FY 2020 Project for Ministry of the Environment, Japan

FY2020
City to City Collaboration for Zero-carbon Society

Promotion Project for Formulation of Circulating and Ecological Economy in Local Cities in Myanmar

Project Report

March 2021

Mitsubishi Research Institute, Inc.
Fujita Corporation

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(Promotion Project for Formulation of Circulating and Ecological Economy in Local Cities in Myanmar)

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List of Abbreviations

This report uses the following standardized units and abbreviations.

Units

t	Ton
kg	kilogram
MJ	Megajoule
MW	Megawatt
kW	Kilowatt
kWh	Kilowatt hour
GWh	Gigawatt hour
TWh	Terawatt hour
MPa	Megapascal
ha	Hectare
km	kilometers
m^2	Square meter
m^3	Cubic meter
t-CO2	Carbon dioxide emissions (t)
kg-CO2	Carbon dioxide emissions (kg)
MMK	Myanmar kyat
USD	U.S. dollar
JPY	Japanese Yen

Abbreviations

ADB	Asian Development Bank
BTG	Boiler, Turbine, Generator
CCET	IGES Centre Collaborating with UNEP on Environmental Technologies
ECD	Environmental Conservation Department
GHG	Greenhouse Gas
IGES	Institute for Global Environmental Strategies
JCM	Joint Crediting Mechanism
JICA	Japan International Cooperation Agency
MAPCO	Myanmar Agribusiness Public Corporation
MCDC	Mandalay City Development Committee
MIMU	Myanmar Information Management Unit
MSDP	Myanmar Sustainable Development Plan
MONREC	Ministry of Natural Resources and Environmental Conservation
NPO	Nonprofit Organization
NWMSMP	National Waste Management Strategy and Master Plan for Myanmar
PE	Polyethylene
PP	Polypropylene
PS	Polystyrene
PVC	Polyvinyl Chloride
RPF	Refuse Paper and Plastic Fuel
SDGs	Sustainable Development Goals
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
YCDC	Yangon City Development Committee
3R	Reduce, Reuse and Recycle

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Executive Summary

Under City to City collaboration, we conducted a research project for the formation of a "Regional Circulating and Ecological Economy" (a decarbonized, local SDGs-type community development that utilizes local resources) in regional cities in Myanmar. In Sagaing Region, we supported the realization of Regional Circulating and Ecological Economy with a decarbonized, CO2-saving, and sustainable waste treatment system at its core. In Ayeyarwady Region, we supported the realization of Regional Circulating and Ecological Economy centered on independent and decentralized local energy.

(Initiatives with Sagaing Region)

Focusing on plastic waste, which is becoming a problem among urban waste and garbage, we studied the realization of Regional Circulating-type 3R system. In the commercialization study, we examined business models such as the conversion of waste plastic into fuel, utilizing the knowledge of Japanese companies in the recycling business. At the same time, in terms of institutional and social system building, we studied the separation of urban waste and garbage, educational activities in local communities, and recycling businesses.

- For a waste treatment system, we studied a total 3R system for urban waste in cooperation with the surrounding areas, with Monywa at the core. As a first step, we focused on the separation of waste plastic and its conversion into fuel. This is expected to extend the life and reduce the volume of final disposal sites.

- In Fukushima City, the initiative of "Waste and Garbage Reduction Operation: Challenge for Waste and Garbage 20% Reduction" is underway, and by introducing the findings of this initiative, we supported local efforts to sort and reduce waste and garbage.

Major achievements and suggestions from the policy dialogue and feasibility study for this fiscal year

- In order to realize policy goals such as sustainability, circular economy, and decarbonization society, Myanmar's local cities will need to promote policy formulation for universal energy access, decarbonization in rural areas, local SDGs, and institutional building for achieving Regional Circulating and Ecological Economy, as well as promoting cooperation among stakeholders. Particularly at the regional level, collaboration among local communities, citizens, businesses, and government is important for achieving decarbonization, local SDGs, and the Regional Circulating and Ecological Economy.

- It is effective to have a shared vision and action plan in promoting stakeholder collaboration in the region. In this City to City collaboration, the key concept is to build a regional model for realizing Regional Circulating and Ecological Economy in local cities in Myanmar, while utilizing the experience and know-how in Fukushima

City, Fukushima businesses, and local communities.

In Fukushima City, the "Fukushima City Action Plan for Realization of a Decarbonized Society" was formulated, and the "Fukushima City Zero Carbon City Declaration" was made on February 25, 2021. In the opinion exchange with the Sagaing Region, we introduced the outline of the Fukushima City Action Plan for the Realization of a Decarbonized Society and the process of its formulation, presented the draft of plan and roadmap (action plan) of the waste plastic fuel conversion project as a reference for local cities in Myanmar to proceed with the formulation of plans for the realization of a decarbonized society, and discussed for future development. The Sagaing Region expressed its intention to start the treatment of municipal waste as soon as possible and to consider securing its own budget, taking into account the proposed roadmap. We also introduced the initiative of Fukushima City to reduce waste and garbage by 20%, and proposed to develop it in Monywa City. In particular, we explained that Fukushima City is promoting group resource collection (schools, etc.) with incentives, and that it is a good example of community participation, and suggested that it should be implemented in Monywa City (proposing a trial basis at the first step). With regard to the study of commercialization of waste plastic fuel, we explained the technology to be used, the facility plan, the commercialization scheme, the results of the feasibility analysis, etc., and discussed the direction for realization and measures to utilize subsidies.

- In addition, we discussed that it is essential to secure a stable supply of waste plastic in order to commercialize the project, and from this perspective, it is important to strengthen cooperation with sorting and collective resource recovery systems and to work on commercialization in an integrated manner.

- The next step is to realize the action plan, and, in particular, it is necessary to clarify the roles of citizens, businesses, and the government, to discuss measures for collaboration (both guidance and regulation), and to develop a mechanism for sorting and group resource recovery that takes advantage of local characteristics. On the other hand, with regard to the conversion of waste plastic into fuel, it is necessary to conduct a detailed survey of the composition of waste plastic, determine the business scheme, and narrow down the subsidies to be utilized.

(Initiatives with Ayeyarwady Region)

We examined measures to promote local electrification in unelectrified rural areas, Labutta located in the south of Myaungmya. In addition, with regard to rice husk power generation, which is a promising method for local electrification, a large amount of incinerated ash is generated. From the perspective of local resource recycling, we examined ways to effectively use the incinerated ashes of rice husks.

Major achievements and suggestions from the policy dialogue and feasibility study for this fiscal year

- In the northern part of Labutta district, agriculture, especially rice, is the most important industry. As for the local distributed power supply, the smallest scale of rice husk power generation is 1.8MW, and it is difficult to secure business feasibility by power generation below this scale. Considering the actual situation in the Labutta area, small-scale facilities of 200-500 kW are suitable, and gasification power generation is promising. In the construction of a decentralized power system utilizing local biomass resources, it is important to develop the system in accordance with power demand and the characteristics of locally available biomass. Construction of woody biomass gasification systems that can be deployed on a smaller scale than rice husk power generation projects is expected to expand the options for decentralized power systems that can be deployed locally.

- As the next step, it is necessary to realize a distributed power generation project that meets the actual conditions of the area, such as electricity demand and available biomass. Specifically, since rice husks need to be made into pellets, which is not cost effective, consideration of gasification of woody biomass for power generation is promising (ideas: cultivation of fast-growing trees, conversion to fuel, regeneration of mangroves, conversion to fuel in managed areas).

1. Purpose and Implementation Arrangement

1.1 Project Objective and Background of City to City Collaboration

1.1.1 Objectives

The Paris Agreement came into effect in November 2016, and this year, which marks 2020, the Paris Agreement has finally entered the implementation stage. The Paris Agreement calls for the acceleration of climate change measures not only by the central government but also by non-governmental entities, including municipalities and cities. Cities and municipalities are key players in considering and implementing specific regional climate change measures and projects. For the realization of a decarbonized society in the world as a whole, it is necessary to accelerate the movement toward the establishment of a sustainable decarbonized society and a low-carbon society as a transition point, especially in Asia, where economic growth is remarkable.

In this project, Japanese research institutes, private companies and universities as well as Japanese municipalities having experience and know-how regarding the formation of a low-carbon society, carried out survey projects to support efforts by overseas local governments to create a decarbonized and low-carbon society and the introduction of equipment that will contribute to the formation of a decarbonized and low-carbon society.

1.1.2 Background of City to City collaboration

In 2015, the Chief Minister of Myanmar's Ayeyarwady Region requested the Mayor of Fukushima City to cooperate, and the City to City cooperation project between the two cities began. In 2017, the Sagaing Region was added to promote horizontal development of City to City cooperation. Another feature is that it is an City to City cooperation between regions such as Fukushima City, Ayeyarwady Region, and Sagaing Region.

(Background of cooperation with Ayeyarwady Region)

The Ayeyarwady Region, which is the main rice-growing region, is having a hard time dealing with rice husks that are generated in large quantities (the largest waste is rice husks). In addition, along with economic growth, dealing with power shortages and the emergence of environmental problems (waste, water quality conservation, etc.) has become the most important issue in local cities in Myanmar.

By utilizing the experience and knowledge of Japanese local governments and

companies to solve these problems, it is expected that a new low-carbon and environmentally friendly industrial park will be realized. In addition, it is important to promote such distinctive regional development in order to promote corporate agglomeration and industrial development.

Myanmar has high expectations for the experience and technology of Japan, which has experienced high economic growth in the past. When the Chief Minister of Ayeyarwady visited Japan in late April 2015, he came into contact with Fukushima City's efforts on energy saving and renewable energy, and in June of the same year, the Chief Minister of the Region requested the Mayor of Fukushima City to cooperate in the Pathein Industrial City development (Cooperation for the formation of a sustainable low-carbon city under City to City cooperation) (Cooperation request form from the Chief Minister of the region to the Mayor of Fukushima City).

In response to this request for cooperation, Fukushima City, Fukushima Chamber of Commerce, Mitsubishi Research Institute, and Fujita collaborated to establish the "Ayeyarwady Low Carbon Promotion Partnership" as a platform for City to City cooperation and promote City to City cooperation efforts. In FY2015, we examined the possibility of policy dialogue and JCM projects through workshops and field surveys in Pathein City in the Ayeyarwady Region and Fukushima City, and in February 2016, Fukushima City officials visited the site. At that time, the Mayor of Fukushima City handed a reply to the request for cooperation to the Minister in charge of the Ayeyarwady Region based on his experience in Fukushima City, in order to realize a low-carbon, resilient and sustainable city. He also announced that it will cooperate not only in the fields of renewable energy and waste treatment but also in various fields required such as the formulation of a master plan.

(Background of expansion to cooperation with Sagaing Region)

Under these circumstances, the central government is discussing the policy development of a regional distributed power system, and the first JCM power generation project in Myanmar (Fujita and MAPCO: Myaungmya project by Myanmar Agribusiness Public Corporation), a central government official requested the local partner MAPCO to consider the horizontal expansion other than the Ayeyarwady region, and the Sagaing Region (Shwebo district was mentioned) was presented as a specific candidate site for consideration.

In response to this, MAPCO conducted an independent field survey, and in June, Fujita officials conducted a preparatory survey on site. After that, in the field of promotion of waste treatment measures (including rice husk power generation business in the region) and promotion of microgrid system by renewable energy in the region, developmental cooperation under the regional cooperation of Sagaing Region and Ayeyarwady Region. (It was issued in an official letter from the minister in charge of the region to the Mayor of Fukushima City in July 2017).

For this reason, it was decided to discuss measures with Fukushima City and the

Fukushima Chamber of Commerce and Industry, develop low-carbon partnership initiatives, and expand City to City cooperation with the Sagaing Region.

1.2 Survey Item and Implementation System

1.2.1 Survey Item

In light of the background mentioned above, the following activities were carried out in order to reduce greenhouse gas emissions and to form JCM projects to contribute to the reduction of greenhouse gas emissions in the waste sector, which is in high demand in Sagaing Region, Myanmar, and in the renewable energy sector, which is in high demand in Ayeyarwady Region, Myanmar.

< Waste sector in Sagaing Region (Monywa City and its surroundings) >

In order to grasp the present state and problems of measures for municipal solid waste (Especially plastic waste) and trends of related policies, and to materialize a Regional Circulating and Ecological Economy model centering on a sustainable waste treatment system with decarbonization and CO2 saving, commercialization and development measures in Monywa City, etc. were examined.

Support measures by the cooperation between cities for the formation of the Regional Circulating and Ecological Economy were examined.

<Renewable Energy Sector in Ayeyarwady Region (Myaungmya and Labutta areas)>

In order to grasp the present state and problems of electrification measures and related policy trends, and to materialize a Regional Circulating and Ecological Economy model using rice husk power generation business, commercialization and development measures in Myaungmya, Labutta areas, etc. were examined.

Support measures by the cooperation between cities for the formation of the Regional Circulating and Ecological Economy were examined.

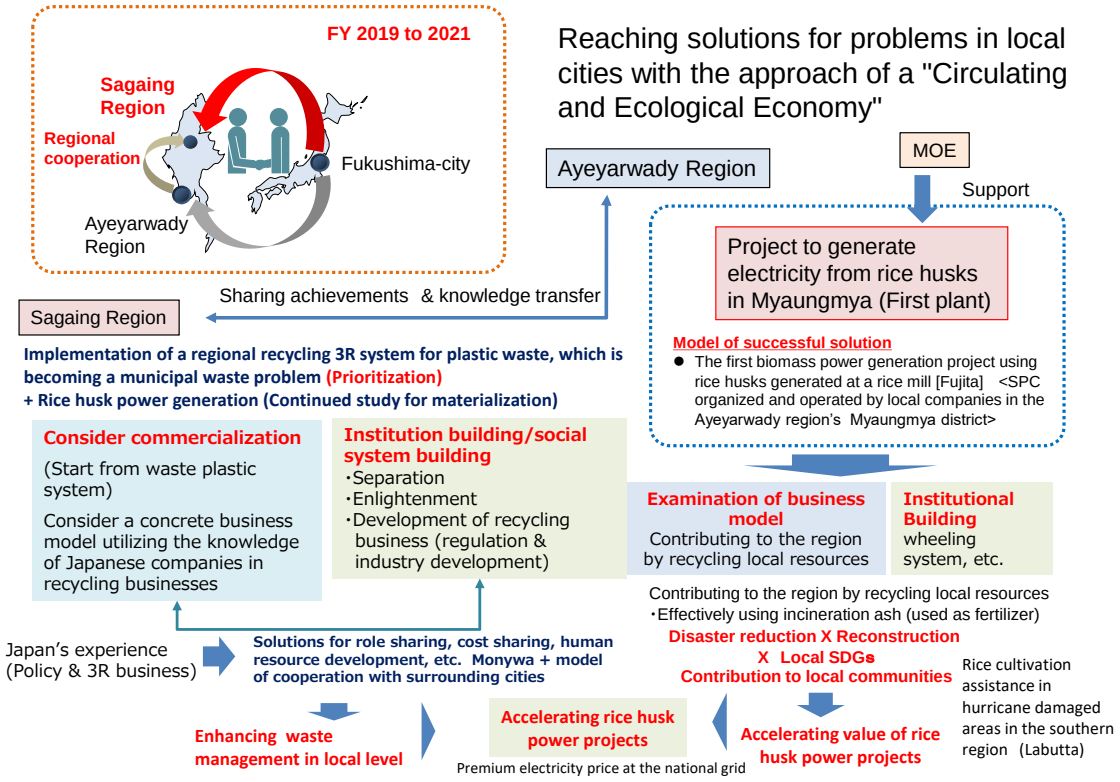


Figure 1-1 Overall view of the study

1.2.2 Survey Implementation System

This survey was conducted with the Mitsubishi Research Institute (Hereinafter referred to as "MRI".) as the representative proponent in cooperation with joint proponents Fujita, Fukushima City, and the Fukushima Chamber of Commerce and Industry. The implementation was carried out in cooperation with local companies and with the cooperation of Sagaing Region and Ayeyarwady Region.

(Role of each entities of Japan)

Utilizing its know-how in policy introduction, planning at the national and local government level in Japan, and study of JCM project, MRI conducted overall supervision, collected relevant information, conducted workshop secretariat operations, considered JCM implementation measures, and supported policy dialogues between Fukushima City and local governments (Sagaing Region, Ayeyarwady Region).

Fujita examined the feasibility of specific projects (Rice husk power generation), utilizing its know-how and business experience in industrial parks, urban development, and regional development, as well as its know-how in commercialization.

Fukushima City held a policy dialogue with the officials of the Sagaing Region and Ayeyarwady Region introducing their experiences in Japan, on a policy approach for aiming at a low-carbon and environment-friendly region, such as waste treatment and the spread of renewable energy, by making use of their experiences and know-how in the formulation of waste treatment plans and renewable energy introduction promotion plans, and in environmental awareness building (Environmental education at schools). In Fukushima City, the Department of Environment played a central role in the study.

The Fukushima Chamber of Commerce and Industry, in cooperation with its member companies, explored the possibility of technology transfer by companies with bases in Fukushima City and companies in Fukushima City, making use of the technology and expertise of companies in commercialization. In addition, the study was conducted by utilizing the knowledge and networks of the participants of the Fukushima-Myanmar Economic Exchange Association, which was established with the occasion of the collaboration between the cities.

(Role of each entity of Myanmar)

In Sagaing Region, the Minister of the Region in charge of the Environment Division led the discussion with the participation of the officials in charge of the relevant departments. In the examination of municipal waste in the capital city of the region, Monywa, the examination was carried out with the cooperation of the Sagaing Region Development Affairs Committee, and Monywa City Development Committee. In the Ayeyarwady Region, the study was conducted with the cooperation of the minister in charge of the electricity, energy, and industry sectors.

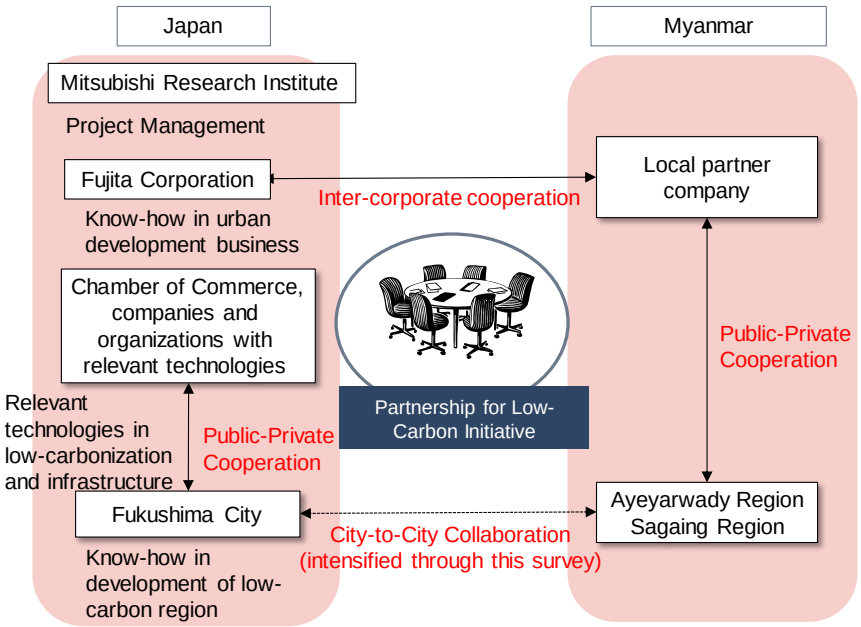


Figure 1-2 **Organizational structure**

1.3 Overview of City to City Cooperation

1.3.1 Status of the Progress

<Past Activities>

June 2015	Chief Minister of Ayeyarwady Region made a request to Mayor of Fukushima City for cooperation.
October 2015	Relevant parties of Ayeyarwady Region visited Fukushima City.
February 2016	Relevant parties of Fukushima City (Deputy Director of Environment Division, etc.) visited Ayeyarwady and hand over a reply letter of Mayor of Fukushima City regarding the request to the responsible Minister of Ayeyarwady Region.

September 2016	Workshop in Ayeyarwady (attendance of Chief Minister of the region)
October 2016	Director of Pathein Development Committee of Ayeyarwady Region, etc., visited Fukushima City.
January 2017	Discussion on the direction of project expansion at WS in Ayeyarwady (attendee: responsible Minister of Ayeyarwady Region, Manager of Environment Division of Fukushima City, etc.)

July 2017	Fukushima Program with officials in Ayeyarwady Region
July 2017	Responsible Minister of Ayeyarwady Region made a request to Mayor of Fukushima City for cooperation for development under collaboration of Sagaing and Ayeyarwady Regions.
September 2017	Workshop in Sagaing Region (in Monywa City, Sagaing Region with attendance of the Chief Minister of the region) , Workshop in Ayeyarwady Region (in Pathein City)
February 2018	Workshop (Yangon city)
February 2018	Discussions in Fukushima City
March 2018	Reporting of city-to-city collaboration activities (Naypyidaw)

July 2018	The first meeting to share the year's activities among concerned parties and to start this project in Fukushima
October 2018	Fukushima Program with officials in Ayeyarwady Region and Sagaing Region, City-to-City seminar in Tokyo.
January 2019	Local workshops and field surveys in Yangon, Myanmar
February 2019	The second meeting to share the year's activities among

	concerned parties and discussed further activity of City to City Collaboration

July 2019	Workshop and field survey (Monywa city)
July 2019	Meeting (Fukushima city)
November 2019	Local workshops and field surveys (Monywa city)
December 2019	Field surveys, Fukushima Program (Ayeyarwady Region)
January 2020	Fukushima Program with officials in Ayeyarwady Region and Sagaing region (Fukushima city; Joint implementation of both regions)
February 2020	Local workshops and field surveys (Naypyidaw; Joint implementation of both regions)

<Preparation stage before the start of this year's project >

August 2020	Exchange of opinions with officials in Sagaing Region Exchange of opinions with officials in Ayeyarwady Region
November 2020	Preparation meeting with stakeholders from Fukushima City

-In the exchange of opinions, the Ayeyarwady Region proposed that the possibility of deployment in the southern Labutta district, where the electrification rate is extremely low and cyclone damage is frequent, should be considered.

<Activities conducted this year>

January 2021	Online meeting with officials in Sagaing Region Waste composition survey in Monywa City, Sagaing Region (conducted with the cooperation of the Monywa City Development Committee)
February 2021	Meeting with stakeholders from Fukushima city (Online) Online workshop with officials in Sagaing Region Exchange opinions with private company from Fukushima city

1.3.2 Past Major Achievements

(Status of the study in Sagaing Region)

Last year, we set the following issues and worked on them.

- In examining the roadmap for municipal waste countermeasures, we confirmed the status of waste generation and the current status of efforts, and examined the draft basic policy (introducing the concept of the Regional Circulating and Ecological Economy, and we confirmed Monywa City will also want to work on it.), support for waste separation efforts (trial efforts have been started), support for awareness raising (leading to the creation of segregation enlightenment pamphlets with reference to Fukushima City).
- For concrete support for the treatment of municipal waste, we examined the kitchen waste treatment technology in the market.
- As for the concrete implementation of the rice husk power generation business, the roadmap for development was formulated (preliminary implementation in the Shwebo area, horizontal development in the Wallet area) and the project was materialized.

Collaboration with the Sagaing Region: Highlights of FY 2019 Activities

Urban Waste Disposal Measures in Monywa City

Final disposal site: Critical situation
- Difficulty securing new locations

Activities for waste and garbage collection
- Making advanced efforts while making various ingenuity. (Regular collection of collected vehicles, collection for households, markets, etc.)

Efforts to separate waste
- Initiate a pilot separation activity
- Created an educational brochure based on waste sorting activities in Fukushima City (Utilization of environmental education in schools)

Environmental education at public elementary schools in the Monywa city
- Taking advantage of exchanges with Japan, they are starting activities.

Current status of final disposal sites in Monywa

In Monywa, waste and garbage collection

Awareness raising for waste sorting at local markets

Brochure of awareness raising for waste sorting (For Children)

(Status of the study in Ayeyarwady Region)

Last year, we set the following issues and worked on them.

- Regarding the examination of a medium-scale model (rice husk power generation business), the development of a road map (organization of the significance of

development in the region, identification of 7 promising areas for promotion of dissemination, etc.), and also, we examined the materialization of the second project.

・For the examination of small-scale models (for rural villages), the business model was examined and the introduction model villages were extracted.

・For the realization of a Regional Circulating and Ecological Economy (system construction, human resource development), 1) extraction of key components of the Regional Circulating and Ecological Economy, 2) system examination (electric power consignment system utilizing the national grid), 3) introduction of human resource development initiatives (Japanese electrical engineer qualification system) etc. As part of the shift to system construction, the minister in charge of electric power, who is the top of the region, was invited to Japan to foster understanding and form consensus for promotion (Courtesy of the Vice-Minister for Global Environmental Affairs).

(Review of roadmap and materialization of Regional Circulating and Ecological Economy)

Through discussions at workshops held in Fukushima City and the local area, it was confirmed that the outline of the roadmap for regional electrification measures would be prepared.

- **Development of roadmap for power generation projects in regional areas**
- Financial mechanism for sustainable business development
- Enlightenment, awareness-raising and consensus building (Citizens and businesses)
- **Human resource development (Training of electrical engineers)**

- The Minister of Ayeyarwady Region attended the Japan Invitation Program in December and exchanged opinions with the Vice-Minister for Global Environmental Affairs. He also participated in the workshop and exchanged opinions with the Parliamentary Vice-Minister of the Environment in February.

- At the local workshop in February, the policy was confirmed to materialize the roadmap under the cooperation among cities in the next fiscal year.
- We introduced Japan's efforts in the regional recycling and Regional Circulating and Ecological Economy and drew interest in the efforts.

Proposal of candidate sites for rice husk power generation from the regional side

(Medium-Scale model projects)

- **A new industrial complex in Patayne was selected as a candidate site, and the possibility of 3.6 MW was confirmed.**
- Examination of a business model for selling electricity to the grid (Fostering Understanding of the Wheeling Service System)

(Small-Scale model projects)

Business Model Review (50 kW scale)

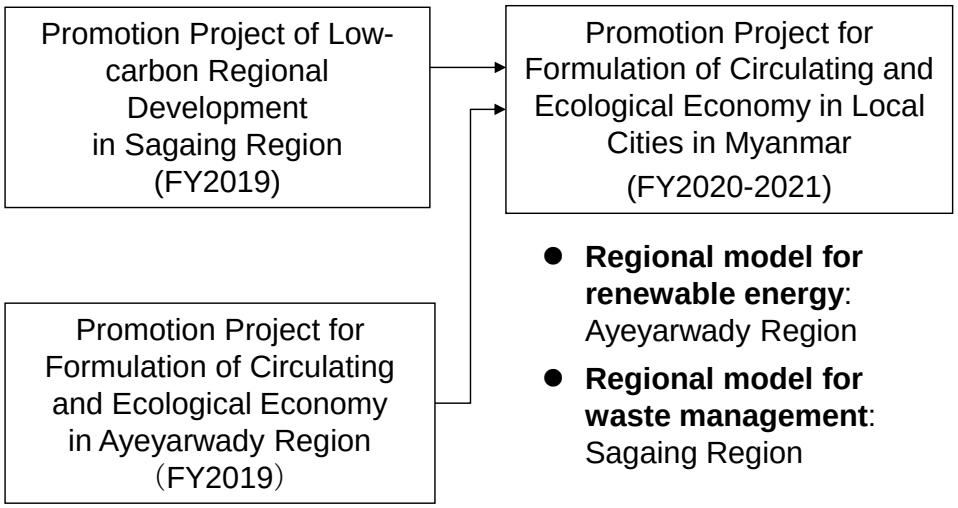
The Wakema County within the Ayeyarwady Region was identified as a candidate site for introduction (Consultations with the Regional Government).

1.3.3 Implementation Plan in This Year

Based on the results of last fiscal year, under the cooperation between cities, in the cooperation with Sagaing Region, it was decided to carry out the separation of municipal wastes, the examination of the concretization of waste treatment system (Conversion of waste plastic into solid fuel) in the region, and the support of the construction of related system (Creation of a system for sorting waste, raising awareness of environmental education, etc., and development of recycling business, etc.). On the other hand, in cooperation with the Ayeyarwady Region, it was decided to implement a model of a Regional Circulating and Ecological Economy using rice husk power generation projects (In particular, we will consider a business model for recycling resources in local areas, including the effective use of rice husk incineration ash.).

In this fiscal year, municipal waste is a common issue in local cities, and one of the models for resource recycling in the local areas is also used. Therefore, it was decided to focus on the consideration of waste disposal in Sagaing Region.

At a policy dialogue held in February 2020 at a joint workshop (At Naypyidaw) with the two regions, the Sagaing Regional Government expressed interest in addressing the field of waste treatment under the concept of "Regional Circulating and Ecological Economy". At the same time, the Ayeyarwady Regional Government also considers that municipal waste is a major issue and they wanted to learn from the result, that is why this year we decided to jointly implement the project as a single project.



2. Situation and Challenges in the Target Area and Related Policy Trends

2.1 Overview of Myanmar

In this section, the socio-economic situation of Myanmar is described. Myanmar has seen remarkable economic growth in recent years and is one of the hottest regions in Asia. The GDP growth rate in 2018 is 6.8%. With economic development, per capita energy consumption and electricity consumption are also on the rise.

Table 2-1 Socioeconomic situation in Myanmar

Year	1990	2000	2010	2018
Population, total (millions)	41.34	46.72	50.60	53.71
Population growth (annual %)	1.5	1.2	0.7	0.6
Population density (people per sq. km of land area)	63.2	71.5	77.5	82.2
Urban population growth (annual %)	2.2	1.8	1.4	1.5
Energy use (kg of oil equivalent per capita)	258	275	277	-
CO2 emissions (metric tons per capita)	0.1	0.22	0.26	0.48
Electric power consumption (kWh per capita)	44	75	124	
GDP (current US$) (billions)	..	8.91	49.54	76.17
GDP growth (annual %)	2.8	13.7	9.6	6.8
Agriculture, forestry, and fishing, value added (% of GDP)	..	57	37	21
Industry (including construction), value added (% of GDP)	..	10	26	38

Source: Word Bank, World Development Indicators database.
https://data.worldbank.org/ (Last accessed：February 12, 2021)

Myanmar has seven administrative divisions [Ayeyarwady, Sagaing, Tanintharyi, Bago, Magway, Mandalay, Yangon] and seven states [Kachin, Kayah, Kayin, Shan, Chin, Mon State, Rakhine State]. In Myanmar, there are multiple District in Region/State, and Districts are composed of Townships. Below counties, there are subdistricts in urban areas (Ward) and villages in rural areas (Ward and Village tract are about the same level of classification).

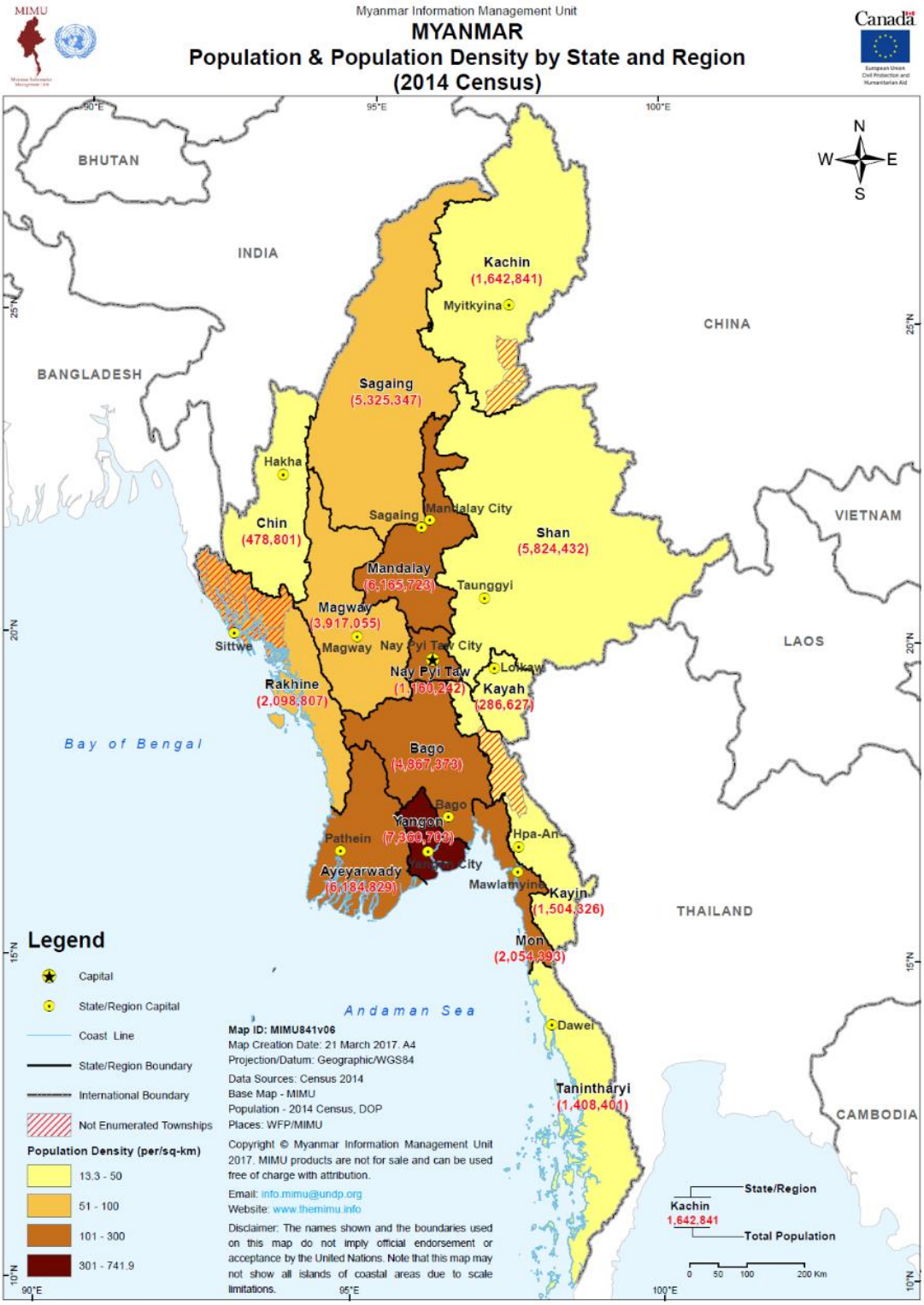


Figure 2-1 Map of Myanmar

Source: Myanmar Information Management Unit, https://themimu.info/sites/themimu.info/files/documents/Population_Map_2014_Population_Density_St_Rg_MIMU841v06_21Mar2017_A4.pdf (Last accessed：February 12, 2021)

(About the target Regions)

The Sagaing Region is located in the northwestern part of Myanmar and is a region where rice production is thriving. It covers an area of about 93,000 km^2 and has a population of about 5 million. The capital city of the region is Monywa, which has a population of about 370,000. On the other hand, the Ayeyarwady Region is an administrative district adjacent to the western part of the Yangon Region, located in the delta area of the Ayeyarwady River, and is an area where rice production is thriving. The capital city of the region is Pathein, which has a population of about 290,000.

Following are the outline of Sagaing Region and Ayeyarwady Region.

	Myanmar	Sagaing Region	Ayeyarwady Region
Area	680,000 km^2 (1.8 times that of Japan)	93,000 km^2	35,000 km^2
population	51 million people (10.88 million households)	5 million people	6 million people (1.49 million households)
Area characteristics	Administrative divisions consist of seven regions and seven states	Located in the northwestern part of Myanmar. Rice production is thriving.	It is an administrative district adjacent to the western part of the Yangon Region, located in the delta area of the Ayeyarwady River, and has a thriving rice production.
Main city	Yangon	The capital city of the region is Monywa Township (population of about 370,000, located about 130 km west of Mandalay) Approximately 730 km by land from Yangon [Tokyo = about the same as Aomori]	The population of Pathein Township, the capital of the region, is about 290,000. About 200 km west of Yangon. About 4-5 hours by car from Yangon

(Reference: Population of Fukushima City: Approximately 290,000)
Note) Area, population and number of households are based on "The 2014 Myanmar Population and Housing Census".

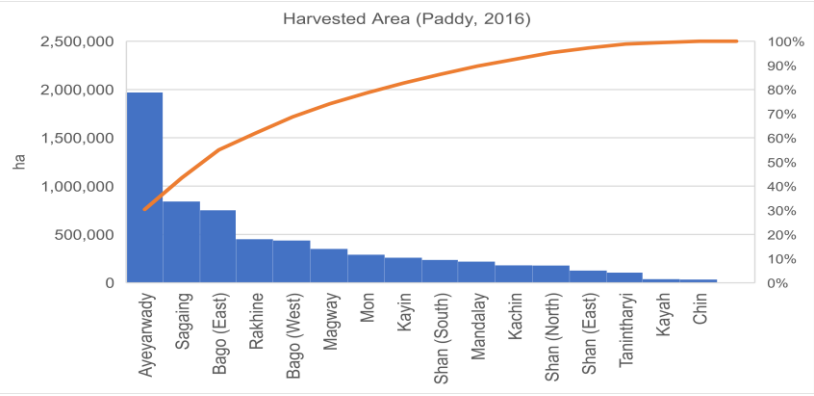


Figure 2-2 Rice planted area in Myanmar (2016)

Source: Based on “MIMU BaselineData Agriculture Countrywide”. https://themimu.info/baseline-datasets (Last accessed: February 4, 2021)

2.2 Current Situation and Challenges in the Sagaing Region and Related Policy Trends

The socio-economic situation of the Sagaing Region, the current status and issues of municipal waste countermeasures, which are regional issues, and trends in related policies are summarized.

2.2.1 Socio-Economic Situation of the Area

Sagaing Region is the second largest region in Myanmar (the largest is Shan). The regional capital is located along the Ayeyarwady River. According to “The 2014 Myanmar Housing and Population Census”, Sagaing Region has an area of approximately 93.7 thousand km^2, with 9 districts, 45 townships. The population is a little more than 5 million; its composition does not differ much from that of the whole country, and an increasing trend in population can be seen.

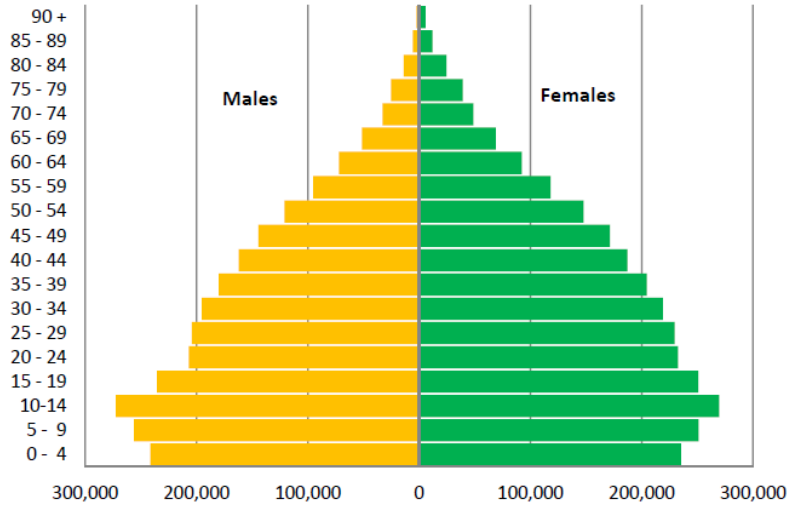


Figure 2-3 Population pyramid in Sagaing Region (2014)

Source: Department of Population, Ministry of Immigration and Population. “The 2014 Myanmar Housing and Population Census: Sagaing Region”. p.12.
https://www.dop.gov.mm/sites/dop.gov.mm/files/publication_docs/sagaing_region_census_report_-_english_0.pdf (Last accessed：February 28, 2021)

There are two major rivers (Ayeyarwady River and Chindwin River) in the region. The main industry is the rice milling industry, but other cereals are also actively cultivated. In addition to agriculture, the region is blessed with resources such as gold, coal, and oil, so the standard of living is relatively high in Myanmar. The Monywa Township,

which is the subject of this survey, is belong to the Monywa district. The district where the capital of the district is located, and has a population of about 757,000.

Table 2-2 Sagaing Region: Population by Region

Region/District	Population(Thousand people)
Sagaing Region	5,325
Sagaing	521
Shwebo	1,433
Monywa	**757**
Katha	861
Kalay	509
Tamu	115
Mawlaik	164
Hkamti	423
Yinmarpin	542

Source: Based on Department of Population, Ministry of Labour, Immigration and Population. “The 2014 Myanmar Housing and Population Census: Sagaing Region”. p.16-18. https://www.dop.gov.mm/sites/dop.gov.mm/files/publication_docs/sagaing_region_census_report_-_english_0.pdf (Last Accessed: February 12, 2021)

The population of Monywa district is about 760,000, of which the population of Monywa Township is about 370,000, 210,000 in urban areas and 160,000 in rural areas. (Monywa Township is the majority of the urban population of the Monywa district).

Table 2-3 Population of Monywa District

District/Township	Total	Urban	Rural
Monywa District	**757,358**	**244,144**	**513,214**
Monywa	372,095	207,489	164,606
Butalin	123,539	5,210	118,329
Ayartaw	155,769	9,516	146,253
Chaung Oo	105,955	21,929	84,026

Source: Based on Department of Population, Ministry of Labour, Immigration and Population. “The 2014 Myanmar Housing and Population Census: Sagaing Region”. p.22. https://www.dop.gov.mm/sites/dop.gov.mm/files/publication_docs/sagaing_region_census_report_-_english_0.pdf (Last Accessed: February 12, 2021)

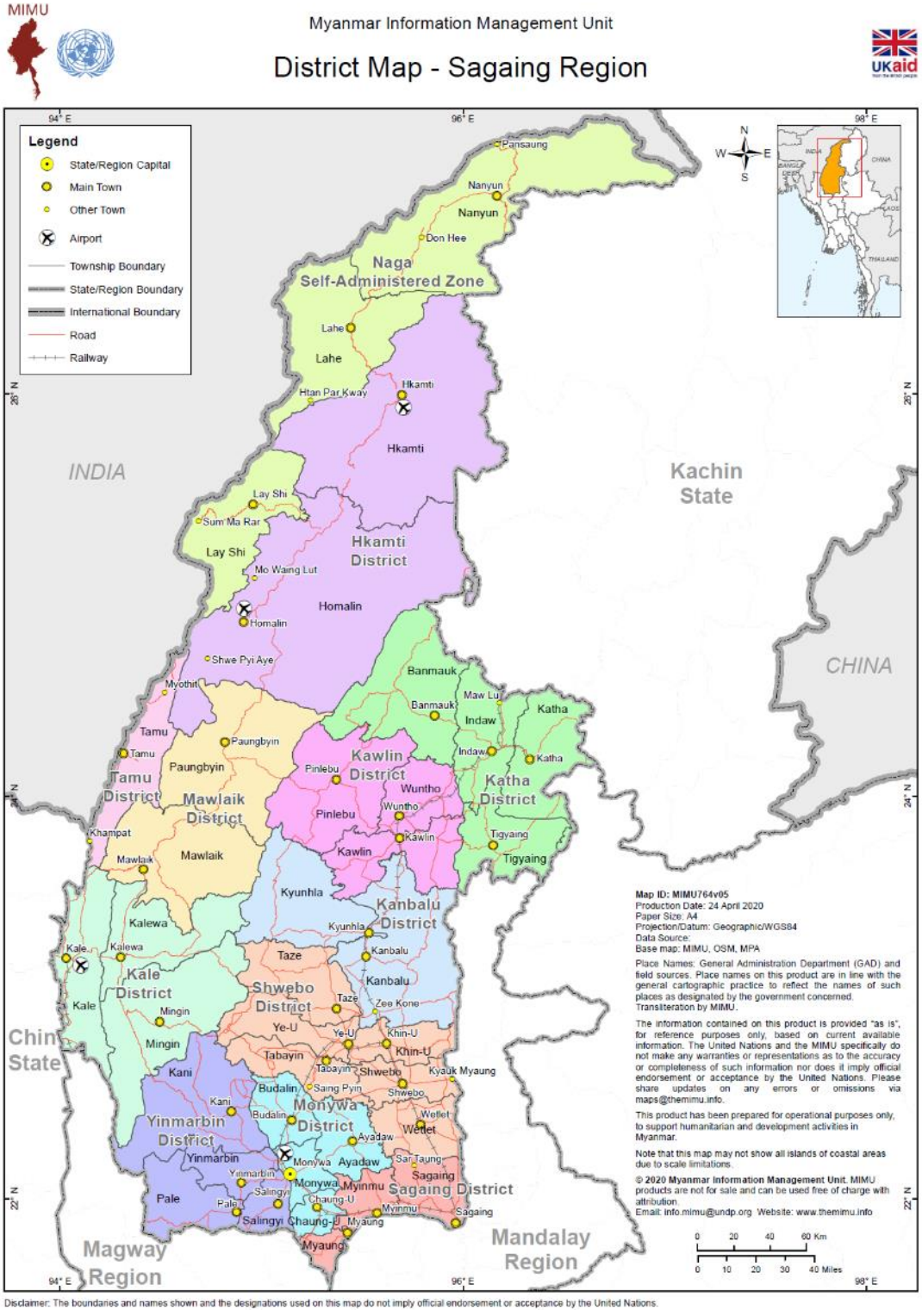


Figure 2-4 District map of Sagaing Region

Source: Myanmar Information Management Unit, https://themimu.info/sites/themimu.info/files/documents/Region_Map_District_Sagaing_MIMU764v05_24Apr2020_A4.pdf (Last Accessed: February 12, 2021)

Table 2-4 Overview of Sagaing Region

Number of Districts	9
Number of Townships	45
Total Population	5,325,347
Population Male	2,516,949 (47.26%)
Population Female Population	2,808,398 (52.74%)
Percentage of urban population	17%
Area (km ^{2})	93,702.48
Population density (per km^2)	56.8
Median age	27.4
Number of private households	1,096,857
Percentage of households urban%	16.8%
Percentage of female headed households	24.8%
Mean household size	4.6
Percentage of population by age group	
Children (0 – 14 years)	28.7%
Economically productive (15 – 64 years)	65.1%
Elderly population (65 + years)	6.2%
Dependency ratios/	
Total dependency ratio	53.5
Child dependency ratio	44.0
Old dependency ratio	9.5
Ageing index	21.7
Sex ratio	89.6 men for every 100 women
Literacy rate (persons aged 15 years and over)	93.7%
Male	96.6%
Female	91.4%

Source: Department of Population, Ministry of Labour, Immigration and Population. “The 2014 Myanmar Population and Housing Census, Sagaing Region Report ”. May 2015. https://www.dop.gov.mm/sites/dop.gov.mm/files/publication_docs/sagaing_region_census_report_-_english_0.pdf (Last Accessed: February 12, 2021)

Table 2-5 Overview of Monywa Township in Sagaing Region

Number of wards	26
Number of village tracts	57
Total Population	372,095
Population Male	171,951 (46.2%)
Population Female Population	200,144 (53.8%)
Percentage of urban population	55.8%
Area (km ^{2})	688.9
Population density (per km^2)	540.1 persons
Median age	28.9 years
Number of private households	75,962
Percentage of households urban%	-
Percentage of female headed households	26.1%
Mean household size	4.6 persons
Percentage of population by age group	
Children (0 – 14 years)	23.6%
Economically productive (15 – 64 years)	69.7%
Elderly population (65 + years)	6.7%
Dependency ratios/	
Total dependency ratio	43.5
Child dependency ratio	33.9
Old dependency ratio	9.6
Ageing index	28.4
Sex ratio	86 men for every 100 women
Literacy rate (persons aged 15 years and over)	94.5%
Male	97.5%
Female	92.1%

Source: Department of Population, Ministry of Labour, Immigration and Population. “The 2014 Myanmar Population and Housing Census, SAGAING REGION, MONYWA DISTRICT Monywa Township Report”. October, 2017. https://www.dop.gov.mm/sites/dop.gov.mm/files/publication_docs/monywa_0.pdf (Last Accessed: February 12, 2021)

2.2.2 Situation and Issues of Municipal Waste Countermeasures in Sagaing Region

(1) Marine plastic pollution

"Survey on Plastic Waste in the Ayeyarwady, 2018" [1] shows following situation in Myanmar.

- Solid waste produced in Myanmar has tripled over the last five years, plastic waste has increased from less than 5% (2000) to more than 13% (Mandalay survey, 2017).
- Since Myanmar does not have sanitary landfills or large scale waste incineration plants, non-recycled plastic waste often ends up as a pollutant either as toxic fumes through open burning or by entering the waterway.

The Ayeyarwady River is Myanmar's largest river, about 60% of the country's population lives in its basin. Waste including plastic discharged into watersheds is discharged directly into the sea, and it is considered to be a cause of marine pollution. It is estimated that about 119 tons of plastic is discharged into the sea per day in the Ayeyarwady River, and it is estimated that this river has the 9th largest amount of plastic pollution in the world.[2] For this reason, the Sagaing region, located in the upper reaches of the Ayeyarwady River, is facing an urgent need to take measures against waste plastic.

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[1] Survey on Plastic Waste in the Ayeyarwady, 2018 -2019 - Rapid river sampling for the first quantitative assessment of floating plastics in Myanmar's great river-, Friedor Jeske, July 2019, FFI Myanmar Working Paper No. 09, Embassy of the Federal Republic of Germany Yangon.
Available at https://www.thantmyanmar.com/en/riversurvey (Last accessed: February 19, 2021)

[2] ditto

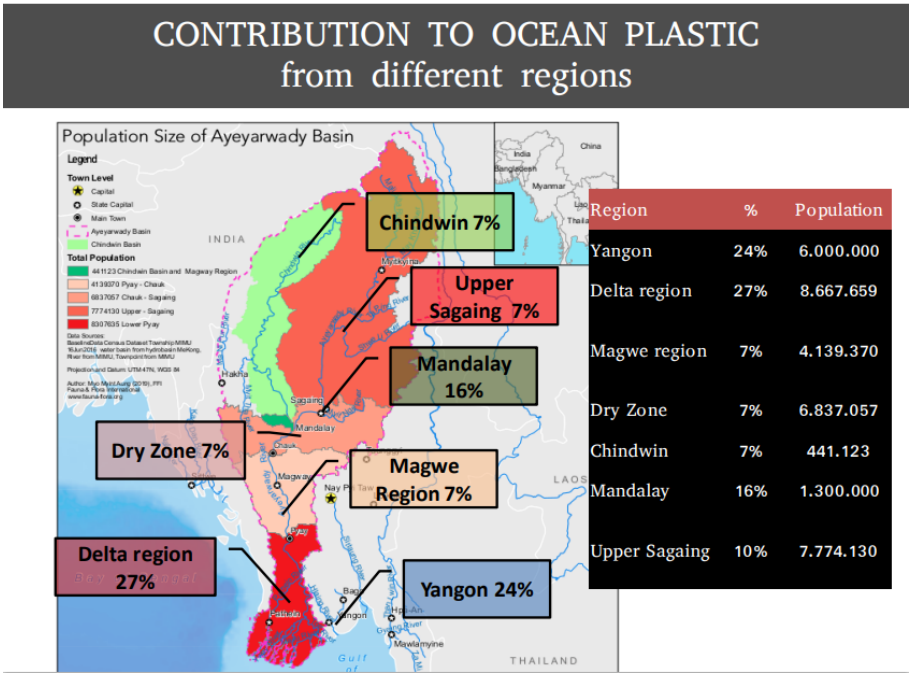


Figure 2-5 Situation of marine plastic pollution in Myanmar

Source: Friedor Jeske, Waste specialist. PLASTICS SURVEY ON THE AYEYARWADY RIVER. 09/07/2019. https://www.thantmyanmar.com/sites/thantmyanmar.com/files/documents-file/ayeyarwaddy_plastic_survey.pdf (Last Accessed: February 19, 2021)

In response to the growing global concern over plastic waste issues, multiple stakeholders in Myanmar have begun to address the issue, according to the National Waste Management Strategy and Master Plan for Myanmar (NWMSMP). The YCDC announced a ban on businesses manufacturing, importing, trading and distribution of high-density polyethylene plastic bags in 2009, and a ban on production, storage and sales of polyethylene bags in 2011. National initiatives are underway, and the food and beverage community launched a campaign in 2017 to reduce the use of plastic straws, called "Straws Suck". Art studios collect plastic garbage from the sea and rivers and use it to create art works. In the industrial sector, private companies are engaging in plastic waste transactions with China as a large-scale effort. In Dala, a suburb of Yangon, plastic recycling is attracting attention as a business through a campaign called "Chu Chu Store"[3].

In these way, in order to reduce plastic waste, local governments and private businesses have begun to restrict the use of plastic and to engage in recycling businesses.

[3] National Waste Management Strategy and Master Plan (NWMSMP, 2018 -2030). (P.13)

As a government initiative, on July 9, 2019, in Naypyidaw, with the support of the German Embassy, MONREC, UNDP and NGOs co-organized a workshop on plastic pollution reduction "Plastic pollution in Myanmar: focus on the Ayeyarwady river". In this workshop, researchers presented the results of a field study on plastic marine pollution in Myanmar, and once again recognized the necessity of plastic waste countermeasures. In the panel discussions, approaches including bans on single-use plastic, taxing, extended producer responsibility were discussed. On the plastics issue in Myanmar, participants recognized reduction of plastics at the source as a top priority. Experts from the government including Mr. Min Maw Director of Pollution Control Division, MONREC mostly prioritized waste collection as the first important step.[4]

(2) Status of municipal waste in Monywa City

Monywa, the capital of Sagaing region, is about 370,000 people and the 6th city in Myanmar, which accounts for less than 1/10 of Yangon's population. With population growth and economic development, the cost of waste disposal has been increasing year by year, putting pressure on local government budgets. The current situation is summarized in the table below.

[4] THANT MYANMAR. "PLASTIC POLUTION IN MYANMAR: 119 TONS OF PLASTIC WASTE ENTER THE AYYARWADY RIVER EVERY DAY".
https://www.thantmyanmar.com/en/news/plastic-pollution-in-myanmar-119-tons-of-plastic-waste-enter-the-ayeyarwady-river-every-day
Myanmar Centre for Responsible Business. “Reducing Single-Use Plastic in Myanmar”. August 05, 2019.
https://www.myanmar-responsiblebusiness.org/news/reducing-single-use-plastic-myanmar.html
(Last accessed: February 19, 2021)

Table 2-6 Status of waste disposal in Monywa Township

Final disposal site	Waste is flooding the final disposal sites, and their acceptance is reaching its limit. Although there are problems in the operation of fire risks, it is difficult to secure new land and there is no appropriate incineration system.
Garbage collection System	There are more than 30 quarters in the city of Monywa, and 43 garbage trucks are patrolled for regular collection. The center collects three types of garbage: household garbage collected by ringing bells, hospital garbage and garbage from eight markets in the city.
Awareness-raising activities	Staff members of the Development Committee provide guidance on waste sorting at specific townships and hold briefings on waste sorting for community level and market participants. In particular, it emphasizes the importance of separating dry garbage from garbage for the market.
At school: educational activity	Education activities aimed at raising awareness of garbage collection are also carried out in elementary schools. It is also trying to translate pamphlets from Fukushima into Burmese and make use of them.
Cost burden	Garbage collection. The cost of disposal is so high that it puts pressure on the budget of the city development.

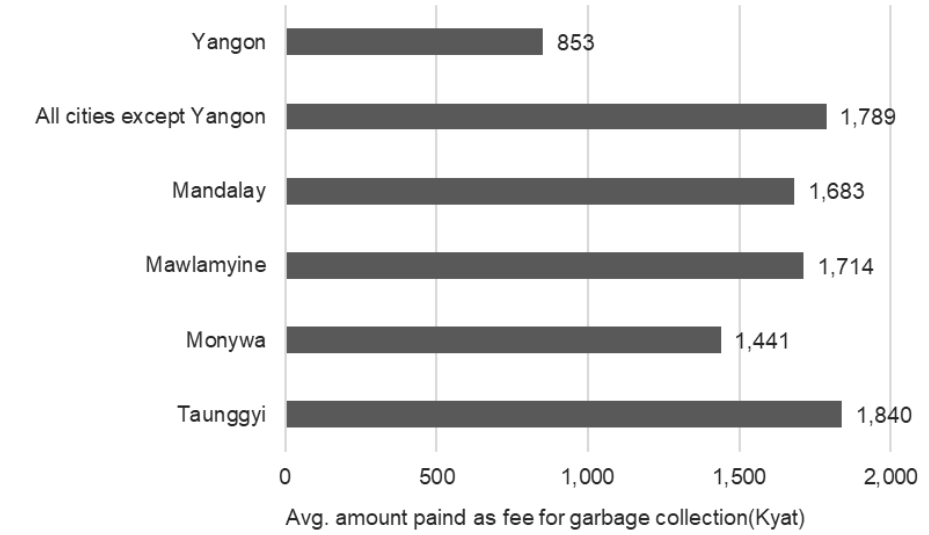
Source: Prepared based on field surveys (FY 2019)

Like other cities in Myanmar, Monywa collects garbage collection fees from households. However, it did not generate enough income to cover the cost, and in 2013, to reduce the cost, a local private company was entrusted with a garbage collection project, but the company went bankrupt because the commission fee was not sufficient, and the contract was canceled in only 2 months, which resulted in an increase in illegal dumping.[5] After returning responsibility for waste disposal to the local government, the city increased the number of collection vehicles and established its own waste management systems involving communities in four wards in the city. Specifically, the ward level staff prioritized activities for waste collection and problem solving, and promoted the planning based on the opinions of citizens[6]. This model can

[5] The Asia Foundation (2020). "An Economic Analysis of Solid Waste Management Outsourcing in Myanmar".

[6] The Asia Foundation (2020). "An Economic Analysis of Solid Waste Management Outsourcing in Myanmar".

be applied to other local cities as a model in which local communities actively participate in the waste treatment field, which is a public service, and play an important role.



Average Garbage Collection Fees Per Month. Based on households that pay a specific fee, not those who either do not pay a fee or where it is part of their property taxes, 2018 City Life Survey.

Figure 2-6 Average monthly garbage collection fee city comparison

Source: Based on the Asia Foundation(2020). “An Economic Analysis of Solid Waste Management Outsourcing in Myanmar”. P.15. https://asiafoundation.org/publication/an-economic-analysis-of-solid-waste-management-outsourcing-in-myanmar/（Last accessed: March 5, 2021）

2.2.3 Policy Trends Related to Municipal Waste Countermeasures

In Myanmar, the "National Waste Management Strategy and Master Plan (2018 -2030 years)" (submitted in August 2018 and approved in January 2020) and the “National Environmental Policy” and “Myanmar Climate Change Policy” were announced in June 2019.

The key to achieving the "Clean environment and healthy, functioning ecosystems" and "Sustainable economic and social development" set out in the "National Environmental Policy" announced in the 2019 report, is the materialization of policies and initiatives in rural areas, and contribution through City to City collaboration is expected.

In the environmental field, Myanmar is also required to take measures against marine plastics. In the area of the environment, Myanmar is also required to deal with marine plastics. Countermeasures against waste plastics in the Sagaing Region, which is located in the upper reaches of Ayeyawady River, is a policy issue that is consistent with these policies (In order to strengthen measures against waste plastics, it is essential to establish treatment methods other than landfill.).

Figure 2-7 The 6 goals of the National Waste Management Strategy and Master Plan

Source: Ministry of the Natural Resources and Environmental Conservation (MONREC) (2018). "National Waste Management Strategy and Master Plan for Myanmar (2018 -2030)".

Figure 2-8 Overview of National Environmental Policy

Source: The Republic of the Union of Myanmar (2019). "National Environmental Policy of Myanmar".

(Reference)

Outline of "National Waste Management Strategy and Master Plan for Myanmar (2018 -2030)"[7]

This strategy was developed by MONREC-ECD with the support of the IGES-UNEP Centre for Environmental Technology Collaboration (CCET). From 2016 to 2018, workshops were held with the participation of a number of stakeholders, including the federal government, regional governments, townships, the industrial sector, the private sector, and academic institutions. Set short-term targets (2018 -2020), medium-term targets (2021 -2025), and long-term targets (2026 -2030). A comprehensive list of strategies and actions, with input from stakeholders at the urban level.

The National Waste Management Strategy and Master Plan links with other national policies, strategies and development plans as well as contributes to achievement of the country's commitments under the Sustainable Development Goals (SDGs) and Paris Climate Agreement.

The main contents are extracted and arranged as follows.

- The national waste management strategy and master plan consists of the following.

・ *1. INTRODUCTION TO THE STRATEGY*

・ *2. STRATEGY DEVELOPMENT – THE PROCESS*

・ *3. WASTE MANAGEMENT - WHERE ARE WE NOW*

・ *4. HOW TO MOVE FORWARD*

・ *5. SETTING NATIONAL GOALS, OBJECTIVES AND TARGETS*

・ *6. IMPLEMENTATION PRIORITIES AND MECHANISMS*

- The following are the six goals to be set.

[7] The "National Waste Management Strategy and Master Plan for Myanmar (2018 -2030)" is available on the IGES website: https://www.iges.or.jp/en/pub/nwmsamp-myanmar-2018-2030/en (Last accessed: February 25, 2021)

- *Goal A: Extending sound waste collection service to all citizens and minimizing uncontrolled disposition and open burning as a first step toward environmentally sound waste management*
- *Goal B: Extending sustainable and environmentally sound management of industrial and other hazardous wastes*
- *Goal C: Substantially prevent waste through 3 Rs and the baby establish a resource circular society*
- *Goal D: Ensure sustainable financing mechanisms*
- *Goal E: Awareness raising, advocacy and capacity building*
- *Goal F: Compliance, monitoring, enforcement and recognition*

(Reference)

Outline of "National Environmental Policy of Myanmar" (Myanmar's National Environmental Policy)[8]

- Myanmar's national environmental policy consists of the following.
  - *Foreword*
  - *Introduction*
  - *Policy Approach*
  - *National Environmental Policy Vision & Mission*
  - *National Environmental Policy Principles*
  - *a) Clean environment and health, functioning ecosystems*
  - *b) Sustainable economic and social development*
  - *c) Mainstreaming environmental protection and management*
  - *Implementing the National Environmental Policy*
- The following are raised as National Environmental Policy Vision & Mission.

[8] The "National Environmental Policy of Myanmar" is available on the UNDP website:. UNDP, National Environmental Policy of Myanmar, Jun 5, 2019. https://www.mm.undp.org/content/myanmar/en/home/library/environment_energy/national-environmental-policy-of-myanmar.html (Last accessed: February 19, 2021)

Vision

A clean environment, with healthy and functioning ecosystems, that senses inclusive development and wellbeing for all people in Myanmar

Mission

To establish national environmental policy principles for guiding environmental protection and sustainable development and for mainstreaming environmental considerations into all policies, laws, regulations, plans, strategies, programs and projects in Myanmar

- The National Environmental Policy Principles include the following key statements relating to waste and renewable energy.

(a) Clean environment and health, functioning ecosystems

(7) Environmental service provisioning (including water management, water treatment, drinking water purification, ambient air and water quality monitoring and management) will be included as necessary parts of infrastructure planning and development for urban and human settlement areas, with resource efficient and zero waste approaches used.

(b) Sustainable economic and social development

(8) Environmental sustainability will always be a central objective in determining Myanmar's economic and social development strategies, which will prioritize low-carbon and green economic pathways, through responsible investment and partnerships with the private sector and civil society

(10) Sustainable and renewable energy for the needs of people and for economic development in Myanmar will be secured, and utilised effectively, through the use of existing technology and innovations in the generation, storage, supply and use of energy.

(11) Climate smart approaches to development, including resilience, climate change adaptation and mitigation, and disaster reduction strategies, will be aligned to environmental protection and good natural resource management approaches in the pursuit of lowcarbon, sustainable development.

(13) Pollution and waste is to be avoided and minimized at the source as more cost effective than remediation, entities will be enforced to adopt clean production principles and best practices.

- The National Environmental Policy Principles also address institutional development, awareness-raising and international cooperation.

(c) Mainstreaming environmental protection and management

(15)Institutional and legal frameworks for implementing and enforcing environmental laws and policies will be strengthened through clear definition of rights and responsibilities, and greater collaboration among different institutions within the government at all levels, as well as with government stakeholders.

(19) Environmental education, public awareness raising and quality research will be promoted to enhance respect for the country's environmental values, understanding of environmental challenges, and commitment to environmental conservation and sustainable development.

(22)International cooperation will be thought to strengthen environmental conservation and sustainable development in Myanmar, and to address regional and global challenges, through bilateral and multilateral agreements, experience sharing and implementation arrangements.

2.3 Current Situation and Challenges in the Ayeyarwady Region and Related Policy Trends

This section describes socioeconomic situation of Ayeyarwady Region, present state and problems of electrification countermeasures which are regional problems, and related policy trends.

2.3.1 Socioeconomic Situation in Ayeyarwady Region

The Ayeyarwady Region is located downstream of the Ayeyarwady River, and the area around the river mouth is a vast delta. Ayeyarwady Region covers an area of about 35,000 square kilometers, and the capital city of the region is Pathein. According to the "The 2014 Myanmar Population and Housing Census" Ayeyarwady Region is the high densely populated region after Yangon and Mandalay Regions, and has a population of more than 6 million. Within the jurisdiction are 6 Regions (Region) and 33 Townships. Ayeyarwady Region has the highest proportion of rural residents in Myanmar (86%).

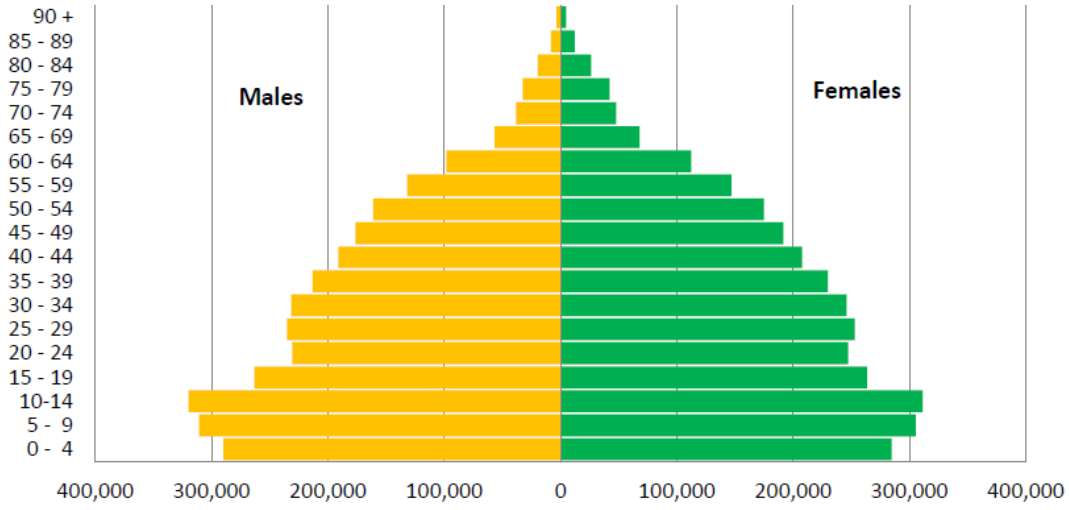


Figure 2-9 Population pyramid of Ayeyarwady Region (2014)

Source: Department of Population, Ministry of Labor, Immigration and Population. "The 2014 Myanmar Population and Housing Census, Ayeyawady Region Report". May 2015.

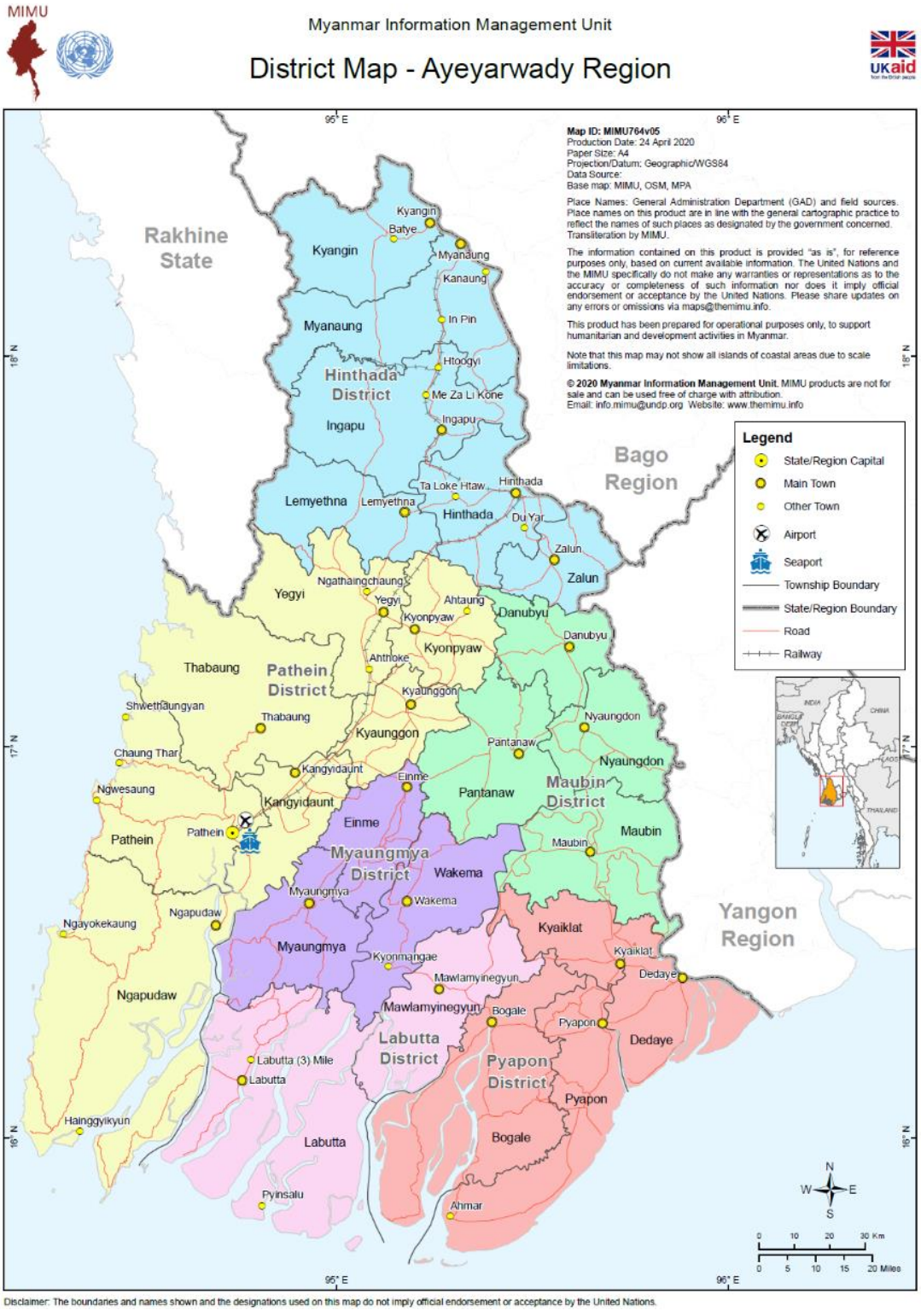


Figure 2-10 District map of Ayeyarwady Region

Source: Myanmar Information Management Unit, https://themimu.info/sites/themimu.info/files/documents/Region_Map_District_Ayeyarwady_MIMU764v05_24Apr2020_A4.pdf (Last Accessed: February 12, 2021)

Table 2-7 Outline of Ayeyarwady Region

Number of Regions	6
Number of Townships	33
Total Population	6,184,829
Population Male	3,009,808 (48.66%)
Population Female Population	3,175,021 (51.34%)
Percentage of urban population	14%
Area (km ^{2})	35,031.88
Population density (per km^2)	176.5
Median age	27.7
Number of private households	1,488,983
Percentage of households urban%	13.5%
Percentage of female headed households	19.3%
Mean household size	4.1
Percentage of population by age group	
Children (0 – 14 years)	29.5%
Economically productive (15 – 64 years)	64.7%
Elderly population (65 + years)	5.8%
Dependency ratios	
Total dependency ratio	54.5
Child dependency ratio	45.5
Old dependency ratio	9.0
Ageing index	19.7
Sex ratio	For 100 women 95 men
Literacy rate (persons aged 15 years and over)	93.8%
Male	95.9%
Female	92.0%

Source: Department of Population, Ministry of Labor, Immigration and Population. "The 2014 Myanmar Population and Housing Census, Ayeyawady Region Report". May 2015. https://www.dop.gov.mm/sites/dop.gov.mm/files/publication_docs/ayeyawady_region_census_report_-_english_1.pdf (Last accessed: March 5, 2021)

Table 2-8 Outline of Ayeyarwady Region, Myaungmya Township

Number of wards	16
Number of village tracts	98
Total Population	298,637
Population Male	145,972 (48.9%)
Population Female Population	152,665 (51.1%)
Percentage of urban population	19.7%
Area (km ^{2})	1,152.2
Population density (per km^2)	259.2 persons
Median age	26.7 years
Number of private households	66,172
Percentage of households urban%	-
Percentage of female headed households	18.4%
Mean household size	4.4 persons
Percentage of population by age group	
Children (0 – 14 years)	30.5%
Economically productive (15 – 64 years)	64.4%
Elderly population (65 + years)	5.1%
Dependency ratios	
Total dependency ratio	55.2
Child dependency ratio	47.3
Old dependency ratio	7.9
Ageing index	16.7
Sex ratio	For 100 women 96 men
Literacy rate (persons aged 15 years and over)	91.3%
Male	93.2%
Female	89.7%

Source: Department of Population, Ministry of Labour, Immigration and Population. “The 2014 Myanmar Population and Housing Census, Ayeyawady Region, Myaungmya District, Myaungmya Township Report”. October 2017. https://www.dop.gov.mm/sites/dop.gov.mm/files/publication_docs/myaungmya_0.pdf (Last accessed: March 5, 2021)

Table 2-9 Outline of Ayeyarwady Region, Labutta Township

Number of wards	10
Number of village tracts	50
Total Population	229,929
Population Male	114,746 (49.9%)
Population Female Population	115,183 (50.1%)
Percentage of urban population	13.6%
Area (km ^{2})	2,007.8
Population density (per km^2)	114.5 persons
Median age	25.6 years
Number of private households	55,146
Percentage of households urban%	-
Percentage of female headed households	14.9%
Mean household size	4.1 persons
Percentage of population by age group	
Children (0 – 14 years)	31.8%
Economically productive (15 – 64 years)	64.0%
Elderly population (65 + years)	4.2%
Dependency ratios	
Total dependency ratio	56.2
Child dependency ratio	49.7
Old dependency ratio	6.5
Ageing index	13.2
Sex ratio	For 100 women 100 men
Literacy rate (persons aged 15 years and over)	90.9%
Male	94.2%
Female	87.8%

Source: Department of Population, Ministry of Labour, Immigration and Population. “The 2014 Myanmar Population and Housing Census, Ayeyawady Region, Labutta District, Labutta Township Report”. October 2017. https://www.dop.gov.mm/sites/dop.gov.mm/files/publication_docs/labutta_0.pdf (Last accessed: March 5, 2021)

The Ayeyarwady Region is a major grain-growing region that produces about 30% of Myanmar's rice production, and the annual rice production in the Ayeyarwady Region is about 7 million tons (As a result, the amount of rice husks generated is estimated to be about 1.4 million tons.).

Table 2-10 Rice production and rice husk generation in Ayeyarwady Region

	rainy season	dry season	Total
Area (Acre)	3,548,198	1,281,847	4,830,045
Yield	63.98	85.58	
Production (basket)	227,119,477	109,708,746	336,828,223
Rice production (MT)	4,664,060	2,252,947	6,917,007
Rice husks (MT)	948,020	457,935	1,405,955

Source: Presentation material by the Ministry of Commerce, Department of Consumer Affairs, Ayeyarwady Region. September 2016.

2.3.2 Situation and Issues of Electrification Measures in the Ayeyarwady Region

(Power sector trends)

The electrification rate (Ratio of electricity as the main source of lighting) of Ayeyarwady Region was 12% as of 2014, which is much lower than the average electrification rate of the whole country of Myanmar of approximately 32%. Compared to other regions and states, the electrification rate in Ayeyarwady is particularly low.

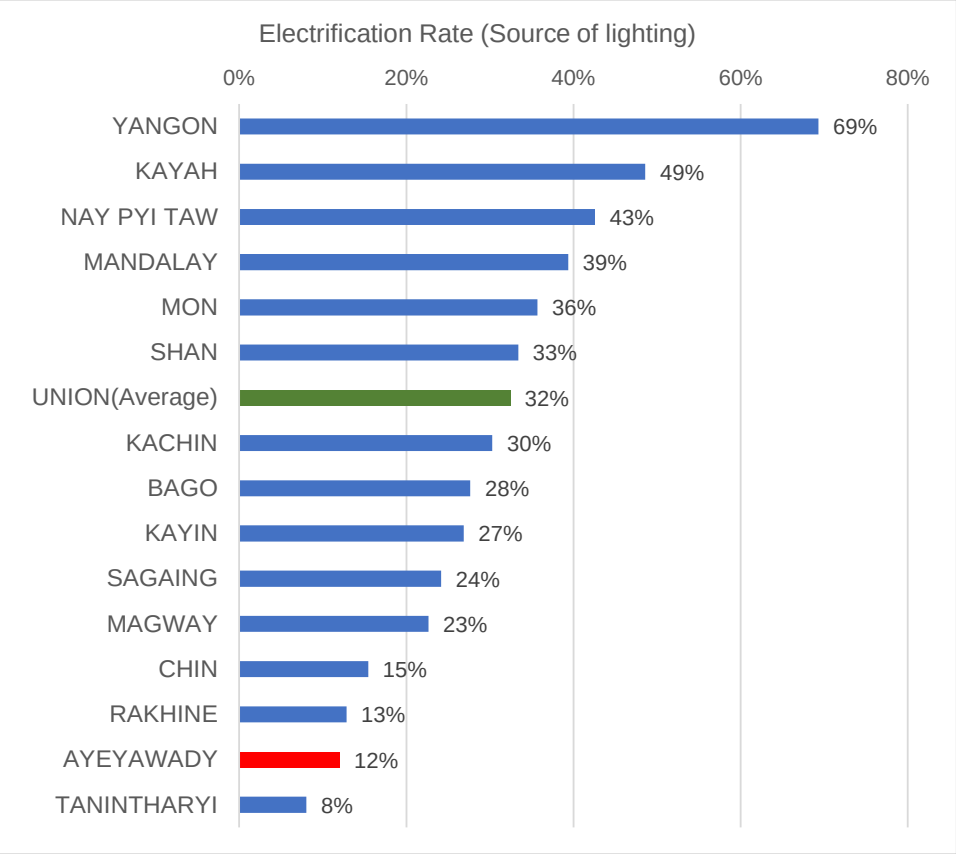


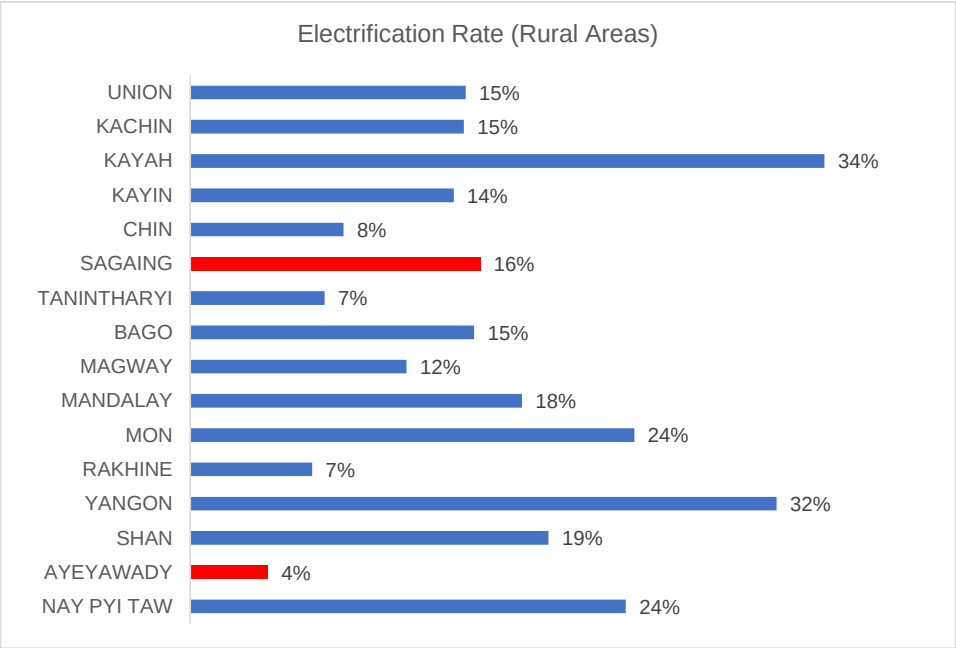
Figure 2-11 Electrification rate in Myanmar (Main source of lighting)

Source: Based on Department of Population, Ministry of Labour, Immigration and Population. “The 2014 Myanmar Population and Housing Census”.

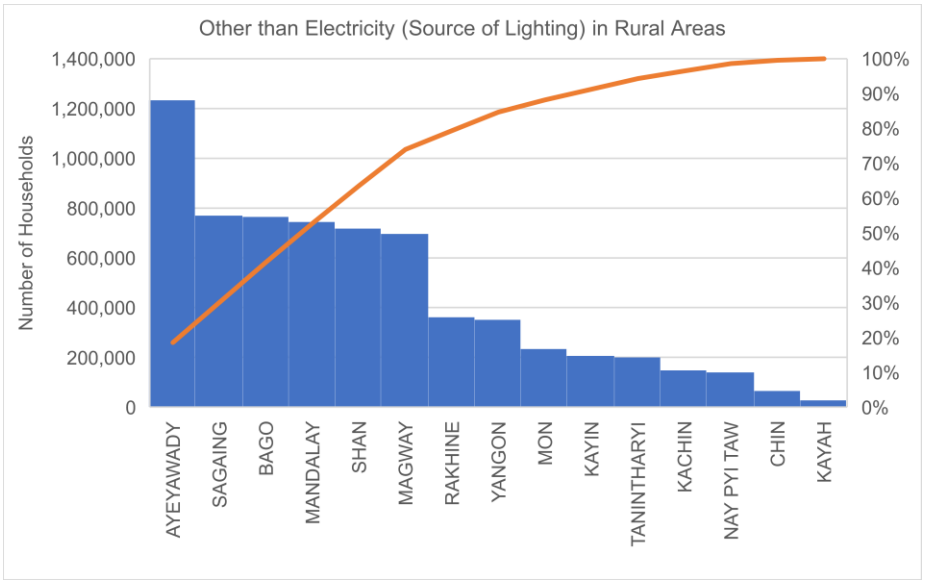
The low electrification rate in rural areas is a common feature of Myanmar, but when comparing the electrification rates in rural areas of other States and Regions, the rural area in Ayeyarwady Region is 4%, which is the lowest in Myanmar.

In addition, the rural areas of Ayeyarwady Region have a large population. Looking at the number of non-electrified households, the Ayeyarwady Region has the largest number, followed by the Sagaing Region. It can be said that it is extremely important to

take measures against electrification in rural areas in the Ayeyarwady and Sagaing regions in order to achieve 100% of the electrification rate of Myanmar as a whole.



a) Electrification rate (by state/region: rural)



b) Non-electrified (main source of lighting) households (by state/region: rural)

Figure 2-12 Situation of electrification (by state/region: rural)

Source: Based on Department of Population, Ministry of Labour, Immigration and Population. "The 2014 Myanmar Population and Housing Census"

(Trends in Myaungmya Township and Labutta Township)

Regarding the status of electrification by region in the Ayeyarwady Region, as of 2014, the total of the district was 12%, Myaungmya Township was 16%, and Labutta Township was 10%, which is the lowest level among the districts.

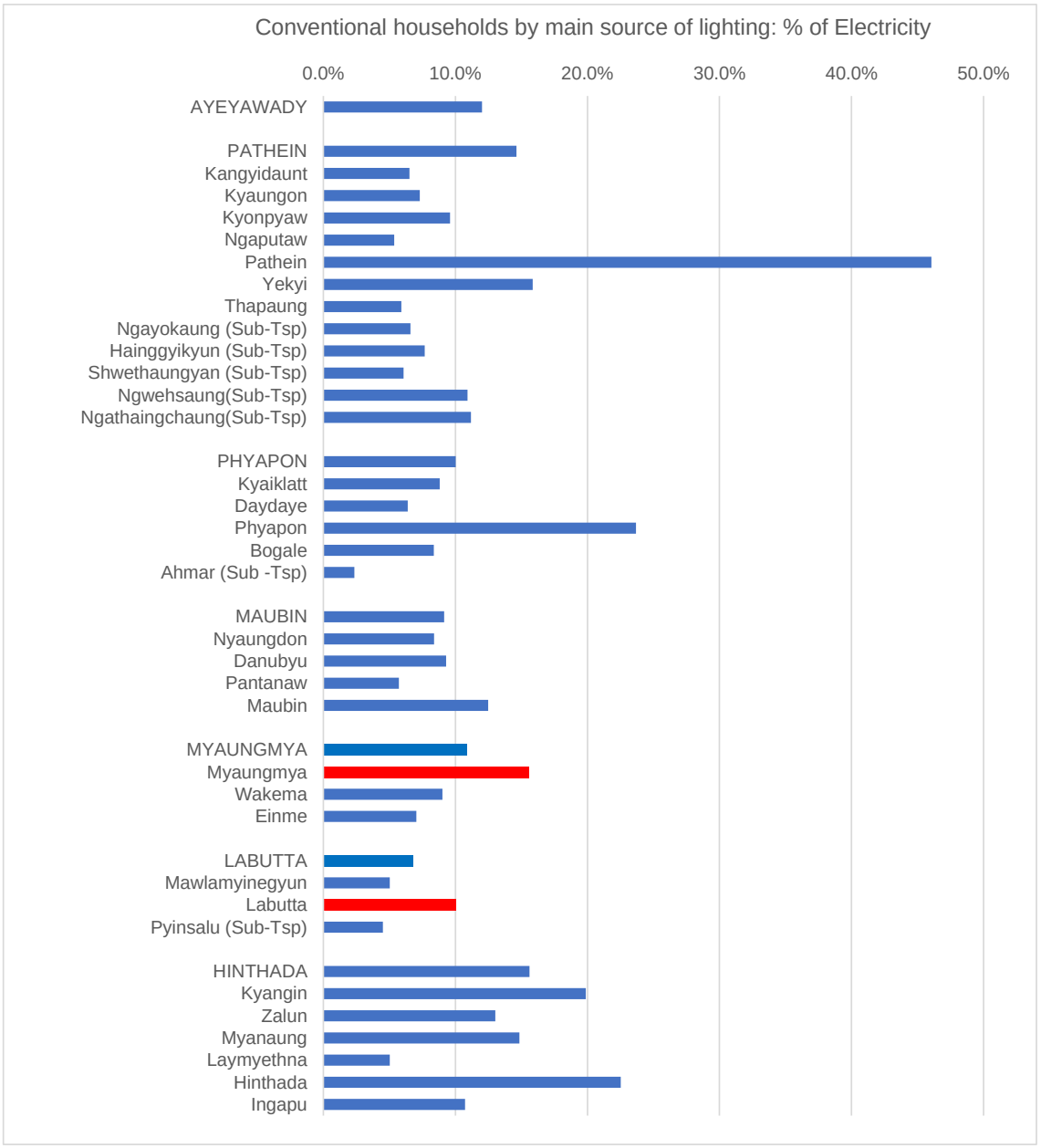


Figure 2-13 Electrification rate in Ayeyarwady Region (2014)

Note: Electrification rate: A numerical value based on the main source of lighting.
Source: Based on Department of Population, Ministry of Labor, Immigration and Population. “The 2014 Myanmar Population and Housing Census”.

(Trends of electrification in Myaungmya Township)

The sources for lighting in Myaungmya Township are as follows, and the electrification rate is as follows. It is 15.6%, which is higher than the average value of 12% in the Ayeyarwady Region. However, the electrification rate in rural areas is 4.0%, which is much lower than 65.4% in urban areas, and electrification measures in rural areas are an issue.

Table 2-11 Conventional households by source of lighting by urban/rural (Myaungmya Township)

Source of lighting		Total	Urban	Rural
Electricity		15.6	65.4	4.0
Kerosene		36.2	1.2	44.4
Candle		9.9	7.2	10.5
Battery		31.8	24.5	33.5
Generator (private)		3.7	1.0	4.4
Water mill (private)		0.1	*	0.1
Solar system/energy		2.3	0.2	2.8
Other		0.4	0.5	0.4
Total	**Per cent**	**100.0**	**100.0**	**100.0**
	Number	**66,172**	**12,513**	**53,659**

Source: Department of Population (Ministry of Labour, Immigration and Population). “The 2014 Myanmar Population and Housing Census, Ayeyawady Region, Myaungmya District, Myaungmya Township Report”. October 2017. https://www.dop.gov.mm/sites/dop.gov.mm/files/publication_docs/myaungmya_0.pdf (Last accessed: March 5, 2021)

(Trends of electrification in Labutta Township)

The following conditions are met regarding sources for lighting in Labutta Township, and the electrification rate is as follows. It is 10.0%, which is lower than the average value of 12% in the Ayeyarwady Region. However, the electrification rate in rural areas is 3.5%, which is much lower than 53.7% in urban areas, and electrification measures in rural areas are an issue.

Table 2-12 Conventional households by source of lighting by urban/rural (Labutta Township)

Source of lighting		Total	Urban	Rural
Electricity		10.0	53.7	3.5
Kerosene		38.0	1.4	43.5
Candle		11.2	12.4	11.1
Battery		27.8	21.1	28.8
Generator (private)		8.7	10.7	8.4
Water mill (private)		0.1	0.1	0.1
Solar system/energy		3.6	0.2	4.1
Other		0.6	0.3	0.6
Total	**Per cent**	**100.0**	**100.0**	**100.0**
	Number	**55,146**	**7,203**	**47,943**

Source: Department of Population (Ministry of Labour, Immigration and Population). “The 2014 Myanmar Population and Housing Census, Ayeyawady Region, Labutta District, Labutta Township Report”. October 2017. https://www.dop.gov.mm/sites/dop.gov.mm/files/publication_docs/labutta_0.pdf (Last accessed: March 5, 2021)

2.3.3 Trends in Related Policies in Electrification

Energy policy and electricity policy are being promoted by the Ministry of Electricity and Energy. On the other hand, the off-the-grid electrification policy in rural areas is being promoted by the Ministry of Agriculture, Livestock, and Irrigation.

The Myanmar government has set a long-term goal of 100% electrification rate for the entire country by 2030. It also sets an intermediate target of 75% in 2025.

According to the "EuroCham Myanmar Energy Guide 2020", the electrification rate in Myanmar (2018) is estimated to be about 47%, the electrification rate in urban areas is 86%, and the electrification rate in rural areas is 33%. 60% do not have access to the National Grid. The Ministry of Electricity and Energy is drafting the "Electrification Master Plan," which aims to achieve 100% electrification by 2030.

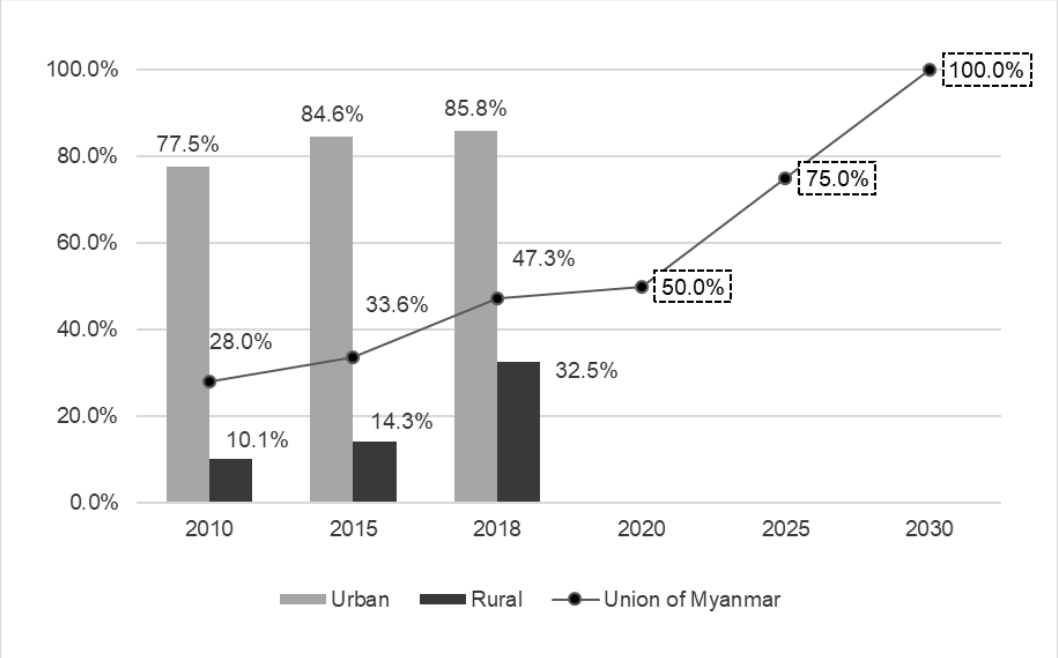


Figure 2-14 Electrification rates in Myanmar

Note: Figures are based on the World Bank (2019), figures in 2020, 2025, and 2030 are target.
Source: EuroCham Myanmar. “Energy Guide 2020”. p.13. https://eurocham-myanmar.org/uploads/c3e36-website_energy-guide-2020.pdf (Last accessed: March 5, 2021)

The World Bank's "Myanmar: Towards Universal Access to Electricity by 2030" requires the development of a total of about 2.6 GW of new power sources and the connection of about 7.2 million new grids throughout Myanmar toward 100% electrification. In particular, the Ayeyarwady Region has 1.08 million locations, accounting for about 15% of the total, and is the region with the greatest room for new power development.

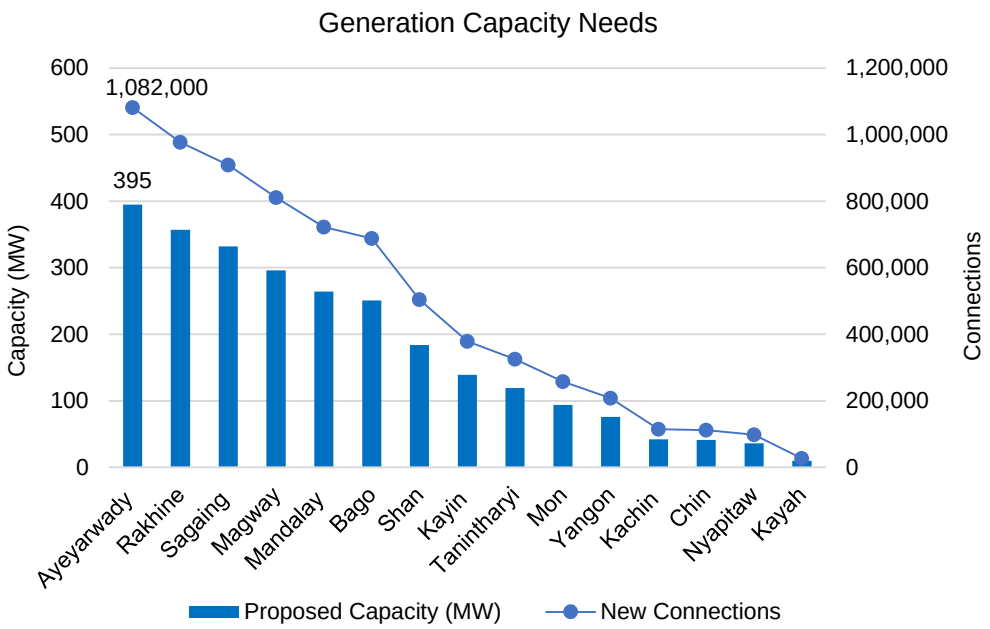


Figure 2-15 Generation capacity needs

Source: Based on the World Bank. “Myanmar: Towards Universal Access to Electricity by 2030”. October 1, 2014. https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/Myanmar%20NEP%20BBL%20presenation%2010-01-2014.pdf (Last accessed: March 5, 2021)

3. Project Feasibility Study

3.1 Consideration of Commercialization in Sagaing Region

3.1.1 Understanding the Composition of Waste at Monywa Township

Focusing on plastic waste, which is becoming a problem in municipal waste, we grasped the composition of municipal waste collected at Monywa Township as a basic information to consider the concrete implementation of a regional recycling 3R system. Specifically, in cooperation with the Monywa City Development Committee, we conducted a field survey on the composition of municipal waste collected in Monywa city. The collected / analyzed data is shown below.

Implementation period: 10 days from January 28 to February 7, 2021

Implementation method: Initially, a local consultant (Yangon) was scheduled to visit Monywa to conduct a field survey, but due to the influence of COVID-19, it became difficult to make a business trip from Yangon.
Therefore, the survey method was changed by the Monywa City Development Committee. After explaining to the staff, they conducted a field survey.

Garbage from the yard was the most common at 38%, followed by kitchen waste at 24% and plastic waste at 31%.

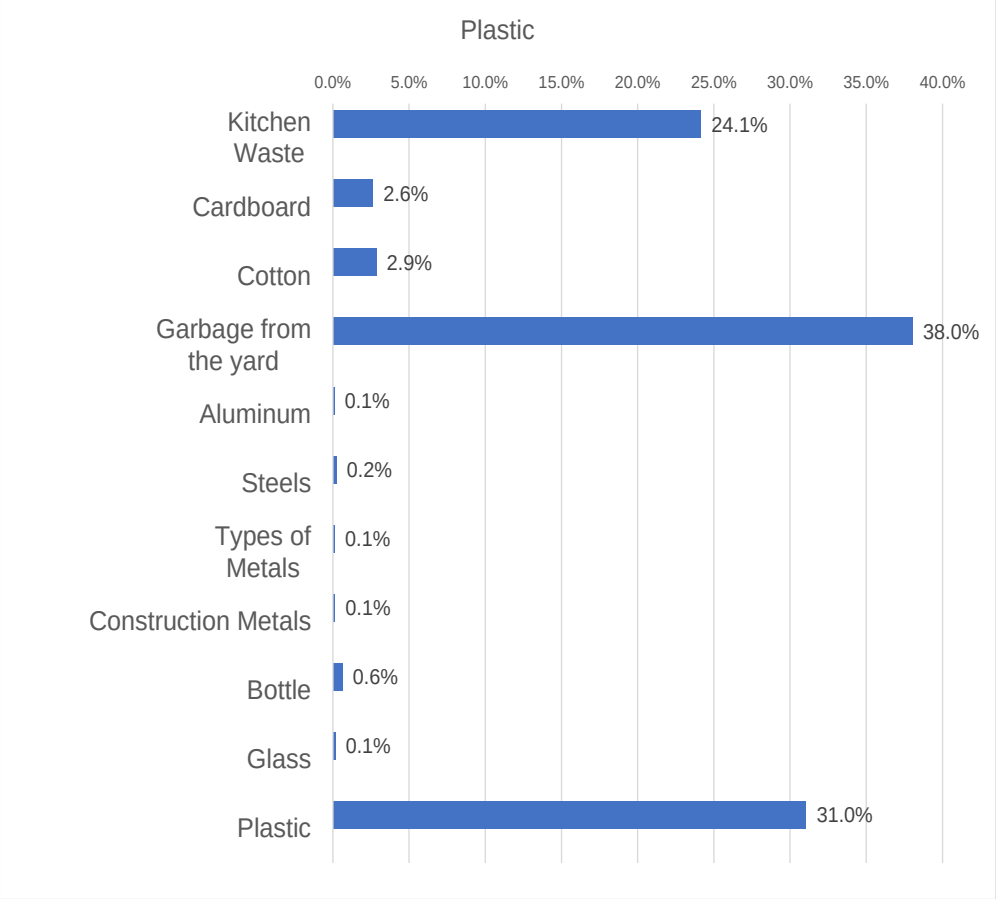


Figure 3-1 Result of waste and garbage composition analysis

As for the ratio of plastics in waste by type, PE (polyethylene) was the most common at 64%, followed by PVC (polyvinyl chloride) at 15%, PP (polypropylene) and PA (polyamide) at 5%, respectively, and PS. (polystyrene) was 4%, and the total of PE, PP, and PS was 74%.[9]

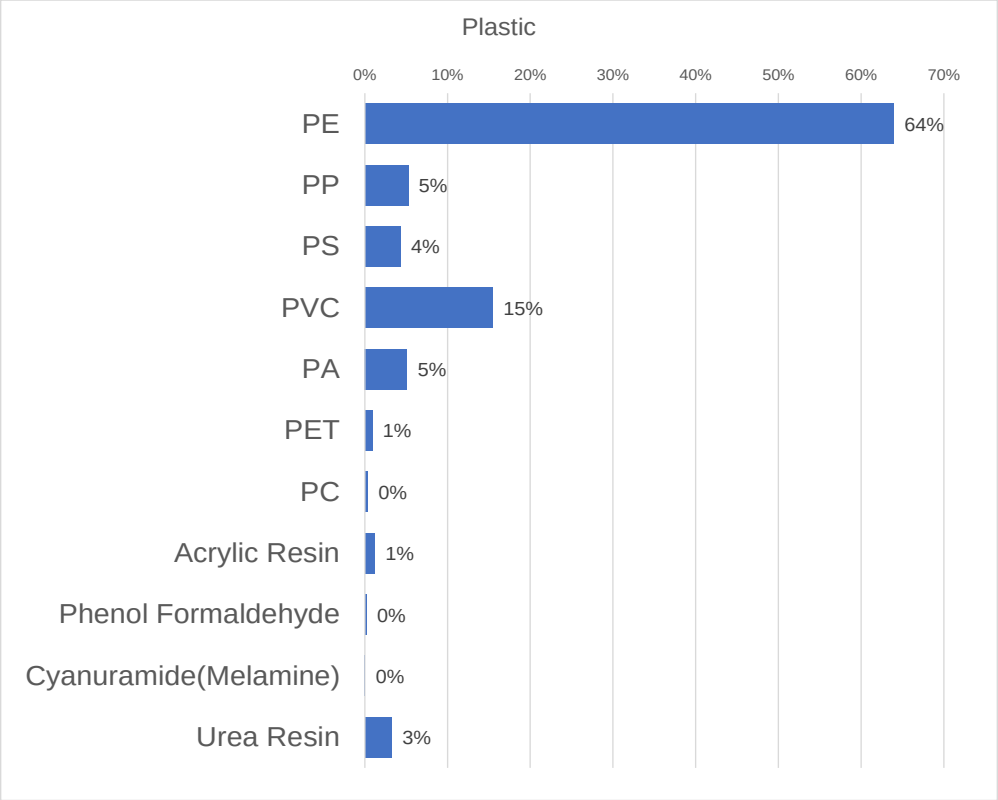


Figure 3-2 Result of waste and garbage composition analysis (by type of plastic)

[9] Note that the values are the values that the workers of the Urban Development Bureau visually identified and grasped the type of plastic at the site.

Figure 3-3 Implementation of grasping the composition of waste and garbage

Source: Photos provided by Monywa City Development Committee.

3.1.2 Examination of Deployment Measures

From the composition survey of municipal waste, garbage from the yard (38.0%) , plastics (31.0%) and kitchen waste (24.1%) are major proportions. If these three components can be treated by a method other than landfill disposal, it will be possible to reduce the amount of waste that was conventionally landfilled by about 90%.

Assuming that the amount of municipal waste discharged in Monywa is 160 t/day, it will be 49.6 t/day for plastics, 38.6 t/day for kitchen waste, and 60.8 t/day for garbage from the yard.

Table 3-1 Generations of municipal waste in Monywa (Setting value)

	Ratio	Generation (t/day)
Total amount of Waste	-	160
Kitchen Waste	24.1%	38.6
Garbage from the yard	38.0%	60.8
Plastics	31.0%	49.6

(Directions of deployment)

Considering the local situation, it is important that the initial cost is as low as possible and the operation is easy. Therefore, the following directions (draft) were proposed.

(1) Use of plastic as fuel (as simple as possible)

(2) Use garbage from the yard as an auxiliary material for converting plastics into fuel

(3) Composting kitchen waste

(Specification plans of each policy)

(1) Fuel conversion of waste plastic

1) Fluff fuel conversion

The simplest method for converting waste plastic into fuel is fluff fuel, which is crushed to a certain size and then compressed and packed to be transported to the demand area. The use of fluff fuel is for the use of boilers for papermaking and power generation, and as a raw material for cement.

The merits of using fluff fuel are that the initial cost of the production line can be suppressed and that the amount of electric power consumed during production is

small.

On the other hand, from the user's point of view, boilers that support fluff fuel often require additional investment because they require a blowing mechanism (modification may be difficult depending on the situation). In the case of coarse coal and pulverized coal, it is relatively easy to modify in the case of fluidized bed and jet layer combustion, but in the case of fixed bed combustion using lump coal, it is difficult to modify.

2) RPF (Refuse derived paper and plastics densified Fuel)

When converting to RPF, it is usually manufactured by mixing paper sludge. The reason is that it is easy to adjust the calorific value of the fuel. The chlorine concentration is set to 0.3% (3,000ppm) in the JIS standard, so in many cases it is set to 3,000ppm by adding waste paper or wood waste and diluting it.

Note) Quality of RPF (grade A) on total chlorine Mass fraction (%) is “less than 0.3” based on JIS Z7311: 2010 "Waste-derived solidified fuel (RPF) such as paper and plastic".

However, since there is no paper mill near which paper sludge is generated, consider using crushed garbage from the yard.

Regarding the waste plastics to be used, from the waste plastic composition survey, excluding PVC, which is unsuitable for RPF conversion, it was found to be a mixture of PE (63.9%), PP (5.2%), and PS (4.3%) for a total of 36.4 t/day. Considering the composition ratio from the calorific value of each plastic, it is estimated to be 45.5 MJ/kg, which is equivalent to PE.

The weight will be 36.4 t/day out of 160 t/day. Of these, if it is set that about 15% is unsuitable for RPF conversion, the target plastic will be 31 t/day.

Table 3-2 Generations of plastic waste in Monywa (Setting value)

	Ratio	Generation (t/day)
Polyethylene (PE)	63.9%	31.7
Polypropylene (PP)	5.2%	2.6
Polystyrene (PS)	4.3%	2.1
Total	-	36.4

Looking at the calorific value of the garbage from the yard as woody biomass, 1 kg is about 10 MJ (moisture 40%, low calorific value)[10], and when the garbage from the yard and 17 t/day are mixed, it becomes 33.3 MJ/kg.

Table 3-3 Daily processing amount (Setting value)

	Daily processing amount (t/day)	Ratio	Unit calorific value (MJ/kg)
Plastics	31.0	65%	46.0
Crushed material of Garbage from the yard	17.0	31%	10.0
Total	48.0		33.3

Even if this RPF is mixed with a coal boiler by about 20%, the calorific value is almost the same as that of coal.

Table 3-4 Unit calorific value (Setting value)

	Ratio	Unit calorific value (MJ/kg)	Calorie (MJ/kg)
Coal	80%	26.6	21.3
RPF	20%	33.3	6.7
Total	-	-	27.9

[Results of examination of RPF system]

- Hand sorting conveyor: 1.5-2.0kW
- Uniaxial crusher: 100kW (2 t/hour)
- RPF molding machine: 200kW (2 t/hour)
- Compression packing machine: 30kW

Since the processing amount of the RPF manufacturing system is 47 t/day, it can be processed by operating 2 t/day lines for 12 hours and providing 2 lines. It is desirable

[10] Forestry Agency, “Woody Biomass Energy Edition” https://www.rinya.maff.go.jp/j/sanson/kassei/pdf/shishin_s2-1.pdf (Last accessed: March 5, 2021)

that the garbage from the yard be finely crushed so that they can be mixed as uniformly as possible. It is movable and easy to handle if it is driven by gasoline.

(3) Composting of kitchen waste

The water content of kitchen waste is 75-90%. For composting to proceed smoothly, it is necessary to reduce the water content to 65% or less. Garbage from the yard are used to regulate the water content. The weight of the remaining garbage from the yard used to regulate the calorific value of RPF is 37.4 t/day. The water content of the garbage from the yard is about 40 to 50%, but after crushing, it is about 40%. Therefore, by mixing, the water content of the mixture becomes 65% or less, which is an appropriate condition for aerobic fermentation.

Table 3-5 Amount of kitchen waste and garbage from the yard (Setting value)

	Water	Wet weight (t/day)	Dry weight (t/day)
Kitchen waste	85%	38.6	5.8
Garbage from the yard	40%	37.4	22.4
Mixture	63%	76.0	28.2

Kitchens whose water content has been adjusted with garbage from the yard are well mixed and piled up in a sedimentary compost house, and composted with occasional stirring with a wheel loader or the like. Although the decomposition of kitchen waste is quick, composting is usually completed within one month when garbage from the yard are included, and compost of about 12 t/day is produced and can be returned to agricultural land. Generally, the compost application rate per 1,000 m^2 is about 1 to 2 tons, so it can be applied to 6,000 m^2 to 12,000 m^2 every day. If it is set to be applied once a year to one agricultural land, 1.8 to 3.6 km^2 of agricultural land will be applied throughout the year (as 300 days).

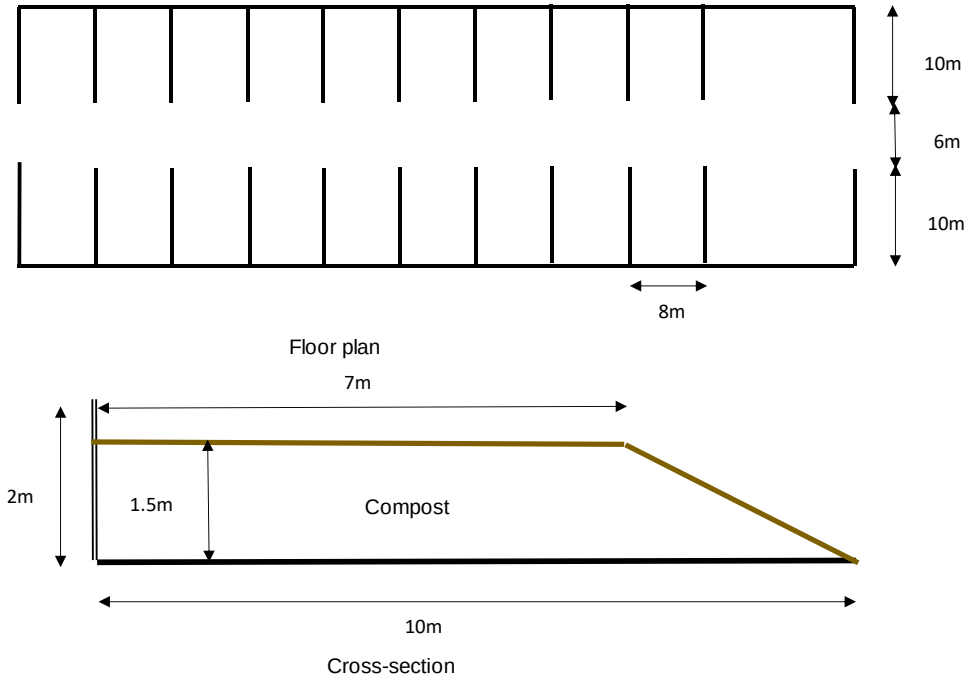


Figure 3-4 Outline of composting facility

For each sedimentary section, make a similar section with a U-shaped reinforced concrete structure with a frontage of 8 m, a depth of 10 m, and a height of 2 m, with 15 sections on each side and a 6 m passage.

It is desirable that the reinforced concrete of the partition wall has a thickness of about 20 cm because the pressure of compost and wheel loader is applied. The walls and roof should be constructed so that at least rainwater does not enter.

3.2 Consideration of Commercialization in Ayeyarwady Region

3.2.1 Situation, issues and needs

In addition to the literature information, we grasped the situation, issues and needs of the region based on the information from local consulting and local people.

Table 3-6 Crops in Labutta (Harvested area in 2016)

(Acres)

Green Gram	16,570
Ground-nut	619
Paddy	392,686
Pigeon Pea	99
Sesame	149
Sun Flower	3
Urad Pea	433

Source: MIMU BaselineData Agriculture Countrywide
https://themimu.info/baseline-datasets（February 4, 2021）

Japan International Cooperation Agency : Sanyu Consultants Inc. : Nippon Koei Co., Ltd. “The project for preservation of farming area for urgent rehabilitation of agricultural production and rural life in areas affected by Cyclone Nargis in the Republic of the Union of Myanmar final report: summary report”. (Japanese version, October 2011) shows following points in Labutta[11].

(Status of regional agriculture)

Agriculture, especially rice production, is the most important industry in the northern part of the Labutta area

Fishing is thriving in the southern coastal areas.

Generally, only nitrogen fertilizer (ingredient content 46%) and phosphoric acid fertilizer (ingredient content 46%) are applied as chemical fertilizers.

Cultivate beans such as peanuts, red beans, and soybeans, which are the back crops

[11] https://openjicareport.jica.go.jp/832/832/832_104_12039855.html (Last accessed: March 8, 2021)

of the dry season.

Farmers with dry season water sources grow cucumbers, cauliflower, watermelons, pumpkins, water spinach, etc. on a small scale in addition to beans.

(Regional issues and needs)

As for water supply, most villages had one or two reservoirs, which were the main source of water in the Ayeyarwady region, other water supply are rivers and shallow wells.

In villages, rainwater is stored in the rainy season for drinking water in the dry season. However, the water quality is not always good.

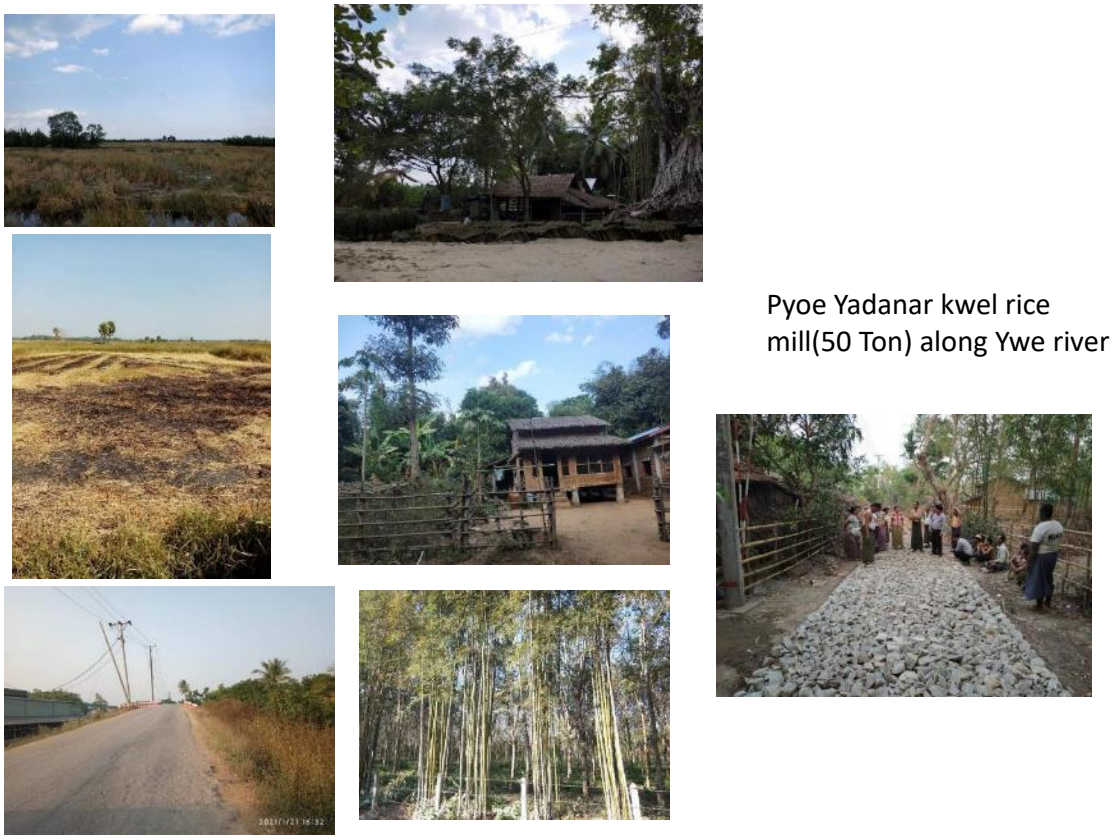


Figure 3-5 Current situation of Labutta

Source: Photos provided by local person concerned.

3.2.2 Consideration of Deployment Measures

(Possibility of distributed power development in the region)

The minimum scale of the rice husk power generation system implemented in Myaungmya is 1.8 MW, and if it is less than this, it is difficult to secure business feasibility. Considering the actual situation in the Labutta, it is necessary to deploy it on

a scale of 200 to 500 kW, and gasification power generation is considered to be promising. Regarding raw material biomass, it is necessary to pelletize rice husks, which is not worth the cost.

Therefore, it is necessary to consider gasification power generation of woody biomass. For example, the idea of fueling woody biomass cultivated in early-maturing trees and fueling in controlled areas in cooperation with mangrove regeneration can be considered.

(Advancement of rice husk power generation business)

The rice husk power generation system in Myaungmya has a power generation efficiency of 10% or less in the conventional 1MW class rice husk direct combustion power generation system. The strength of this facility is that it has achieved a power generation efficiency of 20%, which was not possible with small-scale BTG equipment of 2 MW or less.

In the future, in planning the horizontal development of this system, it is possible to add further advancement by considering measures to effectively utilize the incineration ash generated by rice husk power generation as a local resource.

The problem with rice production in Myanmar is that the yield is lower than that of neighboring countries.

Following reference information shows that rice husk incineration ash by low-temperature combustion at 800 degree Celsius or less has the same fertilizing effect as siliceous fertilizer and is also used for organic farming.

> Reference title: Soil Management Laboratory of Soil Fertilizer Department at the Central Region of Agricultural Research Center, National Agriculture and Food Research Organization (Japan). "Highly soluble siliceous fertilizer material by low temperature combustion of rice husks"
>
> Detail information is available in the website. "Kanto Tokai Hokuriku Agriculture" research result information. FY2004. http://www.naro.affrc.go.jp/org/narc/seika/kanto16/12/16_12_06.html
> (Last accessed: March 5, 2021)

In addition, silicic acid strengthens roots, stems and leaves, reduces damage such as blast, and helps increase yield and quality.

(Reference) About the effect of silicic acid on paddy rice

When silicic acid is absorbed by paddy rice, the light receiving system is improved and root damage is reduced. As a result, photosynthesis becomes popular.

Silicic acid also strengthens roots, stems, and leaves, reducing damage such as blast, helping to increase yield and quality.

Source: ZEN-NOH. ”3. Effect of silicic acid”. P.24.
https://www.zennoh.or.jp/operation/hiryou/pdf/qa_keisankouka.pdf (Last accessed: March 8, 2021)
English translation by MRI.

Therefore, improving the yield of rice is an issue not only in the Myaungmya area, where the first rice husk power generation project is located, but also in the Labutta area, which is adjacent to the southern part of the Myaungmya area. We believe that the construction of a business model that includes the use of incineration ash generated by rice husk power generation is promising.

(Follow-up on the development of rice husk power generation)

Plans for a 500 t/day rice mill in Pathein Industrial City are underway. It was confirmed that a construction plan for a 3.6 MW rice husk power generation facility is underway in the adjacent land. In addition, the need for low-temperature storage of rice has begun to be recognized, and there is a possibility that construction in combination with a rice mill or independent low-temperature storage business will occur in the future. In the future, the policy is to materialize the commercialization model and examine the possibility of development.

A trial calculation of the CO2 reduction effect of rice husk power generation projects shows that a 1.8 MW power plant is expected to reduce about 4,000 t-CO2. JCM is a promising project and is expected to be developed laterally in the Ayeyarwady Division in the future. The details of the trial calculation of CO2 reduction effect are summarized in the following table.

(Reference: Estimation of CO2 reduction effects)

Table 3-7 Specifications of rice husk power generation

	1.8 MW	3.6 MW	Total (5.4 MW)	Unit
Outputs	1,816	3,600	5,416	kW
Self-consumption	201	360	561	kW
Electricity sold	1,615	3,240	4,855	kW
Operating time	24	24	24	hrs/day
	330	330	330	days/year
	7,920	7,920	7,920	hrs/year
Power generation (Electricity sold)	38,760	77,520	116,280	kWh/day
	12,790,800	**25,660,800**	**38,451,600**	kWh/year
Rice husk (approximate amount)	2.3	4.6	6.9	t/h
	56	110	166	t/day
	18,216	**36,432**	**54,648**	t/year

Table 3-8 Trial calculation of emission reductions (Rice husks power generation project)

Capacity (Net)	1.8	3.6	Total (5.4)	MW
Annual power generation (Net)	12,791	25,660	38,451	MWh per year
Emission factor of the national Grid	0.319	0.319	0.319	t-CO_2/MWh
Reference emissions (a)	**4,080**	**8,186**	**12,266**	t-$CO_{2/}$ year
Amount of raw rice husks transported	18,216	36,432	54,648	t/year
Project emissions (b)	0 (Note)	0 (Note)	0 (Note)	t-$CO_{2/}$ year
Estimated amount of emission reduction (a-b)	**4,080**	**8,186**	**12,266**	t-$CO_{2/}$ year

(Note) Regarding the project emissions, about half of the rice husks will be procured from the adjacent rice mill, and the other half will be procured from the neighboring rice mill, so it is considered to be a small amount of emissions and is not considered in the calculation of the reduction amount.

(Reference) Approach to calculation of reduction effects

The following is a calculation method for the effects of rice husk power generation projects, such as reductions in energy-derived CO2 and greenhouse gas emissions. In this project, since heat supply from the rice husk power generation facility is not assumed, only emission reduction due to power supply is covered.

The JCM methodology applied to Fujita's first project is as follows.

Joint Crediting Mechanism Approved Methodology MM _ AM004 "Installation of rice husk power plant in Ayeyarwady region" (JCM _ MM _ AM004 _ ver 1.0 Spectral scope: 01)[12]

- **Reference emissions:**

Since the industrial park to which rice husk power is supplied is connected to the national grid, the reference assumes power supply by the grid.

Methodology: "Monitoring Spreadsheet: JCM _ MM _ AM004 _ ver 1.0" in MM _ AM004 Ver 1.0 sets the following default values.

CO2 emission factor for captive electricity (diesel): 0.800 t CO2/MWh

CO2 emission factor for captive electricity (otherwise): 0.460 t CO2/MWh

List of CO2 emission factors for electricity in the guidelines for submitting proposals of financing programme for JCM model projects from FY2020 to FY2022 (in Japanese version, Global Environment Centre Foundation, April 6, 2020) , in the case of renewable energy (PV, wind power, hydropower, etc.) in Myanmar, 0.533 t CO2/MWh (for displacement of on-site generation only); and 0.319 t CO2/MWh (for other).

However, in Myanmar, the introduction of gas-fired power generation is being considered, and as the composition of power sources shifts from hydroelectric power to thermal power, the grid emission intensity is expected to increase.

- **Project emissions:**

Project emissions are assumed to be from 2 types of sources: emissions from fossil fuels used in the power station (Fuel for emergency diesel power generation) and emissions from fuel consumption during the collection of rice transported from the vicinity by light trucks and coastal vessels. However, in light of the conditions of this project, it is assumed that the amount of emissions is extremely small, and therefore, in such a case, it is excluded from the calculation as a small emission source.

In-house fuel consumption: When power is supplied to the auxiliary equipment of the

[12] The Joint Crediting Mechanism (JCM). https://www.jcm.go.jp/mm-jp/methodologies/101 (Last accessed: March 5, 2021)

rice husk power plant by the emergency power source, etc., the emission of the fuel consumption origin of the power source shall be considered.

Fuel consumption by transportation: Calculate emissions from fuel consumption during transportation of rice husks used for electricity. It is assumed that the default value (Light vehicles or coastal vessels) is used from the viewpoint of conservativeness, although it is mostly manual.

4. Examination of Concrete Support Measures through City to City Cooperation

4.1 Extraction of Available Policies, Experiences, Countermeasures, etc.

4.1.1 Arrangement of Policies for Support Measures through City to City Cooperation

(Support through utilization of experience of local governments in Japan)

In Myanmar, the “National Waste Management Strategy and Master Plan for Myanmar (2018-2030)" (submitted in August 2018, approved in January 2020) and the “National Environmental Policy” and “Myanmar Climate Change Policy” were announced in June 2019. In response to these new policies, it is expected that the legal system will be materialized, policy development at the regional level will be accelerated, and the recycling business will be activated.

Japanese local governments have accumulated experience and know-how to materialize at the regional level in response to national policies, and can support the realization of materialization at the local city level in Myanmar (Local SDGs model).

The key to achieving the "Clean environment and healthy, functioning ecosystems" and "Sustainable economic and social development" set out in the "National Environmental Policy" announced in 2019 is the implementation of local policies and initiatives. Contribution through City to city cooperation is expected.

In the environmental field, Myanmar is also required to deal with marine plastics, and in particular, there is an urgent need to take measures against waste plastics in the Sagaing Region located upstream of the Ayeyarwady River. In order to strengthen countermeasures for waste plastic, it is essential to establish treatment methods other than landfill. On the other hand, in the energy field, the bottleneck in aiming for 100% domestic electrification rate by 2030, which is being promoted by the government, is in rural areas. In particular, the Ayeyarwady Region is an area with a low electrification rate at the end of the national grid (utilization of renewable energy in rural areas is a policy issue), and various business opportunities can be expected to be created in solving it.

(Role and effect of Fukushima City)

The roles and expected effects in promoting City to City cooperation are shown below.

Role	Effect
Through the experience of aiming for both the formation of a low-carbon city and the revitalization of the regional economy after reconstruction, we support the policy formation of the aiming for the development of the regional economy.	In the wake of the earthquake, the city, citizens, and businesses will work together to focus on the introduction of renewable energy, while "preventing global warming and building a low-carbon, recycling-oriented society with less impact on the environment" and "nuclear disasters." We are working on "reconstruction from Japan," "revitalization of the region," "promotion of strong town development in the event of a disaster or emergency," and "Fukushima City Decarbonized Society Realization Implementation Plan". They can provide policy know-how for philosophy and practice based on their experience.
Supporting the capacity development of policy execution within the local administration at the end	Utilizing the characteristics of City to City cooperation between local cities, not only the formulation of basic plans but also the know-how of policy execution in the terminal regional administration will be introduced in an integrated manner, contributing to the improvement of capacity in local administration.
Thinking about solutions to problems in both policy and business.	The city and the local chamber of commerce will work together to relocate the problem-solving system in terms of both policy and business. The collaboration between companies is also expected.

(Policies to support the construction of waste policies)

Contents of supports	Experience and know-how in Fukushima City
Support municipal waste countermeasures (e.g. roadmap review) for municipal waste countermeasures, focusing on promotion of sorting and affordable treatment (e.g. composting, etc.).	・Formulation of general waste treatment basic plan ・Efforts in Fukushima City for " Challenge for Waste and Garbage 20% Reduction " ・Sorting work at Arakawa Clean Center ・Subsidy project for purchasing and installing kitchen waste disposal containers ・Collective resource recovery incentive system
Based on the recognition that it is important to change the awareness of waste in the local community, collaborate on environmental education efforts as the first step to establish segregation (cooperation of environmental education in Myanmar and Fukushima City, etc.) .	・Environmental education activities in school education

(Development toward the realization of business through City to City

cooperation)

The qualities of the counterparts of City to City cooperation (local government officials) are high, and a relationship of trust in collaboration is being built (For the invitation program in Fukushima City held last year and the workshop in Myanmar, the Minister of Ayeyarwady and Director of Sagaing Region Development Affairs Committee attended and deepened their understanding of future directions).

Whether or not a business can be realized in a local citty depends largely on the qualities and motivation of local government officials and the relationship of trust. Monywa is an advanced area where the government takes the initiative in collecting and processing projects and is practicing clean urban development, and there is a high possibility that it will be materialized. In addition, the partners (Monywa Development Committee, Regional Government) intend to build a model city for waste management through City to City cooperation. Through this project, the Japanese side and local government agencies are building a collaborative relationship to solve problems.

- Monywa, which is the subject of the survey, has the foundation for building the 3Rs.

- Citizens' cooperation is indispensable for the separation of households, and it is easier to succeed in local cities where local communities are functioning.

- Monywa is the capital city of the region, and many towns are distributed around it. Monywa plays a central role in wide-area efforts (could be a model for a Regional Circulating and Ecological Economy).

- Mandalay, a neighboring city of Monywa, has a cement factory and a steel mill, and is a promising destination for receiving fuels and materials.

4.1.2 Extraction of Available Policies, Experiences, and Measures in Fukushima City

The following items were sorted out and explained in an online discussion with Sagaing Region officials.

- Current Situation of Waste and Garbage in Fukushima City
- Comparison of Waste and Garbage Conditions between Monywa City (Sagaing Region) and Fukushima City
- Waste and Garbage Reduction Campaign (Challenge for 20% waste reduction)
- Flow of Resource Separation
- Sorting of Recyclable Materials and Problems (Plastics and PET bottles)
- Local Efforts for Proper Treatment of Household Waste and Garbage
- Various Support Programs for Waste and Garbage Reduction
- Efforts to Charge for Plastic Shopping Bags, etc.
- COOL CHOICE (Smart Choice)
- Fukushima City's SDGs Initiatives
- Fukushima City Basic Plan for General Waste and Garbage Treatment (under development) [Basic Plan for Waste and Garbage Treatment and Basic Plan for Domestic Wastewater Treatment]
- Fukushima City Action Plan for Realizing a Decarbonized Society

Fukushima City also faces the challenge of reducing its waste output. In 2014 and 2015, cities with a population of 100,000 or more produced the largest amount of waste per capita per day. The municipal government is working to reduce the volume of waste in view of future issues, such as the aging of two garbage incinerators in the city and the establishment of new final disposal sites.

Since 2019, Fukushima City has been carrying out 4 strategies to reduce waste: " Thoroughly drain raw garbage", "Reduction of food loss", "Thorough separation of waste" and "Thorough composting". In the local efforts to ensure the proper disposal of household waste, disposing of household waste and disposal sites are managed by local residents. As various support projects for waste reduction, efforts are being made to "Group resource recovery incentive system" "Subsidy system for purchasing waste

and garbage disposal containers" "Waste scattering prevention net purchase subsidy system" and "Waste and garbage collection site installation cost subsidy system".

It also aims to create a society in which citizens, businesses, and cities work together to create a great groundswell under the banner of "Challenge 2050 Zero Carbon Fukushima City" and in which actual greenhouse gas emissions will be zero by fiscal 2050.

The following four basic policies are listed for achieving this goal;

Policy 1: To expand introduction and effective use of renewable energy.

Policy 2: To shift lifestyles and work styles toward energy and resource conservation.

Policy 3: To promote initiatives to secure sinks for greenhouse gases.

Policy 4: To promote measures to cope with climate change. (Adaptation measures)

“Fukushima City Action Plan for Realizing a Decarbonized Society” is a new plan to integrate the current "Fukushima City Action Plan on Global Warming Countermeasures" and "Fukushima City Renewable Energy Promotion Plan" plans to reduce greenhouse gas emissions from both renewable energy and energy conservation, as well as to promote climate change adaptation measures.

(Reference)

Outline of " Fukushima City Action Plan for Realizing a Decarbonized Society "

Purpose of the Plan	The purpose of this plan is to realize a decarbonized society by integrating the current "Fukushima City Action Plan for Global Warming Countermeasures" and "Fukushima City Renewable Energy Introduction Promotion Plan", and newly adding measures to deal with the effects of climate change based on the Climate Change Adaptation Law.
Background of the Plan Formulation (Review)	In March 2011, Fukushima City formulated the "Fukushima City Action Plan for Global Warming Countermeasures" (Plan period: FY2011-FY2020), and has been promoting comprehensive and systematic measures against global warming. In addition, in response to the nuclear power plant accident caused by the earthquake, we formulated the "Fukushima City Renewable Energy Introduction Promotion Plan" (Plan period: FY2016 - FY2020) in February 2015, and have been promoting the introduction of renewable energy. In light of changes in the domestic and international situation, such as the adoption of the Paris Agreement, and the progress of global warming, a new plan is being formulated to reduce greenhouse gas emissions through both renewable energy and energy conservation, as well as to promote measures to adapt to climate change.
Outline of the legal basis and higher-level plans	This plan will be formulated as a "Local Government Action Plan" based on the "Law Concerning the Promotion of Measures to Cope with Global Warming" and a "Regional Climate Change Adaptation Plan" based on the "Climate Change Adaptation Law", and will promote the "Fukushima City General Plan", which is the top-level plan of the City, and the "Fukushima City Basic Environment Plan" from the aspects of global warming countermeasures and adaptation measures.
Period of the Plan	From FY2021 to FY2030 (10 years)
Structure of the Plan	Chapter 1: Basic Items of the Plan Background and purpose of the plan, positioning, target, target year, and period Chapter 2: Regional Characteristics of Fukushima City Natural characteristics, social characteristics, amount of renewable energy available, awareness of citizens and businesses

	Chapter 3 Greenhouse Gas Status Greenhouse gas emission and carbon sequestration Chapter 4 Greenhouse Gas Reduction Targets Fukushima City's vision for the future, reduction targets, future estimates Chapter 5 Efforts toward a Decarbonized Society Basic policy, system of measures, development of measures Chapter 6 Promotion of the Plan Promotion system, progress management
Effects of the plan's realization, and its impact on citizens' lives, etc.	By expanding the introduction of renewable energies and shifting lifestyles and work styles toward energy and resource conservation, we will promote efforts to reduce greenhouse gas emissions by 30% or more compared to FY2013 by FY2030, with the long-term goal of achieving virtually zero emissions by FY2050.

Note: Based on the materials at the public comment implementation stage of plan formulation.
Source: Fukushima City website. English translation by MRI.
https://www.city.fukushima.fukushima.jp/seisaku-chousei-sougou/shise/kocho/publiccomment/datsutanso_sakuteichu.html (Last accessed: January 20, 2021)

(Reference)

Outline of "Basic Waste Treatment Plan" in Fukushima City[13]

Purpose of the Plan	The purpose of this plan is to properly dispose of the general waste generated in the city while preserving the living environment and improving public health.
Background of the Plan Formulation (Review)	The current Fukushima City Basic Plan for General Waste Treatment was formulated in August 2014, and efforts have been made to reduce waste and garbage, and promote recycling. Currently, the amount of waste and garbage generated by the City is high compared to other cities in Japan, and it is necessary to further reduce and recycle waste and garbage. Under these circumstances, we will formulate a new Fukushima City Basic Plan for General Waste Treatment, as the current plan's planning period ends in 2020.
Outline of the legal bases and higher-level plans	<Legal bases> Waste Management and Public Cleansing Law <Higher-level plan> Fukushima City General Plan and Fukushima City Basic Environment Plan.
Period of the Plan	From FY2021 to FY2025 (5 years)
Structure of the Plan	Chapter 1 Basic Items of the Plan Chapter 2 Basic Plan for Waste and Garbage Treatment Items related to reduction, resource recycling, and proper treatment of waste and garbage Chapter 3 Basic Plan for Domestic Wastewater Treatment Items related to the proper treatment of manure and domestic miscellaneous wastewater
Effects of the plan's realization, and its impact on citizens' lives, etc.	Proper treatment of waste and garbage and domestic wastewater will help to preserve the living environment and improve public health. In addition, waste and garbage reduction and resource recycling will be promoted, and the creation of a recycling-oriented society will be advanced.

Note: Based on the materials at the public comment implementation stage of plan formulation.
Source: Fukushima City website. English translation by MRI.

[13] Fukushima city website. https://www.city.fukushima.fukushima.jp/seisaku-chousei-sougou/shise/kocho/publiccomment/haikibutsu_sakuteichu.html (Last accessed: February 5, 2021)

(Reference)

Waste and Garbage Reduction Operation - Challenge for Waste and Garbage 20% Reduction

Fukushima City is currently implementing “Waste and Garbage Reduction Operation - Challenge for Waste and Garbage 20% Reduction” with the goal of “reducing the amount of waste and garbage per person per day to 890g or less by 2021”.

The amount of waste and garbage generated in Fukushima City is 1.3 times the national average.

The amount of waste and garbage generated per person per day in Fukushima City was 1,182g in FY2018, which is about 1.3 times higher than the national average of 918g. This is the third worst amount in Japan (among cities with a population of 100,000 or more).

A large amount of money is spent on waste and garbage treatment.

Waste and garbage treatment, including collection and transportation, incineration, recycling, and final disposal, costs a large amount of money, equivalent to 10% of Fukushima City's municipal tax revenue.

Looking at the results of the analysis of the composition of combustible waste and garbage from households conducted by Fukushima City in FY2019, the largest percentage was raw garbage (49.2%), followed by paper (18.2%), and grass and branches (11.7%), showing the same trend as the results of the composition analysis in FY2018.

Fukushima City is working to reduce and recycle waste and garbage through the following "4 strategies + α" as part of "Waste and garbage Reduction Operation.

In order to reduce the amount of waste and garbage, we need the cooperation of each and every citizen.

Let's all work together to reduce and recycle waste and garbage.

Strategy No. 1: Thoroughly drain raw garbage

In order to promote the reduction of waste and garbage, it is necessary to reduce the amount of raw garbage, which accounts for about half of the combustible waste and garbage from households.

It is said that about 80% of raw garbage is water, so “draining it thoroughly” is an effective way to reduce it. Thoroughly draining raw garbage will reduce the amount of waste and garbage, reduce odor and mold, improve the fuel efficiency of garbage trucks, and increase the combustion efficiency of incineration plants.

Strategy No. 2: Reduction of food loss

(Omitted)

Strategy No. 3: Thorough separation of waste and garbage

Thoroughly separate paper in particular!

It is known that more than 40% of paper, which accounts for 18.2% of combustible waste and garbage from households, is recyclable. Let's recycle by separating properly!

Let's make active use of in-store collection at supermarkets!

There are some supermarkets in the city that collect newspapers, PET bottles, food trays, etc. at their stores, so you can drop off your recyclable materials on the way home from work or shopping.

There are also stores where you can earn points, so be sure to take advantage of them!

Let's work together in the community for group resource collection!

The city provides incentives to citizens' groups (neighborhood associations, nurturing groups, etc.) that voluntarily conduct group collection of recyclable materials.

The incentives can be used freely, such as for operating expenses!

Strategy No. 4: Thorough composting

Operation for “raw garbage” and “grass and branches” which account for 60% of the combustible waste and garbage from households.

Reducing these two items is a major key in reducing waste and garbage!

Let's dry the grass and branches!

Grasses and branches can be made into fertilizer by mixing them with soil in the field, but I think it is difficult for ordinary households to do so. Since grass and branches contain a lot of water, please dry before disposing of them on the collection day for combustible waste and garbage.

Thorough implementation of＋3Rs

Let's practice ＋3Rs thoroughly to reduce and recycle waste and garbage!

Source: Fukushima City website. http://www.city.fukushima.fukushima.jp/gomi-genryou/kurashi/recycling/gomidashi/daisakusen.html (Last accessed: February 5, 2021).
English translation by MRI.

4.2 Consideration of Action Plan

4.2.1 Action Plan for Sagaing Region

An online discussion was held with the Sagaing Regional Development Affairs Committee to discuss the proposed action plan roadmap for waste reduction at the Monywa Township.

The proposed roadmap consists of three layers: awareness-raising campaigns, promotion of local collaboration, and construction of a local recycling system. In 2021, the awareness-raising campaign embodied home initiatives to reduce greenhouse gas emissions based on the actual situation in Monywa, and from 2022 to 2024, it implemented the "Monywa Challenge: Challenge for Waste and Garbage 20% Reduction". The promotion of regional cooperation is based on "On-site 3R education course" and "Collecting at schools and other facilities". Collections are being carried out in many Japanese cities, including Fukushima city. In addition to collecting recyclable waste such as plastic and used paper, hazardous waste such as batteries is also collected. In the construction of a resource recycling system, the plan is to convert waste plastic into fuel by 2023.

Regarding the formulation of the "Monywa Challenge: Challenge for Waste and Garbage 20% Reduction " (draft), we explained that the " Challenge for Waste and Garbage 20% Reduction " in Fukushima City will serve as a reference. According to the results of a survey on the composition of garbage conducted jointly with the Development Committee, about 30% of the garbage is plastic, 40% is garbage from the yard, and 20% is kitchen waste. We think that thorough drainage of garbage and thorough composting are effective. We believe that it is important to present ideas and spread them out through on-site lectures for local residents on ways to cope with the actual situation of waste and garbage in Monywa.

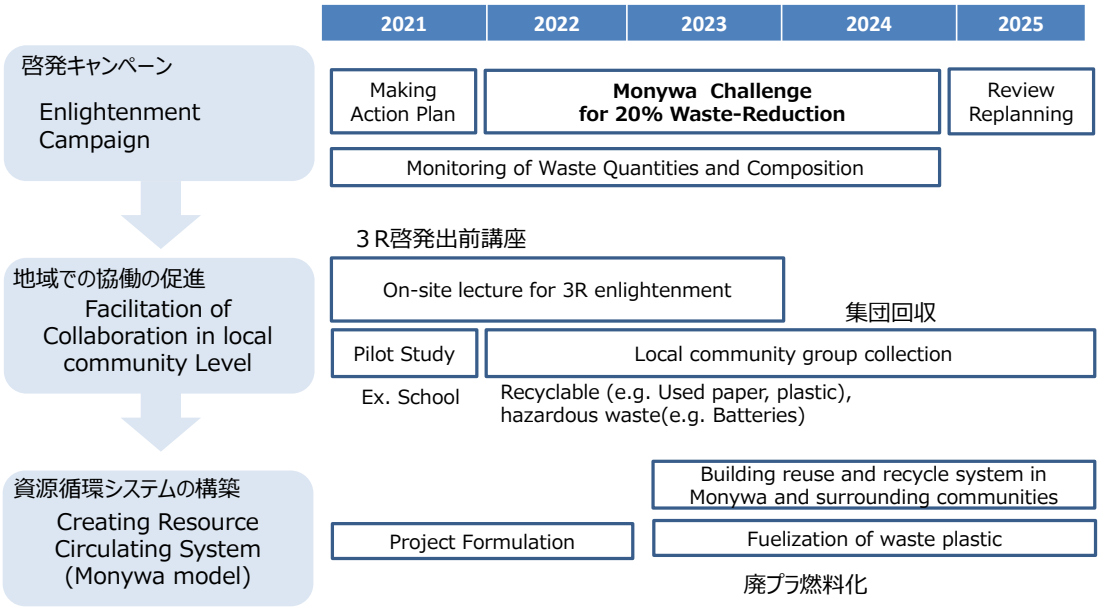


Figure 4-1 Proposed action plan

It is important to promote institutional development and commercialization in a package through policy dialogue through city to city collaboration. It is necessary to develop a system to realize the 3Rs, and to build a business model to ensure economic efficiency, instead of focusing solely on the fuel business of waste plastics. The main body of the waste plastic fuel conversion project should be positioned as a local administrative organ, and the Japanese side considers that the business model of providing technical know-how for a fee (Partial investment in an entity is also an option) and supporting operation and management is promising (Low risk for overseas expansion).

The plan for the next fiscal year based on the study results of this fiscal year is shown below.

Configuration task	Results of this fiscal year	Plan for the next fiscal year
Study of a roadmap for municipal waste countermeasures	Examination of measures to promote separation in cooperation with citizens, businesses, and local governments (Citizen Collaboration: "Challenge for Waste and Garbage 20% Reduction" taking advantage of experiences such as experience in Fukushima City) Formulated as a development	Clarification of the roles of citizens, businesses, and governments, and examination of measures for collaboration (Induction and regulation measures are also discussed.) Examination of appropriate treatment fee levels for sustainable waste treatment (financial aspect)

Configuration task	Results of this fiscal year	Plan for the next fiscal year
	plan for a 20~30% reduction	
Support for concrete treatment of municipal waste	**Consideration of conversion of plastic waste into solid fuel** Study specific business models based on local conditions	Detailed investigation of waste plastic composition Determine business scheme Selection of utilization subsidies and examination of proposals
Realization of rice husk power generation business	The study of the feasibility of the project at the Ayeyarwady Division was introduced to assess the possibility of lateral development.	Detailed discussion of the project with local rice milling companies (Determination of the implementation scheme) Checking grid connection conditions (Unit price of electricity sold) Preparation for JCM facility subsidy application

Future issues to be examined are as follows.

[Collection of waste plastic]

Consider collaboration model with not only Monywa but also surrounding areas (in order to secure scale)

[Conversion of waste plastic into solid fuel]

It is necessary to decide whether to use RPF or to reduce the volume without cost.

Consideration of the possibility of utilizing JICA's private sector support, grants by Japanese government, and other donor support budgets

[Securing disposal sites for solid fuels, metals, etc.]

We will explore the possibility of local resource recycling not only in and around Monywa, but also around Mandalay. (There are several cement plants near Mandalay, these could be a promising final disposal site.) Cement factories can be expected to develop as the core of the recycling business.

4.2.2 Action Plan for Ayeyarwady Region

In an exchange of views with the Minister of the Region August, the Regional Government proposed that the Labutta area (Massive cyclone damage was occurred) in the southern part. Regional Government think that is the most important area for reconstruction assistance and that it should be considered as a destination for such assistance.

Therefore, in this fiscal year, we grasped the current situation and regional needs of the Labutta area, and examined the development measures of distributed electric power in the area. As a result of grasping the current situation and regional needs in the Labutta , it is necessary to develop a 200 - 500 kW scale power generation system, and wood bio-gasification power generation, which can be developed on a smaller scale than rice husk power generation, is considered promising.

For rice husk power generation, a 500 t/day rice mill is under construction in the Pathein Industrial City and a 3.6 MW rice husk power plant is under construction in the adjacent area. The need for rice husk power generation projects is also high, as the need for low-temperature storage facilities for rice has begun to be recognized, and there is a possibility that the plant will be constructed as a set with rice mills or develop independent low-temperature storage projects in the future. In order to make the rice husk power generation business more attractive, there is a great interest in the effective use of silica in incineration ash generated from rice husk power generation. The rice husk ash contains more than 90% silica with derived from rice husks. In Myanmar, increasing the yield of rice is an issue, and silica can be used as a fertilizer containing soluble silicic acid. It is expected that the model of disaster prevention and mitigation × Local SDGs can be constructed by contributing to the prevention of lodging and the improvement of rice yield.

configuration task	Results of this year's study	Plan for the next fiscal year
small-scale model	As a result of ascertaining the current situation and regional needs of the Labutta in the southern part of the country, which was requested by the Region, development on a 200 - 500 kW scale is necessary, and wood bio-gasification power generation, which can be developed on a small scale, is considered promising.	Examination of procurement methods for raw biomass. For example, woody biomass grown from early maturing trees can be used as fuel, and mangroves can be used as fuel in controlled areas in cooperation with mangrove regeneration. Combined effects of creation of local employment and electrification measures can be expected by cooperating with early maturing tree cultivation (Creation of Local Employment x Development of Local

configuration task	Results of this year's study	Plan for the next fiscal year
		SDGs Model).
Medium Model (Rice husk power generation project)	Follow-up on the progress of the concrete study of the second project at the Pathein Industrial Park	Detailed discussion of the project with local rice milling companies (Determination of the implementation scheme) Checking grid connection conditions (Unit price of electricity sold) Study of effective utilization of incinerated ash as local resources (Building a model for disaster prevention and mitigation X Local SDGs) Study for JCM facility subsidy application

5. Summary

In 2015, the Mayor of Fukushima City received a request for cooperation from the Chief Minister of the Ayeyarwady Region. This city to city cooperation started, and the Sagaing Region joined the cooperation in 2017. As for the system, the Mitsubishi Research Institute and Fukushima City worked together to promote policy dialogue. Fujita took the lead in examining the feasibility of projects in cooperation with local stakeholders.

The goal of the initiative is to embody the challenges faced by local cities through a "Regional Circulating and Ecological Economy" approach. The participation of Ayeyarwady Region and Sagaing Region is characterized by the sharing of outcomes among local cities.

In this fiscal year (FY 2020), support was provided for the materialization of a Regional Circulating and Ecological Economy centered on a decarbonized, CO2-saving and sustainable waste treatment system in the Sagaing Region, and for the materialization of a Regional Circulating and Ecological Economy centered on self-sustaining and decentralized regional energy in the Ayeyarwady Region.

In the study at the Sagaing Region, a business model for converting waste plastic into fuel was studied, focusing on plastic waste. At the same time, in terms of system construction and social system construction, separation of municipal wastes, enlightenment activities in the region, and recycling business development measures were examined.

The key concept of the waste treatment system that we are aiming to realize is a total system of the 3Rs for municipal waste, with Monywa at its core and in cooperation with surrounding communities. The first step is separation of waste plastics and conversion to fuel. This is expected to prolong the life and reduce the volume of final disposal sites. In Fukushima City, " Challenge for Waste and Garbage 20% Reduction" is being carried out. By introducing Fukushima’s knowledge and experience, they supported regional efforts to separate waste and reduce waste.

Cooperation among citizens, businesses, and the government is very important at the local level actions.

It is necessary to clarify the vision and action plan in order to promote cooperation among the parties concerned. Introducing Fukushima’s experience and know-how with aim to create a model of cooperation that takes advantage of the characteristics of cities in Myanmar.

In order to achieve the policy goals of local cities such as a decarbonized society, SDGs, and circular economy, it is important to develop an action plan. Fukushima City has formulated the " Fukushima City Action Plan for Realizing a Decarbonized Society".

This is a new plan to reduce greenhouse gas emissions from both renewable energy and energy conservation, as well as to promote measures to adapt to climate change. Under the banner of "Challenge 2050 Zero Carbon Fukushima City" the city aims to create a society in which citizens, businesses, and cities work together to create a great groundswell and achieve virtually zero greenhouse gas emissions by fiscal 2050.

In the workshop with the Region, the outline of the action plan and the process of its formulation were introduced and used as a reference for the formulation of an action plan for the realization of a decarbonized society at the local city level.

The realization of a decarbonized society is also an important challenge for local cities. In order to achieve this, it is essential to realize local SDGs-type regional development through decarbonization utilizing local resources through collaboration among citizens, businesses, and governments.

City to city collaboration is an important platform for connecting people from participating cities and sharing their experiences and knowledge. The advanced model of the regional city type will be materialized through the cooperation among these cities, and will be extended to other cities in Myanmar as well as other cities in ASEAN that have common problems.

Development through City-to-City collaboration

1 Separation of municipal waste and examination of local waste treatment system (Conversion of waste plastic into solid fuel)

2 Study on construction of business model of resource recycling type in local area including effective utilization of rice husk incineration ash

Collaboration with the Sagain Region

Implementation of a local recycling 3R system for plastic waste, which is becoming a problem in urban waste

+ Rice hull power generation (Continuing study to realize)

Experience and know-how of Fukushima City and Japanese companies

Japanese experience (Policy & 3R Business) Example)Volume, home appliances, construction and waste, etc.

Sharing Results

Feasibility study (Starting with plastics)

Taking advantage of expertise in recycling business to study specific business models (Conversion of waste plastic into fuel)

Establishment of systems and social systems

・Sorting

・Raising awareness of environmental education

・Fostering recycling business (Regulation and industrial development)

- Fukushima City is promoting the "Challenge for Waste and Garbage 20% Reduction", and the efforts are helpful.
- Experience in formulating the action plan for achieving a decarbonized society in Fukushima City

Implementation of solutions in terms of role sharing, cost sharing, human resource development, etc.

Cooperation with Ayeyarwady Region

Model of cooperation with Monjuwa + surrounding cities

Review business model

Study of a business model using a small-scale woody biomass gasification system

The development model of the first project, chaff power generation business, was formulated. Specifically, study measures for effective utilization of incinerated ash in local areas

Institutional Review:

Transportation system (Continue to follow)

An important point of view for local cities in Myanmar is **how the city, citizens, and businesses work together as one.**

Expected benefit

Participating Japanese Companies: Building Relationships of Trust with Local Governments and Communities

Acceleration of rice husk power generation projects in local communities
(Example: Acquisition of conditions for grid power sales schemes)

Creating a Recycling Business in Myanmar (Examples: Construction recycling, waste paper recycling, home appliance recycling, etc.)

Relationship with the government and local communities is an important foothold

Appendix

Appendix I

Overview of Project

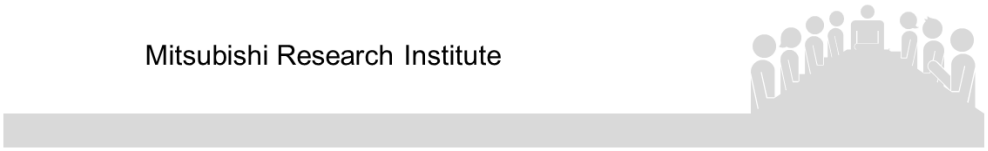
Key Outcomes

Project Outline

City-to-City Collaboration between Fukushima City and Ayeyarwady Region and Sagaing Region for Creating a Zero-carbon Society

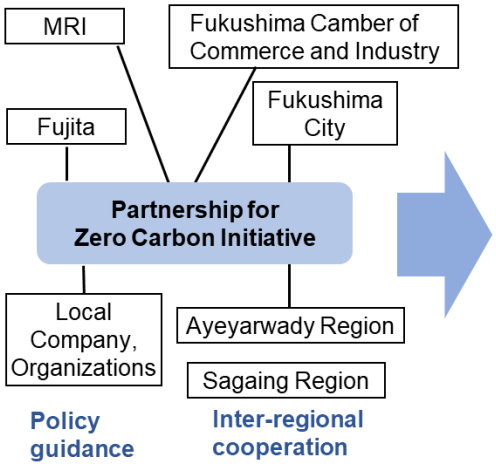
Promotion Project for Formulation of Circulating and Ecological Economy in Local Cities in Myanmar

Mitsubishi Research Institute

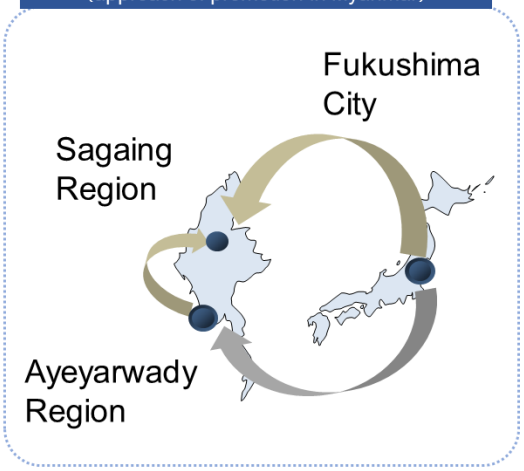


1

Policy dialogue between Fukushima City and Regional governments
(Support through knowledge of Japan's institutional aspects)



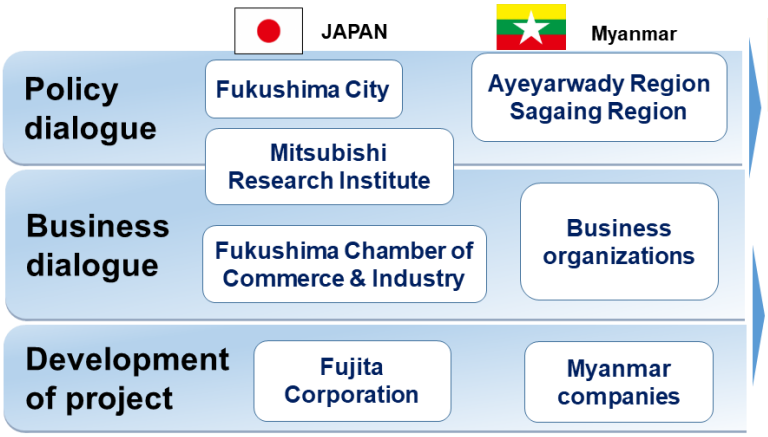
Expansion in Myanmar through inter-regional cooperation
(approach of promotion in Myanmar)



2

Partnership for Zero Carbon Initiative

Our Goal: Realizing the solution of problems in local cities with the approach of "Circulating and Ecological Economy"
Approach: Sharing achievements & knowledge transfer through inter-regional cooperation



Workshops
for facilitating policy formulation

Feasibility study:
Example of achievement;
Rice husk power generation PJ in Myaung Mya Township

3

Key Activities in FY2020

- Through City-to-City cooperation, the project promotes the regional development for achievement of Zero-carbon with solving key challenges of creation of a **Circulating and Ecological Economy** in Ayeyarwady and Sagaing Regions.
- **Sagaing Region**: To create the circulating and ecological economy at the core of sustainable low-carbon waste management system (i.e. waste plastic).
- **Ayeyarwady Region**: To create the circulating and ecological economy at the core of local distributed power system (i.e. biomass power projects).

4

Challenges in Sagain Region

Building a regional recycling 3R system for plastic waste

Business model
(Start from waste plastic system)
Developing a concrete business model by utilizing the knowledge of Japanese companies' recycling business

Institution building/social system building
- Building waste sorting system
- Enlightenment
- Development of recycling business (regulation & industry development)

Japanese experience (Policy & 3R business)

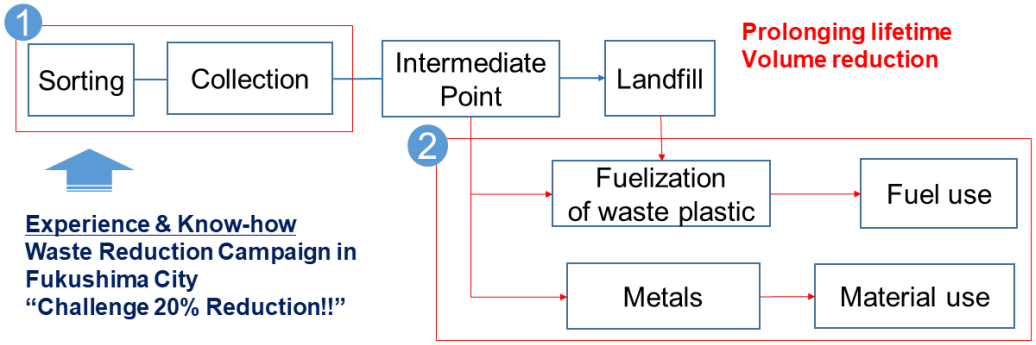
Solutions for role sharing, cost sharing, human resource development, etc. Monywa + model of cooperation with surrounding cities

Enhancing waste management in local level

5

Regional "Circular Economy" Model

- **Building total system of 3R for urban waste in collaboration with the surrounding area centered on Monywa.**
- **The first step is the waste plastic sorting and Fuelization of waste plastic.**



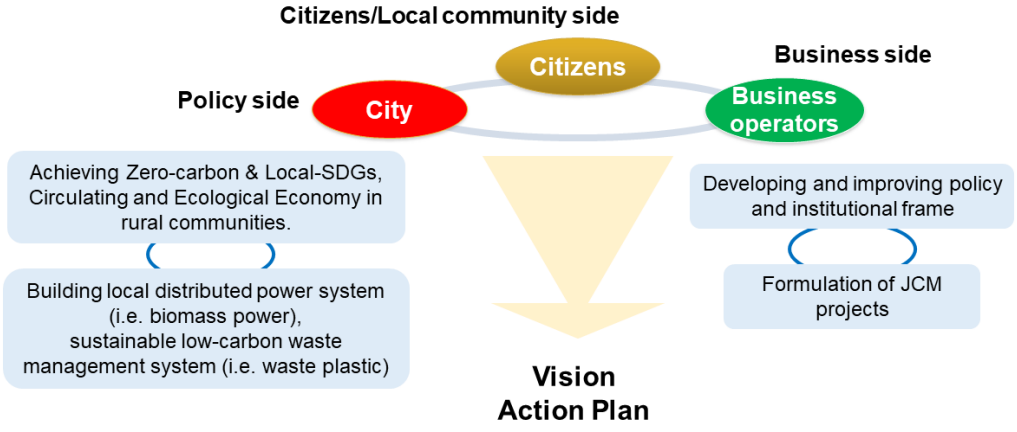
Experience & Know-how
Waste Reduction Campaign in Fukushima City
"Challenge 20% Reduction!!"

Regional "Circular Economy" for solving waste plastic issues

6

Facilitation of Collaboration in Local Level

Key approach **Collaboration in citizens/local community, business, and policy sides with sharing common vision & action plan**



7

Formulation of Action Plan in Local level

Key global trends

Key challenges in rural community

- Facilitating policy formulation for achievement of **universal energy access**.
- Facilitating policy and local collaboration for achievement of **Zero-carbon & Local-SDGs, "Circulating and Ecological Economy" in rural communities**.

City-to-City Collaboration

Experience in Fukushima City
Fukushima City Implementation Plan for Realization of Decarbonized Society
"Challenge 2050 Zero-carbon Fukushima City"

For facilitation of action plan formation in the Regions
- Key concept and approaches
- Consultation with key stakeholders

8

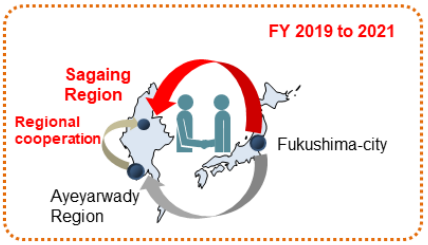
Key outcomes of City to City Collaboration

FY2020 City to City Collaboration for Zero-carbon Society

Promotion Project for Formulation of Circulating and Ecological Economy in Local Cities in Myanmar

March 2021

Project Outline



Reaching solutions for problems in local cities with the approach of a "Circulating and Ecological Economy"

Ayeyarwady Region

MOE

Support

Project to generate electricity from rice husks in Myaungmya (First plant)

Model of successful solution

- The first biomass power generation project using rice husks generated at a rice mill [Fujita] <SPC organized and operated by local companies in the Ayeyarwady region's Myaungmya district>

Sharing achievements & knowledge transfer

Sagaing Region

Implementation of a regional recycling 3R system for plastic waste, which is becoming a municipal waste problem (Prioritization)
+ Rice husk power generation (Continued study for materialization)

Consider commercialization
(Start from waste plastic system)
Consider a concrete business model utilizing the knowledge of Japanese companies in recycling businesses

Institution building/social system building
・Separation
・Enlightenment
・Development of recycling business (regulation & industry development)

Examination of business model
Contributing to the region by recycling local resources

Institutional Building
wheeling system, etc.

Contributing to the region by recycling local resources
・Effectively using incineration ash (used as fertilizer)

Japan's experience (Policy & 3R business)

Solutions for role sharing, cost sharing, human resource development, etc. Monywa + model of cooperation with surrounding cities

Disaster reduction X Reconstruction
X Local SDGs
Contribution to local communities

Rice cultivation assistance in hurricane damaged areas in the southern region (Labutta)

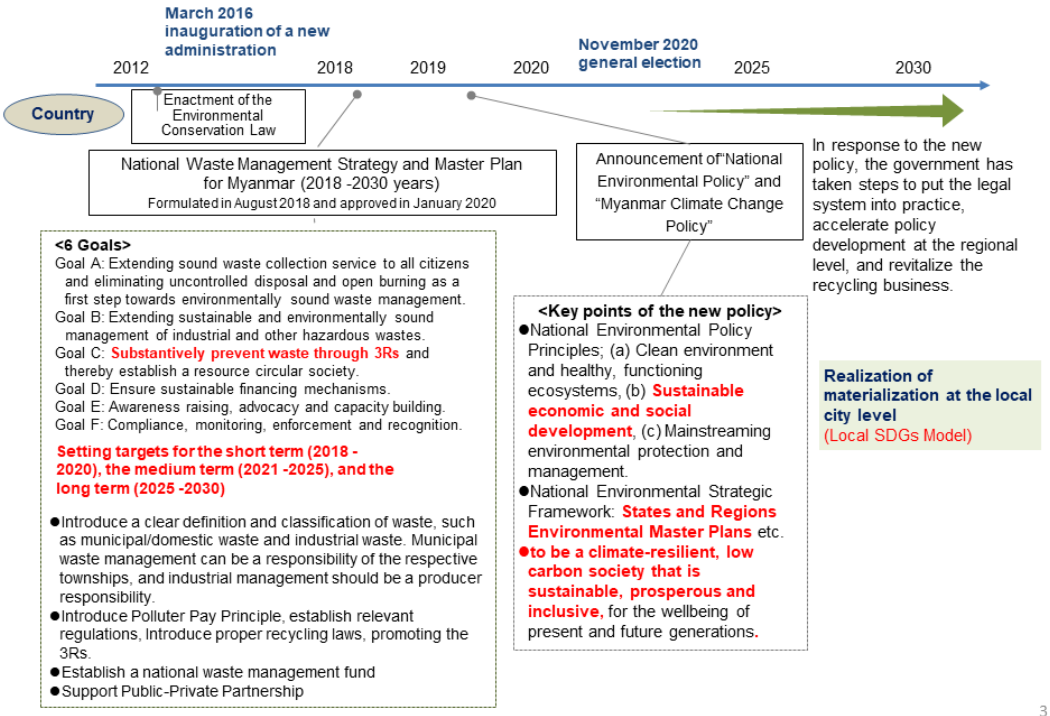
Enhancing waste management in local level

Accelerating rice husk power projects

Premium electricity price at the national grid

Accelerating value of rice husk power projects

(Developments in Myanmar)



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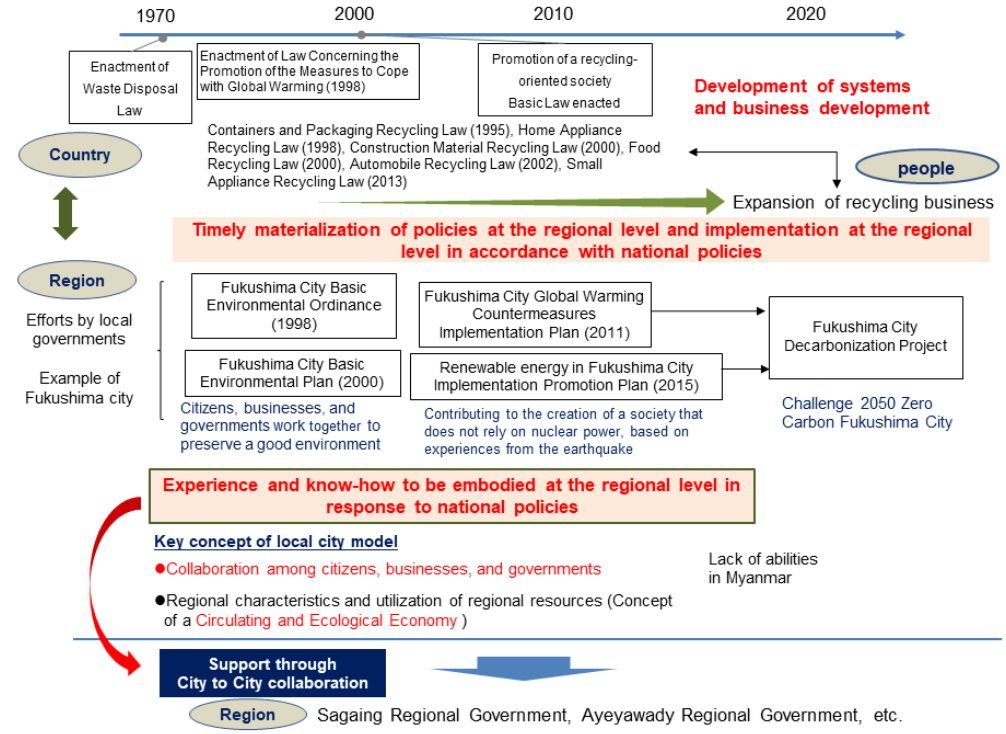
(Japanese experience)

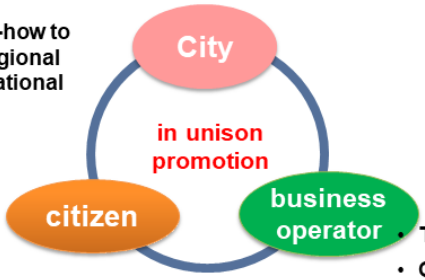


4

[Key concept of regional recycling and circulating and ecological economy in local cities]

Timely materialization of policies at the regional level and implementation at the regional level in accordance with national policies

- **Experience and know-how to be embodied at the regional level in response to national policies**



- **Practicing in the community and life**
- **Contributing to local communities**

- **To business opportunities**
- **Contributing to Local communities**

Measures to promote separation in cooperation with citizens, businesses, and local governments
Citizen Collaboration: "Waste and Garbage Reduction Campaign (Challenge for 20% waste reduction)" in Fukushima City

The Challenge for achieving SDGs and Decarbonization
Fukushima City Decarbonization Project
Corporate SDGs Declaration

Practicing recycling
Participation of citizens and local communities

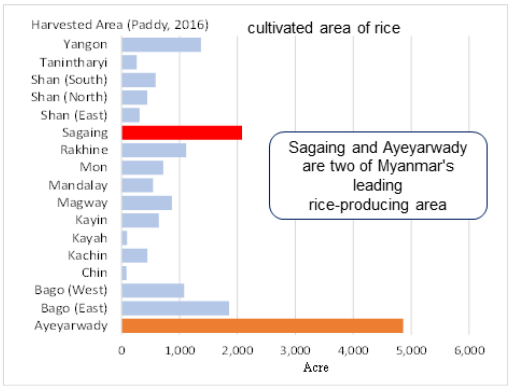
Businesses that support recycling
(within and between regions)

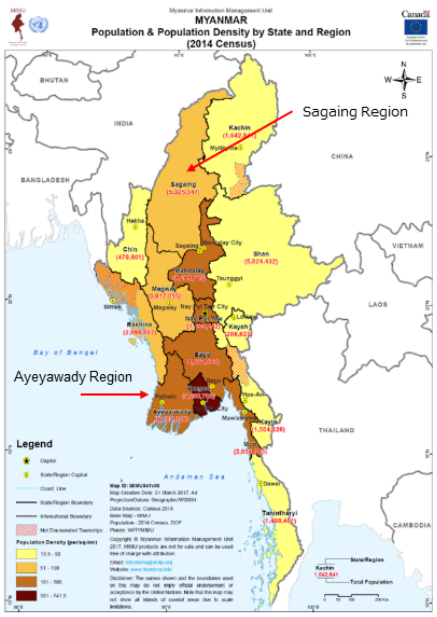
Introduction of renewable and distributed power
Utilization of local resources

Realization of Circulating and Ecological Economy

- The Sagaing Region is located in the northwestern part of Myanmar and produces a lot of rice. It has an area of about 93,000 km2 and a population of about 5 million. The state capital is Monywa city with a population of about 370,000.
- The Ayeyarwady Region is an administrative district adjacent to the western part of the Yangon Region. It is located in the delta of the Ayeyarwady River and is a region where rice production is active. The capital is the Pattine city, with a population of about 290,000.

(Reference: Population of Fukushima City: approximately 290,000)





Source: Myanmar Information Management Unit
https://themimu.info/sites/themimu.info/files/documents/Population_Map_2014_Population_Density_St_Rg_MIMU841v06_21Mar2017_A4.pdf
(Last Accessed: February 12, 2021)

[Overview of Sagaing Region and Monywa Township]

- 2 major rivers (Ayeyarwady River and Chindwin River) flow in the region. The main industry is rice milling, but other crops are also actively grown. In addition to agriculture, the region is blessed with resources such as gold, coal, and oil, so the standard of living is relatively high in Myanmar.
- The Monywa District, which is the capital of the region, has a population of approximately 757,000.
- Monywa Township has 370,000 employees (210,000 in urban areas and 160,000 in rural areas).

Key points of implementation

・We examined a treatment system targeting plastic wastes among municipal wastes (Accumulated in the final disposal site, and newly generated) in Sagaing Region.

<Reason> (1) Comments were received that it would be relatively easy to convert waste plastic into fuel. (However, it is difficult to convert waste plastic into fuel because the sediment at the final disposal site is dirty even after the separation of waste plastic.) (2) Measures to reduce marine plastics have become a problem in Myanmar as well, and land-based reduction measures are an issue (Measures against marine plastics are one of the important themes for the Ministry of the Environment.).

Mixed waste (accumulated at final disposal sites) and newly generated municipal solid waste (Waste that is sorted, incomplete waste, etc.), and waste plastic, paper, and other contaminants (Metals, bottles, etc.) are separated, recovered waste plastic is converted to fuel (Compression/Solidification or RPF), and metals and bottles are recycled as materials.

Present Situation of Final Disposal Sites

(Item to be considered)

- Grasp of municipal solid waste and garbage generation (Investigation of the composition of waste as necessary)
- Study commercialization of waste plastics as fuel (Compression/Solidification or RPF)
- Extraction of destinations of metals, etc.
- Examination of separation and collection system in and around Monywa City
- Creating an Action Plan (Exchange of opinions with regional authorities)

Collection in the city

Trial Sorting

Note)RPF: Refuse Paper & Plastic Fuel

Taking advantage of the City to City collaboration, measures against municipal solid waste are being strengthened (Results of the previous year).

1 Environmental Education for Sorting Waste in Monywa City

Sorting Waste Practices in Daw Na Chan No .2 Basic Primary School

2 Began efforts to separate waste at markets in Monywa City

Monywa Township Development Committee meet with market agencies and share sorting waste knowledge and practice. Now, market people start sorting the waste and disposing separately.

3 Introduction of exchange between a district elementary school and an elementary school in Fukushima City

Sorting waste at elementary schools

4 Based on the efforts made by Fukushima City, regional government prepared educational pamphlets on separation of waste for children

(Photos in 1 and 2: provided by Monywa City Development Committee)

Outline of the results of the on-site investigation (Last fiscal year): located in the city of Monywa









Meeting with Sagaing Region for field survey

Sagaing Region Development Affairs Committee

Mitsubishi Research Institute, Fujita, Tesco, Fujita Yangon Branch

Agenda

- Explanation of the survey policy for this year and proposal of measures for waste plastic from municipal waste
- Explanation of progress in field surveys to date
- Consultations on future on-site inspections (Survey of waste composition, interviews, etc.)

Online discussions

Sagaing Region Development Affairs Committee

Mitsubishi Research Institute, Fujita, Tesco, Fujita Yangon Branch

Fukushima City, Fukushima Myanmar Economic Exchange Association

Agenda

1. Introduction (Outline of Initiatives): Mitsubishi Research Institute
2. Topic of discussion
   1) Outline of Field Survey Results: TESCO YANGON
   2) New ideas for countermeasures: Fujita
   3) Urban Waste Management in Fukushima City: Environmental department, Fukushima City
   4) Current status of municipal waste in Monywa: Sagaing Region Development Affairs Committee
   5) Roadmap (Idea for an action plan): Mitsubishi Research Institute
3. Entire discussion (comments, summary)

Preparatory meeting (November 27, 2020)

Mitsubishi Research Institute, Fujita, Fukushima City, Fukushima-Myanmar Economic Exchange Association, Fukushima Chamber of Commerce and Industry

Meeting of relevant parties in Fukushima (February 2021)

Mitsubishi Research Institute, Fujita, Fukushima City, Fukushima, Fukushima- Myanmar Economic Exchange Association

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Sagaing Region

Sharing the countermeasures of waste management in Fukushima City

Items
Current Situation of Waste and Garbage in Fukushima City
Comparison of Waste and Garbage Conditions between Monywa City (Sagaing Region) and Fukushima City
Waste and Garbage Reduction Campaign (Challenge for 20% waste reduction)
Flow of Resource Separation
Sorting of Recyclable Materials and Problems (Plastics and PET bottles)
Local efforts for proper treatment of household waste and garbage
Various Support Programs for Waste and Garbage Reduction
Efforts to Charge for Plastic Shopping Bags, etc.
COOL CHOICE (Wise Choice)
Fukushima City's SDGs Initiatives
Fukushima City Basic Plan for General Waste and Garbage Treatment (under development) [Basic Plan for Waste and Garbage Treatment and Basic Plan for Domestic Wastewater Treatment]
Fukushima City Action Plan for Realizing a Decarbonized Society

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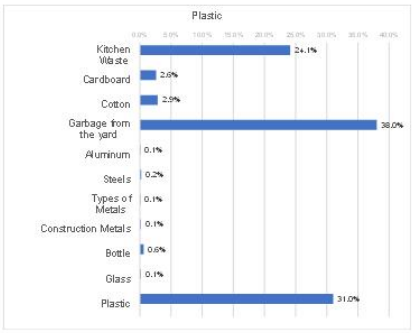
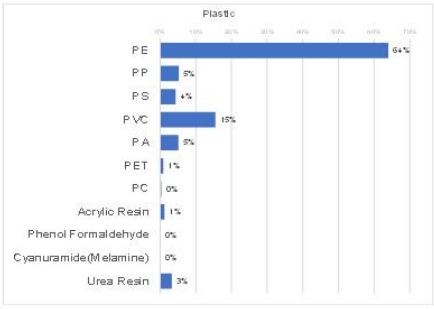
Composition of Waste at Monywa Township





Implementation period: 10 days from January 28 to February 7, 2021

Note: based on values that the workers of visually identified and grasped the type of plastic at the site.

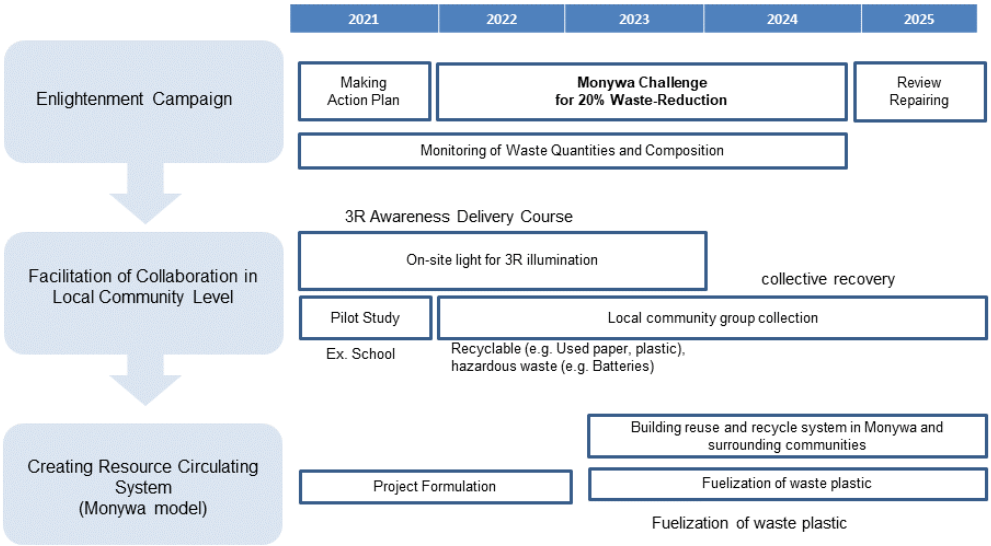
13

(Photos provided by Monywa City Development Committee)

Sagaing Region

- We proposed a road map (action plan) in the online discussion with Sagaing Region.
- The Regional Government of Sagaing expressed its intention to start the treatment of municipal waste as soon as possible, and to consider securing its own budget while taking into account the proposed roadmap.

Roadmap (Ideas of action plan)



14

[Specific Action Plan]

- We introduced efforts to reduce waste by 20% in Fukushima City, and proposed a project in Monywa City.
- In particular, regarding efforts for collective resource recovery (Schools, etc.), Fukushima City provided financial incentives to promote such efforts, and explained that this is a good example of a participatory approach by local residents, and proposed the development of such efforts in Monyuwa City (First of all, the trial was carried out.).

Ideas of action for 20% Waste-Reduction

	Tactics	Enlightenment Campaign
Handling of plastic waste	Thorough Sorting	On-site light for 3R illumination
Handling of paper waste	Thorough Sorting	Facilitation of Collaboration in Community Level
Handling of kitchen waste	・Thorough Draining of Garbage ・Thorough Composting	Local community group collection
Handling of plant waste	・Thorough Composting ・Dry and throw away	Promotion of Garbage Disposal Containers
Handling of meat and fish waste	・Thorough Draining of Garbage	Building environment verification group

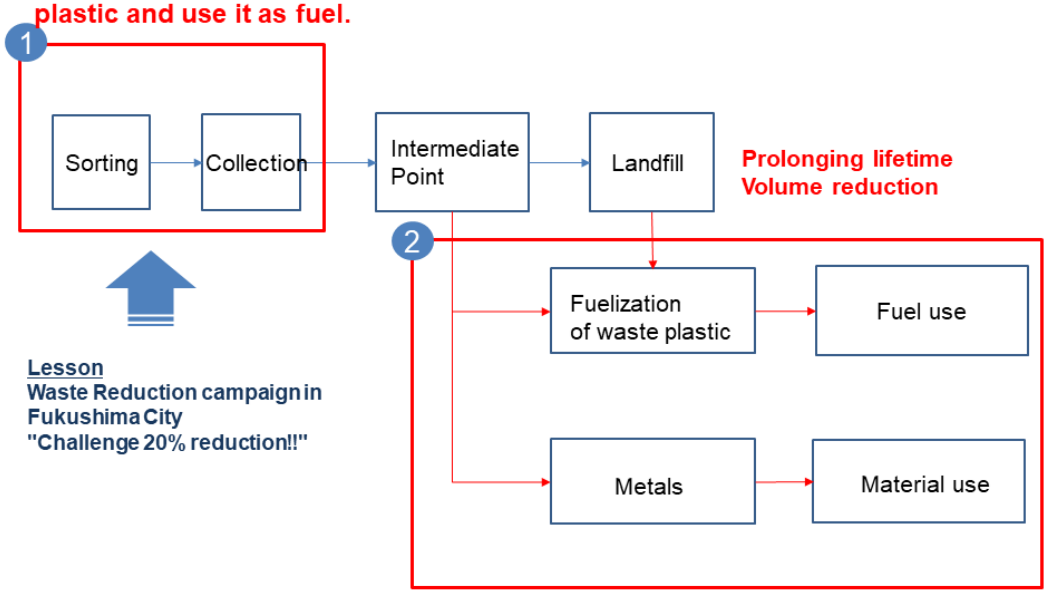
- Study of commercialization of waste plastic fuel

・Consider how to use grants (Example: Co-Innovation)

・Securing a stable supply of waste plastic (Example: Cooperation with systems such as sorting and collective resource recovery)

15

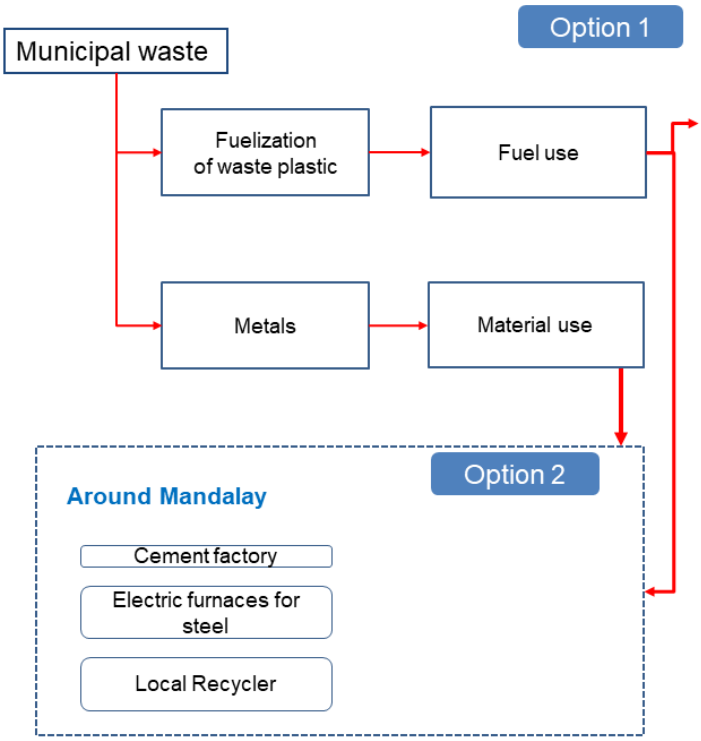
Building total system of 3R for urban waste in collaboration with the surrounding area centered on Monywa. The first step is to separate waste plastic and use it as fuel.



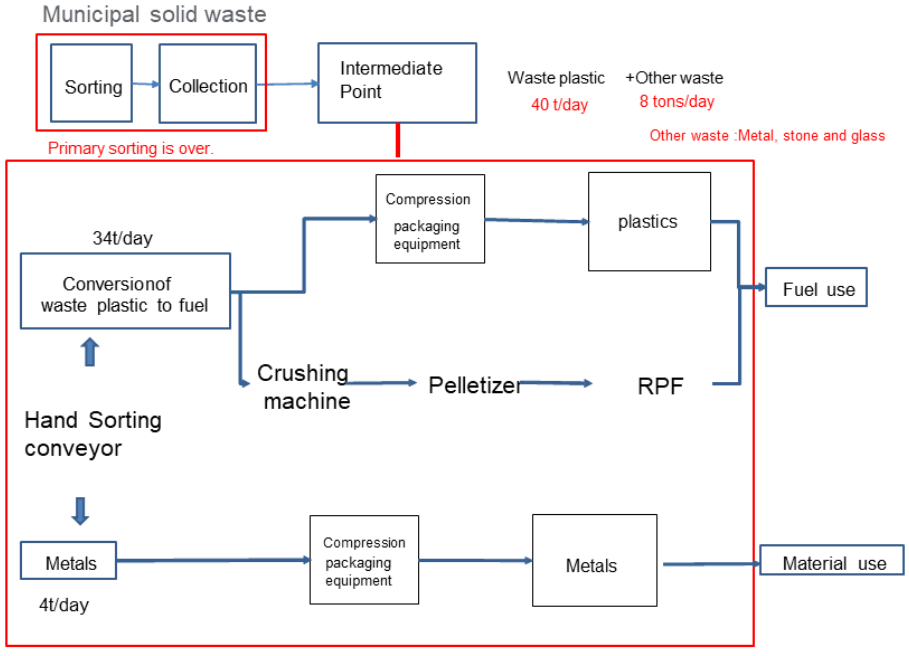
Lesson
Waste Reduction campaign in Fukushima City
"Challenge 20% reduction!!"

Regional "circular economy" for solving Waste and Plastic Issues

16

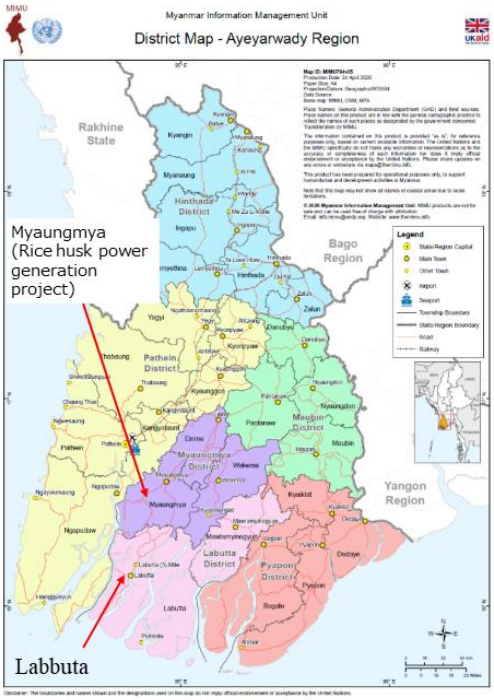


[Details of the proposed business plan (Draft)]



[Overview of Ayeyawady Region, Labutta]

- According to the "The 2014 Myanmar Population and Housing Census" Ayeyarwady Region is the second most densely populated region after Yangon and Mandalay Regions, and has a population of more than 6 million, covering 35,000 square kilometers.
- 6 Districts and 33 Townships in the region. Ayeyawady Region has the highest proportion of rural residents in Myanmar (86%).



Source: Myanmar Information Management Unit, https://themimu.info/sites/themimu.info/files/documents/Region_Map_Region_Ayeyarwady_MIMU764v05_24Apr2020_A4.pdf (Last Accessed: February 12, 2021))

[Ayeyawady Region]

・Rice husk power generation, a powerful method for regional electrification, generates a large amount of incinerated ash. Measures for effective utilization of rice husk incineration ash are examined from the viewpoint of regional resource recycling.

・Study of measures to promote rural electrification without electricity

[Adding Further Innovation] Review for this fiscal year

Study on effective utilization of incinerated ash generated by rice hull power generation as local resources

To a model of Circulating and Ecological Economy in Rural

Incineration Ash x Disaster Prevention and Recovery x Local SDGs

Rice husk power generation → Incineration ash → Agricultural land use as silicate fertilizer → Contribution to local agriculture

90% silica
Other carbide, etc.

- It improves the productivity of rice cultivation and prevents damage (Effects of making roots, stems, and leaves strong, preventing pests and lodging, and promoting photosynthesis).
- **The Labutta area in the southern part of the district is a low-lying area which is severely damaged by hurricanes and is a promising area for deployment (Proposal from the Region).**

[Potential for decentralized power deployment in regions]

<Labbuta Region>

- Regionally distributed power generation: 1.8 MW of rice husk power generation is the smallest. If it is less than this, there is no business. ->200 ~ 500 kW required (Gasification power generation is promising)
- Rice husks need to be made into pellets. It doesn't pay.
- It is necessary to examine gasification power generation of woody biomass in future.
- Idea: Cultivation of early maturing trees → conversion to fuel, regeneration of mangroves → conversion to fuel in controlled areas

Utilization of biomass based on regional situation is key

[Progress of rice husk power generation (In Ayeyarwady Region)]

- 500 ton/day rice mill project is under way in Pathein Industrial City. 3.6 MW rice husk power plant is under construction in the adjacent area.
- In addition, the necessity of low-temperature storage of rice has begun to be recognized, and there is a possibility that construction in combination with rice mills or independent low-temperature storage will occur in the future.
- Incineration ash from rice husk power generation

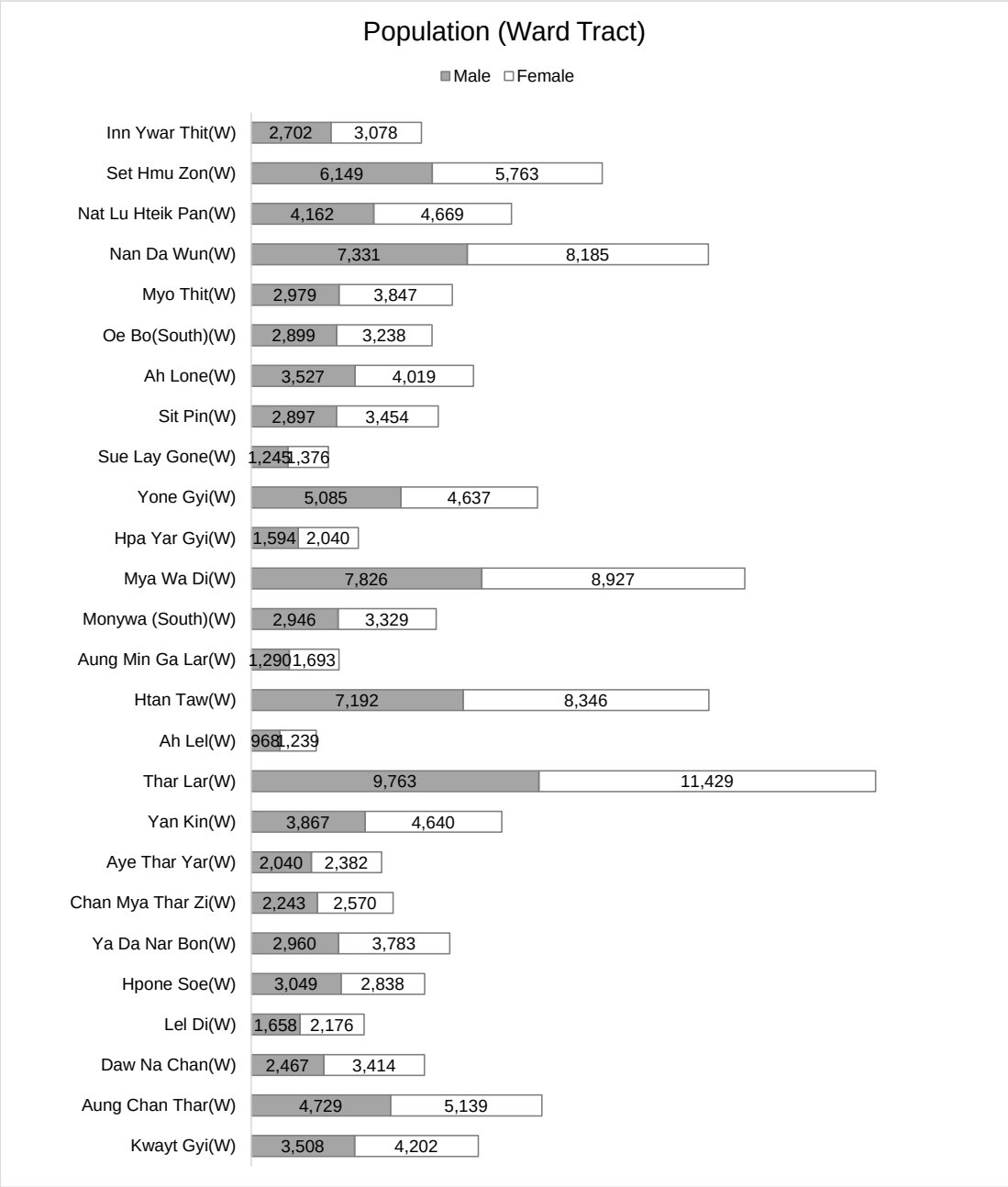
Various business model based on rice husk power generation is expected

Formulation of Circulating and Ecological Economy in Local Communities of Ayeyawady Region

Appendix II

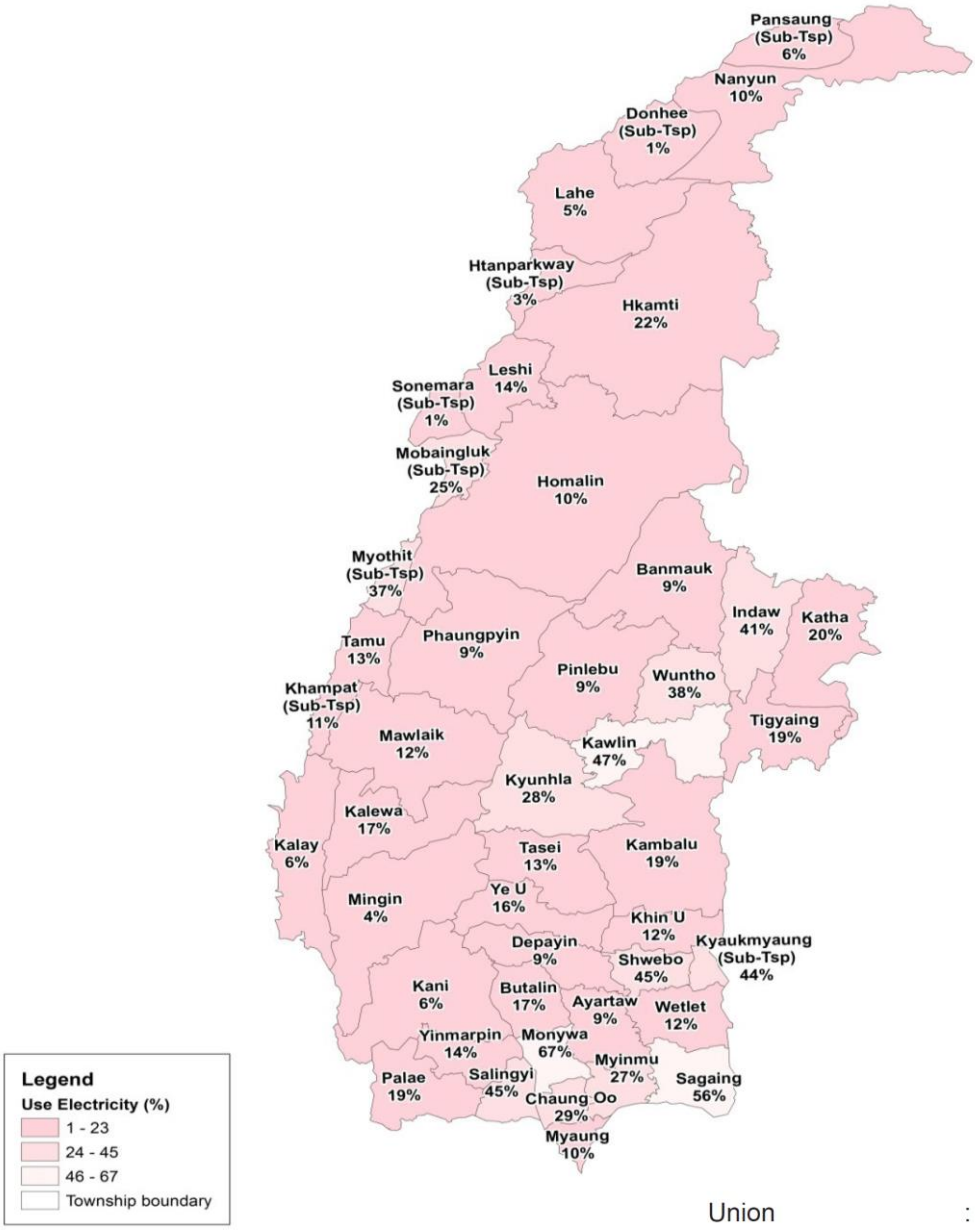
References

Population of Monywa District（2014）



Source: Based on Department of Population, Ministry of Labour, Immigration and Population. “The 2014 Myanmar Population and Housing Census”. https://www.dop.gov.mm/en/data-and-maps-category/2014-census-data（Last accessed: February 12, 2021）

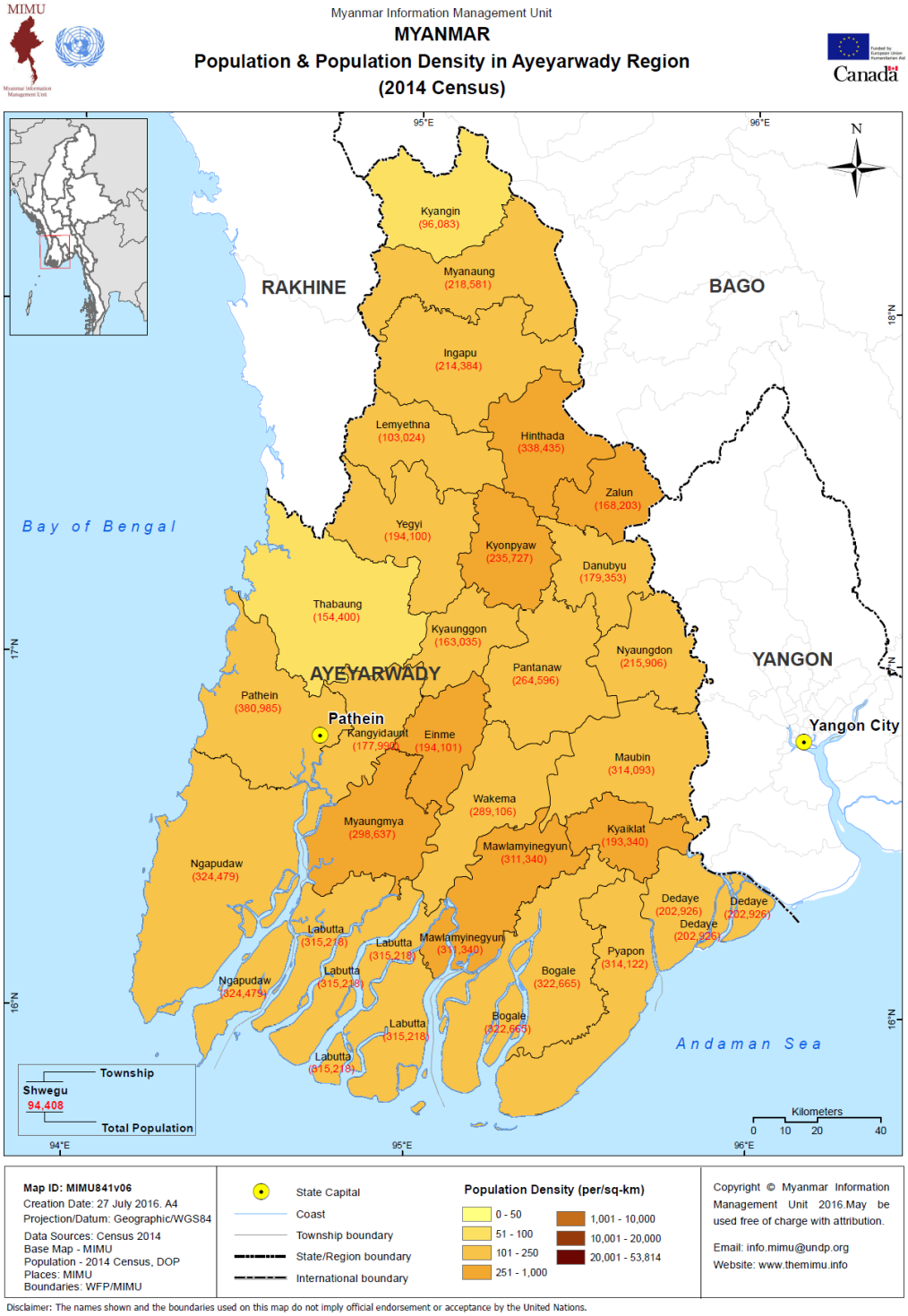
Proportion of households using electricity for lighting



Union	: 32.4%
Sagaing Region	: 24.2%
Monywa District	: 40.3%
Monywa Township	: 67.3%

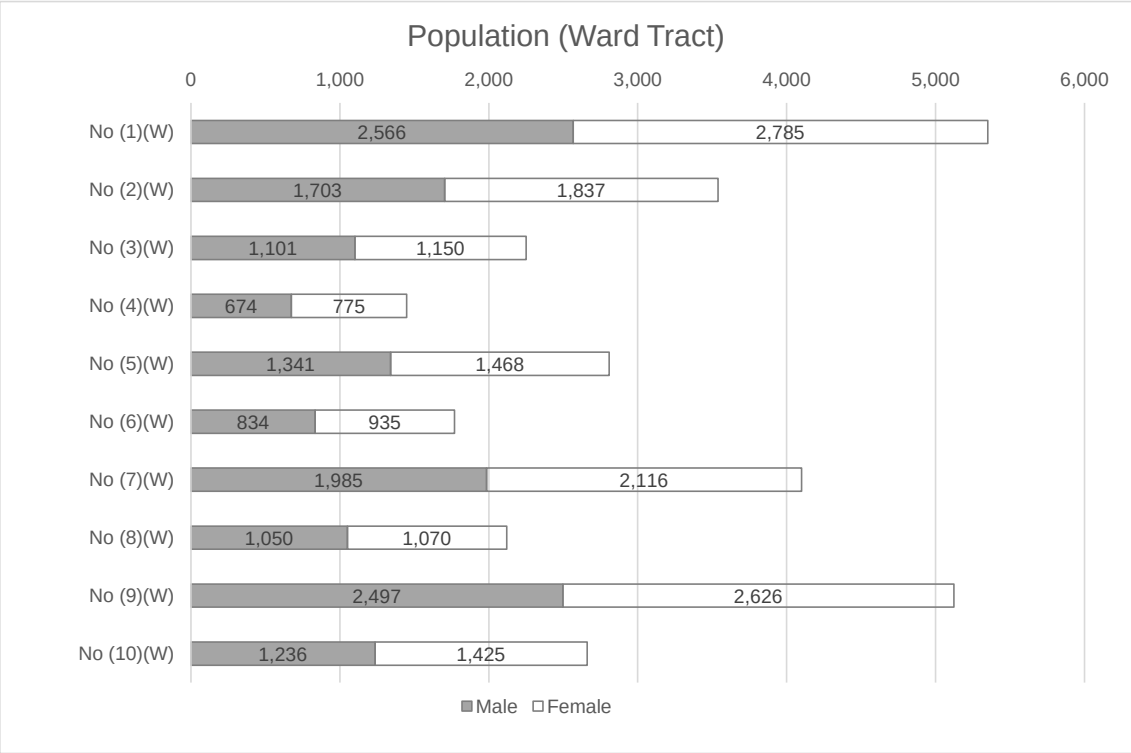
Source: Department of Population, Ministry of Labour, Immigration and Population. “The 2014 Myanmar Population and Housing Census, Sagaing Region Report”. May 2015. https://www.dop.gov.mm/sites/dop.gov.mm/files/publication_docs/sagaing_region_census_report_-_english_0.pdf （Last accessed: February 12, 2021）

Population and population density



Source: Myanmar Information Management Unit. https://themimu.info/sites/themimu.info/files/documents/Population_Map_2014_Population_Density_Ayeyarwady_MIMU841v06_27Jul2016_A4.pdf（Last accessed: February 12, 2021）

Population of Labutta District（2014）



Source: Based on Department of Population, Ministry of Labour, Immigration and Population. “The 2014 Myanmar Population and Housing Census”. https://www.dop.gov.mm/en/data-and-maps-category/2014-census-data (Last accessed: February 12, 2021)

Population of village tract in Labutta Township

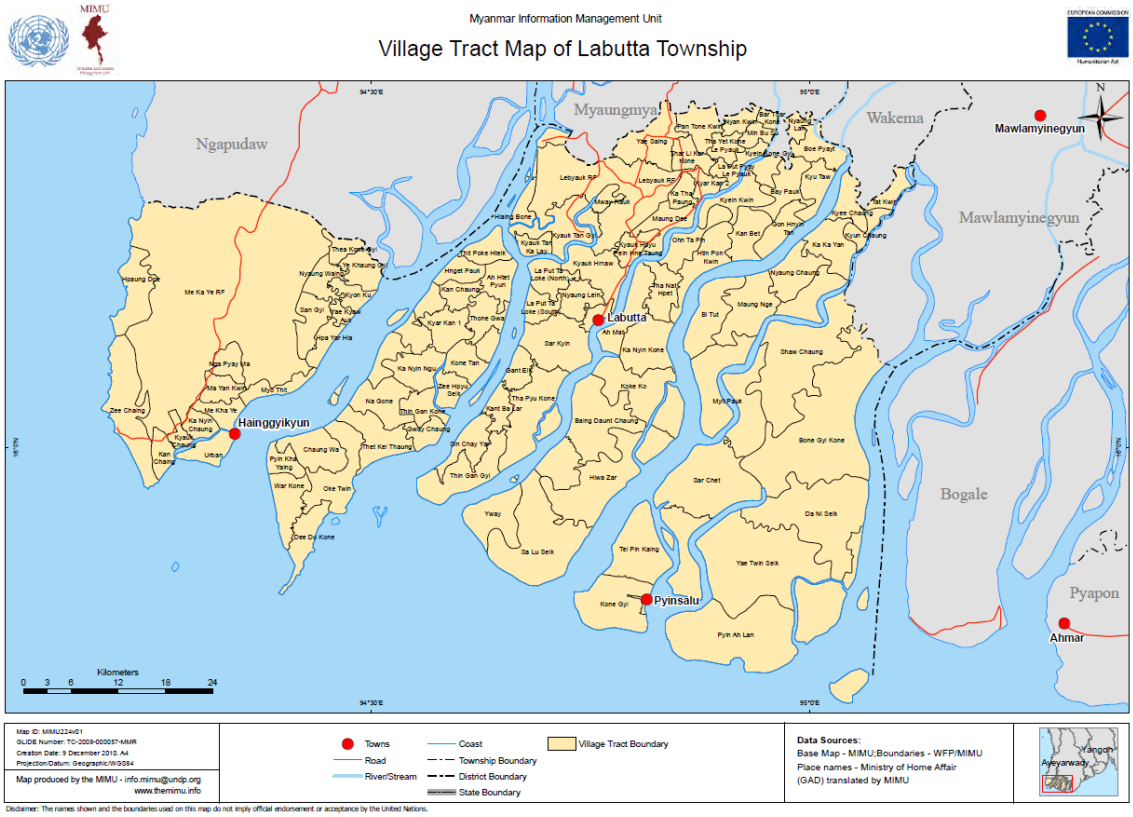
Ayeyawady Region, Labutta District, Labutta Township

29-3-2014

Sr	Village Tract	Population		
		Total	Male	Female
	Village Tract	**198,755**	**99,759**	**98,996**
1	Kyauk Hmaw(VT)	5,880	2,888	2,992
2	Nyaung Lein(VT)	3,801	1,872	1,929
3	La Put Ta Loke (North)(VT)	2,712	1,385	1,327
4	La Put Ta Loke (South)(VT)	3,015	1,468	1,547
5	Sar Kyin(VT)	5,540	2,722	2,818
6	Ka Nyin Kone(VT)	3,354	1,719	1,635
7	Ah Mat(VT)	3,456	1,743	1,713
8	Tha Nat Hpet(VT)	2,355	1,180	1,175
9	Aung Phone(Ohn Ta Pin)(VT)	2,948	1,399	1,549
10	Htin Pon Kwin(VT)	4,934	2,488	2,446
11	Kan Bet(VT)	8,049	4,086	3,963
12	Kyein Kwin(VT)	4,434	2,207	2,227
13	Kyein Kone Gyi(VT)	2,876	1,405	1,471
14	Bay Pauk(VT)	3,912	1,945	1,967
15	Nyaung Lan(VT)	1,761	906	855
16	Boe Pyayt(VT)	3,723	1,825	1,898
17	Kyu Taw(VT)	4,307	2,131	2,176
18	Gon Hnyin Tan(VT)	5,256	2,614	2,642
19	Bi Tut(VT)	7,978	4,001	3,977
20	Maung Nge(VT)	5,448	2,777	2,671
21	Myit Pauk(VT)	8,379	4,407	3,972
22	Shaw Chaung(VT)	6,949	3,569	3,380
23	Nyaung Chaung(VT)	4,182	2,008	2,174
24	Ka Ka Yan(VT)	6,064	3,017	3,047
25	Kyee Chaung(VT)	4,267	2,141	2,126
26	Kyun Chaung(VT)	3,378	1,648	1,730
27	Tat Kwin(VT)	786	390	396
28	Kyar Kan(VT)	3,875	1,834	2,041
29	Tu Myaung(VT)	6,241	3,103	3,138
30	Yae Saing(VT)	8,943	4,546	4,397
31	Kyauk Hpyu/Pein Hne Taung(VT)	4,232	2,104	2,128
32	Ka Tha Paung(VT)	3,510	1,780	1,730
33	Kyauk Tan Gyi(VT)	5,499	2,694	2,805
34	Kyauk Tan Ka Lay(VT)	1,358	698	660
35	Nyan Kwin(VT)	1,578	789	789
36	Pan Tone Kwin(VT)	1,956	972	984
37	Bar Thar Kone(VT)	656	328	328
38	Min Bu Su(VT)	2,559	1,296	1,263
39	Maung Dee(VT)	4,128	2,085	2,043
40	Mway Hauk(VT)	3,667	1,847	1,820
41	La Put Pyay Le Pyauk(VT)	2,240	1,103	1,137
42	Hlaing Bone(VT)	3,219	1,622	1,597
43	Tha Yet Kone Le Pyauk(VT)	2,272	1,105	1,167
44	Thar Li Kar Kone(VT)	1,132	577	555
45	Bone Gyi Kone(VT)	5,083	2,633	2,450
46	Gant Eik (VT)	2,469	1,247	1,222
47	Kant Ba Lar(VT)	1,880	955	925
48	Sin Chay Yar(VT)	2,977	1,548	1,429
49	Tha Pyu Kone(VT)	6,336	3,263	3,073
50	Thin Gan Gyi(VT)	3,201	1,689	1,512

Source: Department of Population, Ministry of Labour, Immigration and Population. “The 2014 Myanmar Population and Housing Census”. https://www.dop.gov.mm/en/data-and-maps-category/2014-census-data (Last accessed: February 12, 2021)

Map of Labutta Township



Source: Myanmar Information Management Unit. https://themimu.info/sites/themimu.info/files/documents/VT%20Map_Labutta%20Tsp_AYE%20Reg_MIMU224v01_08Dec%2010_A4.pdf (Last accessed: February 12, 2021)

Main source of lighting in Ayeyarwady (2014)

Conventional households by main source of lighting

	Source of lighting								
	Total	Electricity	Kerosene	Candle	Battery	Generator (private)	Water mill (private)	Solar system/energy	Other
AYEYAWADY	**1,488,983**	**178,810**	**458,988**	**230,741**	**457,606**	**86,943**	**1,287**	**66,234**	**8,374**
PATHEIN	**394,147**	**57,674**	**128,656**	**53,555**	**108,379**	**25,744**	**350**	**18,033**	**1,756**
Kangyidaunt	42,966	2,798	20,408	6,520	10,549	1,017	15	1,566	93
Kyaungon	41,402	3,025	20,327	5,365	9,078	1,278	16	2,218	95
Kyonpyaw	59,488	5,710	22,624	8,723	17,836	2,112	21	2,310	152
Ngaputaw	37,376	2,005	10,594	5,741	13,859	2,651	23	2,114	389
Pathein	66,036	30,412	10,339	7,942	11,819	3,810	84	1,482	148
Yekyi	27,802	4,410	9,427	2,463	9,594	123	2	1,761	22
Thapaung	37,237	2,197	18,006	3,169	10,281	1,473	24	1,998	89
Ngayokaung (Sub-Tsp)	10,201	673	2,783	1,963	2,996	1,009	5	684	88
Hainggyikyun (Sub-Tsp)	29,075	2,232	3,257	5,112	10,540	6,454	31	1,238	211
Shwethaungyan (Sub-Tsp)	10,181	618	1,827	1,478	2,117	3,524	105	470	42
Ngwehsaung(Sub-Tsp)	9,470	1,034	2,753	1,757	1,680	1,577	20	601	48
Ngathaingchaung(Sub-Tsp)	22,913	2,560	6,311	3,322	8,030	716	4	1,591	379
PHYAPON	**237,761**	**23,827**	**57,635**	**32,471**	**93,278**	**13,476**	**185**	**15,063**	**1,826**
Kyaiklatt	43,748	3,857	18,605	2,852	14,622	1,615	19	2,049	129
Daydaye	48,610	3,105	11,448	5,699	20,789	2,852	85	4,322	310
Phyapon	41,630	9,855	7,765	5,737	13,203	1,828	22	2,733	487
Bogale	75,987	6,358	14,959	13,468	30,585	4,968	42	4,918	689
Ahmar (Sub -Tsp)	27,786	652	4,858	4,715	14,079	2,213	17	1,041	211
MAUBIN	**228,079**	**20,863**	**107,220**	**22,022**	**56,750**	**12,037**	**205**	**8,552**	**430**
Nyaungdon	51,201	4,296	20,797	5,697	15,069	3,313	47	1,815	167
Danubyu	44,797	4,167	18,066	4,731	14,136	1,696	12	1,869	120
Pantanaw	60,277	3,443	33,740	5,772	10,480	4,513	116	2,140	73
Maubin	71,804	8,957	34,617	5,822	17,065	2,515	30	2,728	70
MYAUNGMYA	**180,075**	**19,662**	**77,555**	**21,090**	**47,363**	**9,046**	**153**	**4,539**	**667**
Myaungmya	66,172	10,318	23,970	6,539	21,016	2,481	35	1,536	277
Wakema	67,448	6,075	33,824	8,446	12,339	4,688	32	1,837	207
Einme	46,455	3,269	19,761	6,105	14,008	1,877	86	1,166	183
LABUTTA	**150,469**	**10,211**	**47,538**	**21,667**	**52,301**	**11,490**	**138**	**6,082**	**1,042**
Mawlamyinegyun	74,886	3,761	20,760	11,981	29,677	5,078	87	3,026	516
Labutta	55,146	5,530	20,937	6,200	15,322	4,775	43	2,006	333
Pyinsalu (Sub-Tsp)	20,437	920	5,841	3,486	7,302	1,637	8	1,050	193
HINTHADA	**298,452**	**46,573**	**40,384**	**79,936**	**99,535**	**15,150**	**256**	**13,965**	**2,653**
Kyangin	26,857	5,339	195	8,107	8,865	1,834	17	2,220	280
Zalun	42,073	5,479	12,033	7,963	13,209	1,798	22	1,263	306
Myanaung	59,920	8,891	2,360	24,539	14,974	6,261	168	2,274	453
Laymyethna	26,244	1,320	7,275	5,085	9,578	325	-	2,536	125
Hinthada	86,129	19,401	11,038	17,372	31,298	3,264	17	3,031	708
Ingapu	57,229	6,143	7,483	16,870	21,611	1,668	32	2,641	781

Source: Department of Population, Ministry of Labor, Immigration and Population. "The 2014 Myanmar Population and Housing Census, Ayeyawady Region Report". May 2015. https://www.dop.gov.mm/sites/dop.gov.mm/files/publication_docs/ayeyawady_region_census_report_-_english_1.pdf (Last accessed: March 5, 2021)