Toamasina Agglomeration are specified in order to articulate the development directions.

Goals:

- In addition to logistics industries, Toamasina Agglomeration will host light industries targeting regional consumers' markets in Africa and Indian Ocean, fully utilising the potential of the Port of Toamasina
- Toamasina Agglomeration will be a major destination of domestic and international tourism, by developing coastal resorts, revitalising the Pangalanes Canal, and promoting nature tourism while conserving beaches and natural environment
- Toamasina Agglomeration will provide its residents and visitors with healthy and comfortable living environment with less risk from natural disasters, by improving and developing infrastructure and public services, where people and businesses can explore their potentials.
- Development of Toamasina Agglomeration will support the development of economic sectors of other areas of Madagascar by increasing Toamasina's consumer markets, not only for industries of Antananarivo Agglomeration, but also for economic sectors of Madagascar's coastal areas connected with Toamasina Port by caboteurs and boutres

15.2 Growth Scenarios for Toamasina Agglomeration

15.2.1 Two Alternative Growth Scenarios for Toamasina Agglomeration

In order to select the most appropriate growth scenarios, two alternative growth scenarios are proposed for Toamasina Agglomeration in response to the three alternative growth scenarios for Overall TaToM Area discussed in Section 3.5.

(1) Growth Scenario A for Toamasina Agglomeration

In this scenario, Toamasina Agglomeration will be developed to specialize in logistics function. Taking advantage of the expansion of the Port of Toamasina, logistics and related facilities will be located near the port and NR No.2 to enhance the port functions and to improve efficiency of shipment, transport, and handling of goods. Economic sectors (other than logistics and transport industry that lead the economy of Toamasina) would not be developed, though small-scale industries (such as agro-processing), logistics industry, and tourism will be covered.

In this scenario, the role of a gateway to support Antananarivo Agglomeration will be more emphasized in the development of Toamasina Agglomeration, corresponding to Growth Scenario A of the overall TaToM Area aiming for Madagascar's monocentric development in Antananarivo Agglomeration. In this growth scenario, the objective of development of Toamasina Agglomeration would be to maximize the efficiency of the port and transport of goods and commodities which are necessary to promote development of industries and economic activities in Antananarivo Agglomeration. The scenario has lesser focus on the development effort at economic sectors of Toamasina Agglomeration, but instead targeting consumers markets of Toamasina Agglomeration.

Therefore, the future urban structure is intended to promote strong logistics industries to support the expanded Toamasina Port.

- A mono-centric urban pattern of Toamasina Agglomeration remains strongly similar to the present urban structure of CUT and Toamasina Port at the centre.
- The industrial zone for the logistics industry is located just north of Ambatovy factory, along the second access road to Toamasina Port from National Road No.2.
- Two major access roads are to be developed from the National Road No. 2 to Toamasina Port.
- Residential areas are to expand to the north up to the Ivoloina River, and to the south down to the logistic industrial zone, and also to the west of Toamasina Airport and beyond the wetlands.
- The main commercial areas will remain in and around CUT, there will also be a new commercial area along the National Road No.5, just north of Toamasina Airport, which will serve the surrounding new residential areas.

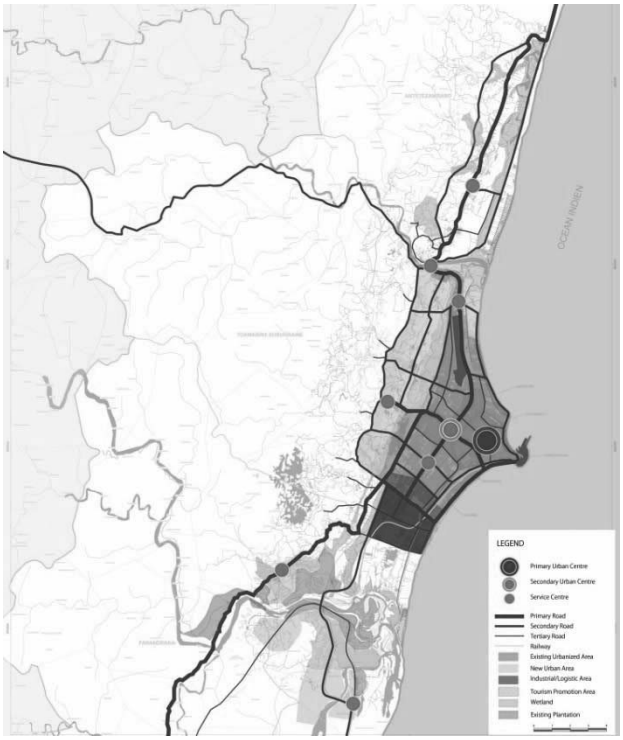
(2) Growth Scenario B for Toamasina Agglomeration

Growth Scenario 2 aims to develop economic sectors in Toamasina Agglomeration for nurturing self-reliant regional economy, in addition to logistics industry. The advantage of strategic location of Toamasina will be fully utilised to develop light industry and agro-processing for export and transhipment targeting the regional markets in Africa and around the Indian Ocean. In parallel, logistics function will be enhanced to support the port function as a gateway of the country, in particular, that of Antananarivo Agglomeration. As a result, industrial areas will be expanded to suburban areas of CUT and in adjacent communes. Tourism will be also promoted by developing tourism development zones along the coast where luxury hotel resorts, shopping malls, and leisure facilities are to be located. Toamasina Agglomeration will be also the market for towns and villages in the hinterland and those in other coastal regions connected by sea.

In this scenario, Toamasina Agglomeration will be a vibrant hub of industry and shall be an attractive coastal tourism town, while supporting the economy of Antananarivo, for the sake of balanced development proposed in the Growth Scenario C of Overall TaToM Area. This Growth Scenario C is selected for Toamasina Agglomeration and discussed in the next section in more detail.

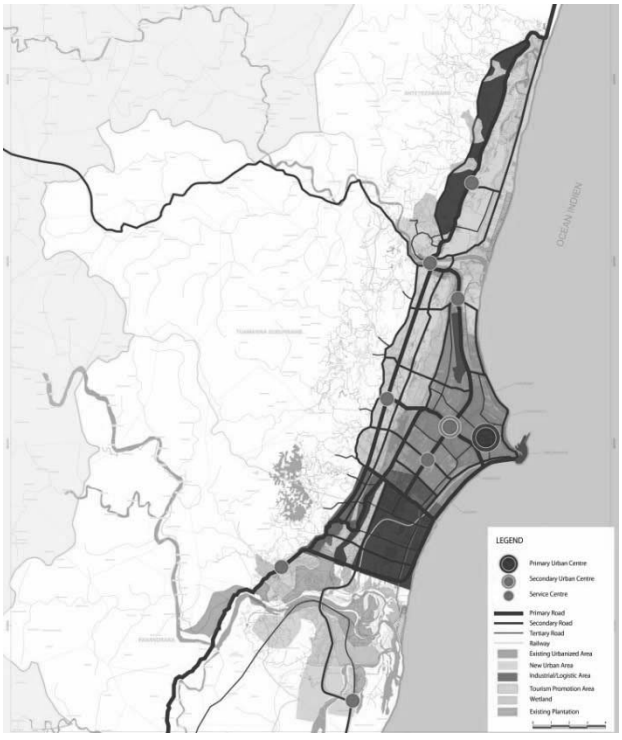
Therefore, large industrial areas will be established to accommodate new manufacturing industries and logistic industries, along with hotel zones for international and domestic tourists.

- Industrial zones for manufacturing industries and logistic industries are located in the north and the south of Ambatovy Factory, and also to the north beyond the Ivoloina River.
- A western bypass road will be constructed to support the industrial area located to the north beyond the Ivoloina River.
- There will be three access roads to Toamasina Port from National Road No.2.
- Residential areas expand to the north beyond the Ivoloina River, southwards until the industrial zone, and also to the west of Toamasina Airport and beyond the wetlands.
- The main commercial areas will remain in and around CUT. However, there will be also new commercial areas along National Road No.5: one just north of Toamasina Airport, another close to the Ivoloina River, and also one area in the north of the Ivoloina River.



Source: JICA Study Team

Figure 15.2.1 Alternative Urban Structure for Scenario A of Toamasina Agglomeration



Source: JICA Study Team

Figure 15.2.2 Alternative Urban Structure for Scenario B of Toamasina Agglomeration

15.2.2 Selected Growth Scenario for Toamasina Agglomeration (Growth Scenario B)

The selected growth scenario Growth Scenario B has the following features:

- Toamasina Port is the largest gateway of Madagascar to the sea connecting to African coastal areas and Indian Ocean countries.
- Seizing the opportunity of Toamasina Port's expansion, Toamasina City (CUT) and its peripheral area will be developed not only as a logistics centre to provide logistics services to Antananarivo Agglomeration and other areas, but also as a thriving industrial city.
- By taking advantage of its strategic location and expanded port functions, and by attracting investments, Toamasina Agglomeration will be able to develop potential economic sectors targeting markets of member countries of regional economic communities (RECs), such as COMESA, SADC and IORA, of which Madagascar is a member.
- In order to make a thriving and attractive agglomeration out of the stagnant port city of

Toamasina, it is also necessary for Toamasina Agglomeration to utilise its own development potentiality for international tourism, such as sun-and-beach tourism and nature tourism.

- In the early stages of economic sector development in Toamasina Agglomeration, the existing and newly emerging problems would appear as obstacles; however, by following this Growth Scenario with the expansion of Toamasina Port, it is possible to resolve the problematic situation and grow into a prosperous industrial city.

The following five conditions should be satisfied to realise the selected Growth Scenario aiming at developing Toamasina Agglomeration as an industrial city:

- Strengthening of logistics functions centering on the expansion of Toamasina Port
- Development of economic infrastructure to support the development of economic sectors in Toamasina Agglomeration
- Development of basic infrastructure to support the people's everyday needs and amenity in Toamasina Agglomeration
- Enhancement of transport capacity along the TaToM Economic Axis between Antananarivo and Toamasina (strengthening of connectivity, especially the improvement of speed of passenger transport)
- Strengthening of business headquarters' functions of Antananarivo Agglomeration to manage business operation in Toamasina Agglomeration, as well as to attract investments to economic sectors in Toamasina Agglomeration

Among the five conditions mentioned above, the first three are the ones to be met for Toamasina Agglomeration. The remaining two conditions are critical because the management of business operations and decision-making on investments are made in Antananarivo.

Toamasina is located more than 350 km away from Antananarivo. Currently, air, road, and railway transport between Toamasina and Antananarivo do not function well in terms of both passenger and cargo transport, creating difficult conditions for investment promotion. It is essential to improve, especially the speed of passenger transport in addition to the enhancement of capacity of cargo transport, in order to promote investments to economic sectors in Toamasina Agglomeration.

By strengthening the business functions and promoting economic activities in Antananarivo Agglomeration, investments to the economic sectors in Antananarivo Agglomeration will increase and support the economic activities in other regions in Madagascar. Such situation will eventually enable the investment promotion for the development of economic sectors and efficient business operations in Toamasina Agglomeration.

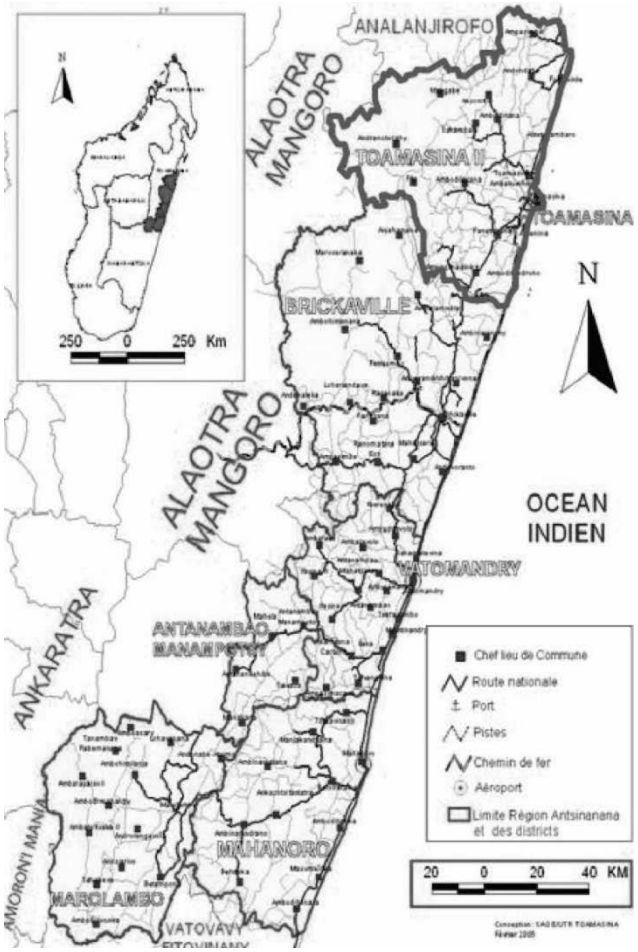
15.3 Socio-economic Framework for Toamasina Agglomeration

15.3.1 Population Framework for Toamasina Agglomeration

(1) Current Population in Toamasina Region

1) Population of Toamasina Agglomeration within Madagascar and Analamanga Region

The port city of Madagascar, Toamasina is located in Atsinanana Region. Atsinanana Region has seven districts. Toamasina Agglomeration spreads to two districts Toamasina District and Toamasina II District. (See Figure 15.3.1)



Source: JICA Study Team based on PRD Atsinanana Region

Figure 15.3.1 Location of Two Districts of Atsinanana Region and 5 Communes

The population in Atsinanana Region is concentrated in Toamasina I District. The district with the largest population is Toamasina I which covers Toamasina Urban Commune (CUT). Its population is approximately 300 thousand in 2015. On the other hand, according to the two previous censuses conducted in 1975 and 1993, district with the highest rate of population growth was Marolambo District followed by Brickaville District. (See Table 15.3.1)

Table 15.3.1 Population of Atsinanana Region by District

	Population			Annual Population Growth Rate		Area (km^2)	Population Density (person/ha)
District	1975[1] (Census)	1993[2] (Census)	2018[3] (Census Preliminary Result)	1975-93	1993-2018		
Toamasina I	168,214	137,782	326,286	2.61%	3.51%	28	116.53
Toamasina II		129,581	261,516		2.85%	5,063	0.52
Brickaville	72,951	122,588	212,572	2.93%	2.23%	5,297	0.40
Antanambao-Manampotsy	87,052	35,533	61,845	2.46%	2.24%	1,641	0.37
Vatomandry	101,385	99,383	170,148	2.68%	2.17%	2,732	0.62
Mahanoro		163,233	284,812		2.25%	3,857	0.72
Marolambo	47,137	92,384	167,224	3.81%	2.40%	3,764	0.44
Atsinanana Region	476,739	780,484	1,484,403	2.78%	2.60%	22,382	0.66

Source 1: Institut national de la statistique et de la recherche économique, Recensement General de la Population et des Habitats 1975

Source 2: Direction Generale de l'Institut National de la Statistique, Recensement General de la Population et de l'Habitats 1993

Source 3: INSTAT, 2019, Troisieme Recensement General de la Population et des Habitats (RGPH-3) Resultats Provisoires

2) Population Distribution in Toamasina Sub-Region

Although the final results of population and housing census 2018 is yet to be released, based on the census surveys conducted, INSTAT had projected that the population of Toamasina Sub-Region was around 440 thousand in 2018. The population was projected to have increased by 3.96% per annum from 1993 to 2018.

It is assumed that approximately 75% of the population in Toamasina Sub-Region is concentrated in CUT with approximately 326 thousand habitants in 2018.

3) Population Growth Rates

It is assumed that the population growth rate of CUT is approximately 3.5% while some communes surrounding CUT, Toamasina Suburbaine Commune have extremely high growth rate which is over 8% per annum.

Table 15.3.2 Population of Toamasina Sub-Region by Commune

Commune	District	Area (km²)	Population		Population Growth Rate	Population Density (person/ha)
			Census[1]	Projection[2]		
			1993	2018	1993-2018	2018
Toamasina Urban Commune	Toamasina I	28	137,782	326,286	3.51%	116.5
Toamasina Suburbaine Commune	Toamasina II	290	7,333	50,571	8.03%	1.7
Antetezambaro	Toamasina II	219	8,832	19,625	3.25%	0.9
Fanandrana	Toamasina II	336	11,517	26,029	3.33%	0.8
Amboditandroroho	Toamasina II	184	-	14,493	-	0.8
Toamasina Sub-Region		1,057	165,464	437,007	3.96%	4.1

Source 1: Direction Generale de l'Institut National de la Statistique, Recensement General de la Population et de l'Habitats 1993
Source 2: JICA Study Team based on INSTAT data

(2) Population Framework for Toamasina Agglomeration

The population framework for Toamasina Agglomeration for 2033 is set based on the past population growth in each commune. Since reliable data of population by fokontany is not available and the future population of Toamasina Sub-Region is assumed to be concentrated in the area to be covered as Toamasina Agglomeration, the population of Toamasina Sub-Region will be used as population of Toamasina Agglomeration in the population framework.

Table 15.3.3 shows the future population by commune for Toamasina Agglomeration in short-, medium- and long-term.

Table 15.3.3 Population Framework for Toamasina Agglomeration

Commune	District	Area	Population				Annual Population Growth Rate	Population Density (2033)
		ha	2018	2023	2028	2033	2018-2033	Pop/ha
Toamasina	Toamasina I	28	326,286	379,373	440,170	506,111	2.97%	180.8
Toamasina Suburbaine	Toamasina II	290	50,571	72,338	105,396	158,342	7.91%	5.5
Antetezambaro	Toamasina II	219	19,625	22,383	26,001	31,145	3.13%	1.4
Fanandrana	Toamasina II	336	26,029	29,787	34,720	41,730	3.20%	1.2
Amboditandroroho	Toamasina II	184	14,493	17,110	20,574	25,511	3.84%	1.4
Outside CUT	Toamasina Agglomeration	1,029	110,718	141,618	186,691	256,728	5.77%	2.5
TOTAL	Toamasina Agglomeration	1,057	437,004	520,991	626,861	762,839	3.78%	7.2

Source: JICA Study Team

15.3.2 Economic Framework for Toamasina Agglomeration

(1) GDP in the Existing Plans and Projections

In order to set the gross regional domestic products (GRDP) growth targets in the Study Areas in 2023, 2028, and 2033, the following existing development plans or projections were reviewed:

- National Development Plan (PND) 2015-2019
- Programme Sectoriel Agricole, Elevage et Pêche ou PSAEP (2015)
- Document de Politique Industrielle de Madagascar (2014)

1) National Development Plan (PND) 2015-2019

According to PND, the growth scenario is shown in Table 15.3.4. The sectors driven the growth in Madagascar include agriculture, fisheries, mining, export processing enterprises, construction, tourism and transport (and related infrastructure).

Table 15.3.4 National GDP Growth Scenario

	2015	2016	2017	2018	2019
Growth Rate	5%	7.0%	8.9%	10.4%	10.5%

Source: National Development Plan (PND) 2015-2019

2) Programme Sectoriel Agricole, Elevage et Pêche ou PSAEP (2015)

The objectives by 2025 are (i) to achieve competitive and sustainable agricultural production, leading to food security and an increase in exports, (ii) to integrate family farms and modernize processing units, and (iii) to achieve agricultural growth of 6 percent per year. There are five programmes for these objectives: rational and sustainable exploitation of the resources and production (two million ha of investment zones will be created by 2025); continuous improvement of productivity; contribution to food security; improvement of access to markets; and improvement of institutional governance.

3) Document de Politique Industrielle de Madagascar (2014)

The industrial policy targets that the share of industrial sector to GDP will be 25% by 2025 and labour intensive industry will be shifted to high technological industry. Additionally, the Government is in the process of updating its legislation pertaining to the mining and upstream petroleum industries to attract foreign investment. Moreover, the Government is developing new legislation on Special Economic Zones.

4) Other Projections

According to the World Economic Outlook Database (October, 2017) by the International Monetary Fund (IMF), projected GDP growth rate is 4.3 percent in 2017, 5.3 percent in 2018, and an average growth rate is 5.4 percent from 2019 to 2022. Furthermore, the World Bank estimated 4.5 percent in 2017, and 4.8 percent in 2018 and 2019.

(2) Methodology of GRDP Projections

GRDP data is based on the share of GRDP to National GDP in 2014 (Table 15.3.5). The economic framework is projected in the regional level (namely, Analamanga region and Atsinanana Region), because there are no data in district level.

There are regional development plans for Atsinanana Region. However, there are no economic indicators for development such as projected growth rate of GRDP and GRDP by economic sectors. Therefore, the share of GRDP to national GDP and the share of each economic sector in Analamanga Region and Atsinanana Region, which are based on the data of National Statistics Institute (INSTAT) estimated in June 2018, is used for the starting point of the projections

The GRDP of Toamasina Agglomeration is adjusted by the share of population of Toamasina Agglomeration to Atsinanana Region.

Table 15.3.5 Share of GRDP to National GDP (2014)

(GDP at Factor Cost, MGA Billion at current prices)

Region	Primary Sector		Secondary Sector		Tertiary Sector		Total	Share
Analamanga	484	6.0%	2,274	57.8%	9,116	55.2%	11,874	41.7%
Atsinanana	381	4.7%	559	14.2%	1,044	6.3%	1,984	7.0%
Others	7,192	89.3%	1,102	28.0%	6,352	3.8%	14,646	51.3%
Total	8,057	100.0%	3,935	100.0%	16,512	100.0%	28,504	100.0%

Note: National GDP in 2014 at 2007 constant prices amounts to MGA 17,368 billion.
Source: JICA Study Team based on National Statistics Institute (INSTAT) (June, 2018)

(3) Economic Framework

The selected growth scenario for Toamasina Agglomeration promotes development in manufacturing, tourism and logistics sectors. Therefore, to set the indicators for preparing economic framework, this growth sector was taken into consideration in addition to the sectorial plans at the national level. The actual growth rates of GRDP for each sector in Toamasina Agglomeration are estimated as follows:

- Primary Sector: The growth rate until 2019 is the same as the growth rate projected for Madagascar by INSTAT in Tableau de Bord Economique, Avril 2017. Beyond 2020, the growth rate is set at 6% per year.
- Secondary Sector: The growth rates of the sector before 2019 are based on the figures by INSTAT in Tableau de Bord Économique, Avril 2017. Beyond 2020, the growth rate is set between 5.5% and 10%. The existence of the largest sea port, which will be expanded by the Japanese Government's support gives locational advantage to Toamasina Agglomeration for developing manufacturing industry. In addition, existence of Ambatovy's nickel and cobalt mining factories may be one of the important factors for the development of the secondary sector. If the global commodities market will expand, it may lead to employment creation in the sector.
- Tertiary Sector: The growth rate for tertiary sector in Toamasina Agglomeration is set 1.1 to 2.6% higher than the growth rate of the tertiary sector in Madagascar. The existence of Toamasina Port, which will be expanded by the Japanese Government's support, may become a driving force to boost the tertiary sector, including logistic industry and trade.

The indicators of the economic growth are shown in Table 15.3.6.

Table 15.3.6 Real Growth Rates of GDP and GRDP for Toamasina Agglomeration

	2016-2023	2024-2028	2029-2033
Madagascar	5.6%	7.7%	7.9%
Antananarivo Agglomeration	6.9%	8.6%	9.5%
Toamasina Agglomeration	6.1%	8.2%	9.5%

Source: JICA Study Team

Table 15.3.7 illustrates the change of share of economic sector and growth rates by economic sector for Toamasina Agglomeration.

Table 15.3.7 Change of Economic Structure in Toamasina Agglomeration

(a) Change of Share of Economic Sector

	GRDP (MGA Billion, at 2007 constant prices)	GDP (USD Million, at 2010 constant prices)	Primary Sector (%)	Secondary Sector (%)	Tertiary Sector (%)
2014 (Actual)	330	203	19.2	28.2	52.6
2023 (Projected)	554	341	16.1	27.8	56.1
2028 (Projected)	822	506	14.5	28.0	57.5
2033 (Projected)	1,297	798	12.3	28.1	59.6

(b) Growth Rates by Economic Sector

	Primary Sector (%)	Secondary Sector (%)	Tertiary Sector (%)	Total (%)
2016-2023 (Projected)	4.5	5.6	6.9	6.1
2024-2028 (Projected)	6.0	8.4	8.8	8.2
2029-2033 (Projected)	6.0	9.6	10.3	9.5

Source: JICA Study Team

Table 15.3.8 shows the changes of share of GRDP for Toamasina Agglomeration to GDP for Madagascar. The share of Toamasina will increase from 1.9 percent in 2014 to 2.2 percent in 2033.

GDP per capita in Toamasina Agglomeration is

Table 15.3.8 Change of Share of GRDP for Toamasina Agglomeration

	Unit	2014 (Actual)	2023 (Projected)	2028 (Projected)	2033 (Projected)
Share of Toamasina Agglomeration's GDP against Madagascar's Total GDP	%	1.9%	2.0%	2.1%	2.2%
GRDP of Toamasina Agglomeration	MGA Billion, at 2007 constant prices	330	554	822	1,297
	USD Million, at 2010 constant prices	203	341	506	798
GDP of Madagascar	MGA Billion, at 2007 constant prices	17,368	27,642	39,966	58,455
	USD Million, at 2010 constant prices	10,688	17,010	24,595	35,972

Source: JICA Study Team

Table 15.3.9 Change of GDP per Capita for Toamasina Agglomeration

	Unit	2014	2023	2028	2033
Population of Toamasina Agglomeration	-	374,111	520,991	626,861	762,839
GRDP of Toamasina Agglomeration	MGA Bullion, at 2007 constant prices	330	554	822	1,297
	USD Million, at 2010 constant prices	203	341	506	798
GDP per Capita for Toamasina Agglomeration	MGA, at 2007 constant prices	882,091	1,063,358	1,311,295	1,700,228
	USD, at 2010 constant prices	543	655	807	1,046
Annual Growth Rate of GDP per Capita at constant prices	-	-	2.10%	4.28%	5.33%

Source: JICA Study Team

Chapter 16 Strategies for Urban Development of Toamasina Agglomeration

16.1 Urban Development Strategies for Toamasina Agglomeration

16.1.1 Overall Issues on Urban Development for Toamasina Agglomeration

The overall issues on urban development for Toamasina Agglomeration are as follows:

- In CUT, basic infrastructure (e.g., for power and water supply), and life services are insufficient while population and urban functions are over concentrated in CUT.
- It is difficult to promote development of economic sectors because of inadequate infrastructure, such as for power and water supply.
- Because urbanisation has been progressing in low-lying areas and maintenance of the drainage infrastructure has been insufficient, rainwater flooding occurs almost every year.
- Public transport is not well developed.
- There are not enough hospitals, educational facilities, and recreation facilities for middle-income people.
- It takes 8 hours by passenger car or 2 days by cargo freight to travel 350 km distance on NR2 from Antananarivo, the capital of the country as well as the centre of the economy.
- As a result, the function of the Port of Toamasina (the primary major port of Madagascar), is not fully utilised for the development of economic sectors in Toamasina Agglomeration.

16.1.2 Overall Objectives for Urban Development of Toamasina Agglomeration

The overall objectives for urban development for Toamasina Agglomeration are as follows:

- To enhance the sustainability of Toamasina Agglomeration in terms of functionality, environment and resilience
- To develop competitive and vibrant economic sectors for providing residents of Toamasina Agglomeration with enough employment opportunities
- To enhance the healthy and resilient residential environment and urban amenity for enjoyable lives of people in Toamasina Agglomeration
- To provide a wide range of social services including high-level medical and educational services for residents and visitors in Toamasina Agglomeration

16.1.3 Overall Strategies for Urban Development of Toamasina Agglomeration

The following overall strategies are formulated for Toamasina Agglomeration:

- To implement necessary strategies to establish an efficient logistics system based on Toamasina Port to be expanded
- To implement a set of development strategies focusing on the promotion of economic sectors, specifically agro-processing industries, light industries and fabricating industries targeting regional consumer markets, in order to transform Toamasina Agglomeration into a thriving industrial city

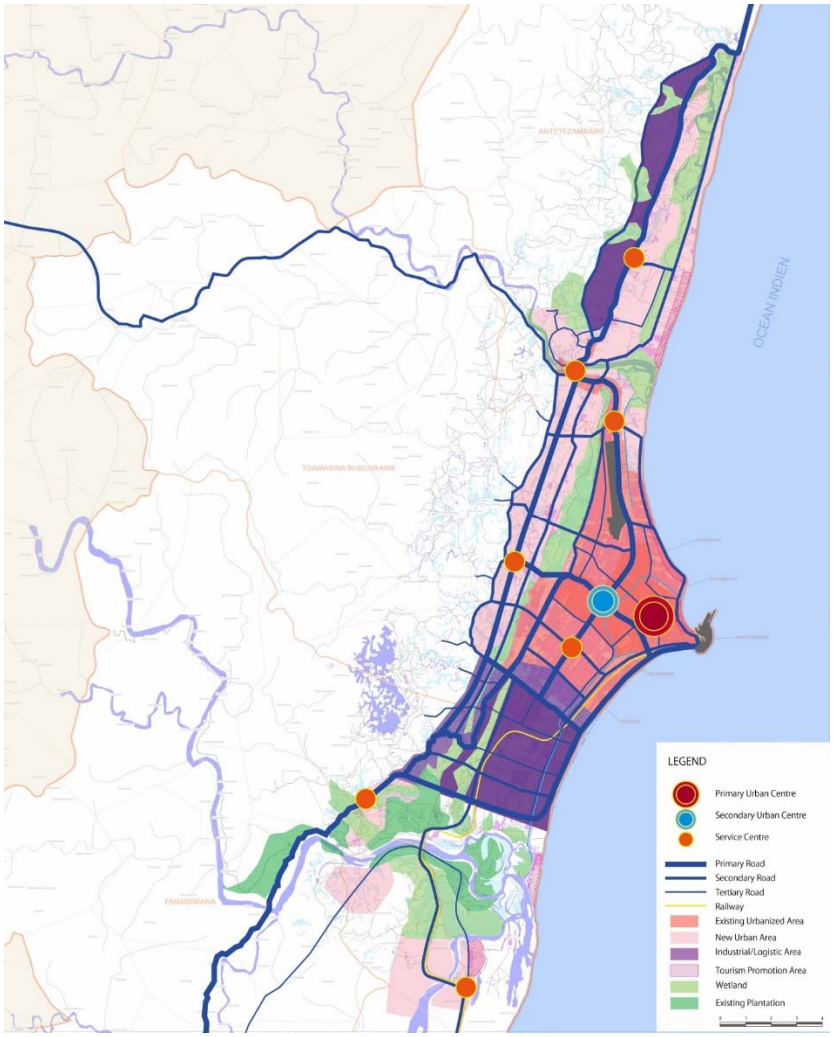
- To set up "Economic Development Zones" and develop industrial parks, together with providing economic infrastructure including access roads, electricity supply and water supply, for attracting investments to light industries targeting the markets of Free Trade Areas of the Regional Economic Organizations with which Madagascar is affiliated
- To promote international and domestic tourism by setting up "Tourism Development Zones" and hotel zones for purposes of attracting investment to hotels, based on the existing infrastructure. The results of this measure on tourism development will be also effective eventually in attracting investments to industries.
- To utilise various and large potentialities of Pangalanes Canal as much as possible, by rehabilitating the functions of drainage and water transport, for providing open space along the canal, and for developing eco-tourism and large-scale agricultural development along the canal

16.1.4 Future Urban Structure for Toamasina Agglomeration

Based on the selected growth scenario in Scenario 15.2, the future urban structure of Toamasina Agglomeration is prepared.

(1) Selected Urban Structure for Toamasina Agglomeration

The future urban structure of Toamasina Agglomeration for 2038, five years beyond the target year of 2033, is shown in Figure 16.1.1.



Source: JICA Study Team

Figure 16.1.1 Future Urban Structure of Toamasina Agglomeration for 2038

(2) Major Elements Comprising the Future Urban Structure of Toamasina Agglomeration

1) Urban Centres

The Urban Structure of Toamasina Agglomeration will have three types of urban centres: Primary Urban Centre, Secondary Urban Centre, and Service Centres.

Primary Urban Centre

The Primary Urban Centre is to have governmental administration, business, commercial, financial, health and educational functions of Toamasina Agglomeration-wide importance, as well as the Atsinanana Regional importance. It includes administrative buildings, regional headquarters of financial institutions, large commercial shopping malls, and large office buildings.

In Toamasina Agglomeration, the Primary Urban Centre is located in Ambodimanga Arrondissement, inside Toamasina Urban Commune (CUT). This area consists of Avenue de l'independence where administrative offices are located, and also Boulevard Joffre where many financial institutions are located. This area also consists of many large hotels and restaurants. There is also the large Bazar Be market. The well-planned grid city will also hold development potential for high-rise buildings.

Secondary Urban Centre

The Secondary Urban Centre is to accommodate large market places and some active work places of Toamasina Agglomeration-wide importance.

In Toamasina Agglomeration, the Secondary Urban Centre is located at the cross-section of National Road No.2 and National Road No.5. Currently, this area has Ankirihiry Market Place. This is called "Ankirihiry-Mangarivotra Secondary Urban Centre."

Service Centres

The Service Centre is to have government administrative and residential service functions including commune government offices and commercial facilities of the commune-wide importance.

Service Centres will be located in existing and new residential areas in Toamasina Agglomeration. They will consist of commercial establishments, such as large supermarkets and clusters of small shops, which would serve the population living in surrounding areas.

There are seven Service Centres located in Toamasina Agglomeration.

- The first one is located to the north of the Ivoloina River, along National Road No.5. This is called Antetezambaro Service Centre.
- The second is located just in the south side of the Ivoloina River. This is called Ivoloina Service Centre.
- The third is located to the north of Toamasina Airport, around the intersection between the National Road No. 5 and the new bypass road running on the west side of Toamasina Airport, and joining National Road No. 2. This is called Toamasina North Service Centre.
- The fourth is located in the middle of the new residential areas to the southwest of CUT. This is called Toamasina West Service Centre.
- The fifth is located in a newly developed residential area in the south of CUT, This is called Toamasina South Service Centre.
- The sixth is located along National Road No.2, in Fanandrana Commune, and will serve new residential areas to be developed around the urban centre along National Road No.2. This is called Fanandrana Service Centre.
- The seventh is located in Commune of Amboditandroroho to the south of the Ivondro River. This is called Amboditandroroho Service Centre.

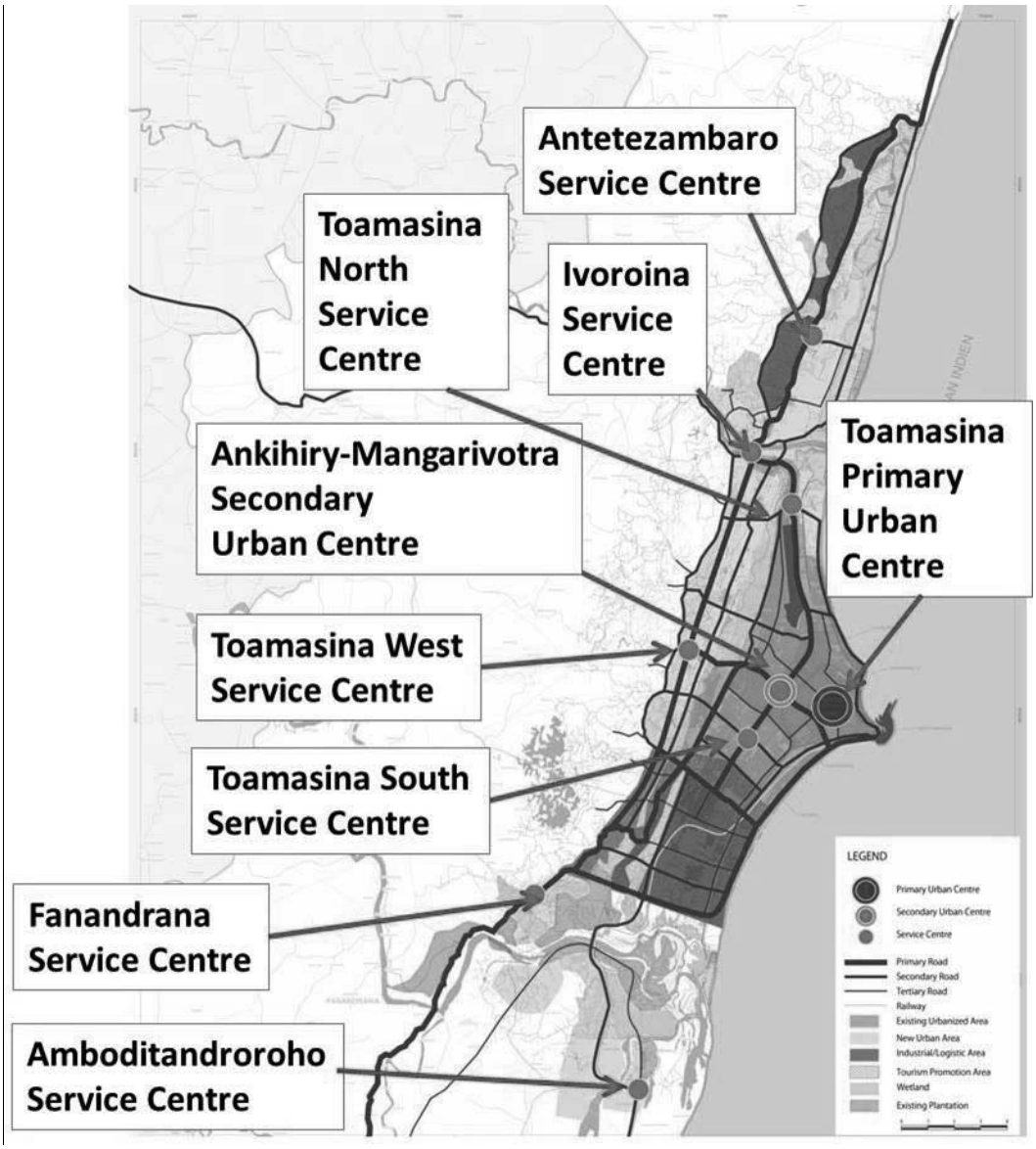


Figure 16.1.2 Urban Centres of Toamasina Agglomeration for 2038

2) Port Access Roads

The Port Access Roads are part of the transport system of TaToM Economic Axis connecting Toamasina Port and Antananarivo Agglomeration. In this sense, the Port Access Roads located within Toamasina Agglomeration are of the national importance.

There will be three major port access roads in Toamasina Agglomeration. The first is the one already in use, National Road No.2. The second one is currently passing through the industrial area, but this needs rehabilitation.

The third is a new road that will run through the south area of Ambatovy Factory up to the port. It will benefit both residential and industrial areas since this new road could service or can be used by trucks coming from Antananarivo to the port or the other way, without passing through Toamasina City.

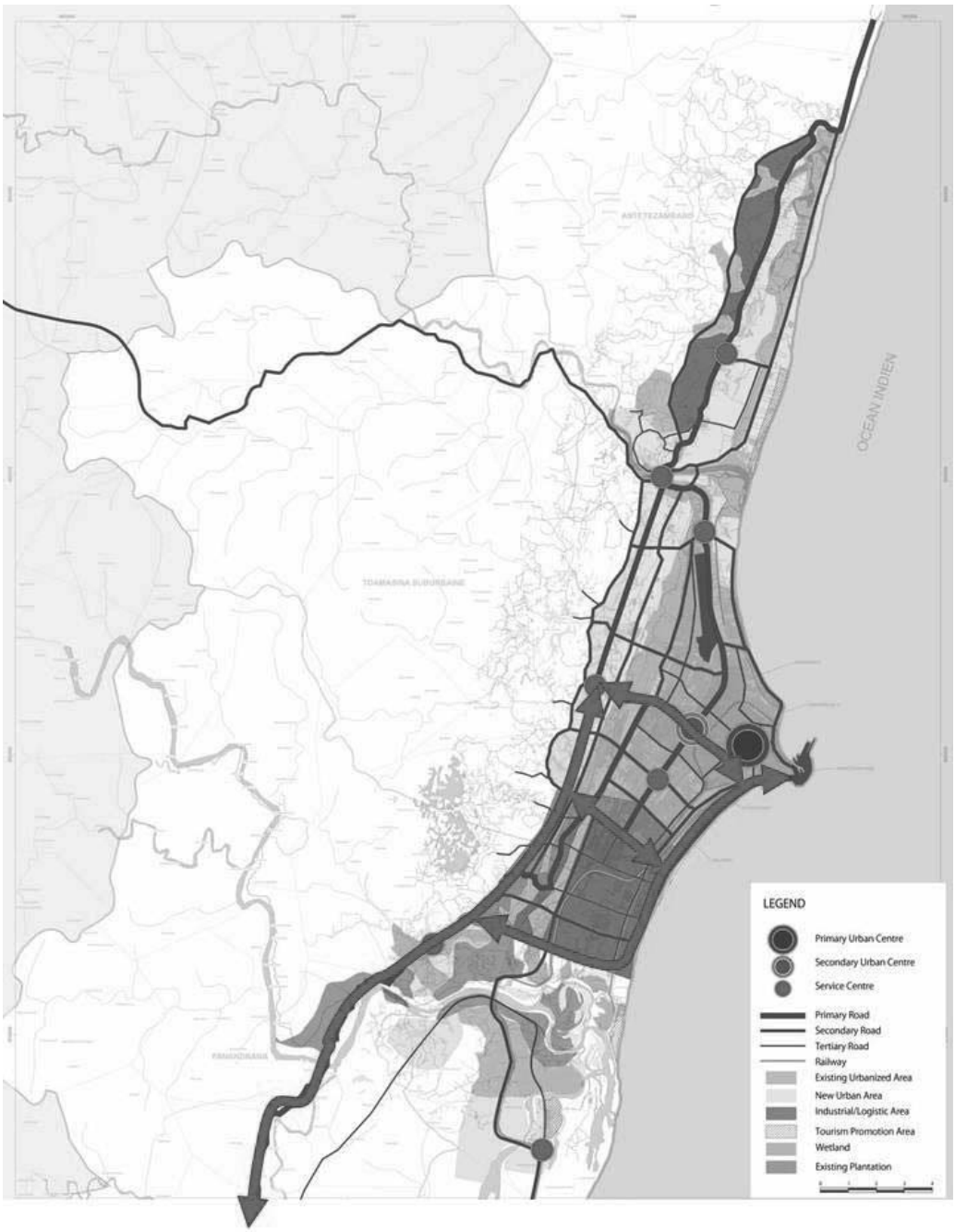


Figure 16.1.3 Three Port Access Roads in Toamasina Agglomeration for 2038

3) Western Bypass Road

The western bypass road is to integrate National Road No.2 with the northern industrial areas. This bypass road will significantly increase the accessibility of the northern industrial areas to the city centre. At the same time, this bypass road will provide access to newly developed western residential areas.

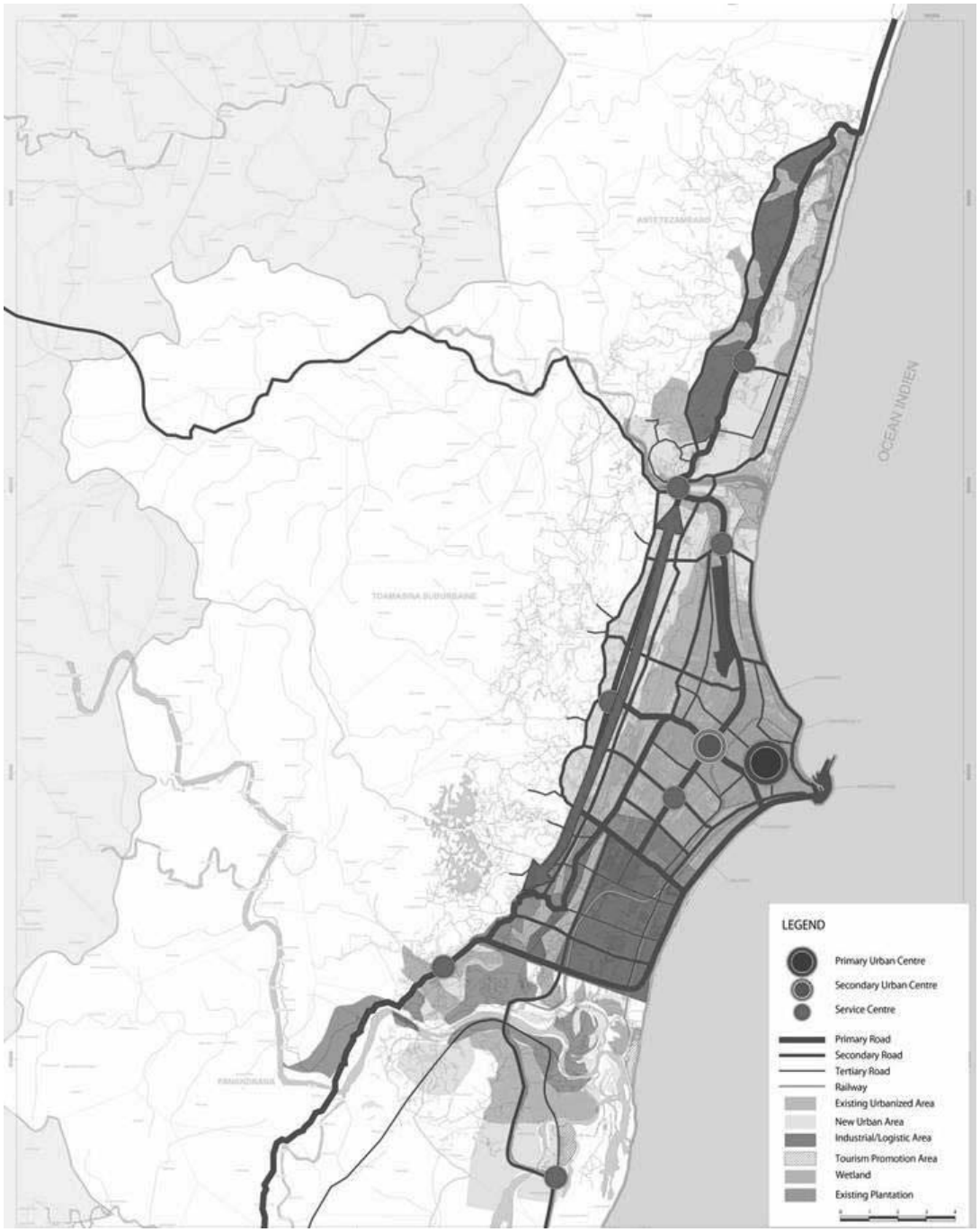


Figure 16.1.4 Western Bypass Road of Toamasina Agglomeration for 2038

4) Residential Areas

Three types of residential areas are planned in the future urban structure of Toamasina Agglomeration. The three types have different population densities.

The high-density residential areas can accommodate a population of 500 people / ha at maximum. These are mainly areas that are highly populated already.

The mid-density residential areas can accommodate up to 200 people / ha. These are areas where urbanisation can already be seen, especially in the areas surrounding CUT.

The low-density residential areas can accommodate up to 100 people / ha. In these areas, urbanisation is not seen so much at present, but will become part of urbanised areas of the agglomeration by 2033-2038.

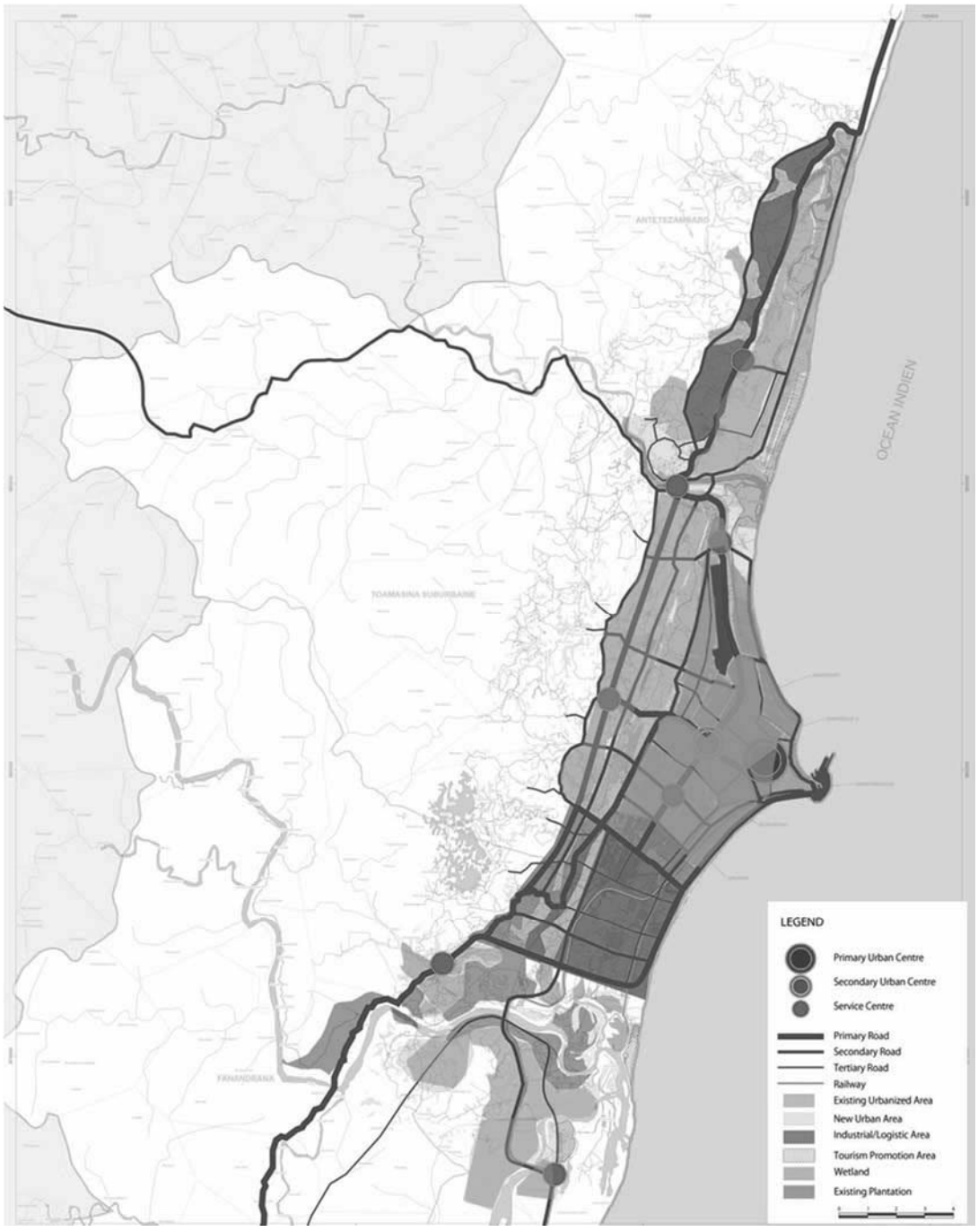


Figure 16.1.5 Residential Areas in Toamasina Agglomeration for 2038

5) Industrial Areas

Toamasina Agglomeration's vision is to become a thriving industrial city. Therefore, in the urban structure, there will be large industrial areas. There will be industrial areas in the north and south of the agglomeration. For both industrial areas, economic infrastructure (e.g., access roads, electricity supply, and water supply) are to be provided.

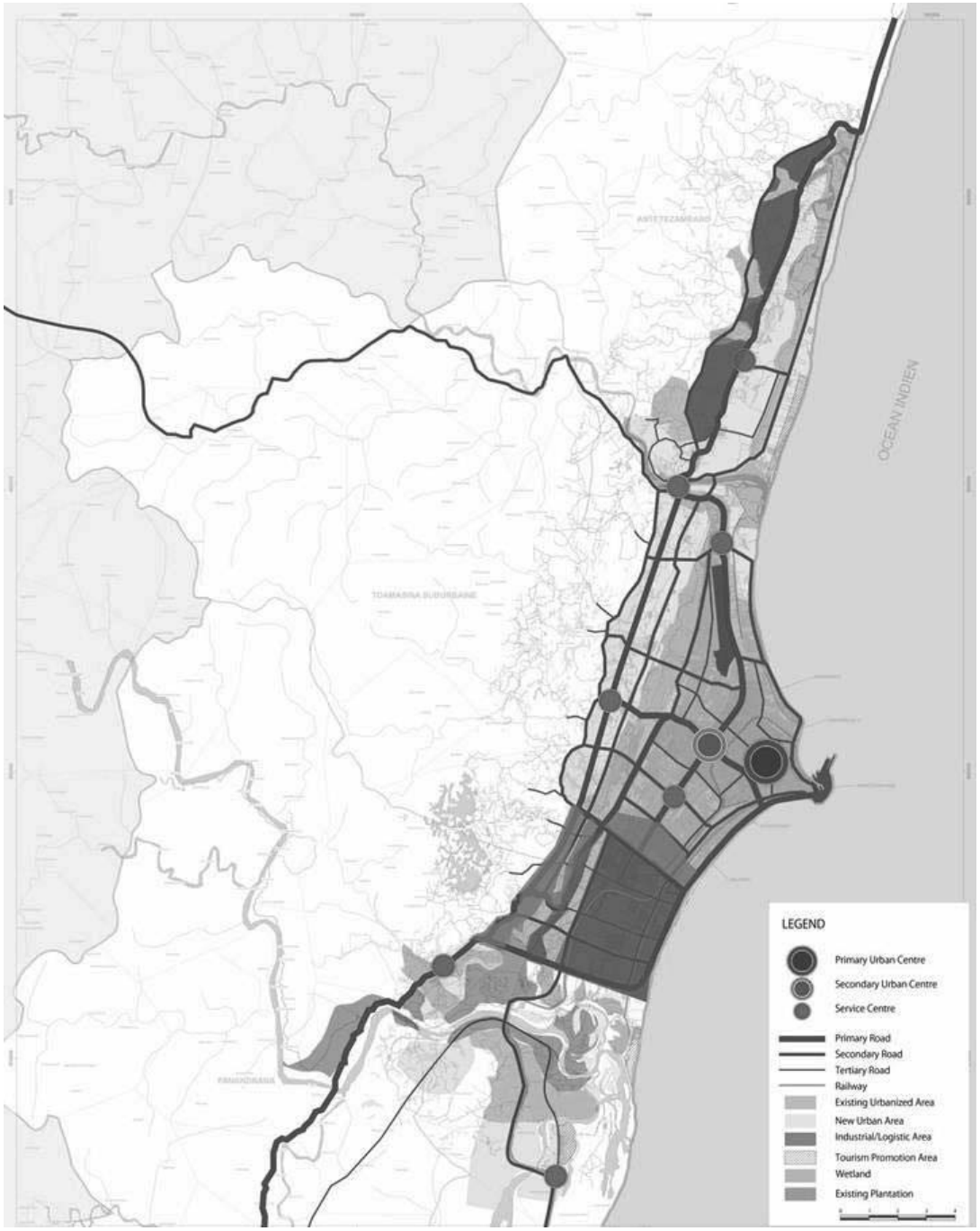


Figure 16.1.6 Industrial Areas of Toamasina Agglomeration for 2038

6) Hotel Zones

Hotel zones are set from the south up to the north along the shoreline of Toamasina Agglomeration. Each hotel zone will be designated as a Tourism Development Zone, and will have hotels and supporting infrastructure.

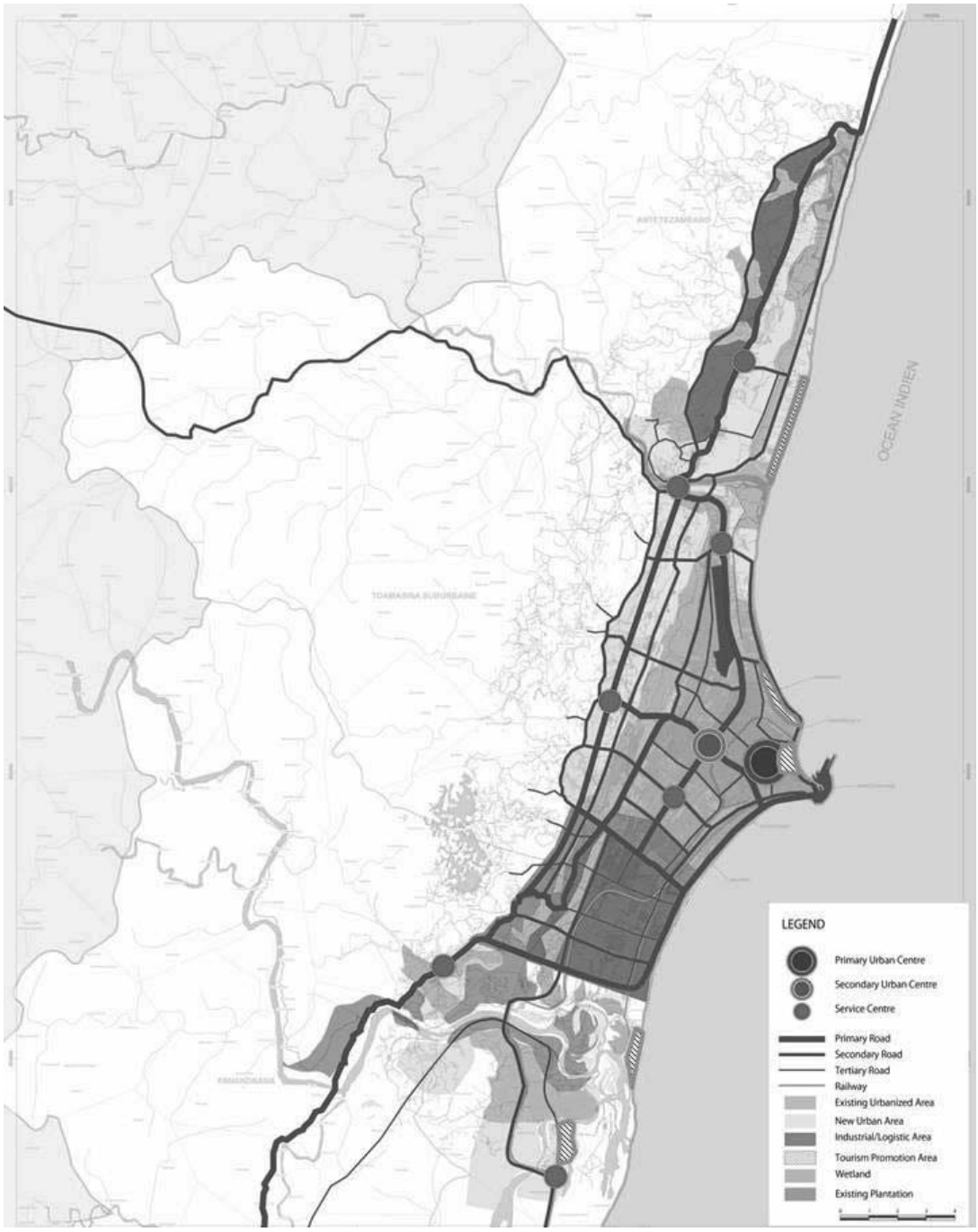


Figure 16.1.7 Hotel Zones in Toamasina Agglomeration for 2038

7) Railway Line

Currently, there is a railway line used for cargos, as well as for inter-regional passengers. This can also be used for tourism purposes. By installing one or two more rail cars, the railway could start its operation with one or two round trips per day, and this could gradually increase its frequency with the development of other tourist attractions in the area. Tourists can enjoy riding the railway line from Toamasina to Amboditandroroho and transfer for a boat ride in the Canal des Pangalanes.

The railway line will be able to function as a public transport, connecting the city centre of Toamasina to the southern side of the Ivondro River.

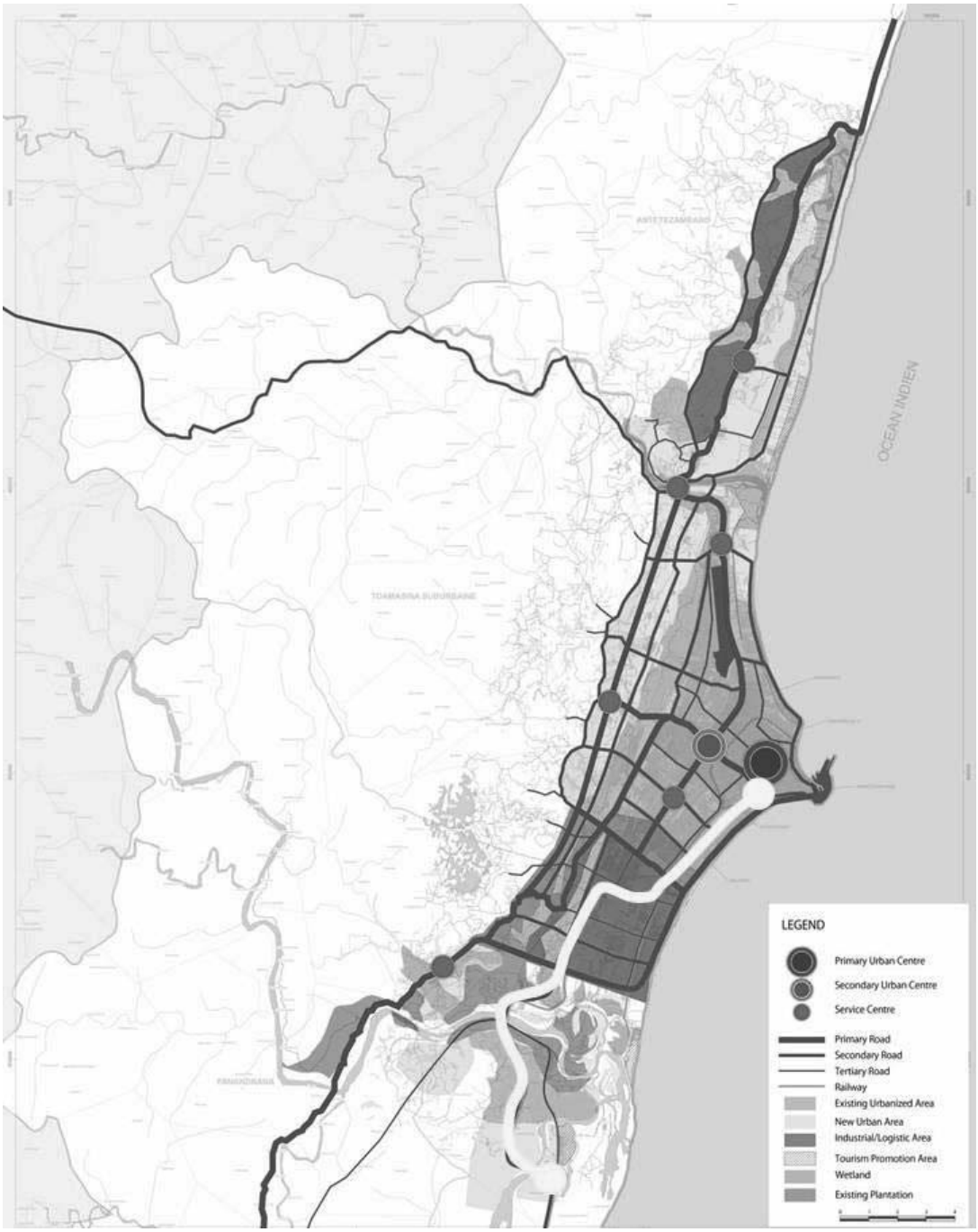


Figure 16.1.8 Tourist Railway for Toamasina Agglomeration for 2038

16.1.5 Phased Development of the Selected Growth Scenario for Toamasina Agglomeration

The selected growth scenario has the following phased development for Toamasina Agglomeration. This includes a starting-up strategy for manufacturing and tourism sectors.

[Phase 1: 2019-2023]

- To attract investment in industries and tourism, "economic development zones" will be designated in Toamasina Agglomeration, and investments in these zones will be promoted by utilising existing infrastructure.
- To develop roads for enabling access to lands for housing development, as well as for development of economic sectors in Toamasina Agglomeration. These roads will not only promote the development of residential areas to accommodate increasing population, but also function as access roads to the port and industrial areas.
- To develop a new Secondary Urban Centre in Magarivotra to enhance commercial and business function of Toamasina Agglomeration.
- To make efforts to develop Service Centres in the outskirt of CUT for providing services to suburban areas, by taking advantage of prospective road construction.

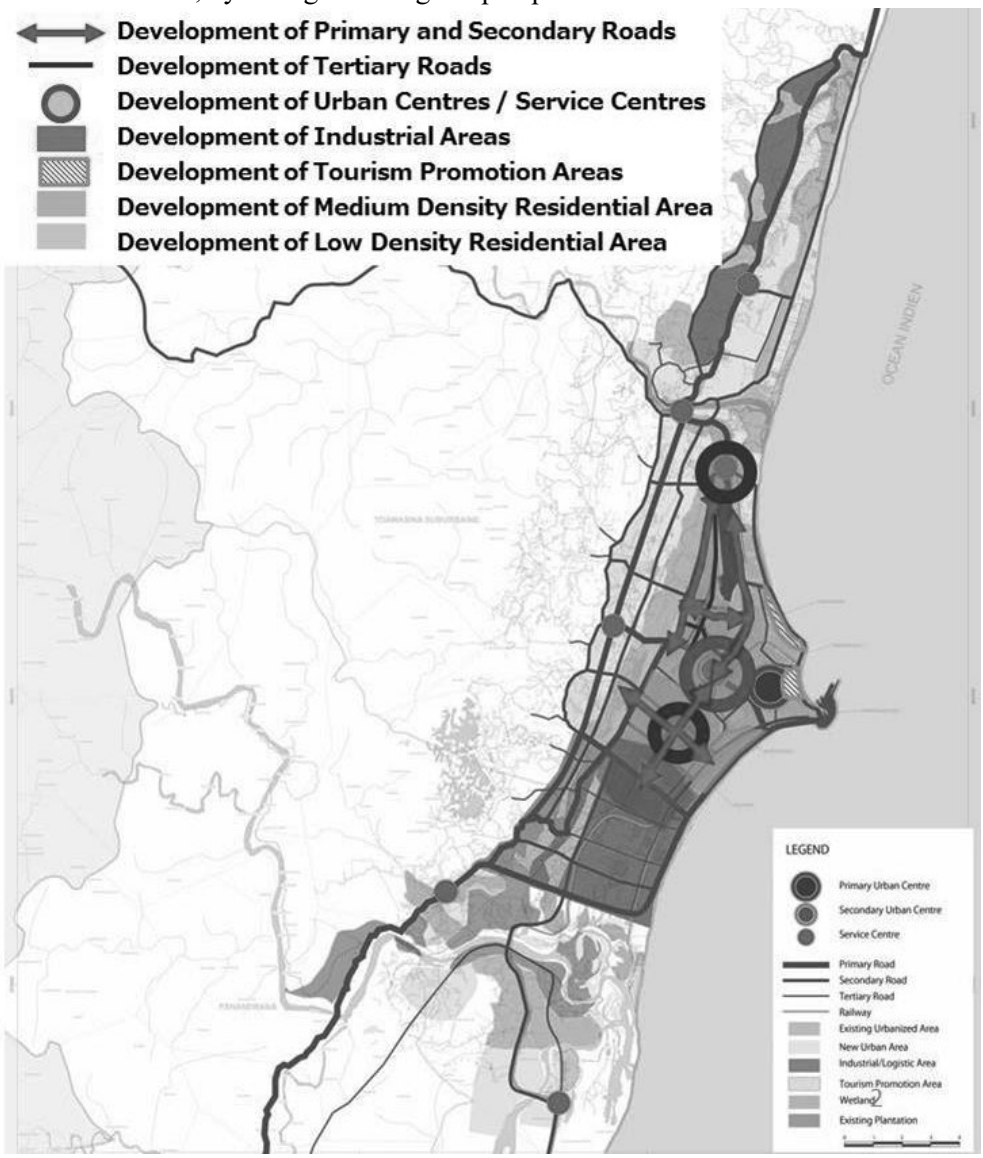


Figure 16.1.9 Phased Development of Toamasina Agglomeration for Phase 1 (2019-2023)

[Phase 2: 2024- 2028]

- To construct the Third Access Road to Toamasina Port for strengthening the logistics, by taking advantage of Toamasina Port Expansion, which is to be completed by 2028.
- At the same time, along this road, industrial areas will be developed.
- To develop Volobe Hydropower Station II, by taking advantage of the new transmission line between Antananarivo and Toamasina which is to be constructed by 2021. The electricity generated by Volobe II will support the development of industries in the south of Toamasina Agglomeration, as well as in the agglomeration as a whole.
- To further attract investment in tourism, and to construct additional roads for accessing designated areas for tourism promotion outside CUT.
- To promote suburban development by improving the connectivity between CUT and outside CUT by constructing bypass roads, and developing service centres.

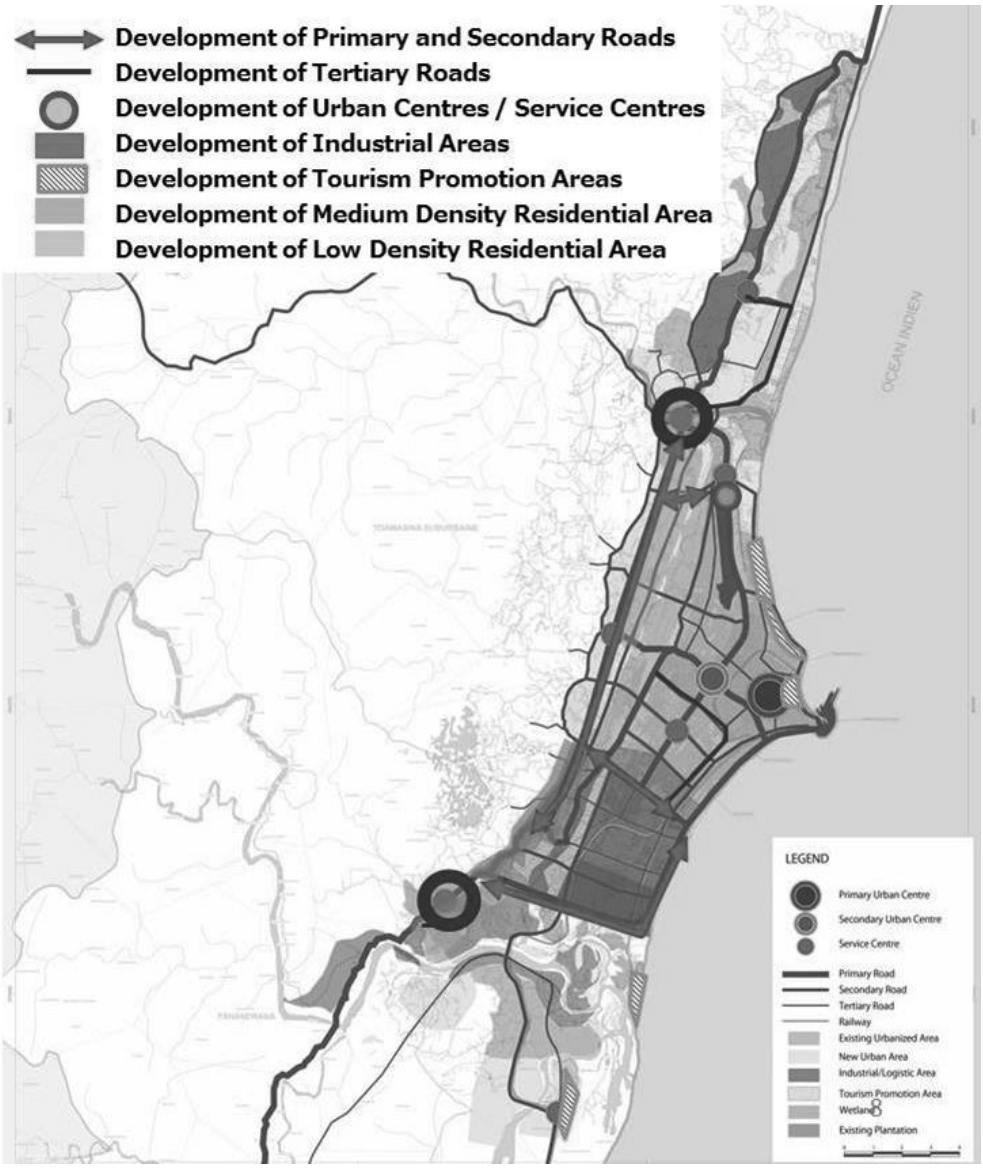


Figure 16.1.10 Phased Development of Toamasina Agglomeration for Phase 2 (2024-2028)

[Phase 3: 2029-2033]

- To develop industrial areas on the north side of the Ivoloina River, by increasing the capacity of power supply and water supply. The construction of the new bypass road will also connect the industrial area in the north of Toamasina to National Road No.2.
- To develop Toamasina Agglomeration as an international tourism centre by attracting further investments to tourism investment promotion areas targeting international tourists.
- To promote suburban development further outside for the increasing population of Toamasina Agglomeration by improving the connectivity within Toamasina Agglomeration by constructing bypass roads, and developing service centres.

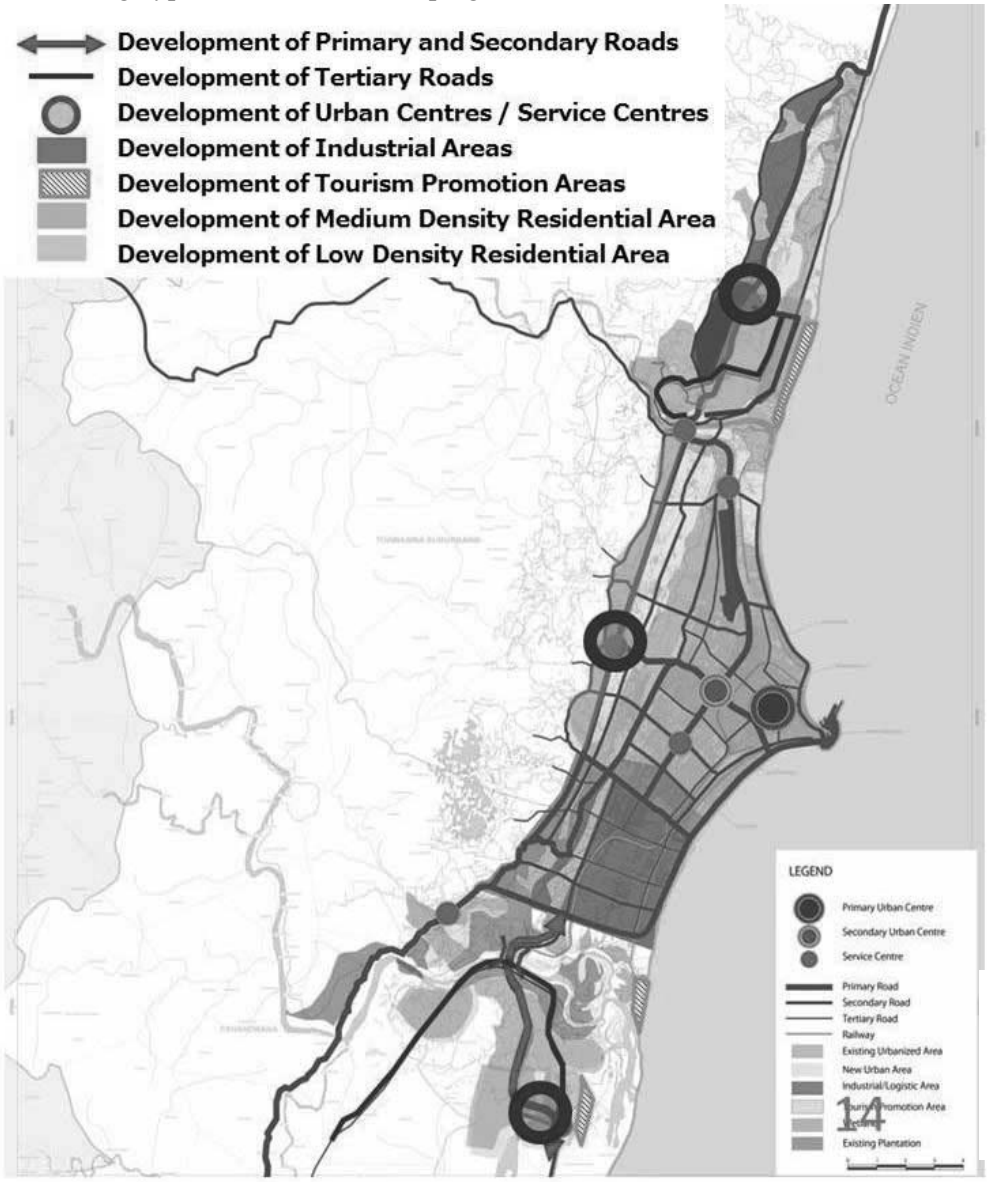


Figure 16.1.11 Phased Development of Toamasina Agglomeration for Phase 3 (2029-2033)

[Phase 4: 2034-2038]

- To further develop industrial areas on the northern side of the Ivoloina River, by constructing a new bridge over the Ivoloina River and upgrading National Road No.5.
- To promote suburban development further to the north for the increasing population of Toamasina Agglomeration by improving the connectivity to CUT.
- To develop power and water supply infrastructure to provide services to new residential areas and industrial areas to be located on the northern side of the Ivoloina River.

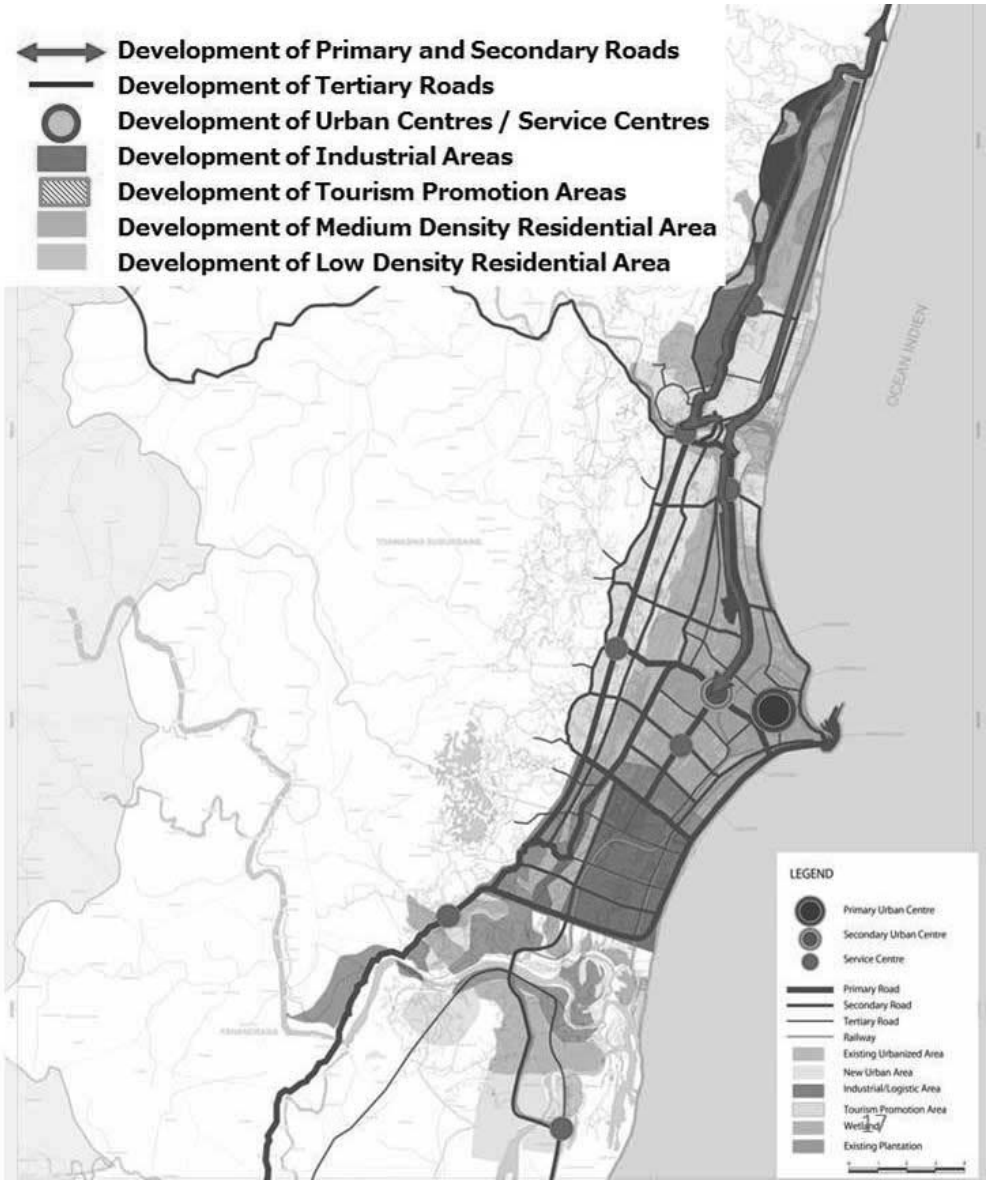


Figure 16.1.12 Phased Development of Toamasina Agglomeration for Phase 4 (2034-2038)

16.2 Strategies for Urban Centre Development in Toamasina Agglomeration

16.2.1 Objectives for Promotion of Urban Centre Development in Toamasina Agglomeration

The objectives for promoting urban centre development in Toamasina Agglomeration are as follows:

- To improve the overall efficiency of urban functions of Toamasina Agglomeration
- To utilize the improved accessibility within Toamasina Agglomeration due to the new port access roads to be constructed for expanding the urban areas
- To decentralize the urban functions concentrated in CUT to other centres in Toamasina Agglomeration

16.2.2 Strategies for Promotion of Urban Centre Development in Toamasina Agglomeration

The following strategies are determined for promoting urban centre development in Toamasina Agglomeration:

- To provide major arterial roads not only to support logistics but for providing land for urban centre development
- To develop the urban centres by phases concurrently with the phased development of roads

16.2.3 Programmes and Projects for Urban Development Strategies in Toamasina Agglomeration

In order to implement the urban development strategies described in Section 16.1, the following urban centre development projects should be implemented in association with road development, industrial area development, tourism are development, water supply and power supply:

Phase 1: 2019-2023

[T-C-01] Project for Promotion of Development of Toamasina Primary Urban Centre Phase 1

[T-C-02] Project for Promotion of Development of Ankirihiry-Mangarivotra Secondary Urban Centre

[T-C-03] Project for Promotion of Development of Toamasina South Service Centre

[T-C-04] Project for Promotion of Development of Toamasina North Service Centre

Phase 2: 2024-2028

[T-C-05] Project for Promotion of Development of Fanandrana Service Centre

[T-C-06] Project for Promotion of Development of Ivoloina Service Centre

16.3 Housing Development Strategies in Toamasina Agglomeration

16.3.1 Objectives for Housing and Settlement Development in Toamasina Agglomeration

From the analysis of the current situation, the objectives for housing and settlement improvement in Toamasina Agglomeration are proposed as follows:

Objective 1: To improve the living condition of the urbanized areas of CUT

- By reducing the population density of the congested urban centres

- By improving and developing basic infrastructure and public services, such as water and power supply, sanitation and hygiene, parks and open space, etc.

Objective 2: To develop residential areas with basic infrastructure and public facilities in the suburban area of CUT to accommodate the future population growth and to lower the population density of the urbanized area of CUT

- By preparing a plan of development of large plots while addressing land tenure issues, and implementing it.
- By developing suburban centres to provide necessary services to the residents in the expand urban area

16.3.2 Strategies for Housing and Settlement Development in Toamasina Agglomeration

In order to achieve the aforementioned objectives while addressing the identified issues, the strategies are identified as follows:

(1) Strategy 1: To develop large plots in suburban areas as residential areas by applying site and service scheme to the plots

In order to accommodate expected population growth in Toamasina Agglomeration, this strategy aims to develop new residential areas in the suburban areas, by applying site and service scheme. For development of plots for residential use with necessary basic infrastructure and services, relatively large vacant plots should be identified for the site and service scheme. In addition to the land owned by the government, the plots without unknown owners can be potential sites for the scheme. In that case, appropriate interventions and legal measures to address the land tenure issue should be sought. Residential development is supposed to target not only low-income households but also medium and high income families, and the areas should have some commercial and industry uses for creation of vibrant neighbourhoods and cost recovery.

(2) Strategy 2: To develop service centres in suburban areas with good transport access to the area for expansion of urbanized areas of Toamasina Agglomeration

In addition to Strategy 1, new service centres should be developed in suburban areas in order to expand urbanized area in Commune of Toamasina Suburbaine, as well as in the south of CUT, and to provide necessary services to residents in newly developed areas. These service centres should be well connected with the Primary and Secondary Urban Centres, as well as other service centres by arterial roads and by public transport. The centres should have government offices, secondary/ high schools, health facilities, branch offices of banks, post offices, market, etc. and provide basic public and commercial services to residents of the surrounding fokontany.

16.3.3 Programmes and Projects Strategies for Housing Development in Toamasina Agglomeration

(1) Suburban Residential Area Development Project

The objective of this project is to develop residential areas with basic infrastructure in the suburban areas of Toamasina, by applying site and service scheme. In order to accommodate the future population of Toamasina Agglomeration, which is expected to be doubled by 2033, it is necessary to prepare residential areas and basic infrastructure in advance for provision of the livable and healthy living environment. Otherwise, the living environment of the newly urbanized suburbs as well as already the congested urban centre of CUT is anticipated to be degraded. By applying a site and service scheme, plots for residential use and basic infrastructure such as roads, water and power supply, and sanitation, as well as schools and health centres, should be developed in advance. For the project site, relatively large plots of land should be acquired at first, by identifying underutilized government lands or land possessed by unknown owners.

Under the scheme, residential area will be developed for a diverse mix of households, including low-income households who migrated from the urban centre of CUT, and middle and upper classes, and will include the areas for commercial and small light industrial use including workshops, in order to develop a vibrant community with work place. The project will be started with the planning phase to examine an appropriate design of the scheme and feasibility of the project. A possibility to invite the private sector shall be also explored for development of PPP.

(2) Suburban Centre Development Project

This project is to develop suburban centres which offer necessary public services to the suburban areas. The development of suburban centres is important for the decongestion of CUT and expansion of the urbanized area. Thus, this project aims to develop new suburban centres in the expanded areas in the communes bordering CUT. The new suburban centres will have public facilities such as schools, clinics, government offices, etc. and commercial and business functions such as shops, restaurants, and other offices. New arterial roads connecting these suburban centres and the urban centre will be proposed with the development of suburban centres. (See Section 16.2 and Section 16.6.2 for detail.)

16.4 Strategies for Development of Open Space in Toamasina Agglomeration

16.4.1 Objectives for Development of Open Space in Toamasina Agglomeration

The objectives for development of open space in Toamasina Agglomeration are as follows:

- To maintain the function of existing open space facilities in Toamasina Agglomeration
- To secure lands to provide necessary urban parks and sports facilities for the increasing urban population of Toamasina Agglomeration

16.4.2 Strategies for Development of Open Space in Toamasina Agglomeration

The following strategies are determined for developing open space in Toamasina Agglomeration:

- Provision of Urban Parks and Sports Facilities by Securing Lands in Newly Developing Service Centres in Suburban Areas
- Provision of Waterfront Parks along the Sea and Pangalanes Canal
- Securing of Lands for Provision of Urban Parks by Land Use Zoning Plans
- Management of Existing Urban Parks and Sports Facilities
  - To rehabilitate and improve facilities of existing urban parks and sport facilities
  - To protect existing open space facilities from emerging development pressure and changing them to other land uses
- Securing of Small Parks in Subdivisions
  - To secure lands for urban pocket parks when developing a subdivision residential area
  - To develop urban pocket parks as part of informal settlement upgrading project or when redeveloping a high-density residential area

16.4.3 Programmes and Projects for Development of Open Space in Toamasina Agglomeration

Some actions necessary for development of open space in Toamasina Agglomeration need to be implemented together with other urban development projects such as development of retention pond and upgrading of informal settlement. Such actions are integrated into the following projects of other sectors:

- Provision of Urban Parks and Sports Facilities by Securing Lands in Newly Developing

Service Centres
  - Projects for promoting urban centre development in Toamasina Agglomeration (T-C-01 to T-C-06)
- Provision of Waterfront Parks along the Sea and Pangalanes Canal
  - Project for Toamasina (Miami) Sea Waterfront Development along the Toamasina Bay (T-T-01)
  - Project for Construction of Toamasina Canal Waterfront Promenade along Pangalanes Canal (T-T-03)
- Securing of Lands for Provision of Urban Parks by Land Use Zoning Plans
  - Project for Capacity Development for Promotion and Coordination of Implementing the PUDi of Toamasina Agglomeration
- Securing of Small Parks in Subdivisions
  - Project for Local Road Development and Improvement of Informal Settlements in CUT

Other projects for development of open space in Toamasina Agglomeration are listed below.

- Project for Formulation of Development Plan for Urban Parks
- Project for Formulation of Development Plan for Sports Facilities

16.5 Strategies for Historical Area Preservation in Toamasina Agglomeration

16.5.1 Objective of Historical Area Preservation

To promote appropriately the preservation of the value of the historical heritage in Toamasina, not only those in Zone of Old City, but those buildings, parks and streets with historical values outside the Old City Zone.

16.5.2 Strategies for Historical Area Preservation

In order to preserve the historical heritage, the following strategies should be implemented:

- To sort out the information about the situation of historic buildings and landscape to clarify what should be preserved.
- To raise people's awareness about the heritage preservation
- To provide clear instruction of what and how to do prepare guidelines for preservation for each zone to those who should preserve the historic buildings and landscape.
- To establish a firm system to monitor the situation of compliance of the preservation regulation
- To establish an incentive system for those who are restricted in their right to use their property and have to comply with the preservation regulations; such incentives are usually provided by the government to promote the preservation

16.5.3 Project for Preservation of Historical Area

To promote the preservation of the preservation of the historical heritage in Toamasina, the following project should be implemented:

- Project for Preservation of Historical Sites in Toamasina Agglomeration

16.6 Profiles of Priority Projects for Urban Development in Toamasina Agglomeration

16.6.1 Capacity Development for Promotion and Coordination for Implementing the PUDi (Urban Development Master Plan) of Toamasina Agglomeration

The first set of actions necessary for implementing the PUDi is "Project for Capacity Development for Promotion and Coordination of Implementing the PUDi (Urban Development Master Plan) of Toamasina Agglomeration."

This Project is composed of the following two components:

- Capacity Development for Communes in Utilization of Land Use Zoning Regulations
- Implementation of Pilot Project for Development of Urban Centres

(1) Capacity Development for Communes in Utilization of Land Use Zoning Regulations

1) Objectives of the Project Component

Overall Objectives

- To become able to coordinate and promote the integrated development delineated by the PUDi (urban development master plan)
- To become able to play their own roles in a proper manner for coordination and promotion for implementation of the PUDi

Individual Objectives

- To become able to enforce land use regulation and architectural regulation, especially in the following aspects:
  - Not to issue construction permits on the lands for arterial roads planned in the PUDi
  - To monitor and prevent illegal construction on the lands for arterial roads planned in the PUDi

2) Targets of Capacity Development

- MAHTP, Central Government Ministry
- SRAT, a Regional Agency of the Central Government Ministry, which is in charge of Territorial Development
- Urban Commune of Toamasina
- Communes outside the Urban Commune of Toamasina
- Private Developers

3) Description of Project Component

This project component is composed of the following steps:

- To study the present situation
- To design a revised system of utilization of land use zoning regulations
- To design a set of training modules for the revised system of utilization of land use zoning regulations
- To conduct training sessions for target personnel and organizations

4) Cost and Duration for Project Component

- 0.75 million USD for 3 years

(2) Implementation of Pilot Projects for Development of Urban Centres

1) Objectives of Implementation of Pilot Project

- To become able to coordinate and promote the implementation of projects of urban centre development covering the following aspects:
  - Formulation of PUDé (detailed urban plans)
  - Construction of infrastructures, such as local roads and electricity distribution
  - Construction of promenade along Pangalanes Canal
  - Development of multi-modal public transportation terminals for urban railway, bus and taxi be

2) Target Areas of Pilot Projects

The target areas of the pilot projects are as follows:

- Toamasina Primary Urban Centre
- Ankirihiry-Mangarivotra Secondary Urban Centre
- Antetezambaro Service Centre.
- Ivoloina Service Centre.
- Toamasina North Service Centre.
- Toamasina West Service Centre.
- Toamasina South Service Centre.
- Fanandrana Service Centre.
- Amboditandroroho Service Centre.

3) Targets of Capacity Development by Implementing Pilot Projects

- MAHTP, Central Government Ministry
- SRAT, a Regional Agency of the Central Government Ministry, which is in charge of Territorial Development
- Urban Commune of Toamasina
- Communes outside the Urban Commune of Toamasina
- Private Developers

4) Description of Project Component

The project component is composed of the following steps:

- To review the present situation
- To design the system of coordination and promotion for implementation of urban centre development projects
- To prepare training modules for the system of coordination and promotion for implementation of urban centre development projects
- To conduct training sessions for target personnel and organizations

5) Cost and Duration of Project Component

- 0.75 million USD and 2 years

16.6.2 Profiles of Priority Projects for Promotion of Development of Urban Centres in Toamasina Agglomeration

(3) [T-C-01] Project for Promotion of Development of Toamasina Primary Urban Centre

1) Objectives

- To develop an urban core (Toamasina Primary Urban Centre) to support central economic functions for the overall Toamasina Agglomeration, based on the existing urban centre (the Old City)
- To strengthen east-west connection and north-south connection for the overall Toamasina Agglomeration through Toamasina Primary Urban Centre
- To improve the urban amenity within Toamasina Primary Urban Centre
- To conserve the historic buildings and environment within Toamasina Primary Urban Centre

2) Project Description

- Development of an urban core consisting of business parks, shopping centres, hotel zones, and other urban functions, based on the existing urban centre (by rehabilitating, upgrading and newly constructing the following infrastructure and facilities
  - Major roads and flyover (grade separated junction)
  - Infrastructure (electricity, water supply, and drainage)
  - Urban parks
  - Waterfront promenade along the Toamasina Bay
  - Designation and conservation of historical buildings
- Promotion of private development

3) Expected Benefits

In Toamasina Primary Urban Centre, more commercial and business activities will be accumulated. This project will consolidate and upgrade the economic performance of the existing urban centre so as to form an upgraded urban core for Toamasina Agglomeration.

4) Executing Agency and Related Institutes

- MAHTP,
- JIRAMA
- CUT

5) Estimated Project Cost

- 10 million USD

6) Implementation Schedule

- 2019-2020 (2 years): Formulation of PUDé for Toamasina Primary Urban Centre
- 2021-2023 (3 years): Construction of infrastructure and urban facilities

7) Related Plans and Projects

- [T-R-01] Project for Construction of Port Access Road for Construction of Toamasina Port
- [T-R-04] Project for Widening of NR5 to 4-Lane Road between Toamasina Airport and the Junction of NR2 & NR5
- [T-T-01] Project for Toamasina (Miami) Sea Waterfront Development along the Toamasina Bay
- [T-F-02] Project for Rehabilitation of Railway for Tourist and Urban Passengers

8) Social and Environmental Impacts

- N.A.

(4) [T-C-02] Project for Promotion of Development of Ankirihiry-Mangarivotra Secondary Urban Centre

1) Objectives

- To modernise existing street-side commercial activities at the junction of NR2 and NR5
- To decentralize urban functions from the existing urban centre (the Old City) for providing urban residents with commercial and businesses facilities, as well as public facilities, to cater for needs of Toamasina Agglomeration
- To promote private development

2) Project Description

- To formulate a PUDé in order to create the Secondary Urban Centre and guide urban developments.
  - To identify tertiary roads to connect other urban centres and local roads to promote urban development.
  - To formulate detailed land use zoning and regulations
  - To attract private investment in the Secondary Urban Centre
- Construction of basic infrastructure, such as water supply, and electricity supply, and drainage, in addition to roads
- Provision of an Urban Park within and around the Secondary Urban Centre

3) Expected Benefits

By constructing Ankirihiry-Mangarivotra Secondary Urban Centre, new commercial, business, residential, and public services are provided outside of the existing urban centre (the Old City). It will mitigate congestion from CUA. As the result, the development of the secondary urban centre will improve the quality of life.

4) Executing Agency and Related Institutes

- MAHTP
- JIRAMA
- CUT

5) Estimated Project Cost

- 5 million USD

6) Implementation Schedule

- 2019-2020 (12 months): Formulation of PUDé for Ankirihiry-Mangarivotra Secondary Urban Centre
- 2021-2023: 3 years: Construction of infrastructure and urban facilities

7) Related Plans and Projects

- [T-R-03] Project for Construction of Urban Arterial Roads in Toamasina South
- [T-R-04] Project for Widening of NR5 to 4-Lane Road between Toamasina Airport and the Junction of NR2 & NR5

8) Social and Environmental Impacts

- Resettlement will be necessary due to widening of NR5

(5) [T-C-03] [T-C-04] Project for Promotion of Development of Service Centre (Toamasina South Service Centre and Toamasina North Service Centre)

1) Objectives

- To distribute urban functions outside CUT for supporting urban residents and businesses and provide facilities to cater for needs of communes
- To provide better living conditions
- To promote private development

2) Project Description

- To formulate a PUDé in order to create service centres and guide urban development outside CUT.
  - ➢ To identify tertiary roads to connect other urban centres and local roads to promote urban development
  - ➢ To formulate detailed land use zoning and regulations.

3) Expected Benefits

By constructing a new service centre, new commercial, business, residential, and public services are provided in suburban areas outside of CUT. It will mitigate congestion from CUA. As the result, the development of the service centre will improve the quality of life in suburban areas outside CUT.

4) Executing Agency and Related Institutes

Toamasina South Service Centre

- MAHTP
- JIRAMA
- Amboditandroroho Rural Commune

Toamasina North Service Centre

- MAHTP
- JIRAMA
- Toamasina Suburbaine Rural Commune

5) Estimated Project Cost

- 3 million USD for Toamasina South Service Centre
- 2 million USD for Toamasina North Service Centre

6) Implementation Schedule

- 12 month: Formulation of PUDé for development of a service centre
- 2 years: Construction of infrastructure and urban facilities for a service centre

7) Related Plans and Projects

Related Projects for Toamasina South Service Centre

- [T-R-03] Project for Construction of Urban Arterial Roads in Toamasina South
- [T-E-02] Project for Construction of Water Treatment Plant by In-taking of Ivondro River Water

Related Projects for Toamasina North Service Centre

- [T-R-02] Project for Construction of Urban Arterial Road in Toamasina West
- [T-R-04] Project for Widening of NR5 to 4-Lane Road between Toamasina Airport and the Junction of NR2 & NR5
- [T-E-01] Project for Construction of Second Water Treatment Plant by In-taking of Ivoloina

River Water

(6) [T-C-05] [T-C-06] Project for Promotion of Development of Service Centre (Fanandrana Service Centre and Ivoloina Service Centre)

1) Objectives

- To distribute urban functions outside CUT for supporting suburban residents by providing commercial, businesses and public services provide to cater for needs of communes
- To provide better living conditions
- To promote private development

2) Project Description

- To formulate a PUDé in order to create the service centre and guide urban development in suburban areas outside CUT.
  - To identify local roads to promote urban development
  - To formulate detailed land use zoning and regulations
  - To find land for constructing a urban park within or around each service centre

3) Expected Benefits

By constructing the two service centres in suburban areas outside CUT, commercial, business, residential, and public facilities will be provided outside of CUT. It will mitigate congestion from CUT. As the result, the development of the service centres will improve the quality of life in suburban areas outside CUT.

4) Executing Agency and Related Institutes

Fanandrana Service Centre

- MAHTP
- JIRAMA
- Rural Commune of Fanandrana

Ivoloina Service Centre

- MAHTP
- JIRAMA
- Rural Commune of Toamasina Suburbaine

5) Estimated Project Cost

- 2 million USD for Fanandrana Service Centre
- 2 million USD for Ivoloina Service Centre

6) Implementation Schedule

- 12 month: Formulation of PUDé for development of a service centre
- 2 years: Construction of infrastructure and urban facilities for a service centre

7) Social and Environmental Impacts

There are environmental impact by land filling wetland and social impact by relocation.

16.6.3 Profiles of Priority Projects for Tourism Development and Open Space Development in Toamasina Agglomeration

(1) Project for Construction of Toamasina Canal Waterfront Promenade along Pangalanes Canal

1) Objectives

- To improve the amenity by creating open space along Pangalanes Canal in Toamasina Agglomeration
- To create commercial and tourist facilities along Pangalanes Canal for citizens and tourists of Toamasina Agglomeration
- To distribute urban functions outside the existing urban centre (the Old City) for supporting urban residents and businesses
- To provide better living conditions
- To promote private development

2) Project Description

A project for developing a complex with a promenade along Pangalanes Canal is composed of the following components:

- To establish a complex of commercial and tourist facilities, such as shops, restaurants, cafés and hotels, along Pangalanes Canal within CUT by attracting private investment
- To establish a promenade along Pangalanes Canal with the function of walkable open space
- To establish a port and passenger terminal at Pangalanes Canal for tourist boats

3) Expected Benefits

- Aesthetic, amenity and asset values of the areas along the canal within CUT will be enhanced.
- Citizens and tourists will be able to enjoy the commercial and tourist facilities, as well as the promenade (walkable open space) along the canal.
- Tourists will be attracted by the canal promenade and commercial/tourist complex.
- Private investments will be attracted to economic sectors of Toamasina Agglomeration due to the enhanced open space and commercial/tourist facilities.

4) Executing Agency and Related Institutes

- MAHTP
- MATTP
- CUT

5) Estimated Project Cost

- 4 million USD

6) Implementation Schedule

- 2019-2020: Formulation of PUDe for the area development along the canal within CUT
- 2021-2023: Construction of the commercial and tourism complex, together with a promenade and a port along the canal

7) Related Plans and Projects

- Project for investment promotion for tourism sector in Toamasina Agglomeration

8) Social and Environmental Impacts

- Utlisation of land for the commercial and tourist complex along Pangalanes Canal might have

impact on the water environment of the canal.

(2) Project for Preservation of Historical Sites in Toamasina Agglomeration

1) Project Description

A project for preservation of historical area is composed of the following components:

- To establish a database of the historic buildings, parks and landscape with the explanation of historic values and location map, based on the academic survey on their historic values.
- To officially designate the historical heritage including the parks and hospital which are proposed by the Urban Group
- To promote public relations about the heritage preservation by preparing publicity materials such as pamphlet about the heritage preservation so that the citizens understand the historic values of the heritage in Toamasina.
- To prepare visual guidelines, particularly including the following items: Facade design, Colour code, Signboard size and colour, Interior code, Building materials to be used, Height, Wall line, Gate and fence, etc.
- To establish an incentive and support system to provide a favourable treatment on taxes related to land or buildings, subsidies for the preservation work and materials, and technical support and so on.

2) Expected Benefits

- Aesthetic, amenity and asset values of the areas of the Zone of Old City and other area with the historical heritage will be raised by the preservation. And the preserved heritage buildings, parks and landscape would vitalize more economic activities by attracting the citizens and visitors.

3) Executing Agency and Related Institutes

- CUT

4) Estimated Project Cost

- To be estimated

5) Implementation Schedule

- Survey of the historical heritage and landscape
- Establishment of database of the historical heritage and landscape
- Designation of the historical heritage
- Preparation and authorization of guidelines
- Determination of incentives and subsidies

6) Necessary Actions for Implementation / Critical Factor

- Survey and study of the historical heritage
- Designation and list-up of heritage buildings, parks, and landscape
- Preparation and authorization of guidelines
- Determination and authorization of incentives and subsidies and procurement of financial source for the preservation activities
- Consensus of the citizen on the preservation as their rights are restricted

7) Related Plans and Projects

- Projects related to the Old City Zone, the coastal road, other parks, and the hospital which are

proposed to preserved

8) Social and Environmental Impacts

- Restriction on usage of private properties in the area to be preserved
- Improvement of landscape and amenity
- Increase in asset values and economic activities in or near the area to be preserved

Chapter 17 Land Use Framework, Land Use Policy and Land Use Zoning Regulations for Toamasina Agglomeration

17.1 Land Use Framework for Toamasina Agglomeration

17.1.1 Present Land Use Framework for Toamasina Agglomeration

Table 17.1.1 shows the present land use of CUT and part of the four surrounding communes as shown in Figure 17.1.1. The present land use map covers approximately 400 km^2 of Toamasina Agglomeration. Therefore, there is much larger area of non-developed area within the four surrounding comumes of CUT.

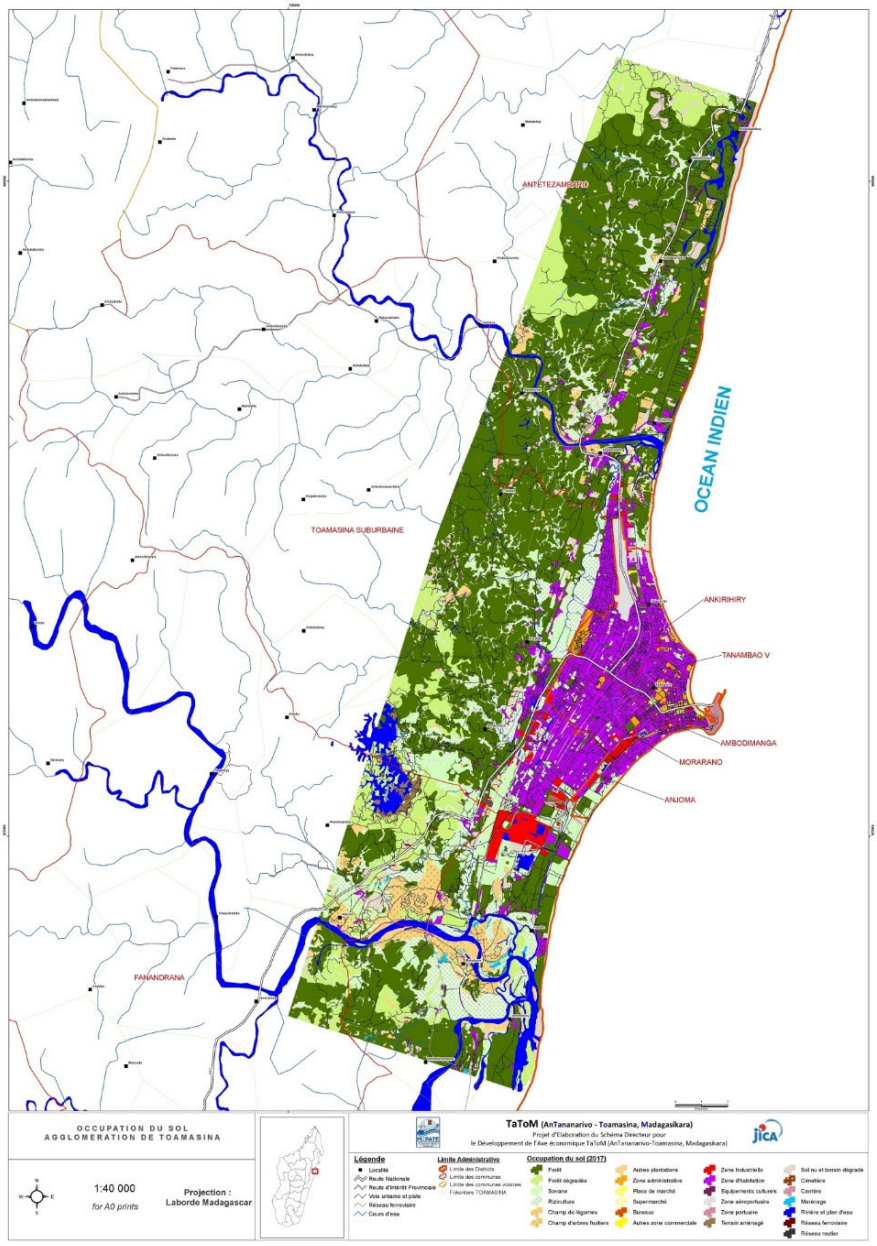


Figure 17.1.1 Area Covered by the Present Land Use Framework for Toamasina Agglomeration

Within the area coverd by the present land use map, the majority of Toamasina Agglomeration is also non-urbanized with only approximately 10% of its land urbanized. while most urbanized areas are concentrated in CUT.

While approximately half of residential areas in Toamasina Agglomeration is in outside of CUT, other urbanized areas such as commercial and administration areas are concentrated in CUT compared to residential areas. On the other hand industrial area is concentrated in Toamasina Suburban Commune.

Table 17.1.1 Present Land Use Framework of Toamasina Agglomeration (2017)

	Residential Areas	Industrial Areas	Other Urbanized Areas	Urbanized Areas	Wetland including Wetland Paddy Areas	Other Non-Urbanized Areas	Non-Urbanized Areas	Total
Toamasina Agglomeration	35.66 km^2	4.01 km^2	7.26 km^2	46.93 km^2	88.29 km^2	266.26 km^2	354.56 km^2	401.48 km^2
CUT	19.35 km^2	0.90 km^2	6.03 km^2	26.28 km^2	0.64 km^2	4.11 km^2	4.75 km^2	31.03 km^2
Outside of CUT	16.31 km^2	3.11 km^2	1.23 km^2	20.64 km^2	87.65 km^2	239.94 km^2	325.59 km^2	348.23 km^2

Source: JICA Study Team

While half of residential areas in Toamasina Agglomeration are in CUT, approximately80% of the population in Toamasina Agglomeration lives in CUT. Therefore, the population density of residential areas is almost three times larger in CUT compared to the communes outside of CUT.

Table 17.1.2 Population Density within Residential Areas in Toamasina Agglomeration (2017)

	Residential Areas (km^2)	Population (persons)	Gross Population Density of Residential Areas (person/km^2)
Toamasina Agglomeration	35.66	437,004	12,254,7
CUT	19.35	326,286	16,862.3
Outside of CUT	16.31	110,718	6788.0

Source: JICA Study Team

17.1.2 Future Land Use Framework for Toamasina Agglomeration

(1) Residential Areas

The future population increase of Toamasina Agglomeration needs to be accommodated by expansion of residential areas and densifying (verticalisation of residential buildings in) some of the residential areas close to primary and secondary urban centres and urban sub-centres.

In order to accommodate the increasing population of Toamasina Agglomeration, the total surface area for residential use needs to almost double in the next 15 years. This residential areas need to be accommodated especially in area outside of CUA, and at least 21km^2 of land needs to be developed for residential usage.

The area necessary to be increased to accommodate the demand of housing need in CUT is much smaller compared with outside of CUT, since possible land for development in CUT is limited. Therefore, in CUT, verticalisation of buildings is important. In addition, areas which are currently used for manufacturing or any other usage which does not need to be in the city centre should be encouraged to be relocated to areas outside of CUT or to be changed to mixed usage zoning area.

Table 17.1.3 Increase of Population and Residential Area within Toamasina Agglomeration

	2017			2033		
	Residential Areas (km^2)	Population (persons)	Gross Population Density of Residential Areas (person/km^2)	Residential Areas (km^2)	Population (persons)	Gross Population Density of Residential Areas (person/km^2)
Toamasina Agglomeration	35.66	437,004	12,254,7	77.09	762,839	9,895.4
CUT	19.35	326,286	16,862.3	20.04	506,111	25,255.0
Outside of CUT	16.31	110,718	6788.0	57.05	256,728	4,500.1

Source: JICA Study Team

Table 17.1.4 Increase of Residential Area by Area in Toamasina Agglomeration

	2017	2033	2017-2033	2017-2033
	Residential Areas (km^2) [A]	Residential Areas (km^2) [B]	Increase of Residential Area (km^2) [C]=[B]-[A]	Increase (%) [D]=[C]/[A]
Toamasina Agglomeration	35.66	77.09	41.43	116.2%
CUT	19.35	20.04	0.69	3.6%
Outside of CUT	16.31	57.05	40.74	249.8%

Source: JICA Study Team

(2) Industrial Area

The economic active population in Toamasina Agglomeration in 2033 is assumed to become approximately 400 thousand (see Table 17.1.5). The future vision of Toamasina Agglomeration aims to develop its economy dynamically by attracting investment to various economic sectors especially manufacturing. Therefore, it is important to prepare necessary land for manufacturing in Toamasina Agglomeration to support this economic growth.

Table 17.1.5 Increase of Economic Active Population in Toamasina Agglomeration

	1993	2018	2023	2028	2033
Population	165,464	437,004	520,991	626,861	762,839
Annual Growth Rate	-	3.96%	3.58%	3.77%	4.05%
Economic Active Population	82,732	218,502	260,496	329,102	419,561
EAP/Population	50%	50%	50%	52.5%	55%

Source: JICA Study Team

The growth scenario for Toamasina Agglomeration aims to attract manufacturing industries such as textile, agro-processing and light industry to become an industrial city in the long-term. Although the current economic infrastructure and labour force in Toamasina Agglomeration are insufficient for such economic development, the agro-processing industries already existing in Toamasina Agglomeration proves the locational advantage close to the port and the planned improvement of economic infrastructure in the next 5 years will further attract investment to Toamasina Agglomeration as a high potential area for manufacturing. Therefore, the economic framework for Toamasina Agglomeration is set to achieve a high growth in the secondary sector, with the contribution of secondary sector to GRDP increasing almost four times in 19 years from 2014.

Table 17.1.6 Changes in Contribution of Secondary Sector in Antananarivo Agglomeration's GRDP

	GRDP (MGA Billion, at 2007 constant prices)	Share of Secondary Sector (%)	Amount of Secondary Sector in GRDP (MGA Billion)	Annual Growth Rate (%)
2014 (Actual)	330	28.2	93	-
2023 (Projected)	554	27.8	154	5.76
2028 (Projected)	822	28.0	230	8.37
2033 (Projected)	1,297	28.1	364	9.63

Source: JICA Study Team

In 1993, approximately 13% of resident in CUT were engaged in manufacturing activities. The necessary land for manufacturing is calculated for three cases, the first assumption that 25% of economic active population in 2033 will be engaged in manufacturing sector and the second and third assumption that 20% and 15% of economic active population in 2033 will be engaged in manufacturing sector, respectively.

In 2017, it is assumed that the industry area in Toamasina Agglomeration had the density of 20 worker/ha. This density is similar to the density in industrial areas for light industry and agro-processing industry in other countries, too. However, Toamasina is also to promote textile industry where higher density of workers are necessary. Therefore, assuming that 10% of the future labour force in the manufacturing sector will be engaged in textile industry, the necessary area for 2033 in Table 17.1.7 uses 38 worker/ha.

The current industrial areas in Toamasina Agglomeration account for 311 ha. Even for the low case almost 13 km^2 of land is necessary to be developed for manufacturing by 2033. In the high case, 19 km^2 of land should be prepared for manufacturing by 2033.

Table 17.1.7 Necessary Area for Manufacturing in 2033 for Toamasina Agglomeration

	Case 1 (High)	Case (Medium)	Case (Low)
Economically Active Population	419,561	419,561	419,561
Share of EAP Engaged in Manufacturing	20%	17.5%	15%
Economically EAP Engaged in Manufacturing	84,000	73,000	63,000
Necessary Area for Manufacturing	2,211 ha	1,921 ha	1,658 ha

Source: JICA Study Team

17.2 Land Use Policies for Toamasina Agglomeration

17.2.1 Land Use Policies by Land Use

(1) Policy on Residential Land Use

- At present, inside CUT, high-density and middle-density residential areas are concentrated.
- In the future, high and mid-density residential areas will be further expanded and the height of residential buildings will be increased.
- At present, outside CUT, low-density residential areas are widely spreading in Toamasina Suburban Commune and towards the fringe of other surrounding communes of CUT.
- In the future, outside CUT, the development of low-density residential areas, will be promoted along the north and south of CUT in the surrounding of urban sub-centres.

(2) Policy on Commercial Land Use

- At present, within CUT, commercial areas including office areas are mostly located in the centre of CUT, Ambodimanga.
- In the future, within CUT, commercial areas including office areas will be expanded along major roads, as well as in existing commercial centres, such as Ankirihiry. More height of

commercial buildings will be allowed in commercial areas.

- At present, commercial areas outside CUT is limited. Small commercial accumulation can be found along NR2 and NR5.
- In the future, outside CUT, the commercial function of these existing commercial areas will be upgraded to be "Service Centres." Service centres will be developed in order to accommodate not only commercial/office areas, but also other urban functions.

(3) Policy on Industrial Land Use

- At present, industrial areas are located in the southern area of CUT along the railway and in the southern area of Toamasina Suburban Commune. In CUT, urbanization is beginning to expand so as to surround those existing industrial areas.
- In the future, those existing industrial areas in CUT will be transformed to commercial/office and residential areas under a mixed land use category.
- In the future, industrial areas will be largely expanded in suburban areas in the south and north of Toamasina Agglomeration along the existing and new arterial road, which could have good connection to Toamasina Port.

(4) Policy on Conservation Areas (Non-Development Areas)

- The coastal area in CUT has risk of erosion. It is necessary to protect these areas from development. However, such areas are also tourism potential area. In the future, it is necessary to limit certain development to protect the coastal area and also avoid effect from coastal errosion.
- There are still large areas with unspoiled environment outside CUT which has mangroves. In the future, limited development for tourism promotion will be allowed but only to certain extent.

17.3 Land Use Zoning Regulations for Toamasina Agglomeration

17.3.1 Proposal of a Common Land Use Zoning System for Urban Areas in Madagascar

In CUT and Commune of Suburban Toamasina, construction permission has not been well utilized. This might be partly because the existing Land Use Zoning System is not easy to use, not only for applicants to prepare and submit construction permission applications, but also for Communes and MAHTP to check and issue construction permits.

In most PUDi, the description of land use zoning regulations is lengthy to read and understand. There are some differences in land use zoning regulations between one PUDi and another PUDi, although those differences are not so large and meaningful. If any PUDi always use the same land use zoning system, it would be convenient for both applicants and communes.

Therefore, considering the land use zoning regulations which have been used for various PUDi, and also considering physical features of urban areas and social characteristics of urban communities in Madagascar, one land use zoning system is created as a Common Land Use Zoning System. The land use zoning categories and regulations of the Common Land Use Zoning System were adopted in the fomulation of PUDis for Antananarivo Agglomeration and Toamasina Agglomeration.

17.3.2 Major Changes of Land Use Zoning System for Toamasina Agglomeration

Major changes proposed for creating the Common Land Use Zoning System is as follows:

(1) No Use of Extension Zone

In most cases, PUDi of Madagascar largely divide the planning area of PUDi into "developed zones" and "extension zones." Different land use zoning categories are put to "developed zones" and "extension zones."

However, in "developed zones," reconstruction of existing buildings and construction of buildings in vacant lands could happen, and such constructions also need to comply with proper land use zoning regulations.

Therefore, it is necessary to apply the same land use zoning regulations for guiding both developed zones and extension zones.

(2) Allowing of Smaller "Minimum Lot Sizes"

It is considered that toward the future, land parcels available for many households are becoming smaller and smaller, especially in CUT. It is necessary to reduce "minimum lot sizes" as much as possible within the range where the residential environment does not deteriorate, so that many could construct houses and buildings in compliance with the official land use zoning regulations.

When many obtain construction permits for their houses and buildings in compliance with the land use zoning regulations, PUDi becomes able to guide many houses and buildings for the purpose of creating a better built environment in the city.

(3) Provision of Larger "Height Regulations"

In PUDi2004 for Toamasina Agglomeration, G+3 for high-density residential areas, G+4 for suburban residential areas. Like this, a larger height of buildings is not allowed. Moreover, the new urban planning and housing law limits the maximum building height (H) to the width (L) of the road where the building is located.

In the future, more 4-lane arterial roads will be constructed and urban centres will be established. It is necessary to allow higher buildings for commercial use and apartment use than before.

It is recommended that the maximum building height should be 2 times higher than the road width where the building is located, especially in commercial use zones in Primary Urban Centre and Secondary Urban Centre.

(4) Detailed Categories for Residential Zones

Land use zoning regulations are a useful tool to guide land use and built environment of certain areas to desirable situation.

Three different types of density (height density, mid density, and low density) residential zones are set for the Common Land Use Zoning System. For each density type, two categories are set for guiding different features of built environment.

(5) Two Different Types of Commercial Zones

In the Common Land Use Zoning System, two different types of commercial zones are set. The first is "Commercial Corridor Zone." The second is "Commercial Centre Zone."

Commercial Corridor Zones are applied along 2-lane and 4-lane Urban Arterial Roads for accommodating large commercial buildings. The height of the buildings will be regulated by the road width, based on the Urban Planning and Housing Law 2015.

The Commercial Centre Zone has two different types of land use zone depending on characteristics of urban centres. The one is "Primary Commercial Centre Zone" to be applied to Primary Urban Centres and Secondary Urban Centres. The other is "Commerical Centre Zone" to be applied to Urban Sub-Centres and Suburban Centres. These two categories of the

Commercial Centre Zone have requirements to be satisfied so that the maxium heights of the building regulation can be applied, as shown in Section 17.3.5.

17.3.3 Land Use Zoning System for Toamasina Agglomeration

(1) Large Categories of Land Use Zones

The Common Land Use Zoning System is composed of the following land use zones:

- Residential Zone
- Commercial Zone
- Industrial Zone
- Facility Zone
- Non-Development Zone

Different land use zoning categories (land use zones) are set as a tool for guiding land use and built environment toward better or desired situation.

(2) Detailed Categories of Land Use Zones

For each detailed category of land use zones, the following features are specified for guiding land use and built environment:

- Minimum Lot Size
- Building Coverage Ratio (BCR)
- Building Height, and
- Permissible Use and Non-Permissible Uses

17.3.4 Minimum Lot Size, Building Coverage Ratio and Building Height Regulated by Land Use Zoning Categories for Development

(1) Residential Zones

Table 17.3.1 Detail of Categories for Residential Zones

Residential Zones	Minimum Lot Size, Building Coverage Ratio (BCR), Maximum Building Height	Major Features of the Zone and Remark for Zoning Application
Very Low-Density Residential	• Minimum Lot Size: 500 m^2 • BCR: 40% • Maximum Height: G+2 (10m)	• Very low density and well developed residential areas • 500 m^2 of "minimum lot size" as specified in PUDi2004 is maintained for "Very Low-Density Residential Zone."
Low-Density Residential	• Minimum Lot Size: 300 m^2 • BCR: 50% • Maximum Height: G+2 (10m)	• Low density residential areas, which are mostly located in suburban areas • A smaller "minimum lot size" of 300 m^2 is applied for "Low-Density Residential Zone."
Mid-Density Residential	• Minimum Lot Size: 150 m^2 • BCR: 50% • Maximum Height: G+3 (13m)	• Mid-density residential areas, where middle-sized houses are located • 150 m^2 of "minimum lot size" is applied for "Mid-Density Residential Zone."
Mid-Rise Residential	• Minimum Lot Size: 150 m^2 • BCR: 60% • Maximum Height: G+3 (13m) --- • Minimum Lot Size: 300 m^2 • BCR: 40% • Maximum Height: G+6 (23m)	• Mid-density and mid-rise residential areas, where the construction of mid-rise residential buildings including apartments is promoted • "Mid-Rise Residential Zone" is set for enabling the construction of apartment buildings.
High-Density Residential	• Minimum Lot Size: 150 m^2 • BCR: 70% • Maximum Height: G+3 (13m)	• High density residential areas, where small-sized buildings are densely located • "High-Density Residential Zones" are applied to areas that are of extremely high density. Most of these areas

		require project-based residential environmental improvement, for example, putting small walkways and drainage.

Source: JICA Study Team

(2) Commercial Zones

Table 17.3.2 Details of Categories for Commercial Zones

Commercial Zones	Minimum Lot Size, Building Coverage Ratio (BCR), Maximum Building Height	Major Features of the Zone and Remark for Zoning Application
Commercial Corridor	• Minimum Lot Size: 200 m² • BCR: 70% • Maximum Height: G+4 (16m)	• Commercial corridors to be developed along Urban Arterial Roads • "Commercial Corridor Zones" are applied along 2-lane and 4-lane Urban Arterial Roads for accommodating large commercial buildings. The height of the buildings will be regulated by the road width, based on the Urban Planning and Housing Law 2015.
	• Minimum Lot Size: 300 m² • BCR: 50% • Maximum Height: G+6 (23m)	
Commercial Centre (before the requirement for urban centres is satisfied)	• Minimum Lot Size: 200 m² • BCR: 70% • Maximum Height: G+4 (16m)	• Commercial areas to be developed in Urban Sub-Centres and Suburban Centres • Commercial Centre Zones are applied to Urban Sub-Centres and Suburban Centres. • The regulations of Commercial Centre Zones are fully applied when the requirement for urban centres is satisfiled.
Commercial Centre	• Min. Lot Size: 200 m² • BCR: 70% • Maximum Height: G+4 (16m)	
	• Minimum Lot Size: 300 m² • BCR: 50% • Maximum Height: G+6 (23m)	
Primary Commercial Centre (before the requirement for urban centres is fulfilled) *	• Minimum Lot Size: 200 m² • BCR: 70% • Maximum Height: G+6 (23m)	• Commercial areas to be developed in Primary Urban Centres and Secondary Urban Centres • Primary Commercial Centre Zones are applied to Primary Urban Centres and Secondary Urban Centres. • The regulations of Primary Commercial Centre Zones are fully applied when the requirement for urban centres is satisfied.
Primary Commercial Centre*	• Minimum Lot Size: 200 m² • BCR: 70% • Maximum Height: G+6 (23m)	
	• Minimum Lot Size: 500 m² • BCR: 50% • Maximum Height: G+9 (33m) • *When Development Permission is obtained: G+19 (+66m)	

Notes: The regulations of "Primary Commercial Area Zone" and "Commercial Area Zone" will be fully applied when necessary requirements for certain urban centres are fulfilled. Details of the requirements are descripted in Section 17.3.5.

Source: JICA Study Team

(3) Industrial Zones

Table 17.3.3 Details of Categories for Industrial Zones

Industrial Zones	Minimum Lot Size, Building Coverage Ratio (BCR), Maximum Building Height	Major Features of the Zone and Remark for Zoning Application
Mixed Development	• Min. Lot: 700 m² • BCR: 50% • Max. Height: G+9 (33m) • *When Development Permission is obtained: G+19 (+66m)	• "Mixed Development Zone" is applied to existing industrial areas and industrial parks for accommodating commercial and office land use. • The application of "Mixed Development Zone" enables the transformation of existing industrial areas and industrial parks to mixed use areas of commercial-office buildings and industrial factories.

Industry	• Min. Lot: 900 m^2 • BCR: 50% • Max. Height: G+3 (13m)	• Industrial Zones are new development areas for relatively large-scale industries. • The Industrial Zones are to be designated for dedicated use for industries.

Source: JICA Study Team

17.3.5 Requirements for Applying Regulations of Commercial Centre Zones

In Toamasina PUDi 2019, "Primary Commercial Centre Zones" and "Commercial Centre Zones" are applied to the Urban Centres shown in the Toamasina Future Structure for 2033. The urban centres will become economic centres of Toamasina Agglomeration, and these zoning categories allow relatively mid-rise and high-rise commercial buildings for relatively large-scale commercial activities (including offices) to be developed in the designated areas.

However, such relatively large-scale commercial activities will require new arterial roads to effectively support the mobility of people and cargo coming in and out of the urban centres. Without such new arterial roads, the current road system will soon reach its traffic capacity, causing a heavy traffic congestion and creating a large economic loss for the entire agglomeration. Before allowing the buildings to be developed to the maximum size regulated in each commercial zone regulation, it is necessary for urban centres to satisfy certain conditions, including construction of new arterial roads supporting the urban centres.

Therefore, until such arterial roads with a large capacity are constructed, each commercial zones will have a different set of regulations, which are shown in Table 17.3.2.

The required conditions of arterial road construction for different urban centres are listed in Table 17.3.4 and Table 17.3.5. Once the requirements are fulfilled, the regulations shown in Section 17.3.4 will be applied.

Table 17.3.4 Requirements for Fully Applying the Regulations of "Primary Commercial Centre Zone" to Primary Urban Centres

Primary Urban Centre	Requirements
Toamasina	Completion of the Second Port Access Road and Completion of Widening of NR5 between the Junction of NR2 & NR5 and Toamasina Airport

Table 17.3.5 Requirements for Applying "Primary Commercial Centre Zone" Category to Secondary Urban Centres

Secondary Urban Centre	Requirements
Ankihiry-Mangarivotra	Completion of Construction of New Urban Arterial Roads in Toamasina South and Completion of Widening of NR5 between the Junction of NR2 & NR5 and Toamasina Airport

17.3.6 Facility Zones

Facility Zones have the following 4 categories of land use zones:

- Administrative and Public Facility Zone
- Solid Waste Facility Zone
- Cemetery
- Military zone

In the Administrative and Public Facility Zones, the construction of facilities, such as administrative facilities, sports facilities, airport and ports, logistic facilities, educaitonal facilities and municipal facilities, is allowed.

17.3.7 Non-Development Zones

In Non-Development Zones, there are the following seven categories of land use zones:

- Wetland
- Forest
- Green Space and Public Parks
- Steep Land (more than 20 degrees)
- Perimeter of Protection (Coastal Strips and Riserves along Rivers)
- Waterbodies

In these categories of Non-Development Zones, the construction of buildings is not allowed.

Since neigher development nor buildings are allowed in Non-Development Zones, no Minimum Lot Sizes, no Building Coverage Rations, no Building Heights and no Permissible Use and Non-Permissible Use are designated for Non-Development zones.

In the designated wetlands including paddy fields, no land filling is allowed and no construction of buildings are allowed.

17.3.8 Permissible Use and Non-Permissible Uses for Land Use Zones

Permissible use and non-permissible use are designated for each land use zone. The following tables enable the comparison of different land use zones in terms of permissible use and non-permissible use.

Table 17.3.6 Permissible Use and Non-Permissible Use for Residential Zones

Zoning Category		Very Low Density Residential	Low Density Residential	Mid Density Residential	Mid-Rise Residential Area	High Density Residential
Permissible Uses						
House	Detached House	OK	OK	OK	OK	OK
	Townhouse (Terrace House)		OK	OK	OK	OK
	Apartment (Height: G+5 and more)				OK	
Commercial and Business Facilities	Store, Restaurant, or Office (maximum floor area 50m²)		OK	OK	OK	OK
	Store, Restaurant, or Office (maximum floor area 400m²)				OK	
	Store, Restaurant, or Office (Not Specified Above) *Commercial/ Office Complx, Supermarket, Shopping Mall					
Special Commercial Facilities	Casino, Gambling Facilities, Entertainment Business, etc.					
	Concert Hall, Music Club, Night Club, Karaoke, Theater, etc.			OK * maximum floor area 50m²	OK * maximum floor area 100m²	OK * maximum floor area 50m²
Hotel and Accommodation	Hotel, Inn			OK * maximum floor area 400m²	OK * maximum floor area 400m²	OK * maximum floor area 400m²
	Etablissement d'hébergement		OK	OK	OK	OK
Industrial Facilities	Factory, Industrial Establishment					
	Workshop (Wood Workshop, Repair Workshop, Craft Workshop) without Environmental concerns			OK * maximum floor area 50m²	OK * maximum floor area 50m²	OK * maximum floor area 50m²
Warehouse	Warehouse with Environmental Concerns					
	Warehouse without Environmental Concerns			OK * maximum floor area 50m²	OK * maximum floor area 50m²	OK * maximum floor area 50m²
Government / Public Facilities	Major Government Facilities (National Governent, City Hall, Court, etc.)					
	Local Government Facilities (Small Government Office, Fokontany Office)	OK	OK	OK	OK	OK
	Assembly Hall, Community Facilities	OK * maximum floor area 400m²	OK * maximum floor area 400m²	OK * maximum floor area 400m²	OK * maximum floor area 400m²	OK * maximum floor area 400m²
	Public Market			OK * maximum floor area 400m²	OK * maximum floor area 400m²	OK * maximum floor area 400m²
Health Facilities	Hospital					
	Clinic (Maximum floor area 400m²)	OK	OK	OK	OK	OK
Educational Facilities	Nursery, Kindergarten	OK	OK	OK	OK	OK
	School (Elementary, Junior High, High School)	OK	OK	OK	OK	OK
	University and College		OK with Acess Road	OK with Acess Road	OK with Acess Road	
Transport Facilities	Bus Stop	OK	OK	OK	OK	OK
	Bus Terminal, Major Transport Facilities					
Cultural Facilities	Library	OK * maximum floor area 400m²	OK * maximum floor area 400m²	OK * maximum floor area 400m²	OK * maximum floor area 400m²	OK * maximum floor area 400m²
	Museum				OK * maximum floor area 400m²	OK * maximum floor area 400m²
Sports Facilities	Stadium, Arena, Large Sports Facilities					
	Small Gymnasium (maximum floor area: 400m²)	OK	OK	OK	OK	OK
	Sports Field	OK	OK	OK	OK	OK
	Swimming Pool	OK	OK	OK	OK	OK
Other Facilities	Recreation Facilities, Theme Park					
	Religious Facilities	OK	OK	OK	OK	OK
	Cemetery	OK	OK	OK	OK	OK
	Park	OK	OK	OK	OK	OK
	Utility (JIRAMA Public Water pump, etc.)			OK * maximum floor area 100m²	OK * maximum floor area 100m²	OK * maximum floor area 100m²
	Establishment for Agricultural Activities	OK	OK	OK	OK	OK
Other Facilities not Specified above						

Table 17.3.7 Permissible Use and Non-Permissible Use for Commercial Zone

Zoning Category		Commercial Corridor	Commercial Centre	Primary Commercial Centre
Permissible Uses				
House	Detached House	OK	OK	OK
	Townhouse (Terrace House)	OK	OK	OK
	Apartment (Height: G+5 and more)	OK	OK	OK
Commercial and Business Facilities	Store, Restaurant, or Office (maximum floor area 50m²)	OK	OK	OK
	Store, Restaurant, or Office (maximum floor area 400m²)	OK	OK	OK
	Store, Restaurant, or Office (Not Specified Above) *Commercial/ Office Complx, Supermarket, Shopping Mall	OK	OK	OK
Special Commercial Facilities	Casino, Gambling Facilities, Entertainment Business, etc.	OK	OK	OK
	Concert Hall, Music Club, Night Club, Karaoke, Theater, etc.	OK	OK	OK
Hotel and Accommodation	Hotel, Inn	OK	OK	OK
	Etablissement d'hébergement	OK	OK	OK
Industrial Facilities	Factory, Industrial Establishment			
	Workshop (Wood Workshop, Repair Workshop, Craft Workshop) without Environmental concerns	OK * maximum floor area 400m²		
Warehouse	Warehouse with Environmental Concerns			
	Warehouse without Environmental Concerns	OK * maximum floor area 400m²	OK * maximum floor area 400m²	OK * maximum floor area 400m²
Government / Public Facilities	Major Government Facilities (National Governent, City Hall, Court, etc.)	OK	OK	OK
	Local Government Facilities (Small Government Office, Fokontany Office)	OK	OK	OK
	Assembly Hall, Community Facilities	OK	OK	OK
	Public Market	OK	OK	OK
Health Facilities	Hospital	OK	OK	OK
	Clinic (Maximum floor area 400m²)	OK	OK	OK
Educational Facilities	Nursery, Kindergarten	OK	OK	OK
	School (Elementary, Junior High, High School)	OK	OK	OK
	University and College	OK	OK	OK
Transport Facilities	Bus Stop	OK	OK	OK
	Bus Terminal, Major Transport Facilities	OK	OK	OK
Cultural Facilities	Library	OK	OK	OK
	Museum	OK	OK	OK
Sports Facilities	Stadium, Arena, Large Sports Facilities	OK	OK	OK
	Small Gymnasium (maximum floor area: 400m²)	OK	OK	OK
	Sports Field	OK	OK	OK
	Swimming Pool	OK	OK	OK
Other Facilities	Recreation Facilities, Theme Park	OK	OK	OK
	Religious Facilities	OK	OK	OK
	Cemetery	OK	OK	OK
	Park	OK	OK	OK
	Utility (JIRAMA Public Water pump, etc.)	OK	OK	OK
	Establishment for Agricultural Activities	OK		
Other Facilities not Specified above				

Table 17.3.8 Permissible Use and Non-Permissible Use for Industrial Zone

Zoning Category		Mixed Development	Industry
Permissible Uses			
House	Detached House	OK	
	Townhouse (Terrace House)	OK	
	Apartment (Height: G+5 and more)	OK	
Commercial and Business Facilities	Store, Restaurant, or Office (maximum floor area 50m²)	OK	OK
	Store, Restaurant, or Office (maximum floor area 400m²)	OK	OK
	Store, Restaurant, or Office (Not Specified Above) *Commercial/ Office Complx, Supermarket, Shopping Mall	OK	
Special Commercial Facilities	Casino, Gambling Facilities, Entertainment Business, etc.	OK	
	Concert Hall, Music Club, Night Club, Karaoke, Theater, etc.	OK	
Hotel and Accommodation	Hotel, Inn	OK	
	Etablissement d'hébergement	OK	
Industrial Facilities	Factory, Industrial Establishment	OK	OK
	Workshop (Wood Workshop, Repair Workshop, Craft Workshop) without Environmental concerns	OK	OK
Warehouse	Warehouse with Environmental Concerns	OK	OK
	Warehouse without Environmental Concerns	OK	OK
Government / Public Facilities	Major Government Facilities (National Goverment, City Hall, Court, etc.)	OK	OK
	Local Government Facilities (Small Government Office, Fokontany Office)	OK	OK
	Assembly Hall, Community Facilities	OK	
	Public Market	OK	
Health Facilities	Hospital	OK	OK
	Clinic (Maximum floor area 400m²)	OK	OK
Educational Facilities	Nursery, Kindergarten	OK	
	School (Elementary, Junior High, High School)	OK	
	University and College	OK	
Transport Facilities	Bus Stop	OK	OK
	Bus Terminal, Major Transport Facilities	OK	
Cultural Facilities	Library	OK	
	Museum	OK	
Sports Facilities	Stadium, Arena, Large Sports Facilites	OK	
	Small Gymnasium (maximum floor area: 400m²)	OK	
	Sports Field	OK	OK
	Swimming Pool	OK	
Other Facilities	Recreation Facilities, Theme Park	OK	
	Religious Facilities	OK	OK
	Cemetery	OK	OK
	Park	OK	OK
	Utility (JIRAMA Public Water pump, etc.)	OK	OK
	Establishment for Agricultural Activities		
Other Facilities not Specified above		OK	OK

17.3.9 Comparison of Major Zoning Categories between Toamasina Agglomeratio PUDi 2004 and PUDi 2019

Land use zoning categories are compared between Toamasina Agglomeration's PUDi 2004 and PUDi 2019, as shown in Table 17.3.9 to Table 17.3.11.

Table 17.3.9 Comparison of Residential Zoning Categories between Toamasina PUDi 2004 and PUDi 2019

Residential Zones in Toamasina PUDi 2004		Residential Zones in Toamasina PUDi 2019	
Zoning Category	**Min. Lot / BCR / Height**	**Zoning Category**	**Min. Lot / BCR / Height**
		Very Low Density Residential	• Min. Lot Size: 500 m² • BCR: 40% • Height: G+2 (10m)
Housing Zone Extension	• Min. Lot: 225 m² • BCR: Max 65% • Height: G+2 (11m)	Low Density Residential	• Min. Lot Size: 300 m² • BCR: 50% • Height: G+2 (10m)
Low Density Housing Zone	• Min. Lot: 250 m² • BCR: Max 50% • Height: G+2 (12m)		
Medium Density Housing Zone	• Min. Lot: 200 m² • BCR: Max: 60% • Height: G+2 (12m)	Mid Density Residential	• Min. Lot Size: 150 m² • BCR: 50% • Height: G+3 (13m)
		Mid Density Residential	• Min. Lot Size: 150 m² • BCR: 60% • Height: G+3 (13m)
			• Min. Lot Size: 300 m² • BCR: 40% • Height: G+6 (23m)
High Density Housing Zone	• Min. Lot: 175 m² • BCR: Max 75% • Height: G+2 (12m)	High Density Residential	• Min. Lot Size: 150 m² • BCR: 70% • Height: G+3 (13m)

Table 17.3.10 Comparison of Commercial Zoning Categories between Toamasina PUDi 2004 and PUDi 2019

Commercial Zones in Toamasina PUDi 2004		Commercial Zones in Toamasina PUDi 2019	
Zoning Category	**Min. Lot / BCR / Height**	**Zoning Category**	**Min. Lot / BCR / Height**
Commercial Zone Extension	• Min. Lot: 1,200m² • BCR: Max 40% • Height: According to PUDé	Commercial Corridor	• Min. Lot Size: 200 m² • BCR: 70% • Max. Height: G+4 (16m)
City Centre	• Min. Lot: 300 m² • BCR: Max 70% • Height: G+3 (14m)		• Min. Lot Size: 300 m² • BCR: 50% • Max. Height: G+6 (23m)
Development Pole	• Min. Lot: 175 m² • BCR: Max 70% • Height: G+2 (12m)	Commercial Centre (before the requirement for urban centres is fulfilled)	• Min. Lot Size: 200 m² • BCR: 70% • Max. Height: G+4 (16m)
		Commercial Centre	• Min. Lot Size: 200 m² • BCR: 70% • Max. Height: G+4 (16m)
			• Min. Lot Size: 300 m² • BCR: 50% • Max. Height: G+6 (23m)
		Primary Commercial Centre (before the requirement for urban centres is fulfilled)	• Min. Lot Size: 200 m² • BCR: 70% • Max. Height: G+6 (23m)
		Primary Commercial Centre	• Min. Lot Size: 200 m² • BCR: 70% • Max. Height: G+6 (23m)

Table 17.3.11 Comparison of Industrial Zoning Categories between Toamasina PUDi 2004 and PUDi 2019

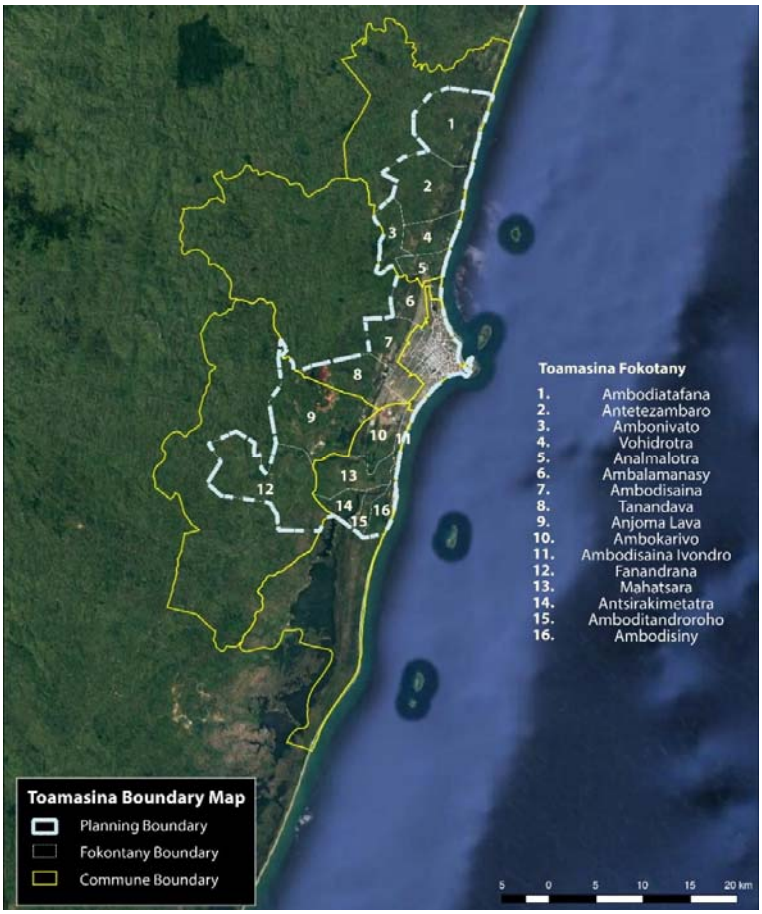
Commercial Zones in Toamasina PUDi 2004		Commercial Zones in Toamasina PUDi 2019	
Zoning Category	**Min. Lot / BCR / Height**	**Zoning Category**	**Min. Lot / BCR / Height**
Industrial Zone	• Min. Lot: 900 m² • BCR: Max 35% • Height: According to PUDé	Mixed Development	• Min. Lot Size: 700 m² • BCR: 50% • Height: G+9 (33m)
Industrial Zone Extension	• Min. Lot: 1,500 m² • BCR: Max 45% • Height: According to PUDé	Industry	• Min. Lot Size: 900 m² • BCR: 50% • Height: G+3 (13m)

17.3.10 Parking Lot Provision in Land Use Zoning Regulations

One parking lot each should be installed for every 200m^2 of the gross floor area of one residential unit. This regulation should be applied to all types of Residential Zones. On the other hand, one parking lot each should be installed for every 400m^2 of the gross floor area of commercial buildings in all types of Commercial Zones. These parking lot regulations are integrated in the regulations for each land use zone.

17.4 Land Use Zoning Plan for Toamasina Agglomeration

The land use zoning plan for Toamasina Agglomeration was prepared for the area shown in Figure 17.4.1.



Source : JICA Study Team

Figure 17.4.1 Area Covered by Land Use Zoning Plan for Toamasina Agglomeraiton 2019-2033

The land use zoning plan for Toamasina Agglomeration 2019-2033 is shown from Figure 17.4.2 to Figure 17.4.12.

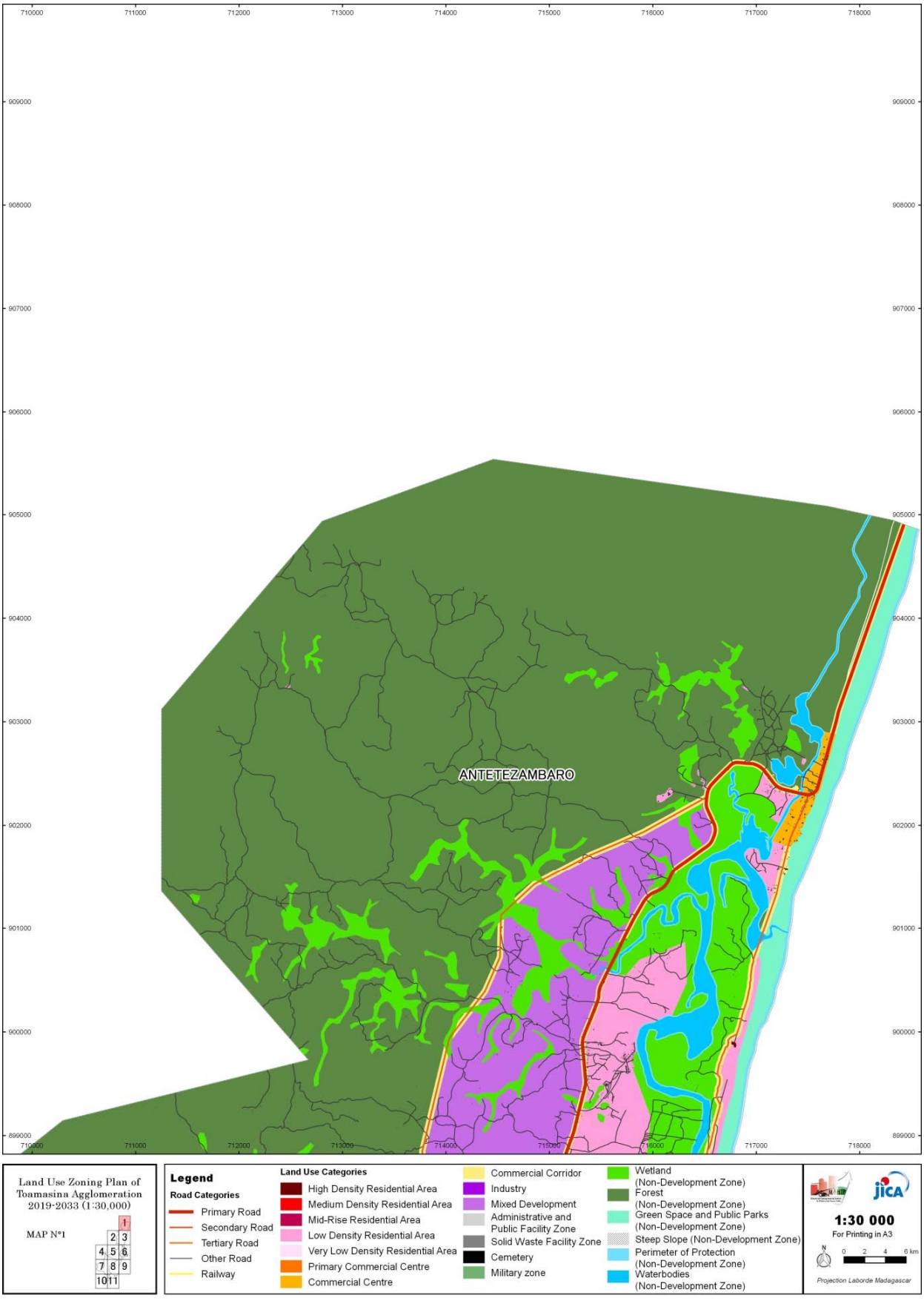


Figure 17.4.2 Land Use Zoning Plan for Toamasina Agglomeration 2019-2033 (1)

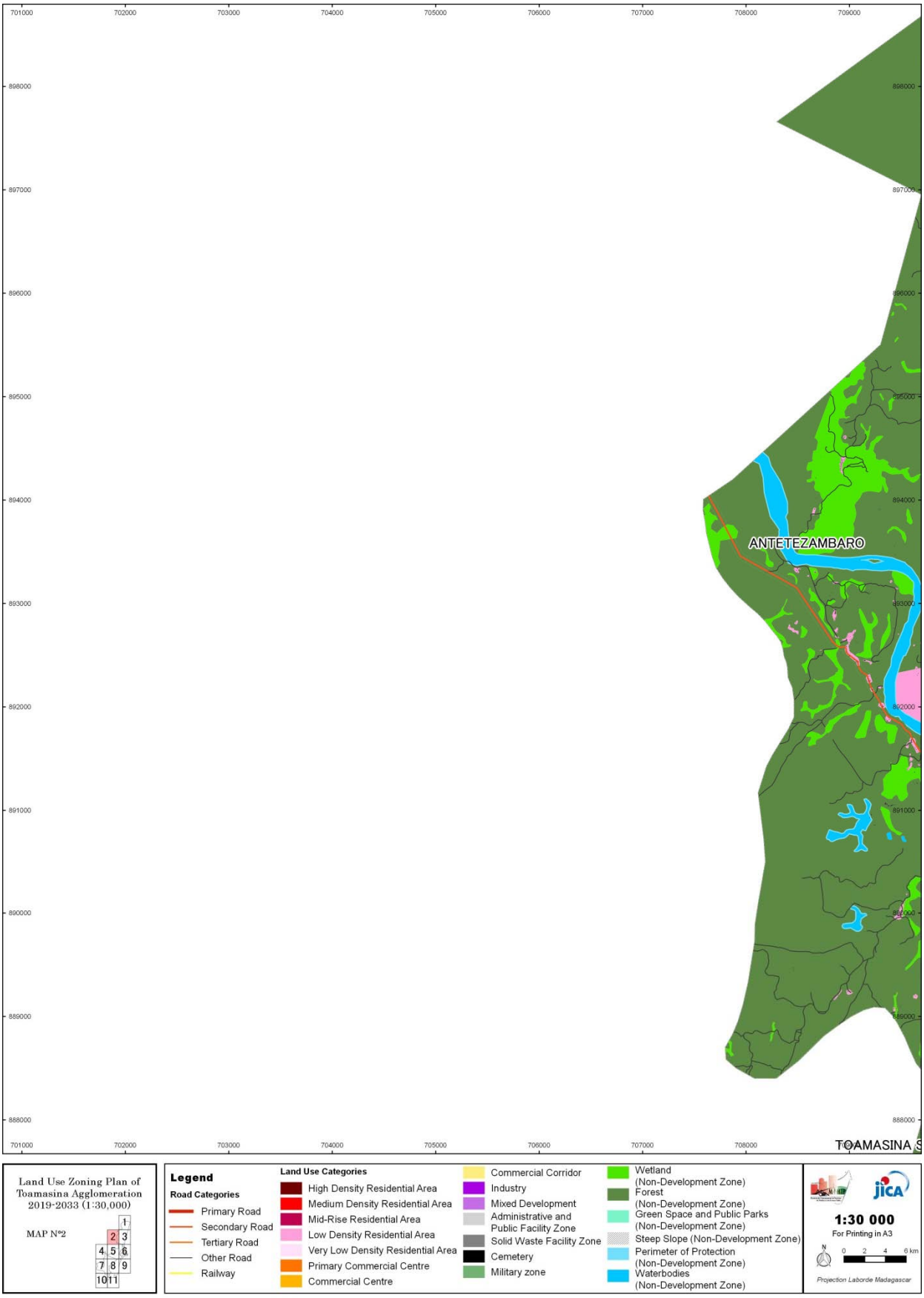


Figure 17.4.3 Land Use Zoning Plan for Toamasina Agglomeration 2019-2033 (2)

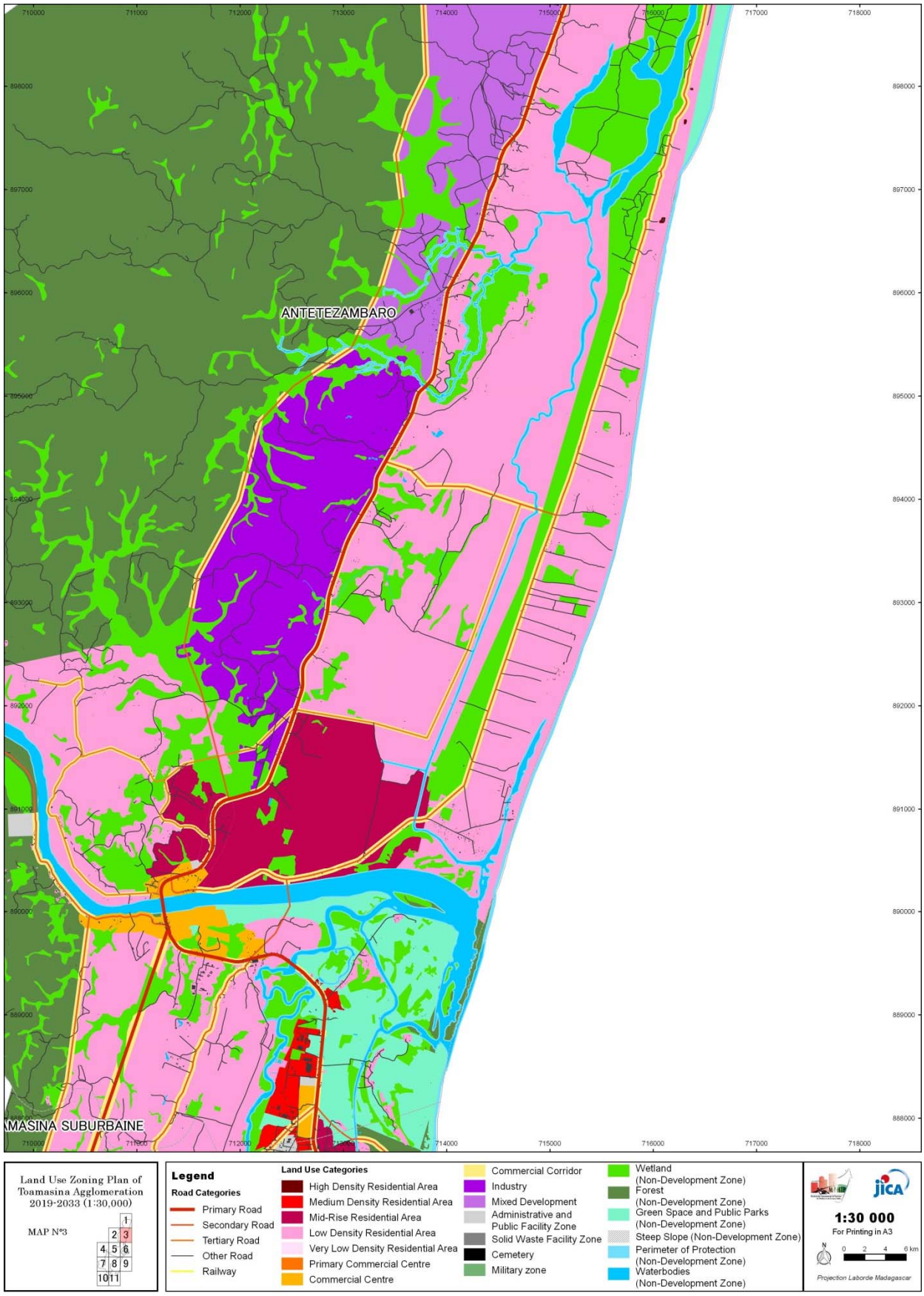


Figure 17.4.4 Land Use Zoning Plan for Toamasina Agglomeration 2019-2033 (3)

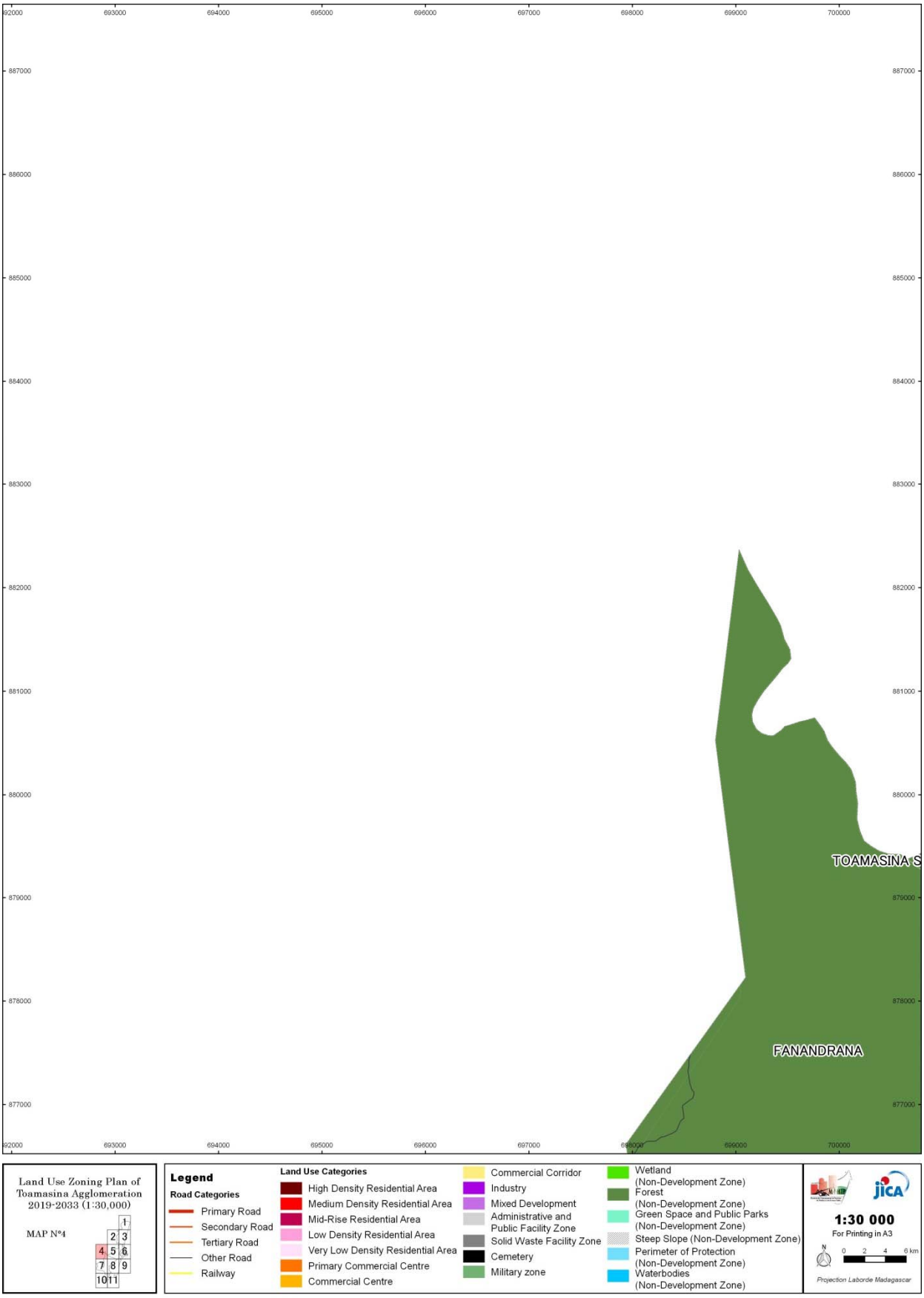


Figure 17.4.5 Land Use Zoning Plan for Toamasina Agglomeration 2019-2033 (4)

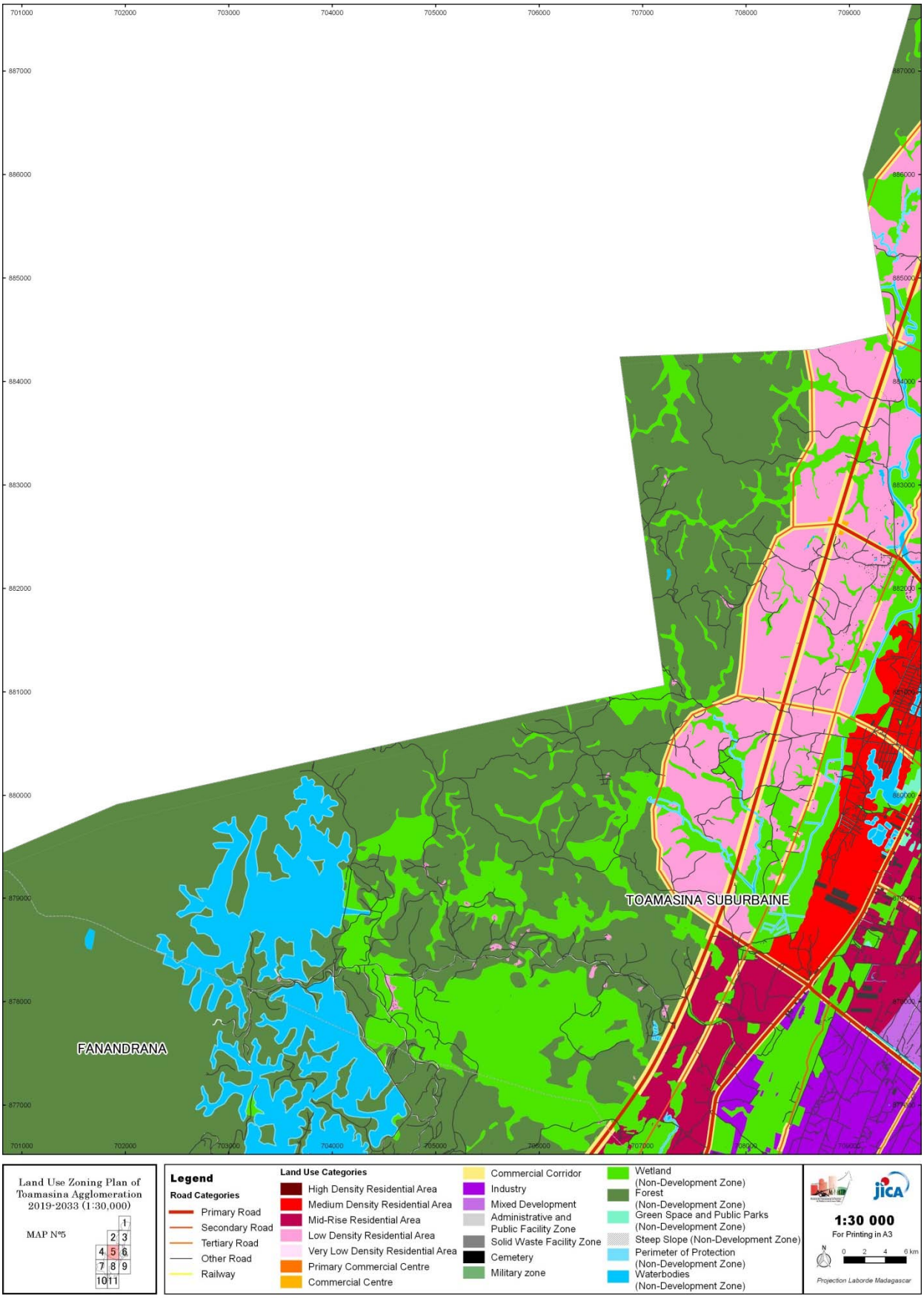


Figure 17.4.6 Land Use Zoning Plan for Toamasina Agglomeration 2019-2033 (5)

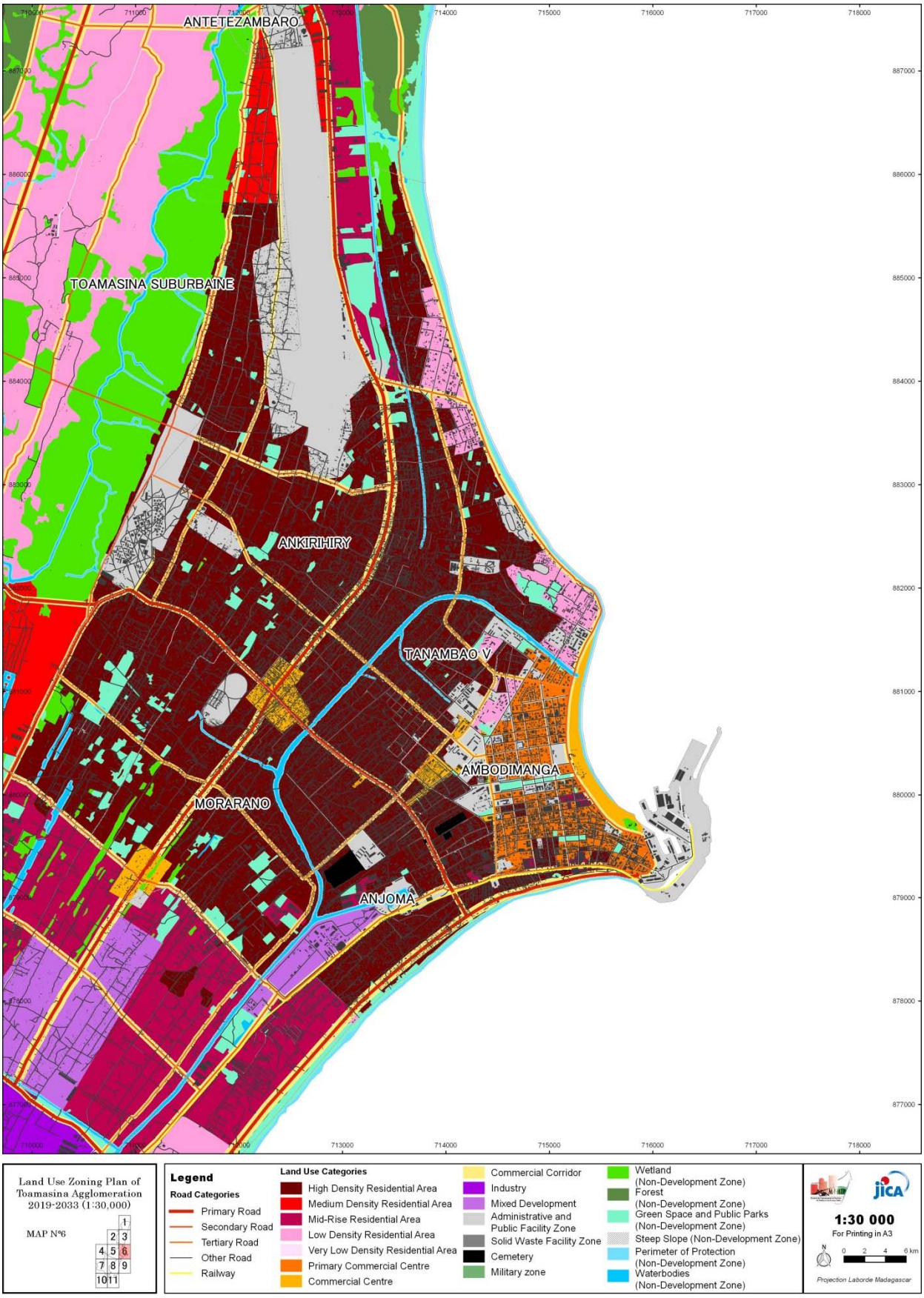


Figure 17.4.7 Land Use Zoning Plan for Toamasina Agglomeration 2019-2033 (6)

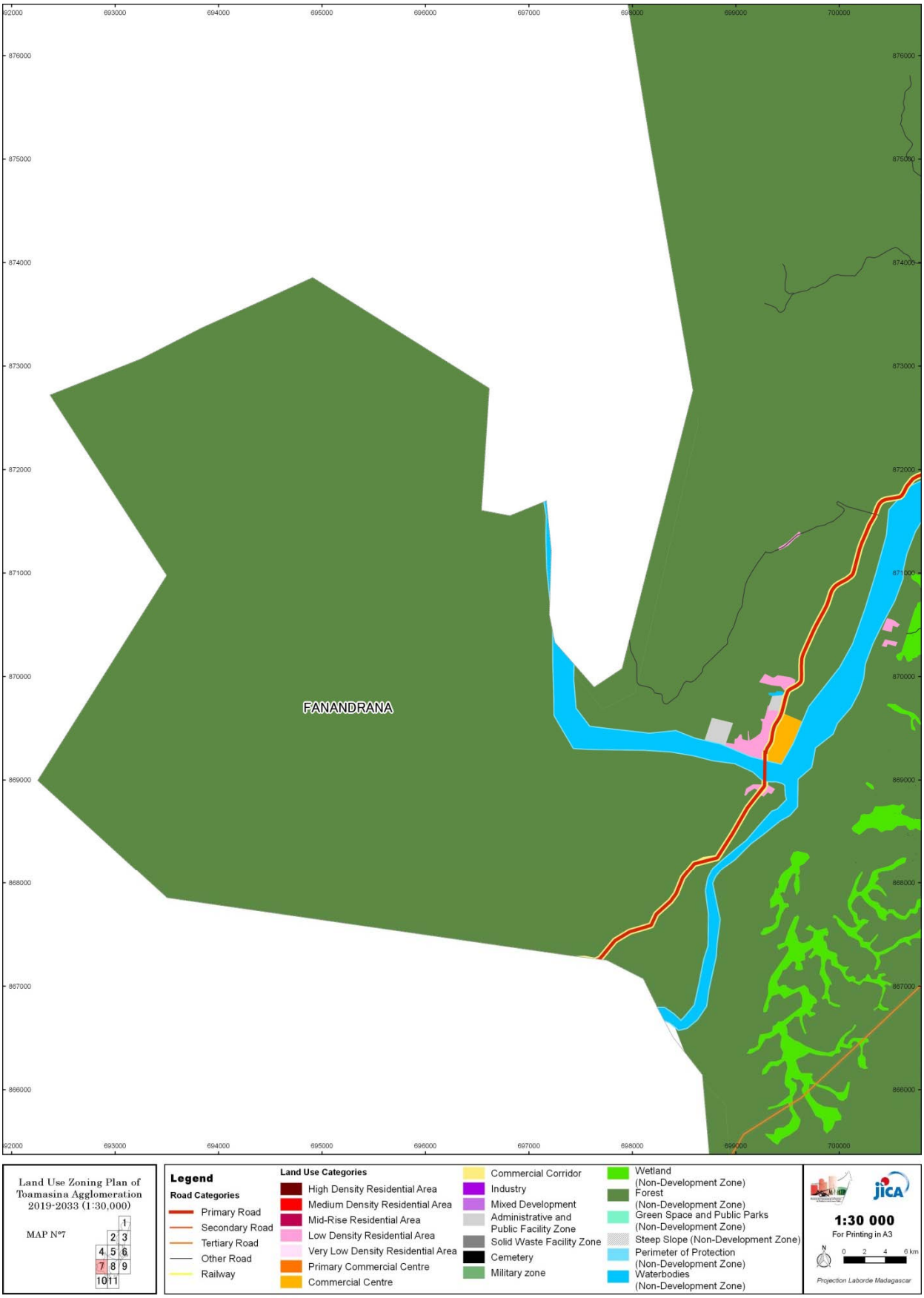


Figure 17.4.8 Land Use Zoning Plan for Toamasina Agglomeration 2019-2033 (7)

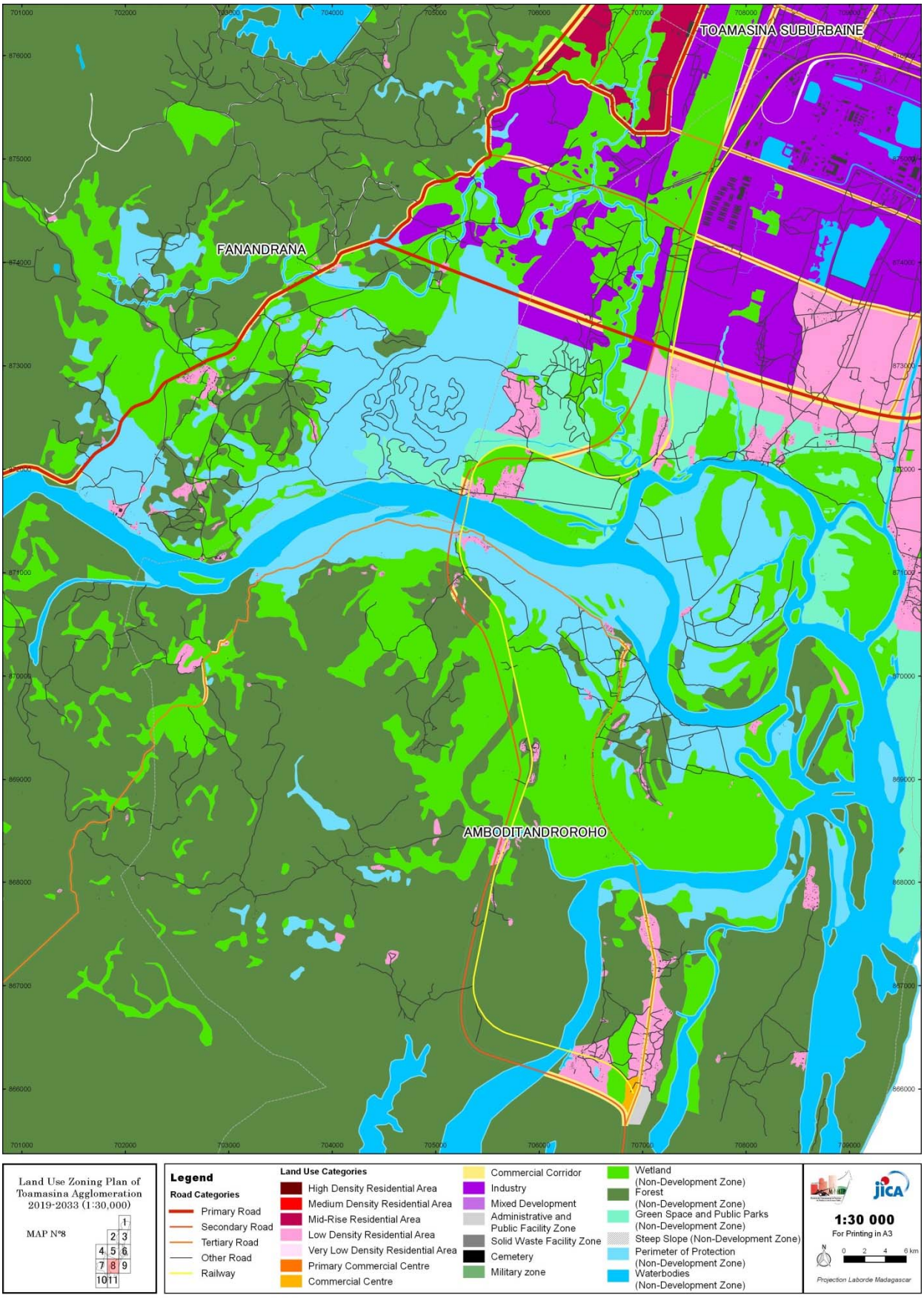


Figure 17.4.9 Land Use Zoning Plan for Toamasina Agglomeration 2019-2033 (8)

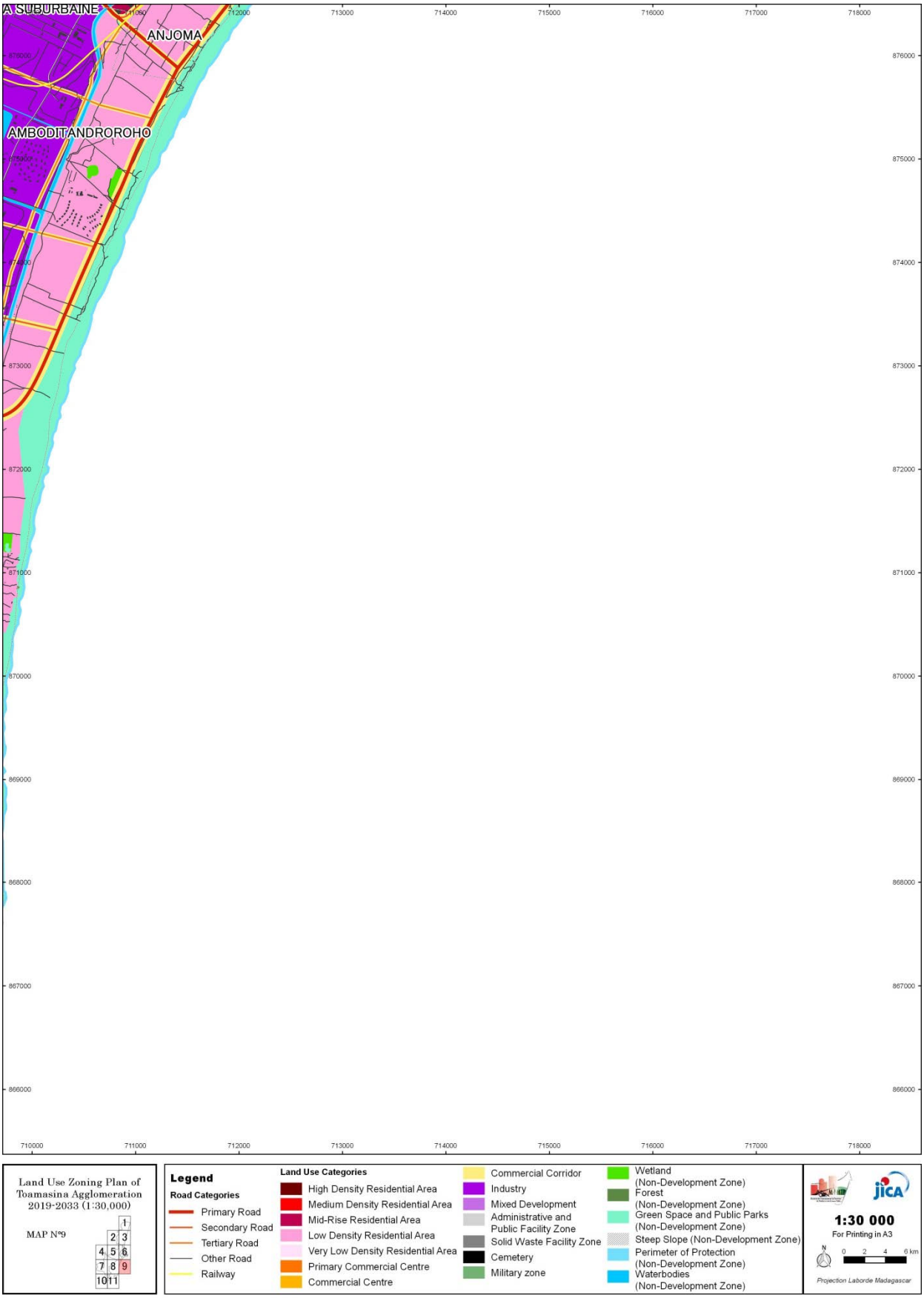


Figure 17.4.10 Land Use Zoning Plan for Toamasina Agglomeration 2019-2033 (9)

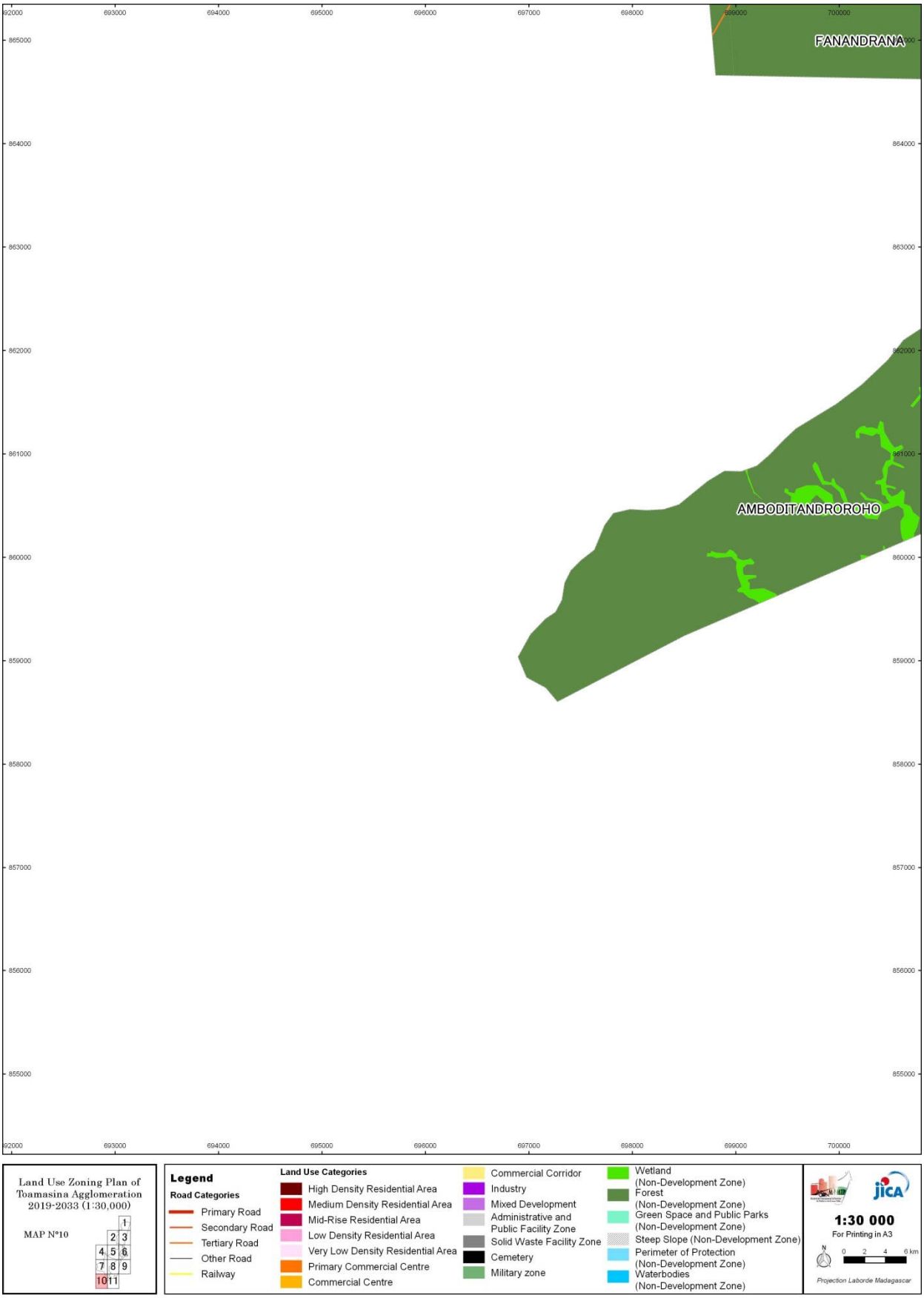


Figure 17.4.11 Land Use Zoning Plan for Toamasina Agglomeration 2019-2033 (10)

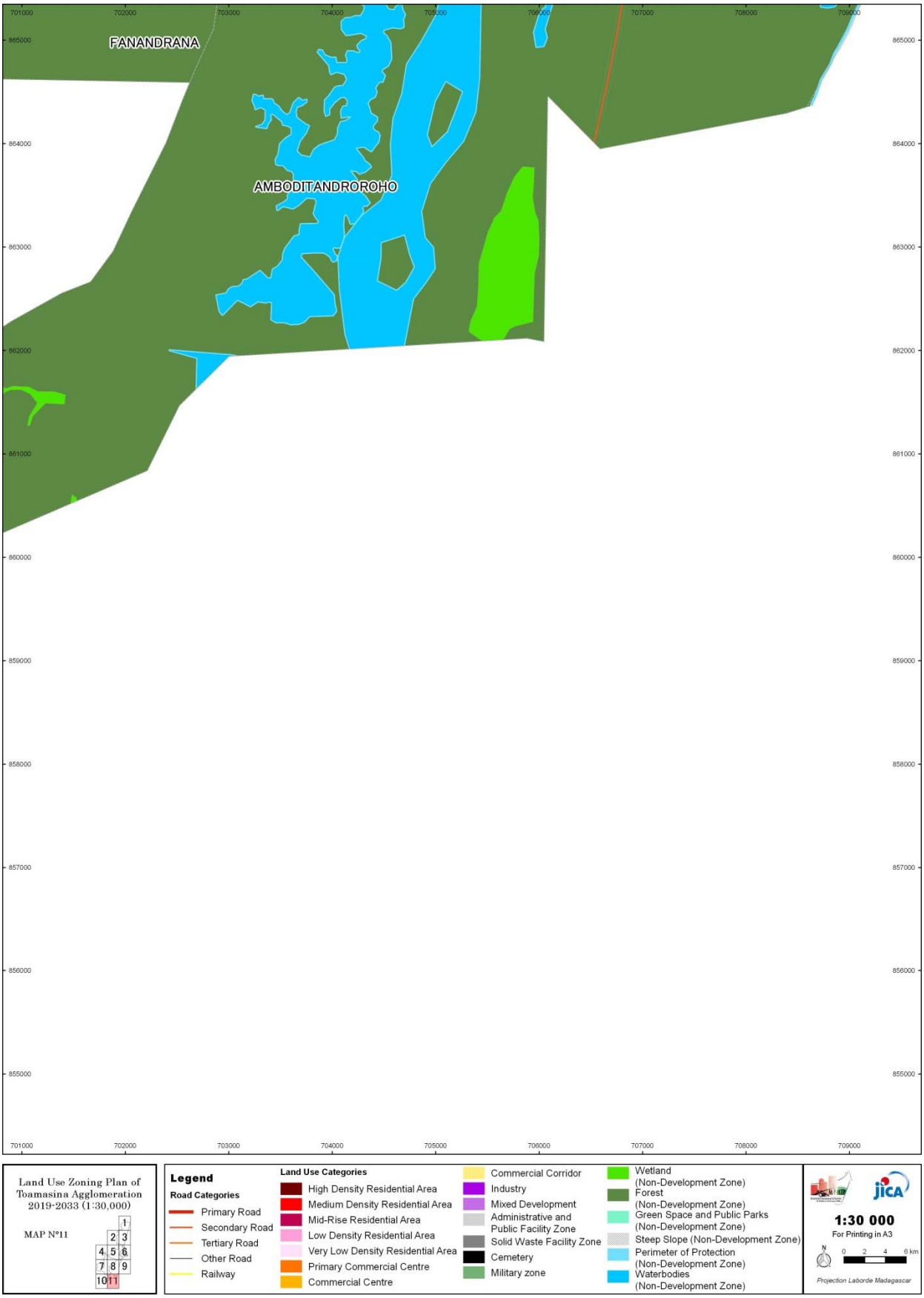


Figure 17.4.12 Land Use Zoning Plan for Toamasina Agglomeration 2019-2033 (11)

17.5 Right of Way and Alignment of Buildings for Toamasina Agglomeration

17.5.1 Construction Permission, Right of Way and Alignment

The Right of Way (ROW) of urban roads and alighment of buildings are also important regulations to designate where to allow the construction of buildings.

17.5.2 Right of Way (ROW)

The ROWs are determined depending on different numbers of lanes by the government as shown in Table 17.5.1. The land designated by the ROW is the area allocated for the construction of roads. As a result, within the ROW, the new construction and reconstruction of buildings are prohibited.

Table 17.5.1 Size of Right of Way depending of Number of Lanes

Size (m) of Right of Way (ROW) from the Centre Line of the Road	Number of Lanes
15 m	6-lane Road
10 m	4-lane Road
5 m	2-lane Road

17.5.3 Alignment

The Aligment lines are determined to show where to allow the construction of buildings from perspectives of maintaining a good building landscape and reserving land for other infrastructure. Different lengths between the boundary of ROW and the Alignment should be specified differently in the mid and high-density suburban areas and the low-density urban areas.

Table 17.5.2 Alignmenst to be set for Low-Density Suburban Areas

Length (m) between the Boundary of the ROW and Alignment	Alignment (m) From the Centre Line of the Road	Size (m) of Right of Way (ROW) from the Centre Line of the Road	Number of Lanes
5 m	20 m	15 m	6-lane Road
2 m	12 m	10 m	4-lane Road
2 m	7 m	5 m	2-lane Road

Table 17.5.3 Alignments to be set for the Mid and High-Density Urban Areas

Length (m) between the Boundary of the ROW and Alignment	Alignment (m) From the Centre Line of the Road	Size (m) of Right of Way (ROW) from the Centre Line of the Road	Number of Lanes
0 m	15 m	15 m	6-lane Road
0 m	10 m	10 m	4-lane Road
0 m	5 m	5 m	2-lane Road

Chapter 18 Strategies for Economic Sectors in Toamasina Agglomeration

18.1 Economic Sectors in Toamasina Agglomeration

18.1.1 Introduction

Atsinanana Region, including Toamasina Agglomeration, shared approximately 7% of the national GDP in 2014, according to the estimation by INSTAT. In terms of economic activity in the region, agriculture, fishery, trade (including port activities), and mining industries are predominant.

The most prominent project in the region is Ambatovy, which is a large-tonnage, long-life nickel and cobalt mining enterprise. It is a partnership of three companies – Sherritt International Corporation (40%) from Canada, Sumitomo Corporation (32.5%) from Japan, and Korea Resources Corporation (27.5%) from Korea. The mine site is located in Moramanga while its plant is in Toamasina. The company started its operation in 2012, and once it is fully operational, it will produce 60,000 tons of refined nickel; 5,600 tons of refined cobalt; and 210,000 tons of ammonium sulphate fertilizer annually for at least 29 years. This will place nickel as Madagascar's top export, providing a significant stimulus to the national economy.[1]

Besides the mining activity for Ambatovy, more than half of the workers in the region are engaged in agriculture, while less than a quarter of workers are in sales and services. According to data from the Demographic and Health Survey (DHS IV), over half of women are employed in agriculture (62.8%) compared to a national average of 72.7%. However, the socio-economic specificity of the Atsinanana Region is the high participation of women in other sectors of activity other than agriculture for their proportions exceed the national average. Such sectors/activities involve executive/technician /management (5.5%), sales and service (20.3%), and unqualified manual labour (7.8%), proportions which are higher than national average. The similar trend can be observed for men, who are mostly engaged in agriculture (61.8%) but also involved in other sectors such as executive/technician /management (7.0%), sales and service (10.7%), and qualified manual labour (15.4%).

Table 18.1.1 Proportions of Employed Population by Economic Activity and by Sex in Atsinanana Region (2008-09)

(%)

Socio-Demographic Characteristics	Executive/ Technician/ Management	Employee	Sales & Service	Qualified Manuals	Unskilled Manuals	Agriculture	Unknown	Total
Atsinanana (male)	7.0	1.6	10.7	15.4	2.7	61.8	0.8	100.0

Source: CREAM, *MONOGRAPHIE: Region Atsinanana*, February 2013 (INSTAT/EDS-IV Madagascar 2008-2009)

In addition to the figures at the regional level, the household and population census conducted in 1993 indicates that a quarter of a century ago, CUT already had over 75% of the household heads employed in the tertiary sector. CUT also had higher share of household heads employed in manufacturing industry compared with other districts, followed by Fanandrana Commune located southwest of CUT.

On the other hand, Toamasina Suburbaine Commune had the highest percentage (approximately 90%) of household heads engaged in the primary sector in 1993.

[1] Ambatovy website (http://www.ambatovy.com/docs/?p=110)

These 1993 figures do not reflect the present workers of Ambatovy.

Table 18.1.2 Economic Activities of Household Heads in Atsinanana Region (1993)

	Primary Sector	Secondary Sector					Tertiary Sector				
			Mining Industry	Manufac-turing Industry	Electricity & Water	Buildings & Public Works		Commer-cial	Transport & Communi-cation	Services	N/A
Ambodimanga	2.72%	13.10%	0.07%	9.86%	0.86%	2.31%	**84.24%**	**27.55%**	20.41%	**32.93%**	3.34%
Anjoma	3.68%	**21.99%**	0.49%	**15.80%**	1.05%	4.64%	74.34%	19.33%	**34.85%**	17.35%	2.81%
Morarano	3.73%	**21.58%**	0.29%	**14.50%**	1.25%	5.54%	74.67%	20.63%	**37.21%**	15.25%	1.58%
Tanambao V	2.69%	18.76%	0.26%	12.26%	0.81%	5.43%	78.57%	21.91%	23.97%	**29.97%**	2.73%
Ankirihiry	5.00%	**21.84%**	0.26%	12.25%	0.95%	**8.37%**	73.18%	17.29%	24.59%	**29.54%**	1.76%
Toamasina I	3.74%	20.02%	0.28%	12.96%	0.99%	5.79%	76.42%	20.64%	28.24%	25.26%	2.28%
Toamasina Suburbaine	**90.42%**	4.62%	0.11%	3.79%	0.56%	0.17%	4.96%	2.73%	0.22%	1.95%	0.06%
Antetezabaro	**86.62%**	4.66%	0.41%	3.35%	0.05%	0.86%	8.73%	2.31%	0.63%	4.75%	1.04%
Fanandrana	**80.53%**	13.66%	0.54%	**12.49%**	0.21%	0.42%	5.77%	1.38%	1.25%	2.34%	0.79%
Toamasina Sub-Region	21.58%	17.39%	0.30%	11.63%	0.83%	4.64%	61.16%	16.58%	22.24%	20.41%	1.93%
Toamasina Province	**84.88%**	4.12%	0.31%	2.85%	0.14%	0.82%	11.00%	3.41%	2.39%	4.60%	0.61%

Source: Direction de la Demographie et des Statistiques Social, 1996, Recensement General de la Population et de l'Habitat Volume III

18.1.2 Existing Plans and Programmes related to Economic Sectors for Toamasina Agglomeration

(1) Regional Development Plan of Atsinanana Region

The Regional Development Plan of Atsinanana Region (PDR: *Plan Régional de Développement Durable Atsinanana*) 2018-2023 sets eight areas of intervention with targets (mesure de succès) for economic development.

Table 18.1.3 Areas of Intervention and Targets of PRD 2018-2023 in the Economic Sector

Area of intervention	Targets (Mesure de succès)
Agriculture and livestock	• Promotion of promising sectors (traditional and new): 6,000 ha of plantation (cloves, coffee, vanilla, pepper, ginger, turmeric oil palms, etc.); • 150,000 newly planted arboreal plants (lychee, soursop, orange tree, pineapple, etc.); • Rehabilitation of 500 ha/year of irrigated perimeters; • 80% of arable land is cultivated until 2018 (60.8% in 2009); • 120 tons of honey produced
Fishing and aquaculture	• 15 billion Ariary of global export of fish products in 2023 (8,704 million in 2007)
Industry and processing	• 3 new large plants located in the region (excluding agribusiness); • 5 new agroindustrial processing units created
Sustainable tourism	• 100,000 tourists a year; • 50,000 cruise passengers per year
Extraction activities	• 20% increase in revenue on mining exports; • 10% increase in formalized actors
Digital development	• 10 digital companies located in Toamasina (call centers, web editors, developers, etc.)
Private sector and entrepreneurship	• 7.5% of sole proprietorships and 25% of companies created in Madagascar located in the region (4.8% and 21.5% in 2008)
Crafts	• 50% increase in crafts sector turnover (art crafts and production crafts); • 30% of formalized craft activities

Source: Plan Régional de Développement Durable Atsinanana 2018-2023

The PDR clearly points the critical bottleneck for Toamasina Agglomeration to be "a locomotive in the ambition of Madagascar to become a dynamic industrial basin (*une locomotive dans l'ambition de Madagascar de devenir un bassin industriel dynamique*)". The lack of processing activity of abundant local agriculture products, mining products and fishery products, which are

exported in the raw, deprives the region and the country of important added values. In this regard, it should be said that development of manufacturing industry with emphasis on processing of agriculture and other local products is a key for the economic growth of the region as well as the whole country.

(2) Agricultural, Livestock and Fisheries Sector Programme

Madagascar has adopted the Agricultural, Livestock and Fisheries Sector Programme (PSAEP: *Programme Sectoriel Agricole, Elevage et Pêche*) which is to quantify the main interventions to be carried out until 2025.

The overall objective of PSAEP is to reduce the poverty incidence rates of the population living below the threshold of 1.25 USD per day from 82% to 20% by 2025; to have an annual growth rate of 6% for the agriculture, livestock, and fisheries sector(currently, it is only 2.6%); and to promote private investments in the three subsectors.

PSAEP, together with its action program, the National Agriculture, Livestock and Fisheries Investment Programme (PNIAEP: *Programme National d'Investissement Agricole, Elevage et de Pêche*), offers the following five well-defined programmes:

- Programme1: Rational and sustainable exploitation of production areas and resources
- Programme2: Sustained improvement of productivity and promotion of competitive production systems
- Programme3: Contribution to food security and nutritional improvement and risk reduction
- Programme 4: Improved access to national markets and repositioning of exports
- Programme 5: Improvement of institutional governance and empowerment of actors

Under each programme are sub-programmes, among which it is Sub-Programme 4.1 that is related to the economic sectors in Toamasina Agglomeration, specifically: Developing Agricultural Commodity Markets within Programme 4.

This Sub-Programme consists of promotion of new technologies of processing, packaging, storage, and transport.

According to the Ministry of Agriculture, the PSEAP-PNIAEP involves the plan to promote export of agriculture products to the Indian Ocean countries, based on the Regional Programme for Food Security and Nutrition (PRESAN) of IOC.

There are several programs related to the PSEAP-PNIAEP implemented by the Ministry of Agriculture and Livestock with the support of international donors. Madagascar Agriculture Transformation Program (PTAM: *Programme de Transformation de l'Agriculture Malagasy*) promotes private sectors' investment into the growth areas called Agropoles and priority sectors, providing support for productivity improvement and capacity building. Through the study on the programme financed by AfDB, four areas including Atsinanana have been identified as the growth areas. Honey, export crops and tropical fruits have been identified as priority sectors in Atsinanana. It is expected that investments will take the form of partnership between the state and the private sector, including professional organizations, to support family farming, agri-business and agricultural transformation[2].

The Agricultural Growth and Land Security Project (CASEF: *Projet de Croissance Agricole et de Securisation Fonciere*) is a project financed by the World Bank that combines value chain support, land security and support for marketing infrastructure to ensure market access for producers. The project covers three areas, namely the upper land zone (Analamanga, Itasy, Vakinankaratra), the East Coast (Analanjorofo and Atsinanana), and the Anosy and Androy regions. In the East Coast, cloves, spices and lychees benefit from the project's support.

[2] MIDI Madagasikara, "Transformation de l'agriculture : Identification des espaces de croissance et des filières prioritaires", 20 October 2018. (http://www.midi-madagasikara.mg/economie/2018/10/20/transformation-de-lagriculture-identification-des-espaces-de-croissance-et-des-filieres-prioritaires/)

The Support Programme for Rural Microenterprise Poles and Regional Economies (PROSPERER) is technically supported by International Fund for Agricultural Development (IFAD) and financed by OPEC and UN. The programme aims to increase the incomes of poor rural people in five regions, including Anatananarivo. It is creating efficient business development services that respond to the needs of small and micro rural enterprises, assisting in structuring traditional clusters into modern value chains, supporting young adults who are entering the job marketing with providing training and apprenticeship, and developing a network of professional apex organizing to offer financial and non financial services to small entrepreneurs[3].

The Inclusive Agricultural Value Chains Development Programme (DEFIS: *Développement des filières agricoles inclusives*) is another project supported by IFAD and financed by OPEC and AfDB. The programme consists of two components: productivity improvement and value chain development. As regards the value chain development, the programme plans to develop the value chains for rice, maize, cassava, onion, groundnuts, coffee, honey and small ruminants by setting up platforms with the participation of small farmers, cooperatives and various market operators. Although the programme is implemented in the eight regions in the southern part of Madagascar, IFAD implies the possibility to extend the target to the Overall TaToM Area

(3) Tourism Master Plan 2004

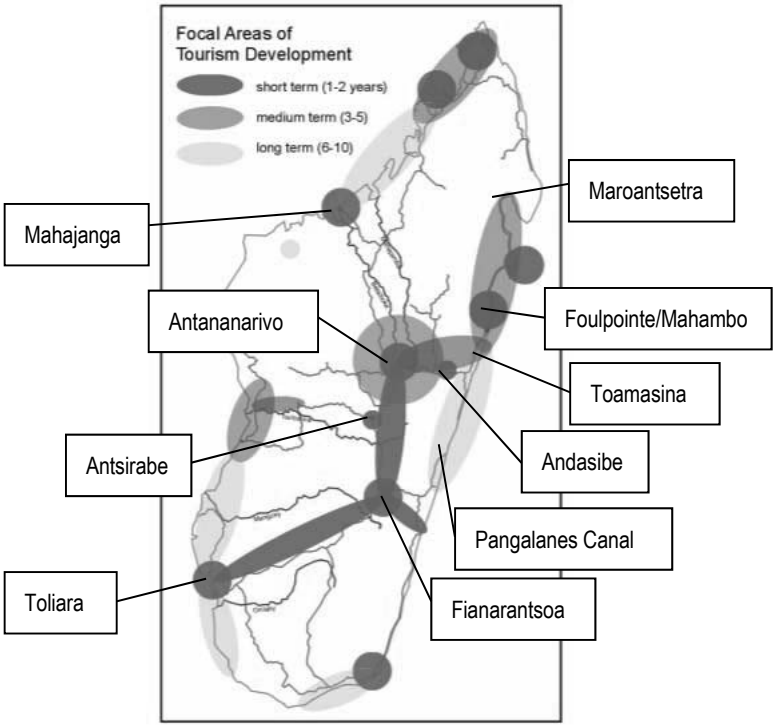
The Tourism Master Plan for Madagascar was prepared and finalized in 2004 by the Ministry of Tourism. The master plan targets the future vision for the tourism sector of Madagascar as follows:

"Madagascar is the land of 1,000 experiences in the heart of the Indian Ocean! The mainland island invites its visitors to discover an endless variety of unique landscapes, nature and culture. Welcoming inhabitants will make their stay unforgettable whether in a place of luxury resort or in a remote eco-lodge".

In the master plan, spatial development in relation to development of the tourism sector is discussed. The following areas for regional development and axis development related to Toamasina Agglomeration are set as the focal areas of tourism development:

- Antananarivo – Toamasina
- Toamasina – Maroantsetra
- Canal des Pangalanes

[3] IFAD website (https://www.ifad.org/en/web/operations/project/id/1401/country/madagascar)



Source: Ministry of Tourism, Plan directeur du Tourisme pour Madagascar, 2004

Figure 18.1.1 Focus Areas for Tourism Development in the Tourism Master Plan 2004

18.1.3 Economic Sectors to Be Targeted in Toamasina Agglomeration

Based on the present situation of economic sectors and on the future vision for the Overall TaToM Area mentioned in Section 3.5, the following economic sectors should be the focus for the economic development of Toamasina Agglomeration:

- Manufacturing Sector (including agro-processing and light industries) targeting regional markets
- Logistics Sector (utilizing Toamasina Port and agricultural areas)
- Tourism Sector (both international and national) utilizing sun-and-beach tourist destinations, as well as natural tourism resources

18.2 Strategies for the Manufacturing Sector in Toamasina Agglomeration

18.2.1 Background on Manufacturing Sector in Toamasina Agglomeration

(1) Present Situation of the Manufacturing Sector in Toamasina Agglomeration

Processing of agricultural products is concentrated mainly in Toamasina I District, while 90% of the region's beverage production units are located in the Brickaville District. The latter, together with the district of Toamasina II, are areas of industrial sugarcane cultivation in the region.

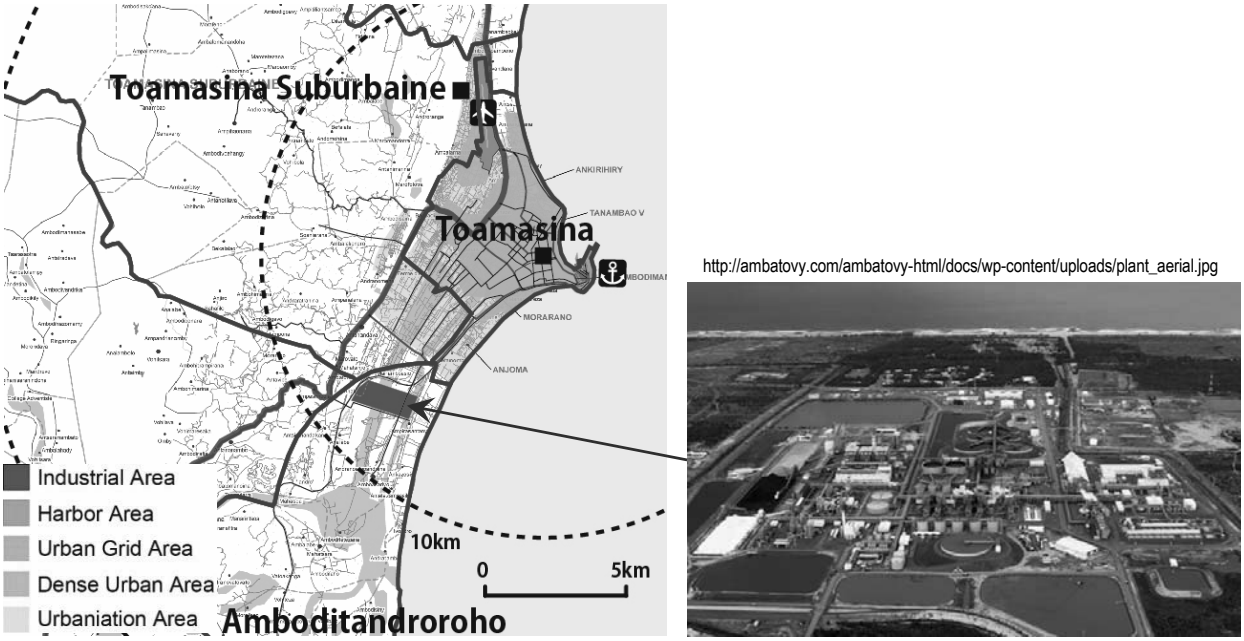
It is noteworthy that a state-owned sugar processing company, SIRAMA, has established a joint venture company named SASM (Société agricole sucrière de Madagascar) with a local major alcohol drink manufacturer VIDZAR, and they made a PPP contract for the operation and management of a sugar processing plant in Brickaville (SASM/VIDZAR is the operator). The plant, which has been closed by SIRAMA for nearly 10 years, is under renovation by VIDZAR. It is planning to produce 14,000 tons of sugar and 10.3 million litres of alcohol drink by 2019, utilizing sugarcane from plantation farms around the plant.

Table 18.2.1 Processing Activities and Number of Production Units in Atsinanana Region

Number of units	Rice mills	Beverage	Processing of agricultural products	Carpentry, sawmill	Processing of wood, fibres, horns and shells	Textile, clothing	Lapidary, jewellery	Metal works	Others
Antanambao Manampotsy	0	0	0	1	0	0	0	0	1
Brickaville	2	9	1	1	1	0	2	0	6
Mahanoro	1	0	1	7	3	0	4	1	4
Marolambo	1	0	0	0	1	0	0	0	2
Toamasina I	0	1	8	61	20	19	23	10	143
Toamasina II	0	0	0	3	2	2	0	0	9
Vatomandry	2	0	0	2	0	0	6	0	6
Atsinanana total	6	10	10	75	27	21	35	11	171
Atsinanana share in the total nation	0.5%	2.3%	2.7%	7.9%	4.4%	1.5%	5.0%	2.7%	2.4%

Source: CREAM, *MONOGRAPHIE: Region Atsinanana* (MEI/CREAM/Monographie 2009)

Besides agro-processing industries, the smelting plant of Ambatovy located south of Toamasina Port in Amboditandroroho Rural Commune completed its construction in 2011 and started commercial production in 2014. Since then, the production of nickel has become the biggest exporting product of Madagascar in terms of value of exports.



Source: JICA Study Team and Ambatovy HP (http://ambatovy.com/ambatovy-html/docs/index.html%3Fp=110.html)

Figure 18.2.1 Location of Ambatovy Plant in Amboditandroroho Rural Commune

(2) Existing Policies and Laws on Manufacturing Sector

1) Document of Industrial Policy of Madagascar 2014 (Document de Politique Industrielle de Madagascar 2014)

The most recent industrial policy of Madagascar was prepared in collaboration with various stakeholders in the public and private sectors, including the Ministry of Industry and Private Sector Development and Small and Medium Enterprises (MIDSPP: *Ministère de l'Industrie, du Développement du Secteur Privé et des Petites et Moyennes Entreprises*) and the Union of Industries of Madagascar (SIM: *Syndicat des Industries de Madagascar*), and in partnership with the Economic Development Board of Madagascar (EDBM) and the Integrated Growth Project (ICP) of the World Bank.

It aims to (1) increase the percentage of contribution of industry to 25% of GDP (compared with about 15% at present), and (2) make the industry competitive and successful in transforming from a low value-added industry to a high-tech industry. In order to achieve the second objective, it also

aims to (i) strengthen the competitiveness of local industries and satisfy the domestic market, (ii) support industries in improving their competitiveness and conquer the international market, and (iii) put in place a global business environment conducive to the development of the private sector in general, and the industrial fabric in particular.[4]

2) New Industrial Development Act (Loi n°2017-047 sur le Développement de l'Industrie (LDI))

The New Industrial Development Act (LDI) was submitted to the Parliament in October 2017. The Act, sharing the same objectives with the Industrial Policy, focuses to better integrate local industry into value chains by targeting agribusinesses, construction materials, and greater substitution on imports. Also, one of the main proposals of that Act is establishing industrial investment zones to focus on spatial clustering methods and improving local supply. Hence, it is regarded desirable that each region has one industrial investment zone[5].

3) New SEZ Bill (Loi n°2017-23 relative aux Zones Economiques Spéciales)

The new Special Economic Zone (SEZ) Bill passed the National Assembly in early 2018 and is now under revision to be approved. The Act, once put in force will fix the legal regime applicable to the SEZs, which includes SEZ for industrial and agro-industrial activities.

There are eight basic criteria for designation of SEZ as follows:

- Economic Situation: The locality chosen for the establishment of the SEZ site responds to an economic situation and presents a favorable industrial dynamic
- Accessibility, Connectivity, and Infrastructure: Proximity and feasibility of infrastructure and transport networks as well as adequate communication channels for the establishment and development of the site
- Accessibility to water and electricity
- The possibility of setting up remediation routes for the site
- Proximity of an agglomeration of population that can meet the needs of manpower
- Existence of social infrastructure within or near the site, such as schools, hospitals, hotels, and retail businesses
- Availability of lands to be designated for the SEZ that will be integrated into its perimeter, with reference to their status
- Establishment of a training centre, a research centre, and a business incubator

(3) Prospects for Development of the Manufacturing Sector in Toamasina Agglomeration

With the existing agro-processing production in Toamasina Agglomeration, the manufacturing sector for agro-processing has high potential for development. There are some notable initiatives by local private companies in the agro-processing sector in the region. For example, Savonnerie Tropicale Huilerie de Melville (STHM), a major palm oil and soap manufacturer in Toamasina, forms a large organic agriculture zone of palm grove in cooperation with local farmers. STHM aims to improve its coefficient of integration of the manufacture of fat and export of the oil of certified organic palm, as well as to preserve nature and biodiversity of the palm grove and promote ecotourism. Another example is HOREB (*Hygiène, Organisation et Restauration de l'Environnement et de la Biodiversité*), initiated by the CEO of Faly Export. HOREB is a production improvement and management system based on Japanese KAIZEN method to establish globally compatible common standards for agro-products, mainly lychee. With the support of the Malagasy Government (Ministry of Environment, Ecology and Forestry and Ministry of Agriculture and Livestock), the HOREB repository system was officially launched in August 2018

[4] Mireille Ramilisoa Ratoaveloson and Oliver Donat Andriamahefaparany, *Document de Politique Industrielle de Madagascar 2014*.
[5] Based on the interview with a director in the Ministry of Industry and Private Sector Development in September 2017.

and the commune of Foulpointe, located in the north of Toamasina, was assigned as a pilot commune to popularize the HOREB system and promote export[6].

As the second largest city with an international port, as well as a relatively large space for business and industry, Toamasina has much potential to develop new industries. In this context, the notion and range of industries of current SEZs may be further widened, and favourable incentives for investment to new industries (for example, assembly of machinery for agriculture and forestry) are considered to be introduced.

18.2.2 Issues on the Manufacturing Sector in Toamasina Agglomeration

(1) Economic Infrastructure Development

The connectivity or accessibility between Toamasina and Antananarivo is limited because of limited travel options, either via one daily flight from Antananarivo, often delayed or sometimes cancelled; or travel by road for eight hours. Since the head offices of companies in Madagascar are mostly located in Antananarivo Agglomeration, the limited accessibility to Antananarivo from Toamasina is one of the bottlenecks for establishing business in Toamasina Agglomeration. The high cost of energy and the frequent disruption of its delivery penalize investors.

(2) Limited Suitable Areas for Industrial Location

The shortfall or limited services in electricity and water supply do not encourage the development of manufacturing sectors in Toamasina Agglomeration. The service areas for electricity and water supply are especially limited outside of CUT.

(3) Access to Toamasina Port

The access road to Toamasina Port is currently congested with heavy vehicles coming to and leaving the port. For industrial development to be realized, it is necessary to strengthen the accessibility to the port and this will hasten not only the economic development of Toamasina Agglomeration, but also the whole Madagascar. Industrial areas in Toamasina Agglomeration need to be established in locations with good access road to Toamasina Port.

(4) Value Chain Development

Agro-processing, beverage production in particular, is highly concentrated in the region. The promotion of linkage between these industries and small farmers is regarded as one of main issues in the region. Among others, sugarcane production and processing will be core in some districts, then capacity upgrading of sugarcane farmers and value addition through utilisation of by-products and wastes from sugar processing will be the issues.

(5) Education and Training of Labour Force

Atsinanana Region is one of the regions with a workforce with relatively low-level of education, based on the proportion of people who have not received any training, nor have completed primary, secondary, or tertiary education.

Opportunities for vocational education and training are insufficient. Considering high unemployment rate of the youth and limited employment absorption capacity in the rural areas, trainings for secondary and tertiary sectors are necessary.

(6) Administration Services

As one of the important logistics hubs in Madagascar, goods are transported through Toamasina for export and import. The upgrading of Toamasina Port will strengthen this logistics structure, and increase the attractiveness for companies to set up manufacturing/processing plants and

[6] Based on a document provided by EDBM and MIDI Madagasikara, “Madagascar: HOREB - Un plan d'action pour restaurer l'équilibre de la biodiversité”, 27 September 2017 (https://fr.allafrica.com/stories/201709270740.html)

logistics centres around the port. In order to respond to and facilitate this momentum, administration services related to business and trade, which are currently provided mainly in Antananarivo, have to be dispersed and made available in Toamasina. This will contribute to mitigate excessive concentration of administrative work for both public and private sectors in the capital area, and to alleviate overloaded transportation of goods between Antananarivo and Toamasina.

(7) Capability of Environment Monitoring and Environmental Management

While Toamasina Agglomeration accommodates the world class-nickel smelting plant, the communes of Toamasina Agglomeration do not have any capability of environment monitoring and management. Even though the Ambatovy Plant obtained an environment permit for its construction and operation from National Office of the Environment of Madagascar (ONE: *Office National pour l'Environnement*), regular environment monitoring and control should be conducted by the local governments.

18.2.3 Objectives for the Manufacturing Sector in Toamasina Agglomeration

The objectives for the manufacturing sector in Toamasina Agglomeration is defined as follows:

- Improvement of Business Environment: One-stop shops for business registration, and for export-import and various applications need to be established.
- Synergetic and Effective Allocation of Production Zones and Industrial Investment Zones: Differentiation of incentives for SEZs established in the area according to industry, products, environmental treatment, location, number of employees, etc. are considered to promote companies' relocation and/or new investments to the region.
- Value Chain Development: Value-chain development through the linkage between agro-processing companies (sugarcane processors) and small-scale farmers should be considered.
- Investment Promotion of Light Industries and Fabricating Industries: With the locational advantage with expansion project undergoing at Toamasina Port, Toamasina Agglomeration has large potential for industries such as light industries and fabricating industries.
- Human Resource Development: As already mentioned, trainings for secondary and tertiary sectors are necessary, considering high unemployment rates of youth and limited employment absorption capacity in the rural communes of Toamasina Agglomeration. It is also important for the local governments, as well as the central government, to have capacity to manage the future development in Toamasina Agglomeration.

18.2.4 Strategies for the Manufacturing Sector in Toamasina Agglomeration

The strategies for the development of manufacturing sector in Toamasina Agglomeration are as follows:

- To designate particular areas for Economic Sector Development Zones, where incentives are given to construction of production facilities and operation of production, for agro-processing, light industry and fabricating industry, by taking advantage of existing infrastructure (access roads, electricity and water supply)
- To develop Economic Sector Development Zones (SEZs), where incentives are given to construction and production operation, for agro-processing, light industry, and fabricating industry in strategic locations with good connection to Toamasina Port by constructing efficient infrastructure in accordance with the future urban structure
- To develop new industrial areas close to Toamasina Port
- To support Technical and Vocational Education and Training (TVET) institutes for providing necessary skilled labour force

- To develop the capacity of the government officers to mitigate severe impact of industrial development on the urban and natural environment
- To increase the number of flights to Toamasina Airport from Antananarivo

For promoting the development of economic sectors, especially the manufacturing sectors, such as agro-processing, light industry and fabricating industry, it is important to formulate and implement a short and medium-term starting up strategy for manufacturing sectors in Toamasina Agglomeration. It is because the formulation of a long-term development plan for manufacturing sectors in Toamasina Agglomeration is difficult.

Such a short and medium-term starting-up strategy includes the following actions and projects:

- Short Term: Designation of Economic Sector Development Zones in particular areas which have relatively good infrastructure and strategic location in relation to Toamasina Port
- Short Term: Rehabilitation of Access Roads, Electricity and Water Supply for Designated Economic Sector Development Zones
- Short Term: Promotion of Investment to Attract Manufacturing Sectors in Designated Economic Sector Development Zones
- Medium Term: Construction of the Third Access Road to Toamasina Port and Development of Industrial Parks along the prospective Third Access Road
- Medium Term: Upgrading of Access Roads, Electricity and Water Supply for Newly Developed Economic Sector Development Zones
- Medium Term: Promotion of Investment to Attract Manufacturing Sectors in Designated Economic Sector Development Zones

18.2.5 Programmes and Projects for the Manufacturing Sector in Toamasina Agglomeration

The following are proposed projects for the manufacturing sector in Toamasina Agglomeration:

- Establishment of SEZ for Agro-processing, Textile Industry, and Light Industry in Southern Toamasina Agglomeration with Third Access Road to Toamasina Port
- Preparing Industrial Zones along the Second Access Road to Toamasina Port
- Establishment of SEZ for Agro-processing, Light industry, Textile Industry and Fabricating Industry in Northern Part of Toamasina Agglomeration
- Establishment of Industrial Training Centre within Southern Toamasina SEZ
- Capacity Development for Communes to Manage Industrial Development
- Upgrading of Toamasina Airport
- Promoting of Domestic Flight Connection from Ivato International Airport and Other Airports

18.3 Strategies for the Logistics Sector in Toamasina Agglomeration

18.3.1 Background on Logistics Sector in Toamasina Agglomeration

Toamasina Agglomeration is home of the Port of Toamasina, the first port of Madagascar. Constituting a crossroads of exports and imports to/from the rest of the world, trade activity is one of the major economic interests in the area. Toamasina Port is currently handling about 75% of the domestic freights and about 90% of the international freights, and its capacity will be expanded by the Japanese ODA project to meet the expected large increase in demand for the both freights.

The port is connected to the capital, Antananarivo, by National Road No. 2. The railway is connected from the port to Antananarivo and also to Ambatodrazaka, which branches off at Moramanga. This railway is operated by Madarail. These infrastructure are the lifelines in terms of logistics for Antananarivo Agglomeration and other areas of Madagascar.

Another interesting aspect of the logistics sector in Toamasina Agglomeration is the Canal des Pangalanes (Pangalanes Canal) which extends over 645 kilometres up to Farafangana. This canal, which was significantly expanded during the French colonial period, is used primarily for transportation and fishing. Agricultural land along the canal has development potential if the canal's transport capacity is restored.

The logistics sector in Toamasina Agglomeration will benefit from the prospective expansion of Toamasina Port, but for purposes of taking advantage of the increased port capacity, it is necessary to prepare pertinent infrastructure for promoting development of economic sectors.

18.3.2 Issues on Logistics Sector in Toamasina Agglomeration

(1) Road Network and Road Congestion

The road network in the region is poorly developed. As a result, a number of communes in the region are accessible only by truck or 4x4 vehicle. The realization of the region's development potential depends largely on improving the road network to get access to the port of Toamasina, as well as to the central area of Toamasina city.

The road congestion around Toamasina Port is also one of bottlenecks for developing logistics industry in Toamasina Agglomeration.

(2) Cargo Handling Services and Storage Facilities Due to Port Expansion

Expansion of Toamasina Port will increase the handling amount of freight and facilitate efficient operation. Accompanying this, expansion of handling services and storage facilities are also needed.

(3) Connection from Toamasina Port to Antananarivo Agglomeration

The connectivity between Toamasina Port and Antananarivo Agglomeration is too vulnerable to natural disaster to support the economies of the national capital, characterized with only a winding two-lane road (the National Road No.2) and a single truck railway, both needing rehabilitation.

(4) River Transport

The Pangalanes Canal requires rehabilitation work to maximise its function for the agriculture industry and tourism.

18.3.3 Objectives for the Logistics Sector in Toamasina Agglomeration

The objectives for the logistics sector in Toamasina Agglomeration are defined as follows:

- Establishment of a Multi-Modal Logistics System: Although there is a plan to develop a highway from Toamasina to Antananarivo, it will take time for such a totally new road to be constructed. Therefore, to support the development of the economic sectors in Antananarivo Agglomeration, as well as in other cities in Madagascar, a secure backup system needs to be developed. The Pangalanes Canal can also provide cargo transportation between Toamasina and the southern areas of Atsinanana Region as a substitute route of National Road No. 11.
- Promotion of Development of Logistics Industry: Modernisation of logistics industry is essential for Madagascar since the present centre of economic activities is in the central area of the island.
- Value Chain Development: The Ministry of Agriculture and Livestock is planning to promote "contract farming" involving small-scale farmers and agro-industries for some target crops. This kind of promotion is quite important as a course of value chain development.
- Promotion of Contract Farming and Establishment of Small Farmers' Groups: Contract farming and grouping are particularly important in farming high value cash crops such as

vanilla, clove, and others. Since the farmers tend to be separated and exploited by middlemen and foreign buyers, as well as exposed to insecurity, grouping and development of transparent business customs are effective for improving farmers' welfare and modernisation of industries.

18.3.4 Strategies for the Logistics Sector in Toamasina Agglomeration

The strategies for the development of logistics sector in Toamasina Agglomeration are as follows:

- To integrate railway transport and road transport by establishing multi-modal terminals in Toamasina Agglomeration
- To utilize Pangalanes Canal for strengthening the movement of agricultural products to Toamasina Agglomeration from production areas
- To provide support to logistics companies by mobilizing government resources
- To provide collection centres in the suburban centres for small-scale farmers in Atsinanana Region by establishing storage for agricultural products

18.3.5 Programmes and Projects for the Logistics Sector in Toamasina Agglomeration

The following are proposed projects for the logistics sector in Toamasina Agglomeration:

- Improvement of Cargo Handling Services and Storage Services at Toamasina Port
- Establishment of Toamasina Logistics Terminals
- Development of Inland Port for Pangalanes Canal
- Establishment of Collection Centres in the South of Toamasina Agglomeration
- Establishment of Collection Centres in Antezambaro

18.4 Strategies for the Tourism Sector in Toamasina Agglomeration

18.4.1 Background on Tourism Sector in Toamasina Agglomeration

(1) Present Situation of the Tourism Sector in Toamasina Agglomeration

Atsinanana Region has rich environmental resources of high biodiversity, and it is home to some endemic flora and fauna. The discovery of this biological diversity makes the region one of the most renowned areas for tourism. Atsinanana Region is well-known tourism area to nationals as well as foreigners. Some popular locations include Ambila-Lemaitso, Akanin'ny Nofy, Foulpointe, Mahambo, Manambato, Irondro palm, and Vohibola.

Canal des Pangalanes (Pangalanes Canal) which extends over 645 kilometres from Toamasina to Faranfanana is also a cultural and environmental tourism attraction.

According to the survey conducted by World Bank in 2002, over 50% of the visitors came to Madagascar for ecotourism, while approximately 20% came for the beaches and resorts. Toamasina Agglomeration is located in a strategic location with both beach and ecological richness. It is also the gateway for Atsinanana Region with daily domestic flight from Antananarivo Ivato Airport. However, for Toamasina to attract more international tourists, it is necessary to increase the number of flights to and from Antananarivo.

According to the statistics obtained for the 2008 monographic data collection, the region had eight travel agencies and 203 formal establishments that rent out rooms (e.g., hotels, inns, boarding houses, rooms, etc.), of which 24 were hotels of "Stars" category, and 179 of "Ravinala" category.

Table 18.4.1 Number of Hotels and Travel Agencies in Atsinanana Region

District	Accommodation Category "Star"	Accommodation Category "Ravinala"	Travel Agency
Antanambao Manampotsy	0	0	0
Brickaville	0	21	0
Mahanoro	1	12	0
Marolambo	0	0	0
Toamasina I	20	53	8
Toamasina II	2	65	0
Vatomandry	1	28	0
Atsinanana Region Total	24	179	8
Portion of Atsinanana in the nation	9.3%	22.4%	1.3%

Source: CREAM, *MONOGRAPHIE: Region Atsinanana* (MEI/CREAM/Monographie 2008)

The Travel & Tourism Competitiveness Report 2017 of the Global Economic Forum ranked Madagascar 121st out of 136 countries in terms of tourism competitiveness. The necessity for improvement in this competitiveness aspect of tourist destinations is obvious. At present, among 14 pillars used for the competitiveness index, Madagascar is ranked relatively high in international openness (74th), price competitiveness (55th), and natural resources (66th). On the other hand, it is ranked low in business environment (126th), health and hygiene (119th), human resources and labour market (122nd), ICT readiness (133rd), environmental sustainability (120th), air transport infrastructure (120th), and ground and port infrastructure (133rd).

(2) Existing Policies and Laws on Tourism Sector

1) National Tourism Development Policy for Madagascar

The National Tourism Development Policy for Madagascar (*Politique nationale pour le développement du Tourisme à Madagascar*) was prepared in 2017. This policy was created to define the main lines of the Government's guidelines to enable tourism to contribute effectively to Madagascar's sustainable development.

Based on the existing PND (National Development Plan) and the Tourism Master Plan 2004, tourism development will focus on four priority areas of Madagascar. This is due to the fact that the geographical extent of Madagascar does not allow simultaneous development of all the potential sites. The four focus areas in the policy are as follows:

- RN7 Axis: Tana - Greater Tuléar,
- RN6 Axis: Diego - Nosy Be
- Toamasina - Sainte-Marie Axis via Foulpointe and Fénérive Est
- Majunga, as a flagship destination for national tourism

The vision stated in the policy is as follows:

"In 2020, Madagascar will be a globally recognised destination for its sustainable management and the exceptional wealth of its natural, cultural and human heritage, "Treasure Island (Île Trésor)""

The key objectives for tourism development consist of the following:

- To reach a target of 500,000 visitors in 2019 (average annual increase of 19.5%)
- To earn USD 1.4 billion as tourism revenue (average annual growth of 24%)
- To double the number of direct jobs in hotels and tourism businesses
- To reach a target of 190,000 foreign visitors in National Parks and Protected Areas (average increase of 15% per year) for sustainable financing of biodiversity conservation
- To achieve a direct tourism contribution to the national GDP, specifically 8% of GDP to conform to the average of African countries.

Based on the key objectives, the following five strategic directions are determined:

- Improved accessibility to Madagascar and its priority tourist areas
- Greater visibility as a tourism destination, nationally and internationally
- Effective sustainable management of tourism destinations
- Facilitation of hotel and tourist investments
- Increased competitiveness of hotel services and tourist services

2) New SEZ Bill (Loi n°2017-23 relative aux Zones Economiques Spéciales)

The new Special Economic Zone (SEZ) Bill passed the National Assembly in early 2018. The Act, once put in force will fix the legal regime applicable to the SEZs, which includes SEZ for tourism activities.

(3) Prospects for the Development of Tourism Sector in Toamasina Agglomeration

Toamasina Agglomeration is part of the Tourism Axis of Toamasina - Sainte-Marie Axis via Foulpointe and Fénérive Est. This is one of the selected tourism focus areas of Madagascar in National Tourism Development Policy 2017.

By taking advantage of the coastal location and Toamasina Airport, as well as cruise ships' calls at Toamasina Port, Toamasina Agglomeration should develop tourist infrastructure so as to be an international tourist base in the Tourism Axis of Toamasina - Sainte-Marie Axis via Foulpointe and Fénérive Est, which is a major tourism area in the eastern Madagascar.

18.4.2 Issues on Tourism Sector in Toamasina Agglomeration

(1) Economic Infrastructure Development

The present situation of air transport infrastructure, and ground and port infrastructure are ranked low in the Travel & Tourism Competitiveness Report 2017.

The access to Toamasina from Antananarivo is limited to one daily flight, which is often delayed or sometimes cancelled, or eight-hour travel by road. The average stay of visitors to Madagascar is around 10 days, so the time necessary for travelling to Toamasina is the major weakness of the city in terms of tourism promotion.

(2) Accommodation Facilities

Accommodation facilities for international tourists are lacking in Toamasina Agglomeration.

(3) Education and Training of Labour Force

Human resources and labour market are poor ranked low in the Travel & Tourism Competitiveness Report 2017.

Atsinanana Region is also one of the regions with a workforce with relatively low level of education, considering the proportions of people who have not received any training, nor have completed primary, secondary, or tertiary education.

18.4.3 Objectives for Tourism Sector in Toamasina Agglomeration

The objectives for tourism sector in Toamasina Agglomeration is defined as follows:

- Improvement of Accessibility: To promote this sector in Toamasina Agglomeration, improvement of accessibility to and within Toamasina Agglomeration is essential for both air and road transport.
- Promotion of Ecological Tourism and Research: Because of rich, diversified, and unique flora and fauna, Toamasina is already well known to tourists. However, in terms of environment preservation and protection, tourism should be ecological and environmentally friendly and also promoted to scientists and practitioners working for ecological and environmental issues.

In conservation areas, poor road network may not be a critical disadvantage.

- Development and Utilization of Pangalanes Canal: Pangalanes Canal is a unique and precious asset for the region. It is not only utilized for transport and logistics or for traditional fishing, but also for various purposes including tourism and restaurant operation, recreation and sports, modern fishery (fish farming and aquaculture) among others. It may be possible to plan new hotel development along the canal (water front development).
- Increase of Accommodation Facilities: The existing number of accommodation facilities is not sufficient for the target number of visitors. Promoting the development of accommodation facilities in Toamasina Agglomeration is necessary.
- Human Resource Development: In addition to public school education, vocational education and training for tourism sector should be developed and promoted.
- Promotion of Environmental Protection: The development of Toamasina Port will attract new industries in Toamasina Agglomeration with impacts to the environment. Implementation of measures for environmental protection is important for natural resource conservation.

18.4.4 Strategies for Tourism Sector in Toamasina Agglomeration

The strategies for development of tourism sector in Toamasina Agglomeration are as follows:

- To increase the number of flights to Toamasina Airport from Antananarivo as well as international flights from the neighbouring islands
- To develop a long-distance bus terminal in a strategic location within Toamasina Agglomeration for the future urban development
- To establish SEZ for tourism in the coastal area within Toamasina Agglomeration to provide sufficient accommodation and service as resort destination for tourists
- To promote investments in the Pangalanes Canal for tourism development
- To establish a hospitality business training centre in economic development zone for tourism in CUT that will strengthen the capacity of human resources for the tourism sector
- To establish a research centre for promoting ecological tourism and environmental protection

18.4.5 Programmes and Projects for Tourism Sector in Toamasina Agglomeration

The following are proposed projects for the tourism sector in Toamasina Agglomeration:

- Upgrading of Toamasina Airport
- Promoting Domestic Flight Connection from Ivato International Airport
- Development of a Long-Distance Bus Terminal in Toamasina Agglomeration
- Establishment of Tourism SEZ within Toamasina Agglomeration
- Development of Ecological Accommodation Facilities and Research Parks in Toamasina Agglomeration
- Development of Pangalanes Canal as an Ecotourism Site
- Establishment of Hospitality Business Training Centre for Tourism SEZ in Toamasina Agglomeration

18.5 Profiles of Priority Projects for Economic Sectors of Toamasina Agglomeration

(1) Establishment of Economic Development Zones for Agro-Processing, Textile Industry, Light Industry and Fabricating Industry

1) Rational

With the existing agro-processing production in Toamasina Agglomeration and the recent active initiatives by the local companies to strengthen the sector, the manufacturing sector for agro-processing has high potential for development. As the second largest city with an international port, as well as a relatively large space for business and industry, Toamasina has much potential to develop economic development zones (industrial parks). With the locational advantage along with expansion project undergoing at Toamasina Port, Toamasina Agglomeration has a large potential for industries such as light industries and fabricating industries.

2) Objectives

To attract investments to the agro-processing, textile (not only fabric clothing, but also spinning, dyeing and other related industries are involved) light industries (soap, footwear, ceramic products, glassware and cutleries, etc.) and fabricating industry (assembly of machinery for agriculture and forestry etc.) in strategic locations with good connection to Toamasina Port with efficient infrastructures in accordance with the future urban structure.

3) Project Description

To establish economic development zones for agro-processing, textile, light and fabricating industries in southern Toamasina Agglomeration with the third Port Access Road to Toamasina Port and at northern Toamasina Agglomeration. The economic development zones should have good accessibility to water and electricity. According to the new SEZ Bill, various advantages are to be provided to the companies in the economic development zones, including exemption from import tax and customs duties for materials and equipment, VAT exemption for imports exemption, etc. Training centres for employees and research centres are also needed to be established in these zones. In this regard, research centres shall be particularly featured in these zones to create a synergetic effect with ecological tourism and environmental protection promotion in the tourism sector. In addition, when the products developed in the economic development zones in Toamasina have eco-conscious and energy saving characters in terms of their utility and production process, they could be distinguished in the export market and soled in higher price ranges.

4) Expected Benefits

In addition to the direct benefit of export increase of the products and job creation, when the factories purchase materials from local suppliers, forward linkage effect is expected. In this regard, agro-processing industry is expected to have much potential of creating the linkage effect with agriculture production, including organic agriculture in particular. Training centres will contribute to improve the capacity of workforce in entire region.

5) Executing Agency and Related Institutes

- Ministry of Industry, Trade and Handicrafts
- EDBM

6) Estimated Project Cost

To be determined

7) Implementation Schedule

Phase 1 (2019-2023), Phase 2 (2024-2028) and Phase 3 (2029-2033) of Project TaToM

8) Necessary Actions for Implementation / Critical Factor

- Land acquisition and development for economic development zone, including related infrastructure.
- Promotion of the economic development zones to investors.

9) Related Plans and Projects

- IEM (Initiative Emergence Madagascar) Programme

10) Social and Environmental Impacts

Environmental impact study should be conducted to understand actual impact on the both built and natural environment.

(2) Establishment of Tourism Development Zones and Development of Ecological Accommodation Facilities and Research Parks

1) Rational

Toamasina Agglomeration is part of the Tourism Axis of Toamasina - Sainte-Marie Axis via Foulpointe and Fénérive Est. This is one of the selected tourism focus areas of Madagascar in National Tourism Development Policy 2017. By taking advantage of the coastal location and Toamasina Airport, as well as cruise ships' calls at Toamasina Port, Toamasina Agglomeration should develop tourist infrastructure so as to be an international tourist base in the Tourism Axis. Establishing economic development zone for tourism in the coastal area, with providing sufficient accommodation and service, contributes to become not only as resort destination for tourists, but also as a "mecca" of ecological tourism and environmental protection.

2) Objectives

To attract investments to the tourism (ecological tourism, in particular) and research activity, by increasing the level of service and creating a favourable environment. To create linkages with local food suppliers and other service providers and establish a value chain for tourism industry. Furthermore, to enhance consciousness of visitors and local communities of ecology and environment protection.

3) Project Description

To stablish a tourism development zone in the coastal area (of Anjoma Fokontany in CUT), which consists of the following zones: hotel and accommodation zone; restaurants and apparel, crafts and artisanal products shops zone; attraction and entertainment zone; research and training centre zone.

Investors and entities operating within this zone are provided various incentives based on new SEZ Bill. In addition, visitors shall be exempted from visa. In order to promote ecological tourism, tourists are encouraged to participate in excursions and field visit to surrounding eco-tourism spots and organic agriculture sites. In this regard, establishing appropriate accommodations (lodges, guest houses, and bungalows) in these areas is necessary.

4) Expected Benefits

Direct benefit of increase of tourists and visitors, and job creation is expected. When the SEZ succeeds to create linkages with local food suppliers and other service providers (including local tourism industry) and establish a value chain, improvement of the regional economy is expected. Furthermore, enhancement of consciousness of visitors and local communities of ecology and environment protection is also anticipated.

5) Executing Agency and Related Institutes

- Ministry of Transport, Tourism and Meteorology
- Ministry of Industry, Trade and Handicrafts
- Ministry of Environment and Sustainable Development

- EDBM

6) Estimated Project Cost

- 8,045,000 Euro

7) Implementation Schedule

Phase 1 (2019-2023) of Project TaToM

8) Necessary Actions for Implementation / Critical Factor

- Establishment of tourism development zone, including providing necessary infrastructure. Promotion of the economic development zones to investors and tourism agencies.
- Collaboration with local tourism industries and organic agriculture farmers and plantations. Infrastructure development of tourism sites in surrounding area.

9) Related Plans and Projects

- Tourism Master Plan
- IEM (Initiative Emergence Madagascar) Programme

10) Social and Environmental Impacts

- Not Applicable

Chapter 19 Strategies for Disaster Risk Reduction and Management of Toamasina Agglomeration

19.1 Background on Disaster Risk Reduction and Management of Toamasina Agglomeration

19.1.1 Natural Conditions of Toamasina Agglomeration

(1) Climate

The climate in the study area is hot and humid subtropical type, characterized by two distinct seasons: the hot season (temperature ranges between 29°C to 32 °C) from November to April, and the cool season (temperature ranges between 25°C to 30 °C) from May to October.

The rainfall amount is high throughout the year and exceeds 3,000 mm / year. The atmospheric humidity is relatively high and exceeds 60% throughout the year.

Except the year when important cyclones landfall, the intensity of wind is generally stronger during the cool season, and southerly winds are dominant throughout the year

(2) Relief and Geology

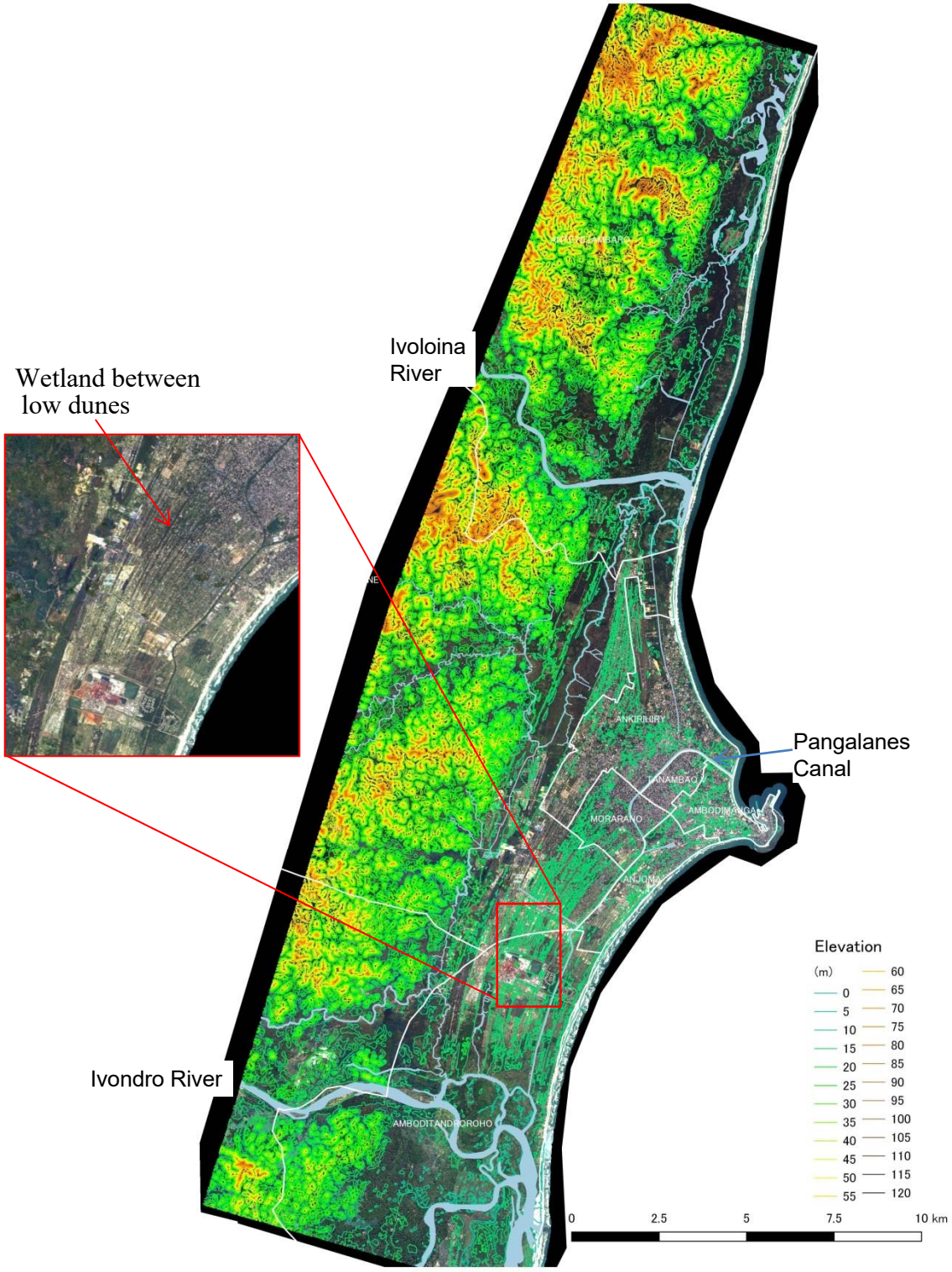
The study area is located on the low coastal narrow plains composed of sedimentary land formed by alluvial deposits, sands, bright sand dunes, and sandstones. In particular, almost the entire area of CUT is lying on low wetland with elevation under 10 m between former dunes generally with low undulations (the elevation of the dunes is varying between 6 m and 10 m above sea level).

(3) Hydrological Condition

The study area is crossed by important rivers and waterways, such as Pangalanes Canal (In French: *Canal des Pangalanes*) and Ivondro River.

The Pangalanes Canal was originally constructed in 1904 as navigation way to link the lakes, lagoon, and rivers between Foulpointe in the north and Faranfangana in the south (distance of 650 km), but due to its degradation it now serves as the major drainage channel in the area, discharging rainwater into the sea during floods.

The length of Ivondro River is around 150 km and its watershed covers 3,513 km^2. It originates from the west of the Didy marshy plain and goes east. The slope is steep up to the Volobe electricity plant and then decreases to run into the sea at the south of CUT.



Source: JICA Study Team

Figure 19.1.1 Elevation Map of Toamasina Agglomeration

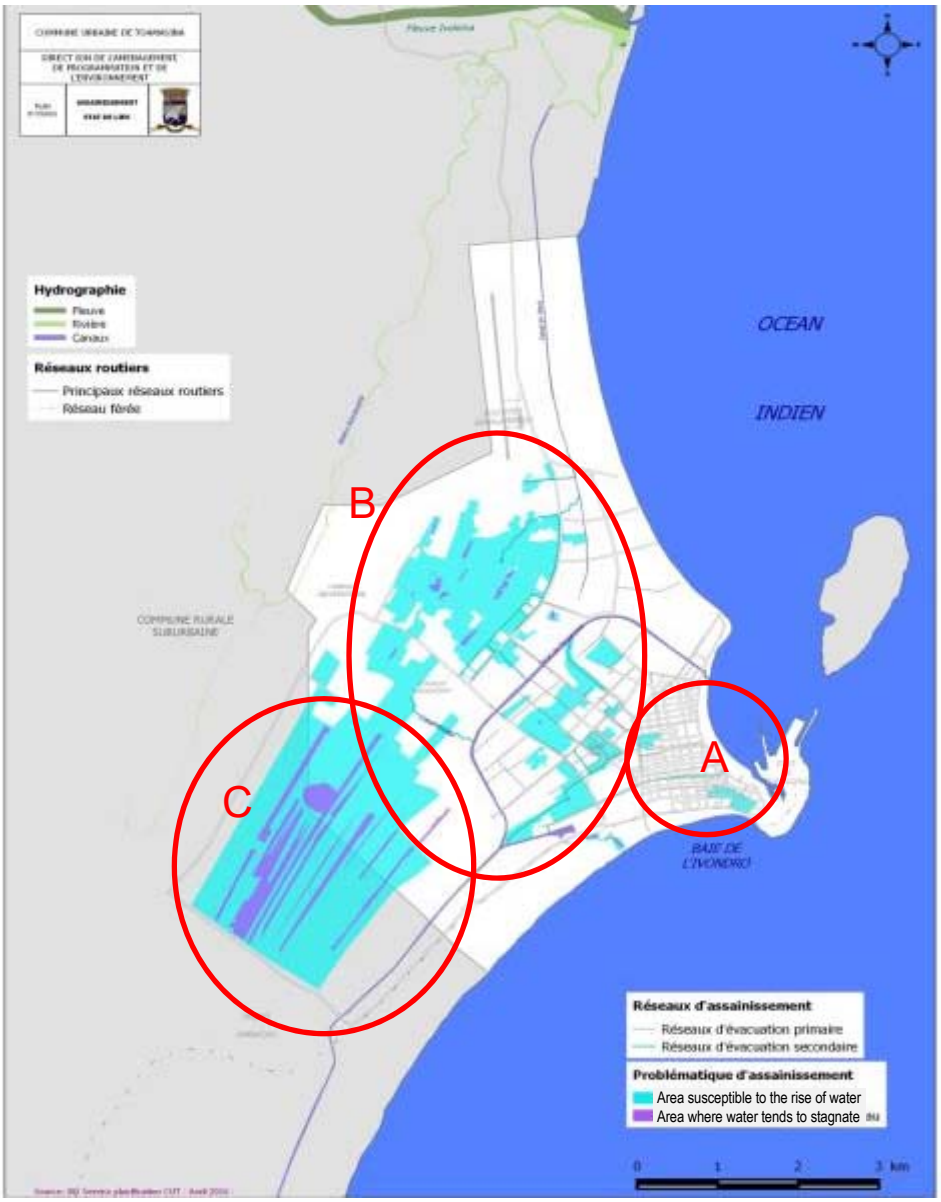
19.1.2 Disaster Risk Profile of Toamasina Agglomeration

Due to climatic conditions and its location along the eastern coast, Toamasina Agglomeration is often affected by cyclones. In the urban areas of CUT and Sub-Urban Commune, rainwater flooding occurs almost every year due to lack or non-functioning of the existing drainage network. In the communes of Antetezambaro, Fanandrana, and Amboditandrorohoa, their location along rivers expose them to river flooding.

In general, due to its low and flat topography and to the insufficient drainage capacity, water tends to stagnate. Consequently, the risk of pandemic outbreak after flooding is high.

(1) Urban Rainwater Flooding Risk in CUT

The Plans Service of CUT is conducting surveys in order to investigate the actual situation of the drainage network (this work is not completed yet due to the limitations in budget and human resources). Parallel to this survey the areas susceptible to inundation were identified as follows:



Source: CUT

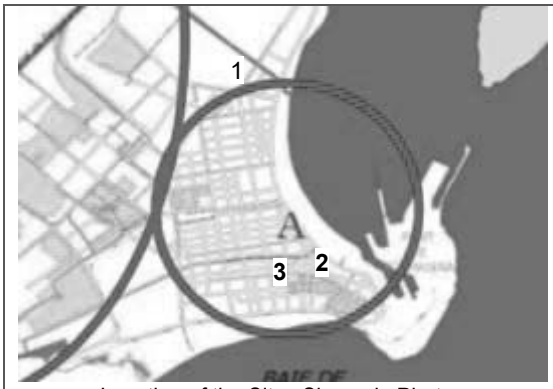
Figure 19.1.2 Flood-Prone Areas Identified by CUT

1) Area A[1]

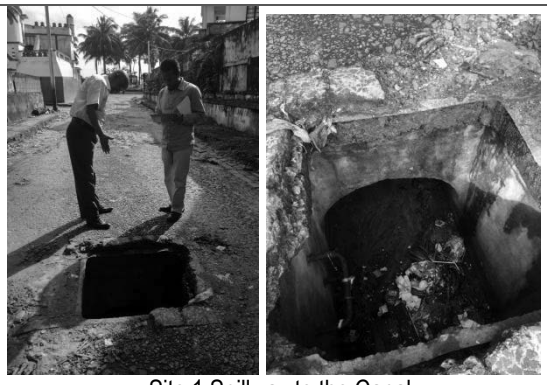
This area corresponds to the old core area of the commune bounded on the south by the Ivondro Boulevard; on the east by Ratsimilaho Boulevard; on the west by the OUA boulevard; and on the north by the Ivoloina Road.

An Urban Plan was formulated in 1952 and revised in 1963. This area was developed based on this plan, and benefits from paved and structured roads as well as public lighting at regular intervals along the roads.

However, due to the deterioration of facilities, sedimentation, and accumulation of waste, the function of the drainage network is restrained, and the frequency of urban rainwater flooding is increasing.



Location of the Sites Shown in Photos


Site 1:Spillway to the Canal


Site 2: Drainage with depth of 1.5 m silted and clogged


Site 3: Boulevard Joffre

Figure 19.1.3 Some Causes of Worsening Urban Rainwater Flooding in Area A (Old Core Area)

2) Area B[2]

Dwellings and small shops (grocery stores and others) are located along the Ivoloina Road and National Road 2. Compared to the old town of Ambodimanga (Area A), urban infrastructure are sparse in this area.

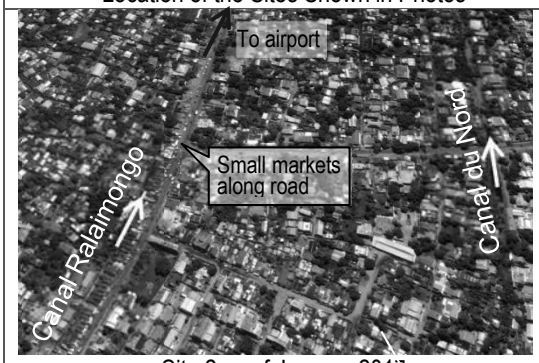
Due to rural exodus, the southern part (District Anjoma, Morarano, Ambolomadinika, Deposit Analakininina) and west (Ankirihiry) of the city as well as part of the city centre (Tanambao V) are experiencing rapid population growth. These areas are not structured and there is proliferation of illegal settlements where the minimum standards of construction are not observed.

In these areas, small channels are connected to the existing drainage network in CUT; and individual or informal connections also exist. Due to the increase of water discharged into channels that are not so large, rainwater flooding occurs almost every year.

[1] Corresponds to the "Urbanised Sectors (secteurs urbanisés)" of the PUDi2007
[2] Regroups the "Linear Sectors (secteurs linéaires)" and "Popular Sectors (secteurs populaires)" of the PUDi2007

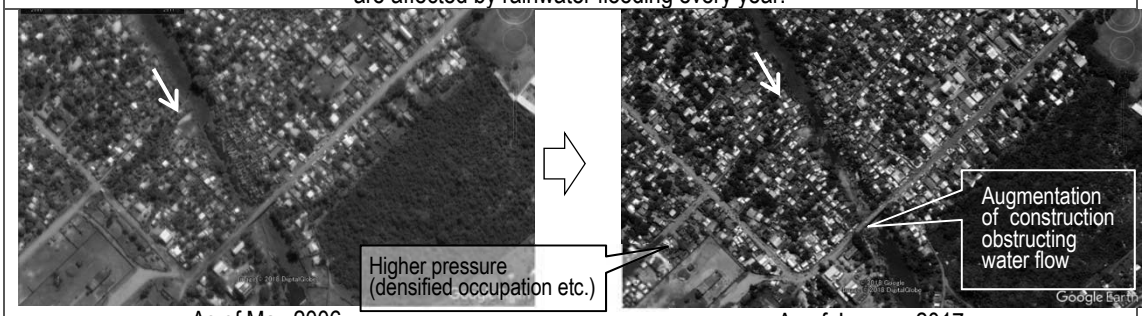
Location of the Sites Shown in Photos


Site 1: Due to low capacity and gentle slope, water (wastewater and rainwater) from habitations stagnate.



Site 2 as of January 2017

Site 2: Canal Ralaimongo drains the areas of Cité Haras and fokontany of Andranomadio (west of the market) that are affected by rainwater flooding every year.



As of May 2006 As of January 2017

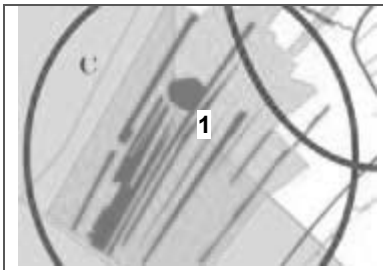
Site 3: Changes in land use and increasing land occupation in drainage channel

Source: Google Earth

Figure 19.1.4 Some Causes of Worsening Urban Rainwater Flooding in Area B (Growing Area)

3) Area C

The development status and population density in this area remains low. During rainy season, since there is no specific countermeasures due to low need, water tends to stagnate in the area between dunes.



Location of the Site Shown in Photos


As of May 2006


As of January 2017

Site 1: Even if the density is still low, the development of low-lying flood prone area has started (e.g., augmentation of population and assets exposed to flood risk).

Source: Google Earth

Figure 19.1.5 Changes in Land Use in Area C (Low Developed Area)

(2) Urban Rainwater Flooding Risk in the Commune Toamasina Suburbaine

Like CUT, the Commune Toamasina Suburbaine is affected by urban rainwater flooding especially newly occupied areas that were established due to rural exodus, which caused the population of the commune to grow rapidly.

Originally, people settled only on the hills, where flooding risk is low. Low-lying areas prone to flooding are now occupied and people experienced rainwater flooding every year during rainy season and cyclone period, mainly due to lack of drainage capacity.

Upgrading of drainage capacity has to be done especially in the Fokontany of Ambalamanasy, which is the most agglomerated, in order to reduce flooding risks.

Betainomby Canal has the function to drain rainwater of the Fokontany Ambodisaina to the Pangalanes Canal. Since it is small and clogged, overflow occurs every year

The Canal du Port Sec was fully buried by the construction of the road (which did not include the construction of bridge). Even if the Commune Toamasina Suburbaine installed pipes, due to the large diminution of discharge capacity, overflow occurs every rainy season.

During Cyclone Enawo, this school was flooded to a depth of 50 cm.

Figure 19.1.6 Major Causes of the Worsening Urban Rainwater Flooding in Commune Toamasina Suburbaine

(3) River Flood Risk in the Commune of Antetezambaro

Agricultural lands for manioc and rice in the Commune of Antetezambaro, along Ivoloina River, are affected by river floods almost every year during cyclone season. However, due to the sandy type of soil in the area which enables the rapid water infiltration, the impacts caused by floods are not so severe. (Notably, farmers in the area are starting to adopt resilient agricultural methods.)

Since damages caused by river floods are confined to agricultural lands, people's awareness on floods is low, according to the results of consultations with the commune.

Figure 19.1.7 Agricultural Lands Affected by the Rise of Ivoloina River

(4) River Flood Risk in the Commune of Fanandrana

One of the major economic activities in the Commune of Fanandrana, located along the river Ivondro and Ranomainty is the cultivation of banana, rice, and manioc. These agricultural lands are affected by river floods almost every year during the season of cyclones.

Figure 19.1.8 Low Agricultural Lands Affected by the Rise of Ivondro River

(5) Flood Risk Profile of Amboditandrorohoa

The Commune of Amboditandrorohoa is located at the mouth of Ivondro River, which collects all rainwater coming from the Ankeniheny Zahamena Corridor (Alaaotra Mangoro Region) with its dense forests, commune of Anjahamana (district of Brickaville), municipalities of Fito, Satrandroy, Amboditazana, Ampasimadinika and Fanandrana. Consequently, the volume of water is abundant.

Cyclone Kesiny (2002) caused 14 fatalities in the fokontany of Mahatsara when the river level raised to 4 metres.

Figure 19.1.9 Settlement Area Affected by Flooding in 2002

On the other hand, the left bank erosion of Ivondro River is also an issue to tackle. It is said that the riverbed widens by 200 metres per year, causing large losses of agricultural / palm plantation lands.

Figure 19.1.10 Erosion on the Left Bank of Ivondro River

19.2 Issues on Disaster Risk Reduction and Management of Toamasina Agglomeration

In this section, the issues to consider in the PUDi are summarized.

(1) Need of Structural Countermeasures to Mitigate Future Disaster Impacts

As explained above, due to its location, climate, hydrological system, urbanisation, and other aspects, the Agglomeration of Toamasina is highly exposed to river floods, and urban rainwater flooding. It is also frequently affected by the landfall of cyclones.

Drainage network exists in the urbanised area of CUT and Commune Toamasina Suburbaine. However, its capacity is not enough and urban rainwater flooding occurs every year. And in the Communes of Antetezambaro, Fanandrana, and Amboditandrorohoa, wide agricultural lands are affected every year by river floods.

Furthermore, according to various studies assessing the impacts of climate change, Madagascar will be one of the country most vulnerable to climate change since the population and assets exposed to risks are growing, and since the intensity of hazard itself is assumed to be stronger.

The major sector affected by disaster is agriculture, but the situation may change in the very near future with the establishment of new industries (the cost of damage will increase). Since the importance of the Toamasina Agglomeration as a socio-economic pole is expanding, it will be fundamental to enhance its level of protection to reduce the impacts from future disasters.

(2) Need to Enhance Disaster Awareness to Reduce Human Losses

As explained previously, the agglomeration is highly exposed to various hazards; and the population and assets exposed to disasters are increasing. Moreover, the impacts of flooding in urban areas will increase in term of duration and depth. And without any countermeasures, it will be difficult to avoid human losses, especially in newly urbanised areas where people are not aware of what natural hazards they are likely to face.

It has been discussed also in Section 18.2 that the capacity of the existing drainage network is reduced by human behaviours (use of drainage channels as rubbish dump, informal connection among others), and consequently unexpected flooding occurs in urban areas. To reduce disaster risk itself, the awareness on urban environment needs to be raised.

(3) Need to Upgrade Important Infrastructures to Ensure Disaster Response Activities

In the past, Toamasina Agglomeration was affected by severe cyclones, such as Enawo in March 2017 and Ava in January 2018, during which power shortage occurred even in CUT.

Meanwhile, urban rainwater flooding occurs every year and the flooding of important roads hampers disaster response activities, such as Research and Rescue.

Even if many efforts[3] to enhance the efficiency and effectiveness of disaster response were done, important infrastructure (e.g., transport, electricity, water, communication, health) need to be upgraded.

19.3 Objectives of Disaster Risk Reduction and Management of Toamasina Agglomeration

The objectives in PUDi of Disaster Risk Reduction and Management will be aligned with the vision of the National Strategy on Disaster Risk Management 2016-2030 (SNGRC) which was formulated in September 2016, and aims to establish "A nation resilient to shocks, protected from all damage, in its social, cultural, economic and environmental dimension for sustainable development[4]".

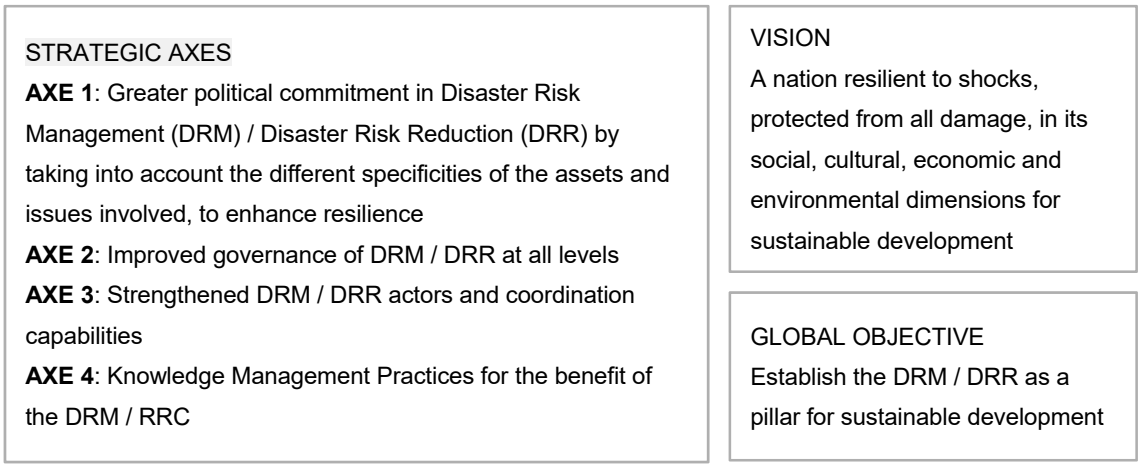


Figure 19.3.1 National Strategy on Disaster Risk Management 2016-2030

Based on this vision, the objectives in the PUDi related to Disaster Risk and Management will aim to avoid human losses and minimise the impacts of disasters to society and economy.

[3] Such as the creation of the Regional Unit for Urgency Operations (CROU), periodic review and revision of the Regional Contingency Plan, strengthening of coordination with NGOs and others

[4] In French: « Une nation résiliente aux chocs, protégée de tous dégâts, dans sa dimension sociale, culturelle, économique et environnementale pour un développement durable ».

19.4 Strategies for Disaster Risk Reduction and Management of Toamasina Agglomeration

The general strategies related to Disaster Risk Reduction and Management of Toamasina Agglomeration are as follows:

(1) Promote the planning and implementation of pre-disaster countermeasures (Whole Area)

Due to its location, climate, hydrological system, urbanisation, and other aspects, Toamasina Agglomeration is highly exposed to river floods, urban rainwater flooding, and frequently affected by the landfall of cyclones.

Considerable efforts were completed to enhance the efficiency and effectiveness of disaster response. However, to drastically reduce and mitigate the impacts from disasters, the implementation of preventive structural measures is fundamental.

To plan strategically preventive measures, the knowledge on disaster risk has to be enhanced at all the level of governance, from residents to national agencies. Even if some studies[5] were launched to consider issues to reduce the risk of inundation in Toamasina, their results and insights were not shared to relevant agencies and not published to residents. Consequently, the level of knowledge on disaster risk is low and the implementation of disaster mitigation countermeasures is not a priority for a great majority.

On the other hand, even if the need for countermeasures is recognized, due to the lack of budget, human resources, equipment, material among others, its implementation would be difficult. Consequently, it is important to elaborate a comprehensive and strategic disaster risk reduction plan identifying priority actions.

(2) Secure the operation of Critical Infrastructure even during Disasters (in CUT and Commune Toamasina Suburbaine)

As explained in Section 19.2, power shortage, road disruption, and flooding in schools and hospitals occurred during the past severe disasters. In addition to the damage caused by floods, severe destructions were caused by winds.

To ensure search, rescue, and early post disaster recovery, the upgrade of arterial roads (raising them to avoid submersion during flooding, and widening them to enable the smooth traffic of emergency vehicles, relief trucks, etc.) is fundamental.

Furthermore, all the regional offices are located in the agglomeration, which play important roles from the viewpoint of coordination with the central headquarters of each ministry. To secure the execution of effective and efficient operations, the business continuity of these offices will be crucial, and backup facilities of power and communication have to be installed in these regional offices; and in each Commune Offices.

(3) Encourage the Construction of Disaster-Resistant Structures (Whole Area)

Through the World Bank project's "Emergency Infrastructure Preservation and Vulnerability Reduction Project (PUPIRV) (2012-2017)", the Emergency Prevention and Management Unit (CPGU under the Primature) has formulated a series of new standards aiming to enhance resistance of "Roads against floods", "Buildings against cyclones", and "Hydro-agricultural infrastructures against floods". However, since the retrofit countermeasures aiming to improve the resistance of assets are expensive, it is difficult to follow these new standards[6].

Nevertheless, almost all parts of the Agglomeration are highly exposed to strong inundation and cyclonic winds, and a great number of buildings needs to be reinforced against disasters. However,

[5] Such as the « PROGRAMME DE REDUCTION DES RISQUES D'INONDATION(2016) » of BNGRC
[6] According to the results of meetings with CPGU

since it is not feasible to impose the construction of resistant residences, for a start, only the reinforcement of critical buildings (such as schools used as evacuation centres) will be encouraged.

(4) Enhance Public Awareness (in particular in Newly Developed Areas)

As explained in Section 19.2, reduction and degradation of existing infrastructure are generated by human behaviours. To reduce disaster risk itself, the awareness on urban environment/sanitation need to be raised.

Communes and NGOs are already conducting public awareness or educational activities in selected areas. Through such programmes, civil groups (such as the "Groupes des Jeunes (Young People Group)") were formed to facilitate disaster response as well as to raise people's awareness in their communities. The continuity and extension of such activities will be fundamental to reduce human losses and maintain a healthy urban environment.

19.5 Programmes and Projects for Disaster Risk Reduction and Management of Toamasina Agglomeration

The programmes and projects for Disaster Risk Reduction and Management of Toamasina Agglomeration are proposed as follows:

(1) In Short Term (2019-2023): Formulation of Comprehensive and Strategic Disaster Risk Reduction Plan / Prevention Plan to promote pre-disaster countermeasures

As explained above, various efforts were already completed to improve the coordination during disasters. For example, contingency plans were formulated and regularly updated. However, due to various factors such as limited funds and low incentive and unclear demarcation of roles of responsible agencies to invest into Disaster Risk Reduction, the implementation of preventive infrastructures is limited. On the other hand, TaToM proposes an ambitious PUDi enabling a remarkable economic growth. Therefore, structural preventive countermeasures have to be promoted in order to minimise the impacts from natural disasters.

On the other hand, as explained in the following paragraphs, in addition to structural countermeasures, non-structural countermeasures such as campaign to enhance public awareness in new developed areas and upgrade of basic infrastructures or formulation of Business Continuity Plans to ensure the supply of water and electricity and other services even during and after disasters, will be needed.

Therefore, the formulation of Comprehensive and Strategic Disaster Risk Reduction Plan / Prevention Plan is a priority and will be explained in detail in the Section 15.6.

(2) Short Term (2019-2023) to Long Term (2029-2033): Upgrade of critical infrastructure (i.e., roads, electricity, communication) to secure disaster response

Countermeasures will be integrated to other basic infrastructures to ensure disaster response activities during flooding.

Backup facilities of power and communication in Regional Offices and Communes will be installed at short term.

The upgrade of arterial roads (i.e., raising of roads to avoid submersion; and using of permeable paving to manage runoff, infiltration, and pollutant transport) will be done at mid to long term.

(3) Mid Term (2024-2028) to Long Term (2029-2033): Encouraging the construction of disaster-resistant structures

The reinforcement of critical buildings, such as schools used as evacuation centres, will be encouraged.

1) Identification of target buildings

The target buildings will be selected based on the population exposed to risk and assumed intensity of disaster at mid tem.

2) Upgrade / construction of buildings

At long term, critical buildings that can be used as evacuation centres will be upgraded or constructed.

(4) Short Term (2019-2023) to Long Term (2029-2033): Enhancement of Public Awareness

Efforts to establish proper risk knowledge to residents, through explicit and clear explanations of the potential risks in the area, are fundamental to the formulation of business plans reflecting disaster risks and to consensus building needed to implement countermeasures. Consequently, the anticipation of hazard becomes possible and earlier actions to enhance the safety of the people as well as assets can be carried out.

Various efforts, such as evacuation drills, are already conducted by BNGRC, communes, and NGOs to enhance public awareness; the continuity of these activities are fundamental.

Additionally, some wide low-lying areas that are actually not occupied are projected to be developed as residential, industrial, or tourism areas. To develop these areas, awareness activities will be conducted to promote the implementation of individual flood countermeasures such as "temporary" storage of rainwater in industrial areas, and elevating structures (piloti) in residential and tourism areas.

Table 19.5.1 Provisional Action Plan for Disaster Risk Reduction in Toamasina Agglomeration

Item		2019-2023	2024-2028	2019-2033
1)	Formulation and implementation of a Comprehensive and Strategic Disaster Risk Reduction Plan / Disaster Prevention Plan to promote preventive measures			
1-1	Formulation of the Plan	▬		
1-2	Implementation of Priority Projects		▬	▬
2)	Upgrade of critical infrastructure (roads, electricity, communication) to secure disaster response			
2-1	Backup facilities for power and communication in Regional Offices and Communes	▬		
2-2	Upgrade of arterial roads to ensure traffic management during floods		▬	▬
3)	Encouraging the construction of disaster-resistant structures			
3-1	Identification of target buildings	▬		
3-2	Upgrade / construction of buildings		▬	▬
4)	Enhancement of public awareness			
4-1	Continuity/expansion of existing programmes	▬	▬	▬

Source: JICA Study Team

19.6 Profiles of Priority Projects for Disaster Risk Reduction and Management of Toamasina Agglomeration

(1) Project to Formulate and Implement a Comprehensive and Strategic Disaster Risk Reduction Plan Enabling the Promotion of Preventive Measures Implementation

1) Rationale

As explained in Section 20.5, the implementation of disaster risk reduction or preventive countermeasures is limited in Toamasina. Various efforts are conducted to facilitate people's evacuation and coordination between government agencies when the occurrence of natural and also industrial disaster is anticipated. However, based on the reflection of expected future condition

of the Agglomeration such as its attraction to new businesses and people, the efforts being conducted in existing urbanised areas will have to be extended to new areas. Moreover, structural countermeasures for natural disasters such as river dikes and embankment reinforcement works will be needed to create safe new land.

Therefore, a number of important countermeasures can be considered for the Toamasina Agglomeration, and there is a need to sort out the fundamental countermeasures to implement in an early time frame. That is why Disaster Risk Reduction Plan which is "A document prepared by an authority, sector, organization or enterprise that sets out goals and specific objectives for reducing disaster risks together with related actions to accomplish these objectives (UNISDR)" should be formulated at an early stage.

2) Objectives

The proposed project aims:

- To clarify roles and responsibilities of related agencies and enhance coordination
- To set Objectives, Targets, and Vision towards Disaster Risk Reduction reflecting the future aspects of the Agglomeration
- To consider plan concrete countermeasures that reflect the disaster profile and consistent with existing plans
- To consider and secure budgetary allocations to implement disaster risk reduction infrastructure
- Identify priority countermeasures

3) Project Description

The proposed project will include the following activities:

- 1.Creation of a platform enabling the sharing of risk knowledge[7] :

  This platform will enable the agencies relevant to Disaster Risk Reduction and Management (BNGRC, CROU, communes, Fourth Unit for the Civil Protection, corps of firefighters, Red Cross, NGOs, and others groups), including Urban Planning, Environmental, Academic Sectors, and others to build a consensus on the exposure of Toamasina Agglomeration to disaster risk, set priorities and consider concrete countermeasures.

- 2. Setting of Objectives, Targets, and Vision towards Disaster Risk Reduction / Prevention:

  The level of protection expected will depend on the population, socio-economic importance, location of strategic infrastructure and other criteria. To ensure the implementation of effective and efficient countermeasures, it will be important to set legitimate objectives, target year and target areas by reflecting the National and Regional Directions, and development perspectives proposed by PUDi.

- 3.Consideration and Sorting Out of Countermeasures:

  The Sanitation Master Plan formulation Project supported by AfDB is supposed to start soon and it is expected that the rainwater and wastewater drainage countermeasures proposed by this Project will reflect the TaToM Plan. Furthermore, there are planned and on-going individual projects conducted by government organisations and also by NGOs that need to be considered and looked into.

  The formulation of the Disaster Risk Reduction Plan will present the opportunity to promote the interaction of existing efforts and to identify the vulnerable locations where countermeasures will be needed.

[7]"Risk knowledge" is the recognition of the importance of the impacts of disasters to society, livelihood, and others.

Since the number of countermeasures may be considerable, they will be sorted out based on the analysis of effects and impacts, cost, needed institutional arrangement and other issues.

- 4. Formulation of the Plan:

  By reflecting the Strategies and Vision on Disaster Risk Reduction and the upper development plan, the Comprehensive and Strategic Disaster Risk Reduction Plan for the Agglomeration of Toamasina will be formulated. This will clarify the roles and responsibilities of agencies to secure budget for the implementation, operation and maintenance of each countermeasure.

4) Expected Benefits

The implementation of both structural and non-structural countermeasures will be promoted.

5) Executing Agency and Related Institutes

- BNGRC
- CROU
- Communes including Urban Planning Department
- Other groups (NGOs, Academic Sector, etc.)

6) Estimated Project Cost

USD 500,000

7) Implementation Schedule

3 years (2020 to2023)

*It is expected that the Sanitation Master Plan dealing with rainwater flooding and reflecting PUDi is already formulated.

8) Necessary Actions for Implementation / Critical Factor

Coordination within related agencies

9) Related Plans and Projects

Project to formulate Sanitation Master Plan (supported by AfDB)

10) Social and Environmental Impacts

None.

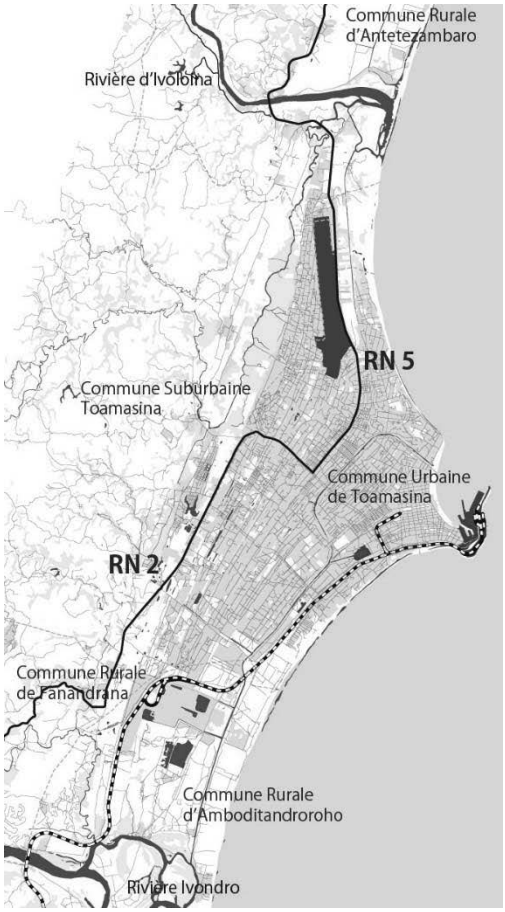
Chapter 20 Strategies for the Road and Transport Sector of Toamasina Agglomeration

20.1 Present Situation of Road and Transport in Toamasina Agglomeration

20.1.1 Present Situation of Road and Traffic

(1) Present Situation of Roads and Traffic

Toamasina Agglomeration is a harbour city which developed around Toamasina sea port. Urban areas have expanded to 6 km in the west direction, and 10 km in the north–south direction from the port. The downtown, administrative area, and railway station have been developed inside Pangalanes Canal which is located within a radius of 3 km from the port. The southern area outside of NR2 bypass, which is called NR2-Ter, is demarcated as an industrial development zone and land for commercial use, and this is where the nickel plant of Ambatovy exists. The river in the north direction and Ivondro River in the south direction are edges of the urbanised areas of Toamasina Agglomeration. There are no satellite cities in the suburbs of CUT, but the above-mentioned areas can be covered by day trips. Meanwhile, in areas along NR5 to the east of Toamasina Airport located 7 km away from the city centre, urban areas have expanded without basic infrastructure.



Source: JICA Study Team

Figure 20.1.1 National Roads of Toamasina Agglomeration

The arterial road network of Toamasina is composed of NR2, NR5, and other principal commune roads. However, these roads are mostly two-lane roads. In addition, many temporary shops and vendors occupy roadsides of the arterial roads: NR2 and NR5 of the city centre. This situation degrades transport functions of national roads and arterial roads in Toamasina, and causes ambiguities in road hierarchy. As a consequence, the traffic capacity of roads of Toamasina Agglomeration becomes extremely low, resulting in chronic traffic congestion. Although the traffic volume is not supposed to be so much vis-a-vis the traffic capacity, the traffic congestion seems to occur due to problems other than the traffic demand.

Based on the result of traffic survey, it is presumed that the number of vehicles is still small in Toamasina. Heavy traffic occurs only in roads at the city centre and at daytime. Traffic volume on suburban roads is still small.

According to the result of travel speed survey, heavy traffic congestion is observed in city centre. The major causes of bottlenecks observed are as follows: concentration of traffic at the city centre; narrowness of road width; prevalence of low-speed vehicles on roads, such as pousse-pousse, bicycle, and tuk-tuk. Chronic traffic congestion is also observed on the harbour road near the port caused by trucks waiting for entry to the port, and this is due to lack of truck parking space.

In addition, many pousse-pousse type of vehicles and majority of their drivers are not aware of the rules on the road.

Based on the road inventory survey conducted in TaToM Project, these above results indicate that:

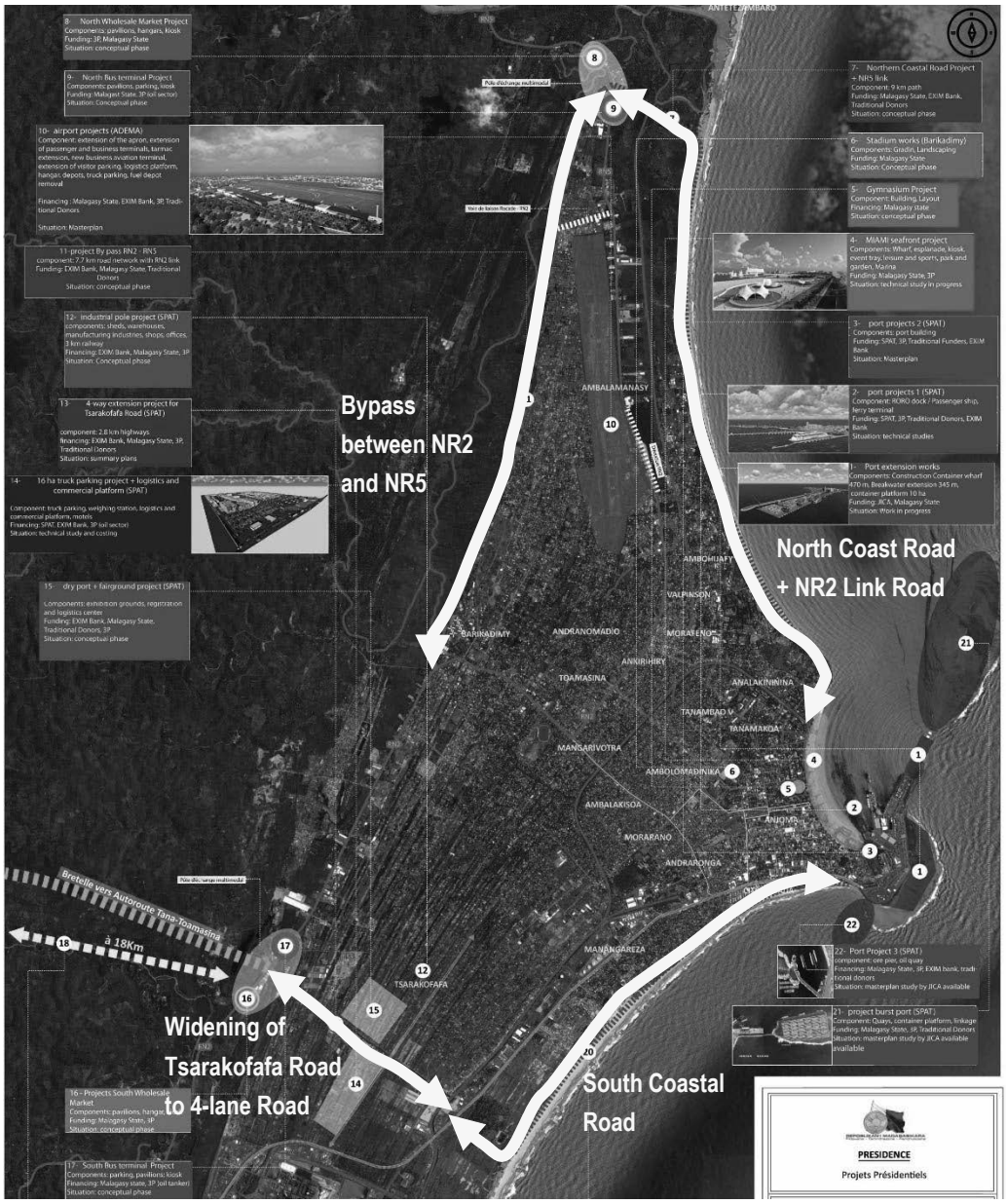
- Most of the objective roads are 2-lane roads.
- For tertiary roads of communal roads, around 90 % of them have carriageway width of less than 5 meters. Although 9% of the tertiary roads have a carriageway of 5 to 8 meters, the effective carriageway width is reduced to around 5 meter due to the large number of pousse-pousse and tuk-tuk.
- Regarding road pavement condition, only the national road has pavement kept in good condition. Bad road pavement condition is observed in 20% of primary and secondary roads, while it is more than 60% for tertiary roads.

(2) Existing Projects for Roads in Toamasina Agglomeration

The list of Presidential Projects for road development in Toamasina Agglomeration includes the following projects:

- North Coast Road + NR2 Link Road
- Bypass between NR2 and NR5
- Widening of Tsarakofafa Road to 4-lane Road
- South Coastal Road

The location of these projects are shown in Figure 20.1.2 and the description of these projects are provided below.



Source: JICA Study Team on map prepared by DGPP, 2019

Figure 20.1.2 Location of Presidential Projects for Road Development in Toamasina Agglomeration

1) North Coast Road + NR2 Link Road

- Description: 9km of road
- Objectives
  - Rehabilitation of the existing road
  - Connectivity between Toamasina Port and Toamasina Airport
  - Opening tourism sites along the coast
- Proposed Finance Sources
  - Malagasy Government
  - Development Partners
  - EXIM Bank
- Current Situation: Concept Phase
- Implementation Phase: Medium
- Project Cost: 6.7 million Euro

2) Bypass between NR2 and NR5

- Description: 7.7km of high standard road with ramp
- Objectives
  - Connecting NR2 and NR5
  - Decongesting the city
  - Link between Airport and Tsarakofafa Industrial Area
- Proposed Finance Sources
  - Malagasy Government
  - EXIM Bank
  - Development Partners
- Current Situation: Concept
- Implementation Phase: Medium
- Project Cost: 5.7 million Euro

3) Widening of Tsarakofafa Road to 4-lane Road

- Description: Widening of 2.8 km of road to 4-lane road
- Objectives
  - Improve mobility
  - Development industrial sector
- Proposed Finance Sources
  - Malagasy Government
  - EXIM Bank
  - Development Partners
  - PPP
- Current Situation: Plan formulated and available
- Implementation Phase: Medium
- Project Cost: 2.1 million Euro

4) South Coastal Road

- Description: Road improvement of 6.6 km as well as railway and pipeline along the road
- Objectives
  - Provide direct access from NR2-bis to Toamasina Port via coastal line
  - Improve the transportation of products from the port to the hinterland, especially the industrial area at Tsarakofafa
  - Improve tourism attraction opportunity along the coastal area
- Proposed Finance Sources
  - EXIM Bank
- Current Situation: On going
- Implementation Phase: Medium
- Project Cost: 50 million Euro

(3) Existing Projects for Logistics in Toamasina Agglomeration

The list of Presidential Projects for logistics development in Toamasina Agglomeration includes the following projects:

- Truck Terminal Development and Establishment of Logistic and Commercial Platform
- Dry Port

1) Truck Terminal Development and Establishment of Logistic and Commercial Platform

- Description
  - Establishing 16ha of truck parking
  - Establishing weighing station and logistic platform
  - Establishing hotels, restaurants, shops and service centres, real estate offices
- Objectives
  - To improve the traffic congestion at the entrance of the port due to trucks parked on the roads
  - To create value-added economic activity
  - To promote economic dynamic
- Proposed Finance Sources
  - Malagasy Government (SPAT)
  - Exim Bank
  - PPP
- Current Situation: Technical studies conducted
- Implementation Phase: Long term
- Project Cost: 23.75 million Euro

2) Dry Port

- Description: Establishment of dry port and industrial exhibition centre
- Objectives
  - Relocation of logistics centre
  - Establishment of exhibition centre
- Proposed Finance Sources
  - Malagasy Government
  - Exim Bank
  - Development partners
  - PPP
- Current Situation: Concept
- Implementation Phase: Long
- Project Cost: To be determined

20.1.2 Present Situation of Public Transport

(1) Present Situation of Public Transport

Public transport in Toamasina is not well developed as in Antananarivo. There are only two lines for Taxi-bé; the first line has route to the Airport, and the second line has route to the University. The means of transport for the majority are bicycle, pousse-pousse, motorbike, and tuk-tuk. Taxi-bé operated by five cooperatives has 45 vehicles. Before, there were five lines of taxi-bé but these were abolished due to profit losses. Although there is only one bus terminal constructed in the city centre, it is not being used by the bus operator due to its insufficient space and function. Aside from this, it has unpaved parking and the insufficient drainage function in the terminal. Hence, the bus company opted to use informal parking spaces dispersed in the city, so smooth connection between buses has not been realised. One operator of taxi-brousse is using the bus station.

(2) Existing Projects for Public Transport

CUT has a plan to implement a bus terminal in the city. This bus terminal is planned to function as taxi brousses station.

Besides the plan of CUT, the list of Presidential Projects for transport development in Toamasina Agglomeration includes the following projects:

- North Bus Terminal
- South Bus Terminal

The location of these projects are shown in Figure 20.1.2 and the description of these projects are provided below.

Source: JICA Study Team on map prepared by DGPP, 2019

Figure 20.1.3 Location of Presidential Projects for Public Transport Development in Toamasina Agglomeration

1) North Bus Terminal

- Description: Bus terminal including benches with shed, storages, parking and kiosks
- Objectives
  - Improve public transport of Toamasina Agglomeration
  - Improve the congestion situation of CUT
  - Providing areas for small commercial shops
- Proposed Finance Sources
  - Malagasy Government
  - PPP
- Current Situation: Concept
- Implementation Phase: Medium
- Project Cost: 2.2 million Euro

2) South Bus Terminal

- Description: Bus terminal including benches with shed, storages, parking and kiosks
- Objectives
  - Improve public transport of Toamasina Agglomeration
  - Improve the congestion situation of CUT
  - Providing areas for small commercial shops
- Proposed Finance Sources
  - Malagasy Government
  - PPP
- Current Situation: Concept
- Implementation Phase: Medium
- Project Cost: 2.2 million Euro

20.2 Issues on Road and Transport Sector of Toamasina Agglomeration

The development of urban transport is the priority of Toamasina Agglomeration, especially in recent years since the city's population has been exponentially. The existing situation of road infrastructures no longer meet the needs of local residents in terms of capacity and practicality. The main roads are engorged and gradually deteriorating, while the small axes in the neighbourhoods are shrinking day by day and becoming impassable. Urban mobility is slowed down and disorganised.

Major issues on road and urban transport in Toamasina Agglomeration are summarised as follows:

- The arterial road network is insufficient, and the road function hierarchy is unclear.
- Some sections of the arterial roads are in poor condition. The tertiary roads are in even worse condition, with more than 50% of the total tertiary roads being in bad condition,
- Roads around the port are congested due to parked trucks and trucks circulating in the central areas. However, it is prohibited for trucks to circulate in the city centre because the roads are not necessarily able to support their tonnage, hence accelerating the degradation of these roads. In addition, since these roads are heavily used by local residents, the situation accentuates the clogging of the roads.
- The urban area is divided by the canal. Traffic is concentrated in the limited cross section of the river due to insufficient number of bridges.
- Because of the inadequate evacuation systems in the arterial arteries, the decrease of circulatory function and the function of prevention of disasters commonly do not exist in the commune.
- Illegal occupation of rights-of-way on arterial roads
- The development of the urban road is not synchronised with urban expansion.
- The isolation of the so-called "Andalampasika" zones (areas served with sand roads) is developing in many places.
- Due to the expansion of urban area, the distance travelled by the inhabitants will also extend. It is planned that the motorization will progressively replace the transport with human energy. Improvement of the public transport network is necessary,
- The clogging of the main axes asphalted for years and which need rehabilitation regulations are not respected,
- Bus stations have proliferated throughout the city, causing congestion on the axes already over-occupied by all types of transport.

- Public transport is in poor condition and does not adhere to the specifications.

20.3 Objectives for Transport Development of Toamasina Agglomeration

The objectives of urban transport development is mainly to improve economic efficiency of transport, conserve the environment, formation of easy-to-live streets and neighbouring residential areas, securing traffic safety, contribute to economic growth, collateral for fair mobility, etc. Following these objectives, the three pillars of basic policy of transport development in Toamasina are set as follows:

Objective 1: Promoting the basic urban transport infrastructure to correspond to rapidly developing motorisation and to the growing traffic demand

Objective 2: Promoting the development of transportation infrastructure for realising a fair transportation services and traffic safety for all residents.

Objective 3: Promoting the formation of a transportation system to support the formation of eligible future urban structures

20.4 Strategies for Transport Development of Toamasina Agglomeration

For a healthy growth and development of Toamasina city, it is important to develop the fundamental road network that can reliably support the expansion of the urban area. In particular, development of road network in areas aiming to become industrial cities triggered by port development, is essential. Toamasina is the central city of the eastern coastal area and it has also aspects as a commercial area. It is necessary to develop the road as it contributes to the revitalisation of tertiary industry such as commercial, services, and tourism as well. The current car traffic volume is limited and motorisation is underdeveloped. However, considering the growth of vehicle traffic and industrialisation contributed by economic growth and population increase, it is expected that motorisation would develop in the near future. To address the situation properly, the development of fundamental roads is the most important aspect in road traffic development. And in order to develop road network, focus will be on improvement of the connectivity from port to inland and from port to industrial area, and development of road in the area where it forms as backbone of urbanisation. The proposed future highway network is shown in Figure 20.4.1.

Considering the afore-cited conditions of road and transport in Toamasina Agglomeration, the following traffic infrastructure development strategy is set up:

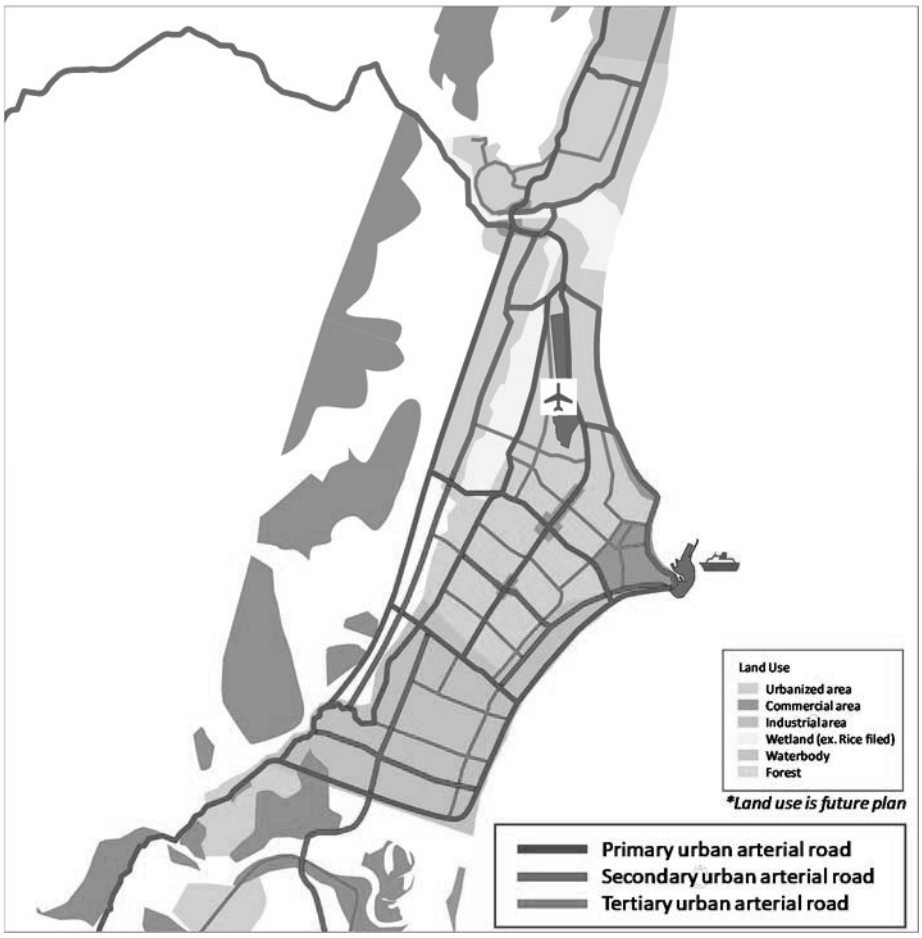
Strategy 1: Early realisation of development of urban arterial roads to form the basic structure of Toamasina Agglomeration

Strategy 2: Planning and development of urban road network to promote sound and orderly urban development

Strategy 3: Development of urban arterial road network and multi-modal transport facility to promote effective use of the port, supporting industrial development

Strategy 4: Enhancement of public transportation system responding to the expansion of urban areas and supporting urban mobility

Strategy 5: Road and transport network for tourism transportation



Source: JICA Study Team

Figure 20.4.1 Future Urban Arterial Road Network in the Long Term

20.5 Programmes and Projects for the Transport Sector of Toamasina Agglomeration

20.5.1 Programmes and Projects for the Transport Sector by Phases

(1) Development Plan in Phase I, 2019-2023

In this phase, development projects for the arterial urban road to form the basic city structure commence. And the preparation for road project launching has started aiming to operate the road by the time of completion of the port extension project.

Major projects:

- Road widening to 4-lane road of National road No.5; Section between Toamasina international airport and the cite nouvelle ville
- Road widening to 4-lane road of the Rue de Rigny and Rue de Melville as part of NR2; Section between Toamasina international airport and Cite nouvelle ville
- Road widening to 4-lane road of NR2 TER
- New primary urban road; Road section between NR5 and NR2 TER
- New urban road the voie 6 bis
- New urban road the voie 8
- New urban road the voie 11

- New urban road in new industrial area in south area of Toamasina
- Construction of city bus terminal in CUT
- Introduction project of taxi be system

(2) Development Plan in Phase II, 2024-2028

In this phase, development projects for the arterial urban road to form the basic city structure is promoted to correspond to urban sprawl that supports sound and orderly urban development. Furthermore the road project, enhancing effective use of the port to support industrial development, is promoted continually from Phase I.

Major projects:

- New coastal expressway between Toamasina port and National Road No.2 Tre
- New bypass of National road No.5; Road section between Toamasina Airport and National road No.5
- New coastal road between Toamasina port and Toamasina Airport,
- New urban roads to support new residential areas
- New urban road in emerging industrial zone in south area of Toamasina
- Development of truck terminal at Tsarakofafa
- Introduction of zonal bus system and development of related bus terminal
- Improvement of Toamasina railway station to become a transportation hub connecting railway and local transport

(3) Development Plan in Phase III, 2029-2033

The road development plan in Phase III is planned to promote sub-urbanisation developing new towns in northern area of Toamasina. The road development supporting the industrial location in the north area of Ivoloina River is promoted.

Major projects:

- New access road including bridges construction between Toamasina Airport and the north area of Ivoloina River
- New urban road in north area of Ivoloina River

20.5.2 Priority Projects for Transport Sector of Toamasina Agglomeration

The following projects are list of priority projects for transport sector selected for Toamasina Agglomeration:

- [T-R-01] Project for Construction of Port Access Road for Construction of Toamasina Port Expansion
- [T-R-02] Project for Construction of Urban Arterial Road in Toamasina West
- [T-R-03] Project for Construction of Urban Arterial Roads in Toamasina South
- [T-R-04] Project for Widening of NR5 to 4-Lane Road between Toamasina Airport and the Junction of NR2 & NR5
- [T-R-05] Project for Construction of Third Access Road to Toamasina Port
- [T-R-06] Project for Construction of Toamasina Western Bypass
- [T-F-01] Project for Development of Multi-Modal Freight Terminal
- [T-F-02] Project for Rehabilitation of Railway for Tourist and Urban Passengers
- [T-B-01]Project for Construction of Bus Terminal in Toamasina Central
- [T-B-02] Project for Establishment of Bus Terminal in Toamasina North
- [T-B-03] Project for Establishment of Bust Terminal in Toamasina South

20.6 Profiles of Priority Projects for Road and Transport Sector of Toamasina Agglomeration

(1) Project for Widening of NR5 to 4-Lane Road between Toamasina Airport and the Junction of NR2 & NR5 [T-R-04]

1) Rational

The road between the airport and the junction of NR 2 and NR5 is an urban axis of Toamasina and is functioning as a commercial corridor where many vendors and shops are located along this road. Functionally, this road must play a role as arterial road that accommodate traffic to the north of Toamasina from the central area of Toamasina. However, this road consists of only narrow 2-lane road and local traffic concentrates to this road section due to lack of road network.

2) Objectives

The objectives of this project are as follows:

- To reduction of traffic congestion on NR5,
- To create an urban axis of Toamasina Agglomeration,
- To enhance of development potential of roadside development along NR5.

3) Project Description

This project is widening of National Road No.5 to 4-lane road between Toamasina International Airport and the junction of NR2 and NR5 (Mangarivotra Area).

This road widening project to 4-lane road including service roads installation will realise the reinforcement of the two types of function (transport function for through traffic and function for access to roadsides).

- Road length: 4.5km
- Road width: 25m (4 lanes, service road)

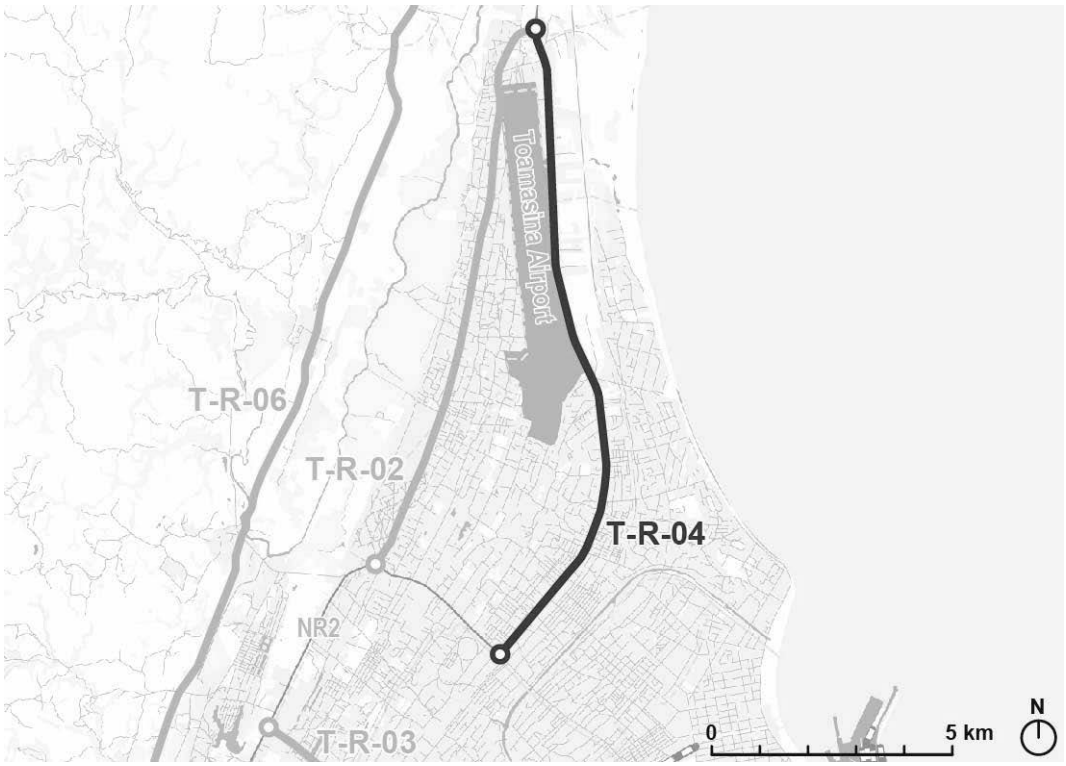


Figure 20.6.1 Location of Project for Widening of NR5 to 4-Lane Road between Toamasina Airport and the Junction of NR2 & NR5

4) Expected Benefits

- To provide smooth access between east area and west area,
- To reduce of traffic congestion on NR5, to reduce traveling time and travel cost,
- To promote a healthy urban development in area along NR5.

5) Executing Agency and Related Institutes

- MAHTP

6) Estimated Project Cost

- 20 million USD

7) Implementation Schedule

- Phase 1 (2019-2023) of Project TaToM
- 24 month (Design)、24month (Tender and Construction)

8) Necessary Actions for Implementation / Critical Factor

- None

9) Related Plans and Projects

- None

10) Social and Environmental Impacts

- Some residents need to be relocated.

(2) Project for Construction of Urban Arterial Roads in Toamasina South [T-R-03[

1) Rational

The international port of Toamasina imports goods which are daily transported to the capital city. There it is important for the city of Toamasina to provide efficient road network to connect to the port.

In addition, the population of Toamasina Agglomeration is concentrated in a limited area within CUT, due to underdeveloped infrastructure outside CUT and the drainage condition. As a result, the population density of this area is very high. In order to promote housing development, it is important to provide arterial roads with drainage.

2) Objectives

The objectives of this project are as follows:

- To reduction of traffic congestion on NR5,
- To create urban axis of Toamasina Agglomeration,
- To enhance of development potential of roadside development along the NR5.

3) Project Description

This road project is new 4-lane road development that will be urban axis and to promote the cite “nouvelle ville” where don't develop healthy or efficiency. This road connects the intersection NR2 and NR5 to NR2 ter. The road network is not developed in the area surrounded by NR2 and NR2 ter.

- Road length: 4.5km + 3.5km = 7.0km
- Road width: 25m (4 lanes, Service road) for 4.5 km, 20 m (4 lanes) for 3.5km

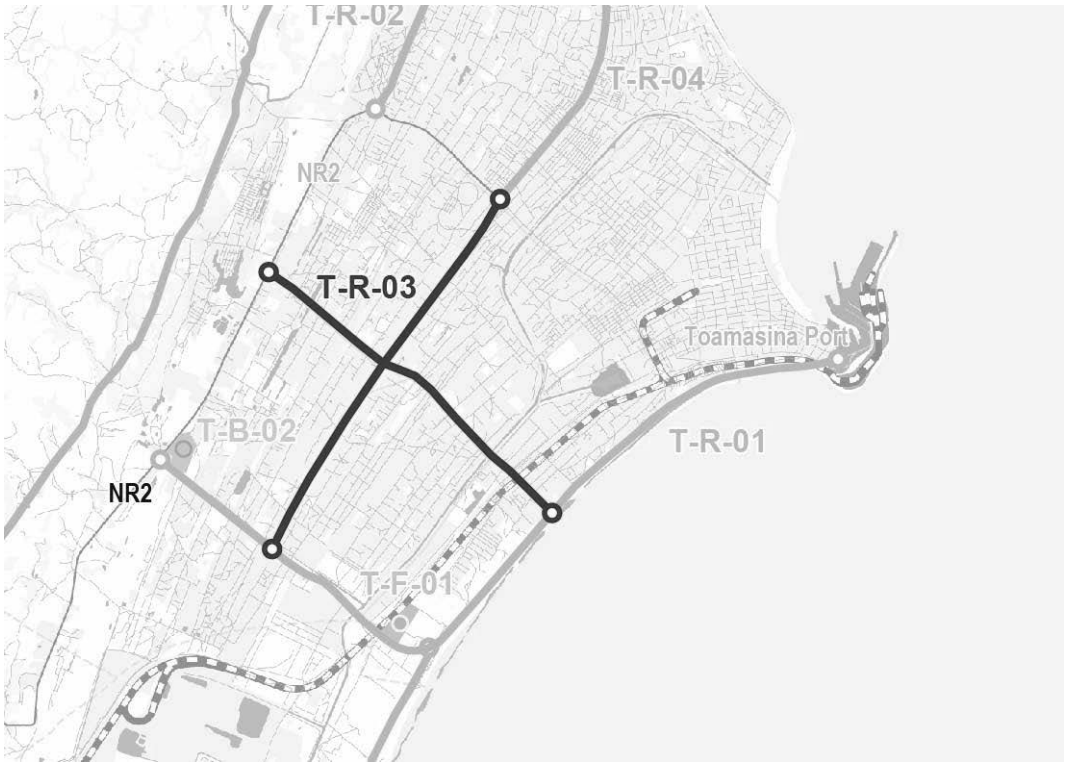


Figure 20.6.2 Location of Project for Construction of Urban Arterial Roads in Toamasina South

4) Expected Benefits

- To provide smooth access between east area and west area,
- To reduce of traffic congestion on NR5, to reduce traveling time and travel cost,
- To promote a healthy urban development in area along the NR5.

5) Executing Agency and Related Institutes

- MAHTP
- CUT

6) Estimated Project Cost

- 40 million USD

7) Implementation Schedule

- Phase 1 (201902023) of Project TaToM
- 4 month (Design)、24 month (Tender and Construction)

8) Necessary Actions for Implementation / Critical Factor

- None

9) Related Plans and Projects

- None

10) Social and Environmental Impacts

- Some residents need to be relocated.

Chapter 21 Strategies of the Infrastructure Sectors in Toamasina Agglomeration

21.1 Water Supply of Toamasina Agglomeration

21.1.1 Background on Water Supply of Toamasina Agglomeration

(1) Institutional Framework of Water Supply in Madagascar

Ministry of Water, Energy and Hydrocarbons (MEEH: *Ministere de l'Eau, de l'Energie et des Hydrocarbures*) is the ministry in charge of water supply in Madagascar. Within MEEH, Directorate of Management of Water Resources (DGRE: *Direction Gestion de Ressources Eau*) under General Directorate of Water Management, Sanitation and Hygiene (DGEAH: *Direction Générale de l'Eau, de l'Assinissement et de l'Hygiéne*) is in charge of water supply.

JIRAMA is the national water and electricity company of Madagascar owned by the Malagasy government. Technical Directorate of Water in Antananarivo (DTOA: *Direction Technique Eau Antananarivo*) of JIRAMA exclusively concentrates on the operation of water supply in Antananarivo. Attached to DTOA there is the Coordinator of Non-Revenue Water (NRW) which is the responsible office for NRW. Its mandates focus on the improvement of the strategy for NRW reduction, and to undertake all activities on loss reduction. Other than DTOA, Director of Water Equipment (DEXO: *Direction Equipement Eau*) is in charge of equipment and projects and the Director of Strategic Planning (DPS: *Directeur de la Planification Stratégique*) is in charge of planning for both energy and power sectors.

(2) Present Situation of Drinking Water Access in Toamasina Agglomeration

1) Drinking Water Access Rate

In 2016, MEEH conducted a study on the water supply and sanitation infrastructure inventory for Regional Objective Budget Programme (BPOR: *Budget Programme par Objectif par Région*) covering the whole country. According to this study, the access rate to appropriate drinking water[1] in Madagascar was estimated to be 23%.

Table 21.1.1 shows the provisional results of water supply infrastructure inventory for Regional Objective Budget Programme 2016 (BPOR: *Budget Programme par Objectif par Région*) for 5 communes of Toamasina Agglomeration. Total population counted in the survey was 401.3 thousand and beneficiary was 113.0 thousand. Therefore, access rate to drinking water in 2016 is calculated to be 28.15%. As the numbers of population is the sum of the interview result in each fokontany, they are different from the figures of census of INSTAT.

[1] The following water sources were considered as appropriate water sources in Antananarivo Agglomeration:
- BP: Branchement Particulier (Private Connection)
- BF : Borne Fontaine Public et Sociale (Public and Social Connection (Water Kiosk))
- FPMH : Forage avec Pompe à Motricité Humaine (Deep Well with Human Powered Pump)
- PPMH : Puit avec Pompe à Motricité Humaine (Shallow Well with Human Powered Pump)

Table 21.1.1 Provisional Results of Water Supply Infrastructure Inventory for BPOR in Toamasina Agglomeration

No.	Commune	Population	BF		BP	FPMH		PPMH		Beneficiaries	Access Rate (%)
			F	NF		F	NF	F	NF		
1	Toamasina Urbaine	339,221	490	30	11,792	1	0	0	5	99,989	29.48
2	Toamasina Suburbaine	17,950	26	64	0	0	0	114	265	6,525	36.36
3	Antetezambaro	16,858	1	1	1	7	11	24	25	1,113	6.61
4	Fanandrana	12,267	1	0	1	14	15	1	6	1,945	15.86
5	Amboditandroroho	15,032	0	0	0	9	6	0	6	3,382	22.50
Total		**401,328**	**518**	**95**	**11,794**	**31**	**32**	**139**	**307**	**112,954**	**28.15**

BF: Borne fontaine (Public Connection) BP: Branchement Particulier (Particular Connection)
FPMH: Forage avec Pompe à Motricité Humaine (Deep Well with Human Motorized Pump)
PPMH: Puit avec Pompe à Motricité Humaine (Shallow Well with Human Motorized Pump)
F: Functioning NF: Not functioning
Note) The above data remains to be finalized by MEEH.

Figure 21.1.2 shows a map of Toamasina Agglomeration which indicate access rate to drinking water of each commune. Generally, access rates are rather low in this area, which are between 6.61 to 36.36 %. JIRAMA network covers only Urban Commune of Toamasina (CUT: *Commune Urbaine de Toamasina*) and a small part of Suburban Commune of Toamasina. In coastal areas, almost all household has a shallow well with vacuum type manual pump called "Tani Pump" (See Figure 21.1.1). However, as "Tani Pump" takes water from very shallow phreatic aquifer, water pollution by domestic water is concerned.

Source: Water and Sanitation Directorate in Toamasina of MEEH

Figure 21.1.1 Picture of "Tani Pump"

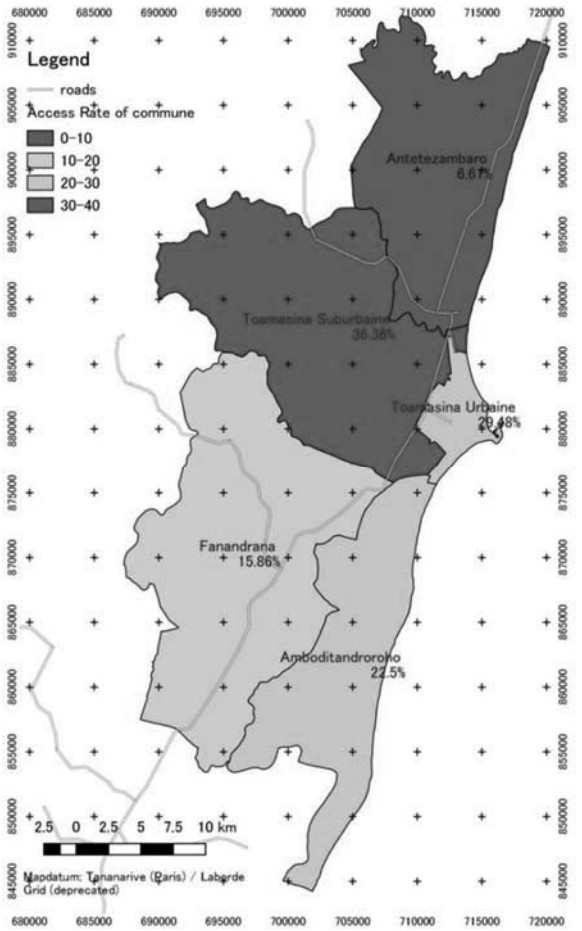
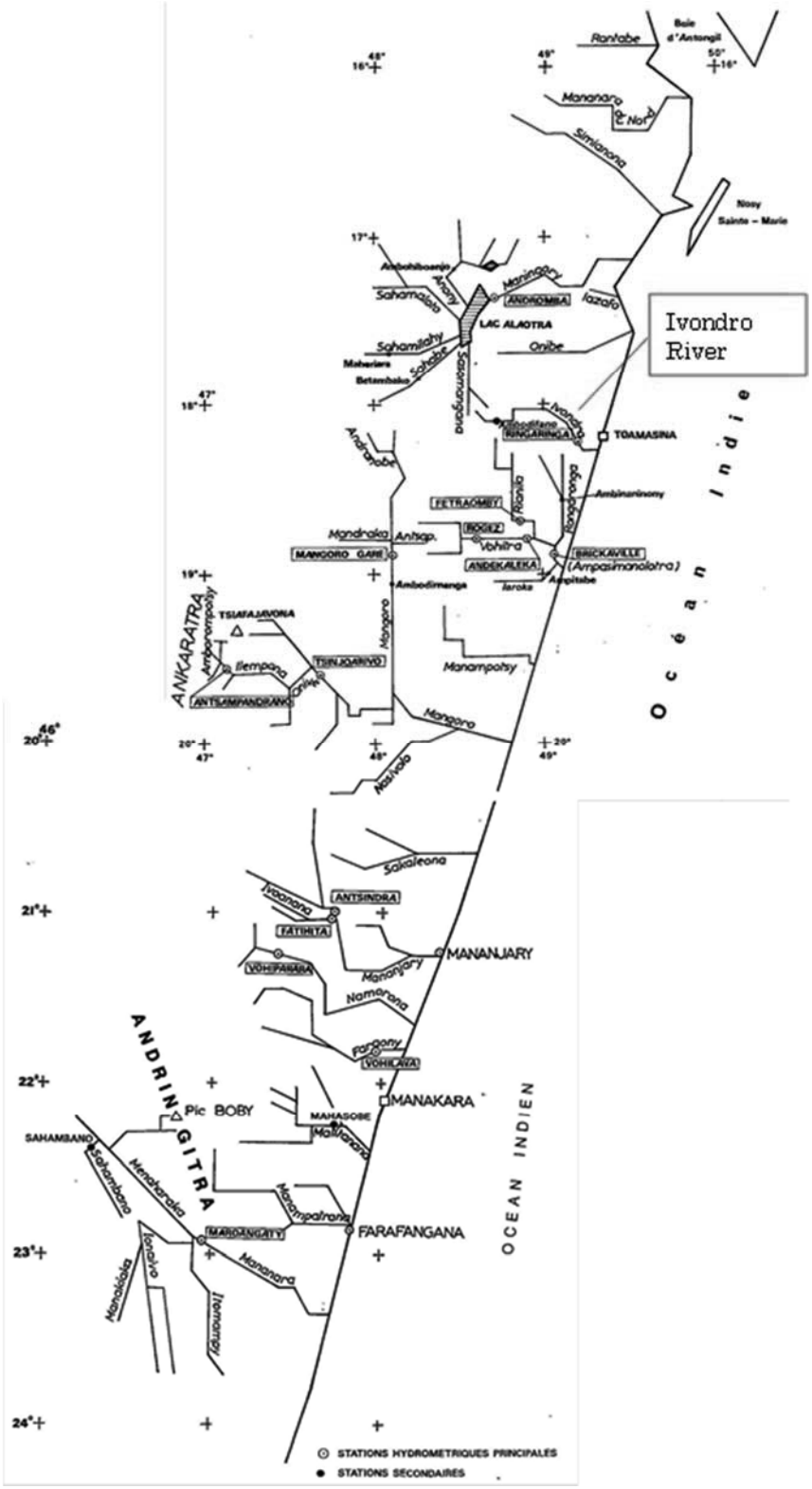


Figure 21.1.2 Access Rates to Drinking Water in Toamasina Agglomeration

2) Water Resources for Toamasina Agglomeration

The main source of water for Toamasina Agglomeration is surface water from Ranomainty River. The rural communes also use underground water from shallow well. Toamasina Agglomeration is situated in Ivondro sub-watershed in eastern water shed of Madagascar (See Figure 21.1.3).



Source: Fleuves et rivières de Madagascar, ORSTOM, 1993

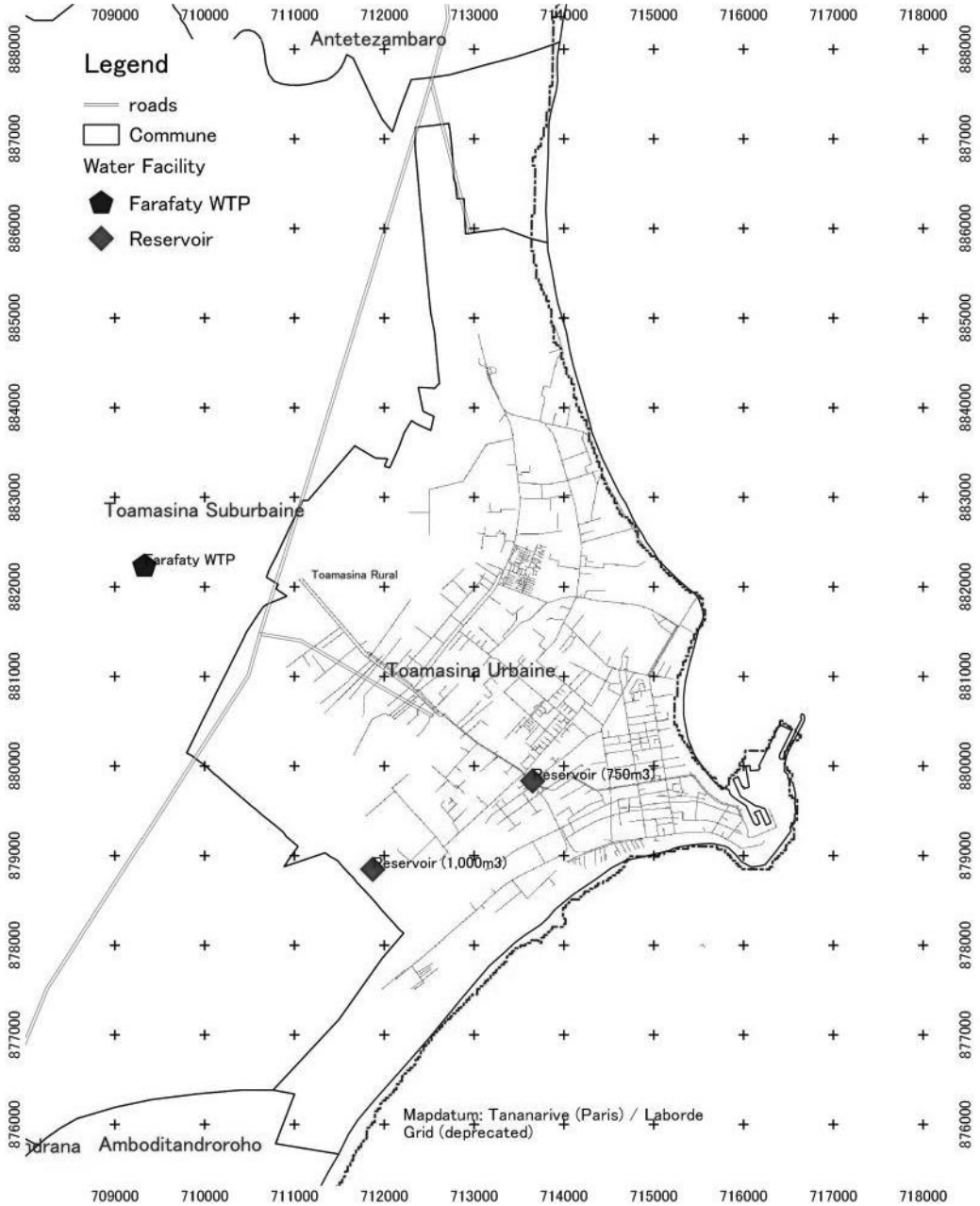
Figure 21.1.3 Hydrology of Eastern Watershed in Toamasina Agglomeration

Besides Ivondro River, which is the principal river in the Toamasina Agglomeration, there are many small rivers and streams which principally flow from western mountainous areas to the eastern seaside. Such rivers are potential water sources for future water supply of Toamasina Agglomeration.

(3) Water Supply Facilities of Toamasina Agglomeration

1) JIRAMA's Water Supply Network

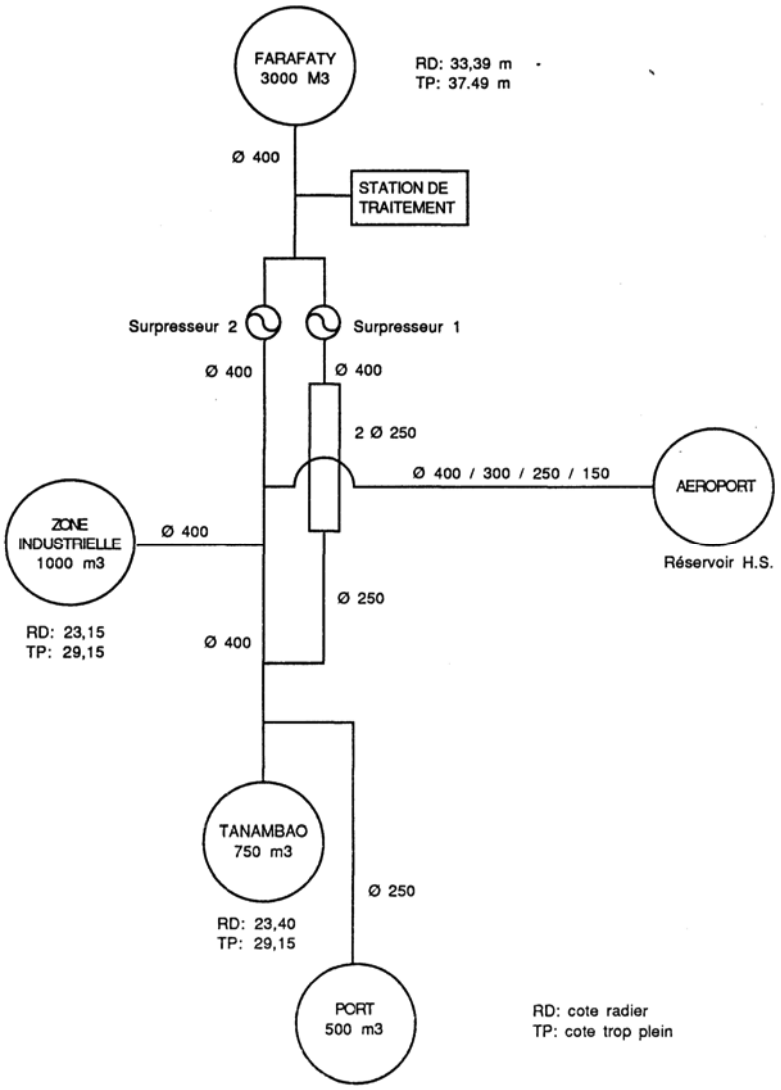
Figure 21.1.4 shows JIRAMA's water supply network in Toamasina Agglomeration. It only covers a part of Toamaisna Urban Commune (CUT) and very small part of Toamaisna Suburban Commune. There is only one water treatment plant (WTP) for Toamasina Agglomeration's water supply, which is located at Farafaty in Toamasina Suburban Commune. Toamasina Suburban Commune has only nine BF (public connection), while Toamasina Urban Commune has 357 BF. Other three communes of Toamasina Agglomeration, Antezambaro, Fanandrana and Amboditandroroho, do not have JIRAMA's network.



Source: JICA Study Team based on data from JIRAMA

Figure 21.1.4 JIRAMA's Water Network and Facilities in Toamasina Agglomeration

Figure 21.1.5 shows the connection diagram of water supply network in Toamasina Agglomeration. From Farafaty WTP, two booster pumps transmit water to reservoirs in the town.



Source: Feasibility study on water resources mobilisation from Ivoloina River, JIRAMA, 2013

Figure 21.1.5 Connection Diagram of Water Network in Toamasina Town

Total length of pipelines of JIRAMA's network is approximately 156 km. The types of pipe and their diameters are as follows:

- PVC – 63, 75, 90, 110, 125, 160, 200mm
- Steel- 60, 100, 200, 400 mm
- Galvanized Steel – 60 mm
- Gray Cast Iron – 60, 80, 100, 125, 150, 200, 250, 300mm
- Ductile – 60, 100, 150, 200, 250, 300, 400 mm

Table 21.1.2 shows length of pipelines by pipe type and diameter. PVC pipes are longest (53.4 % of total length) and gray cast iron pipes are the second longest (29.2 %). JIRAMA intends to replace old pipes with PVC pipes.

Table 21.1.2 Length of Pipelines by Pipe Type and Diameter in Toamasina Town

Nominal Diameter (mm)	Pipe Type					Total
	Steel	Gray Cast Iron	Ductile Cast Iron	Galvanized Steel	PVC	
60	435	8,062	640	767		9,904
63					42,133	42,133
75					12,990	12,990
80		743				743
90					3,025	3,025
100	210	5,720	1,691			7,621
110					5,564	5,564
125		4,170			3,768	7,938
150		7,530	4,942			12,472
160					7,390	7,390
200	5,239	3,361	3,644		8,667	20,911
250		14,887	3,270			18,157
300		1,178	2,155			3,333
400	53		4,127			4,180
Total	5,937	45,651	20,469	767	83,537	156,361
Ratio	3.8%	29.2%	13.1%	0.5%	53.4%	100.0%

Source: JIRAMA

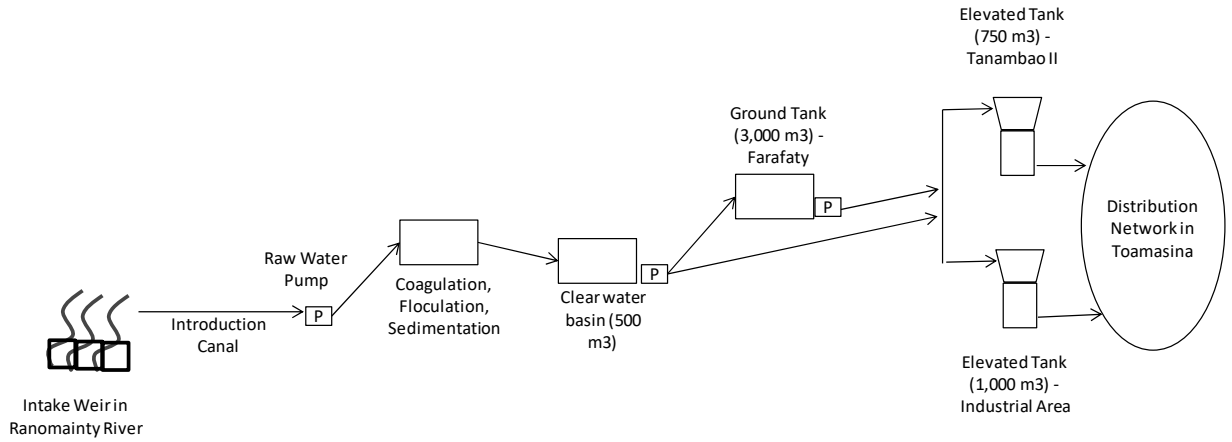
2) Water Treatment Plant

The only water treatment plant (WTP), Farafaty WTP was constructed in 1929. The water from intake weir located at the distance of 100 m from WTP in the Ranomainty River is introduced to the WTP. Treatment capacity is 300m^3/h and operating hours are 24 hours/day.

The water capacity of reservoir for Farafaty WTP is 3,000 m^3. In CUT, there are two water tanks, one is in Tanambao II (750 m^3, constructed in 1928) and another is in the industrial area (1,000 m^3). See Figure 21.1.4 for locations of WTP and two reservoirs in CUT.

Figure 21.1.6 shows concept diagram of treatment and transmission system. Water is taken from the Ranomainty River through introduction canal from the point before intake weir. At the end of the introduction canal, raw water is pumped up to water treatment units.

Daily average production of Farafaty WTP is approximately 17 thousand m^3 in 2016 (see Figure 21.1.6).



Source: JICA Study Team based on site visit at Farafaty WTP (2016) and JIRAMA's feasibility report on water mobilization from Ivoiloina River (2013)

Figure 21.1.6 Concept Diagram of Farafaty WTP

Figure 21.1.7 shows pictures of Farafaty WTP and two reservoirs in CUT.

Reservoir (750m^3) in Tanambao II

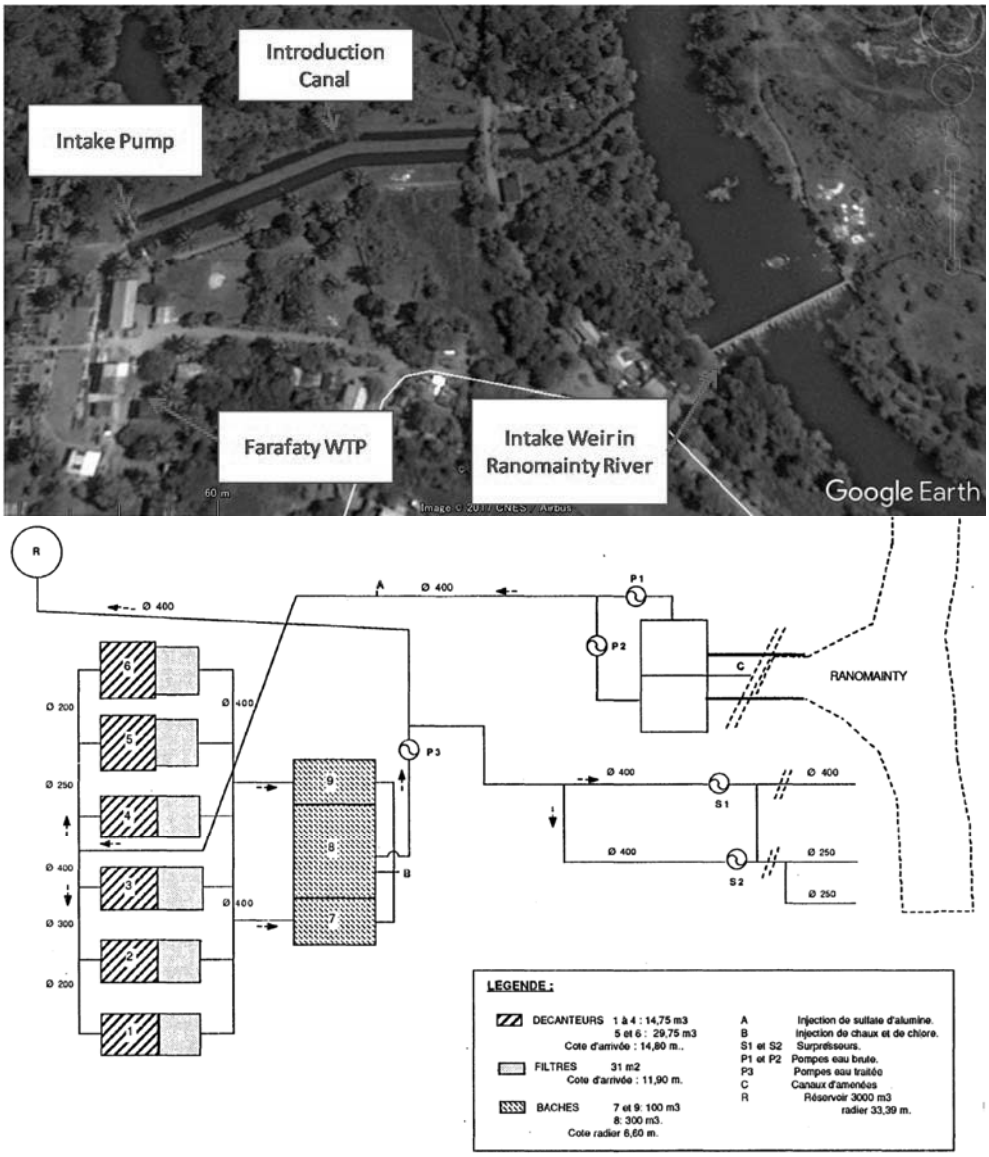
Intake Weir at Ranomainty River

Reservoir (1,000 m^3) in Industrial Area

Water Treatment Unit at Farafaty WTP

Figure 21.1.7 Pictures of JIRAMA's Water Facilities in Toamasina City

Figure 21.1.8 shows a layout of Farafaty WTP. Farafaty WTP has six water treatment units of rapid filtering system three of six filters are of simple layer type and others are of double layer type. Daily production capacity is 16 thousand m^3. There are four transmission pumps, of which one is of 600 m^3/h and other three are of 250m^3/h. Treated water is pumped from a clear water basin of 500 m^3 to reservoirs.



Source: Site visit at Farafaty WTP (2016) and JIRAMA's feasibility report on water mobilization from Ivoloina River (2013)

Figure 21.1.8 Layout of Farafaty WTP in Toamasina Agglomeration

3) Water Supply Infrastructures

Figure 21.1.9 shows the concept diagramme of private connections (BP: *branchement particulier*) of JIRAMA. Upon the acceptance of the request from the subscriber, JIRAMA will install a connection pipe between the water network and water meter. The pipes from the water meter to a household shall be installed by the subscriber. A private connection shall include connection pipe and water meter. They will be property of the subscriber during the five years from the installation, after that they will become property of JIRAMA. JIRAMA shall be responsible for the maintenance of private connections after the installation.

Number of subscribers of BP (particular connections) in Toamasina Agglomeration is 9,876 in 2015. Though JIRAMA receives approximately 60 requests of new connections each month (700 / year), actual work completed is 200 to 300 / year. JIRAMA recognizes two reasons for this delay: 1) Limited production capacity (17.5 to 19 thousand m^3 /day) and 2) Insufficient materials for new connection.

JIRAMA shall ensure minimum 0.5 bar of pressure at each particular connection. However, especially for peripheral areas, this actual pressure is less than 0.5 bars, according to JIRAMA's record of pressure measurement.

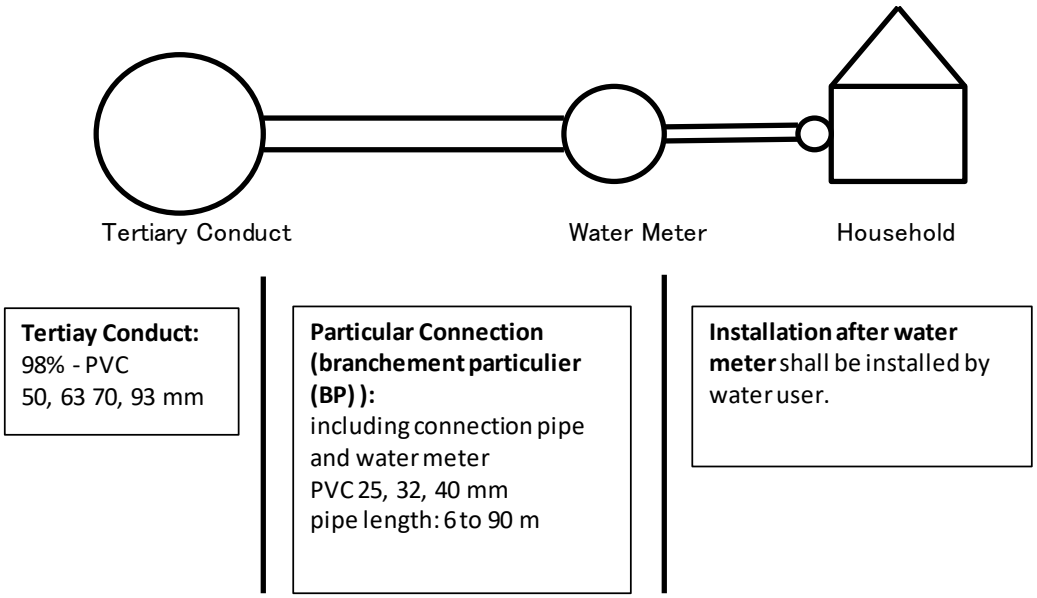


Figure 21.1.9 Conceptual Diagram of Private Connection (BP) of JIRAMA

There are two types of water kiosk, of which public water kiosk and private water kiosk. Public water kiosk is managed by communes and private one is managed by private water associations. The water association is responsible for the infrastructure and collecting water fee. The water association has a water connection contract with JIRAMA and make monthly payments for the invoice of JIRAMA. The number of public water kiosk in Toamasina in 2016 is 12, while that of private is 371. Due to the difficulties on management of public water kiosk, JIRAMA plans to decrease the number of public water kiosk to zero by 2020.

Among 357 BF (Public Stand Pipe) of JIRAMA in CUT and Toamasina Suburban Commune, there are 20 washing blocks.

Table 21.1.3 shows situation of water supply operation in two BF shown in Figure 21.1.10. Principally, the operation system and water fee is not much different from those in Antananarivo.

Table 21.1.3 Water Supply Operation of Two BF in Toamasina Suburban Commune and Toamasina Urban Commune

BF	Commune	Operation Hours	Numer of Users	Water Consumption	Water Fee
BF1	Toamasina Suburban Commune.	6 :30 to 19 :00	600 to 700 persons / day	60 to 80 m^3 / month	100 ariary / 20 L
BF2	Toamasina Urban Commune	-	200 persons / day	-	100 ariary / 20 L

Source: JIRMA

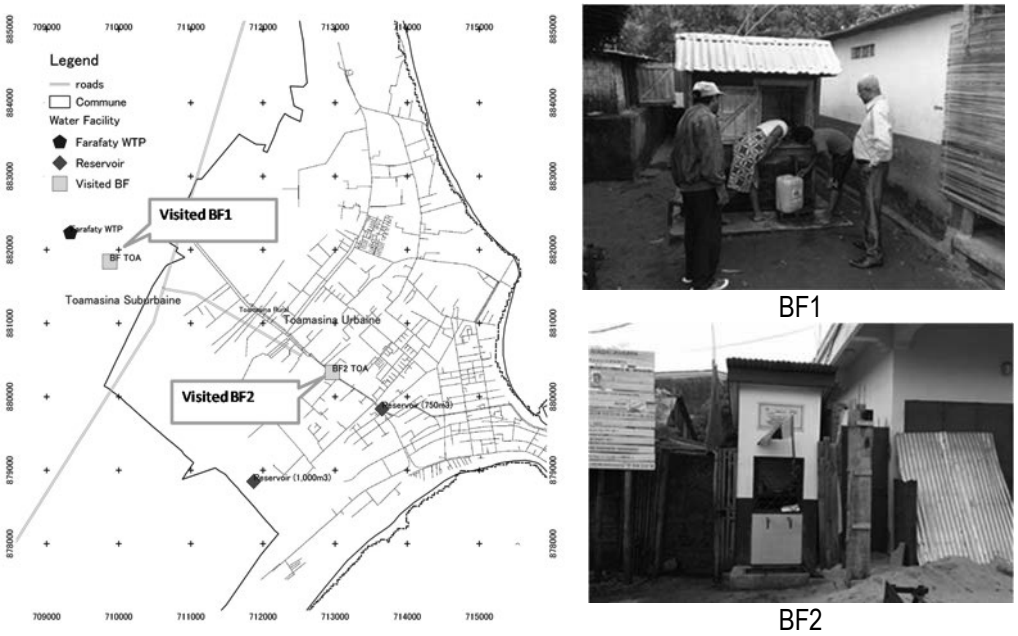


Figure 21.1.10 Location of Two BFs in Toamasina Agglomeration

4) Water Supply Facilities in Toamasina Urban Commune (CUT)

JIRAMA partly covers the water supply in CUT. It takes very long time before the request of the extension of water infrastructure using communal tax which is included in water fee collected by JIRAMA, is implemented by JIRAMA, due to their financial capacities. The request of water infrastructures in 2012 has not yet been implemented. Therefore, the access rate to drinking rate is low in CUT. In addition, JIRAMA at the regional office also has no power of decision making.

The commune, together with fokontany is trying to improve water supply situation by using several financial options, a distinct progress has not been yet achieved.

In the areas without access to JIRAMA's network, commune and fokontany have initiative for the development of infrastructures. In such fokontany, they are currently waiting for funding from Ambatovy. However, government's contribution has not yet disbursed.

5) Water Supply Facilities in Toamasina Suburban Commune

The commune conducted inventory survey of water supply infrastructures to grasp the water situation in the commune to be reflected in a communal development plan (PCD: Plan Communal de Développement) which is under preparation. Table 21.1.4 shows the inventory results of the inventory.

JIRAMA's network covers only a small part of the commune and there are only few numbers of other types of independent water supply system such as water FPMH (*Forage a pompe a motricite humaine*) or small gravity water supply system. Some people use vacuum type shallow well pump which are concerned of water quality.

Based on the results of the inventory, future water supply development plan in the commune will be described in PCD. However, the time of the completion and approval of this plan remains to be seen.

Table 21.1.4 Results of Water Supply Infrastructure Inventory by Toamasina Suburban Commune

Fokontany	Existing Infrastructure	Number	Public/Private	State
Ambalamanasy	Vacuum Pump Water Tap of JIRAMA	04 None	Public Public payment	Functioning
Ambodimandresy	BF	03		Not Functioning
Ambodisaina	FPMH Water Tap of JIRAMA	01 '02 water points	Public Public payment	Functioning
Ampangarinantelo	BF	03	For school	1 Functioning
Ampasimazava	Water Tower	01	-	Not Functioning
Ampihaonana Vohitrambato	BF Manual Pump Pump Station	03 05 01	Public Public Public	Functioning Functioning Not Functioning
Ranomena	BF	07	-	Functioning
Sahandahatra	Vacuum Pump Water Tower	01 01	Public For school	Not Functioning
Tanandava	FPMH Water Tower BP	03 01 None	Public For school Particular Payment	01 Functioning Not Functioning Functioning
Anjahamarina	None	0	-	-
Antseanambe	None	0	-	-
Vohibolo	None	0	-	-

BF: Public Connection, BP: Particular Connection, FPMH: Deep Well with Human Motorized Pump
Source: Toamasina Suburban Commune

6) Water Supply Facilities in Amboditandroroho Commune

Only Tani Pumps exist as water supply facilities in Amboditandroroho Commune. There are 70 Tani Pumps constructed with the support from Ambatovy Project in 2016 and 2017. The goal of the commune is to construct 50 Tani Pumps per year. One set of Tani Pump costs 300,000 ariary and installation fee is 50,000 ariary. The commune wishes to have JIRAMA's connections in the future.

7) Water Supply Facilities in Antetezambaro Commune

The commune is composed of 13 fokontany and the commune office is situated in Antetezambaro Fokontany which is the only fokontany having a piped water supply scheme with seven stand pipes (BF) and one private connection (BP: *Branchement Particulier*) for the commune office. In other 12 fokontany, people use water from rivers.

Since Antetezambaro Fokontany is the only commune with access to appropriate drinking water, the commune wishes to have additional piped water supply scheme for other fokontany.

Figure 21.1.11 Stand Pipe of Antetezambaro

8) Water Supply Facilities in Fanandrana Commune

The commune office is situated in Fadranana Fokontany. The major water supply facilities in Fanandrana Commune are shallow wells with hand pump. There are 40 hand pumps in the commune. Tani Pumps are not applicable due to the hard lateritic soil in this area.

There is one piped water supply scheme in Ambodibonara Fokontany, of which water source is taken from the spring on a hill, having filter and reservoir of $7m^3$ and distribute water of $6m^3$/ day to 12 public stand pipes (BF). The private user pay 2,000 ariary/month and a college pay 10,000 ariary/month. One water technician is employed for the maintenance and water fee collection of the scheme. Figure 21.1.12 shows pictures of this water supply scheme.

The commune wishes to construct other gravity water supply schemes for other fokontany. The request was sent to JIRAMA in 2004. However, it was not accepted due to its cost.

Intake Weir

Filter and Reservoir

Public Stand Pipe

Figure 21.1.12 Gravity Piped Water Supply Scheme in Ambodibonara Fokontany

(4) JIRAMA's Water Production and Consumption

1) Water Production

Table 21.1.5 shows the evolution of JIRAMA's water supply in Toamasina Agglomeration between 2012 and 2016. Yearly gross production was decreased between 2012 and 2016 by 1%. Non-revenue ratio slightly decreased from 36% to 35% and the number of subscribers was increased by 13% from 9,832 to 11,087.

Table 21.1.5 Water Supply in Toamasina Agglomeration by JIRAMA (2012-2016)

Item	Year					Increasing Ratio between 2012 and 2016
	2012	2013	2014	2015	2016	
Gross production (1,000 m^3 / year)	6,260	6,702	7,473	6,979	6,225	99%
Average Gross production (m^3 / day)	17,150	18,360	20,474	19,120	17,055	99%
Net production (1,000 m^3 / year)	5,850	6,336	6,979	6,578	5,731	98%
Average Net production (m^3 / day)	16,027	17,360	19,121	18,023	15,702	98%
Sold (1,000 m^3 / year)	3,991	3,856	4,211	3,973	4,053	102%
Subscriber	9,832	10,263	10,514	10,717	11,087	113%
Revenu (million Ariary / year)	3,497	3,696	3,820	3,519	3,846	110%
Revenue Ratio	64%	58%	56%	57%	65%	102%
Non-Revenue Ratio	36%	42%	44%	43%	35%	96%
Average Price (Ariary / m^3)	876	958	907	886	949	108%

Source: Statistics of JIRAMA, 2017

2) Amount of Water Consumption

Table 21.1.6 shows the number of subscribers of JIRAMA in Toamasina Agglomeration by category as of December 2016. The largest majority of subscribers are of particular connection (BP) which occupies 91.6 %. The second largest category is water kiosk. However, it is only 3.3%. Other categories are not distinct, those are less than 2%. This structure of number of subscriber is not much different comparing to that of Antananarivo.

Table 21.1.6 Number of JIRAMA's Subscribers in Toamasina Agglomeration by Category (2016)

Code	Category	Subscribers	
		No.	Ratio
03	JIRAMA agent (Active)	175	1.6%
04	JIRAMA agent (Retired)	78	0.7%
06	Internal consumption transfer	19	0.2%
50	Small Private Connection (BP)	10,322	91.6%
55	Gross Private Connection (BP)	13	0.1%
	Sub-Total BP	**10,335**	**91.7%**
52	Private water kiosk (BF)	372	3.3%
71	Public water kiosk (BF)	12	0.1%
	Sub-Total BF	**384**	**3.4%**
08	Electricity activity transfer	1	0.0%
60	Administration small user	137	1.2%
65	Administration gross user	14	0.1%
70	Communal service	106	0.9%
72	Other Installation	22	0.2%
Total		**11,271**	**100.0%**

Note*: Small private connection (BP): Not more than 1,000 m3 of consumption per month
Gross private connection (BP): More than 1,000 m3 of consumption per month
Private kiosk (BF): Water kiosk managed by user's associations
Public water kiosk (BF): Water kiosk managed by communes
Small administration user: Not more than 1,000m3 of consumption per month
Gross administration user: More than 1,000 m3 of consumption per month

Source: JIRAMA, 2016

Table 21.1.7 shows daily average consumption of JIRAMA's subscribers in Toamasina Agglomeration by category as of December 2016. The first largest category is particular connection which occupies 73.5% of total daily average consumption. The second is water kiosk whose daily average consumption is 8.2% of total consumption. There is not significant different in structures comparing with consumption of Antananarivo.

Table 21.1.7 Daily Average Consumption of JIRAMA's Subscribers in Toamasina Agglomeration by Category (2016)

Code	Category	Average Daily Consumption	
		m^3/day	Ratio
03	JIRAMA agent (Active)	169	1.5%
04	JIRAMA agent (Retired)	126	1.1%
06	Internal consumption transfer	139	1.3%
50	Particular small user (BP)	8,117	73.5%
55	Particular gross user (BP)	171	1.5%
	Sub-Total BP	**8,288**	**75.0%**
52	Private water kiosk (BF)	808	7.3%
71	Public water kiosk (BF)	102	0.9%
	Sub-Total BF	**910**	**8.2%**
08	Electricity activity transfer	0	0.0%
60	Administration small user	506	4.6%
65	Administration gross user	538	4.9%
70	Communal service	232	2.1%
72	Other Installation	136	1.2%
Total		**11,044**	**100.0%**

Source: JIRAMA's statistics 2016

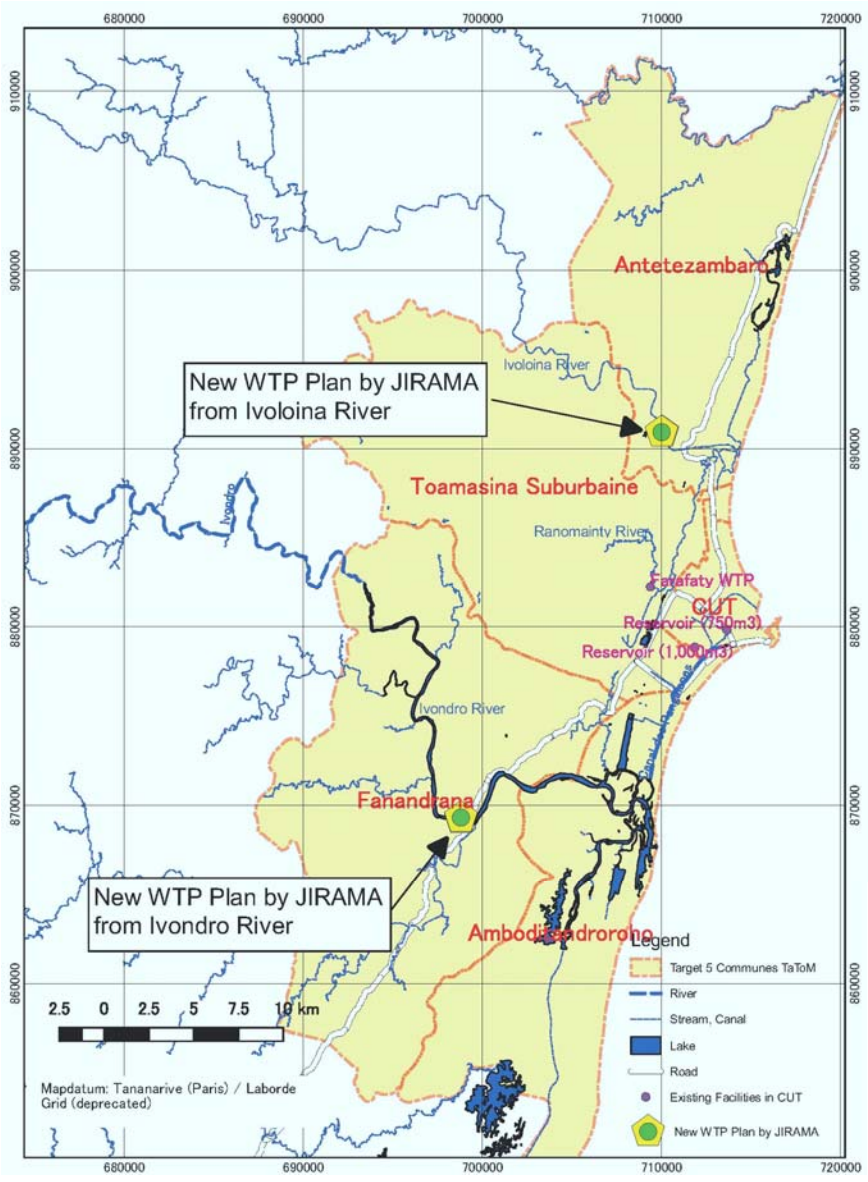
3) Non-Revenue Water

Non-revenue ratio in 2016 was 35%, of which commercial loss is 10% and technical loss (mainly from primary conduct) is 20%. JIRAMA's interregional directorate in Toamasina does not have special team for the activities of non-revenue water reduction.

(5) Existing Project for Water Supply

JIRAMA is implementing reinforcement of Farafaty WTP intending to increase the production capacity from 19,000 m^3/day in 2015 to 32,000 m^3/day. 32,000 m^3/day is equivalent to maximum intake capacity of Ranomainty River which was estimated by a hydrogeological study of an international consultant[2].

JIRAMA has a plan of construction of new water treatment plants by taking water from Ivoiloina River and Ivondro River. Figure 21.1.13 shows provisional locations of these plants. JIRAMA conducted a preliminary survey for this project and prepared a project sheet in 2018. According to this project sheet, JIRAMA's current plan is to construct two of new water treatment plant of which production capacity is 15,000 m^3/day respectively (30,000 m^3/day in total).



Source: JICA Study Team

Figure 21.1.13 JIRAMA's Plan of New WTP from Ivoloina River and Ivondro River

The WTP project for Ivoloina River is planned to include the following:

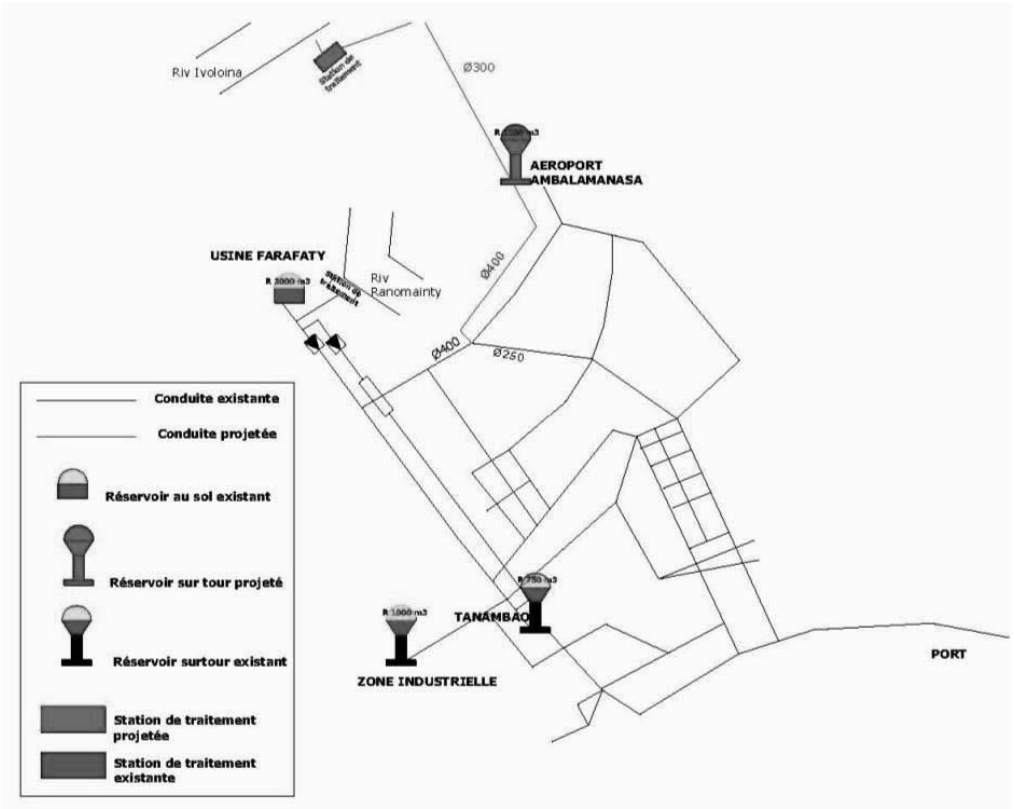
- Intake facilities from Ivoloina River,

[2] Feasibility study on water resources mobilisation from Ivoloina River, JIRAMA, 2013

- Aqueduct pipelines to new water treatment plan,
- New water treatment plant, 350m^3/h hourly maximum,
- Power supply facilities,
- New elevated reservoir 1,200 m^3, 20 mH near the airport,
- Conduit pipelines 300 mm and 400 mm to be connected to existing conduits.

The project are planned to be divided into two phases.

Figure 21.1.14 shows a concept plan of the project of water mobilization from Ivoiloina River.



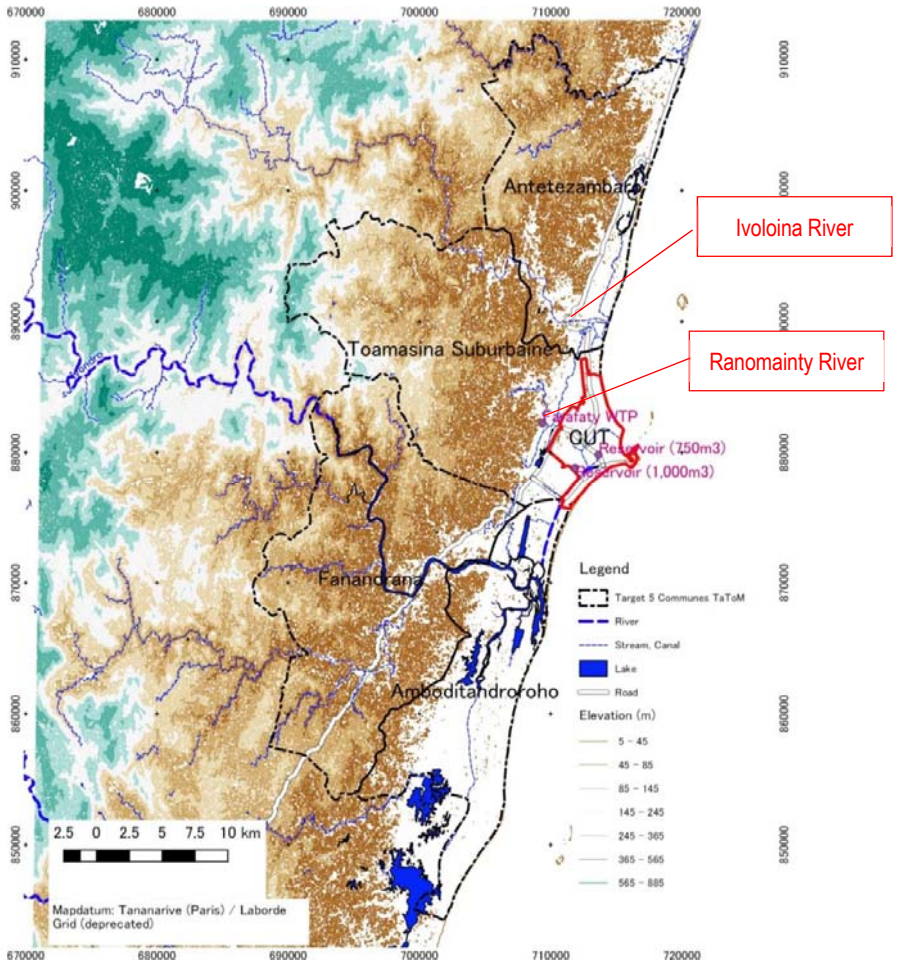
Source: Feasibility study on water resources mobilisation from Ivoloina River, JIRAMA, 2013

Figure 21.1.14 Concept Plan of New Water Supply Facility for Toamasina Agglomeration by JIRAMA

21.1.2 Future Demand Forecast for Water Supply of Toamasina Agglomeration

(1) Expansion of Water Supply Areas

Current water supply areas of JIRAMA in Toamasina Agglomeration is only CUT and a small part of Toamasina Suburban Commune. In consideration of rapid urbanization and population growth of Toamasina Agglomeration, Water supply areas of JIRAMA shall be expanded to all the five target communes of TaToM.



Source: ASTGTM2 S18E049 and S19E049

Figure 21.1.15 Target Communes of TaToM in Toamasina Agglomeration

(2) Population Projection

Table 21.1.8 shows JIRAMA's projection of population, served population and coverage rate in JIRAMA's water supply areas until 2033, which was estimated based on the operation results between 2007 and 2015.

Table 21.1.8 Population and Coverage Projection of Toamasina Agglomeration until 2033 by JIRAMA

Year	2007	2010	2015	2025	2033
Population	251,066	282,709	342,567	492,680	656,110
Served Population	97,283	110,402	153,980	234,936	299,848
Coverage Rate (%)	38.7%	39.1%	44.9%	47.7%	45.7%

Source: JIRAMA's statistics 2016
Note) Served population and coverage rate of 2007, 2010 and 2015 are from results of operations while those of 2015 and 2033 are projection.

Meanwhile, Table 21.1.9 shows population projection of Toamasina Agglomeration by TaToM Project until 2033. Projected population of 2033 is 763 thousand which includes five communes of Toamasina Agglomeration.

Table 21.1.9 Population Projection of Toamasina Agglomeration until 2033 by TaToM

Year	1993	2018	2023	2028	2033
Population	165,464	437,004	520,991	626,861	762,839

Source: JICA Study Team

(3) Demand Projection

1) JIRAMA's Projection

JIRAMA estimated the following unit as a basic parameters for the estimation of future demand in Toamasina Agglomeration:

- For particular connection
- Number of persons / 7 persons
- Consumption / person/day: 100 L/person/day
- For water kiosk
- Number of persons / kiosk: 240 persons/kiosk
- Consumption / person/day: 7L/person/day

According to JIRAMA's estimation, JIRAMA's objectives in the horizon 2033 are as the followings:

- Population of water supply area: 656,110 persons
- Served population: 299,848 persons (45.7 % of coverage rate)

Table 21.1.10 shows the summary of the above-mentioned demand projection of JIRAMA until 2033 based on the following scenario.

Served Population and Number of Subscribers

- Population is projected from the value of INSTAT 1993. Served Population is for JIRAMA's water supply area only,
- Coverage rate is calculated by (Served Population / Population of Water Supply Area). JIRAMA plans to increase coverage rate from 44.9% in 2015 to 45.7% in 2033,
- Domestic water will be supplied to the population by means of small particular connections (BP) and water kiosk (BF). JIRAMA's plan in 2033 is to supply 36.3% of served population by BP and 63.7% by BF,
- Numbers of subscribers of small BP and BF in 2015 occupies 94.8% of entire subscribers. It will be 95.3% in 2033,
- Number of public water kiosk will be disappeared by 2020. Number of private water kiosk will be increased from 337 in 2015 to 796 in 2033.

- Daily Consumption and Production
  - Percentage of domestic use (BP + BF) will be increased from 75.6% in 2015 to 77.5% in 2033,
  - Gross private use will be increased from 525 m^3/day in 2015 to 653 m^3/day in 2033,
  - Other consumptions will be increased from 722 m^3/day in 2015 to 732 m^3/day in 2033,
  - Total sold (revenue water) will be increased from 10,885 m^3/day in 2015 to 17,046 m^3/day in 2033,
  - Revenue ratio will be increased from 60.4 % in 2015 to 75.0 % in 2033,
  - Daily average production will be increased from 23,450 m^3/day in 2015 to 33,179 m^3/day in 2033.

Table 21.1.10 Summary JIRAMA's Demand Projection of Toamasina Agglomeration until 2033

Item	Operation Results						Demand Projection			
	2007		2010		2015		2025		2033	
	Value	Ratio	Value	Ratio	Value	Ratio	Value	Ratio	Value	Ratio
Population and Coverage Rate										
Population (Instat)	251,066		282,709		342,567		492,680		656,110	
Served Populatoin	97,283		110,402		153,980		234,936		299,848	
Coverage Rate	38.7%		39.1%		44.9%		47.7%		45.7%	
By BP	53,123	54.6%	58,562	53.0%	70,700	45.9%	91,896	39.1%	108,808	36.3%
By BF	44,160	45.4%	51,840	47.0%	83,280	54.1%	143,040	60.9%	191,040	63.7%
Unit Consumption										
BP (L/day/person)	101		103		110		109		109	
BF (L/day/person)	9		9		8		8		8	
Person / BP	7		7		7		7		7	
person / BF	240		240		240		240		240	
Subscrivers	8,286	100.0%	9,058	100.0%	10,717	100.0%	14,138	100.0%	16,848	100.0%
Small particular connection (BP)	7,589	**91.6%**	8,366	**92.4%**	9,862	**92.0%**	12,867	**91.0%**	15,267	**90.6%**
Water Kiosk (BF)	184	**2.2%**	216	**2.4%**	347	**3.2%**	596	**4.2%**	796	**4.7%**
Public Water Kiosk	1	0.0%	6	0.1%	10	0.1%	-	0.0%	-	0.0%
Private Water Kiosk	183	2.2%	210	2.3%	337	3.1%	596	4.2%	796	4.7%
Gross Particular Connections (BP)	23	0.3%	21	0.2%	14	0.1%	16	0.1%	19	0.1%
Other Consumptions	165	2.0%	138	1.5%	131	1.2%	138	1.0%	141	0.8%
Daily Average Consumption (m^3/day)										
Small particular connection (BP)	5,358	**55.3%**	6,010	**62.4%**	7,563	**69.5%**	9,823	**68.8%**	11,655	**68.4%**
Water Kiosk (BF)	408	**4.2%**	472	**4.9%**	666	**6.1%**	1,165	**8.2%**	1,555	**9.1%**
Public Water Kiosk	6	0.1%	10	0.1%	76	0.7%	-	0.0%	-	0.0%
Private Water Kiosk	402	4.2%	463	4.8%	590	5.4%	1,165	8.2%	1,555	9.1%
Gross Particular Connections (BP)	1,208	12.5%	374	3.9%	525	4.8%	560	3.9%	653	3.8%
Other Consumptions	893	9.2%	735	7.6%	722	6.6%	718	5.0%	731	4.3%
Total Sold (m^3/day)	9,688	100.0%	9,634	100.0%	10,885	100.0%	14,269	100.0%	17,046	100.0%
Daily Production (m^3/day)	9,688		9,634		10,885		14,269		17,046	
Daily Maximum Production (m^3/day)	16,985		18,215		23,450		28,352		33,179	
Daily Average Production (m^3/day)	14,223		15,446		18,023		19,421		22,728	
Revenu Ratio (%)	68.1		62.4		60.4		73.5		75.0	

Source: JIRAMA's demand projection until 2045

2) TaToM's Demand Projection for 2033

Water demand in 2033 is projected for five communes of Toamasina Agglomeration. Table 21.1.11 shows the demand projection for 2033 by TaToM. The average daily production was calculated to be 109 thousand m^3/day, in which revenue water was to be 97 thousand m^3/day.

Table 21.1.11 TaToM's Demand Projection for Toamasina Agglomeration in 2033

Unit Consumption

BP (L/day/person)	103	Gross BP (m3/day/no.)	25		
BF (L/day/person)	25	Other Consumption (m3/day/no.)	4		
Person / BP	8.2	Peak Factor	1.12		
person / BF	240				

		2018		2023		2028		2033	
		Value	Ratio	Value	Ratio	Value	Ratio	Value	Ratio
Population and Coverage Rate	Population (TaToM Estimation)	437,004		520,991		626,861		762,839	
	Served Population	437,004		520,991		626,861		762,839	
	Coverage Rate	100.00%		100.00%		100.00%		100.00%	
	By BP	196,652	45.00%	234,446	45.00%	282,087	45.00%	343,278	45.00%
	By BF	240,352	55.00%	286,545	55.00%	344,774	55.00%	419,561	55.00%
Subscribers	Small particular connection (BP)	23,023	43.20%	27,447	43.20%	33,025	43.20%	40,189	43.20%
	Water Kiosk (BF)	961	52.80%	1,146	52.80%	1,379	52.80%	1,678	52.80%
	Public Water Kiosk								
	Private Water Kiosk	961		1,146		1,379		1,678	4.30%
	Gross Particular Connections (BP)	240	0.45%	286	0.45%	344	0.45%	419	0.45%
	Other Consumptions	1,931	3.50%	2,302	3.50%	2,770	3.50%	3,371	3.50%
	Total Subscribers	27,116	100.00%	32,328	100.00%	38,897	100.00%	47,335	100.00%
Daily Average Consumption (m3/day)	Small particular connection (BP)	19,445	49.94%	23,182	49.94%	27,893	49.94%	33,943	49.94%
	Water Kiosk (BF)	5,768	14.82%	6,877	14.82%	8,275	14.82%	10,069	14.82%
	Public Water Kiosk								
	Private Water Kiosk	5,768	14.82%	6,877	14.82%	8,275	14.82%	10,069	14.82%
	Gross Particular Connections (BP)	5,995	15.40%	7,148	15.40%	8,600	15.40%	10,466	15.40%
	Other Consumptions	7,725	19.84%	9,209	19.84%	11,081	19.84%	13,485	19.84%
	Total Sold (m3/day)	38,934	100.00%	46,416	100.00%	55,848	100.00%	67,963	100.00%
Daily Production (m3/day)	Daily Maximum Production (m3/day)	76,501		86,644		96,231		108,741	
	Daily Average Production (m3/day)	**68,305**		**77,360**		**85,921**		**97,090**	
	Revenue Ratio (%)	57.0		60.0		65.0		70.0	

Source: JICA Study Team

(4) Necessity of Water Production Capacity Reinforcement

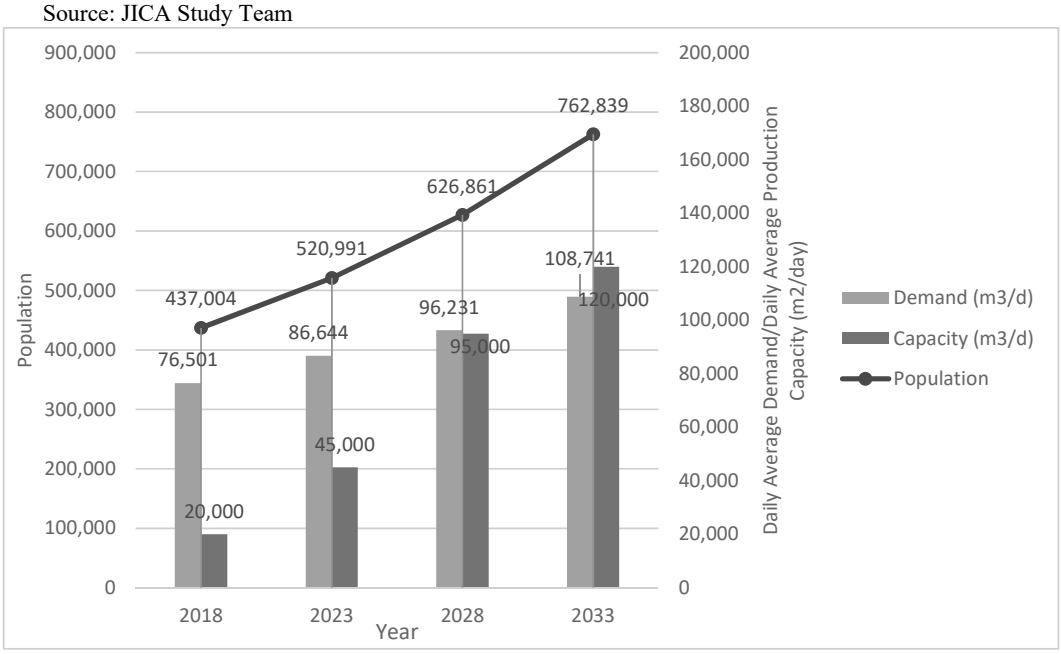
Currently there is a large gap between water demand and water production capacity of JIRAMA in Toamasina Agglomeration. This gap will continuously increase according to the rapid population increase. Therefore, phased reinforcement of water production capacity is indispensable to catch up the increase of water demand in 2033.

Table 21.1.12 and Figure 21.1.16 shows an example of water production capacity reinforcement plan by 2033. According to JIRAMA's statistics, actual water production capacity in Toamasina Agglomeration between 2014 and 2015 was 20,000 m^3/day. Therefore, deficit between actual water production capacity and demand estimation in 2033 (120 thousand m^3/day) is approximately 100,000 m^3/day.

Table 21.1.12 Water Production Capacity Reinforcement Plan by 2033

Year	2018	2023	2028	2033
Population	437,004	520,991	626,861	762,839
Demand (m3/d)	76,501	86,644	96,231	108,741
Capacity (m3/d)	20,000	45,000	95,000	120,000
Construction of New WTP from Ivoloina river		25,000	25,000	
Construction of New WTP from Ivondro river			25,000	25,000

Source: JICA Study Team



Source: JICA Study Team

Figure 21.1.16 Water Production Capacity Reinforcement Plan by 2033

21.1.3 Issues on Water Supply of Toamasina Agglomeration

Issues on water supply of Toamasina Agglomeration are summarized as the followings:

(1) Water Supply Areas and Supply Population

- JIRAMA's water supply area is limited to only a part of the Toamasina Agglomeration. It shall cover all the area of five target communes of TaToM,
- There is a certain gap between the JIRAMA's population projection of JIRAMA's water supply area in Toamasina Agglomeration in 2033 (0.656 million persons) and that of the provisional estimation of TaToM (0.763 million persons). JIRAMA's water supply plan shall be revised based on the TaToM's estimation, as well as water supply target areas.

(2) Water Supply Coverage

- Access rate to urban water supply in JIRAMA's water supply area in 2015 is only 44.9% with 0.154 million of served population to 0.343 million of total population. Served population in 2033 projection by JIRAMA is 0.300 million, which is calculated to be 39.3% to 0.763 million of provisional population projection in 2033 by TaToM.
- There are two types of domestic water supply, one of which is small private connection (BP) and another is water kiosk (BF). Served population in 2015 is 0.070 million by BP (45.9% to total) and 0.083 million by BF (54.1% to total). Numbers of BP and BF are insufficient to cover the population of Toamasina Agglomeration in 2033 and numbers of BP and BF shall be increased to meet the growing demand until 2033.

- Number of subscribers of gross particular connections (more than 1,000 m^3/month of consumption) is 14 (0.1% to total) in 2015 and their daily average consumption is 525 m^3/day (4.8 % to total). Considering the rapid urbanization of Toamasina Agglomeration, increase of number of subscribers and daily consumption shall be considered for the horizon 2033.
- Number of subscribers other consumption (small administration user, gross administration user, communal service and other installation) in 2015 is 131 (1.2% to total) and their daily average consumption is 727 m^3/day (6.6 % to total). Considering the future infrastructure development according to rapid urbanization of Toamasina Agglomeration, increase of number of subscribers and daily consumption shall be considered for the horizon 2033. In addition, activities for reduction of waste water use and delay of payment by administrative organization shall be promoted.

(3) Water Production and Water Resources

- There is a large gap between the daily average production in 2033 by JIRAMA (0.023 million m^3/day) and that of provisional projection by TaToM (0.109 million m^3/day).
- Daily average production by JIRAMA in Toamasina Agglomeration in 2014 is 0.020 million m^3/day total of which are produced in Farafaty station.
- JIRAMA is trying to increase the production capacity by future projects of new production station taking water from Ivoloina River and Ivondro River. If these projects are completed, water production capacity will be increased up to 0.050 million m^3/day. However, there is still deficit of production capacity for the demand in 2033 estimated by TaToM. Drinking water resources to be further developed to meet the demand in 2033 remains to be clarified.
- Increase of planned capacity of new water treatment plants from Ivoloina River and Ivondro River shall be planned in order to cover the areas of northern, western and southern sides of CUT based on the population distribution in 2033 to be projected by TaToM. However, in order to meet the demand in 2033 (120,000 m^3/day), the plan for the new water treatment plants shall be revised into that each plant shall be of capacity of 50,000 m^3/day as shown in Table 21.1.12 and Figure 21.1.16.

(4) Water Supply Operation Management

- Existing pipelines of JIRAMA is aged and non-revenue water ratio is as high as 43% in 2015.
- Due to the aging of pipes and under dimension of facilities, pressure at the connection is below 0.1 MPa in many locations.
- Recently, annual net income of JIRAMA (including both energy and water sectors) have been negative every year and accumulated losses are increasing. An appropriate financial model for water supply operation by JIRAMA shall be introduced and increase of water tariff shall be considered to secure the budget of water supply facilities development under the concession contract between Madagascar government and JIRAMA.

(5) Reinforcement and New Construction of Water Supply Facilities

- JIRAMA's water supply network cover only a part of Toamasina Agglomeration.
- Numbers of water supply facilities such as pipelines, reservoirs and pump stations are insufficient and under dimensions. Master plan of facility renewal and new construction shall be formulated to fulfill the demand in the horizon 2033.

21.1.4 Objectives for Water Supply of Toamasina Agglomeration

The objectives of the water supply of Toamasina Agglomeration are summarized as the followings:

(1) Water Supply Areas and Supply Population

- Water supply areas shall be five target communes of TaToM.
- All population in 2033 shall be covered by JIRAMA's network by 2033. Population projection in 2033 by TaToM is 0.763 million persons.

(2) Water Supply Coverage

- Access rate to JIRAMA's water supply shall be 100 % in 2033.
- Domestic water shall be supplied by measures of small private connection (BP) and water kiosk (BF). The ratio and served population of each type in 2033 are as follows:
- BP – 0.343 million (45.0%), BF – 0.419 million (55.0%)
- Daily average demand and its ratio to total demand of gross particular connection shall be 0.011 million m^3/day (14.8%) in 2033.
- Daily average demand and its ratio to total demand of other consumption (small administration user, gross administration user, communal service and other installation) shall be 0.013 million m^3/day (19.8%) in 2033.

(3) Water Production and Water Resources

- Construction of new water treatments plants from Ivoloina River and Ivondro River shall be planned and implemented, so as to realize additional production of 100,000 m^3/day.

(4) Water Supply Operation Management

- Revenue Ratio shall be increased to 70%, by measures against technical losses and commercial losses, and renewal of pipelines.
- GIS based hydraulic model shall be introduced, for the purpose to improve pressure management and asset management.
- Financial model for water supply operation shall be introduced to JIRAMA. The annual net income of water supply sector shall become positive by 2023.

(5) Reinforcement and New Construction of Water Supply Facilities

- Renewal and new construction plan of pipelines, reservoirs, pump stations, particular connections and water kiosks shall be formulated.

21.1.5 Strategies for Water Supply of Toamasina Agglomeration

(1) Water Supply Areas and Supply Population

- Divisions of water supply areas shall be determined after the finalization of population projection of TaToM.

(2) Water Supply Coverage

- Promotion of renewal of existing network and new construction of facilities where currently JIRAMA's networks do not exist and/or exist but insufficiently is principal activities to achieve objective in water supply coverage. Appropriate hydraulic model shall be introduced to materialize appropriate dimensioning of networks which can ensure satisfactory water supply until the horizon 2033.
- Further examination on the distribution of water uses such as domestic use, gross particular use and other consumptions shall be conducted according to the results of the examination of urban structure and population distribution in Toamasina Agglomeration by TaToM.

(3) Water Production and Water Resources

- Surface water resources study shall be conducted to clarify the intake capacity of Ivoloina River and Ivondro River.
- New construction of retention reservoir shall be planned in order to increase the intake capacity.
- Construction of new water treatments plants from Ivoloina River and Ivondro River shall be planned and implemented, so as to realize additional production of 100,000 m^3/day.

(4) Water Supply Operation Management

- Based on the current database of JIRAMA's existing facilities and operation statistics, a hydraulic model shall be developed which can simulate the actual water supply for the rehabilitation and renewal plan and also the future water supply by 2033 for an appropriate dimensioning of the facilities to be renewed and/or constructed.
- Non-revenue water reduction plan shall be formulated. Activities of reduction of non-revenue water shall be planned to achieve the target value of revenue-ratio in 2033.
- A financial model shall be developed in JIRAMA to observe and analyze the cost structure and to balance the revenue and the water supply cost. At the same time, water tariff setting shall be reexamined.

(5) Reinforcement and New Construction of Water Supply Facilities

- Dimension of primary conduits which shall cover all the area of Toamasina Agglomeration shall be designed based on the hydraulic model.
- Secondary and tertiary conduits shall be designed based on the population distribution of urban planning.
- New reservoirs shall be planned to equilibrate the fluctuation of water transmission and distribution. Total capacity of stock shall be increased to half of daily average demand.
- New relay pump stations shall be planned in each of distribution areas. Distance from the production station and difference in elevation especially in the peripheral areas of Antananarivo Agglomeration shall be considered for the hydraulic design.

21.1.6 Programmes and Projects for Water Supply of Toamasina Agglomeration

(1) Action Plan of Water Supply of Toamasina Agglomeration in the Horizon 2033

In order to achieve objects of the water supply of Toamasina Agglomeration in the horizon 2033, at first water supply master plan of Toamasina Agglomeration shall be formulated with the consideration of expanded water areas and demand projection for 2033. After that, water supply facility renewal/construction and operation management shall be conducted according the revised master plan. Table 21.1.13 shows the provisional action plan for water supply Toamasina Agglomeration until 2033.

Table 21.1.13 Provisional Action Plan of Water supply of Toamasina Agglomeration until the Horizon 2033

Item	2019-2023	2024-2028	2029-2033
(1) Formulation of Water Supply Master Plan in Toamasina Agglomeration			
- Water resources potential study (Ivondro River and Ivoloina River) - Water resources development plan - Water demand estimation - Facility rehabilitation and construction plan (intake, aqueduct, treatment, transmission, stock, distribution, supply facilities) - Business operation plan - Environment impact assessment			
(2) Construction of New Water Treatment Plants			
New Water Treatment Plant from Ivoloina River			
Design			
Construction – Phase 1 (25,000 m^3/day)			
Construction – Phase 2 (25,000 m^3/day)			
New Water Treatment Plan from Ivondro River			
Design			
Construction – Phase 1 (25,000 m^3/day)			
Construction – Phase 2 (25,000 m^3/day)			
(3) Reinforcement and New Construction of Water Supply Facilities			
Renewal of existing pipelines			
Construction of primary conduits			
Construction of secondary and tertiary conduits			
Construction of reservoirs			
Construction of relay pump stations			
(4) Water Supply Coverage			
Installation of BP and BF			
From existing networks			
From new networks			
(5) Water Supply Operation Management			
Formulating of non-revenue water reduction plan			
Development of hydraulic model			
Development of financial model			
Asset management			
Non-revenue water reduction and renewal of pipelines			

(2) Action Plan of Water Supply for Toamasina Agglomeration in 2033

The rapid increasing of the water supply in the Toamasina Agglomeration is the urgent issue. In the course of the action plan shown in Table 21.1.13, TaToM proposes the priority project to reinforce the actual production capacity in Toamasina Agglomeration, most of which have been already planned by JIRAMA and another prosed by TaToM. Table 21.1.14 shows the list of priority projects.

Table 21.1.14 Priority Projects for Water Supply in Toamasina Agglomeration

Project	Contents	Remarks
Water Supply Master Plan Formulation Project in Toamasina Agglomeration	1) Social / Water Demand Survey 2) Existing Facility Survey 3) Water Supply Operation Study 4) Water Use Survey (Potable, Irrigation and Industrial Water) 5) Water Resources Development Plan (Ivondro River and Ivoloina River) 6) Water Resources Development Plan (Ivondro River and Ivoloina River) 7) Outline Design and Cost Estimation (New Facility Construction)	The objective of this project is to formulate the water supply master plan in order to fulfil the water demand in Toamasina Agglomeration in 2033. Especially for grasp of the water resources development potential in order to make appropriate plans and designs of new water treatment plants is a quite important issue for the water supply in Toamasina Agglomeration.

Project	Contents	Remarks
	8) Outline Design and Cost Estimation (Rehabilitation of Existing Facility) 9) Construction Plan 10) Water Supply Operation Plan 11) Social Environment Assessment	
Construction of New WTP by taking water from Ivoloina River	Intake weir, intake pump, conduits, WTP, reservoir basin and transmission pump. Average production 25,000 m³/day x 2 units.	Preliminary study was conducted by JIRAMA. Waiting for feasibility study.
Construction of New WTP by taking water from Ivondro River	Intake weir, intake pump, conduits, WTP, reservoir basin and transmission pump. Average production 25,000 m³/day x 2 units.	Preliminary study was conducted by JIRAMA. Waiting for feasibility design study.

Source: JICA Study Team

Total average production of the above priority projects is 0.100 million m^3/day, which covers 100% of 0.100 m^3/day (production to be increase by the horizon 2033). At the same time of the implementation of the priority projects, concrete plan of further water resource development, extension of transmission and distribution network, reinforcement of stock facilities shall be formulated through the preparation of the water supply master plan in order to commence as soon as possible the facilities construction to fulfil the future needs.

21.1.7 Profiles of Priority Projects for Water Supply of Toamasina Agglomeration

(1) Water Supply Master Plan Formulation Project in Toamasina Agglomeration

1) Rational

TaToM estimated the population and water demand in Toamasina Agglomeration until 2033, to be 0.763 million persons and 116 thousand m^3/day respectively. However, current water production capacity by Farafaty WTP, which is the only plant for Toamasina Agglomeration, is only 20,000 m^3/day. Therefore, the gap between current production capacity and future demand until 2033 is as large as 100,000 m^3/day. In addition, JIRAMA's current network covers only a part of Toamasina urban commune and sub-urban commune. The concrete and detailed plan of development of water resources and water supply facilities shall be urgently formulated for the purpose to fulfil the needs of Toamasina Agglomeration which is rapidly growing and being urbanized.

2) Objectives

To formulate water supply master plan in Toamasina Agglomeration to meet water demand until 2033.

3) Project Description

The project shall be composed of the followings:

- 1 Water resources potential study (surface water of Ivoloina River and Ivondro River)
- 2 Water resource development plan
- 3 Water demand estimation
- 4 Facility rehabilitation and construction plan (intake, aqueduct, treatment, transmission, stock, transmission, distribution, supply facilities)
- 5 Business operation plan
- 6 Environmental impact assessment"

4) Expected Benefits

Contents of necessary projects such as 1) water resources development, 2) expansion and renovation of water transmission and distribution network, 3) construction and rehabilitation of electrical/mechanical facilities etc., will be clearly determined for the commencement of the detailed studies for the implementation and budget securing.

5) Executing Agency and Related Institutes

JIRAMA and the Ministry of Water

6) Estimated Project Cost

Euro 2.0 million (2.3 million USD)

7) Implementation Schedule

Two years

8) Necessary Actions for Implementation / Critical Factor

- JIRAMA shall start to secure the budget and to prepare for the TOR.
- Coordination with related authorities such as communes in Toamasina Agglomeration, Ministry of Water, ANDEA etc.

9) Related Plans and Projects

- Community development plans
- River improvement projects
- Drainage projects

10) Social and Environmental Impacts

Not applicable

(2) Construction of New Water Treatment Plant by Taking Water from Ivoloina River

1) Rational

TaToM estimated the population and water demand in Toamasina Agglomeration until 2033, to be 0.768 million persons and 116 thousand m^3/day respectively. However, current water production capacity by Farafaty WTP, which is an only plant for Toamasina Agglomeration, is only 20,000 m^3/day. Therefore, the gap between current production capacity and future demand until 2033 is as large as 100,000 m^3/day.

In order to meet the water demand until 2033, the above gap on water production capacity shall be fulfilled by the construction of new water intake and treatment plant. In this respect, Ivoloina River which is flowing in the north of Toamasina Agglomeration is regarded as one of major water source for the future demand and the construction of new water treatment plant taking water from Ivoloina River will greatly contribute to the reinforcement of water production capacity in Toamasina Agglomeration.

2) Objectives

Construct water intake and treatment facility at Ivoloina River to transmit and distribute drinking water to CUT and the northern part of Toamasina Agglomeration.

3) Project Description

Construction of two units of new water treatment plant each of which includes the following components:

- Intake facility from Ivoloina River
- Water treatment plant (25,000 m^3/day)
- Water tower (1,500 m^3)
- Power supply facilities
- Aqueduct and transmission pipeline

4) Expected Benefits

Water production capacity in Toamasina Agglomeration will be increased by 50,000 m^3/day. This capacity is equivalent to 42% of 120,000 m3/day of total water demand of Toamasina Agglomeration in 2033.

5) Executing Agency and Related Institutes

JIRAMA and the Ministry of Water

6) Estimated Project Cost

Euro 60 million (68 million USD)

7) Implementation Schedule

- Phase 1 (25,000 m^3/day)
  - Design – One Year
  - Construction – Two Years
- Phase 2 (25,000 m^3/day)
  - Design – One Year
  - Construction – Two Years

8) Necessary Actions for Implementation / Critical Factor

- JIRAMA shall start measurement of water level and flow of Ivoloina River.
- Coordination with related authorities such as communes in Toamasina Agglomeration, Ministry of Water, ANDEA etc.

9) Related Plans and Projects

- Community development plans
- River improvement projects
- Drainage projects

10) Social and Environmental Impacts

Normal mitigation measures should be designed.

(3) Construction of New Water Treatment Plant by Taking Water from Ivondro River

1) Rational

TaToM estimated the population and water demand in Toamasina Agglomeration until 2033, to be 0.768 million persons and 116 thousand m^3/day respectively. However, current water production capacity by Farafaty WTP, which is an only plant for Toamasina Agglomeration, is only 20,000 m3/day. Therefore, the gap between current production capacity and future demand until 2033 is as large as 100,000 m3/day.

In order to meet the water demand until 2033, the above gap on water production capacity shall be fulfilled by the construction of new water intake and treatment plant. In this respect, Ivoloina River which is flowing in the north of Toamasina Agglomeration is regarded as one of major water source for the future demand and the construction of new water treatment plant taking water from Ivondro River will greatly contribute to the reinforcement of water production capacity in Toamasina Agglomeration.

2) Objectives

Construct water intake and treatment facility at Ivondro River to transmit and distribute drinking water to CUT and the northern part of Toamasina Agglomeration.

3) Project Description

Construction of two units of new water treatment plant each of which includes the following components:

- Intake facility from Ivoloina River
- Water treatment plant (25,000 m^3/day)
- Water tower (1,500 m^3)
- Power supply facilities
- Aqueduct and transmission pipeline

4) Expected Benefits

Water production capacity in Toamasina Agglomeration will be increased by 50,000 m^3/day. This capacity is equivalent to 42% of 120,000 m^3/day of total water demand of Toamasina Agglomeration in 2033.

5) Executing Agency and Related Institutes

JIRAMA and the Ministry of Water

6) Estimated Project Cost

Euro 60 million (68 million USD)

7) Implementation Schedule

- Phase 1 (25,000 m^3/day)
  - Design – One Year
  - Construction – Two Years
- Phase 2 (25,000 m^3/day)
  - Design – One Year
  - Construction – Two Years

8) Necessary Actions for Implementation / Critical Factor

- JIRAMA shall start measurement of water level and flow of Ivondro River.
- Coordination with related authorities such as communes in Toamasina Agglomeration, Ministry of Water, ANDEA etc.

9) Related Plans and Projects

- Community development plans
- River improvement projects
- Drainage projects
- Ambatovy project
- Volobe power station

10) Social and Environmental Impacts

Normal mitigation measures should be designed.

21.2 Sewerage and Drainage System of Toamasina Agglomeration

21.2.1 Background on Sewerage and Drainage Systems of Toamasina Agglomeration

(1) Hydrological Conditions and River System

Toamasina Agglomeration is crossed by important rivers and waterways, such as Pangalanes Channel (In French: *Canal des Pangalanes*) and Ivondro River.

Even if the Pangalanes Channel was originally constructed in 1904 as a navigation way to link the lakes, lagoon, and rivers between Foulpointe in the North and Faranfangana in the South (distance of 650 km), its roles have changed due to its degradation and is now the major drainage channel, discharging rainwater to the sea during floods.

The length of Ivondro River is around 150 km and its watershed covers 3,513 km^2. It originates from the west of the Didy marshy plain and goes east. The slope is steep up to the Volobe electricity plant and then decrease to run into the sea at the south of CUT.

(2) Actual Situation of the Sewer and Drainage Systems in Toamasina Agglomeration

1) CUT and Commune Rural of Toamasina Suburbaine

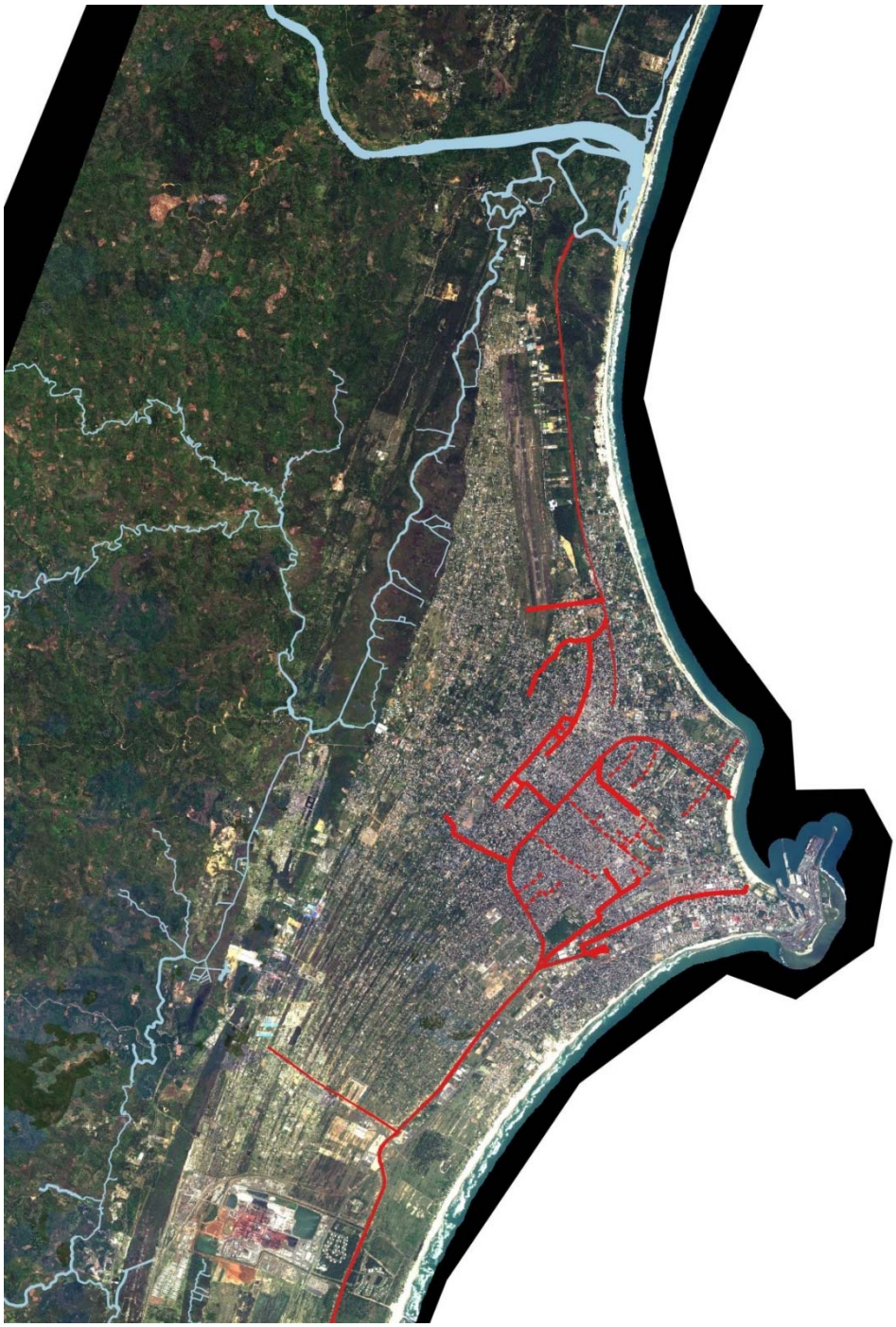
According to the results of the commune survey carried out by Project TaToM in May 2017, and based on a series of interviews to concerned organisations, only CUT and Toamasina Suburbaine Commune have sewer and drainage network to manage both rainwater and wastewater.

The major part of the drainage system was designed and established during the colonisation and extended based on the Urban Plan of 1952 (amended in 1963). This system, mainly localised in the old town central area, aims to collect both rainwater and wastewater and to spill it to the sea through Pangalanes Canal and North Canal (in French: *Canal du Nord*).

Both communes have extended their drainage networks to respond to the extension of their urban areas and rapid population growth. However, due to various restrictions (funds, human resources, materials, equipment among others), the capacity of the actual drainage system is not enough to respond to new growing needs.

2) Other Communes: Antetezambaro, Fanandrana, and Amboditandrorohoa

The other communes, namely Antetezambaro, Fanandrana and Amboditandrorohoa, only have gutters along national roads to drain rainwater and individual sanitation measures to manage excreta.



Source: JICA Study Team

Figure 21.2.1 Major Drainage Canals in CUT and Toamasina Suburbaine Commune

21.2.2 Future Demand for Sewerage and Drainage Systems of Toamasina Agglomeration

The rainwater drainage system will be the rehabilitated, improved and extended in order to minimize flooding into residential complexes and industrial zones. Regarding wastewater, the ratio of volume managed is low, only a portion in CUT is collected, and most of the wastewater. Therefore, a gradual improvement of both rainwater and wastewater management will be needed in order to respond to the increase of population, businesses, assets etc.

The concrete target flood protection level, strategy on wastewater and scale of drainage infrastructures will be determined through Sanitation Master Plan Formulation Project (SDAUM

Project: *Projet d'élaboration de schémas directeurs d'assainissement de huit villes secondaires de Madagascar*) which is expected to start soon and will reflect TaToM.

21.2.3 Issues on Sewerage and Drainage Systems of Toamasina Agglomeration

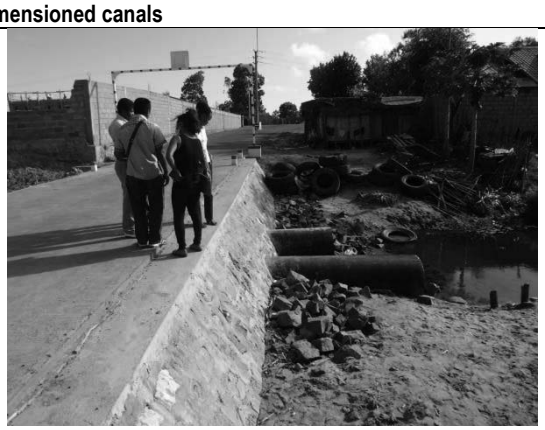
(1) CUT and Toamasina Suburbaine Commune

1) Channels not in Compliance with the Norms and On-going Constructions Prevent Improvement Works

Some difficulties are encountered in constructing new canals even in flood-prone areas due to the presence of roads, markets, and houses. Furthermore, some canals that have been recently constructed are not in compliance with the norms (e.g., under-dimensioned). For example, Ralaimongo II Canal at Andranomadio Fokontany in CUT is under-dimensioned, and overflow occurs every year. Regarding Betatamo Canal which has to be enlarged since it is the receiving water body of Réservée Canal and Ralaimongo Canal, new construction at the confluence at Ralaimongo Canal is making the recalibration of the canal difficult.

Photo 1 Under-dimensioned canals

New Construction impeding the upgrade of canals



Since the canal was fully buried by the construction of the road (which did not include the construction of bridge), the Toamasina Suburbaine Commune installed the pipes.

Photo 2 Construction of new facilities reducing canals' capacity

Figure 21.2.2 Lack of Drainage Capacity in the Canal of Toamasina

2) Decrease of Canals' Capacity caused by Growing Human Pressure

According to the results of the meetings with CUT, drainage canals were constructed in the centre of the city through the sanitation plan of 1963. However, except in the Ambodimanga Fokontany,

most of this network is now filled with mud and waste. As a result, the drainage canals are not working.

With the expansion of urban areas, new canals were constructed. However, due to rapid population growth, the amount of waste and uncontrolled house constructions largely increased. As a result, canal capacities have been reduced and the risk of rainwater flooding has increased.

Toamasina Suburbaine Commune is also faced with the same challenges. Compared to CUT, Toamasina Suburbaine is less endowed with resources (budget, human resources, material, equipment, and others), hence the poor hygiene conditions generated by population densification in some fokontany (such as Ambodisaina) would be more serious.

Photo 3 Accumulation of waste in and near the channels reducing canals' drainage capacity

Figure 21.2.3 Examples of Causes of Reduced Drainage Capacity in Toamasina Suburbaine Commune

3) Absence of Comprehensive Measures/Sanitation Master Plans

As explained above, the drainage system's capacity is deeply affected by the lack of solid waste management. Many efforts were done by CUT and some NGOs to deal with solid waste and drainage issues; however, the measures taken were not always coordinated and linked. To implement drastic countermeasures, a comprehensive plan covering rainwater and wastewater drainage issues and solid waste management is needed. SDAUM Project supported by AfDB will consider these three issues. Therefore, PUDi will need to update the necessary measures addressed in SDAUM once the plan is formulated.

(2) Other Communes: Antetezambaro, Fanandrana, and Amboditandrorohoa

1) Absence of River Flooding Countermeasures

Unlike CUT and Toamasina Suburbaine Commune, the three other communes are located in hilly areas along the river. Since there is no river flooding countermeasures, these three communes are exposed almost every year to the risk of river floods, resulting to agricultural losses.

As an example, the agricultural lands in the Commune of Amboditandroroho at the river mouth of Ivondro as well as its river banks are heavily eroded, affecting farm productivity.

Photo 4 Wide agricultural lands affected by rising of water almost every year

Photo 5 Loss of palm plantation due to left bank erosion caused by Ivondro River

Figure 21.2.4 Unprotected Agricultural Lands in Toamasina Agglomeration

21.2.4 Objectives for Sewerage and Drainage Systems of Toamasina Agglomeration

The objective of rainwater and wastewater management is the minimisation of damage to humans and on socio-economic aspects caused by rainwater and river flooding; and to consequently contribute to the sustainable and prosperous development of Toamasina Agglomeration.

Since Toamasina Agglomeration has considerable potential for tourism development, the sustainability of its environmental resources is important. However, the Agglomeration is actually facing challenges caused by the degradation of social environment or hygiene conditions[1]. Consequently, the target of PUDi related to wastewater management will be the earliest implementation of wastewater facilities (that are mostly non-existent at present), that will contribute to the establishment of a sustainable and healthy social environment.

21.2.5 Strategies for Sewerage and Drainage Systems of Toamasina Agglomeration

Due to its location in the low and flat delta areas in front of the Indian Ocean, most areas of Toamasina Agglomeration are prone to flooding.

From the viewpoint of flood risk, the basic principles or strategies to consider in planning for the sewerage and drainage systems in the area are the topographical aspects and causes of flooding explained in Section 21.2.1.

(1) Strategy 1: Restructuring and Establishment of Drainage Network in Urbanised Areas of CUT and Toamasina Suburbaine Commune.

Due to its low altitude of under 10 m, high pressure on land use, and low drainage capacity, this area delimited by Ivondro River in the South, Ivoloina River in the North, and Ranomainty River, is exposed to rainwater flooding.

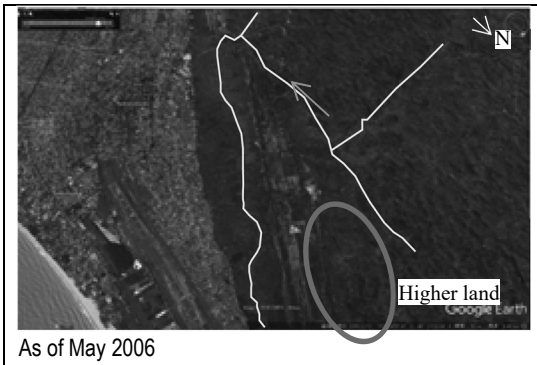
In these areas, the existing drainage network will be rehabilitated and upgraded. Furthermore, wastewater treatment system such as ponds or aerated lagoon will be installed.

(2) Strategy 2: Preservation of the Ranomainty River's Pool (wetland and agricultural land) to Hold Rainwater from the Western Riverines

As mentioned in Section 21.2.1, the water resources of Toamasina Agglomeration are abundant, and many small rivers flow into Ivondro River, Ivoloina River, and Ranomainty River.

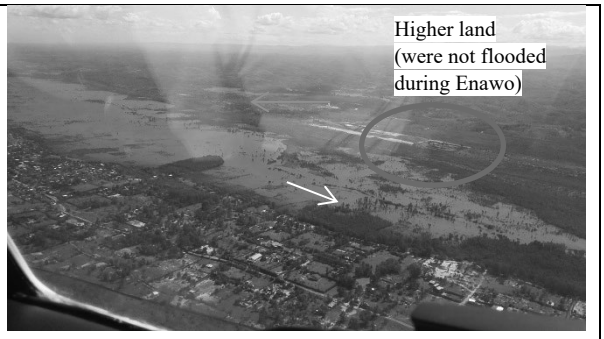
[1] Due to its low and flat topography, and to the insufficient drainage capacity, water tends to stagnate. Consequently, the risk of pandemics outbreaks after floods is also high.

As the Ranomainty River's pool has a large water retention capacity, this piece of wetland usually used for agriculture will be preserved.



As of May 2006
Source: Google Earth

Photo 6 Wetlands usually used for agriculture



As of March 10, 2017 (After Enawo)
Source: CROU

Photo 7 Water retention during rainy season

Figure 21.2.5 Ranomainty River's Pool

(3) Strategy 3: Encouragement of the Installation of Water Storage Facilities in Newly Developed Areas

Most of the rainwater drained in the urbanised area of CUT and Commune Suburbaine de Toamasina is discharged into the Canal Pangalanes and Canal du Nord. With the changes on land use increasing the run-off coefficient ratio, the discharge capacity of these two canals could be insufficient. However, since their banks are already densely occupied, widening of those canals will be difficult.

To control the discharge into these two manifolds, the installation of water storage facilities will be encouraged and established in newly developed areas.

(4) Strategy 4: Encouragement of Individual Flood Protection Measures in the Newly Developed Areas of Antetezambaro, Fanandrana and Amboditandroroho

Due to their location along the river, the Communes of Antetezambaro, Fanandrana and Amboditandroroho are affected by river floods almost every year. However, unlike CUT and Toamasina Suburbaine Commune, these three communes are not yet affected by the rural exodus, and the traditional knowledge on flood risk is inherited. The communes are also adopting their own countermeasures to reduce both human and material losses.

Photo 8 Passerelle Akoraobe constructed to facilitate evacuation

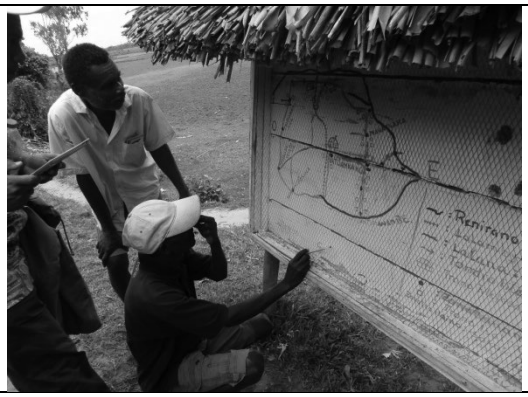
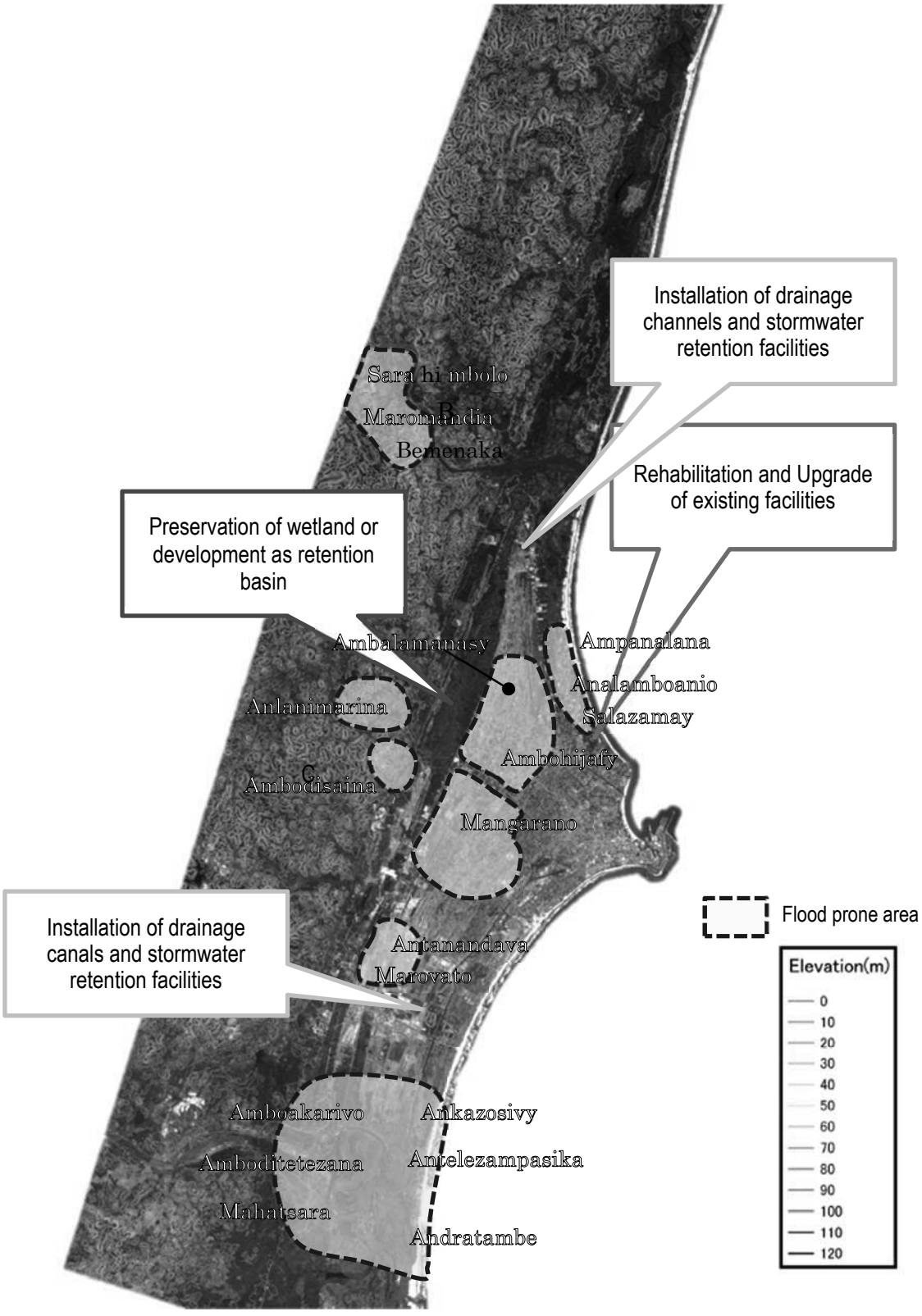


Photo 9 Evacuation map of Mahatsara

Figure 21.2.6 Examples of Countermeasures to Mitigate Human Losses in Amboditandroroho Commune

Since the implementation of drastic countermeasures (such as river improvement) takes time, individual flood protection measures (e.g., elevated residential structures) will be encouraged in the newly developed areas.



Source: JICA Study Team based on the results of meeting with the Regional Director of BNGRC

Figure 21.2.7 Flood-prone Areas in Toamasina Agglomeration

21.2.6 Programmes and Projects for Sewerage and Drainage Systems of Toamasina Agglomeration

The programmes and projects for sewerage and rainwater drainage systems of Toamasina Agglomeration at the short, mid, and long term are proposed as follows:

(1) Short (2019-2023) to Long Term (2029-2033): Formulation and Implementation of a Comprehensive Sanitation Master Plan

The sanitation master plan of Toamasina Agglomeration is planned to be formulated during the SDAUM Project by AfDB. Through this study, the assessment of the actual facilities will be conducted and priority actions will be identified.

The concrete schedule of this project is not yet consolidated. However, it is recommended that this is formulated at the short term to enable its implementation at the mid to long term.

Especially, high priority will be given to the rehabilitation and upgrading of existing drainage infrastructures such as the dredging of Pangalanes Canal and North Canal that are the manifolds collecting the rainwater from existing urbanised areas.

On the other hand, since measures to treat wastewater do not exist yet, the basic infrastructure for wastewater (aerated lagoon or ponds) should be considered and installed in priority.

(2) Mid Term (2024-2028): Development of the Ranomainty River's pool as a retention basin aiming to protect the highly urbanised areas of CUT and Commune Suburbaine de Toamasina, in accordance with the upgrading of RN2

As mentioned above, the pool of Ranomainty River is already functioning as retention basin, collecting water from the western mountainous areas during rainy season. Since the elevation of the urbanized area of CUT and Commune Suburbaine de Toamasina is lower, and the land on the left bank of Ranomainty River are also planned to be urbanised, the NR2 portion along the right bank of Ranomainty River will be raised and strengthened (e. g., it will function as a dike) .

(3) Mid (2024-2028) to Long Term (2029-2033): Implementation of the Sanitation Master Plan and Upgrading of Arterial Roads to Ensure Traffic Transport in the Highly Urbanised Area of CUT and Toamasina Suburbaine Commune

Drainage network will be upgraded and widened in accordance with the expansion of the urbanised area.

On the other hand, countermeasures will be integrated to other basic infrastructures to ensure disaster response activities during flooding. For example, major (arterial roads) will be elevated and use of permeable paving to manage runoff, infiltration, and pollutant transport will be encouraged.

Furthermore, spaces to "temporary" store rainwater in highly or newly developed areas will be developed to minimise or control the augmentation of water flowing into Pangalanes Canal and North Canal.

(4) Long Term (2029-2033): Encouragement of Individual Flood Protection Measures in the Newly Developed Areas of Antetezambaro, Fanandrana and Amboditandroroho

In the long term, individual flood countermeasures will be implemented in the newly developed areas of Antetezambaro, Fanandrana and Amboditandroroho.

Table 21.2.1 Provisional Action Plan for Sewerage and Drainage Systems of Toamasina Agglomeration

Item		2019-2023	2024-2028	2019-2033
1)	Formulation and implementation of Comprehensive Sanitation Master Plan			
1-1	Capacity assessment of the actual sewer and drainage facilities			
1-2	Formulation of priority actions reflecting the future land use and population perspectives			
1-3	Implementation of Sanitation Master Plan			
2)	Development of the Ranomainty River's pool as a retention basin (to integrate into Road Project)			
2-1	Raise of RN2			
2-2	Upgrade of RN2 (permeable paving)			
3)	Upgrade of arterial roads (to integrate into Road Project)			
3-1	Upgrade of arterial roads to ensure traffic flow during floods			
4)	Encouragement of individual flood protection measures in the newly developed areas of Antetezambaro, Fanandrana and Amboditandroroho (Integrated into Urban Development Project)			
4-1	Implementation of flood countermeasures in each newly developed area			

Source: JICA Study Team

21.2.7 Profiles of Priority Projects for Sewerage and Drainage Systems of Toamasina Agglomeration

(1) Early Implementation of SDAUM Project in Toamasina

1) Rationale

The Sanitation Master Plan Formulation Project (SDAUM Project) is supported by AfDB (around EUR 1.8 million or 95% of the project budget will be provided by AfDB). As a background of this project, there are the cumulative effects of climate change and socio-political crises that have weighed heavily on the human development and access to basic infrastructures. Regarding sanitation, the access rate to infrastructure has dropped from 53% to 46 % during the 2004 – 2012 period. This situation led the Government to formulate a New National Strategy on Water, Sanitation and Hygiene for the period 2013 – 2018, which is giving a high priority to the preparation of Sanitation Master Plan in 8 communes, namely Antsirabe, Taolagnaro, Nosy-BeToliara, Fianarantsoa, Mahajanga, Toamasina and Antsiranana. These eight communes are identified as important Poles of Development and their total population is about 1.6 million.

From the view point of TaToM, the implementation of this Project is crucial to minimize the impacts from rainwater and enhance urban environmental conditions.

2) Objectives

The overall goal of the Project is to improve the level and living conditions in urbanized areas through the integrated management of waste (liquid and solid), environmental resources and to strengthen urban resiliency to enable economic growth.

3) Project Description

Under this Project, a Sanitation Master Plan will be elaborated through the following activities:

- Survey and analysis on the actual situation of:
  - Environmental Context (geography, climate, soil typology, hydrology, hydrogeology)
  - Socio-economic Strategy, Land Use (PUDi)
  - Management systems of wastewater, rainwater and solid waste
  - Organizational framework
  - Coverage or access of people to sanitation infrastructure,

  - Level of maintenance of existing infrastructure and equipment,
  - Quality of the sanitation service,
  - Investment and operating costs, sources of financing,
  - Others (economic activities such as urban and peri-urban agriculture, agricultural speculations, types and amounts of fertilizers used).
- Reflections on Future Land Use (since the PUDi for Toamasina Agglomeration is updated, it is supposed that the PUDi will be the Basic Document for analysis)
- Formulation of Sanitation Master Plan including actions plan targeting 2020, 2025, 2030 (Note, since the start of the Project has been delayed, the target years may have changed). The Master Plan will comprise the following:
  - Infrastructures and equipment needed in each zone
  - Organizational and regulatory arrangements including the specification of each agency's roles and responsibilities (public sector, private enterprises, NGOs, communities and other)
  - Mechanism to finance or promote investment to implement, maintain infrastructure and equipment
  - Action Plan for 2020, 2025, and 2030

4) Expected Benefits

With the implementation of the Sanitation Master Plan reflecting the perspectives proposed by TaToM, the damage caused by rainwater flooding is expected to be minimised in existing urban areas and also the areas where development is planned. On the other hand, with the construction of wastewater facilities that are actually almost inexistent, living conditions in urban areas will be improved.

5) Executing Agency and Related Institutes

- Ministry of Water-Headquarter (responsible to manage the overall project targeting 8 Communes)
- Ministry of Water-Regional Office
- JIRAMA
- Communes
- Others (Private Sectors, NGOs)

6) Estimated Project Cost

2.5 million USD for Toamasina

(21 million USD [2] for the whole project covering 8 communes)

7) Implementation Schedule

3 years (The implementation schedule for CUT has to be determined. Originally, the project was planned to start in 2016, however the study on Toamasina is not yet started).

8) Necessary Actions for Implementation / Critical Factor

Close coordination between agencies responsible to manage Water, Urban Environment and Urban Planning Agencies from Communes up to Regional Offices.

[2] Cost estimation of the Project Evaluation Report prepared in November 2015

9) Related Plans and Projects

Will have to reflect the future projections on population, land occupation and other factors proposed by TaToM.

10) Social and Environmental Impacts

None

21.3 Power Supply of Toamasina Agglomeration

21.3.1 Background on Power Supply of Toamasina Agglomeration

(1) Power Demand-and-Supply Situation

The record of power demand, supply, transmission, and distribution losses of Toamasina Regional Interconnection (RIT) system in the past five years is shown in Table 21.3.1. The average annual growth of power production is 3.3%. Gross power production of RIT accounts for about 7% of Madagascar's total. On the average, the annual growth of the peak demand in the past five years is 2.1%[1].

The average transmission and distribution losses in the past five years is 32.8%. This value is significantly higher than those of neighbouring countries which have the same situation as RIA. High distribution loss is being caused by the deterioration of equipment due to aging, overloading the equipment due to lack of rehabilitation and/or replacement of the equipment responding to increase in the power demand, and commercial loss including power theft by illegal connections.

Table 21.3.1 Power Demand, Supply, and Losses of Toamasina Regional Interconnection System

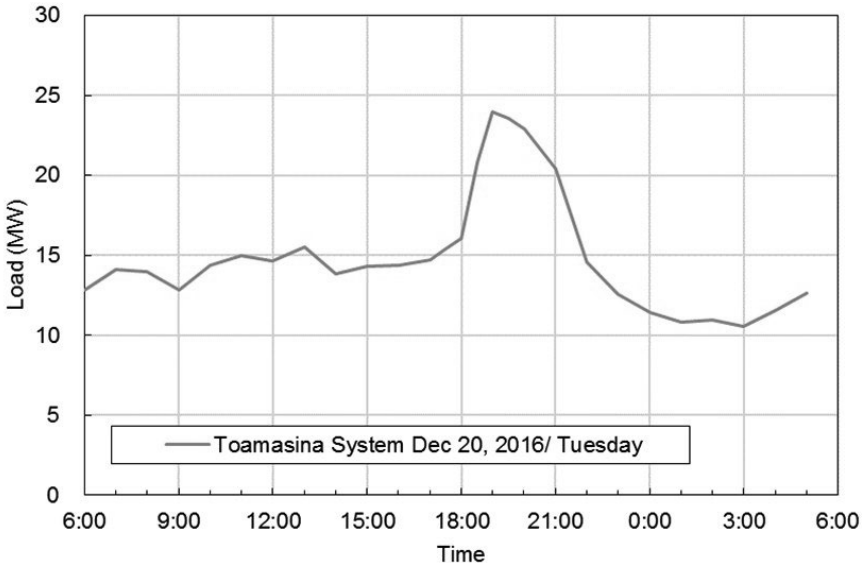
Items	Year				
	2012	2013	2014	2015	2016
A. Gross Power Production in Madagascar (GWh)	1,350.2	1,423.4	1,487.5	1,542.2	1,651.0
B. Gross Power Production of Toamasina System (GWh)	102.6	106.3	105.1	111.5	121.9
C. Ratio of Gross Power Production of Toamasina System to that of Madagascar (B / A x 100) (%)	7.6	7.5	7.1	7.2	7.4
D. Energy delivered to transmission network (GWh)	98.6	102.9	100.9	108.3	117.5
E. Energy delivered to distribution networks (GWh)	85.5	98.9	97.3	103.9	103.5
F. Consumption (GWh)	66.7	68.4	68.5	72.5	79.2
G. Transmission Loss (GWh)	13.2	3.9	3.6	4.4	14.0
J. Transmission Loss (G / D x 100%) (%)	13.3	3.8	3.6	4.1	11.9
I. Distribution Loss (GWh)	18.8	30.6	28.8	31.4	24.3
J. Distribution Loss (I / E x 100%) (%)	22.0	30.9	29.6	30.3	23.5
K. Transmission &Distribution Loss (GWh)	32.0	34.5	32.4	35.9	38.3
L. Transmission &Distribution Loss ((G + I) / D x 100) (%)	32.4	33.6	32.1	33.1	32.6
M. Peak Demand in Madagascar (MW)	285.7	305.7	320.6	328.3	342.5
N. Peak Demand Annual Growth Rate in Madagascar (%)	2.5	7.0	4.9	2.4	4.3
O. Peak Demand of Toamasina System (MW)	22.9	23.4	24.0	24.5	24.9
P. Peak Demand Annual Growth Rate of Toamasina System (%)	-21.8	2.0	2.8	1.9	1.6

Source: JIRAMA Annual Report 2015, Data by JIRAMA Strategic Planning Department, World Development Indicators (World Bank), and JIRAMA Operating Statistics by ORE (www.ore.mg)

1) Daily Load Curve

The daily load curve of the Toamasina System on the day when the maximum system load was recorded on 2016 December 20, is shown in Figure 21.3.1. The daily peak hour of the system was from 6:00 PM to 10:00 PM. Primary cause of the steep increase in the power demand in the evening is considered lighting.

[1] The annual growth rate of -21.8% from 2011 to 2012 was omitted as an outlier for calculation of the average growth rate.

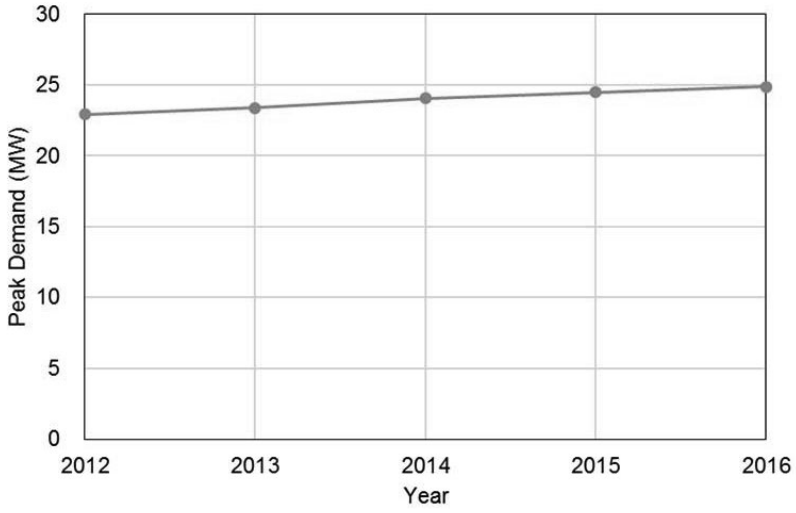


Source: JIRAMA

Figure 21.3.1 Daily Load Curve of Toamasina Regional Interconnection System

2) Peak Demand

As shown in Figure 21.3.2, the peak demand of the RIT had increased by 2.1% per annum in the past 5 years. In 2016 peak demand was 24.9 MW while the supply capacity was 30.7 MW. So there had been no problem from the viewpoint of power supply and demand balance.



Source: JIRAMA

Figure 21.3.2 Peak Demand in the Past Five Years (Toamasina Regional Interconnection system)

(2) Electricity Access Rate

Access to electricity in Madagascar, is calculated based on the following formula and assumptions[2]:

$$\text{Access to Electricity} = \frac{(Number\ of\ subscribers\ of\ JIRAMA + Number\ of\ subscribers\ of\ private\ operators) \times Q1 \times Q2}{Total\ number\ of\ population}$$

[2] Source: MEEH "Mode de calcul du taux d'accès à Madagascar", October 2017

Q1: Average number of households served by a subscription (in rural area, Q1 = 1.3; in urban area, Q1 = 1.7; Throughout the country; Q1 = 1.5[3])

Q2: Average household size (Rural Q2 = 4.90, Urban Q2 = 4.5, Throughout the country Q2 = 4.8[4])

The electricity access rate of each commune in Toamasina Agglomeration was estimated based on the number of JIRAMA's individual customers in 2017. The result of the calculation is shown in Table 21.3.2[5]. The average electricity access rate of Toamasina Agglomeration through JIRAMA's distribution grid connection is about 53%.

Table 21.3.2 Electricity Access Rate of Communes in Toamasina Agglomeration in 2017

Name of Commune	District	Population	Number of Connection (JIRAMA)	Population with Access to Electricity	Electricity Access Rate (%) (Estimate)
		Estimate			
Toamasina	Toamasina I	315,226	28,537	218,308	69.3%
Fanandrana	Toamasina II	25,194	340	2,166	8.6%
Toamasina Suburbaine	Toamasina II	46,812	557	3,548	4.4%
Antetezambaro	Toamasina II	19,008			
Amboditandroroho	Toamasina II	14,020			
Toamasina Agglomeration		420,260	29,434	224,022	53.3%

Source: JICA Study Team (based on JIRAMA's customer data)

(3) Existing Power System

In the RIT, there is only one hydropower station, the Volobe Hydropower Station (Figure 21.3.3), supplying power to Toamasina Agglomeration. The evacuated power from the hydropower station flows to Bureau Control Command (BCC) No.1 (Figure 21.3.4), a facility that has the functions of both substation and control centre. There are two heavy oil fired thermal power stations connected to the Toamasina system: one is Toamasina IV Thermal Power Station (Figure 21.3.5) owned by JIRAMA, and another is ENELEC Thermal Power Station (Figure 21.3.6) which is owned by an English private company. There is only one 35 kV transmission line between Volobe Hydropower Station and BCC No.1, and other lines are all distribution lines with the nominal voltage not exceeding 20 kV. Therefore, the existing power system is still in the early stage of power system formation. The schematic diagram of the Toamasina system is shown in Figure 21.3.7.

Figure 21.3.3 Volobe Hydropower Station

[3] Data from the permanent household survey (EPM), INSTAT 2010

[4] Data from the permanent household survey (EPM), INSTAT 2010

[5] For Toamasina Suburbaine, Antetezambaro and Amboditandroroho, the number of connections, population with access to electricity, and electricity access rate are based on the gross value since no data on individual number of connections for each commune are available.

Figure 21.3.4 Bureau Control Command (BCC) No.1

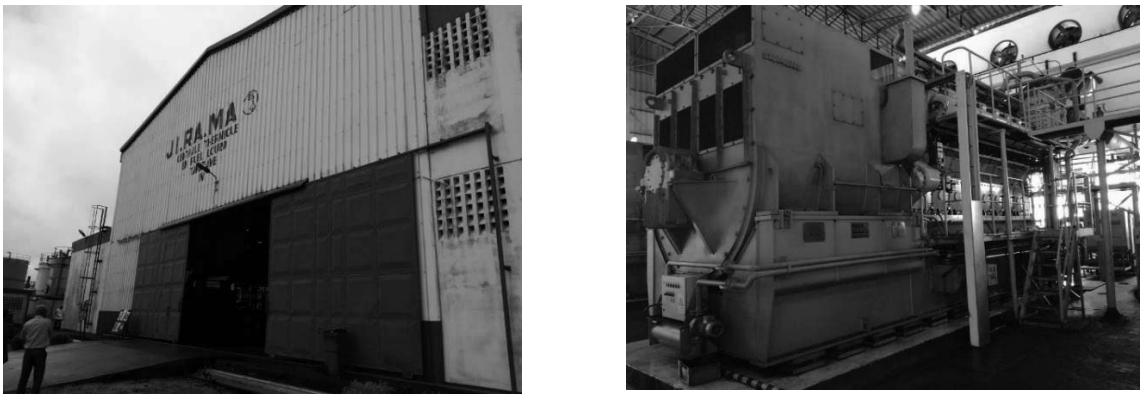
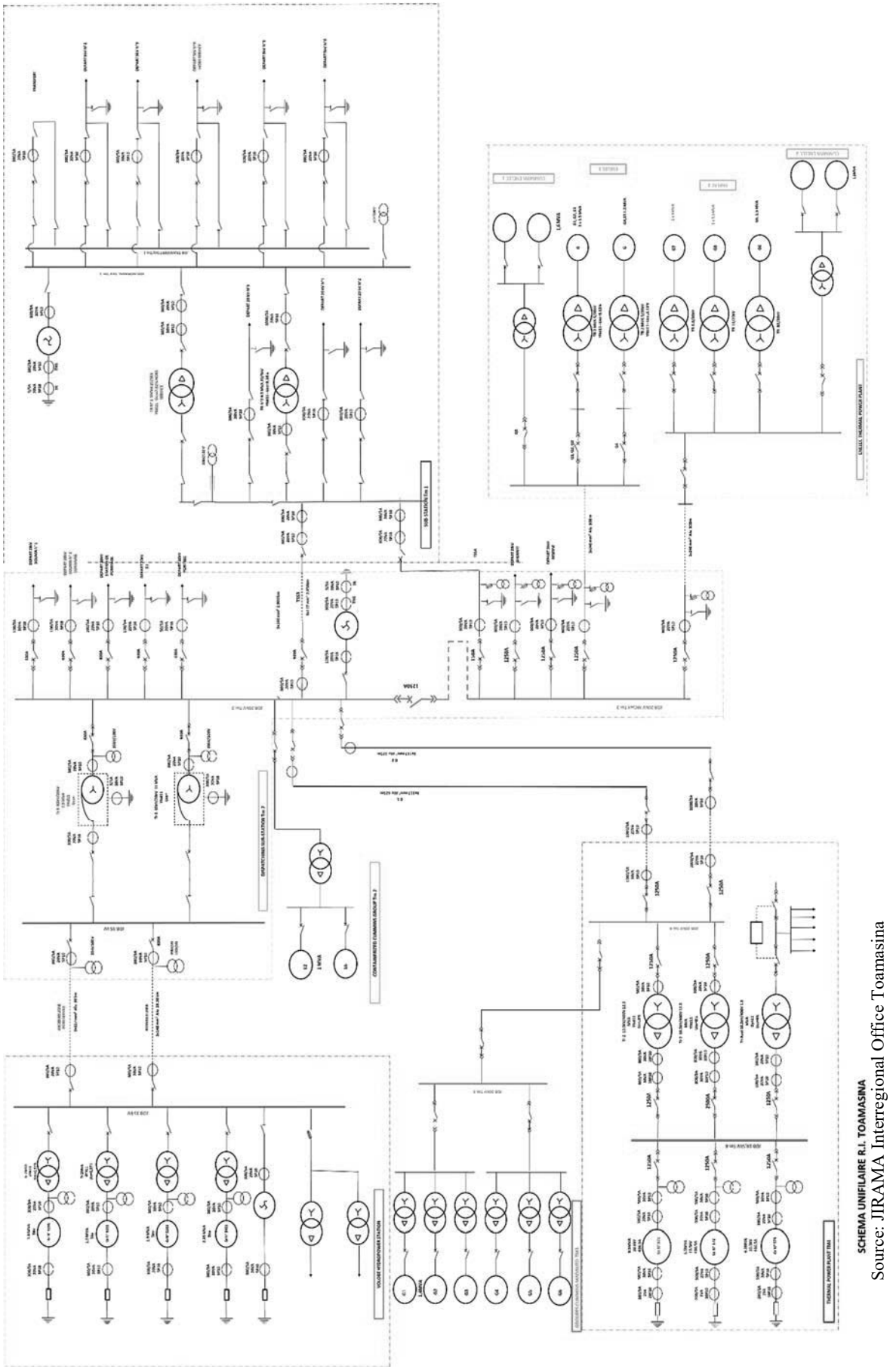


Figure 21.3.5 Toamasina IV Thermal Power Station

Figure 21.3.6 ENELEC Thermal Power Station



Source: JIRAMA Interregional Office Toamasina

Figure 21.3.7 Schematic Diagram of Toamasina Regional Interconnection System

(4) Existing Facilities for Power Supply

1) Power Plants

A list of the existing power plants in the RIT is shown in Table 21.3.3. The total installed capacity is 73.618MW. Out of 73.618 MW, hydropower accounts for only 9.2% (6.76 MW) and thermal power for the remaining 90.8% (66.858 MW). In 2016, 49.1% of the annual power production in the Toamasina system was supplied by JIRAMA's properties, and the remaining 50.9% was supplied by a private company, ENELEC. JIRAMA's power plants constitute of 21.3% hydropower and 78.7% thermal power in terms of the installed capacity. Meanwhile, the only power plant owned by a private company is thermal power station.

Volobe Hydropower Station is the only hydropower station in Toamasina area, which is located about 56 km from the city of Toamasina. This power station started commercial operation in 1931 and has played a vital role of supplying power to Toamasina area as the only hydropower station in the area. Its installed capacity is 6.76MW. Volobe Power Station constitutes 4 groups of water turbine generators (1.52MW x 3units + 2.2MW x 1unit).

Although there are two JIRAMA's thermal power stations, namely, Toamasina III and IV; Toamasina III Power Station, a diesel power station, is no longer in use since JIRAMA is making efforts to convert a diesel power plant with high power generation cost to a less expensive heavy oil thermal power plant under the National Energy Policy 2015-2030 (NPE: *Nouvelle Politique d'énergie de Madagascar 2015-2030*). The generator configuration of the Toamasina IV Power Station is 6 MW x 3units, but it can be used with two units, Unit 2 and Unit 3. These generators became available as generators were rehabilitated under Ambatovy[6] company's financial support in 2016. After the rehabilitation, Unit 1 broke down. Therefore, the available power output is 10 MW (5 MW x 2 units).

Table 21.3.3 Existing Power Plants in Toamasina Regional Interconnection System

Name of Power Plants	Type of Operation	Owner of Property	Fuel Type	Installed Capacity (kW)	Available Capacity (kW)	Power Production (kWh)	Power Production (%)	Note
1. JIRAMA								
(1) Hydropower Plants								
Volobe	JIRAMA	JIRAMA		6,760	5,700	40,459,976	33.2	1.52MW x 3 + 2.2MW x 1
Hydropower Total				6,760	5,700	40,459,976	33.2	
(2) Thermal Power Plants								
Toamasina IV	JIRAMA	JIRAMA	Fuel Oil	18,500	10,000	19,359,691	15.9	6MW x 1 + 6.25MW x 2
Toamasina III	JIRAMA	JIRAMA	Diesel	6,528	750			1.088MW x 6
Thermal Power Total				25,028	10,750	19,359,691	15.9	
JIRAMA Total				31,788	16,450	59,819,667	49.1	
2. Private Companies								
(1) Thermal Power Plants								
RI Toamasina	leasing	ENELEC	Fuel Oil	41,830	19,200	62,011,865	50.9	1.62MW x 5 + 1.4MW x 1 + 5.1MW x 1 + 6.3MW x 1 + 1.2MW x 1+4.27MW x 2+ 12.81MW x 1
Thermal Power Total				41,830	19,200	62,011,865	50.9	
Private Companies Total				41,830	19,200	62,011,865	50.9	
Grand Total				73,618	35,650	121,831,532	100.0	

Source: JIRAMA

[6] Ambatovy is one of the world's largest lateritic nickel mines. It is a joint venture among the Canadian mining company Sherritt, Sumitomo Corporation, and Kores.

2) Transmission Lines

As mentioned in the previous section, there is only a 35 kV transmission line between Volobe hydropower station and BCC No.1 (Figure 21.3.8). The details of the transmission line are shown in Table 21.3.4.

Table 21.3.4 Existing Transmission Line of Toamasina Regional Interconnection System

Voltage (kV)	From	To	Number of circuits	Conductor Type	Conductor Size (mm)	Length (km)
35	Volobe HPP	BCC No.1	1	ACSR	117	30

ACSR: Aluminum Conductor Steel Reinforced

Source: JIRAMA

Figure 21.3.8 Existing 35 kV Transmission Line

3) Substation

Table 21.3.5 shows the list of existing substations in the RIT. There are two substations in Toamasina System and the total capacity is 27 MVA. The capacity of the transformers is sufficient, and no overloading occurs to the equipment at present.

Table 21.3.5 Existing Substations of Toamasina Regional Interconnection System

No.	Name of Substation	Transformer No.	Primary Voltage (kV)	Secondary Voltage (kV)	Capacity (MVA)
1	BCC No.1	AT5	35	20	11
		AT6	35	20	11
2	BCC No.2	TR5	20	5	5
Total Capacity					27

Source: JIRAMA

4) Distribution Facilities

In Toamasina Agglomeration, 20 kV and 5 kV are applied as the nominal voltages of the MV system and 380 V and 220 V for LV system, respectively. The total lengths of MV and LV distribution lines are 116.79 km and 307.07 km, respectively. The total number of MV and LV transformers is 253 units, and the total capacity is 57.346 MVA.

Four 20 kV feeders start from BCC No.1, but they will be abolished in 2018. From BCC No. 2, there are seven 20 kV feeders and four 5 kV feeders, but the four 5kV feeders are to be abolished in 2018 and four new 20 kV feeders will be added. These distribution rehabilitation and expansion plan is part of the PAGOSE project. Also, BCC No.2, which is in the premise of JIRAMA's Interregional Office in Toamasina, is planned to be moved to other location. The list of existing distribution lines and transformers are shown in Table 21.3.6 and Table 21.3.7, respectively.

Table 21.3.6 Existing Distribution Lines of Toamasina Regional Interconnection System

(Unit: km)

Operating Centers	Voltage (kV)	Medium Voltage Line		Low Voltage Line			Total	
		Underground	Overhead	Overhead (Bare)	Overhead (Cable)	Underground	MV	LV
DIR TOAMASINA								
GC Toamasina	5	11.73	27.92	21.34	252.18	33.55	39.65	307.07
GC Toamasina	20	11.28	65.87				77.15	
Total		23.01	93.78	21.34	252.18	33.55	116.79	307.07

Source: JIRAMA

Table 21.3.7 Existing Distribution Transformers of Toamasina Regional Interconnection System

Operating Centers	Voltage (kV)	JIRAMA		Private		Mixed		Total	
		No.	Power (kVA)	No.	Power (kVA)	No.	Power (kVA)	No.	Power (kVA)
DIR TOAMASINA									
GC Toamasina	5	43	6,770	46	8,391	3	450	92	15,611
GC Toamasina	20	76	15,820	82	25,405	3	510	161	41,735
Total		119	22,590	128	33,796	6	960	253	57,346

Source: JIRAMA

Typical existing distribution lines and substations are shown in Figure 21.3.9 and Figure 21.3.10, respectively.

Figure 21.3.9 20kV Distribution Line

Figure 21.3.10 20kV/380V Substation

21.3.2 Objectives for Power Supply of Toamasina Agglomeration

The objective of the power supply for Toamasina Agglomeration is to achieve the goal set in the NPE, specifically, 70% of the households get access to electricity or modern lighting source. Also, realisation of stable and reliable power supply for urban and economic development in the target area is expected.

(1) Power Demand Forecast and Power Development Plan

The power demand forecast and power development plan of the Toamasina system up to the year 2033, the target year of the Project TaToM, are shown in Table 21.3.8. According to JIRAMA's estimates, the peak demand in 2033 is 85.4 MW and the average annual growth rate of the demand is 7.5% per annum. In the power development plan of JIRAMA, only an IPP hydropower project (Volobe-II project[7]) is planned to be implemented.

On the other hand, the peak demand in 2033, which is based on the calculation using the GDP elasticity of power consumption, is 86.7 MW. The average GDP elasticity of the power

[7] The joint venture of the two companies, JOVENNA and COLAS, won the bid of the development right of Volobe-II project in 2017.

consumption of the RIT is shown in Table 21.3.9. The calculation result is 7.27; however, this value is significantly affected by the GDP elasticity in the period between 2010 and 2011, in which the power consumption of the industry sector jumped by 186%[8] due to entry of only three large customers. The average GDP elasticity resulted in approximately 0 if this singular condition is eliminated. Therefore, the GDP elasticity of the power consumption for the future period was assumed as 1.0; that is, equal to the expected future GDP growth rates used in 15.2.1 considering uncertainty of such a bulk future demand. Consequently, the power demand forecast of the latter method is slightly bigger than that projected by JIRAMA.

A demand-and-supply balance chart is shown in Figure 21.3.11. The red line shows the power demand provided by JIRAMA and the blue line shows the power demand with the annual growth rates which are equal to those of the annual GDP growth rates by National Development Plan (PND), INSTAT statistics, and other sector's plans described in the previous chapters. The following assumptions are made:

- Power supply in wet season from 2017 to 2033 is aggregation of the available capacity in 2016 (36 MW) and accumulated installed capacity of the new projects
- For the power supply in dry season from 2017 to 2033, the installed capacity of existing Volobe hydropower station is reduced to 25%[9] of the installed capacity taking into consideration the available capacity of existing run-of-river type hydropower stations.
- For the power supply in dry season from 2017 to 2033, the installed capacity of Volobe-II hydropower station is reduced to 70% of the installed capacity taking into consideration the ratio of wet and dry season output of typical reservoir-type hydropower stations commonly used.

According to the chart, there is the risk of power supply shortage from 2018 until 2024, period when Volobe-II Hydropower Station is expected to commence commercial operation in dry season. From 2021 to 2024, power supply shortage is anticipated even in the wet season. Since the power output of the existing Volobe hydropower station has been reduced due to aging and deterioration of equipment, reduction in the available power will cause degradation of power shortage situation. Also, if the Volobe-II project is delayed, this power supply shortage situation will continue and become worse. The power development plan would be updated once the Least Cost Power Development Plan (LCPDP), which is under preparation as a part of the PAGOSE project, becomes ready[10].

[8] According to "Evolution Annuelle Des Productions, Ventes, et Nombre D'Abonnes" published by ORE in 2016, the power consumption of the individual middle voltage/high voltage customers of industry sector in 2010 and 2011 were 11,684,122 kWh and 21,780,833k Wh, respectively; and the amount accounts for about 30% of the total power consumption of the RIT in 2011.
[9] According to JIRAMA, the power output of the existing Volobe hydropower station is stable throughout the year; however, more severe condition considering drought was assumed as the output of a run-of-river type hydropower station is significantly affected by decrease in water level of the river.
[10] As of December 2017, LCPDP had not been completed and no detailed information were available.

Table 21.3.8 Power Demand Forecast and Power Development Plan of RIT

Name of Planned Power Plants	Type	Unit	Year																	
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Volobe-II	Hydro	MW									90	90	90	90	90	90	90	90	90	90
Power Demand by JIRAMA			24.9	28.0	29.8	31.7	34.2	37.0	40.0	43.3	46.8	50.2	54.0	58.1	61.7	65.7	70.5	75.2	80.1	85.4
Annual G.R. of Demand by JIRAMA's Forecast		%/year		12.6	6.4	6.4	7.8	8.4	8.2	8.1	8.0	7.3	7.6	7.6	6.2	6.3	7.4	6.6	6.5	6.6
Power Demand based on GDP G.R.		MW	24.9	26.3	29.6	31.5	33.5	36.1	39.2	42.4	46.7	50.5	54.2	58.3	62.7	66.8	71.0	76.3	81.3	86.7
Annual G.R. of Deamnd equal to GDP G.R.		%/year		5.8	5.8	5.8	5.8	5.8	5.8	5.8	7.9	7.9	7.9	7.9	7.9	8.2	8.2	8.2	8.2	8.2
Power Supply (Wet Season)		MW	35.7	35.7	35.7	35.7	35.7	35.7	35.7	35.7	125.7	125.7	125.7	125.7	125.7	125.7	125.7	125.7	125.7	125.7
Power Supply (Dry Season)		MW	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6
Power Surplus (+) /Shortage (-) (Wet Season)		MW	10.8	7.6	5.9	4.0	1.5	-1.4	-4.4	-7.6	78.9	75.5	71.6	67.5	63.9	60.0	55.1	50.5	45.6	40.3
Power Surplus (+) /Shortage (-) (Dry Season)		MW	5.7	2.6	0.8	-1.1	-3.5	-6.4	-9.4	-12.7	46.9	43.4	39.6	35.5	31.9	28.0	23.1	18.4	13.5	8.2

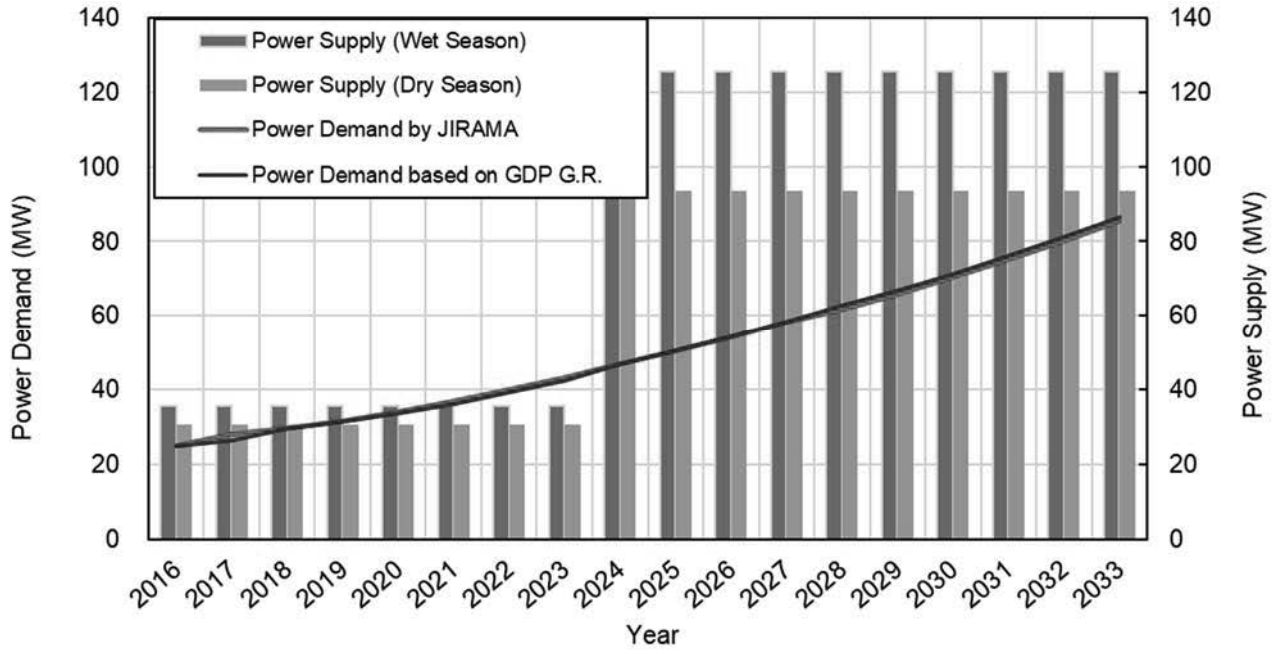


Figure 21.3.11 Power Demand and Supply Balance of RIT

Table 21.3.9 GDP Elasticity of the Power Consumption of the RIT

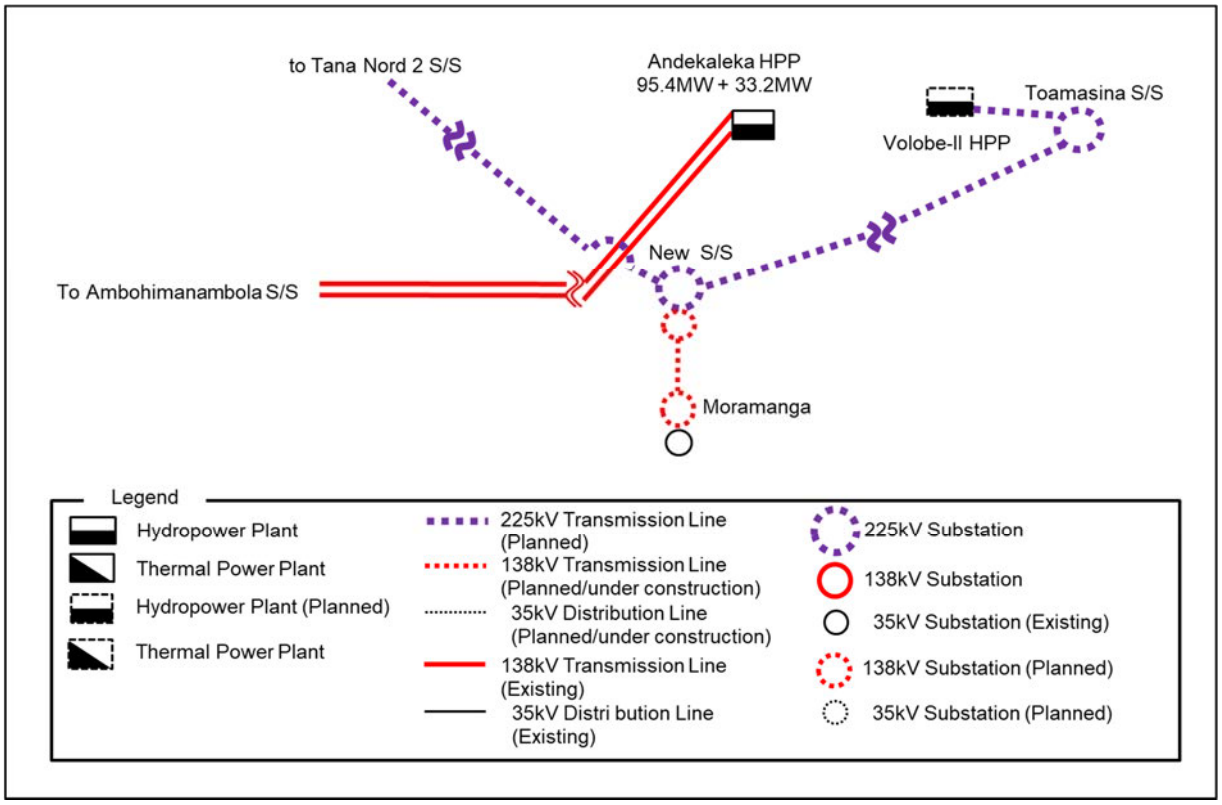
Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Power Consumption of RIT (GWh)	42.2	40.3	45.9	48.3	48.8	50.1	48.4	57.9	55.4	55.8	70.7	66.7	68.4	68.5	72.5
Power Consumption Annual G.R. (%)	-4.6	14.0	5.2	1.1	2.7	-3.5	19.6	-4.3	0.7	26.8	-5.7	2.5	0.2	5.7	
GDP G.R (%)	6.0	-12.7	9.8	5.3	4.6	5.0	6.2	7.1	-4.0	0.3	1.5	3.0	2.3	3.3	
GDP Elasticity	-0.8	-1.1	0.5	0.2	0.6	-0.7	3.1	-0.6	-0.2	102.0	-3.9	0.8	0.1	1.7	
GDP Elasticity (Average of period 2001 to 2014)	7.27														

Source: World Development Indicator 2016, https://data.worldbank.org/products/wdi

(2) Power System Development

There is a concept of network interconnection between the RIA and RIT via high-voltage transmission line. The line will connect Volobe-II hydropower station, a new substation in Toamasina (tentative name is Toamasina), and a new substation near the existing Tana Nord substation (tentative name is Tana Nord 2) in Antananarivo via a new substation from which a new 138 kV line to Moramanga area will be developed. The power system diagram of the future RIT is shown in Figure 21.3.12. In 2011, Sherritt, a major Canadian mining company, conducted a pre-feasibility study on the project. Detailed design is expected to be implemented under the auspices of the African Development Bank.

Another transmission system development plan is the addition of another circuit of 35 kV transmission line between existing Volobe Hydropower Station and BCC No.1 for reinforcement to meet the expected power flow increase accompanied by installation of the fifth unit of existing Volobe Hydropower Station.



Source: JICA Study Team

Figure 21.3.12 System Configuration of Future RIT

21.3.3 Issues on Power Supply of Toamasina Agglomeration

(1) Securing Power Supply Capacity in the Short Term

As mentioned in the section 21.3.2 (1), the power supply would be insufficient in dry season from 2018 until 2024 under the assumption of severe drought condition. Also, from 2021 to 2024, power supply shortage is anticipated even in the wet season until Volobe-II Hydropower Station starts commercial operation. Besides,

if completion of Volobe-II Hydropower Station is delayed, power supply shortage would continue much longer. In order to secure the source of power supply to fill the gap of the demand and supply in the short to middle term, it is necessary to develop new power plants with shorter construction periods, implement rehabilitation and reinforcement of the existing power plants, or make leasing or power purchase contracts with independent power producers (IPPs).

(2) Increase in Power Supply Capacity in the Long Term

Since one of the aims of Volobe-II Hydropower Station is to supply bulk power to meet the demand growth in Antananarivo Agglomeration, only a part of the total output of the power station will be added to the power supply capacity for Toamasina Agglomeration. Moreover, in the case of periodical maintenance of the generator units, some of the generators have to be shut down. In such case, the power supply capacity will not be enough to accommodate the peak demand even after completion of Volobe-II hydropower station. In terms of the industry sector, the demand for large-scale industries is expected to increase as companies penetrate the region. Considering the situation, it is necessary to develop more power plants to secure the reserved margin.

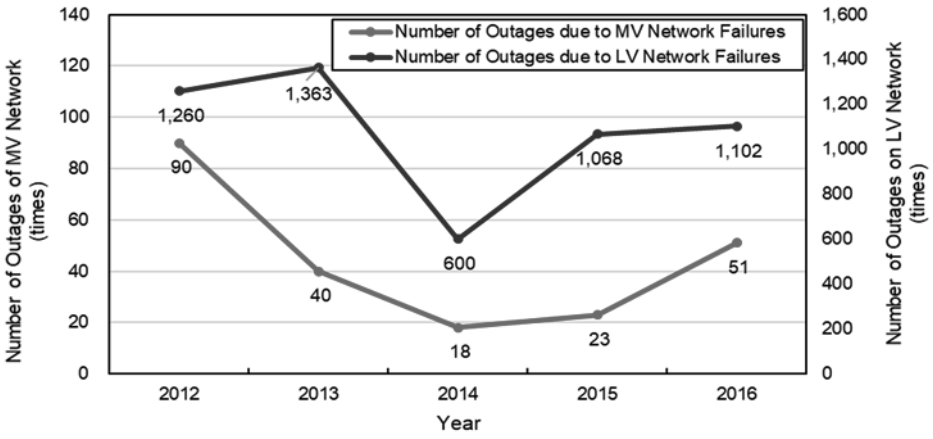
(3) Deteriorated Distribution Facilities

JIRAMA does not have its own geographic information system (GIS) data for identifying the location of the distribution facilities (such as distribution sections, poles, transformers, switches, etc.) for individual distribution lines. For this reason, it has been difficult to efficiently formulate the facility refurbishment and/or reinforcement plans for overloaded equipment, deteriorated equipment due to aging, and damaged equipment based on the power system analysis, periodical inspection and patrol records, and on the distribution system operating records[11]. There are many overloaded MV and LV distribution lines and distribution transformers due to JIRAMA's severe financial situation. Figure 21.3.13 shows the record of outages due to failures of both MV and LV networks for the past five years. Significant number of outages have occurred to the secondary system of the RIT. This situation is one of the principal reasons of high distribution loss rate. JIRAMA has not been able to take drastic countermeasures for the considerable number of overloaded and deteriorated distribution facilities due to difficulty in financing refurbishment and replacement of the equipment because of its deficit operation for years. For a part of existing distribution lines with high priority, replacement of deteriorated equipment, construction of new 20 kV lines, and/or upgrading of 5 kV lines to 20 kV lines have been implemented under the PAGOSE project and are supposed to be finished by 2020. In order to efficiently implement the rehabilitation and/or reinforcement projects according to their priority, it is necessary to take advantage of the GIS data, maintenance record, and system operation record such as loading status of lines and transformers.

(4) Expansion of Distribution System

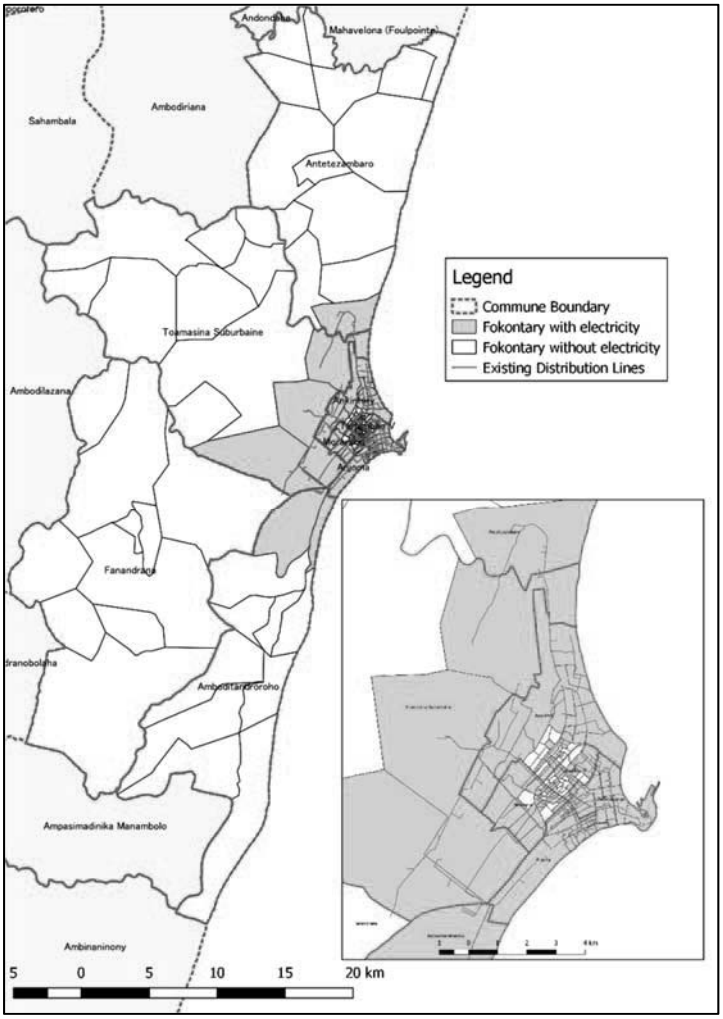
In Toamasina Agglomeration, only CUT has relatively high electricity access rate of about 70% of population. For the other four communes (Fanandrana, Toamasina Suburban, Antetezambaro, and Amboditandroroho), the electricity access rate is only 5.6% to 12.6%. The existing distribution network and the fokontany with access to electricity are shown in Figure 21.3.14. In these communes, no distribution network has been developed so far. In order to achieve the goal of the NEP (70% of households have access to electricity), it is necessary to examine the necessity and the appropriate options of power supply to these areas considering the future plan of urban development and distribution of the expected power demand.

[11] As of October 2017, the GIS data of the existing distribution system of RIT were under preparation.



Source: JIRAMA

Figure 21.3.13 Number of Outages Due to Network Failures of RIT



Source: Commune Survey conducted by JICA Study Team

Figure 21.3.14 Existing Distribution Network in RIT

21.3.4 Strategies for Power Supply of Toamasina Agglomeration

In this section, fundamental strategies based on the observation of the power supply situation at present are described. However, the strategies on power supply for Toamasina Agglomeration should be in line with the LCPDP.

(1) Power Development

There is the risk of power supply shortage from 2018 until 2024. As countermeasures the following should be implemented: development of small-scale power stations; rehabilitation/enhancement of existing Volobe Hydropower Station, including installation of additional generator unit; repairing of a broken generator of Toamasina IV Thermal Power Station[12]; introduction of renewable energy power supply with large-scale power storage system, the policy of which is in line with the NPE[13].

(2) Development of Regional Interconnection Transmission Line

Development of regional interconnection transmission line is planned for the purposes of both transmission of bulk power from Volobe-II Hydropower Station to Antananarivo Agglomeration and enhancement of power supply to Toamasina Agglomeration. Although the applicable nominal voltage has not been determined, there are two candidate voltage levels, 225kV and 220kV. The number of circuits and bundles should be carefully examined taking the transient stability of the system into account since the distance is quite long (more than 300 km).

(3) Transmission System Expansion

The transmission system expansion should be implemented in order to accommodate the power demand increase and to enhance the capacity of transmission and substation facilities. The system expansion consists of introduction of new transmission lines, installation of new substation for receiving power from Volobe-II Hydropower Station and upgrading of distribution substations. The system configuration, specification of the facilities such as applicable voltage, type and size of conductors, rated capacity of transformers, breaking capacity of the circuit breakers, amount of reactive power compensation, should be determined based on the power system analysis.

(4) Distribution System Expansion

The distribution system expansion should be implemented to meet the load increase of the secondary system to be caused by urbanisation in Toamasina Agglomeration. It constitutes construction of new MV and LV distribution lines, construction of new transformer stations to step-down from MV voltage to LV voltage. The distribution expansion plan should be formulated taking the locations of the newly installed substations and future land use plan into account. The specification of the facilities such as type and size of conductors, and rated capacity of transformers should be determined based on the power system analysis.

(5) Replacement/Repairing of Existing Transmission and Distribution Networks

The existing distribution network had a number of deteriorated equipment due to aging and lack of investment in rehabilitation projects. The deteriorated equipment has become one of the causes of a significant number of outages and high distribution losses. In order to increase the reliability of the distribution network and reduction of distribution losses, dilapidated equipment should be replaced with new ones based on the priority.

21.3.5 Programmes and Projects for Power Supply of Toamasina Agglomeration

(1) Power Development

In order to reduce the power demand and supply gap until commencement of commercial power supply by Volobe-II hydropower station, the following projects are proposed during the period of 2018 to 2023:

- Rehabilitation and reinforcement of existing Volobe hydropower station
- Repairing of unit No.1 generator of Toamasina IV thermal power station
- Leasing of diesel power stations for temporary use

[12] As of June 2017, out of 3 units of generators, only unit No.2 and 3 were in operation since unit No.1 was out of order.

[13] "For the development of plant types, the NPE estimates that production electricity will come from 75% of hydropower, 5% from wind, and 5% from 85% of clean energy sources, the remaining 15% being thermal in addition to and in support of renewable energies, by 2030.", LETTRE DE POLITIQUE DE L'ENERGIE DE MADAGASCAR 2015-2030, p.10, September 2015

Even after commencement of commercial power supply by Volobe-II Hydropower Station, it is necessary to develop new power station(s) to ensure a sufficient amount of reserved margin and in preparation for periodic inspection of the generator and its stoppage due to unexpected accidents. Conforming to the NPE, development of renewable energy power station(s), especially hydropower stations, is proposed for the long-term up to the year 2033.

(2) Development of Regional Interconnection Transmission Line

A series of projects related to development of regional interconnection transmission line are proposed during the period of 2018 to 2023. Detailed study should be conducted to determine the targets and scope of the projects.

1) Installation of new transmission lines

- 225kV transmission line (Volobe-II Hydropower Station to new substation in Toamasina)
- 225kV transmission line (New substation in Toamasina to new substation in Moramanga)
- 225kV transmission line (New substation in Moramanga to Tana Nord 2 Substation)

2) Installation of new substations

- 225kV/35kV substation in Toamasina

(3) Transmission System Expansion/Rehabilitation/Repairing

The following projects for expansion of the transmission system are proposed during the period of 2018 to 2023:

1) Installation of new transmission lines

- 35kV transmission line (New substation in Toamasina to existing substation)

2) Installation of new substations

- 35/20kV substations in Toamasina

Detailed study should be conducted to determine the targets and scope of the projects.

3) Rehabilitation of transmission line

- 35kV transmission line (Volobe Hydropower Station to BCC No.1) (reconstruction of poles, wiring of conductor (one of two circuits))

From 2023 to 2033

The appropriate programme should be proposed considering the power development plan, distribution of regional future power demand caused by progress of urbanisation, and condition of the future power system. Also, the programme should be in line with the LCPDP.

(4) Distribution System Expansion/Rehabilitation/Repairing

The following projects for expansion of the distribution system are proposed during the period of 2018 to 2023:

- Rehabilitation and/or upgrading of existing distribution network by PAGOSE project (on-going project supposed to be completed by 2020)
  - Replacement of 20/0.4 kV overloaded transformers by new transformers with adequate capacities
  - Installation of associated accessories and switchgear
  - Construction of 20 kV lines
  - Installation of distribution sub-stations with primary voltage of 20 kV
  - Replacement of 5/0.4 kV pole mounted transformers and of insulators, accessories, and conductors of existing 5 kV lines to upgrade the infrastructure to operate in 20 kV

From 2023 to 2033

The target and scope of the distribution system expansion projects should be determined based on the detailed study. It is necessary to develop both existing and future distribution system models for the analysis based on the precise and comprehensive inventory data. Grasp of the regional distribution of future demand and land use plan is essential to determine the location of the candidate transformer stations and the route of distribution lines.

21.3.6 Profiles of Priority Projects for Power Supply of Toamasina Agglomeration

(1) Project for Development of Volobe II Power Plant

1) Rational

Access to electricity of the people in Toamasina Agglomeration in 2017 is on average 50.5% for the whole area, with 60.1% for Toamasina Urban Commune, 12.6% for the area of Fanandrana, Toamasina suburban Communes, and Antetezambaro, and 5.6% for Amboditandroroho, against a target of 70% described in the National Energy Policy.

The available capacity of power supply, combining of JIRAMA's Volobe Hydro Power Plant and two thermal plants, and private thermal power plant, is 35.6 MW out of the installed capacity of 73.6 MW, which is surpasses the peak demand, 24.9 MW in 2016. Volobe Power Plant has been operating since 1931 and become dilapidated.

As such, a new hydro power plant, Volobe II Hydro Power Plant, as IPP is planned to be developed by JIRAMA in 2024, to supply power mainly for Antananarivo Agglomeration as well as Toamasina Agglomeration.

Thus, the timely development of Volobe II Power Plant is imperative, otherwise the future power demand will not be met appropriately.

2) Objectives

- To expand power supply capacity to supply power Antananarivo Agglomeration as well as Toamasina Agglomeration.

3) Project Description

- To develop a hydro power plant at the upper stream of the existing hydro plant, Volobe II Power Plant, with a height of 15 meters and a width of 150 meter.
- The capacity of the new plant is 120MW, out of which 30 to 35 MW will be for Toamasina Agglomeration.
- This Plant will be operated as IPP under an already-signed 50-year concession contract agreement and will start commercial operation in 2024.

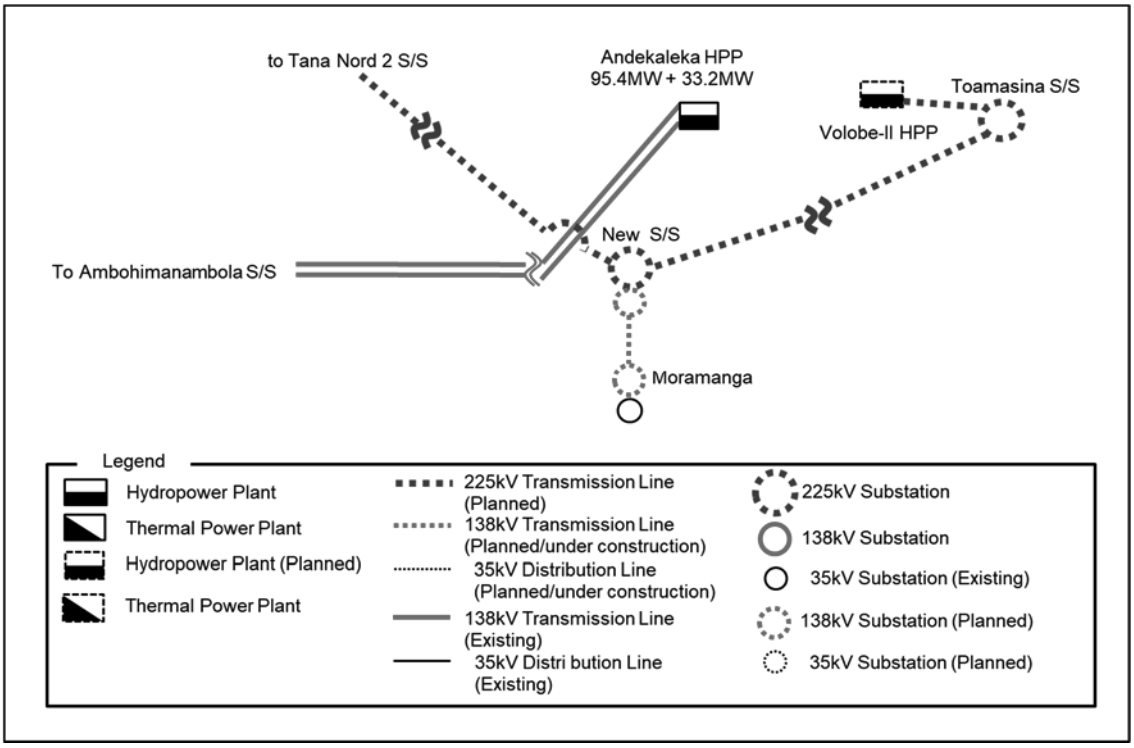


Figure 21.3.15 Location of Volobe II Power Plant, Transmission Lines and Substations

4) Expected Benefits

- Provides necessary electricity for TaToM area to support manufacturing sector development.
- Provides necessary electricity in Toamasina Agglomeration for 2033

5) Executing Agency and Related Institutes

- JIRAMA
- Private Company

6) Estimated Project Cost

To be estimated

7) Implementation Schedule

- FS, DD: 2020~2021
- Construction: 2022 ~ 2024

8) Necessary Actions for Implementation / Critical Factor

- Volobe II Power Plant –Antananarivo and Volobe II Power Plant-Toamasina 225 kV transmission system included in LEAD Project of WB
- Land acquisition and relocation plan, if any

9) Related Plans and Projects

- Least-Cost Electricity Access Development Project (LEAD)

10) Social and Environmental Impacts

Standard measure is necessary.

21.4 Solid Waste Management of Toamasina Agglomeration

21.4.1 Present Situation on Solid Waste Management of Toamasina Agglomeration

(1) Present Situation on Solid Waste Management System in CUT

SWM has become a serious problem in CUT due to the rapid rate of urbanisation, uncontrolled population, lack of resources, institutional weaknesses and lack of civic sense towards solid waste disposal. The average solid waste collection rates in CUT are currently less than 50% (CUT). This current waste collection rate in CUT is a result of poor employment and management of SWM being employed by a public waste service body of CUT.

Primary responsibility for SWM rests with CUT since 2007. Waste engineering section of CUT is in charge of waste public services of collection, transport and disposal at a final open dump site. On the other hand, there is a waste service provider for SWM of CUT under a memorandum of understanding with CUT and the "polluter-pays-principle" based on the "Environmental Sanitation Policy"; that is "Tamadiu Project" funded by Ambatovy Mining Company. The Tamadiu Project was established to join waste collection and disposal services for the SWM activity for CUT, including provision of a transfer of technology and land procurement in recycling since 2014. However, it is noted that the present services of SWM undertaken by CUT and the Tamadiu Project is not properly conducted at all, in terms of the SWM activities of collection, transportation and disposal at the open dumping site.

In particular, out of the seven waste pick-up/collection points in CUT, at some points such as No.1 and No7 (refer to Figure 21.4.1), they have become wild-up waste garbage mountains. As of end of March 2017, daily waste garbage brought by the residents or fokontany to dumping points on the alley and roads has become piles, since in the past year there has been no garbage collection and transport service by CUT. As a result, waste is scattered and piled-up in and around the collection points, and they cause odour and deteriorates the environment in CUT.

The department in charge of SWM at CUT municipality is "urban engineering department" which consists of five service sections (the total number is 238 staff and workers; 53 permanents and 185 daily workers); namely, infrastructure service, road service, public cleaning service, water supply service, and public lighting service. Out of these five service sections, the public cleaning service section (16 permanent staff and 33 daily workers) is in charge of waste collection, transport and disposal activities, and the road service section (11 permanent staff and 85 daily workers) are for the services of street sweeping, park and garden hygiene and cleaning.

Although the urban engineering department of CUT is responsible to cover the waste collection and transportation service, there are only few waste collection and transportation vehicles available; one truck (10 m^3 capacity) and one tractor with a trailer (10 m^3 capacity) for street weeping, waste collections at markets and public bus stations. The Tamadiu Project also only provides one truck (8 m^3 capacity). These trucks cover only four waste collection points out of the total seven collection points twice a week (two trips per day only) to collect pilled-up waste to a final dumping site. The above number of waste collection vehicles is insufficient for the collection of all wastes generated in CUT. According to the urban engineering department of CUT municipality, a daily waste amount collected at the collection points and public market facilities are estimated to be about 60 m^3 in total.

(2) Insufficient Waste Collection and Transport by CUT

Due to lack of resources, institutional weaknesses and lack of civic sense towards solid waste disposal, un-collected waste is illegally piled on the waste collection points, sidewalks, in open spaces, or sewer drainage lines and blockage of wastewater flow in the sewers are seen. It is also noted that the laws and regulations related to the SWM in Madagascar are limited and insufficient.

The most serious issue on the SWM for CUT is that the collection and transportation activities of SWM services by CUT are not performed properly and systematically. According to CUT, due

to lack of finance, it may lead to extremely poor SWM services by CUT. There were some cleanliness activities conducted by major industrial factories, commercials, fokontany communities and NGOs in Toamasina responding to major challenge of maintaining clean environmental sanitation status in the period of March 2016. However, a daily waste management activity on collection, transport and disposal to a final landfill is more crucial. The significant impacts are on environment.

Waste Collection by a Waste Trailer of CUT, March 2017
(CUT)

A Tractor for Waste Trailer, March 2017
(CUT)

Waste Transport by a Rental Truck (CUT) at the Final Dumping Site, March 2017
(R.C.Amboditandroroho, Toamasina Agglomeration)

Final Dumping Site and Hazardous Medical Sharps (in a black frame photo), March 2017
(R.C.Amboditandroroho, Totamasina Agglomeration)

Piled-up Waste due to Poor SWM Activity by CUT at Pick-up Point No.1 of CUT
Insufficient waste collection activity since April 2016.
March 2017

Piled-up Waste due to Poor SWM Activity by CUT at Pick-up Point No.7 of CUT
There is no waste collection activity since April 2016.
March 2017


Informal Number of Waste Collection and Transport Workers in CUT Area (Sep. 2017)

Figure 21.4.1 Current Situation of SWM in CUT

(3) Current Situation of Solid Waste Management Process in Toamasina Suburbaine Commune and Three Rural Communes

Table 21.4.1 shows the current situation on SWM services in each commune of the Toamasina Agglomeration adjoining to CUT.

Table 21.4.1 Present Situation of SWM System in Toamasina Suburbaine Commune and Three Rural Communes of Toamasina Agglomeration

Adjoining Four Rural Communes	Toamasina Suburbaine Commune	Antetezambaro Rural Commune	Fanadrana Rural Commune	Amboditandroroho Rural Commune
Interviewee	Mayor	Mayor/Deputy mayor/Admin.staff	Deputy Mayor	Admin. staff
Laws and Regulations for SWM	Commune and its residents are not aware of any law and regulation regarding SWM.			
SWM System in the Commune	• There is no proper SWM system in the commune and fokontany (i.e.,collection, transport and disposal system). • CUT and the adjoining communes have a long boundary dispute. Commune office is also within Fokontany Ankirihiry in CUT.	• There is no section in charge of waste disposal; no SWM equipment. • In 2015, an NGO implemented health programmes and initiated compost making (Velon-Tena 1st GABRIEL), which was helpful. • In recent years, along NR5, illegal dumping of solid waste occurs and trash is brought in from CUT. Residents have appealed against illegal dumping.	• There is no section in charge of waste disposal and equipment is necessary. • In July 2017, Catholic NGO (ODDIT) carried out an organic-development campaign in 10 fokontany. • CDP is prepared in 2010 and Monograph was created in 2015.	• There is no section in charge of waste disposal and equipment is necessary. • CDP is not made since there is no budget.
SWM Practices in the Communes	• In recent years, there has been rapid increase of population in three fokontany at the boundary of the CUT (Fkt. Ambalamanasy, Fkt. Ambodisaina, Fkt. Tanandaya). • The volume of illegally disposed waste increased, especially the general waste dumped from CUT. • Recently, more residents of the commune are willing to have dialogue with CUT.	• Residents of the commune are handling the waste on their own, usually by burying or burning.	• Residents of the commune are handling the waste on their own, usually by burying or burning.	• Residents of the commune are practicing reuse of certain types of waste streams, such as plastic bottles used as water and milk containers.

SWM System in the Communes	The commune residents are doing their own waste treatment and this practice will continue for a while.			
Waste Amount per Capita per Day	0.3 ~ 0.4kg / capita / day	Refuse amount of 0.2 ~ 0.4kg / capita / day	Refuse amount of 0.3 ~ 0.4kg / capita / day	Refuse amount of 0.2 ~ 0.4kg / capita / day
Photos of SWM situation in the commune				
	Illegal dumping of waste behind residential houses	Illegal dumping of waste from CUT along NR5	Waste container in a public market	Residential houses near the rural commune

Note: NR.5 stands for National Road No.5; Fkt. stands for fokontany.

Source: JICA Study Team based on interviews conducted in each commune

(4) Current Dumping Site

The present final open dumping site at Rural Commune of Amboditandroroho is located about 13 km south from CUT at a coastal low-lying area. The surface area is about 3 ha and is within the land owned by CUT. The final open dumping has still a vacant capacity in volume for future use. However, there is no equipment of truck-scale and heavy machine-like bulldozers, and no documented records for waste transport trucks at site. A potential final sanitary landfill should be developed and rehabilitated with a truck-scale system, sanitary engineering drained typed and equipment at this area.

Informal Dumping Site along NR.2 (Sep. 2017)

Informal Dumping Site along NR.2 and Informal Waste Collectors from CUT (Sep. 2017)

Figure 21.4.2 Current Situation of the Disposal Site (Antsarimasina)

(5) Informal Waste Collection and Transport Workers

In CUT, there are number of waste wheel loaders. They are informal micro waste collection and transport workers. They go around the residential houses and commercial shops in the city to collect waste and carry them to a dumping site located in a suburban wetland area when the loader becomes full. Wetland landowners welcome wastes as a material for raising land. Their role as waste collection and transport workers is an important element for the CUT's SWM services.

Referring to the cleanliness campaign and contributions achieved by daily cleaning activities since 2007 in CUT, the Tamadiu Project association, CUT, and major enterprises/ companies in CUT carried outs special cleaning activities in the area in 2014. Such activities help to improve SWM services in CUT, and the impacts of cleanliness and daily cleaning activities support the prevention of epidemic diseases among others, such as the pest epidemic that occurred in 2017.

	
Illegal Dumping Waste behind Residential Houses in R.C. Toamasina Suburbaine (Sep. 2017)	**Illegal Dumping Sites along NR.2 in R.C. Toamasina Suburbaine** (Sep. 2017)

Figure 21.4.3 Current Situation on SWM in CUT and Surrounding Rural Communes

(6) Present 3R (Reduce, Reuse, Recycle) Activities in CUT

Since there seems not much activate in waste recycling in CUT, it is considered that recycling organic waste into compost for agricultural use can be assisted by private companies, related local governments and NGOs.

Environmental education on intensive hygiene and sanitation to the public seems not activate in CUT. The public targeting the rural communes, residents, school children, NGOs, and private sector entities involved, should all enhance their capabilities through the IEC (Information, Education and Communication) campaign.

Insufficient financial independence in SWM services can be observed in CUT. It falls back on subsidies from the Government of Madagascar.

(7) Laws and Regulations in SWM

There is no comprehensive law on SWM in Toamasina that is understandable to officials and residents. Also, there seems lack of laws and regulations related to 3R (reuse, reduce, recycle) in CUT. There seems no enforced legal system such as laws and regulations on SWM and 3R activities in Madagascar, to support and promote 3R activities in CUT and the rural communes.

There is no proper enforcement of laws, by-laws and regulations in Madagascar dealing with management of the waste discharged from municipal and industries. Mixing of industrial waste with municipal waste is seen at the illegal dumping sites along the national roads such as NR2 in CUT. Industrial data of the entire city is not available from any government or private sector.

(8) Hazardous Risk Waste

Hazardous medical sharps from medical clinics or facilities were found in mixed municipal waste at the CUT's open dump site of R.C. Amboditandroroho, resulting in a major risk to sanitary workers. Similar situation was observed at the final landfill site of the CUA, however, the number of such hazardous waste found in CUT's dump site was more than in that of CUT. The sanitary workers of CUT are not aware of the hazardous nature of medical e-risk waste and they do not use any personal protective equipment at the time of sweeping.

(9) Workers in Risk for Social Considerations

Currently, waste pickers are working in severe condition of SWM services with dangerous environment and health risk. In a SWM plan, waste pickers can be involved in official process of SWM. They can be involved in the various programmes for sorting recyclable materials at the controlled area or in organic waste composting. Trying to remove waste pickers will result in failure in SWM initiatives, according to past experiences of many developing countries. Waste

pickers should be involved as a part of the SWM system, and this will benefit both Toamasina Agglomeration and waste pickers, including sanitary workers and informal waste collectors.

21.4.2 Future Forecast of Waste Amounts in Toamasina Agglomeration

Based on the population predicted values in the TaToM Project, future waste generation amounts are estimated for the SWM plan from 2018 to 2033 in Toamasina Agglomeration as shown in the table below. For the waste amount estimation, the per capita per day waste generation rates of 0.5 kg/capita/day for CUT, and 0.4 kg/capita/day for rural commune in 2017, the minimum increase rate of 1% per annum, waste collection rate for commercial, institutional and other resources of 14% for urban area and 12% for rural area in 2017 are assumed for the future waste amounts based on the footnote of the table below.

Table 21.4.2 Estimation of Projected Solid Waste Management Amount for Toamasina Agglomeration

Unit: t/d or ton/day

Description / Year			2018	2019	2023	2028	2033
CUT	Waste collection amount from CUT (t/d)		**112**	**150**	**222**	**343**	**508**
		domestic (t/d)	83	111	161	245	356
		commercial, institutional, market (t/d)	29	39	60	98	152
Outside CUT	Waste collection amount from urban communes (t/d)		**3**	**3**	**6**	**11**	**22**
		domestic (t/d)	2	3	4	8	16
		commercial, institutional, market (t/d)	1	1	1	3	6
	self-disposal (t/d)		36	38	45	59	79
CUT+ Outside CUT	Total waste generation amount (t/d)		**150**	**191**	**272**	**413**	**609**
	Total waste collection amount (t/d)		**115**	**153**	**227**	**354**	**530**

Source: JICA Study Team

Notes: The following are adopted for estimation of the waste amount in the above table based on the information obtained from CUT office.

- Adopted capita domestic waste generation rate in 2018: 0.50 (kg/capita/day) for CUT, 0.50 for urbanized Commune, 0.40 for rural Commune, based on information from SAMVA and interviews from rural communes of Toamasina Agglomeration.
- Waste collection rate for commercial, institutional and other resources are assumed to be at 14% for urban area in CUT and 12 % for urbanized rural Commune, based on neighbouring developing countries..
- Projected population from 2018 to 2033 for Toamasina Agglomeration is estimated by the TaToM JICA Study.

21.4.3 Issues on Solid Waste Management in Toamasina Agglomeration

Based on the results of field surveys and reconnaissance, the issues of SWM in Toamasina Agglomeration are identified as below.

- Low level of waste collection service coverage, especially in CUT
- Existence of a number of illegal dumpsites in CUT and Toamasina Suburbaine Commune
- Absence of formal intermediate treatment and 3R facilities
- Lack of waste vehicles for collection and transportation in CUT and rural communes
- Lack of public awareness and IEC to encourage participation of residents
- Lack of human resource, SWM facilities and financial resource in the rural communes
- Lack of laws and regulation related to SWM

21.4.4 Objectives of Solid Waste Management in Toamasina Agglomeration

The objectives of SWM in CUT and the surrounding rural communes of Toamasina Agglomeration are as follows:

- To improve the existing collection and disposal services, and expand the coverage of SWM

service area in order to maintain public sanitation and cleanliness of Toamasina Agglomeration. By 2033, the average solid waste collection rates in CUT and in the urbanised fokontany of Toamasina Suburbaine Commune and the rural communes adjacent to the CUT to reach 100%.

- To formulate SWM Development Plan for Toamasina Agglomeration, for instance, intermediate treatment and 3R promotion plan for reduction of domestic waste generation, recovery of resources, reuse, recycling, and intermediate treatment and resource circulation

21.4.5 Strategies for Solid Waste Management of Toamasina Agglomeration

To solve the issues, SWM plan of Toamasina Agglomeration should be achieved for the long-term financial sustainability based on the following strategies:

- Reorganisational structure of SWM services for CUT and the surrounding rural communes
- Identify potential sites for sanitary landfill facility in Toamasina Agglomeration

The above strategies are discussed below.

(1) Reorganisational Structure of SWM Services for CUT and Rural Communes

In order to enhance SWM services in Toamasina Agglomeration, reorganisational structure of the urban engineering department of the CUT, Toamasina Suburbaine Commune, and the three rural communes should be developed step by step simultaneously with population growth.

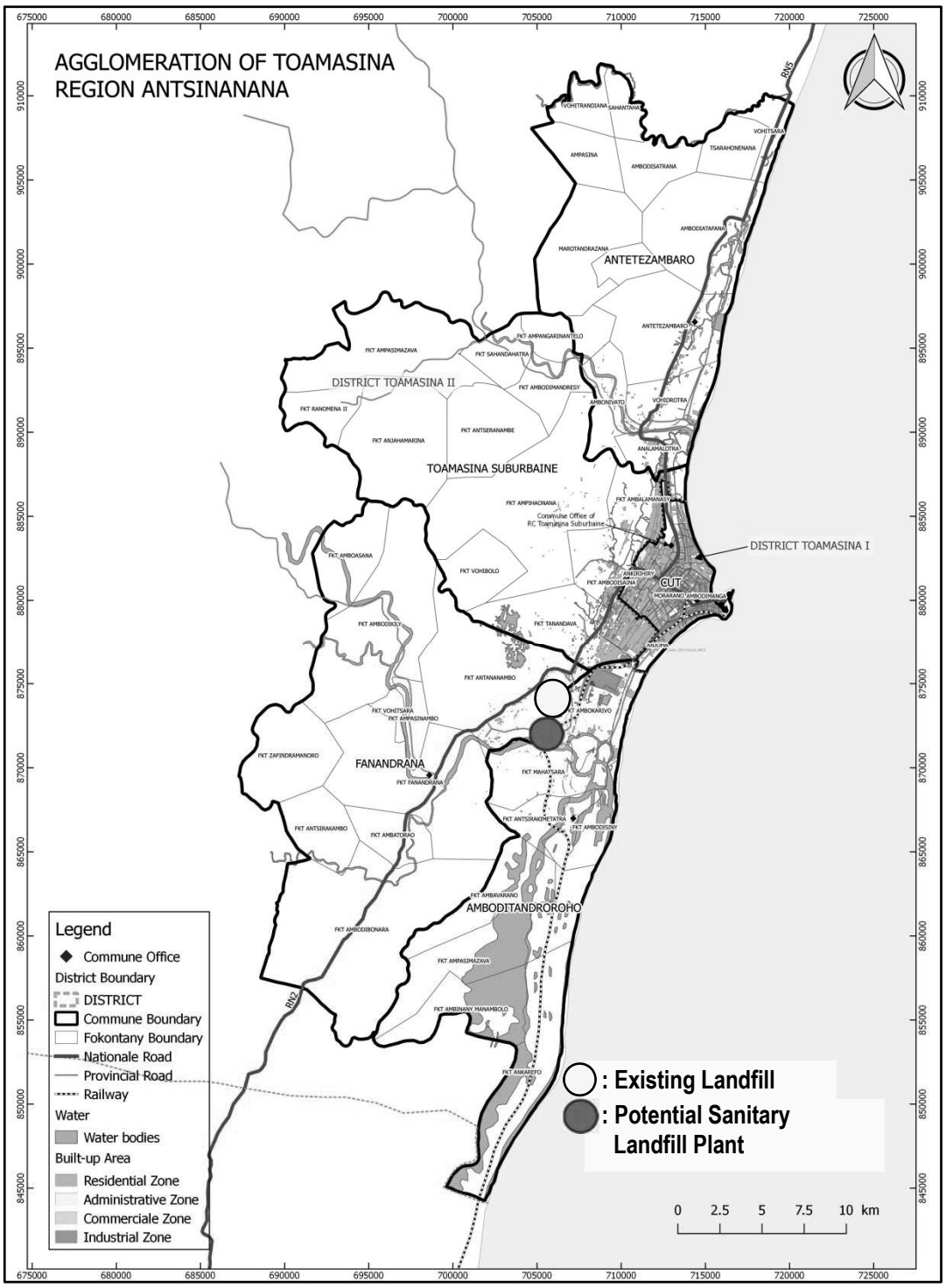
CUT, Toamasina Suburbaine Commune and the 3 rural communes are responsible for collecting and processing the solid waste in their areas of administration. Also, they are responsible for the selection of an appropriate landfill site.

Responsible section or department of the commune has limited SWM activities due to insufficient staffing and budget allocation. For these reasons, it is necessary to revitalise as an organization responsible for SWM services in the future to cope with population increase. Because the organisation structure of SWM department/section can be a future model of SWM services for the neighbouring rural communes of CUT, it is also a good practice to let the rural communes exchange opinions on the organisation structure, roles, responsibility, implementation of the system, etc.

(2) Existing Dumping Site and Potential Sanitary Landfill Facility in Toamasina Agglomeration

A new potential sanitary landfill facility site must be studied and constructed. While the existing dumping site in Amboditandroroho Rural Commune has not reached its capacity yet, considering the rapid population growth of the agglomeration, it is important that studies for a new potential sanitary landfill facility site starts as soon as possible. Figure 21.4.4 shows the locations of existing dump sites and potential sanitary landfill facility in Toamasina Agglomeration.

Additionally, new intermediate treatment and 3R facilities should be developed close to the new sanitary landfill facility. While the SWM system of Toamasina Agglomeration develops into a modern SWM system, there will be more need for intermediate treatment facilities. Moreover, new industrial facilities and new medical facilities will produce more hazardous waste needed to be separated and treated properly.



Notes: RC (Rural Commune)
Source: JICA Study Team, CUT Agglomeration

Figure 21.4.4 Locations of Existing Dump Sites and Potential Sanitary Landfill Facility in Toamasina Agglomeration

21.4.6 Programmes and Projects for Solid Waste Management of Toamasina Agglomeration

The project components for SWM plan are formulated to tackle the measures concerning issues defined in Subsection 21.4.3 which pointed out that the CUT and four rural communes are taking

measures for the preparation of an SWM plan, especially the establishment of a potential landfill facility in Toamasina Agglomeration. The first priority is given to the development of a sanitary landfill plan with intermediate treatment and 3R facilities at the existing dumping site, or in another potential landfill site by the CUT. Responsible public associated organisations in Toamasina Agglomeration as well as the respective rural communes, the Toamasina Suburbaine, and the CUT are the ones to formulate and implement the integrated SWM plan, including a proposed sanitary landfill facility. They should also carry out a feasibility study for the sanitary landfill site selection and the preparation of a detailed design report, under the international donors. The evaluation factors for siting that are adopted in the report composed of the key items derived from the available provisions in Madagascar. These evaluation factors are land area, location, environment, society and economy among others.

The second priority is given to environmental monitoring of a potential sanitary landfill with appurtenant facilities in Amboditandroroho rural commune, or in another potential sanitary landfill site.

The SWM plan is formulated in three stages: short-term from 2019 to 2023, mid-term from 2024 to 2028, and long-term from 2029 to 2033 as shown in the list of projects below.

1) Short-term from 2019 to 2023

- Feasibility study on a potential sanitary landfill facility including intermediate treatment and 3R facilities at the existing open dumping site or in another site
- Detailed design of a potential sanitary landfill plant including intermediate treatment and 3R facilities
- IEC for SWM for Toamasina Agglomeration (1)

2) Mid-term from 2024 to 2028

- Construction of a potential sanitary landfill plant with appurtenant facilities like composting, etc.
- IEC for SWM for Toamasina Agglomeration (2)
- Environmental monitoring of the potential sanitary landfill plant in Amboditandroroho Rural Commune (1) or in another landfill site

3) Long-term from 2029 to 2033

- IEC for SWM for Toamasina Agglomeration (3)
- Environmental monitoring of the potential sanitary landfill plant in Amboditandroroho Rural Commune (2)

21.5 Health Infrastructure in Toamasina Agglomeration

21.5.1 Background on Health Infrastructure in Toamasina Agglomeration

(1) Health Sector in Madagascar

The health care facilities are categorized into the following categories:

- Basic Health Centre (CSB: *Centre de Sante de Base*)
  - CSB Level I (CSB I)
  - CSB Level II (CSB II)
- Reference Hospital
  - District Reference Hospital (CHRD: *Centre Hospitalier de Reference de District*)
  - Regional Reference Hospital (CHRR: *Centre Hospitalier de Reference Regional*)
- University Centre Hospital (CHU: *Centre Hospitalier Universitaire*)

(2) Primary Health Care Facilities and Health Care Personnel

The overview of the current situation of primary health care facilities by commune is presented in Table 21.5.1, Figure 21.5.1 and Figure 21.5.2. The standard for CSB facilities is satisfied in the two communes out of the five communes of Toamasina Agglomeration if all public and private CSBs are taken into account, compared with the standard of one CSB II for a population of 8,000. In Antetezambaro, Toamasina Suburbaine and CUT, the standard for CSB facilities is not satisfied. However, if only public CSBs are considered, the service population of public CSB II exceeds the standard in Antetezambaro, Fanandrana, Toamasina Suburbaine and CUT. In CUT, the public CSBs are insufficient against standard, considering that each of which serves about 54,400 persons, and the private CSBs and clinics are the ones making up for the gap in health care service there.

The current status of health care personnel in public primary health care facilities in the Toamasina Agglomeration is presented in Table 21.5.2 and from Figure 21.5.3 to Figure 21.5.5. The number of health care personnel is not sufficient in all communes, especially in three communes: Toamasina Suburbaine, CUT and Antetezambaro.[1] Furthermore, among the three professionals, nurses are the ones most significantly lacking, followed by doctors and midwives. More nurses are necessary in CUT, Toamasina Suburbaine, Antetezambaro and Fanandrana to meet the standard. Doctors are most needed in Toamasina Suburbaine, followed by CUT and Antetezambaro. The deficiency of midwives is most significant in Antetezambaro, Toamasina Suburbaine and Amboditandroroho.

In addition to the number of facilities and personnel, distribution or location of the health care facilities is another concern. According to Table 21.5.3, 53% of the population have to travel more than 10 km to reach the closest health facility in Antetezambaro. On the other hand, in Amboditandroroho and Toamasina Suburbaine Commune 85% to 91% of the population are not serviced by any CSB within 5 km from their place of residence. As shown in Figure 21.5.6, though most public and private CSBs are located in fokontany near major roads (such as NR 2), there are existing CSBs in some fokontany in mountainous areas of the western part of the Agglomeration. However, CSBs with doctor are not that many, and they are concentrated in the fokontany in the coastal areas. Therefore, the access to medical care provided by doctors becomes an issue for some fokontany, such as the fokontany in the north and the western part of Antetezambaro, fokontany in the north and the centre of Suburban, and the southern fokontany of Amboditandroroho which are separated by Ivondro River and water bodies.

[1] The standards for health care professionals are: one doctor for 10,000 persons; and one nurse and midwife for 5,000 population.

Table 21.5.1 Overview of Primary Health Care Facilities in Toamasina Agglomeration

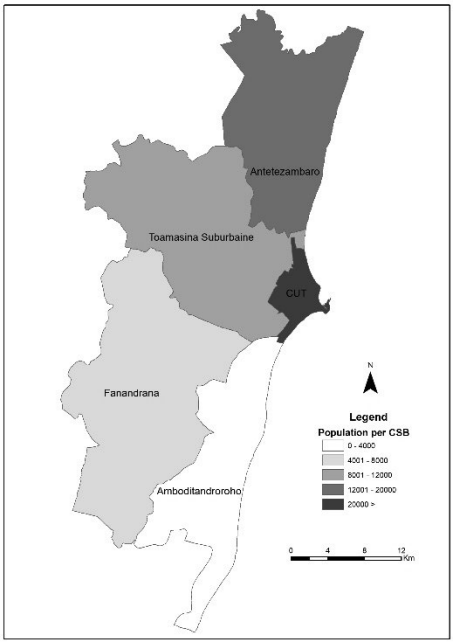
No.	Commune	Population 2018	CSB Total	Public			Private			Population per CSB (All)	Population per Public CSB	Population per Public CSB II
				CSB I	CSB II	Total	CSB I	CSB II	Total			
1	Amboditandroroho	14,493	3	2	1	3	0	0	0	4,831	4,831	14,493
2	Antetezambaro	19,625	2	1	1	2	0	0	0	9,813	9,813	19,625
3	Fanandrana	26,029	4	0	2	2	1	1	2	6,507	13,015	13,015
4	Toamasina Suburbaine	50,571	6	2	2	4	1	1	2	8,429	12,643	25,286
5	CUT	326,286	27	0	6	6	NA	NA	21	12,085	54,381	54,381
	Total	356,469	42	5	13	18	-	-	25	10,405	24,278	33,616

Source: DRSP –Atsinanana (Regional Directorate of Public Health) 2017. Population: JICA Study Team

Table 21.5.2 Overview of Health Care Personnel Working for Public Primary Health Care Facilities in Toamasina Agglomeration

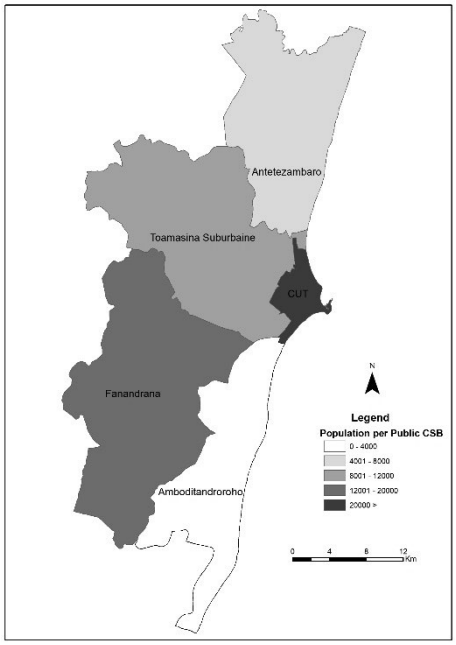
No.	Commune	Population 2018	No. of Health Personnel Working at Public CSBs			Population per Doctor	Population per Nurse	Population per Midwife
			Doctor	Nurse	Midwife			
1	Amboditandroroho	14,493	1	2	0	14,493	7,247	-
2	Antetezambaro	19,625	1	1	1	19,625	19,625	19,625
3	Fanandrana	26,029	2	0	2	13,015	-	13,015
4	Toamasina Suburbaine	50,571	1	1	2	50,571	50,571	25,286
5	CUT	326,286	17	8	36	19,193	40,786	9,064
	Total	356,469	22	12	41	19,864	36,417	10,659

Source: DRSP Atsinanana 2017. Population: JICA Study Team



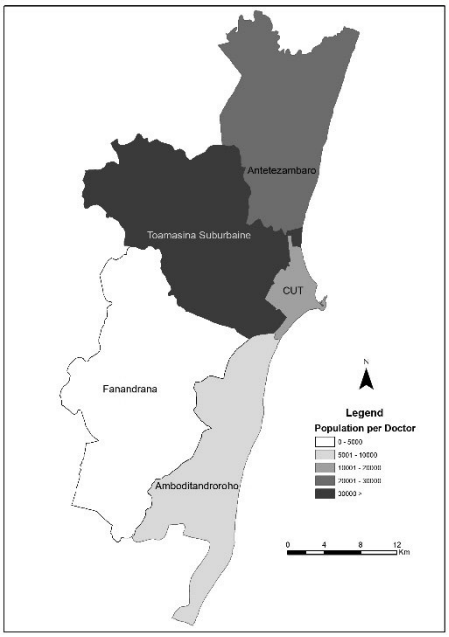
Source: DRSP Atsinanana 2017. Population: JICA Study Team

Figure 21.5.1 Population per CSB (including both public and private) in Toamasina Agglomeration



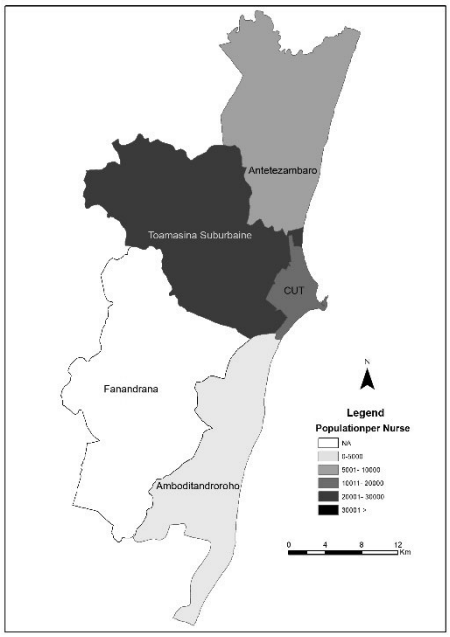
Source: DRSP Atsinanana 2017. Population: JICA Study Team

Figure 21.5.2 Population per public CSB in Toamasina Agglomeration



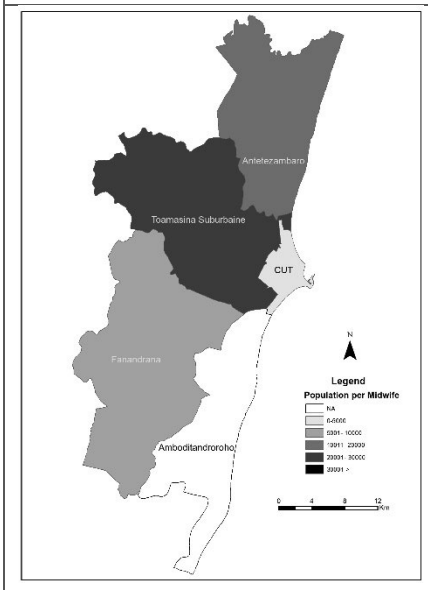
Source: DRSP Atsinanana 2017. Population: JICA Study Team

Figure 21.5.3 Population per Doctor Working at Public CSB in Toamasina Agglomeration



Source: DRSP Atsinanana 2017. Population: JICA Study Team

Figure 21.5.4 Population per Nurse Working at Public CSB in Toamasina Agglomeration



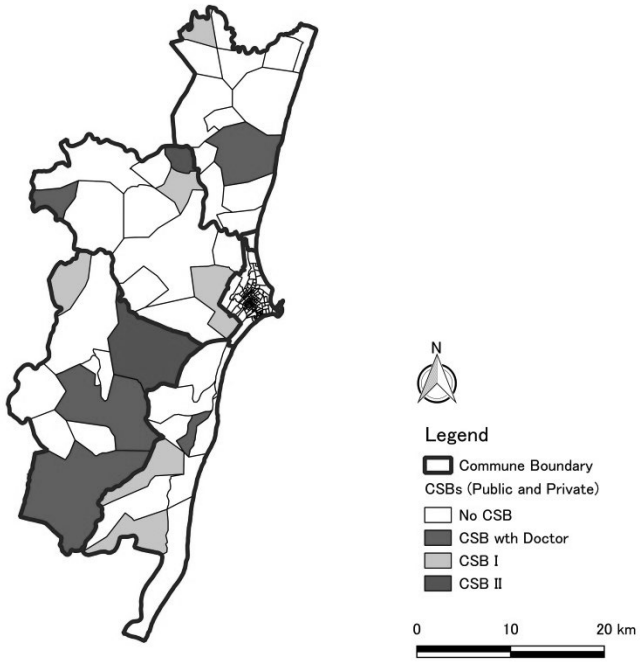
Source: DRSP Atsinanana 2017

Figure 21.5.5 Population per Midwife Working at Public CSB in Toamasina Agglomeration

Table 21.5.3 Accessibility to Primary Health Care Facilities in Toamasina Agglomeration

Commune	< 5 Km	5 - 10 Km	> 10 Km
Amboditandroroho	10%	59%	32%
Antetezambaro	22%	25%	53%
Fanandrana	32%	45%	23%
Toamasina Suburbaine	15%	74%	11%
CUT	47%	53%	0%

Source: DRSP Atsinanana 2017.



Source: DRSP Atsinanana 2017.

Figure 21.5.6 Fokontany with CSBs and Public CSBs with Doctors in Rural Communes in Toamasina Agglomeration

Being the capital of the District of Toamasina I and the Region, CUT has four district reference hospitals and two university centre hospitals. All the CHRDs are private hospitals; however, the CHUs are public. No CHRD is located in the four surrounding communes which are part of Toamasina II District, the residents of the four communes visit the CHRDs in CUT. Table 21.5.4 and Figure 21.5.7 present the brief information and location of CHRDs and CHUs in the Study Area.

Table 21.5.4 District Reference Hospitals (CHRDs) in Toamasina Agglomeration

No.	Type	District	Commune	Name	No. of Doctors	No. of Paramedics (Nurse, Midwife, etc.)	No. of Beds
1	CHRD II	Toamasina I	CUT	Clinique Mére-Enfant JN	2 - General practitioners 1 - Gynaecologist	3 Midwives 3 Nurse assistants	18
2	CHRD II	Toamasina I	CUT	Clinique "Soamiafara"Ambodimanga	2 - General practitioners 1 - Gynaecologist	NA	7
3	CHRD II	Toamasina I	CUT	Clinique MSI Toamasina	3 - General practitioners 1 - Gynaecologist	2- Midwives 2 Nurses 1 laboratory assistant 1 Anesthetist	12
4	CHRD II	Toamasina I	CUT	Clinique Saint-Laurent Laperouse	3 - General practitioners 1 - Gynaecologist	2- Midwives 2 Nurses 1 laboratory assistant	6
5	CHU	Toamasina I	CUT	CHU Hopital BE	3 - Professors 56- Doctors	114-Paramedics 6 -Medical technicians	414
6	CHU	Toamasina I	CUT	CHU Morafeno	29- Medical Staff	39- Paramedics	120

Source : Health Personnel Management Support /DRH/MSP March 2017

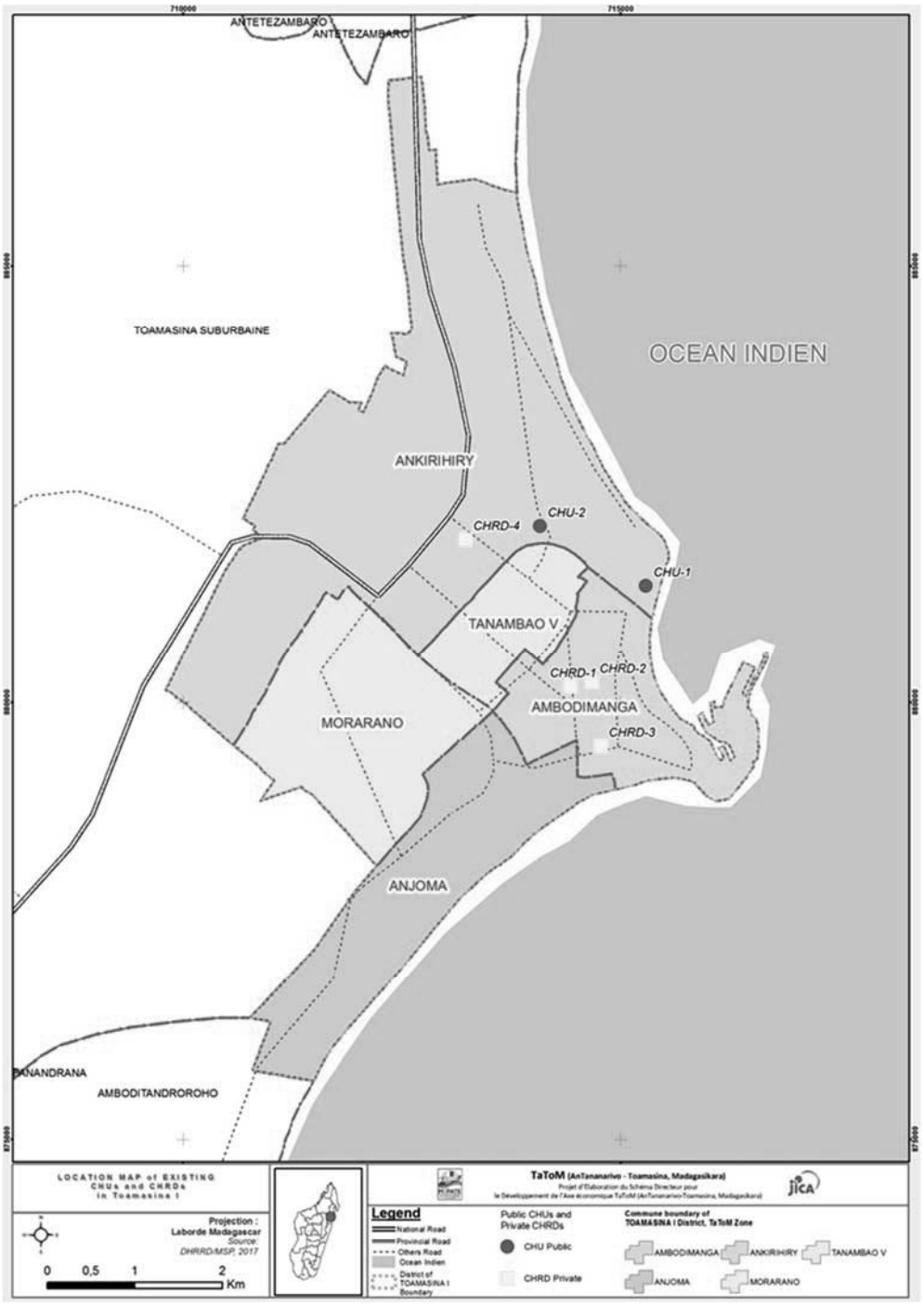


Figure 21.5.7 Location Map of CHRDs and CHUs in Toamasina Agglomeration

21.5.2 Issues on Health Infrastructure in Toamasina Agglomeration

The issues concerned with health care infrastructure in Toamasina Agglomeration are summarised as follows:

1) Access to primary health care facilities in rural communes
2) Insufficient provision of public primary health care services in CUT
3) Lack of health care personnel

Firstly, access to primary health care facilities is an important issue for the rural communes, because of insufficient provision and uneven distribution of the facilities. In particular, this is a serious challenge for Antetezambaro and Amboditandroroho. In Antetezambaro, both the

quantity and distribution of CSBs are not sufficient. On the other hand, the lack of road access and limitation of river transportation are critical concerns in the provision of health care in Amboditandroroho. The transport access in the inland fokontany in Suburban Commune should be improved as well. It is also important to consider the location and access to CSBs with doctor, since doctors are stationed in a handful CSBs. According to the standard of the Ministry of Public Health, a doctor is in residence in CSB II only; therefore, the spatial distribution of two basic health care facilities, CSB I and CSB II, should be more carefully examined regardless of the commune boundaries within the agglomeration. Thus, the construction of additional CSB(s) and the improvement of transport access to health care facilities, especially to the ones with doctor should be considered in the mountainous / remote fokontany of the rural communes and to be taken into account in the preparation of a development plan of the health care infrastructure. An option worth examining is to establish a road access to a CSB in a neighbouring commune, disregarding commune boundary, if said CSB is the nearest one.

Secondly, provision of affordable primary health care is an essential issue in CUT, because it is close to the standard of the number of primary health care facilities, if the private facilities are taken into account. There are also CHRDs available. The population of Toamasina Agglomeration increased at 3.5% per annum in the last decade and the growth is estimated to accelerate to 4% rate by 2033.[2] Because a large portion of the population growth is expected in CUT, and the number of needy families and vulnerable population are also expected to rise, the provision of affordable primary health care at public CSB should be increased to correspond to population growth in current and expected urbanised areas.

Lastly, a lack of health care personnel such as doctors, nurses, and midwives at public primary health care facilities is a common issue in all the communes. In particular, the public CSBs in Antetezambaro and Toamasina Suburbaine do not have sufficient health care staff. Nurses are most needed in the two communes, followed by midwives and doctors. The deficiency of nurses is significant in CUT as well. The health care personnel are relatively available in Fanandrana and Amboditandroroho; however, no nurse or midwife is stationed in any of the CSBs in Fanandrana and Amboditandroroho, respectively. Furthermore, though data is not provided in this report, no dental service is available in the rural communes. Although the Ministry of Public Health provides incentives for medical personnel staying in remote and isolated communities, it is difficult to make them stay in rural fokontany. By providing education and training, and recruiting of personnel, considerable effort is necessary to increase availability of health care professionals, especially in rural communes.

The three development issues concerned with health infrastructure discussed above (i.e., the lack of and accessibility to health care facilities, and insufficient health care personnel) are mutually related. In order to provide necessary health care services, the location, road networks and transport access, types of CSBs, and availability of workforce should be simultaneously considered in the Agglomeration as a whole, rather than by commune; and this should be the approach in the preparation of a development plan on health care infrastructure, although this study does not directly deal with the issue on health care personnel.

21.5.3 Objectives for Health Infrastructure Development in Toamasina Agglomeration

From the discussion and analysis of the current situation, the objectives for health care infrastructure development in Toamasina Agglomeration are proposed as follows:

Objective 1: To expand access to affordable primary health care in CUT and urbanized areas

[2] JICA Study Team estimate.

- By improving access to primary health care, especially for the vulnerable and in highly populated areas
- By developing public CSBs to meet increasing needs for health service in the areas with high population growth and to be urbanized

Objective 2: To improve access to primary health care facilities in rural communes

- By constructing a new public CSB facility to meet the standard of the health care facilities
- By improving road / transport access to primary health care facilities

Objective 3: To develop a CHRD for the provision of advanced medical care

Objective 4: To make public CSBs disaster resilient especially against typhoon.

Objective 5: To increase the number of health care professionals at public health care facilities and improve access to the medical care provided by doctor

21.5.4 Strategies for Health Sector of Toamasina Agglomeration

In order to achieve the objectives and to address the issues stated above, the strategies are identified as follows:

(1) Strategy 1: To develop public CSBs in highly populated areas and in residential areas with concentration of low-income families in CUT and suburban areas,

Because the majority of health care service providers are private health clinics, the provision of affordable health care service is an issue in CUT. In order to provide affordable primary health care to low income families, this strategy aims to develop new public CSBs in highly populated areas and in residential areas of CUT and suburban areas where the concentration of low-income families is identified.

(2) Strategy 2: To systematically develop public CSBs with residential development project in the suburban areas where high population growth is expected

In addition to Strategy 1 targeting inside CUT, affordable primary health care should be provided in the areas to be urbanized in future where would be resided by incoming migrant population including low-income and vulnerable families. Thus, this strategy tries to develop public CSBs in urbanizing areas at the same pace with the process of urbanization, by incorporating the plan and location of CSBs in the development plan of those areas in advance.

(3) Strategy 3: To develop new CSBs in rural centres of rural communes, with good access from the surrounding areas

The first strategy intends to improve primary health care provision and access in the rural communes by constructing new CSBs in rural centres which are accessible from surrounding fokontany. The centres in rural communes include the current and centres to be developed in rural communes. A choice of CSB type, either CSB I or CSB II will be determined based on the consideration on the accessibility, service population, health staff and quality of health service to be provided.

(4) Strategy 4: To improve road / transport access, especially in remote areas, considering the spatial distribution of CSBs

This strategy aims to address the issue of transport access to primary health care centres by developing commune roads or other type of transport access such as river transportation, if it is applicable. Because transport access is one of key issues in rural communes, in addition to the lack of the health care facilities, access to health facilities should be considered, based on the future transport network and the distribution of the health facilities.

(5) Strategy 5: To construct a new CHRD in the suburban area of CUT

Because the existing CHRDs and CHUs are located in the urbanized area of CUT, a strategy is suggested to construct a new CHRD in the suburban area of CUT or in a fokontany of a rural commune near CUT. This CHRD will be equipped with state-of-the-art medical devices and aims to offer advanced medical care.

(6) Strategy 6: To assess disaster resilience of the health facilities and improve resilience of the health facilities by installing disaster risk mitigation measures especially against hurricane

Toamasina Agglomeration is often hit by hurricane and suffers from the damage from it. This strategy is to make the health facilities in the agglomeration, including CSBs, CHRDs and CHUs disaster resilient, especially against hurricane by evaluating the disaster resilience of the health facilities and installing necessary risk mitigation measures to the facilities.

(7) Strategy 7: To accelerate education and training of health care professionals, and assign them in public CSBs

In order to deal with the lack of health care personnel, this strategy aims to increase health care professionals at public health care facilities by encouraging education and training of new health care workers from the local population and providing certain incentives to stay in remote areas.

21.5.5 Programmes and Projects for Health Sector of Toamasina Agglomeration

(1) CSB Development Project for Improvement of Primary Health Care Provision in CUT

This project aims to develop public CSBs in CUT where the public primary health care facility is significantly lacking and the standard of the facilities is not satisfied. The project will include assessment of concentration of the low-income families and the vulnerable population, affordability, preparation of project proposals, selection of priority projects, feasibility study, and construction of the CSBs.

(2) CSB Development Project in Newly Urbanized Suburban Area of CUT

This project aims to develop public CSBs in newly urbanized suburban areas of CUT. By 2033, the urbanized area of the Toamasina Agglomeration will be expanded to include some fokontany of Toamasina Suburbaine, Antetezambaro and Amboditandroroho adjacent to CUT. Some of these new residential areas will be developed by applying site and service scheme or by the private sector. A plan of public CSBs should be incorporated in development plans such as the PUDé of these new residential areas in advance. This project is to construct public CSBs as one of the basic facilities to be developed in the plan.

(3) CSB Development Project for Improvement of Primary Health Care Provision in Rural Communes

This project aims to develop public CSBs in rural communes where primary health care facility is lacking and access to primary health care is constrained. The project will assess the availability and distribution of the existing CSBs and transport means and road access to primary health care services in adjacent areas, select and prioritize the priority areas, propose the projects, select priority projects, and construct CSBs.

(4) Health Care Facilities Access Improvement Project

The objective of this project is to improve transport access to a health care facility in the rural communes. In order to improve the transport access, the project will include the components of commune road improvement and river transport access, depending on the local situation. River transportation is used not only in Amboditandroroho but also in some inland areas of other communes. Based on the transport plan and future network in PUDi, the project will identify

and prioritize the potential projects, conduct a feasibility study of the priority projects, and implement the selected projects.

(5) Development Project of an Advanced Medical Hospital

This project intends to develop an advanced medical hospital such as CHRD in suburban area of CUT. The hospital is to provide advanced medical care, including emergency service, which will be equipped with state-of-the-art clinical devices. As a result, expats, international tourists, and well-off persons will be able to be treated in Toamasina. A development plan of the hospital should be recognized/ reflected in PUDi and the location of the hospital will be specified in the PUDé before the project. The project will be implemented in pace with the development of the suburban areas.

(6) Project for Disaster Resilience Improvement of Health Care Facilities

This project is to enhance disaster resilience of health care facilities in Toamasina Agglomeration. The targeted health facilities will include public CSBs, and CHRDs and CHUs, though the private health facilities are only the subject of the assessment. The project will conduct tasks of assessment of disaster risk of the location of health facilities based on hazard maps of various risk, especially of hurricane, evaluation of disaster resilience of the structure of health care facilities, identification and prioritization of necessary measures to strengthen disaster resilience of the facilities, cost estimation and evaluation of benefits of the projects, and implementation of the priority projects.

(7) Programme for Human Resource Development in Health Sector

Human resource for the health sector should be improved for improvement of public health care services. This project will educate prospective health workers and provide training to the existing paramedical staff such as nurses and midwives who are working at the public CSBs and health care facilities. Also, the project will propose some incentives to encourage the health care professionals to stay in rural areas. The target health care personnel will focus on the staff originated from the Study Area.

21.6 Education Infrastructure in Toamasina Agglomeration

21.6.1 Background on Education Infrastructure in Toamasina Agglomeration

In this section, the current situation of the education infrastructure in Toamasina Agglomeration is reviewed before discussion on the issues and development directions. The current situation of school infrastructure is evaluated in accordance with the standard of **50 students per classroom** for all school levels.

In Toamasina Agglomeration, significant needs for classrooms are identified in public primary schools in CUT, followed by Amboditandroroho and Fanandrana. In CUT, additional 107 classrooms are required to meet the standard. The private primary schools play an important role to complement the insufficient capacity of the public schools there. There exist 87 private primary schools in which about 50% of the total primary students in the commune are enrolled.[1] The congestion in the primary schools in Amboditandroroho is highlighted with the highest number of 83 students per classroom. On the other hand, the public primary schools in Antetezambaro and Toamasina Suburbaine Commune have sufficient capacity. In rural communes, at least one primary school is located in each fokontany. (See Figure 21.6.1 and Table 21.6.1).

Meanwhile, the public secondary schools in all communes need additional classrooms to meet the standard of 50 students per classroom. Similar to the situation of the primary schools, needs for more than 100 classrooms are observed in CUT, followed by Toamasina Suburbaine and Fanandrana. The secondary school classrooms in CUT and Toamasina Suburbaine accommodate almost 100 students, which is double the standard. In four rural communes, there are only a few secondary schools in each. It is suspected that access to secondary school might become an obstacle to continue their education for some children in remote fokontany. There are 29 private secondary schools in CUT, where about 20% of the total secondary school students of the commune are studying. (See Table 21.6.2, Figure 21.6.2 and Table 21.6.3).

There are only two public high schools in Toamasina Agglomeration, in CUT and Toamasina Suburbaine Commune. Both schools need additional classrooms to meet the standard; 17 and 10 classrooms are necessary for the school in CUT and Toamasina Suburbaine, respectively. (See Table 21.6.4 and Figure 21.6.3.) There were seven private high schools in CUT as of 2008. A lack of high school in rural communes might impose a great burden on the students in the Communes of Amboditandroroho, Antetezambaro and Fanandrana to continue their high school studies, since they cannot commute to school and have to seek an accommodation in CUT or Toamasina Suburbaine Commune.

The allocation of teaching staff in public primary and secondary schools is presented in Table 21.6.5. On the average, the sufficient number of teaching staff is allocated to the primary and secondary schools in Toamasina Agglomeration. The exception is the primary schools in Amboditandroroho and the secondary schools in Antetezambaro. In the two communes, the pupil-teacher ratios exceed 60 pupils per teacher. (See Figure 21.6.4 and Figure 21.6.5).

[1] 16,632 students were enrolled in the private primary schools in CUT (MEI/CREAM/Monography 2008 in Monography Region Atsinanana 2013.)

Table 21.6.1 Current Situation of Public Primary Schools in Toamasina Agglomeration

Commune	Population 2018	Fokontany	No. of Schools	No. of Students	No. of Classrooms	Students/ Classroom	Desired No. of Classrooms*	Classroom Needs
Amboditandroroho	14,493	11	17	3,643	44	83	73	29
Antetezambaro	19,625	14	19	3,162	63	50	63	0
Fanandrana	26,029	10	19	3,148	54	58	63	9
Toamasina Suburbaine	50,571	12	23	2,033	71	29	41	0
CUT	326,286	138	24	15,185	197	77	304	107
Total	437,004	185	104	27,171	429	63	543	114

Source: DREN Atsinanana, 2015/2016. Population: JICA Study Team

Table 21.6.2 Current Situation of Public Secondary Schools in Toamasina Agglomeration

Commune	Population 2018	Fokontany	No. of Schools	No. of Students	No. of Classrooms	Students/ Classroom	Desired No. of Classrooms*	Classrooms Needed
Amboditandroroho	14,493	11	1	277	5	55	6	1
Antetezambaro	19,625	14	1	538	8	67	11	3
Fanandrana	26,029	10	3	1,194	19	63	24	5
Toamasina Suburbaine	50,571	12	2	756	8	95	15	7
CUT	326,286	138	7	11,553	116	100	231	115
Total	437,004	185	14	14,318	156	92	286	130

Source: DREN Atsinanana, 2015/2016. Population: JICA Study Team

Table 21.6.3 Current Situation of Private Primary and Secondary Schools in Toamasina I and II

District	Primary School				Secondary School			
	No. of Schools	No. of Classrooms	No. of Students	Students/ Classroom	No. of Schools	No. of Classrooms	No. of Students	Students/ Classroom
Toamasina I	87	500	16,632	33	29	180	2,683	15
Toamasina II	11	48	8,755	182	4	11	2,048	186

Source: MEI/CREAM/Monography 2008 in Monography Region Atsinanana 2013.

Table 21.6.4 Current Situation of Public High Schools in Toamasina Agglomeration

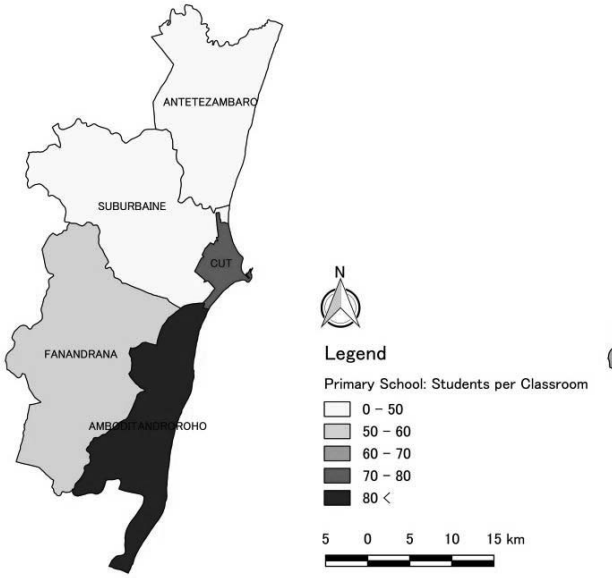
Commune	Population 2018	Fokontany	No. of Schools	No. of Students	No. of Classrooms	Students/ Classroom	Desired No. of Classrooms*	Classroom Needs
Amboditandroroho	14,493	11	-	-	-	-	-	-
Antetezambaro	19,625	14	-	-	-	-	-	-
Fanandrana	26,029	10	-	-	-	-	-	-
Toamasina Suburbaine	50,571	12	1	1,525	21	73	31	10
CUT	326,286	138	1	3,949	62	64	79	17
Total	437,004	185	2	5,474	83	66	109	26

Source: DREN Atsinanana, 2015/2016. Population: JICA Study Team

Table 21.6.5 Current Situation of Teaching Staff in Public Primary and Secondary Schools in Toamasina Agglomeration

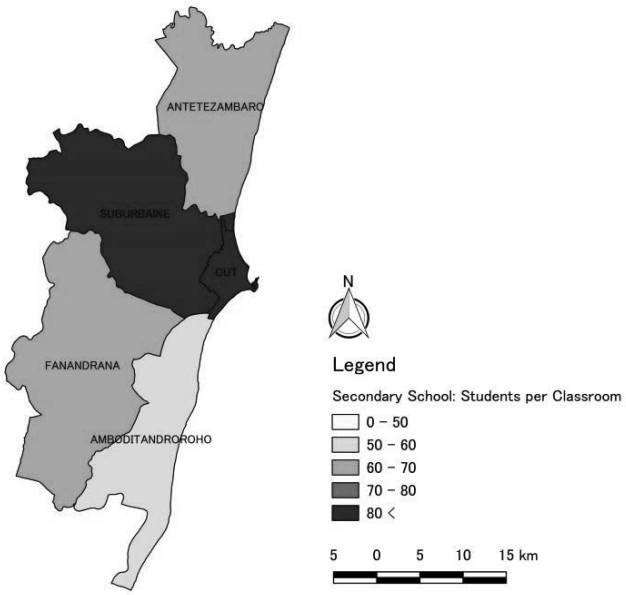
Commune	Pupils		Teachers		Pupil-Teacher Ratio (Net)	
	Primary	Secondary	Primary	Secondary	Primary	Secondary
Amboditandroroho	3,643	277	53	10	69	28
Antetezambaro	3,162	538	71	9	45	60
Fanandrana	3,148	1,194	63	31	50	39
Toamasina Suburbaine	2,033	756	98	26	21	29
CUT	15,185	11,553	335	345	45	33
Total	27,171	14,318	620	421	44	34

Source: DREN Atsinanana, 2015/2016.



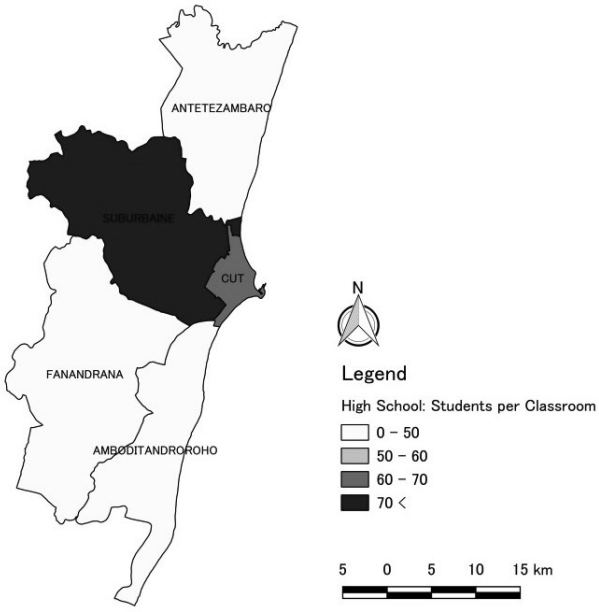
Source: DREN Atsinanana, 2015/2016.

Figure 21.6.1 Students per Classroom in Public Primary Schools



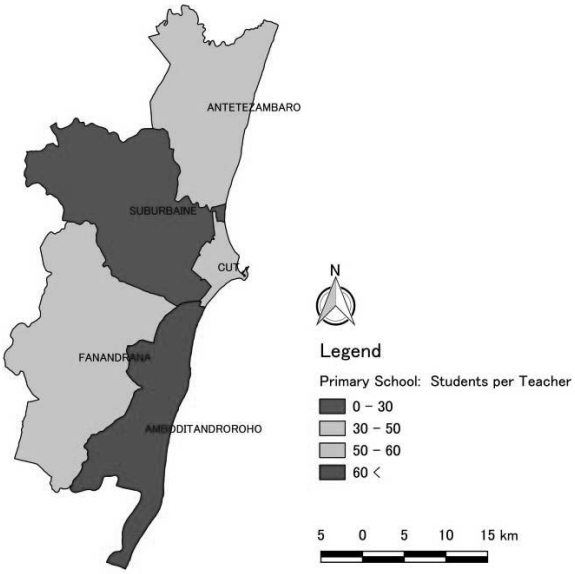
Source: DREN Atsinanana, 2015/2016.

Figure 21.6.2 Students per Classroom in Public Secondary Schools



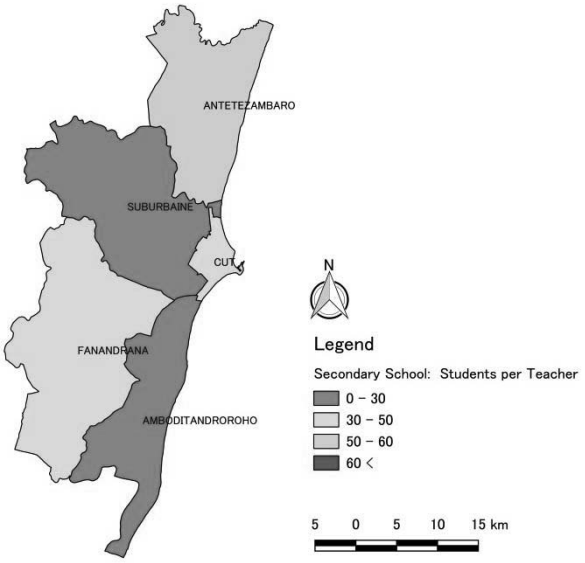
Source: DREN Atsinanana, 2015/2016.

Figure 21.6.3 Students per Classroom in Public High Schools



Source: DREN Atsinanana, 2015/2016.

Figure 21.6.4 Students per Teacher in Public Primary Schools



Source: DREN Atsinanana, 2015/2016.

Figure 21.6.5 Students per Teacher in Public Secondary Schools

There are five public and one private institutions of higher education in Toamasina Agglomeration as presented in Table 21.6.6. The first five public institutions (from No. 1 to 5) compose the University of Toamasina system. All of these institutions, except one, are located in Toamasina Suburbaine Commune.

Table 21.6.6 List of Universities and Institutions for Higher Education in Toamasina Agglomeration

No.	Name of University	Public/ Private	Location	Commune	No. of Students
1	Faculty of Economics and Management	FAC/EG	Barikadimy	Toamasina Suburbaine	6,862
2	Faculty of Arts and Humanities	FAC/LSH	Barikadimy	Toamasina Suburbaine	2,034
3	Medical School	FAC/MED	Barikadimy	Toamasina Suburbaine	565
4	Higher Institute of Sciences, Environment, and Sustainable Development	ISSEDD	Barikadimy	Toamasina Suburbaine	288
5	Automated Management Centre / Higher Professional Management Institute	CAG/ISPG	Barikadimy	Toamasina Suburbaine	83
6	School of Penitentiary Administration	-	Ambodiatafana	Antetezambaro	-
PRIVATE UNIVERSITY					
1	Technical Training Institute	IFT-Toamasina	Barikadimy	Toamasina Suburbaine	309

21.6.2 Issues on Education Infrastructure in Toamasina Agglomeration

From the analysis of the current situation and the direction of spatial development in Toamasina Agglomeration, the issues concerned with the education infrastructure are identified below:

- Lack of primary and secondary schools in CUT
- Increasing needs for secondary schools in rural communes
- Need to expand the capacity of primary schools in selected communes to accommodate student population
- Lack of the capacity of the current high schools, and need for a new high school for rural communes
- School facilities are not disaster resilient

In Toamasina Agglomeration, the most impending issue would be CUT's insufficient capacity of primary and secondary schools to accommodate student population. As shown in Figure 21.6.6, the classroom needs in public primary and secondary schools exceed 100 classrooms. In

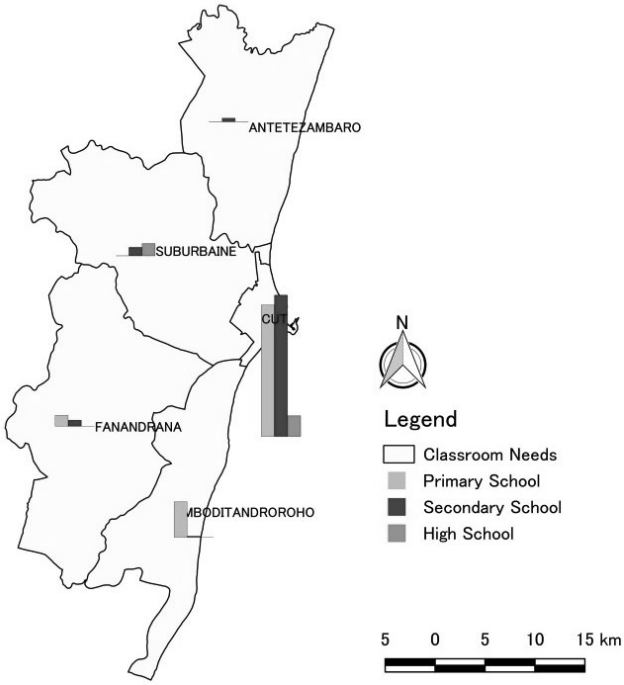
public secondary schools, each classroom accommodates 100 students. Currently, 75% of the total population in Toamasina Agglomeration resides in CUT and the population of the Agglomeration is estimated to be doubled by 2033 (see Table 21.6.7). Moreover, the current enrolment ratio in Toamasina Agglomeration is lower than the national average as presented in Table 21.6.8 and Table 21.6.9. However, the enrolment ratio should be improved to achieve the target set in PSE (see Table 21.6.10). Thus, it is to be expected that the needs for the primary and secondary schools in CUT will expand, because of the increase in enrolment rates along with population growth. Since the private primary schools accept about half of all primary school students in CUT, expansion of the capacity of both its public and private primary schools should be considered.

Secondly, it is necessary to expand the capacity of secondary schools in the rural communes to accommodate student population in the future. Currently, the deficiency of classrooms in secondary schools in these areas is not as serious as in CUT. However, it is important to prepare ahead for the expansion of the secondary schools because of the transition to new 9-year fundamental education, which aims to increase the enrolment rate in secondary schools. A concern related to expansion of the capacity of secondary schools in rural communes is accessibility and lack of boarding facilities. There is only one secondary school in each of Amboditandroroho and Antetezambaro, though there is a plan to build a new secondary school in Antetezambaro. Because it is unrealistic to build a secondary school in every fokontany, and therefore, secondary schools would be located in only selected fokontany for a time being, it is inevitable for some students in remote areas to leave their homes and stay in the area near secondary schools. Thus, the development of secondary schools in rural communes should take into account accessibility to the schools and possibility of establishing boarding houses.

The lack of classrooms in primary schools in some rural communes should be addressed by expanding the capacity of the primary schools to accommodate student population. In particular, Amboditandroroho needs additional 29 classrooms. Because of the geographical characteristics of the commune causing the constraint on transport access, it is important to develop sufficient number of classrooms of the schools at accessible location. On the other hand, it is anticipated in Fanandrana that its population growth, the area being located along NR 2, is raising the demand for schools. Though the lack of the capacity of primary schools in rural communes (with the exception of two communes) is not significant, the population growth by 2033 is expected to occur in the rural communes, since CUT is already congested. It is also essential to consider how to expand the capacity of primary schools in the areas adjacent to CUT, and access to the schools in mountainous areas and remote fokontany.

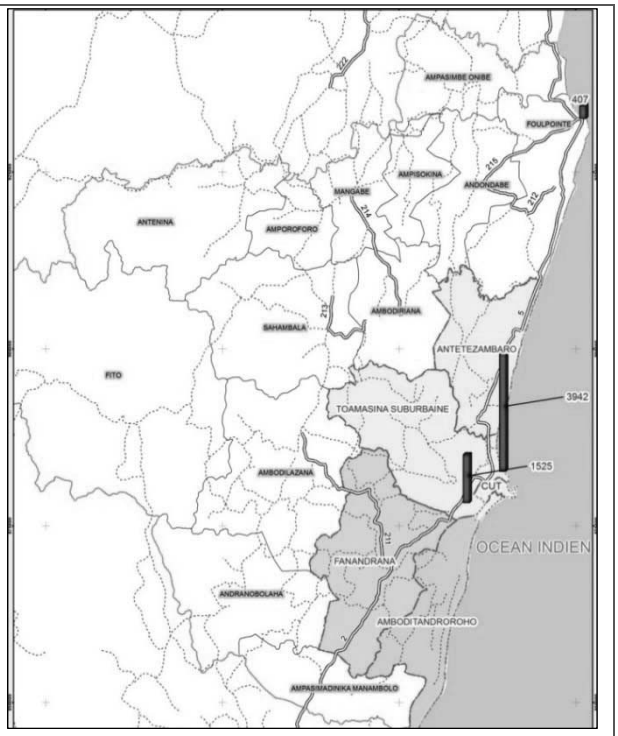
The expansion of the capacity of high schools to accommodate student population needs to be considered in planning of PUDi. The existing two high schools in CUT and Toamasina Suburbaine do not have sufficient classrooms to meet the standard of 50 students per classroom; in fact, the high school in CUT is one of the largest high schools in the country, having nearly 4,000 students. Thus, it is necessary to build a new high school in one of the rural communes as a priority, in addition to expanding the current schools. Because there is no high school in the southwestern part of the District of Toamasina II, one possible location would be in the southern area of Toamasina Agglomeration, such as Fanandrana (See Table 21.6.10.)

Lastly, disaster resilience of school facilities should be improved. Since hurricane hits Toamasina every year, damage to the school facilities by hurricane is reported, specifically in the communes near coastal areas, such as Amboditandroroho. The disaster resilience of school facilities, especially against hurricane, should be taken into account in the projects for school building construction and rehabilitation.



Source: DREN Atsinanana, 2015/2016.

Figure 21.6.6 Classroom Needs in Public Primary, Secondary, and High Schools



Source: DREN Atsinanana, 2015/2016.

Figure 21.6.7 Location and Number of Students of High Schools

Table 21.6.7 Population Framework by 2033

		1993	2018	2033
Toamasina Agglomeration	Population	165,464	437,004	762,839
	Annual Growth Rate		3.96%	3.78%

Source: JICA Study Team

Table 21.6.8 Admission Rate in the 1st Grade at Primary School in Atsinanana Region

	Admission Rate (Grade 1)		Enrolment Ratio	
	Net	Gross	Net	Gross
Atsinanana Region	21.0%	93.4%	-	-
Urban (excluding Antananarivo)	-	-	84.4%	127.8%
Rural	-	-	66.1%	105.7%
National	26.8%	99.5%	69.4%	108.4%

Source: INSTAT/ ENSOMD 2012-2013

Table 21.6.9 Enrolment Ratio at Secondary and High School in Atsinanana Region

	Secondary School		High School	
	Net	Gross	Net	Gross
Atsinanana Region	20.2%	35.8%	-	-
Urban (excluding Antananarivo)	54.8%	88.2%	28.2%	72.0%
Rural	22.3%	37.5%	5.9%	13.6%
National	27.8%	45.5%	10.0%	23.4%

Source: INSTAT/ ENSOMD 2012-2013

Table 21.6.10 Target Indicators by 2030 in PSE

	2015	2022	2030*	2030**
Primary Completion Rate	69%	70%	100%	100%
Effective Transition Rate from Primary to Secondary General	83%	88%	97%	93%
Secondary 1st Cycle Completion Rate	38%	44%	89%	88%
Secondary 2nd Cycle Completion Rate	18%	18%	25%	42%

Source: PSE 2018-2022

* Scenario that assumes external financing to achieve the SDG 4

** Scenario that assumes a constant external financing

21.6.3 Objectives of Education Infrastructure Development in Toamasina Agglomeration

Based on the analysis and discussion of the current situations of educational infrastructure in Toamasina Agglomeration, the objectives of the educational infrastructure development in PUDi 2033 are proposed as follows:

Objective 1: To expand the capacity of primary and secondary schools in CUT and urbanised areas for them to be able to meet current and future demand, and for them to achieve the standards for school facilities

- By increasing the capacity of public schools by developing new public primary and secondary schools in newly developed areas so as to expand existing public schools' capacity in urbanised areas
- By expanding the capacity of private schools through proper guidance and regulations

Objective 2: To improve the accessibility to primary education of the residents of rural communes thereby achieving 100% enrolment ratio

- By building primary schools in remote areas
- By improving transport access to the schools
- By expanding the capacity of the existing schools

Objective 3: To develop new secondary schools in rural centres and expand the capacity of the secondary schools in rural communes

Objective 4: To develop a new high school in one of the rural communes to expand the capacity of high schools

Objective 5: To make school buildings disaster resilient, especially against hurricane

21.6.4 Strategies for Education Infrastructure Development in Toamasina Agglomeration

In order to achieve the objectives and address the issues stated above, the strategies for each are identified as follows:

(1) Strategy 1: To expand the capacity of primary and secondary schools in CUT and the areas to be urbanized

In order to expand the capacity of primary and secondary schools in CUT and in the future urbanized area, three sub-strategies are identified. Strategy 1-1 aims to develop new public primary and secondary schools in the newly urbanized areas in CUT and in surrounding areas. These new schools will be designed to correspond to newly introduced 9-year education system. Strategy 1-2 intends to construct additional classrooms in the existing schools in urbanized areas, and to build mid/high-rise school building in the highly congested areas. Strategy 1-3 tries to

expand the supply of education service by the private sector, since the need for schools cannot be fulfilled by the public sector alone.

Strategy 1-1: To construct new public primary and secondary schools in newly urbanized areas of CUT and surrounding areas by planning the school facilities and secure the lands in the development plan

Strategy 1-2: To expand the capacity of the public primary and secondary schools in urbanized areas of CUT through construction of additional classrooms and mid/high-rise school facilities

Strategy 1-3: To improve the capacity and quality of private schools by improving the study environment, monitoring and evaluation, conducting training to instructors, and providing supports

(2) Strategy 2: To make primary education accessible to all residents of rural communes and to achieve the standard of the education facilities

Strategy 2, consisting of three sub-strategies, is to achieve Objective 2 focusing on the improvement of primary education in rural communes. Strategy 2-1 aims to address the issue of the deficiency of primary schools in remote or isolated areas, while Strategy 2-2 tries to cope with physical accessibility by improving roads and transport access. Strategy 2-3 is to prepare the capacity of primary schools to meet the growing future demand, especially in rural centres and other areas with development potential.

Strategy 2-1: To construct new primary schools in the remote areas so that all children can commute to primary school

Strategy 2-2: To improve roads and other transport access to school (such as river transportation)

Strategy 2-3: To estimate the future demand for the schools and expand the capacity of the existing schools in rural centres and areas where population growth is expected

(3) Strategy 3: To plan development of secondary school, and to develop secondary schools along with the development process in rural centres

This strategy intends to develop secondary schools in rural centres in order to deal with the expected demand for secondary education. The target is centres in the rural communes where good transport access can be established, and which have potential to be developed by 2033. The expansion of secondary schools will be planned as part of the spatial plan of the centres in advance, based on the estimation of the future demand and be developed in the process.

(4) Strategy 4: To construct a new high school in a rural commune

To address the deficiency of high school in Toamasina Agglomeration, Strategy 4 suggests construction of a new high school in a sub-centre in one of rural communes to be developed as a new centre in the rural area. The plan of new high school should be incorporated ahead into the spatial development plan.

(5) Strategy 5: To improve disaster resilience of the school facilities, especially against hurricane, in high risk areas

Due to the periodical damage by hurricanes, Strategy 5 aims to enhance the disaster resilience of public schools in high risk areas. By improving disaster resilience, the school facilities can be used not only as evacuation centres but also as multi-functional facilities for community activities.

21.6.5 Programmes and Projects for Education Infrastructure Development of Toamasina Agglomeration

(1) The Project for Construction of New Public Schools for 9-year Fundamental Education (Primary and Secondary) in Newly Developed Areas of CUT and Surrounding Areas

This project is to develop new public schools for the 9-year fundamental education in the areas to be newly urbanised in CUT and surrounding areas. Because the urbanized areas of CUT are already congested and population growth is expected to occur in the suburban areas, this project aims to plan necessary education infrastructure as part of the development plan, and develop new public schools in such areas along with residential development. By developing education facilities ahead, the residential areas will have liveable environment with necessary social infrastructure and will attract residents from the congested urban centres. The school buildings will be designed to have necessary disaster resilience and to function as multifunctional facility, i.e., community centre cum evacuation centre during times of disaster.

(2) The Project for the Expansion of Public Primary and Secondary School's Capacity in CUT

This project is to expand the capacity of primary and secondary schools in the urbanized areas of CUT. In this project, classrooms will be constructed to the existing schools and the effective use of the land will be pursued by construction of mid/high-rise public school buildings in congested areas. In the project, the disaster resilience of the school facilities will be examined and strengthened.

(3) Private School Improvement and Capacity Expansion Programme

The importance of the private sector in education cannot be ignored now and in future, because the nearly half of the primary school students in CUT are attending private schools, and shortage of schools in CUT would not be resolved by the sole efforts of the public sector. The private schools' pupil-teacher ratio in CUT is still below the standard, so that the private schools have the capacity to accept additional students. In order to fully utilize the capacity and potential of the private schools, this project will provide support to the private schools to improve their study environment and the quality of teaching, strengthen monitoring and management of the private schools, and so forth. The project will focus on the capacity expansion of the private secondary schools and the private schools in rural communes as well.

(4) Project for 9-year Fundamental School Development in Rural Centres and Remote Areas

This project aims to develop fundamental (primary and secondary) schools in rural centres and remote areas of the rural communes. The project will consist of two components: construction of secondary schools in rural centres and construction of primary schools in remote areas. The first component focuses on the development of secondary schools in rural centres to accommodate the increasing demand for secondary education. The secondary schools will be developed or expanded at the rural centres with good transport access from the neighbouring areas. The second component intends to develop primary schools in remote areas where students have difficulty to commute to existing schools. By developing two types of schools simultaneously as part of the 9-year fundamental education, the project aims to improve the transition rate from primary to secondary schools in rural areas.

(5) School Access Improvement Project

The objective of this project is to improve transport access to schools in the rural communes. In order to improve the transport access, the project will include the components of commune road improvement and river transport access, depending on the local situation. River transportation is used not only in Amboditandroroho but also in some inland areas of other communes. Based on the transport plan and future network in PUDi, the project will identify and prioritize the

potential projects, conduct a feasibility study of the priority projects, and implement the selected projects.

(6) High School Development Project

The project objective is to develop a new high school in one of the rural communes of the Study Area. The project will include the tasks of estimation of the current and future needs for high school in the Agglomeration, assessment of the potential sites, site selection, high school's basic and detailed design, and construction. Fanandrana might have the potential to be the target site due to its good transport access and the lack of high school in the surrounding areas. The location will be decided not only from the perspective of the Toamasina Agglomeration but also from the consideration on the distribution of high schools in the District of Toamasina II, since the school district for high school is based on district boundary.

Chapter 22 Action Plan for Integrated Urban Development in Toamasina Agglomeration

22.1 Introduction

It is possible to achieve effective urban development when different types of actions are combined in a timely manner. For example, residential area development requires not only land development in accordance with land use regulations, but also provision of access roads and power supply and water supply. At the same time, in a wider view, drainage capacity needs to be rehabilitated for reducing inundation impact. Moreover, recycling factories and final disposal sites are also to be developed for solid waste management. That is, integrated development is essential for realizing a better urban agglomeration. Such integrated urban development is necessary not only at the local level, but also at the agglomeration level.

The PUDi is composed of the following components:

- Urban Development Strategies and Priority Projects,
- Land Use Policy and Land Use Zoning Regulations,
- Strategies for Development of Economic Sectors and Priority Projects,
- Strategies for Disaster Risk Reduction and Management and Priority Projects,
- Strategies for Road and Transport Development and Priority Projects, and
- Strategies for Development of Infrastructure Sectors and Priority Projects.

In order to implement the Revised PUDi for Toamasina Agglomeration, an Action Plan is formulated by consisting of the following three sets of actions:

- Capacity Development for Communes in Utilization of Land Use Zoning Regulations in Toamasina Agglomeration,
- Action Areas to Promote Integrated Urban Development in Toamasina Agglomeration, and
- Priority Projects and High Priority Projects of Various Sectors in Toamasina Agglomeration.

In this chapter, these three sets of actions are described.

22.2 Action Areas to Promote Integrated Urban Development in Toamasina Agglomeration

22.2.1 Introduction

In order to promote integrated urban development described by the PUDi, it is necessary to take concerted actions at the local level, as well as at the agglomeration level.

In order to achieve the integrated urban development envisioned by the PUDi, the following different types of action areas are required:

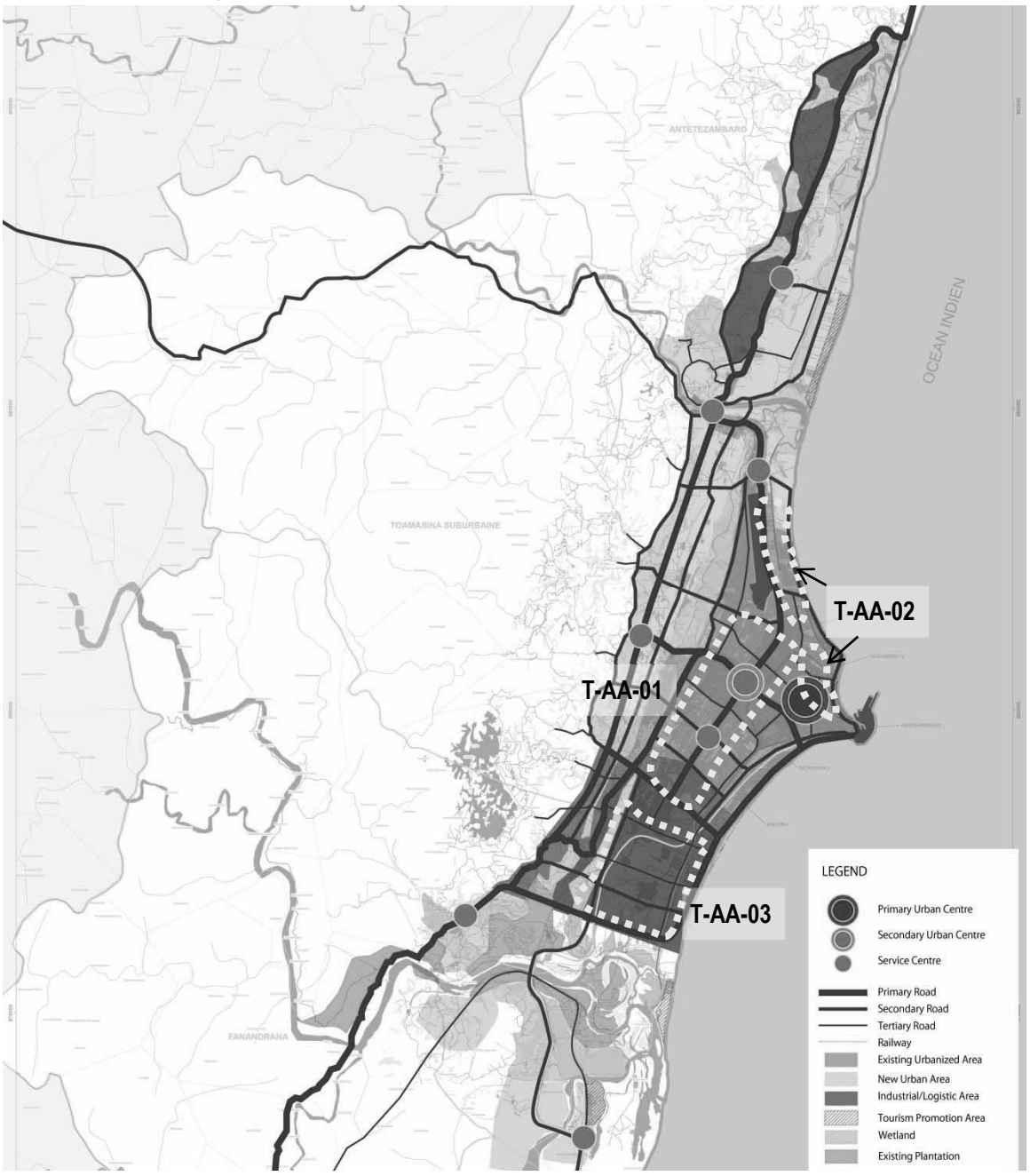
- Action Areas for Development of Urban Centres and their Surrounding Areas
- Action Areas for Development of Industrial Areas
- Action Areas for Development of Tourism Areas

Therefore, a variety of priority action areas are designated, as shown in Table 22.2.1 and Figure 22.2.1. For each priority action area, actions are described for promoting integrated development.

Table 22.2.1 Priority Action Areas for Toamasina Agglomeration

No.	Title of Action Area	Type of Action Areas
T-AA-01	Development of Tourism Zones along Toamasina Bay	Tourism Area
T-AA-02	Integrated Development of Ankirihiry-Mangarivotra Secondary Urban Centre, its Surrounding Residential Areas and Industrial Areas	Urban Centre
T-AA-03	Development of Industrial Areas in the South of Toamasina Agglomeration	Industrial Area

Source: JICA Study Team



Source: JICA Study Team

Figure 22.2.1 Location of Priority Action Areas for Integrated Development in Toamasina Agglomeration

(1) Toamasina Action Area No.01 [T-AA-01]: Development of Tourism Zones along Toamasina Bay

1) Objectives

- To attract tourists to Toamasina
- To attract investments to tourism sector in Toamasina

2) Major Components for Action Area

- [T-I-01] Project for Toamasina (Miami) Sea Waterfront Development along the Toamasina Bay)
- [T-I-02] Project for Designation of Tourism Development Zones and Investment Promotion for Tourism in Toamasina Agglomeration
- [T-C-01] Project for Promotion of Development of Toamasina Primary Urban Centre Phase 1

3) Schedule

- Phase 1 (2019-2023) of TaToM Project

4) Main Executive Agencies

- Ministry of Territorial Development, Housing and Public Works (MAHTP)
- Ministry of Transport, Tourism and Meteorology (MTTM)
- EDBM

5) Related Agencies

Not available

(2) Toamasina Action Area No.02 [T-AA-02]: Integrated Development of Ankirihiry-Mangarivotra Secondary Urban Centre, its Surrounding Residential Areas and Industrial Areas

1) Objective

By constructing a North-South Road and a East-West Road, to promote the following developments:

- Secondary Urban Centre
- Residential Areas
- Industrial Areas

2) Major Components of Action Area

- To construct a North-South Road and an East-West Road together with roadside drainages
- To formulate PUDé for Ankirihiry-Mangarivotra Secondary Urban Centres, its Surrounding Residential Areas and Industrial Areas
- To attract private investments for development of residential areas
- To attract private investments to industries utilizing the industrial areas

3) Schedule

- Phase 1

4) Main Executive Agencies

- Ministry of Territorial Development, Housing and Public Works (MAHTP)
- Ministry of Industry, Trade and Handicrafts

- EDBM

5) Related Agencies

Not available

(3) Toamasina Action Area No.03 [T-AA-03]: Development of Industrial Areas and Logistics Facilities in the South of Toamasina Agglomeration

1) Objectives

To promote the development of industrial sector in Toamasina Agglomeration in an integrated manner by seeking the following:

- To attract investments to industrial sectors, especially agro-processing industries, new light industries and textile industries
- To development industrial areas equipped with basic infrastructures
- To develop infrastructures for power supply and water supply to the industrial sectors

2) Major Components of Action Area

- [T-R-05] Project for Construction of Third Access Road to Toamasina Port
- [T-I-02] Project for Development of Industrial Parks in the South of Toamasina Agglomeration
- [T-I-03] Project for Designation of Industrial Development Zones and Investment Promotion for Industry in Toamasina Agglomeration Phase 2
- [T-E-02] Project for Construction of Water Treatment Plant by In-taking of Ivondro River Water
- [T-P-02] Project for Volbe Hydropower Station II
- [T-P-03] Project for Strengthening of Power Distribution Netwrok to Toamasina Southern Industrial Area

3) Schedule

- Phase 2 (2014-2023) of Project TaToM

4) Main Executive Agencies

- Ministry of Territorial Development, Housing and Public Works (MAHTP)
- Ministry of Industry, Trade and Handicrafts (MICA)
- EDBM

5) Related Agencies

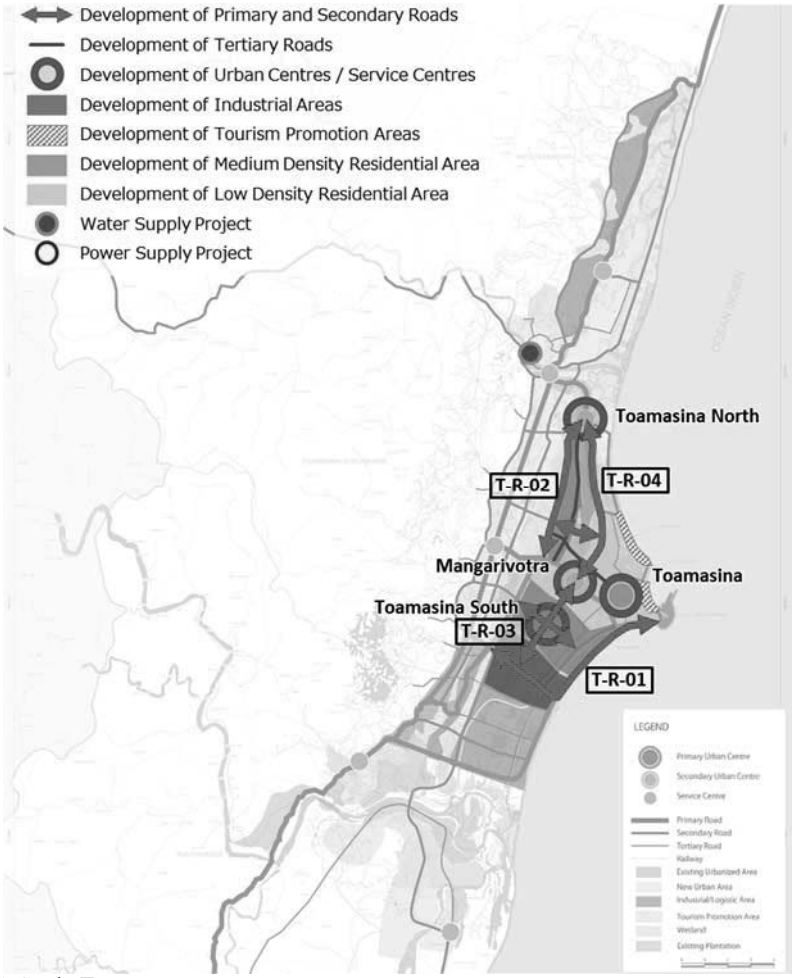
Not available

22.3 Implementation of Priority Projects and High Priority Projects of Various Sectors in Toamasina Agglomeration

22.3.1 Priority Projects and High Priority Projects for Phase 1 (2019-2023)

(1) Priority Projects of Constructing of Roads (Phase 1)

The priority projects of construction of roads for Phase 1 are shown in Figure 22.3.1and listed in Table 22.3.1.Table 22.3.1 List of Priority Projects of Roads (Phase 1: 2019-2023)



Source: JICA Study Team

Figure 22.3.1 Location of Priority Projects of Constructing of Roads (Phase 1: 2019-2023)

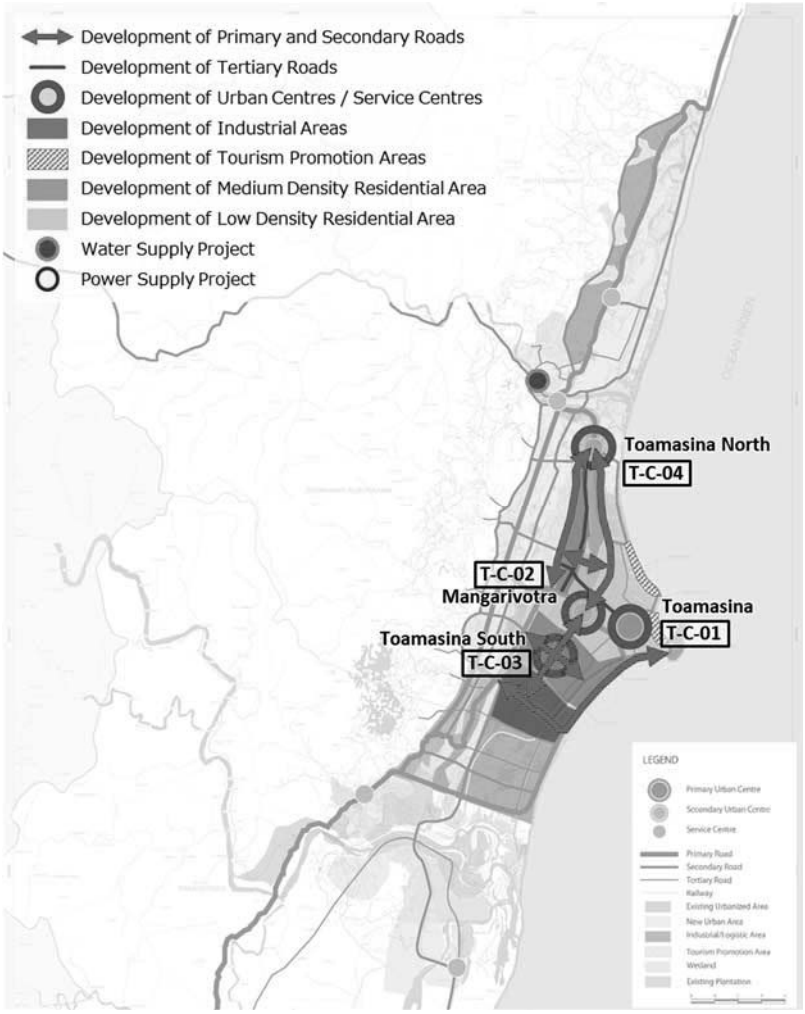
Table 22.3.1 List of Priority Projects of Roads (Phase 1: 2019-2023)

No	Priority	Ring Road Project Name	Cost (USD)	Organization in Charge
T-R-01	High	Project for Construction of Port Access Road for Construction of Toamasina Port Expansion	9 mil.	MAHTP
T-R-02	High	Project for Construction of Urban Arterial Road in Toamasina West	20 mil.	MAHTP
T-R-03	High	Project for Construction of Urban Arterial Roads in Toamasina South	40 mil.	MAHTP
T-R-04	High	Project for Widening of NR5 to 4-Lane Road between Toamasina Airport and the Junction of NR2 & NR5	20 mil.	MAHTP
No	**Priority**	**Bus Terminal Project Name**	**Cost (USD)**	**Organization in Charge**
T-B-01	High	Project for Construction of Bus Terminal in Toamasina Central	2 mil.	MTTP, CUT, PPP

Source: JICA Study Team

(2) Priority Projects of Development of Urban Centres (Phase 1: 2019-2023)

The priority projects of development of urban centres for Phase 1 are shown in Figure 22.3.2 and listed in Table 22.3.2.



Source: JICA Study Team

Figure 22.3.2 Location of Priority Projects of Development of Urban Centres (Phase 1: 2019-2023)

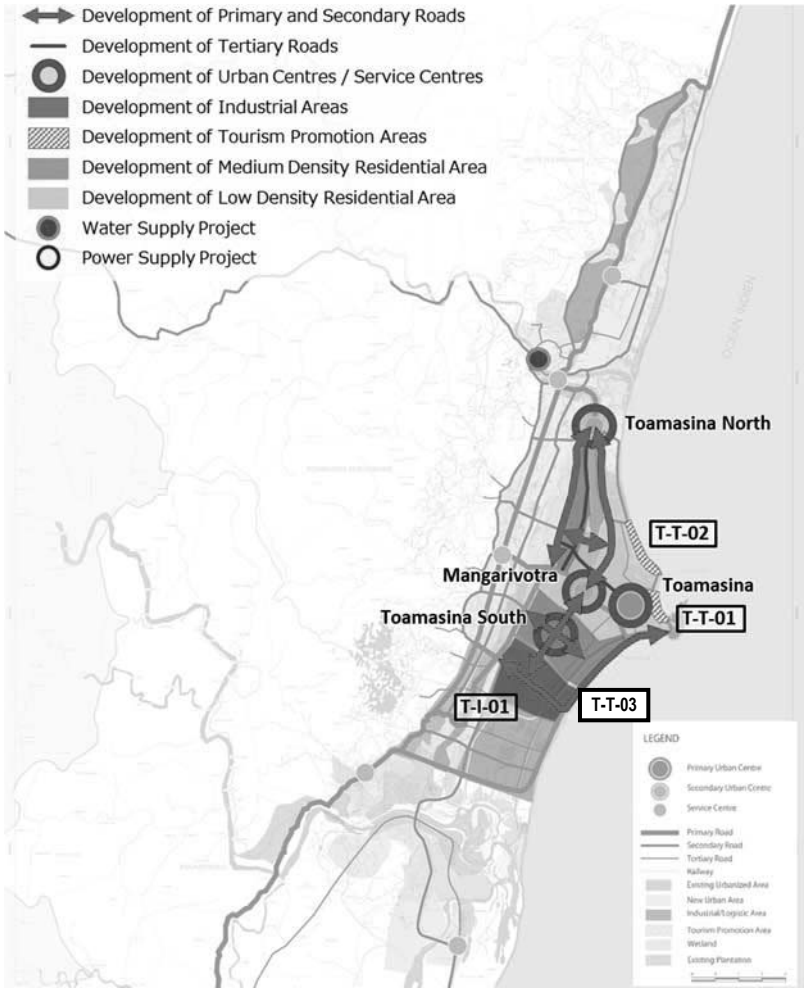
Table 22.3.2 List of Priority Projects of Development of Urban Centres (Phase 1: 2019-2023)

No	Priority	Urban Centre Project Name	Cost (USD)	Organization in Charge
T-C-01	High	Project for Promotion of Development of Toamasina Primary Urban Centre	10 mil.	MAHTP, PPP
T-C-02	High	Project for Promotion of Development of Ankirihiry-Mangarivotra Secondary Urban Centre	5 mil.	MAHTP, PPP
T-C-03	High	Project for Promotion of Development of Toamasina South Service Centre	3 mil.	MAHTP, PPP
T-C-04	High	Project for Promotion of Development of Toamasina North Service Centre	2 mil.	MAHTP, PPP

Source: JICA Study Team

(3) Priority Projects of Development of Industrial Areas (Phase 1: 2019-2023)

The priority projects of development of industrial areas and tourism development areas for Phase 1 are shown in Figure 22.3.3 and listed in Table 22.3.3.



Source: JICA Study Team

Figure 22.3.3 Location of Development of Industrial Areas and Tourism Areas (Phase 1: 2019-2023)

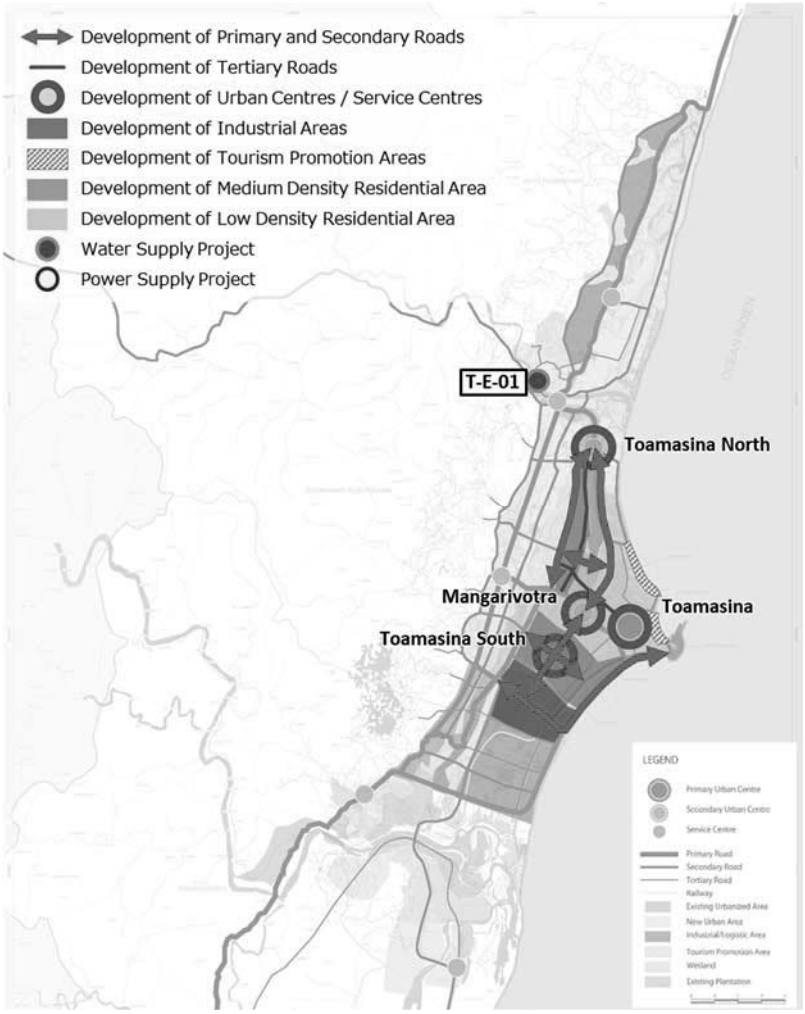
Table 22.3.3 List of Priority Projects of Development of Industrial Areas and Tourism Areas (Phase 1: 2019-2023)

No	Priority	Industrial Area Project Name	Cost (USD)	Organization in Charge
T-I-01	High	Project for Designation of Industrial Development Zones and Investment Promotion for Industry in Toamasina Agglomeration Phase 1	1 mil.	MAHTP, MICE EBDM
No	**Priority**	**Logistics Project Name**	**Cost (USD)**	**Organization in Charge**
T-L-01		Project for Establishment of Truck Parking and Logistics/Commercial Platform	27 mil.	SPAT, PPP
No	**Priority**	**Tourism Development Area Project Name**	**Cost (USD)**	**Organization in Charge**
T-T-01	High	Project for Toamasina (Miami) Sea Waterfront Development along the Toamasina Bay	9 mil.	MAHTP, MTTM
T-T-02	High	Project for Designation of Tourism Development Zones and Investment Promotion for Tourism in Toamasina Agglomeration Phase 1	1 mil.	MAHTP, MTTM, EDBM
T-T-03	High	Project for Construction of Toamasina Canal Waterfront Promenade along Pangalanes Canal	4 mil.	MAHTP, CUT, PPP

Source: JICA Study Team

(4) Priority Projects of Water Supply and Power Supply (Phase 1: 2019-2023)

The priority projects of water supply and power supply for Phase 1 are shown in Figure 22.3.4 and listed in Table 22.3.4.



Source: JICA Study Team

Figure 22.3.4 Location of Priority Projects of Water Supply and Power Supply (Phase 1: 2019-2023)

Table 22.3.4 List of Priority Projects of Water Supply and Power Supply (Phase 1: 2019-2023)

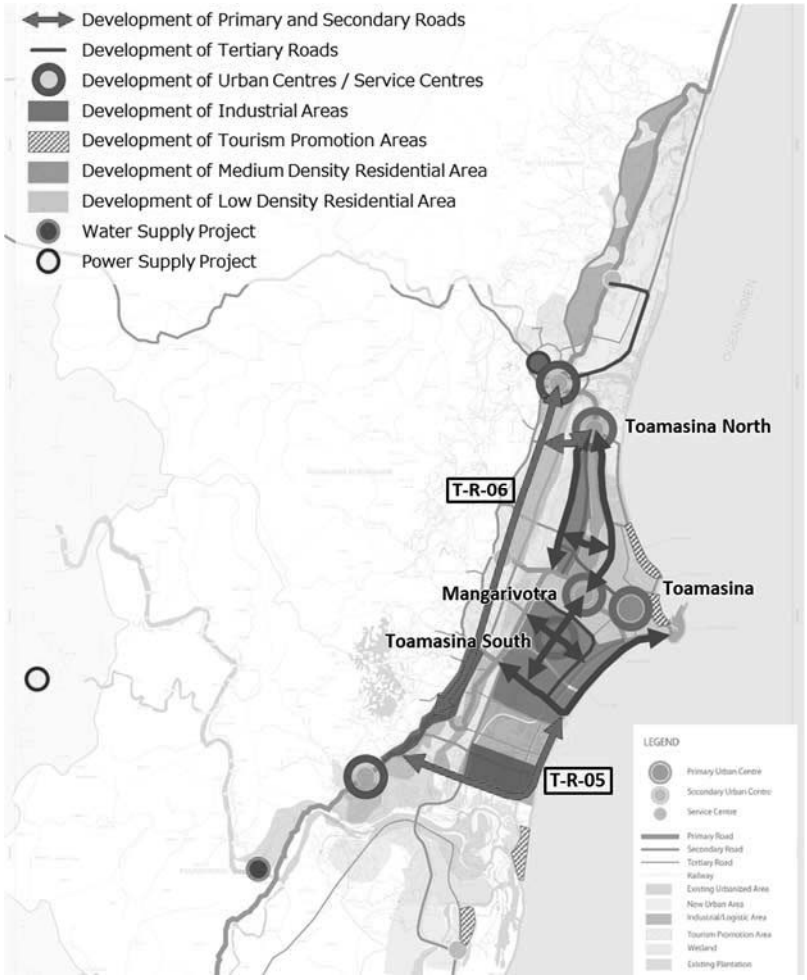
No	Priority	Water Supply Project Name	Cost (USD)	Organization in Charge
T-E-01	High	Project for Construction of Second Toamasina Water Treatment Plant by In-Taking of Ivoloina River Water	68 mil.	JIRAMA
No	**Priority**	**Power Supply Project Name**	**Cost (USD)**	**Organization in Charge**
T-P-01	High	Project for Installation of Transmission Line between Antananarivo and Toamasina	80 mil.	JIRAMA

Source: JICA Study Team

22.3.2 Priority Projects and High Priority Projects for Phase 2 (2024-2028)

(1) Priority Projects of Constructing of Roads (Phase 2: 2024-2028)

The priority projects of construction of roads for Phase 2 are shown in Figure 22.3.5 and listed in Table 22.3.5.



Source: JICA Study Team

Figure 22.3.5 Location of Priority Projects of Constructing of Roads (Phase 2: 2024-2028)

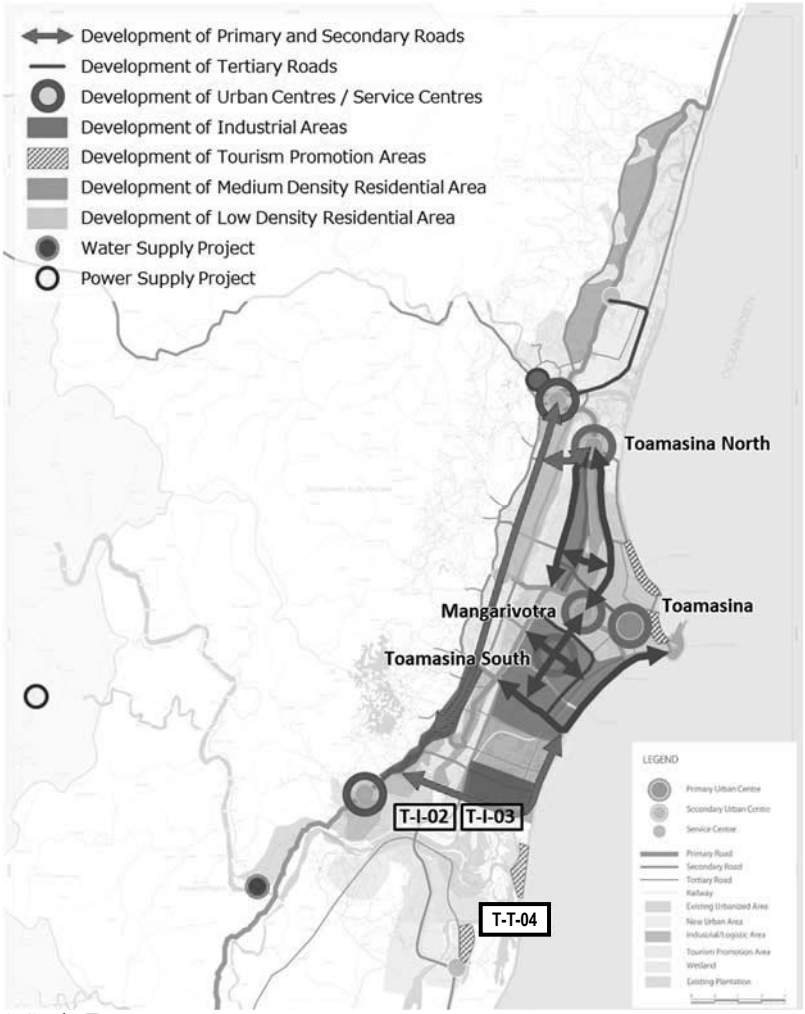
Table 22.3.5 List of Priority Projects of Roads and Railway (Phase 2: 2024-2028)

No.	Priority	Arterial Road Project Name	Cost (USD)	Organization in Charge
T-R-05	High	Project for Construction of Third Access Road to Toamasina Port	30 mil.	MAHTP
T-R-06	High	Project for Construction of Toamasina Western Bypass	35 mil.	MAHTP
No.	**Priority**	**Railway Project Name**	**Cost (USD)**	**Organization in Charge**
T-F-01	High	Project for Development of Multi-Modal Freight Terminal	30 mil.	MTTM, PPP
T-F-02	High	Project for Rehabilitation of Railway for Tourist and Urban Passengers	30 mil.	MTTM, PPP
No.	**Priority**	**Bus Terminal Project Name**	**Cost (USD)**	**Organization in Charge**
T-B-02	High	Project for Establishment of Bus Terminal in Toamasina North	2 mil.	MTTM, PPP
T-B-03	High	Project for Establishment of Bust Terminal in Toamasina South	2 mil.	MTTM, PPP

Source: JICA Study Team

(2) Priority Projects of Development of Industrial Areas and Tourism Development Areas (Phase 2: 2024-2028)

The priority projects of development of industrial areas and housing areas for Phase 2 are shown in Figure 22.3.6 and listed in Table 22.3.6.



Source: JICA Study Team

Figure 22.3.6 Location of Development of Industrial Areas and Tourism Areas (Phase 2: 2024-2028)

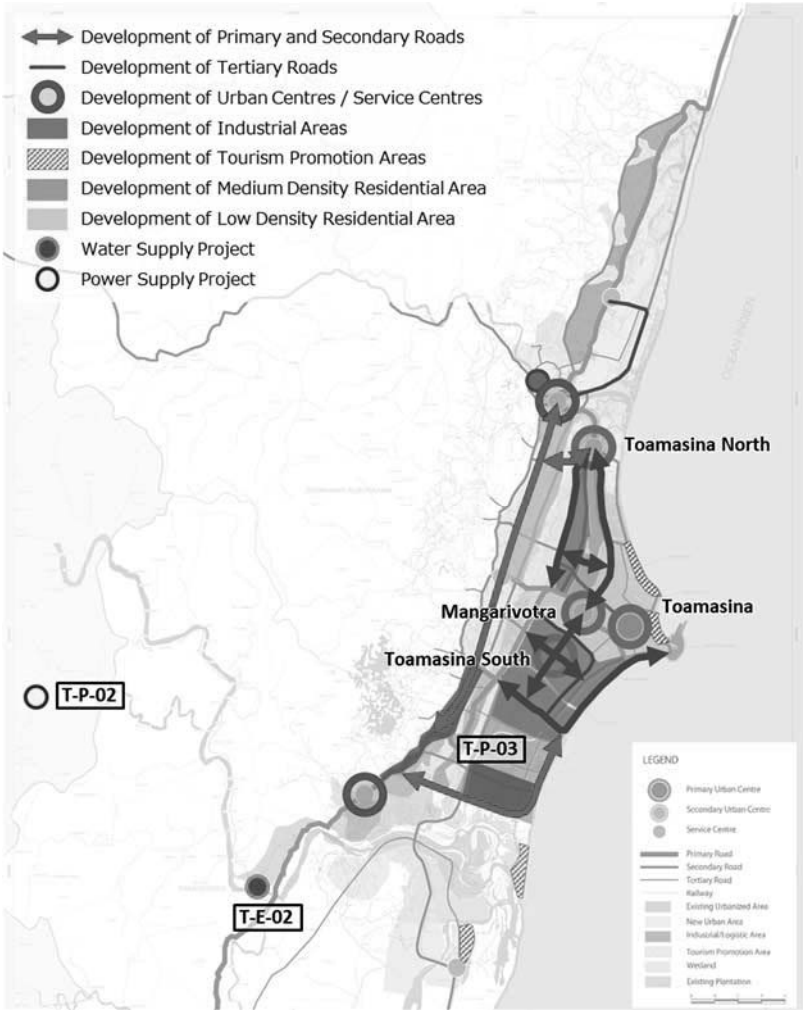
Table 22.3.6 List of Development of Industrial Areas and Tourism Areas (Phase 2: 2024-2028)

No	Priority	Industrial Area Project Name	Cost (USD)	Organization in Charge
T-I-02	High	Project for Development of Industrial Parks in the South of Toamasina Agglomeration Phase 1	35 mil.	MAHTP, MICA, EDBM, PPP
T-I-03	High	Project for Designation of Industrial Development Zones and Investment Promotion for Industry in Toamasina Agglomeration Phase 2	1 mil.	MAHTP, MICA, EDBM
No		**Tourism Development Area Project Name**	**Cost (USD)**	**Organization in Charge**
T-T-04	High	Project for Designation of Tourism Development Zones and Investment Promotion for Tourism in Toamasina Agglomeration Phase 2	1 mil.	MAHTP, PPP

Source: JICA Study Team

(3) Priority Projects of Water Supply, Power Supply, and Urban Centres (Phase 2: 2024-2028)

The priority projects of water supply, power supply, and disaster risk management for Phase 2 are shown in Figure 22.3.7 and listed in Table 22.3.7.



Source: JICA Study Team

Figure 22.3.7 Location of Priority Projects of Water Supply and Power Supply (Phase 2: 2024-2028)

Table 22.3.7 List of Priority Projects of Water Supply and Power Supply (Phase 2: 2024-2028)

No.	Priority	Water Supply Project Name	Cost (USD)	Organization in Charge
T-E-02	High	Project for Construction of Water Treatment Plant by In-taking of Ivondro River Water	68 mil.	JIRAMA
No.	**Priority**	**Power Supply Project Name**	**Cost (USD)**	**Organization in Charge**
T-P-02	High	Project for Volbe Hydropower Station II	-	JIRAMA, PPP
T-P-03	High	Project for Strengthening of Power Distribution Network to Toamasina Southern Industrial Area	1 mil.	JIRAMA
No.	**Priority**	**Urban Centre Project Name**	**Cost (USD)**	**Organization in Charge**
T-C-05		Project for Promotion of Development of Fanandrana Service Centre	2 mil.	MAHTP, PPP
T-C-06		Project for Promotion of Development of Ivoroina Service Centre	2mil.	MAHTP, PPP

Source: JICA Study Team