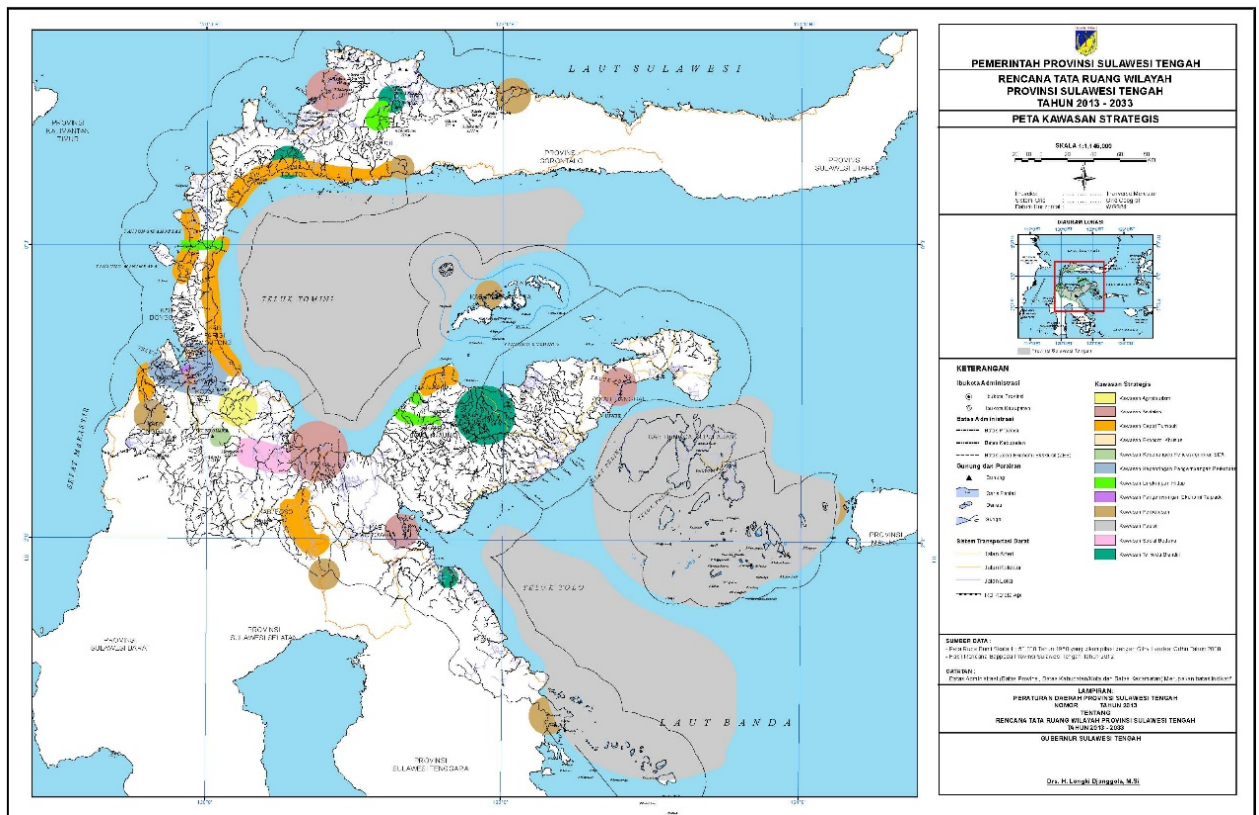


Source: Central Sulawesi Spatial Plan 2013-2033

Figure 2-11 Land Use Pattern in Central Sulawesi RTRW 2013-2033



Source: Central Sulawesi Spatial Plan 2013-2033

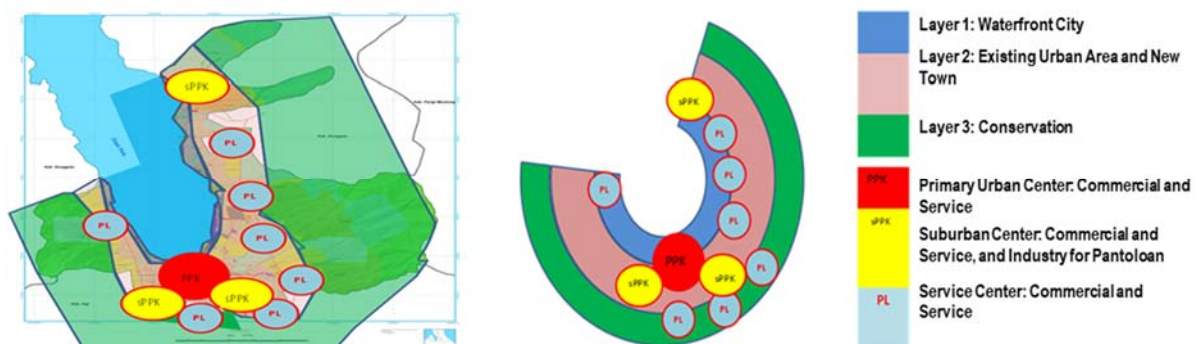
Figure 2-12 Strategic Areas in Central Sulawesi RTRW 2013-2033

(2) Palu City RTRW 2010-2030

1) Development Policy/ Concept

The Palu Bay Southern Coastal Area is waterfront, which is identified as the representing location of Palu City in RTRW 2010-2030. Based on this idea, policies and strategies in spatial planning were adopted in Palu City, some of which are specified below:

- Establishment of a coastal city as a front porch of Palu City with the concept of “Gandaria”.
- Establishment of the area of commerce, government, education, culture and settlements as the central of the city with the concept of “Tatangana”.
- Establishment of the area of agriculture, industry and mining as behind the city with the concept of “Poavua”.
- Development of an integrated system of transportation infrastructure, telecommunications, energy and water resources networks to support the urban structure of Palu City as a coastal city.
- Improvement of the quality and range of infrastructure system services to support the characteristics of Palu City as an eco-friendly city.

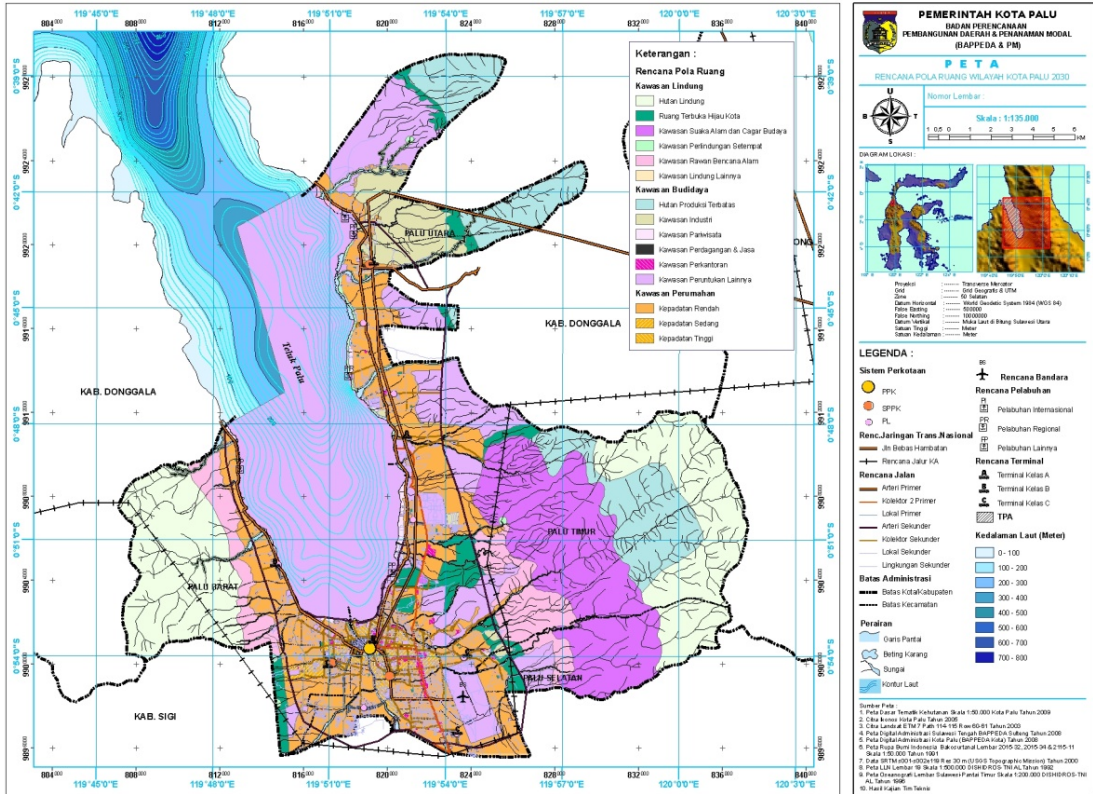


Source: Palu City Spatial Plan 2010-2030

Figure 2-13 The “SOURAJA” Concept in Palu City RTRW 2010-2030

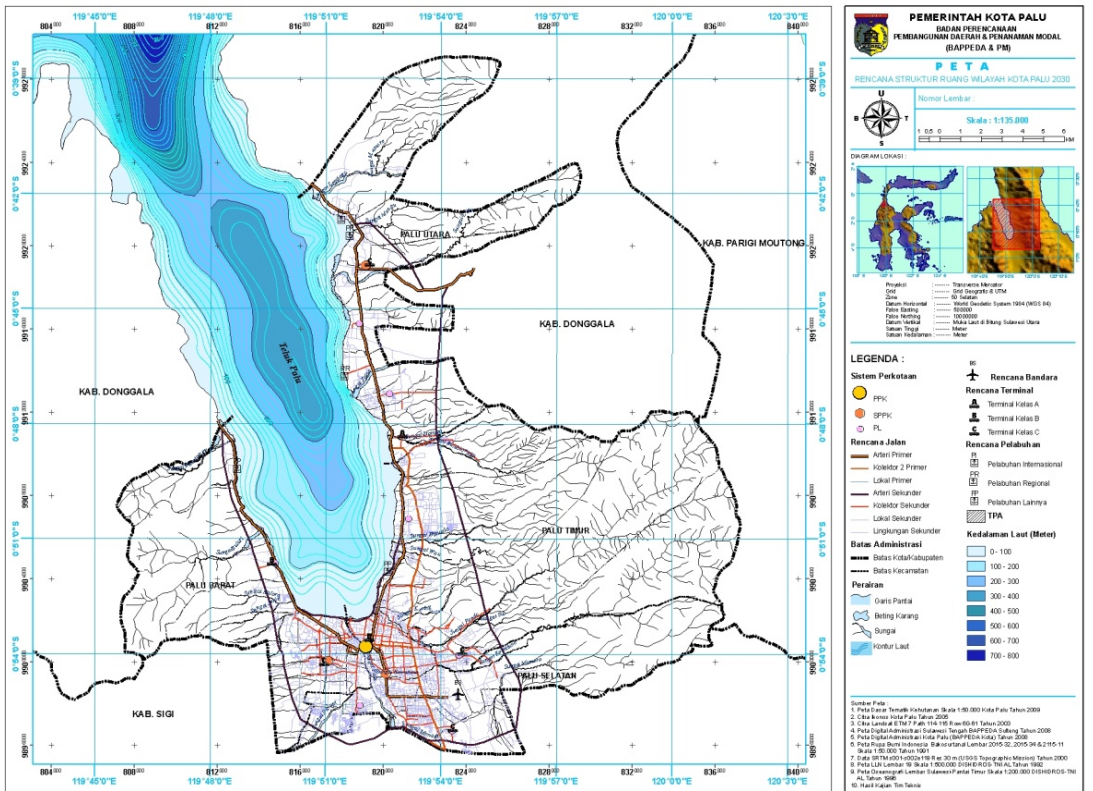
2) Land Use Pattern and Infrastructure Development Plan

The spatial structure of Palu City in RTRW 2010-2030 suggests mono-centric spatial structure, which is developed from the urban center/ central business district of Palu to the surrounding areas as shown in Figure 2-14 and Figure 2-15. The Palu Bay southern coastal area, which was severely damaged by the tsunami during the disaster 2018, is identified as the urban center. The residential areas are planned to be expanded in the eastern and western coastal areas along the arterial road. However, sub-urban centers are not very clearly identified in the plan.



Source: Palu City Spatial Plan 2010-2030

Figure 2-14 Land Use Patterns (Palu City RTRW 2010-2030)



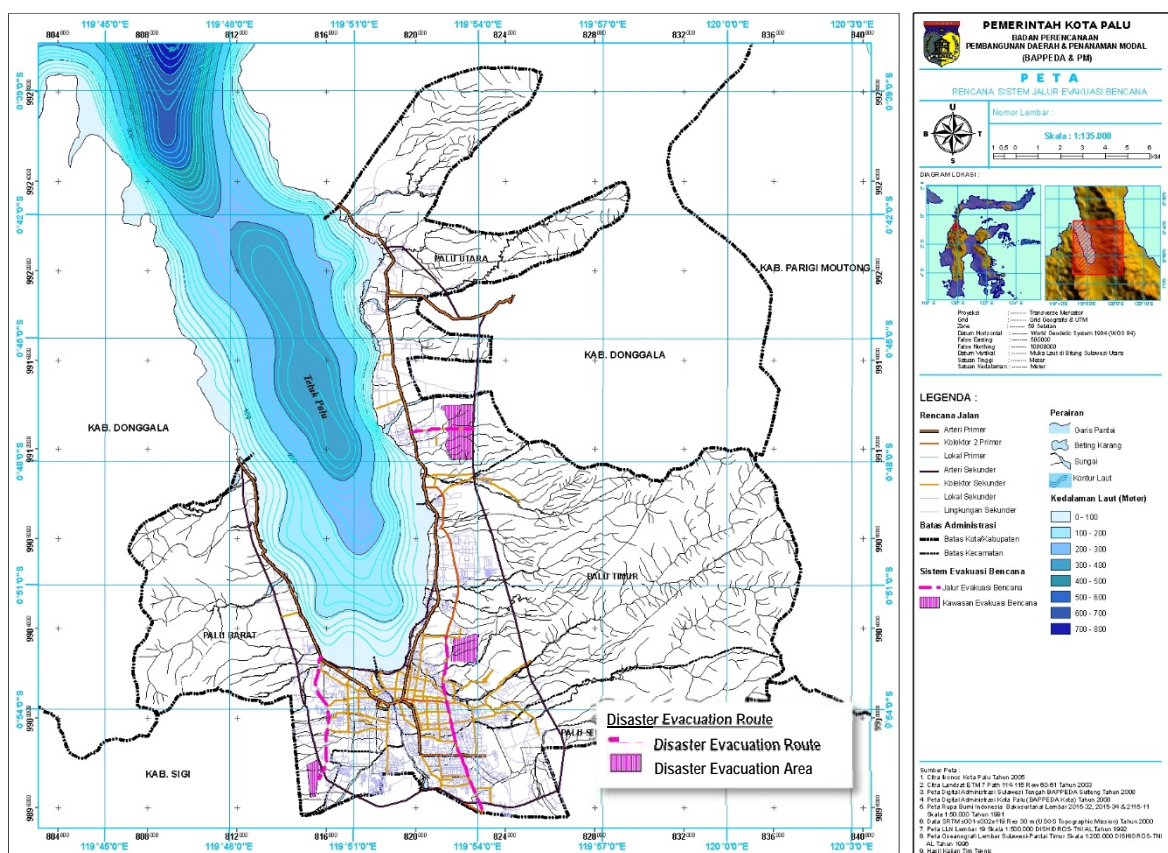
Source: Palu City Spatial Plan 2010-2030

Figure 2-15 Space Structure Map (Palu City RTRW 2010-2030)

3) Designation of Road and Space for Disaster Evacuation

Disaster evacuation routes were designated in the sub-districts of Palu Barat, Palu Timur, Palu Selatan and Palu Utara. Therefore, road plans for disaster evacuation routes in Palu City are divided based on these 4 sub-districts.

- Palu Utara Sub-district includes Jaelangkara road connected to the Palu Industrial Estate.
- Palu Timur Sub-district includes Soekarno Hatta road connected to Jabal Nur hill.
- Palu Selatan Sub-district includes Muhammad Yamin road connected to Watulemo Field.
- Palu Barat Sub-district includes Munif Rahman road and Gawalise road connected to Gawalise Stadium



Source: Palu City Spatial Plan 2010-2030

Figure 2-16 Map of Planned Disaster Evacuation Network System in RTRW 2010-2030

(3) Palu City Draft RTRW 2018-2038

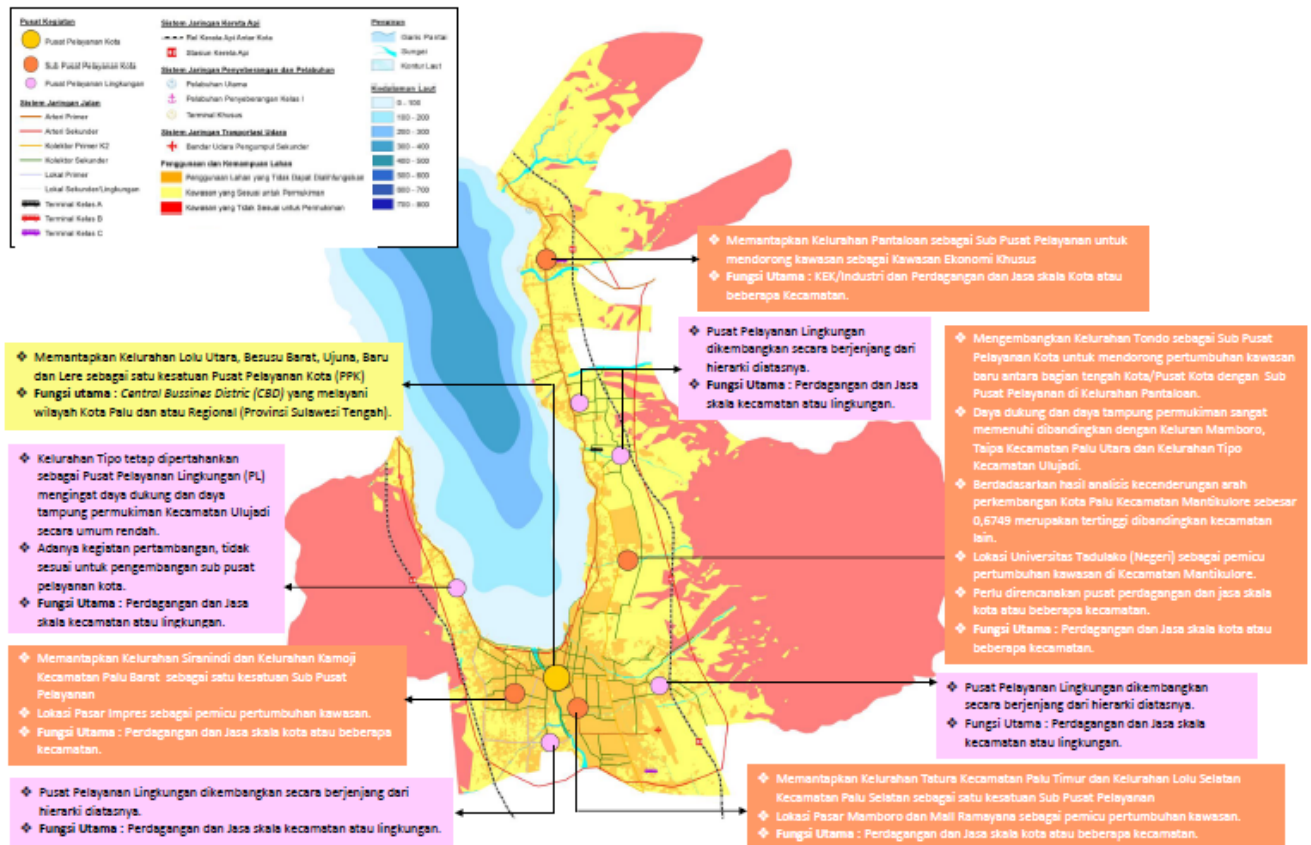
1) Objectives / Concept of Spatial Plan

The objective of the Palu Spatial Plan is stated as:

- Palu's spatial planning aims to realize Palu City as a Bay City with environmental insight based on services, trade and industry based on local wisdom and excellence for sustainable development

The Palu Bay remains as part of the important identity of Palu even after the disaster.

Guided by this objective, the space structure concept proposes development of four suburban centers in the sub-districts of Palu Barat and Palu Selatan, and kelurahans of Tondo and Pantoloan, and five service centers in suburban areas.



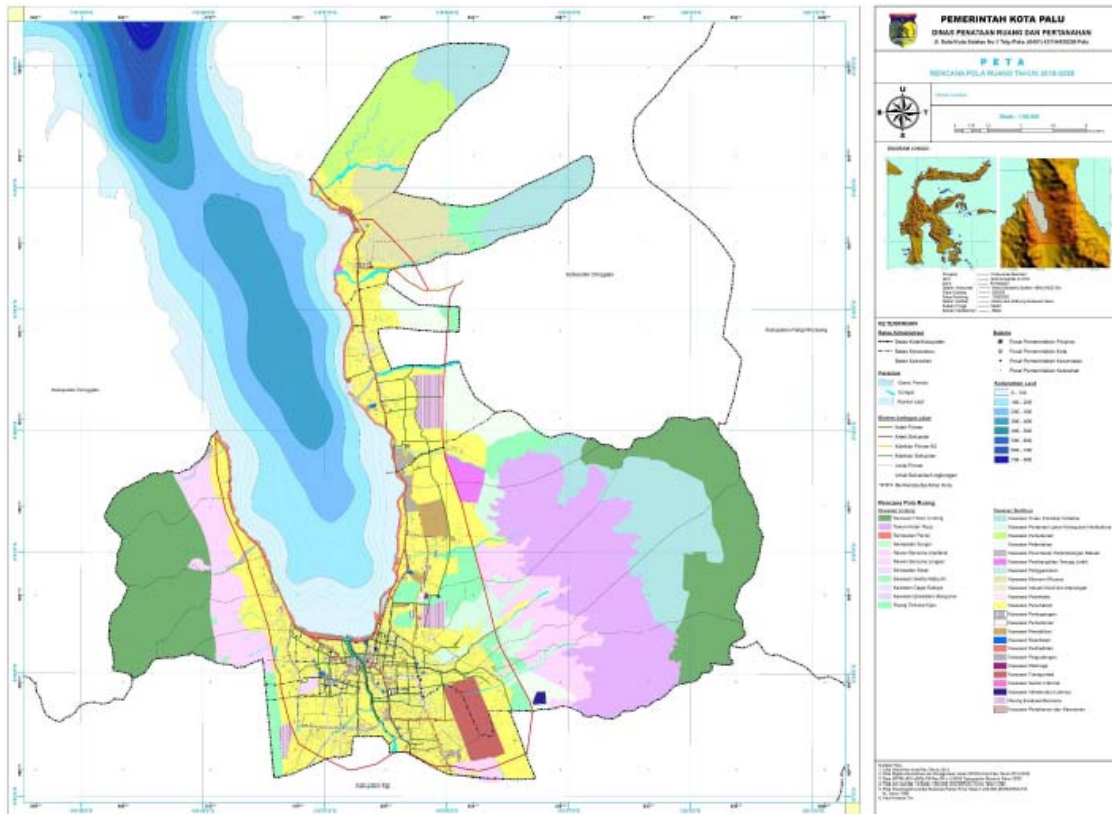
Source: Revisi Rencana Tata Ruang Wilayah Kota Palu 2018 (Draft)

Figure 2-17 Concept of Space Structure (Palu City Draft RTRW 2018-2038)

2) Land Use Pattern and Infrastructure Development Plan

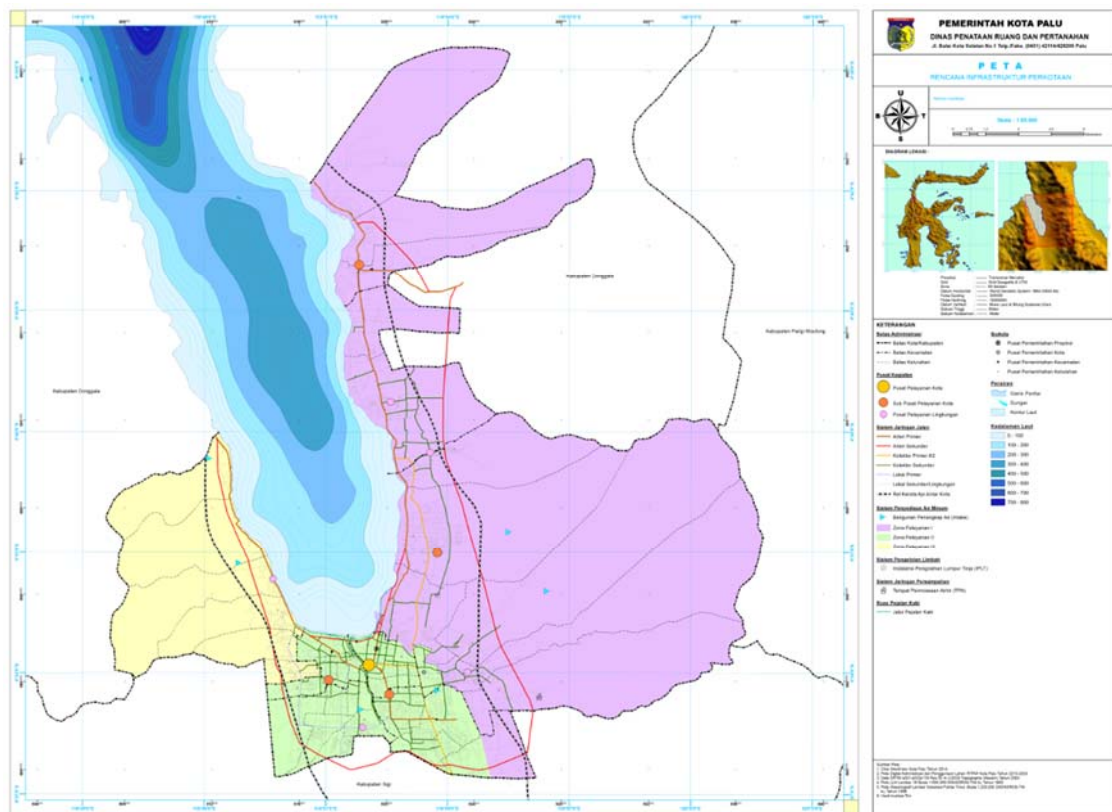
In order to realize the space structure concept presented above, the proposed land use pattern shows the expansion of the residential area in the eastern area of the Palu Bay where denser transport networks, including the Outer Ring Road, are also proposed in Figure 2-18 and Figure 2-19.

This land use pattern map reflects the ZRB map by ATR by adopting the land use recommendations for ZRB4. The disaster-affected areas (including the Palu Bay southern coastal area, Petobo and Balara) and high risk areas along the coast and active fault line of Palu-koro, which are designated as ZRB4, are preserved as protection areas in Figure 2-18. However, more detailed information and analysis of the disaster hazard are necessary to propose appropriate land use pattern and infrastructure development plan.



Source: Revisi Rencana Tata Ruang Wilayah Kota Palu 2018 (Draft)

Figure 2-18 Land Use Patterns (Palu City Draft RTRW 2018-2038)



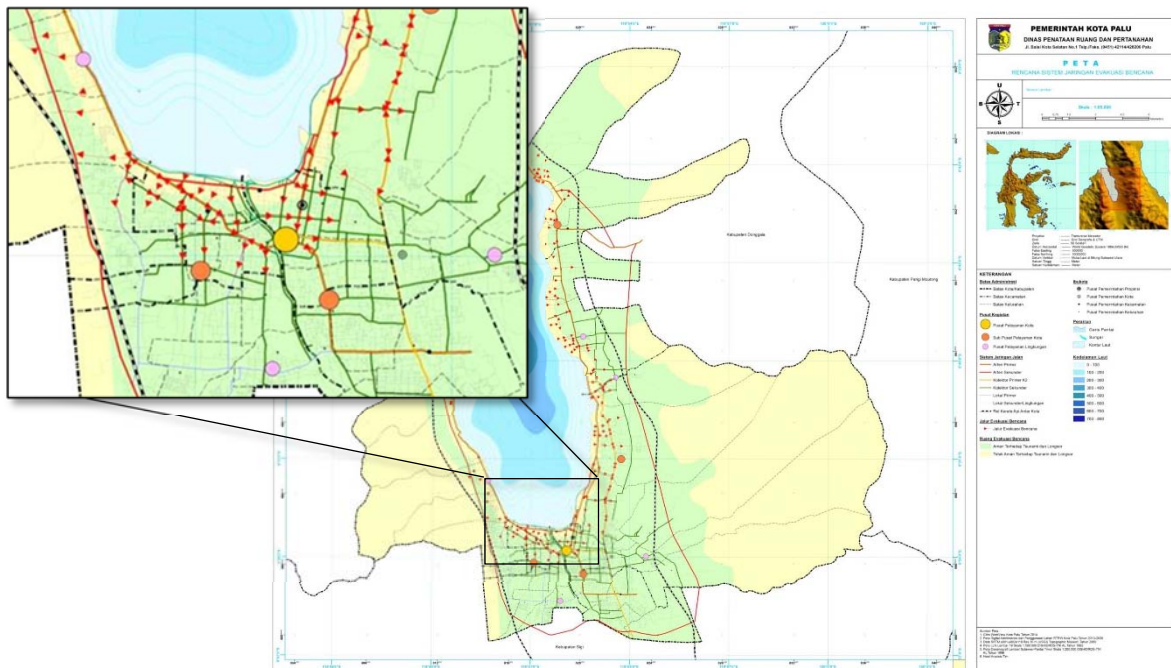
Source: Revisi Rencana Tata Ruang Wilayah Kota Palu 2018 (Draft)

Figure 2-19 Infrastructure Plan (Palu City Draft RTRW 2018-2038)

3) Designation of Road and Space for Disaster Evacuation

In RTRW of Palu City under revision, the disaster evacuation route in Palu City is divided into two, namely, Ring I evacuation route and Ring II evacuation route. Compared to the previous RTRW, evacuation routes have become much detailed and networked.

- **Ring I Disaster Evacuation Route:** This route is an evacuation route from the coast and perpendicular to the coastline that can be used in case that earthquake may trigger tsunami.
- **Ring II Disaster Evacuation Route:** This route is parallel to the coastline and connects to hills. Furthermore, it is connected to Ring I evacuation route.



Source: Revision of Palu City Spatial Planning 2018 (Draft)

Figure 2-20 Map of Planned Disaster Evacuation Network System in Draft RTRW 2018-2038

In addition to the above, disaster evacuation facilities have also been defined in RTRW under revision as described below:

- Roof of building ≥ 3 floors along the inner ring road.
- Open spaces in each sub-district with a distance of > 500 meters from the coastline
- Public facilities
- The evacuation room is centered in Tatanga Sub-district, Mantikulore Sub-district and Palu Utara Sub-district.

(4) Sigi Regency RTRW 2011-2031

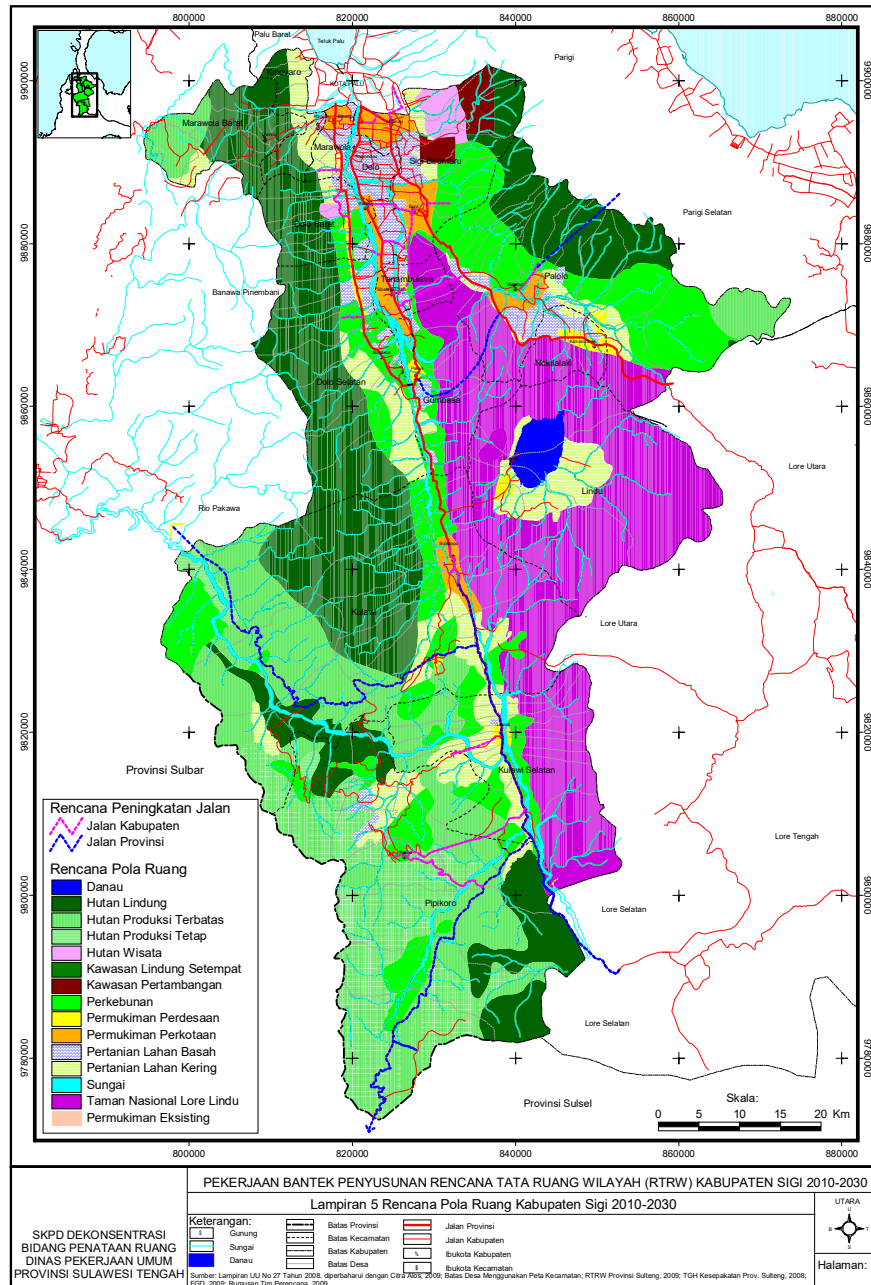
1) Development Policy

The development policies cited in Sigi Regency RTRW 2011-2031 include:

- Limiting urban areas so as not to be widespread and irregular
- Maintaining the existence of protected areas by limiting widespread of spaces in the sub-districts of Lindu, Nokilalaki, Palolo, Gumbasa, Kulawi which are in the Lore Lindu National Park Area
- Integrating functions and service centers in cities outside the main city (Biromaru Urban Area), in order to spread the center of growth and reduce the burden on the main city.

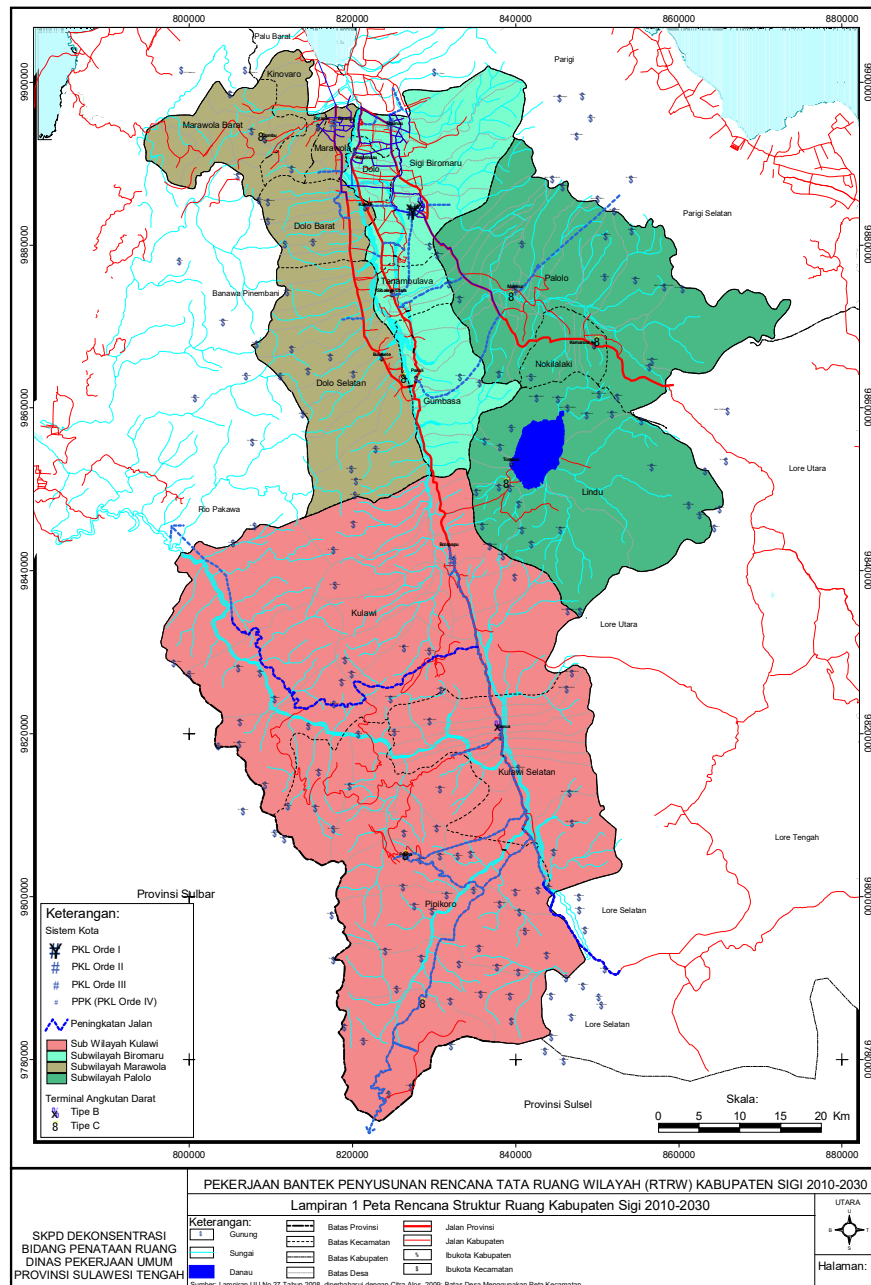
2) Land Use Patterns and Infrastructure Development Plan

In the land use pattern of Sigi RTRW 2010-2030, the urban area is found only in the areas bordering Palu City, such as the Sub-districts of Sigi-Biromaru and Marawola, the areas along the Palu River such as Dolo, and some inland areas. Large area of land is designated for agriculture, forest, and national park. The land for wetland agriculture is concentrated in the Sub-districts of Sigi-Biromaru and Dolo and other areas along the rivers. The areas next to Palu, or the suburban areas of Palu, are quite important for development of Sigi Regency in terms of urbanization and agricultural production.



Source: Sigi Regency RTW 2010-2030

Figure 2-21 Land Use Patterns (Sigi Regency RTRW 2010-2030)



Source: Sigi Regency RTW 2010-2030

Figure 2-22 Space Structure Map (Sigi Regency RTRW 2010-2030)

3) Designation of Road and Space for Disaster Evacuation

There is no description on disaster evacuation routes and space in Sigi RTRW 2010-2030.

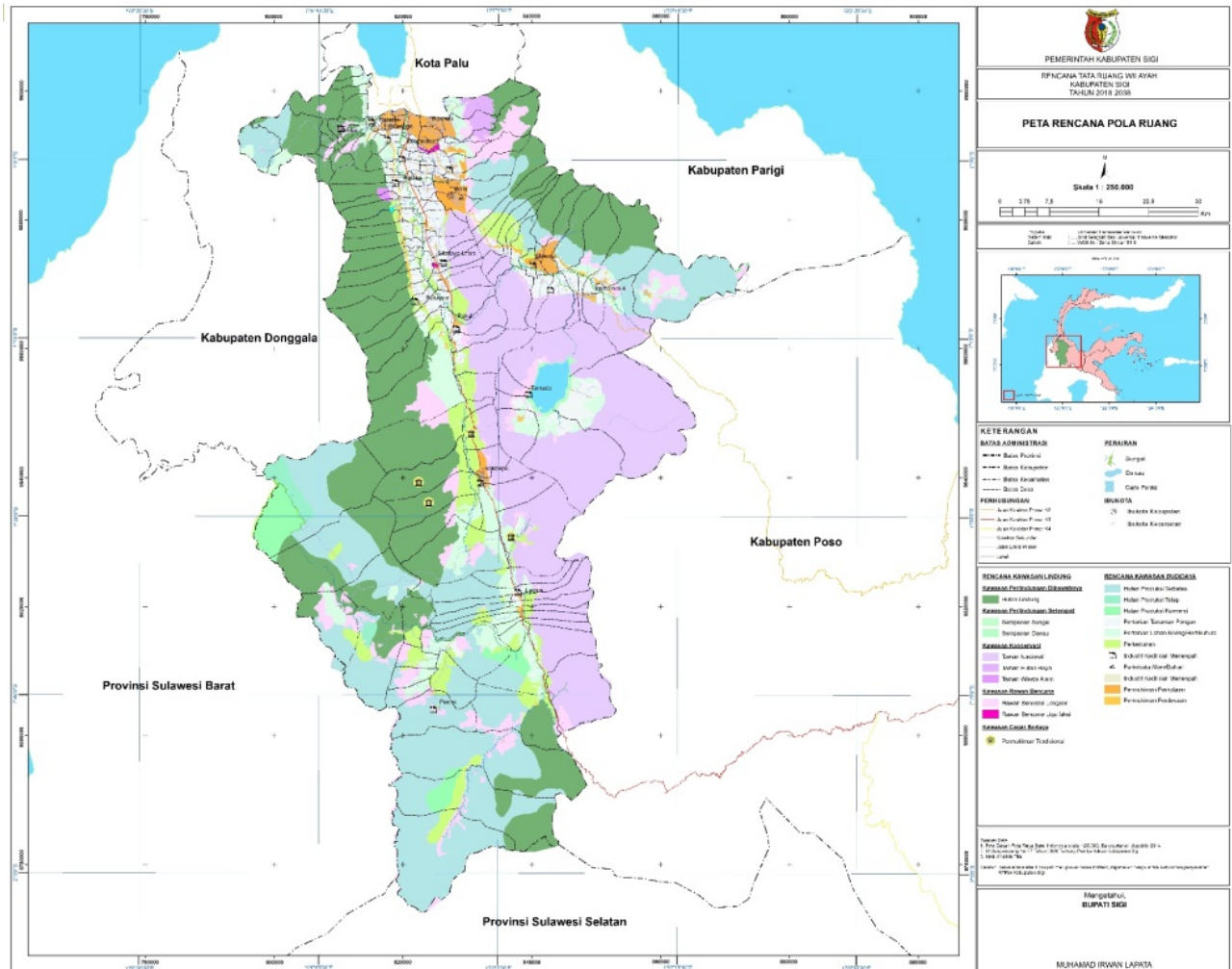
(5) Sigi Regency Draft RTRW 2018-2038

1) Objectives and Concept of Spatial Plan

The spatial plan of Sigi Regency aims “to realize the implementation of development that relies on the agricultural sector, the agricultural processing industry, forestry, tourism and realize state defense and security in a sustainable and fair manner” (Page 2-2)

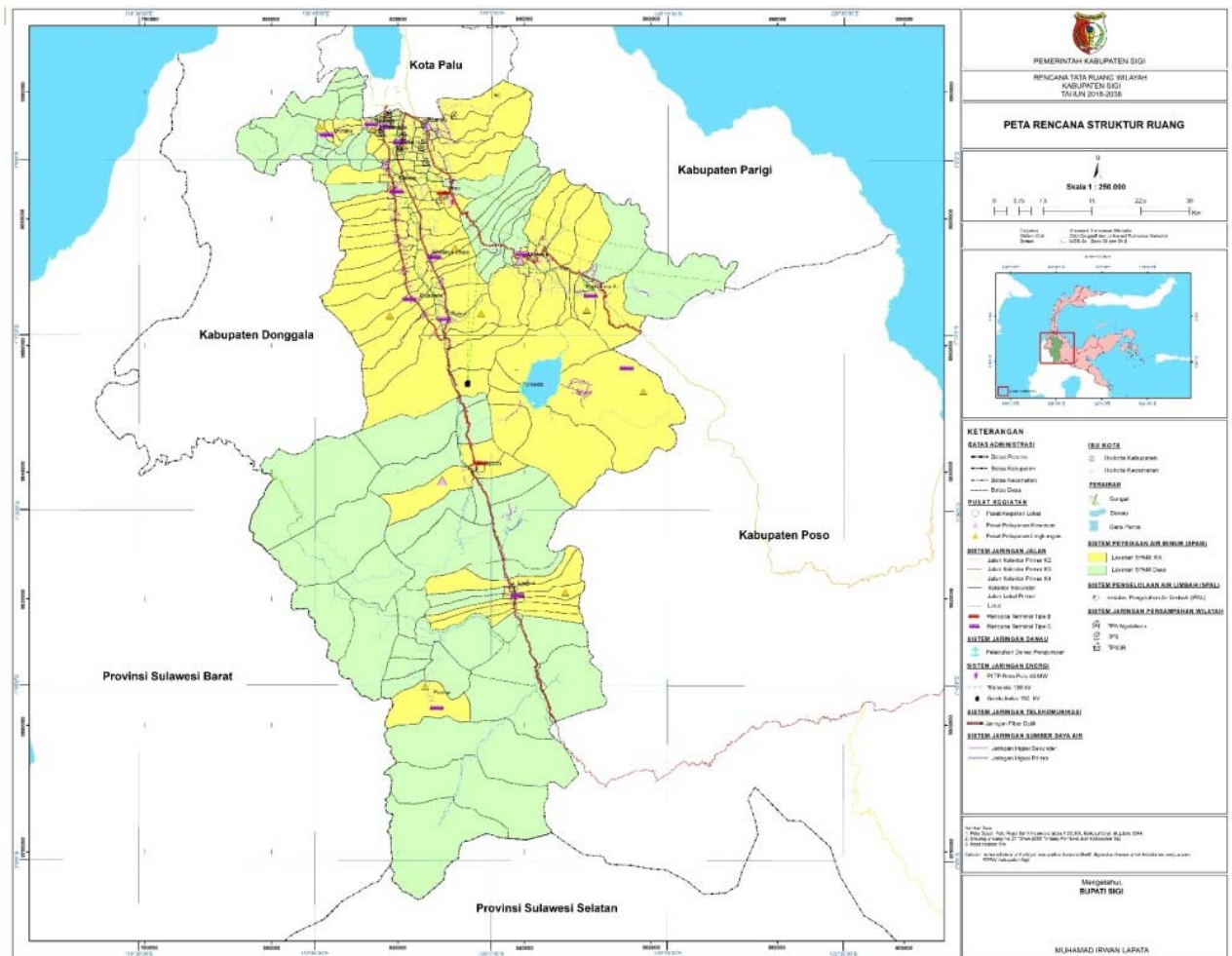
2) Land Use Pattern and Infrastructure Development Plan

The land use pattern and infrastructure development of Sigi are strongly affected by the urbanization of Palu, due to its location bordering Palu. In the land use pattern in the draft RTRW 2018-2038, urban settlement areas are designated in the areas of Sigi-Biromaru and Marawola facing Palu, and the area around Boro where the Regent Office is located and is specified as the primary center in Sigi. The ZRB map by ATR is reflected in the proposed land use patterns. The Nalodo-affected area of Jono Onge is specified as liquefaction-prone area for protection, and the permanent relocation site areas are identified as urban settlement area. Agricultural use is suggested for the vast area of the south of Jono Onge.



Source: Rencana Tata Ruang Wilayah Kabupaten Sigi 2018-2038 (Draft)

Figure 2-23 Land Use Patterns (Sigi Regency RTRW 2018-2038 under revision)



Source: Rencana Tata Ruang Wilayah Kabupaten Sigi 2018-2038 (Draft)

Figure 2-24 Space Structure Map (Sigi Regency RTRW 2018-2038 under revision)

3) Designation of Road and Space for Disaster Evacuation

In the RTRW of Sigi Regency under revision, disaster evacuation routes and spaces are considered. Even though those locations are not specified in this plan, a concept is mentioned that disaster evacuation route networks are established by development of evacuation routes in urban and rural areas, and open spaces such as parks, sports fields, and public service facilities in each village or sub-district.

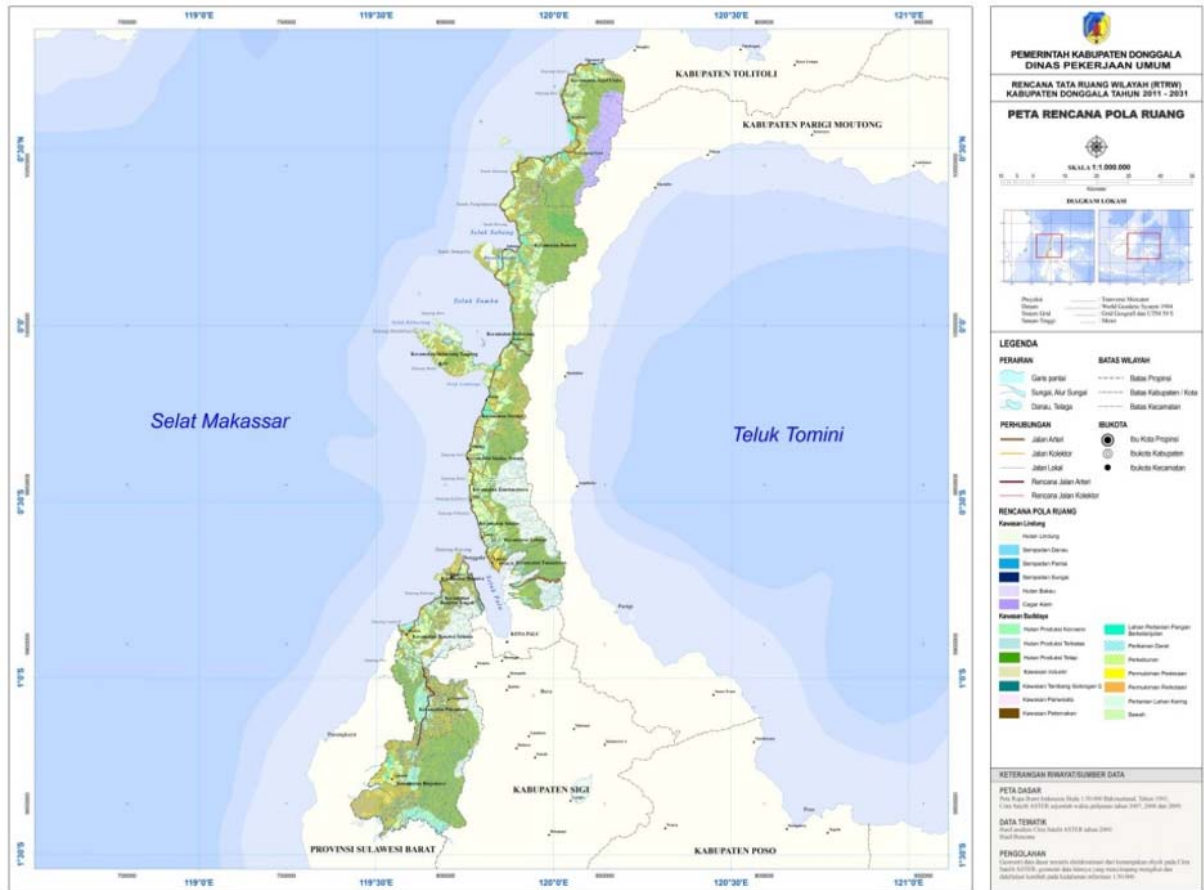
(6) Donggala Regency RTRW 2011-2031

1) Development Vision and Mission

In the Donggala RTRW, Donggala 2005-2025 is envisioned “The Donggala Regency is Independent, Prosperous and Peaceful”. On the other hand, the development missions of Donggala Regency entail: 1) Realizing an independent Donggala District, 2) Realizing a Prosperous and Quality Society, 3) Realizing a Safe and Peaceful Atmosphere, and 4) Realizing Participatory Government, Transparency and Accountability. The numerical targets set halving poverty, annual economic growth of 7-8%, and per capital income of Rp 25 million in 2025.

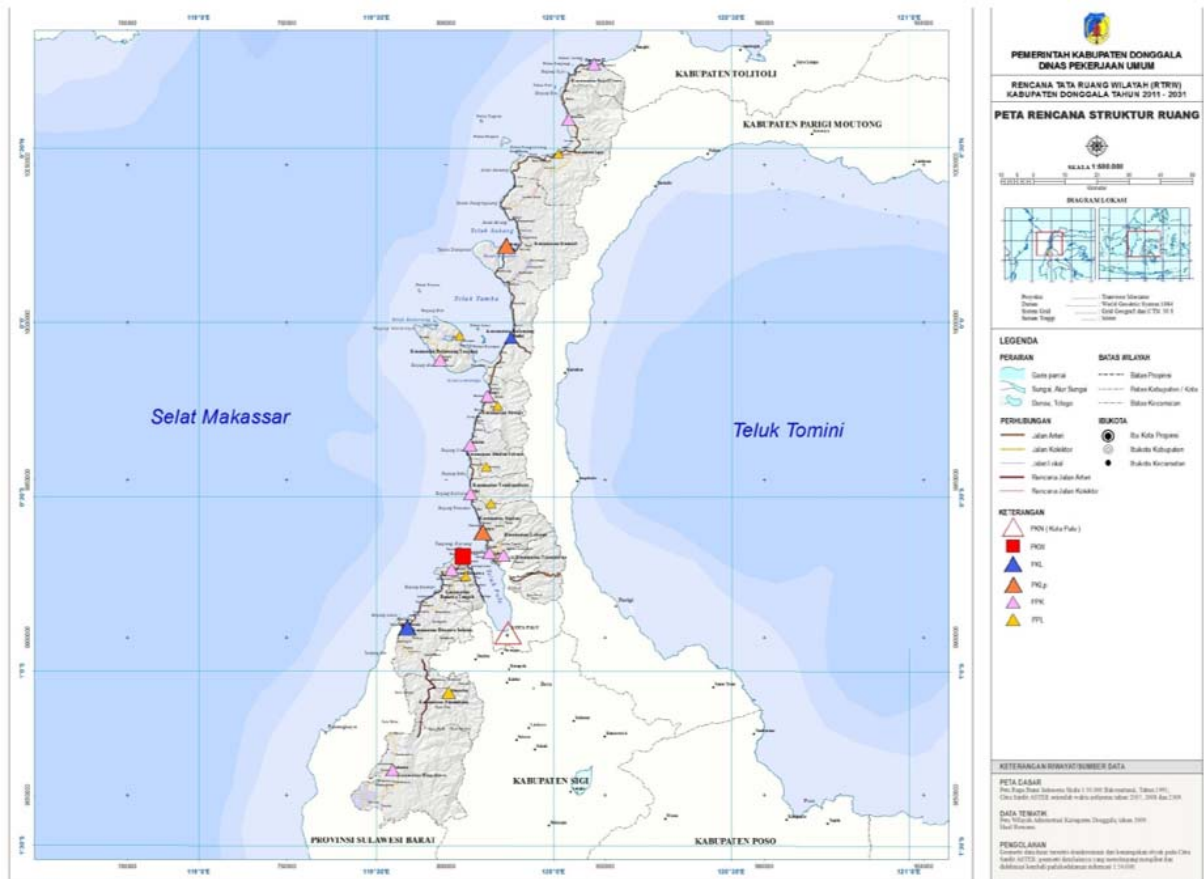
2) Land Use Patterns and Infrastructure Development Plan

The land use patterns and spatial structure of Donggala Regency in 2031 are presented in Figure 2-25 and Figure 2-26. The settlement system in Donggala consists of 1) Kota Donggala as urban center and 2) local service and development promotion activity centers of Tambu, Watatu, Toaya and Sabang.



Source: Donggala Regency RTRW 2011-2031

Figure 2-25 Land Use Patterns (Donggala Regency RTRW 2011-2031)



Source: Donggala Regency RTRW 2011-2031

Figure 2-26 Spatial Structure Map (Donggala Regency RTRW 2011-2031)

3) Designation Road and Space for Disaster Evacuation

The RTRW proposes developing the city of Tambu as an urban area with the main function of “Minapolitan”; Toaya as an urban area with the main function of “Agropolitan”; and Watatu as an urban buffer and a center for industrial development, agriculture and fisheries. Furthermore, the city of Banawa shall be developed as an office center, and Malei as education, service and fisheries service area. Alindau also shall be developed as the center of industrial estates, energy and fisheries sources, while Sabang and Tibo as protected areas.

In the RTRW of Donggala Regency, locations of disaster evacuation routes and spaces have not been specified, however, several conditions for better designation of them have been mentioned as follows:

- An evacuation route is a rescue route from the disaster site to a safer place.
- Pathways designed to make residents easier to go to places that can be used as evacuation spaces.
- Public roads are used in order to anticipate a large number of evacuees.
- The evacuation route must be far from the location of the source of disaster.

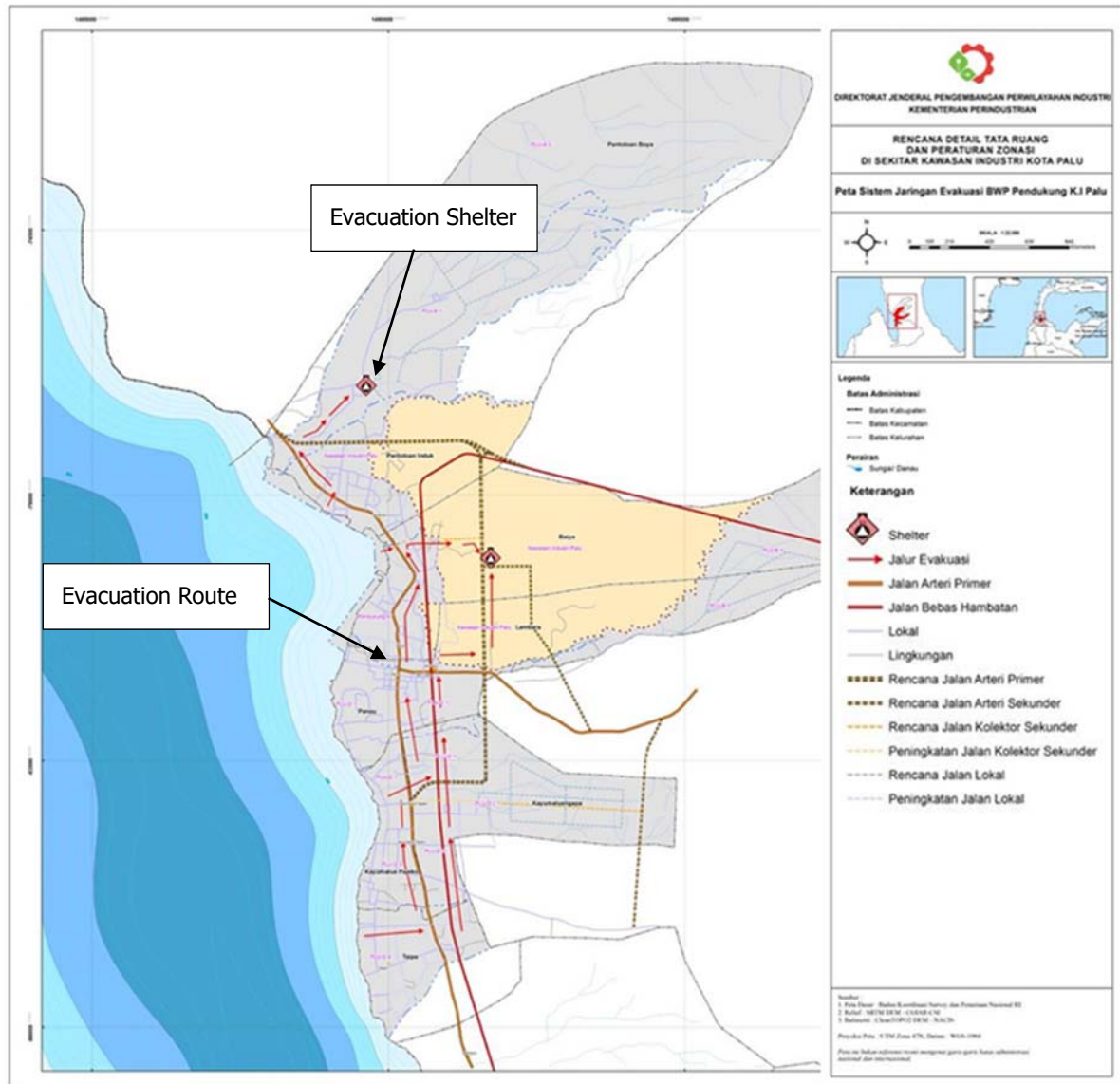
2-3 Review of Existing and Draft Detailed Spatial Plans (RDTR)

Each city and regency had prepared draft RDTR(s) before the disaster occurrence; however, the approval procedure by the local government legislature had not been completed so that there was no officially approved and enforced RDTR. Thus, there is no official RDTR in any city or regency. The brief descriptions of RDTRs of the city and regencies are given hereafter:

(1) Palu

Draft RDTRs have been produced for five (5) zones of Palu City, in addition to one thematic RDTR. There are several core plans prepared, such as Land Ownership Maps, Land Use Maps, Spatial Allocation Maps, Disaster-Prone Area Maps with scale of 1/5,000. The duration of plan effectiveness is set for twenty (20) years (from 2010 through 2030), and each zone plan should come with the population forecast at the target year of 2030. Necessary demand forecast and development policy of each infrastructure development plan are also indicated. There are evacuation roads and routes planned in relation to the development policy for infrastructure concerned about disasters and hazards. However, there is no infrastructure development plan or policy in particular based on concerned hazards (refer to Figure 2-27).

The draft RDTRs of Palu City have four (4) level classification of permissiveness for building development in each zone based on the land use (I: Allowed, T: Conditional – limiting condition, B: Conditional – specified condition, X: Not allowed); however, this classification does not consider any hazard evaluation criteria. The draft RDTRs of Palu City also prohibit any building construction within the land with higher probability of natural disaster occurrence.



Source: Rencana Detail Tata Ruang (RDTR) Pendukung Kawasan Industri Palu (Draft) 2015-2035

Figure 2-27 Example of Disaster Evacuation Network System Plan

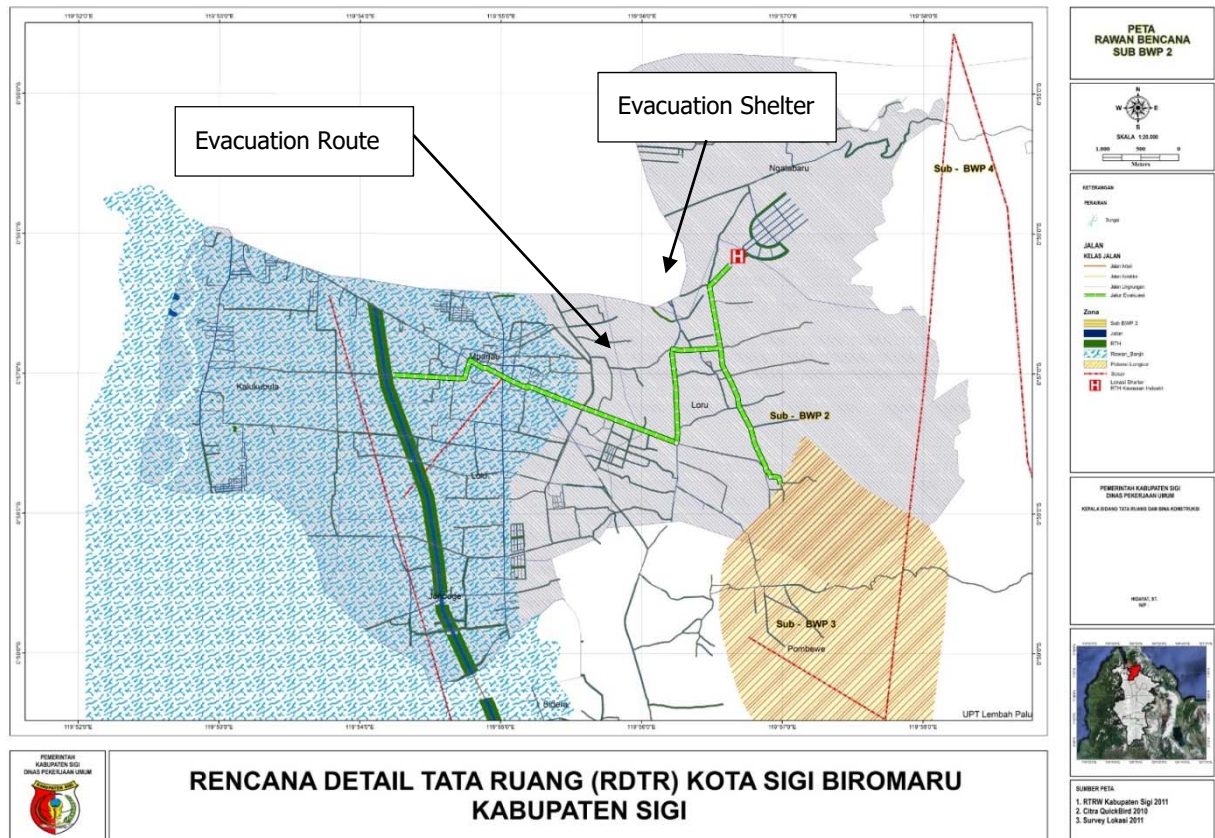
(2) Sigi

The draft RDTR in Sigi Regency has been produced for only one (1) zone, which is Sigi-Biomaru.

The draft Sigi-Biomaru RDTR has four (4) level classification of permissiveness for building development in each zone based on the land use (I: Allowed, T: Conditional – limiting condition, B: Conditional – specified condition, X: Not allowed); however, this classification does not consider any hazard evaluation criteria.

Land use is regulated based on the disaster types, and agricultural land use within the earthquake-prone areas is controlled with the establishment of protection areas for forest or permanent vegetation areas around the farm land.

This draft RDTR also indicates disaster protection system plan.



Source: RDTR 2010-2030 for Sigi Biromaru

Figure 2-28 Example of Disaster Evacuation Route Map (Sigi Biromaru)

(3) Donggala

The draft RDTRs in Donggala Regency were produced for two (2) zones: Kota Donggala and Kota Watatu, which are both urban areas.

The draft RDTRs have four (4) level classification of permissiveness for building development in each zone based on the land use (I: Allowed, T: Conditional – limiting condition, B: Conditional – specified condition, X: Not allowed); however, this classification does not consider any hazard evaluation criteria.

Regulations on property land use and building footprint area are also enforced based on the disaster types regarding the architectural specification. The regulation for the buildings within the area with higher earthquake risks specifies that applying the seismic structural design and green coverage of 10% of the project land area should be maintained. The regulation for the buildings within the area with higher flood risks specifies that applying the high water proofing design and specification and 10% green coverage of the project land area should be maintained.

Chapter-3 Support Local Governments and the Ministry of Land and Spatial Planning to Formulate Spatial Plan(s)/(RTRW) and Detailed Spatial Plan(s)/(RDTR) Based on the Result of Disaster Risk Assessment

3-1 Approach and Contents of Output 2 Technical Assistance for ATR and Local Governments

Based on the ZRB maps compiled by ATR and the hazard maps established by the JICA Study Team, disaster hazards and risks within Palu Metropolitan Area were evaluated. The JICA Study Team examined disaster-safe spatial structures and spatial development directions in major disaster-affected areas. In addition, a future population framework for Palu Metropolitan Area was set based on existing spatial plans and existing demographic data. These study results were shared with Bantek consultants, who are in charge of different spatial plans.

Prior to the official spatial planning works by Bantek consultants, the JICA Study Team proposed a safe spatial structure for the Palu Metropolitan Area and alternative spatial development concepts for major disaster areas, along with proposed land use regulations, in order to enhance resilience across the metropolitan area. Then, the JICA Study Team presented and discussed these study results at the workshops for different spatial plans. In the spatial planning for different areas, Bantek consultants adopted part of the urban structures and spatial development concepts proposed by the JICA Study Team for formulating spatial plans especially for Sigi and Donggala Regencies.

3-2 Consideration of Spatial Development Directions for Reconstruction

3-2-1 Assessment of ATR's ZRB Map and JICA Study Team's Hazard Maps for the Project Area

(1) ATR's ZRB Map

The disaster-prone zone map (so-called "ZRB Map") for Palu City and its surrounding area affected by the disasters in September 2018 was prepared in December 2018 through collaboration among Indonesian Government agencies and authorized by ATR/BPN, BAPPENAS, ESDM, PUPR, BMKG, BNPB, Governor and Chairperson of the local council of the Central Sulawesi Province, Mayor of Palu City, and Regents of Sigi and Donggala.

Assessing the hazard levels of five disasters, namely, tsunami, liquefaction landslide (Nalodo), earthquake, flood and sediment disaster, this map categorizes the area into four levels of hazard (from ZRB1 with the least hazard, to ZRB4 with the highest hazard) and provides suggestions on spatial use of each zone (see Figure 3-1).

As shown in Table 3-1, ZRB4 with the highest disaster risk is identified as "prohibited land" hence not recommended for any use and development. Thus, relocation of the existing residents is recommended and conservation of the land is suggested. ZRB4 areas include the areas affected by liquefaction landslide (Nalodo), areas which are 100 m to 200 m away from the highest tide line (high tsunami risk areas), and those which are 10 m from the Palu Koro active fault.

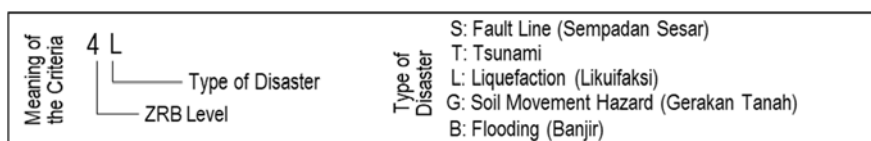
ZRB3 with the second highest hazard level is suggested as "limited zone" where new construction of residences and important facilities is prohibited, though the existing housing is allowed with the

required enforcement of the structures. ZRB3 areas include areas which are 10 to 50 m from the active fault (high risk zone of liquefaction and tsunami).

ZRB2 and ZRB1 areas have low disaster risk and considered as developable lands where new construction with earthquake resistance design is permitted. However, low intensity land use is recommended for ZRB2, while middle to high intensity land use is allowed for ZRB1.

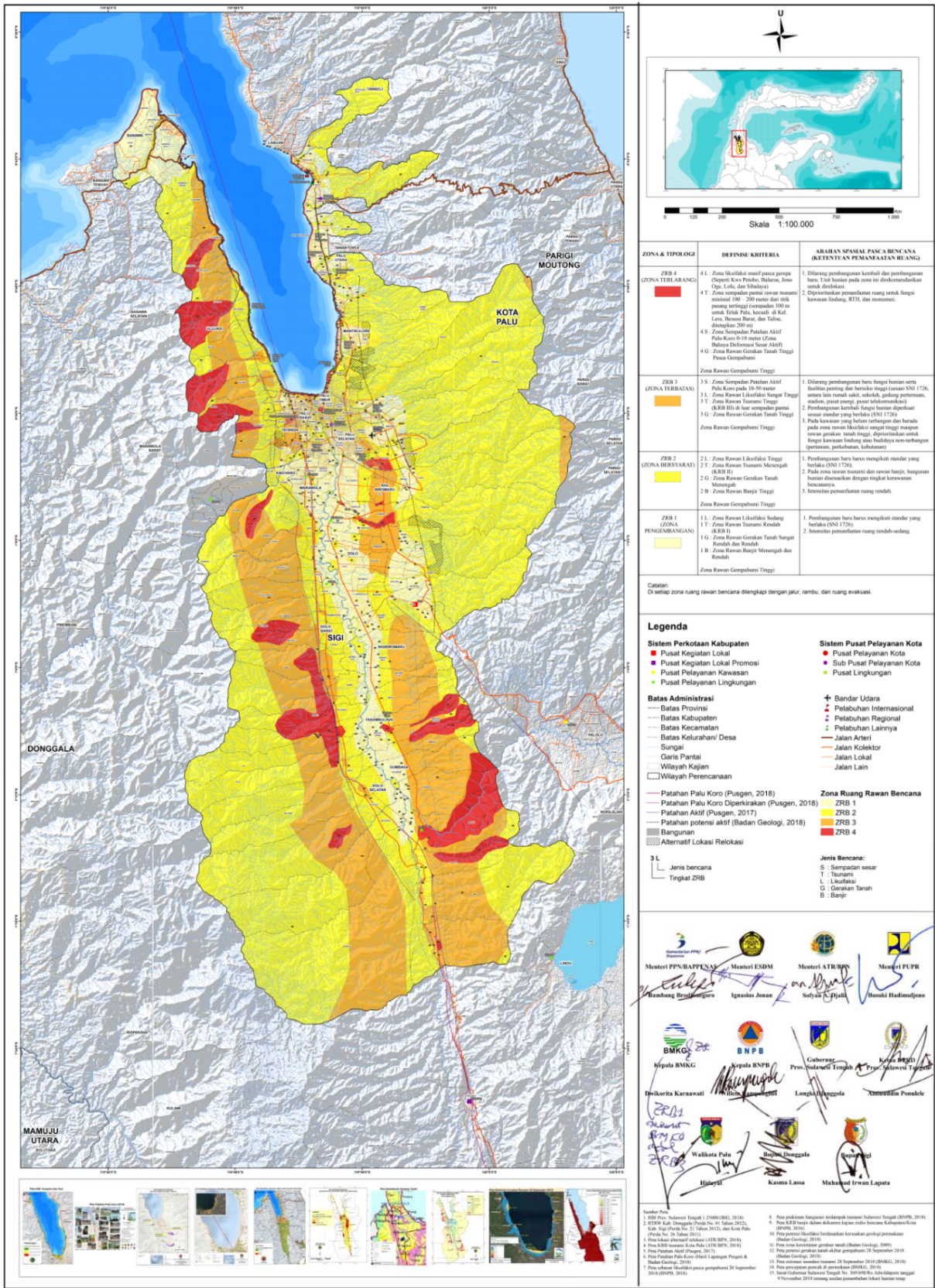
Table 3-1 Suggested Land Use Policy for Different Zones of ZRB Map

Zone and Typology	Definition/ Criteria	Post-Disaster Spatial Direction (Provision on the use of space/area)
ZRB4 (Prohibited Zone)	<p>4L: Zone experiencing Massive Liquefaction (After Earthquake) (such as: Petobo, Balaroa, Jono Oge, Lolu and Sibalaya)</p> <p>4T: Tsunami-Prone Buffer Zone (Sempadan Pantai), Minimum 100-200 m from the Highest Tide Spot (200 m for Lere, West Besusu and Talise).</p> <p>4S: Palu Koro Active Fault Line Buffer Zone, 0-10 m (Active Fault Deformation Hazard Zone)</p> <p>4G: Soil Movement Hazard Zone Level "High" (Post Earthquake)</p> <p>Earthquake Hazard Zone Level "High"</p>	<ul style="list-style-type: none"> Prohibited (not allowed) to rebuild and do new development. Existing houses in this zone are recommended to be relocated. Prioritized to be used as protected area, open green space (RTH) and monument site.
ZRB3 (Limited Zone)	<p>3S: Palu Koro Active Fault Line Buffer Zone (<i>Sempadan patahan aktif</i>), 10-50 m</p> <p>3L: Liquefaction Hazard Zone "Very High"</p> <p>3T: ZRB Tsunami "High" (KRB III) – Outside the Tsunami-Prone Buffer Zone (sempadan pantai)</p> <p>3G: Soil Movement Hazard Zone Level "High"</p> <p>Earthquake Hazard Zone Level "High"</p>	<ul style="list-style-type: none"> It is prohibited to build new residential houses and important & high-risk facilities (according to SNI 1726, including hospitals, schools, meeting venues, stadiums, energy centers, telecommunication centers) Reconstruction of residential houses should be reinforced according to applicable standards (SNI 1726) In area that has not been built yet and inside this zone (Liquefaction Zone "Very High" or Soil Movement Hazard Zone Level "High"), priority is given for its use as protected area (<i>kawasan lindung</i>) or non-built cultivation area (agriculture, plantations, forestry).
ZRB2 (Controlled Zone)	<p>2 L: Liquefaction Hazard Zone "High"</p> <p>2 T: ZRB Tsunami "Medium" (KRB II)</p> <p>2 G: Soil Movement Hazard Zone "Medium"</p> <p>2 B: Flood Hazard Zone "High"</p> <p>Earthquake Hazard Zone "High"</p>	<ul style="list-style-type: none"> New development will require earthquake-resistant design. Refer to applicable standards (SNI 1726). In Tsunami and Flood Hazard Zone, buildings are adjusted to the vulnerability level of the disaster. Land utilization/usage level "Low intensity".
ZRB1 (Development Zone)	<p>1 L: Liquefaction Hazard Zone "Medium"</p> <p>1 T: Tsunami Hazard Zone "Low" (KRB I)</p> <p>1 G: Soil Movement Hazard Zone "Very Low and Low"</p> <p>1 B: Flood Hazard Zone "Medium and Low"</p> <p>Earthquake Hazard Zone "High"</p>	<ul style="list-style-type: none"> New development will require earthquake-resistant design. Refer to applicable standards (SNI 1726). Land utilization/usage level "Low to Medium Intensity"



Source: Government of Indonesia, December 2019

PETA ZONA RUANG RAWAN BENCANA PALU DAN SEKITARNYA (ALTERNATIF 1)

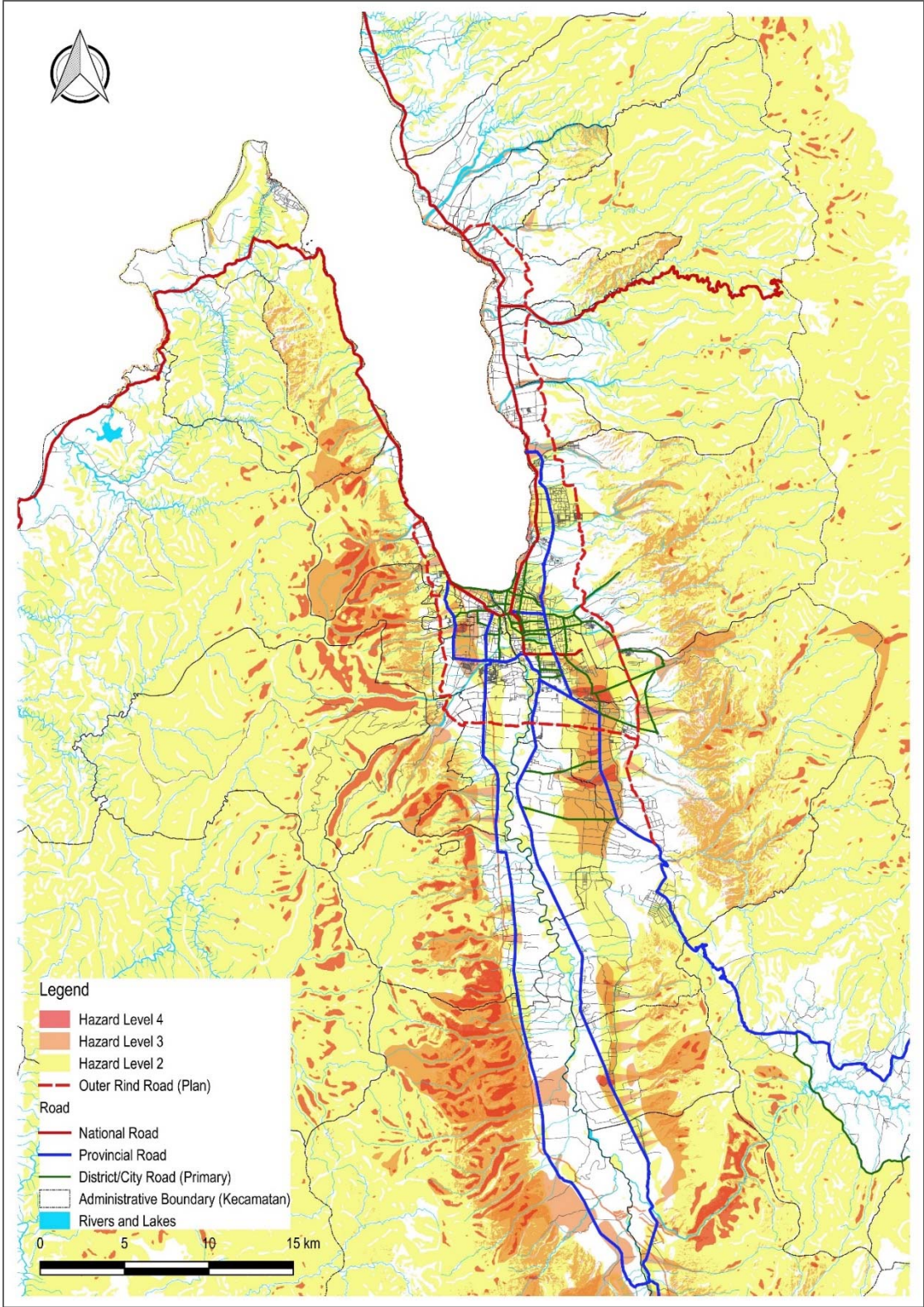


Source: Government of Indonesia, December 2019

Figure 3-1 Disaster-Prone Zone (ZRB) Map Compiled by ATR

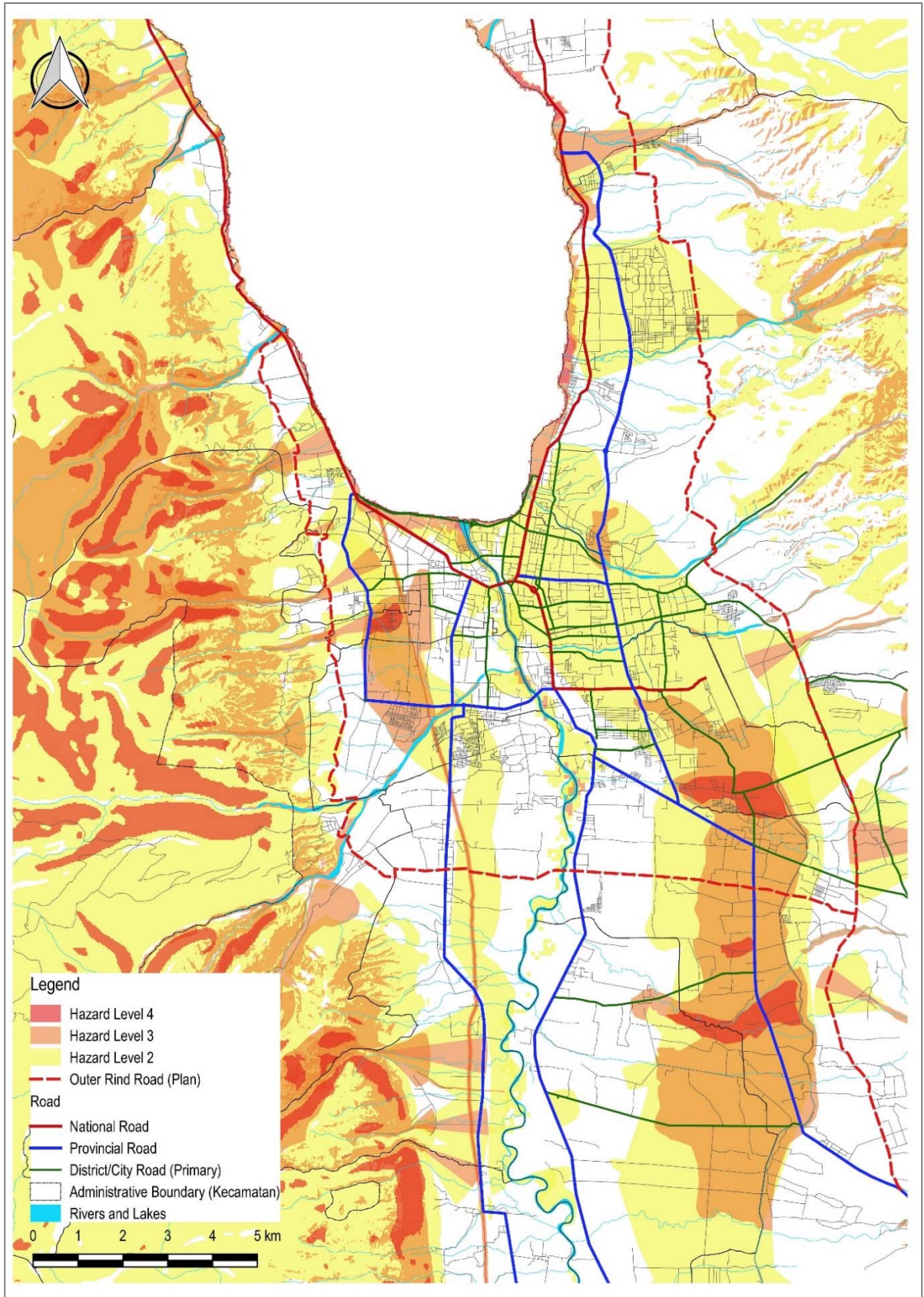
(2) Hazard Maps Prepared by the JICA Study Team

The JICA Study Team prepared hazard maps for different disaster types by conducting geological surveys and detailed assessments of disaster damage conditions and related aspects. See Figure 3-2 and Figure 3-3.



Source: JICA Study Team, Version 0919, 2019

Figure 3-2 Multi-Hazard Map JICA Study Team



Source: JICA Study Team, Version 0919, 2019

Figure 3-3 Multi-Hazard Map by JICA Study Team (Palu City and Its Surrounding Area)

3-2-2 Spatial Development Policy for the Reconstruction of Palu Metropolitan Area

(1) Two Objectives in Spatial Development Policy for the Reconstruction of Palu Metropolitan Area

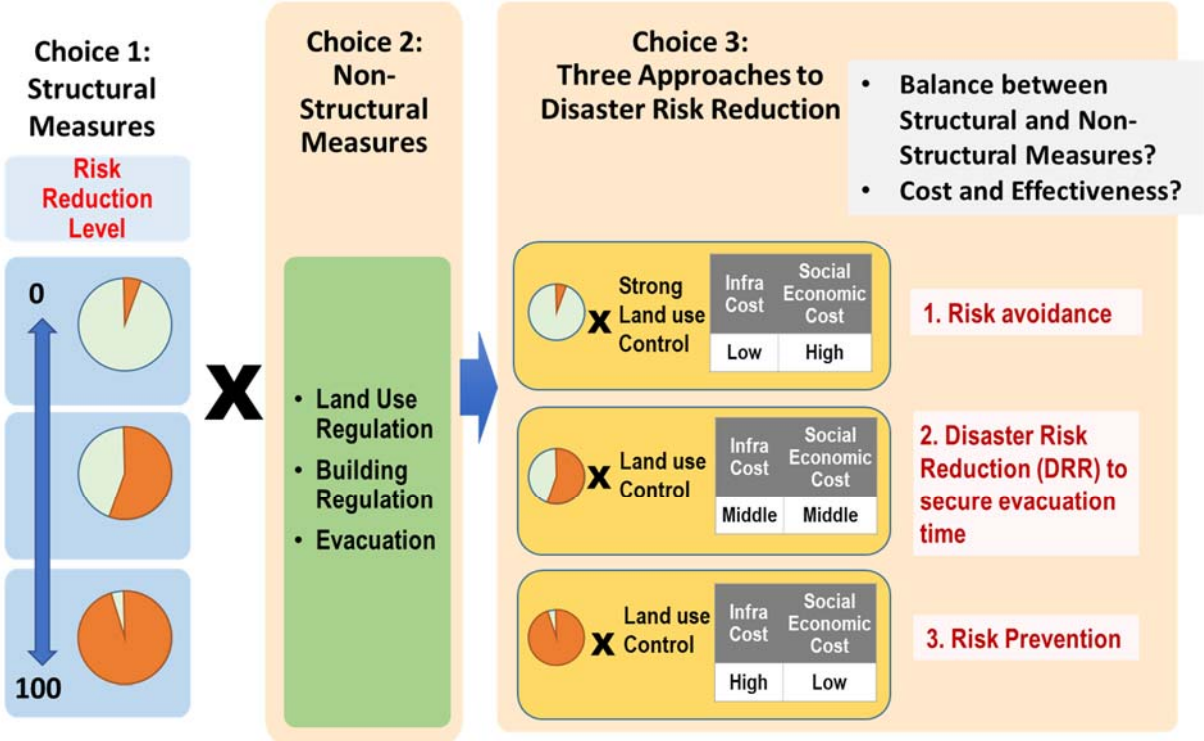
A spatial development policy for the reconstruction of Palu Metropolitan Area is considered for achieving Build Back Better by seeking the following two objectives:

Disaster Resilience and Safety

- To achieve disaster resilience and safety by mitigating disaster risk with structural measures such as elevated road and non-structural measures of land use control regulations or relocation
- To select a best balance of disaster risk mitigation measures between structural measures and non-structural measures by considering infrastructure cost and social economic cost, and effectiveness of the selected measures (see Figure 3-4, Figure 3-4)

Economic Development

- To propose a reconstruction policy and spatial structure which support economic development of the affected areas and the region, because the disaster-affected areas such as the southern coastal area of Palu Bay where commercial facilities like hotels and shopping mall were located and the Nalodo-affected area (Sigi-Biromaru which is the economic center of Sigi Regency) are important for economic development of the region.



Source: JICA Study Team

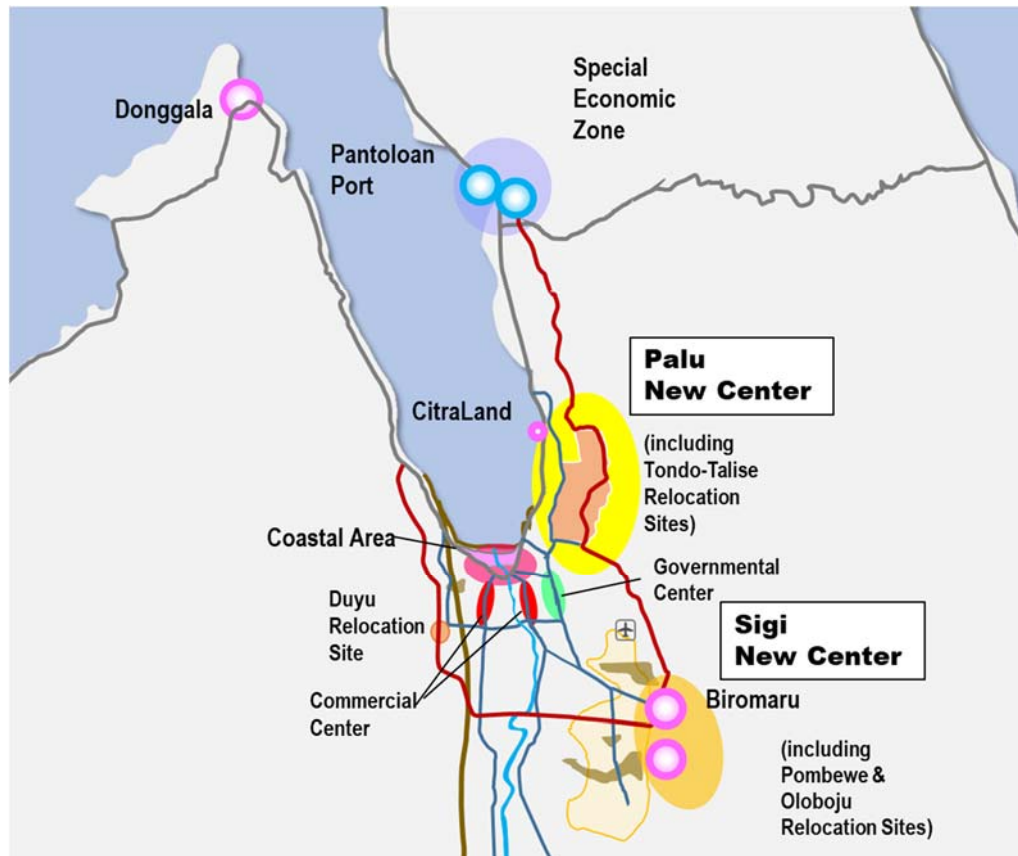
Figure 3-4 How to Achieve Disaster Resilience in the Reconstruction of Palu Metropolitan Area

(2) Overall Spatial Development Direction in the Reconstruction of Palu Metropolitan Area

An overall spatial development direction for reconstruction is considered for Palu Metropolitan Area to propose alternative spatial concepts for the five areas. Future spatial structure and urban / economic centers for it are suggested, examining the current roles and functions, disaster risk of each area, locational advantages, development potential and infrastructure development.

At the metropolitan level, the Palu Bay southern coastal area, which was severely hit by tsunami, has been the primary commercial center where a shopping mall and hotels are located. However, the spatial structure of the Palu Metropolitan Area is being transformed with the plan and development of the Outer Ring Road. The Outer Ring Road is planned to connect to Pantoloan Port and Special Economic Zone in the north and Biromaru in the south, and some sections has been developed already. Along with this Outer Ring Road (ORR), new urban centers in Tondo-Talise of Palu and Biromaru in Sigi have been developed. In the new center of Tondo-Talise Area, the campus of Tadulako University and government offices are located and CitraLand, a private high-end gated community, has been developed along the coast. The permanent relocation sites for the affected communities in Palu are also planned in this area. Furthermore, even before the disaster, the State Islamic Institute of Palu (IAIN) had opened a new campus in Sigi along the Outer Ring Road. In addition to these, the permanent relocation sites of Petobo, Pombewe, and Oloboju will be developed along the eastern side of the Ring Road, and the relocation site of Duyu is planned along its western side.

These development trends indicate the development of the urban centers in inland areas along the ORR, thus the development axis will shift to the eastern side from the existing center in Palu. In fact, this development trend and new spatial structure are desirable from the perspective of disaster hazard, since these inland areas are safer than the existing urban centers with lower hazard level of tsunami and liquefaction landslide (Nalodo).



Source: JICA Study Team

Figure 3-5 Spatial Structure and Urban Economic Centers of Palu Metropolitan Area

3-2-3 Population Trend Analysis and Future Population Framework for Palu Metropolitan Area

(1) Population Trend Analysis in Palu Metropolitan Area

1) Palu City

Compared with the population growth of Central Sulawesi Province and Indonesia, Palu City experienced much higher population growth from 1990 to 2000. However, the population growth of Palu City from 2000 to 2010 declined to the level of the provincial population growth, which was still higher than the Indonesian national population growth of 1.43%, as presented in Table 3-2.

Meanwhile, the population of Palu increased sharply between 1990 and 2000. After that, the annual growth rate of the population was around 1.6 to 1.8% from 2000 to 2017. In 2017, population of Palu was 379,782. Its population annual growth rate of 1.80% in 2010-2017 was higher than that of the province, which was 1.71%. (See Table 3-3) Therefore, it can be said that Palu City is a growing area in the province.

Among the sub-districts (kecamatan) in 2017, Kec. Palu Timur had the largest population (71,452) and highest population density (9,257 persons/km² or 92.6 persons / ha). This is partly due to boundary change, by which some parts of Kec. Palu Timur in 2017 formerly belonged to Kec. Palu Selatan in 2010 and was reclassified. Table 3-5 shows the population projections up to 2029s provided in RTRW Palu 2010-2030. According to the results of its projections, the population growth from 2010 to 2029 is

expected to decline to 1.41%. Moreover, a large number of the population will continue to dwell in Kecamatan Palu Barat and Palu Selatan. Also, Kec. Palu Utara will experience high population growth among the four kecamatans until 2029.

Table 3-2 Comparison of Population Growth in Palu, Central Sulawesi Province and Indonesia from 1990 to 2010

	Population (Persons)			Average Annual Population Growth	
	1990	2000	2010	1990-2000	2000-2010
Palu	199,445	284,314	335,297	3.61%	1.66%
Central Sulawesi	1,711,327	2,218,435	2,635,009	2.63%	1.74%
Indonesia	179,378,946	206,264,595	237,641,326	1.41%	1.43%

Source: Population Census

Table 3-3 Population and Annual Growth Rate in Palu, 1990-2017

Kota	Population (Persons)				Average Annual Growth Rate (%)		
	1990	2000	2010	2017	1990-2000	2000-2010	2010-2017
Palu	199,445	284,314	335,297	379,782	3.61	1.66	1.80

Sources: 1990/2000 Data: BPS Kota Palu, <https://palukota.bps.go.id/statictable/2015/03/20/12/pertumbuhan-penduduk-tahun-2010.html>

2010 Data: Hasil Sensus Penduduk 2010 Kota Palu, Badan Pusat Statistik Kota Palu

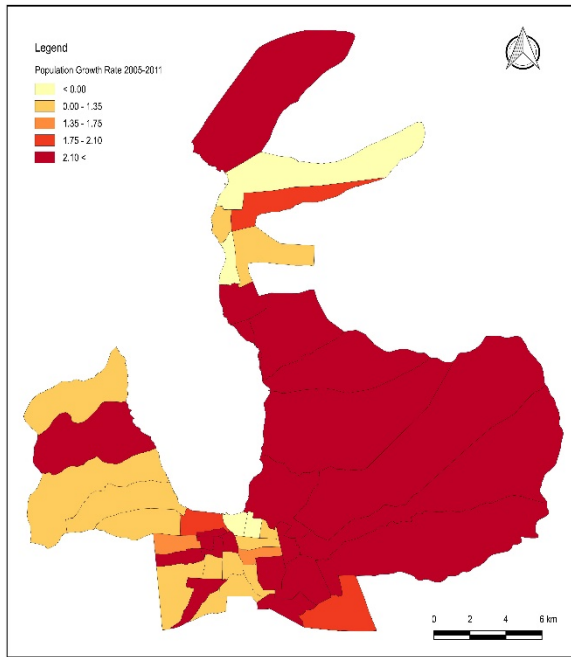
2017 Data: Kota Palu, Dalam Angka 2018, Badan Pusat Statistik Kota Palu

Table 3-4 Population and Population Density by Kecamatan in Palu, 2017

Kecamatan	Area 2017 (km ²)	Population 2017 (Persons)	Population Density 2017 (Persons/km ²)
Palu Barat	8.28	62,293	7,523
Palu Selatan	27.38	70,571	2,577
Palu Timur	7.71	71,452	9,267
Palu Utara	29.94	23,196	775
Tatanga	14.95	39,997	2,675
Ulujadi	40.25	27,763	690
Mantikulore	206.80	63,804	309
Tawaeli	59.75	20,706	347
Kota Palu	395.06	379,782	961

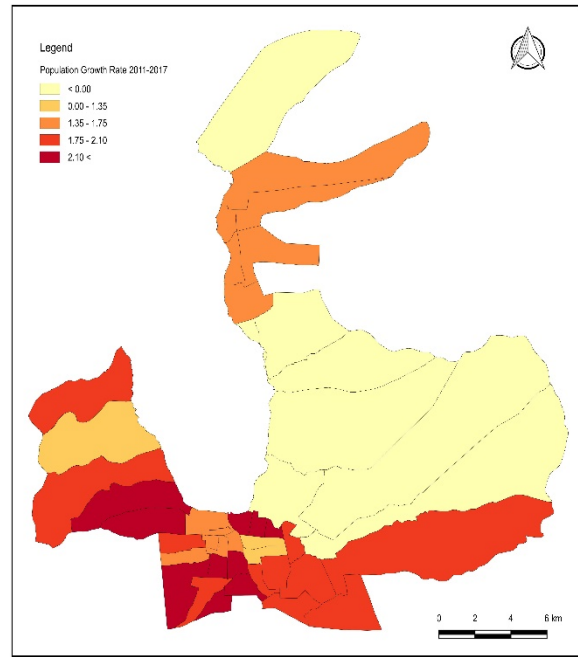
Source: Kota Palu, Dalam Angka 2018, Badan Pusat Statistik Kota Palu

The average annual population growth rates from 2005 to 2011 and from 2011 to 2017 by urban village (kelurahan) are presented in Figure 3-6 and Figure 3-7. The kelurahans in the eastern side of Palu experienced population growth from 2005 to 2011, while those in the western and southeastern areas bordering Sigi Regency showed population increase from 2011 to 2017. Thus, it can be said that the recent population growth in Palu is occurring especially in suburban areas toward Sigi Regency, population of which will expand in the near future due to suburbanization from Palu.



Source: JICA Study Team based on Population Data in Dalam Angka Kecamatan 2006 and 2012

Figure 3-6 Average Annual Population Growth Rate (%) 2005-2011



Source: JICA Study Team based on Population Data in Dalam Angka Kecamatan 2012 and 2018

Figure 3-7 Average Annual Population Growth Rate (%) 2011-2017

Table 3-5 Population Projection and Population Growth Rate by Kecamatan in Palu City, 2010-2029

Kecamatan	Population(Persons)		Average Annual Growth Rate (%)
	2010	2029	
Palu Barat	98,791	131,071	1.50
Palu Selatan	121,903	155,931	1.30
Palu Timur	75,732	98,541	1.40
Palu Utara	38,871	51,666	1.51
Total	335,297	437,209	1.41

Sources: 2010 Data: Hasil Sensus Penduduk 2010 Kota Palu, Badan Pusat Statistik Kota Palu/ 2029 Data: Rencana Tata Ruang Wilayah (RTRW) Kota Palu 2010-2030

2) Sigi Regency

The population of Kabupaten Sigi was 234,588 in 2017. Its population annual growth rate 2010-2017 was 1.27%, which was lower than that of the province (1.71%). As for the kecamatan, Kec. Sigi Biromaru had 46,754 population in 2017, which was the largest population among all kecamatans in Sigi.

Two kecamatans, Dolo and Marawola, had the second highest annual growth rate (1.36%), after kecamatan Lindu (1.67%). On the other hand, the population density of Dolo (624 persons/km²) was the highest in Sigi Regency, followed by that of Kec Marawola. These indicate that urbanization is occurring in the kecamatans bordering Palu City.

Table 3-7 shows the population projection of Sigi by kecamatans from 2008 - 2030. According to the projection, the population in Sigi will increase to 280,000 in 2030. The projection assumes the decline of population growth from 1.35% from 2008 to 2010, to 1.00% from 2025 to 2030.

Table 3-6 Population, Population Growth Rate and Population Density by Kecamatan in Kabupaten Sigi, 2010-2017

Kecamatan	Area 2017 (km ²)	Population(Persons)		Average Annual Growth Rate (%)	Population Density 2017 (Persons/km ²)
		2010	2017		
Pipikoro	956.13	7,801	8,533	1.29	9
Kulawi Selatan	418.12	8,465	9,244	1.27	23
Kulawi	1,053.56	14,241	15,462	1.18	15
Lindu	552.03	4,579	5,141	1.67	10
Nokilalaki	75.19	5,622	6,139	1.26	82
Palolo	626.09	27,368	29,834	1.24	48
Gumbasa	176.49	11,682	12,744	1.25	73
Dolo Selatan	584.71	14,454	15,763	1.25	27
Dolo Barat	112.18	12,513	13,718	1.32	123
Tanambulava	56.33	7,866	8,585	1.26	153
Dolo	36.05	20,437	22,463	1.36	624
Sigi Biromaru	289.60	42,811	46,754	1.26	162
Marawola	38.65	21,013	22,904	1.36	593
Marawola Barat	150.51	6,374	6,966	1.24	47
Kinovaro	70.38	9,474	10,388	1.27	148
Total	5,196.02	214,700	234,638	1.28	45

Sources: 2010 Data: Hasil Sensus Penduduk 2010 Kabupaten Sigi, Badan Pusat Statistik Kabupaten Sigi / 2017 Data: Kabupaten Sigi Dalam Angka 2018, Badan Pusat Statistik Kabupaten Sigi

Table 3-7 Population Projection of Kabupaten Sigi by Kecamatan, 2008-2030

Kecamatan	Population Projection (Persons)						Average Annual Population Growth Rate				
	2008	2010	2015	2020	2025	2030	2008-2010	2010-2015	2015-2020	2020-2025	2025-2030
Pipikoro	7,799	8,012	8,494	8,977	9,459	9,942	1.36%	1.18%	1.11%	1.05%	1.00%
Kulawi Selatan	8,064	8,284	8,784	9,283	9,782	10,281	1.35%	1.18%	1.11%	1.05%	1.00%
Kulawi	13,680	14,053	14,900	15,746	16,593	17,439	1.35%	1.18%	1.11%	1.05%	1.00%
Lindu	4,106	4,218	4,473	4,727	4,981	5,235	1.35%	1.18%	1.11%	1.05%	1.00%
Nokilalaki	6,424	6,600	6,997	7,395	7,792	8,190	1.36%	1.18%	1.11%	1.05%	1.00%
Gumbasa	13,079	13,436	14,245	15,054	15,864	16,673	1.36%	1.18%	1.11%	1.05%	1.00%
Palolo	25,645	26,344	27,931	29,518	31,105	32,692	1.35%	1.18%	1.11%	1.05%	1.00%
Dolo Selatan	15,302	15,719	16,666	17,613	18,560	19,507	1.35%	1.18%	1.11%	1.05%	1.00%
Dolo Barat	13,372	13,737	14,564	15,392	16,219	17,047	1.36%	1.18%	1.11%	1.05%	1.00%
Tanambulava	8,246	8,471	8,982	9,492	10,002	10,512	1.36%	1.18%	1.11%	1.05%	1.00%
Dolo	20,137	20,686	21,932	23,178	24,424	25,670	1.35%	1.18%	1.11%	1.05%	1.00%
Sigi Biromaru	41,516	42,646	45,216	47,785	50,354	52,923	1.35%	1.18%	1.11%	1.05%	1.00%
Marawola	21,734	22,326	23,671	25,016	26,361	27,706	1.35%	1.18%	1.11%	1.05%	1.00%
Marawola Barat	11,006	11,307	11,988	12,669	13,350	14,031	1.36%	1.18%	1.11%	1.05%	1.00%
Kinovaro	9,935	10,206	10,821	11,436	12,050	12,665	1.35%	1.18%	1.11%	1.05%	1.00%
Total	220,045	226,045	239,664	253,281	266,896	280,513	1.35%	1.18%	1.11%	1.05%	1.00%

Source: Rencana Tata Ruang Wilayah (RTRW) Kabupaten Sigi 2010-2030

3) Donggala Regency

The population of Donggala Regency was 299,174 in 2017. Its population annual growth rate 2010-2017 (1.09%) was lower than that of the province (1.71%). On the other hand, Kec. Banawa had population of 33,788 in 2017, which was the largest among all kecamatans in Donggala and its population density was the highest as well. However, its population annual growth rate 2010-2017 (0.76%) was lower than those of the other kecamatans in the western side of the kabupaten. In Kec. Banawa, Tanjung Batu and Boya (two villages near Donggala Port) had the highest population density.

Table 3-10 shows the population projections for 2015 – 2030 used in RTRW Donggala 2011-2031.

The projections assumed the population growth of 1.41%, which is higher than the actual population growth from 2010 to 2017.

Table 3-8 Population, Population Growth Rate and Population Density in Donggala Regency, 2010-2017

Kabupaten	Area 2017 (km ²)	Population(Persons)		Average Annual Growth Rate (%)	Population Density 2017 (Persons/km ²)
		2010	2017		
Donggala	5,275.69	277,236	299,174	1.09	57

Sources: 2010 Data: Hasil Sensus Penduduk 2010 Kabupaten Donggala, Badan Pusat Statistik Kabupaten Donggala / 2017 Data: Kota Palu Dalam Angka 2018, Badan Pusat Statistik Kabupaten Donggala

Table 3-9 Population, Population Growth Rate and Population Density by Kecamatan in the Western Side of Donggala Regency, 2010-2017

Kecamatan	Area 2017 (km ²)	Population(Persons)		Average Annual Growth Rate (%)	Population Density 2017 (Persons/km ²)
		2010	2017		
Banawa	99.04	32,042	33,788	0.76	341
Rio Pakawa	872.16	21,821	24,850	1.87	28
Pinembani	402.61	5,817	7,038	2.76	17
Banawa Selatan	430.67	23,450	25,367	1.13	58
Banawa Tengah	74.64	10,061	10,950	1.22	147

Sources: 2010 Data: Hasil Sensus Penduduk 2010 Kabupaten Donggala, Badan Pusat Statistik Kabupaten Donggala / 2017 Data: Kota Palu Dalam Angka 2018, Badan Pusat Statistik Kabupaten Donggala

Table 3-10 Population Projection by Kecamatan in the Western Side of Donggala Regency, 2015 to 2030

Kecamatan	Population Projection (Persons)				Average Annual Growth Rate (%)		
	2015	2020	2025	2030	2015-2020	2020-2025	2025-2030
Banawa	37,781	40,733	43,686	46,638	1.52%	1.41%	1.32%
Rio Pakawa	26,052	28,088	30,124	32,160	1.52%	1.41%	1.32%
Pinembani	7,982	8,606	9,229	9,853	1.52%	1.41%	1.32%
Banawa Selatan	25,754	27,767	29,779	31,792	1.52%	1.41%	1.32%
Banawa Tengah	11,592	12,498	13,404	14,310	1.52%	1.41%	1.32%

Source: Rencana Tata Ruang Wilayah (RTRW) Kabupaten Donggala 2011-2031

(2) Projection of Future Population for Palu Metropolitan Area

The projection of future population by 2030 was conducted based on the current demographic trend shown in Table 3-11. The population of Palu Metropolitan Area including the urbanized areas of Sigi and Donggala Regencies was estimated at 451,600 in 2010, and this has been projected to increase to 618,350 in 2030. This population projection is slightly higher than the population projection of 596,300, the figure utilized by Palu, Sigi, and Donggala in the current RTRWs.

This population projection means that the population of Palu City will continue to grow at an average annual growth rate of 1.62% towards 2030, while the surrounding areas of Palu City will also see an average annual growth rate of 1.58%. Thus, suburbanization is expected to extend beyond the territory of Palu City, as presented in Table 3-11.

Table 3-11 Future Population Framework by 2030 for Palu Metropolitan Area

District	Kecamatan	Population (persons)		Population Projection		Average Annual Growth Rate		
				RTRW	JICA Study Team	Actual	RTRW Projection	JICA Study Team
		2010*1	2018*2	2030*3	2030*4	2010-2018	2018-2030	2018-2030
Palu City		335,297	385,619	443,359	467,455	1.76%	1.17%	1.62%
Sigi Regency		84,261	93,050	106,299	112,246	1.25%	1.12%	1.58%
	Dolo	20,437	22,700	25,670	-	1.32%	1.03%	-
	Sigi Biromaru	42,811	47,230	52,923	-	1.24%	0.95%	-
	Marawola	21,013	23,120	27,706	-	1.20%	1.52%	-
Donggala Regency		32,042	34,061	46,638	38,647	0.77%	2.65%	1.06%
	Banawa	32,042	34,061	46,638	-	0.77%	2.65%	-
Palu Metropolitan Total		451,600	512,730	596,296	618,348	1.60%	1.27%	1.57%

Sources: *1 Population Census 2010, *2 Kota Palu Dalam Angka 2019, Kabupaten Sigi Dalam Angka 2019, Kabupaten Donggala Dalam Angka 2019, *3 Population of Palu City in 2030 is projected based on the population projection in 2029 in RTRW Palu 2010-2030; RTRW Sigi 2010-2030; and RTRW Donggala 2011-2031, *4 JICA Study Team

In addition, the past population trends and future population projections of Palu City, Sigi Regency and Donggala Regency are summarized in Table Table 3-12.

Table 3-12 Past Population Trend and Future Population Projections of Palu City, Sigi Regency and Donggala Regency

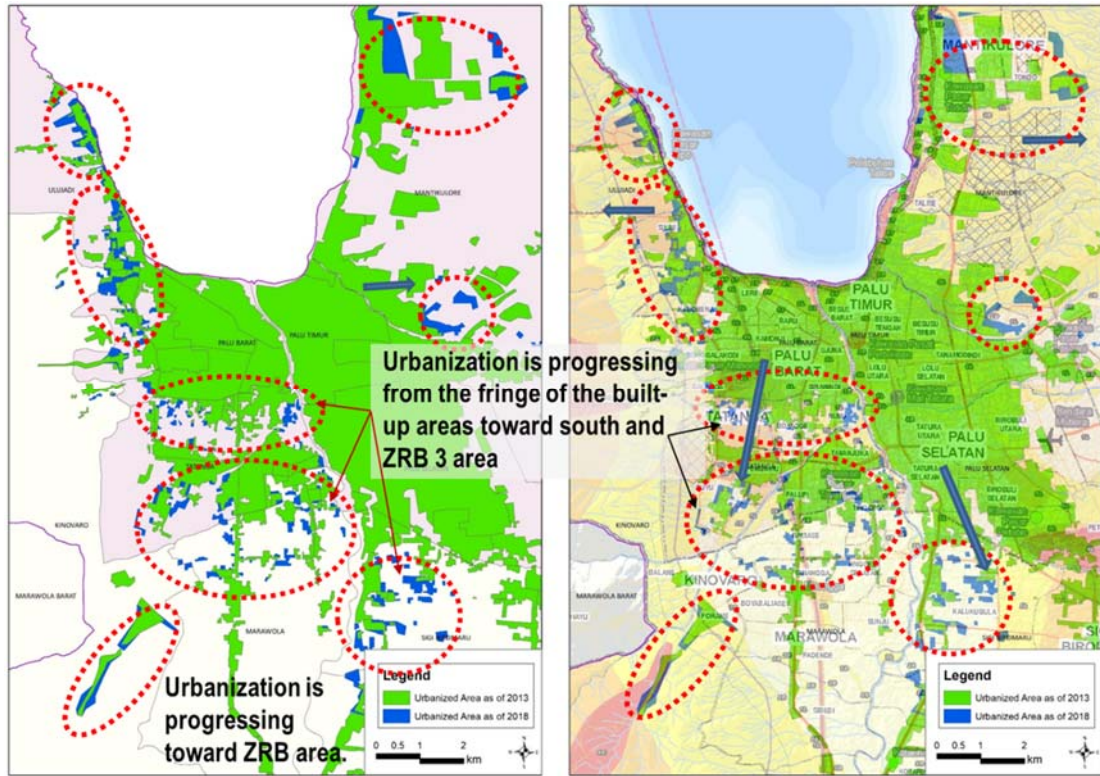
City / Regency	Population		RDTR/RTRW Population Projection	Average Annual Growth Rate	
				Actual	RDTR/ RTRW Projection
	2010*1	2018*2	2030*3	2010-2018	2018-2030
Palu City	335,297	385,619	478,484	1.76%	1.81%
Sigi Regency	215,030	237,011	269,883	1.22%	1.09%
Donggala Regency	277,236	301,591	375,382	1.06%	1.84%
Pasiggala (Palu/ Sigi/Donggala)	827,563	924,221	1,123,748	1.39%	1.64%

Sources: *1 Population Census 2010; *2 Kota Palu Dalam Angka 2019, Kabupaten Sigi Dalam Angka 2019, Kabupaten Donggala Dalam Angka 2019; *3 Population in 2030 was projected based on population projection in RDTR Palu BWPI, BWP2, BWP3, and BWP4 Techniacl Material, 2010-2030, RTRW Kabupaten Sigi Revision: Material for Focus Group Discussion, and RTRW Kabupaten Donggala Revision: Population and Social Condition.

3-2-4 Urbanization Trends in Palu Metropolitan Area

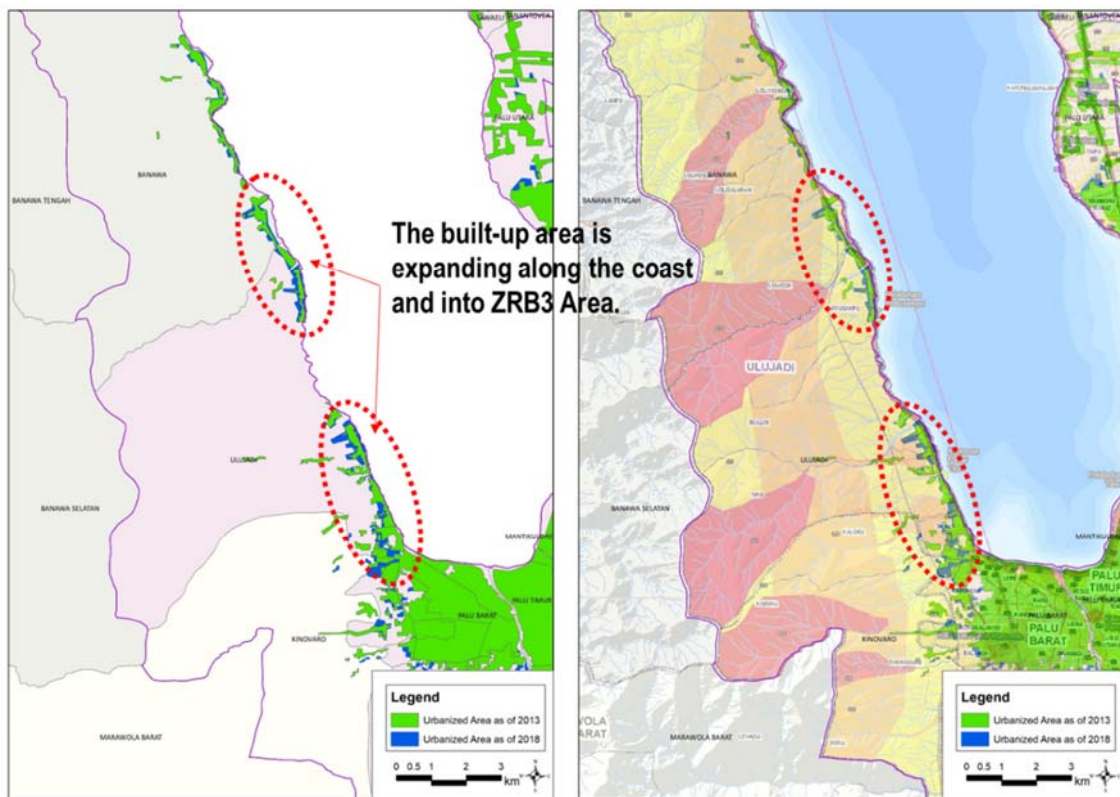
The analysis of the urbanization trend in Palu Metropolitan Area from 2013 to 2018 shows the expansion of urbanization in the suburban area of Palu, as shown in Figure 3-8. In the southern direction, the urbanization is progressing toward Sigi-Biromaru area, the eastern side of the Palu River, and also the western side of the River. The urbanization is also observed in the directions toward the inland area of Tondo-Talise in the eastern coastal area and toward the hillside of Ulujadi in the western coastal area. Some developments are approaching the area of ZRB3 in the south-west and the western hill area. (See Figure 3-9 and Figure 3-10)

These urbanization trends match the new spatial structure of Palu Metropolitan Area discussed in the previous section. Because the ORR is passing through the suburbanizing fringe areas of Palu City, its development can facilitate further development in these areas which will be urban centers, and transform the spatial structure into the one in Figure 3-5.



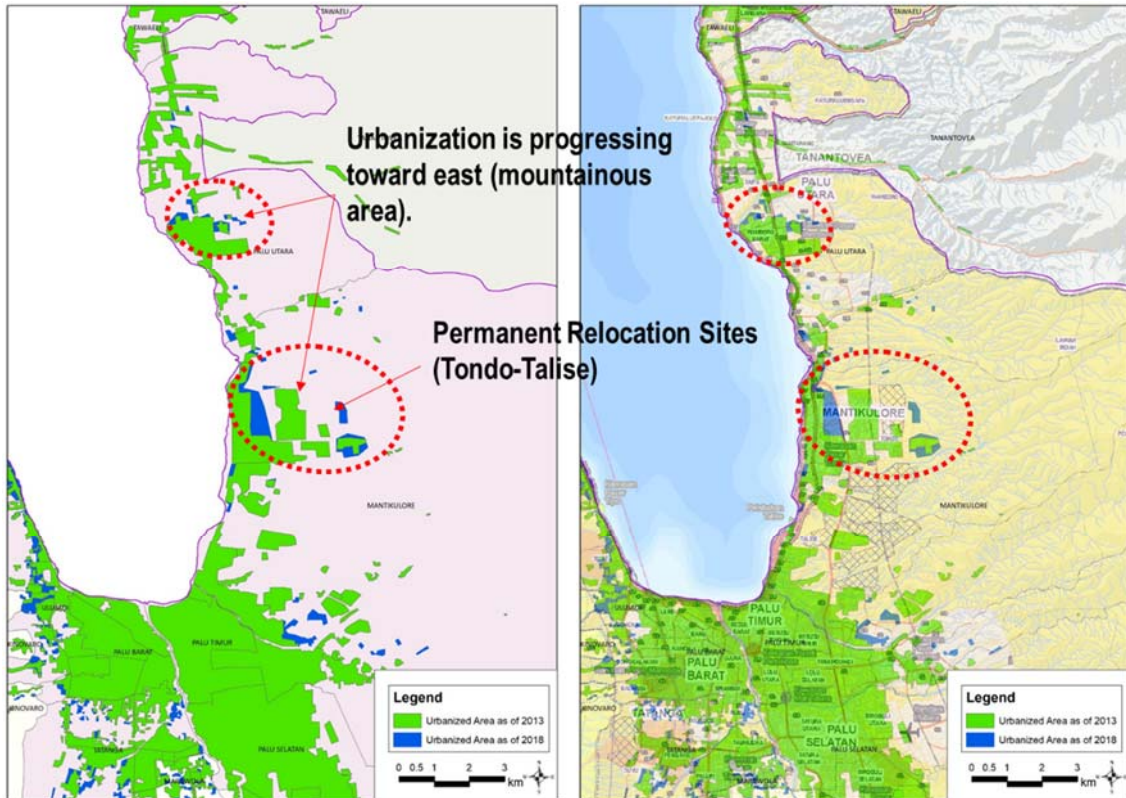
Source: JICA Study Team

Figure 3-8 Urbanization Trend in Palu Metropolitan Area from 2013 to 2018



Source: JICA Study Team

Figure 3-9 Urbanization Trend in Palu Bay Western Coastal Area from 2013 to 2018



Source: JICA Study Team

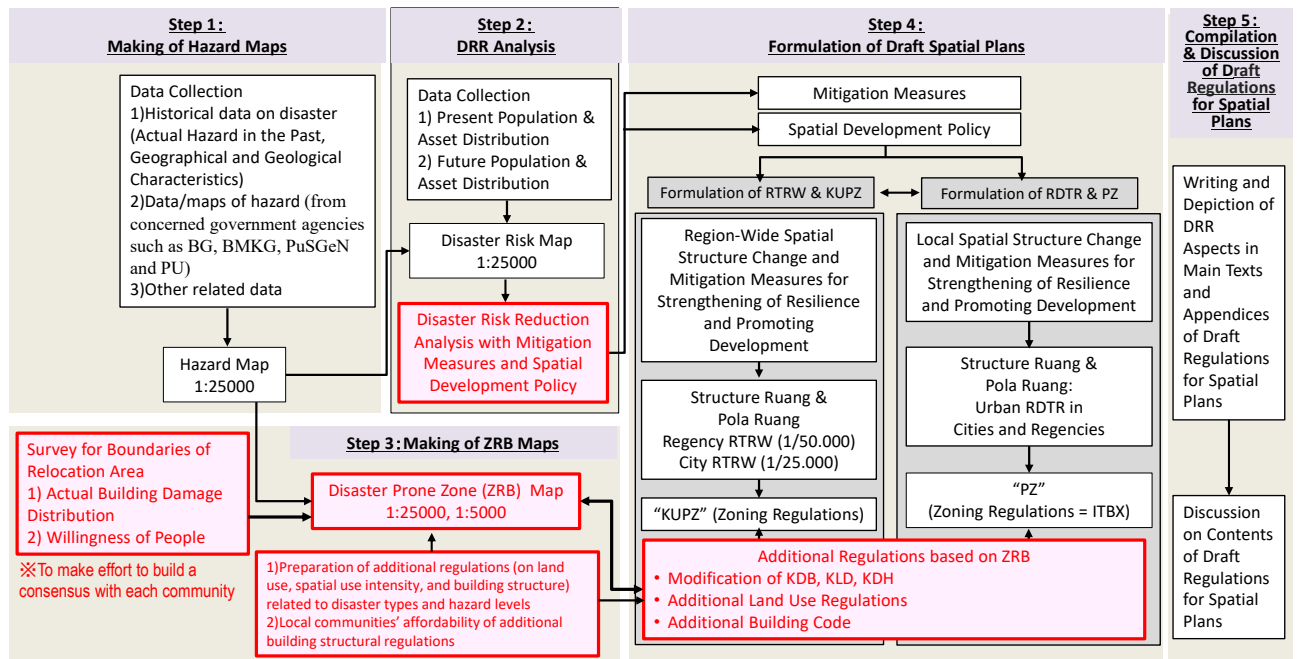
Figure 3-10 Urbanization Trend in Palu Bay Eastern Inland Area from 2013 to 2018

3-3 Method for Formulation of Spatial Plans for Disaster Risk Reduction

(1) Steps in Preparing Spatial Plans for Disaster Risk Reduction

Process of preparing spatial plans for disaster risk reduction is shown in Figure 3-11. First, based on the results of the field survey, after the factors that cause various disasters (tsunami, Nalodo, earthquake, flood, and landslide) are analyzed, the areas where various disasters are likely to occur are identified and detailed hazard maps for each disaster are prepared. Land use regulations and building regulations corresponding to the hazard levels of the prepared hazard maps are examined and ZRB maps are prepared.

Secondly, using the risk maps prepared based on the hazard maps, the relationships between population growth and economic development vis-a vis disaster risk are analyzed; disaster risk reduction measures (structural and non-structural measures) are studied; various regulations are proposed to promote appropriate space use. Based on both analyses, the final draft of land use regulations and building regulations are prepared.



Source: Prepared by JICA Expert and JICA Study Team

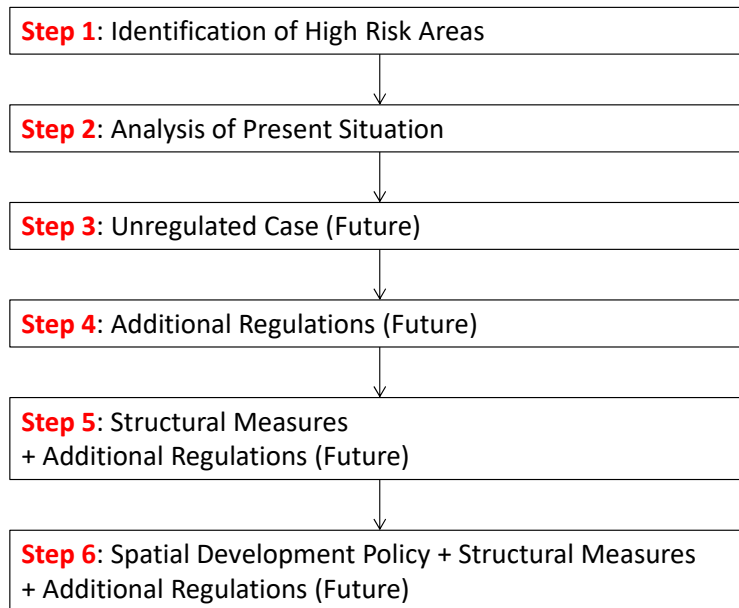
Figure 3-11 Process of Preparing Spatial Plans for Disaster Risk Reduction

(2) Analysis of Disaster Risk Reduction, Disaster Risk Reduction Measures, and Spatial Development Policy

In order to achieve Build Back Better (BBB) after the disaster, in addition to disaster risk reduction, it is necessary to pursue the promotion of local socio-economic development while strengthening local resilience. Therefore, it is necessary to follow the six steps shown in Figure 3-12 to conduct the disaster risk reduction analysis and select better disaster reduction measures while considering the socio-economic development policy of the region.

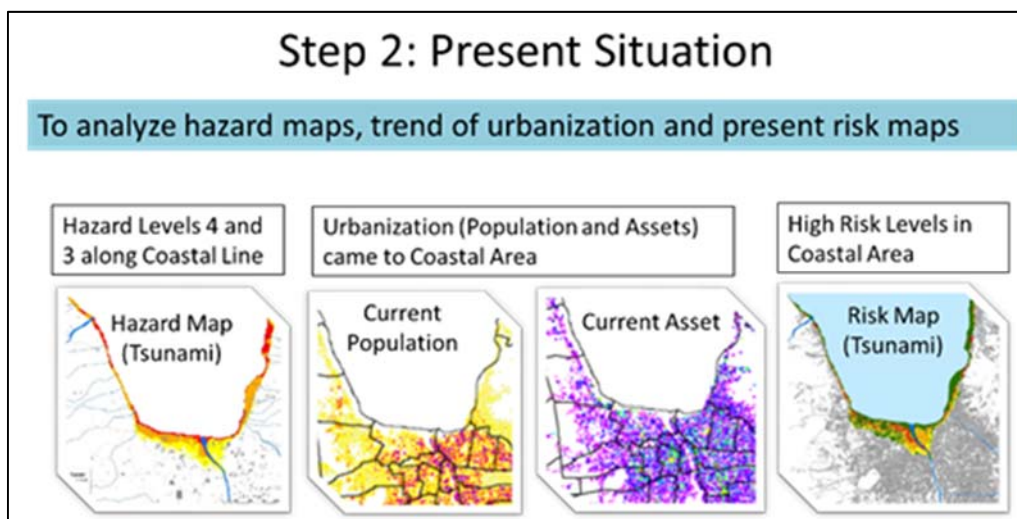
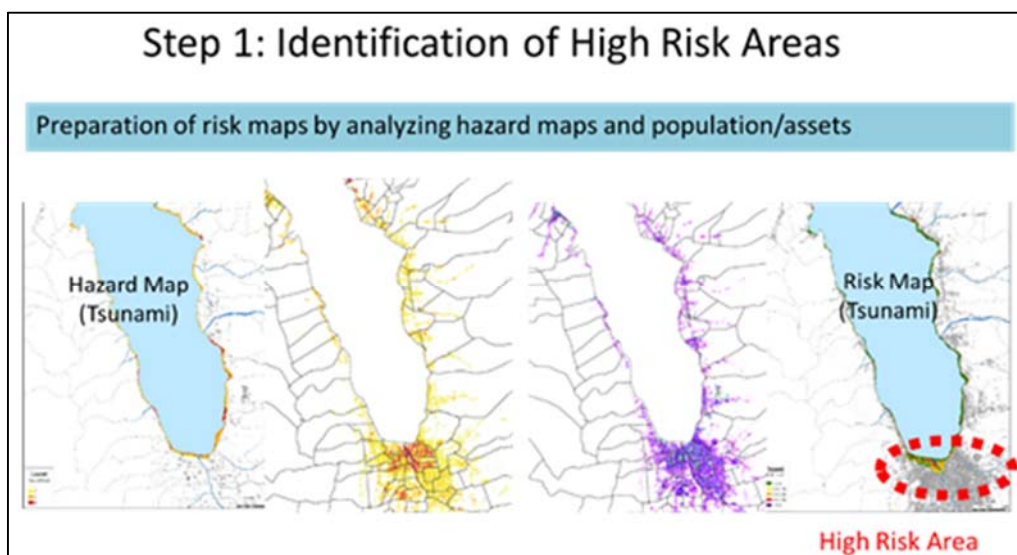
First, a risk map should be prepared based on current population and asset data. Next, a future risk map will be developed based on the future population and asset projections. In addition, the future disaster risks will be analyzed with and without different combinations of additional regulations, disaster reduction measures, and spatial development policies.

Scenario planning methods are used to examine the impact of additional regulations and disaster reduction measures in the long-term development process of the target area. For this purpose, hazard and risk maps are used in a complementary manner in the six steps. Figure 3-12 shows a case study of spatial planning for the “Southern Coastal Area of Palu Bay” with high tsunami risk.



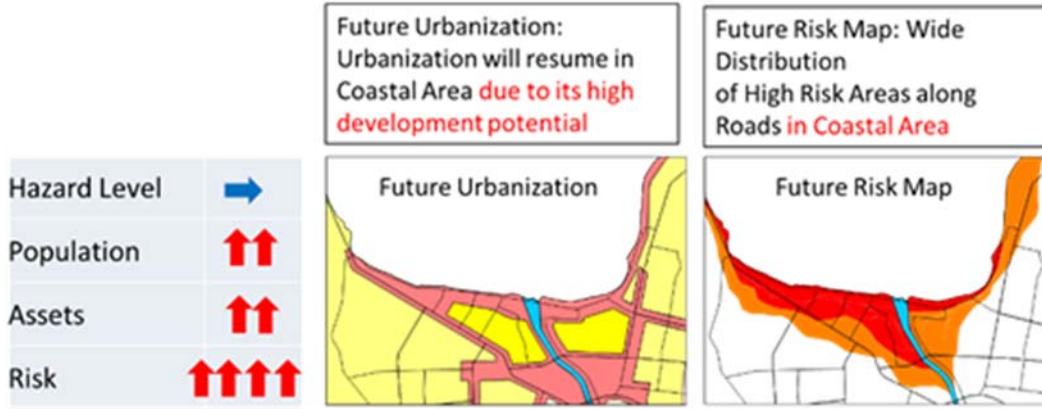
Source: Prepared by JICA Expert and JICA Study Team

Figure 3-12 Steps in Spatial Planning Using Hazard Maps and Risk Maps



Step 3: Unregulated Case (Future)

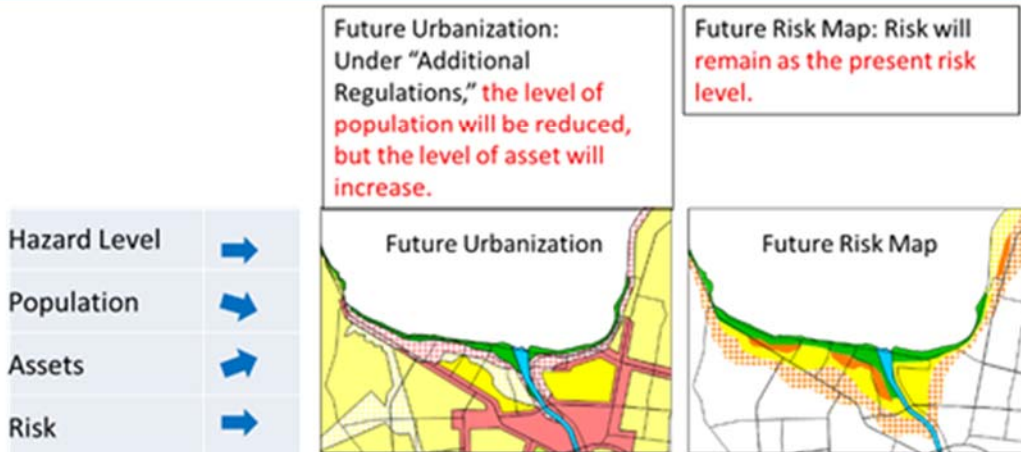
Without regulation, urbanization will resume in coastal area.
That will increase risk in coastal area.



Step 4: Additional Regulations for Disasters (Future)

Under "Additional Regulations"

- New construction of houses and important facility is prohibited
- Reconstruction of houses and important facility is allowed
- Any construction of other buildings is allowed



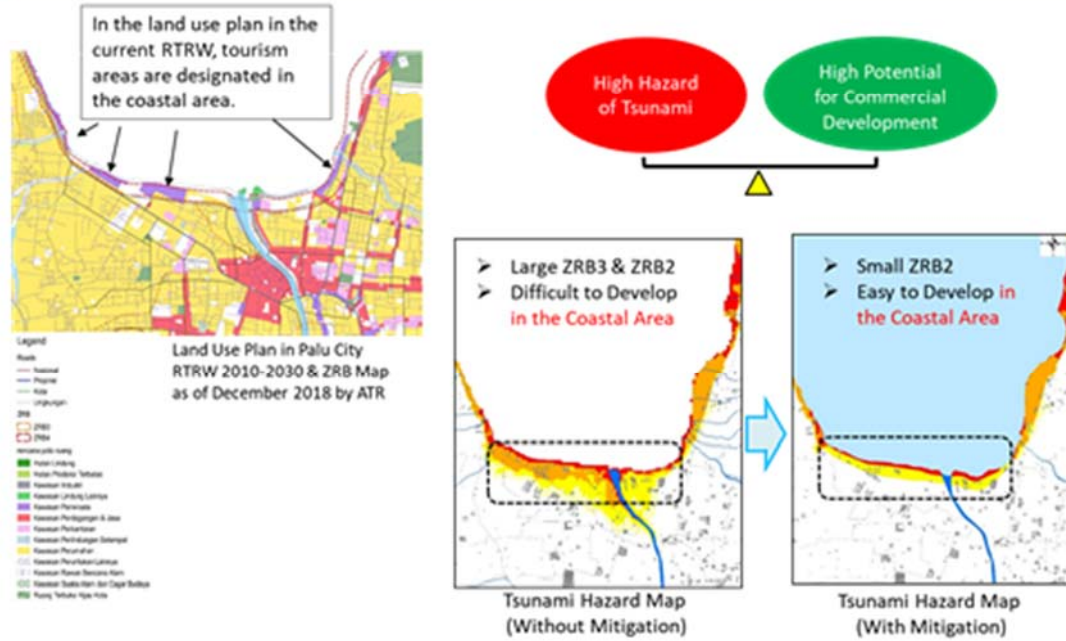
Step 5: Structural Mitigation Measures (Future)

To achieve balanced situation between socio-economic revitalization and DRR with mitigation measures



Step 6: + Spatial Development Policy (Future)

To achieve total balanced situation socio-economic revitalization and DRR by all means



Source: Prepared by JICA Expert and JICA Study Team
Figure 3-13 Steps in Spatial Planning Using Hazard Maps and Risk Maps for the Southern Coastal Area of Palu City

3-4 Basic Spatial Concepts for Selected Target Areas in Palu Metropolitan Area

3-4-1 Alternative Spatial Development Concepts for Six Target Areas

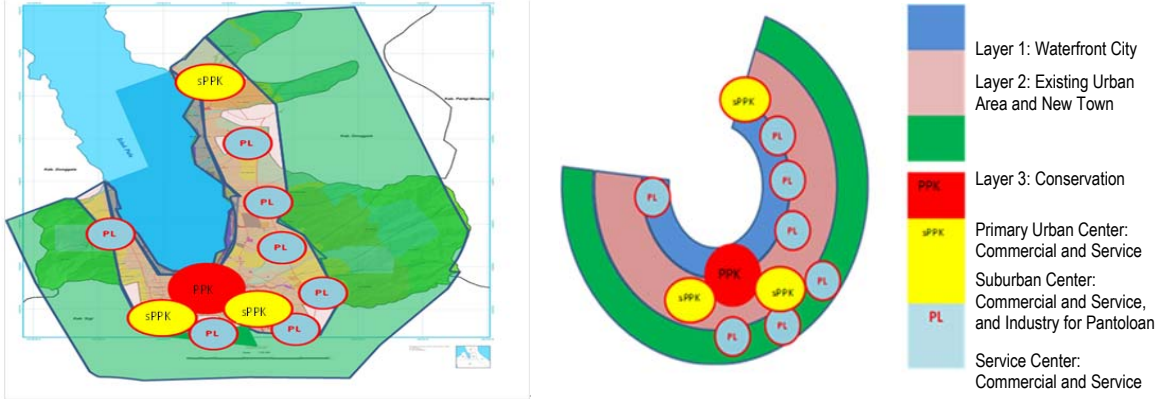
Using the method described in the previous section, the following six areas were selected as target areas to study, of which areas with high development potential and high disaster hazard risk were identified as well as the DRR measures (non-structural and structural measures) that should be applied to improve disaster resilience within the Palu Metropolitan Area:

- Southern coastal area of Palu Bay
- Eastern inland area of Palu Bay
- Western coastal area of Palu Bay
- Nalodo-affected area in Palu
- Nalodo-affected area in Sigi Regency
- Banawa area, Donggala Regency

3-4-2 Palu Southern Coastal Area

(1) Existing Development Plans for Palu Bay Coastal Area

The Palu Bay Southern Coastal Area is identified as an important urban center that characterizes the City of Palu in the existing development plans. In Palu City General Spatial Plan (RTRW) 2010 to 2030, the Palu Bay Southern Coastal Area is planned to be developed to a waterfront city, as a primary urban center and a face of the City. In unapproved Palu Coastal Master Plan 2017, which was formulated by the initiative of the Mayor, development of tourism, leisure, and commercial establishments had been planned.



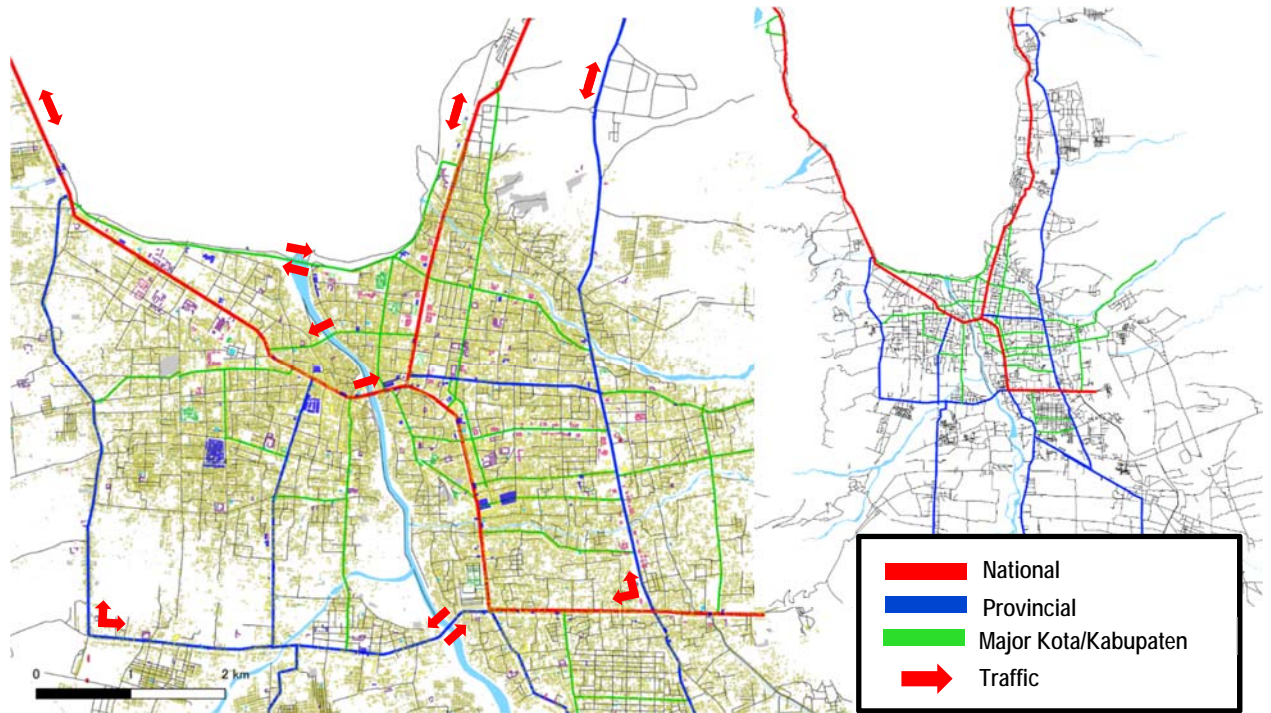
Source: Palu City Spatial Plan 2010-2030

Figure 3-14 “SOURAJA” Concept in Palu City RTRW 2010-2030

In the Palu Bay Southern Coastal Area, there is a coastal road running along the coast. The functional status of the coastal road, which is a city road, is the same as the Provincial Road (Secondary Road) and it played an important role in terms of traffic functions (Figure 3-15). Because there are only four bridges crossing the Palu River, and two of them are for one-way traffic, this coastal road and the two-way Palu IV Bridge crossing the river supported logistics movements between Pantoloan Port and the western side of the Palu Bay such as Donggala. Meanwhile, this road also worked as an access road to

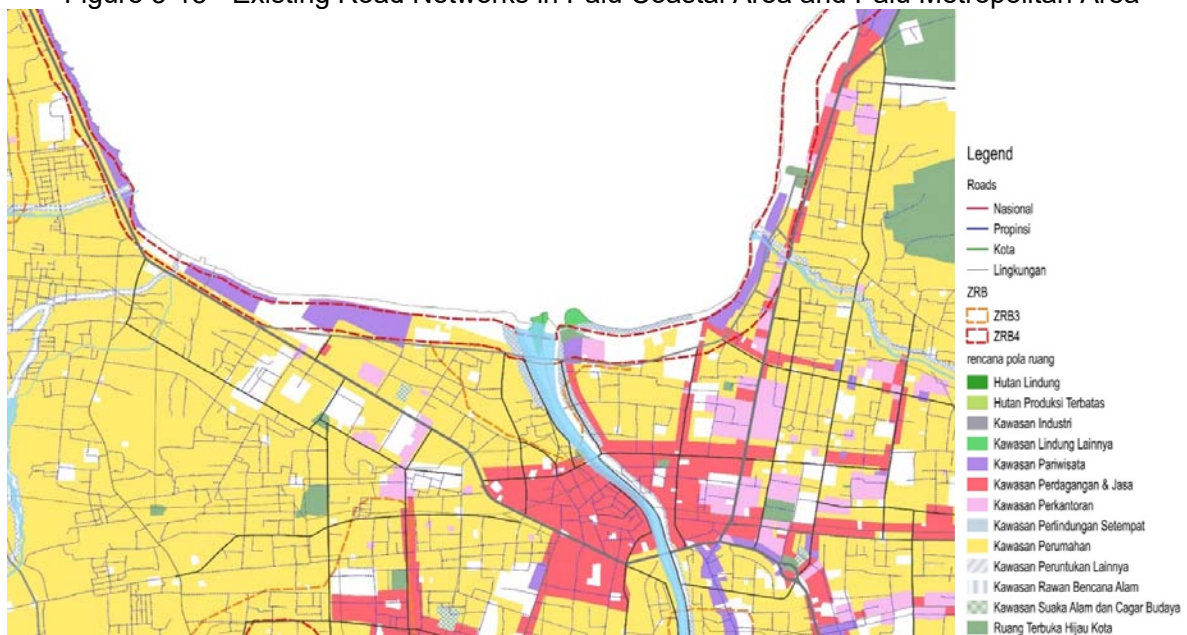
major commercial facilities located in the area, such as Palu Grand Mall, Swissbell Hotel, Mercure Hotel, the campus of the State Islamic Institute (IAIN) of Palu, etc.

In the Palu City Spatial Development Plan (RTRW) 2010-2030, commercial use is suggested for the Palu Southern Coastal Area. Several locations within the ZRB4 are specified for tourism development, including the current areas for Palu Grand Mall, Swiss-bell Hotel, and Mercure Hotel (see Figure 3-16).



Source: JICA Study Team formulated based on the draft Palu City Spatial Plan (RTRW) 2018-2038

Figure 3-15 Existing Road Networks in Palu Coastal Area and Palu Metropolitan Area



Source: Palu City Spatial Plan (RTRW) 2010-2030

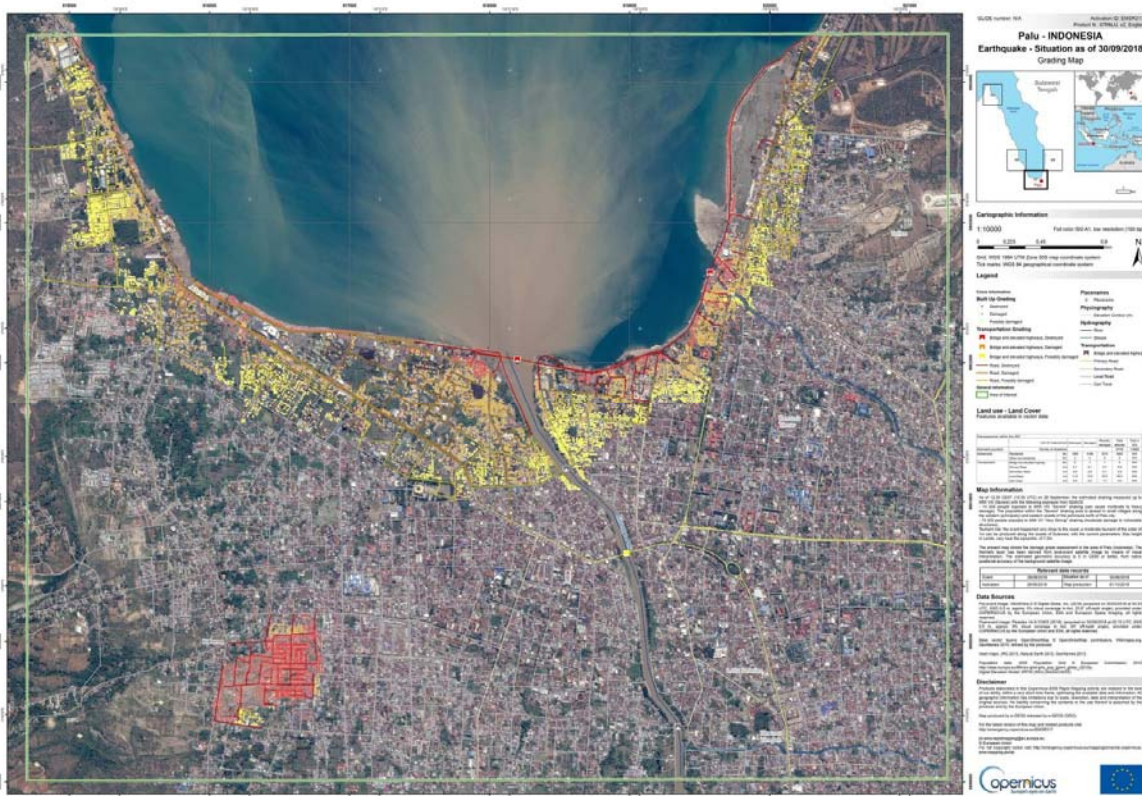
Figure 3-16 Land Use Plan in Palu City Spatial Plan (RTRW) 2010-2030

(2) Disaster Damage, Disaster Characteristics and Disaster Hazard

The damage maps of the disaster that occurred in 2018 (Figure 3-17 and Figure 3-18) show that the serious damage by tsunami is observed only near the coast. Although most of the completely destroyed buildings were located within 200 meters from the coast, designated as ZRB4 zone in ATR's ZRB map, the ZRB 4 area is much larger than the actual inundation area of the tsunami.

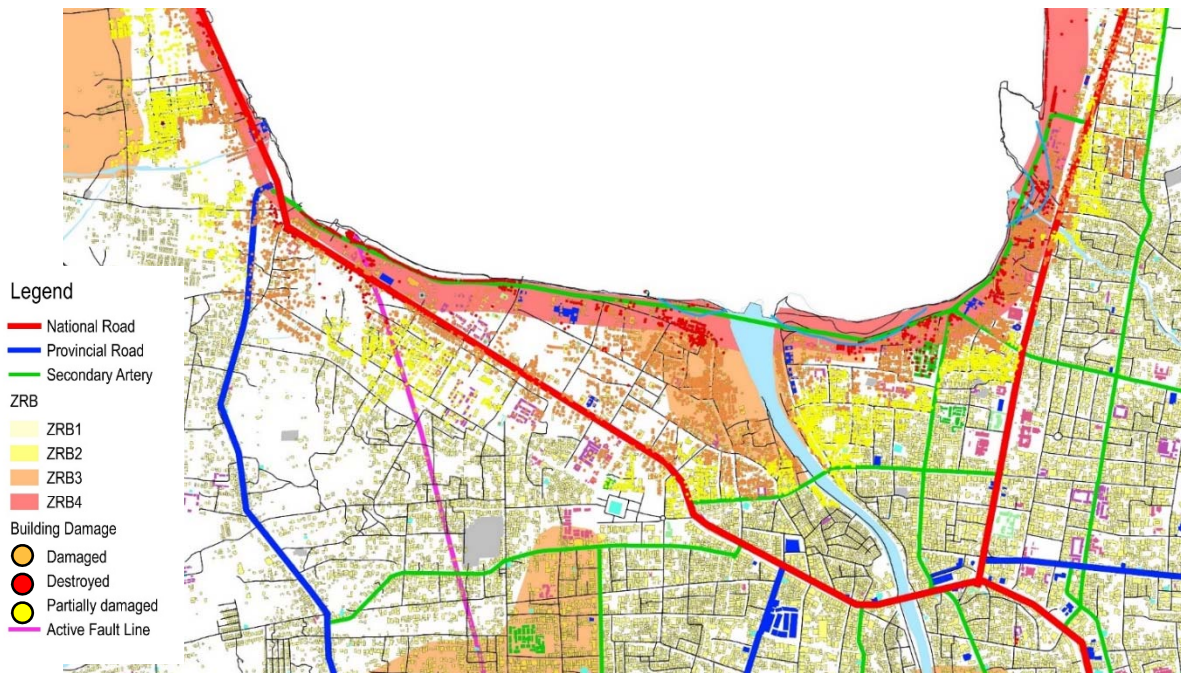
According to the hazard map developed by JICA Study Team based on the simulation of 2018 tsunami, Level 4 areas with the highest risk comprised a much smaller zone than what is on the ZRB map as presented in Figure 3-20. The Level 4 areas where more than 3-meter high tsunami is expected are only identified in the following: around the mouth of the Palu River, on the eastern shore of the River, area in front of PGM, and other several locations. Level 4 areas are not recommended for residential use. On the other hand, conditional residential use (excluding residential use of ground floor) is suggested for Level 3 areas where 1 to 3-meter high tsunami is anticipated. Because arrival time of tsunami in Palu Bay is very short, about 3 to 5 minutes, due to landslide inducing the tsunami, there is hardly no time for the residents to evacuate (Figure 3-19).

The change of the hazard levels due to installation of a mitigation measure, such as an elevated road, is presented in Figure 3-20. The Level 4 and Level 3 areas became smaller, while the Level 2 area is expanded with an elevated road, which means that installation of mitigation infrastructure can increase usable land in the coastal area.



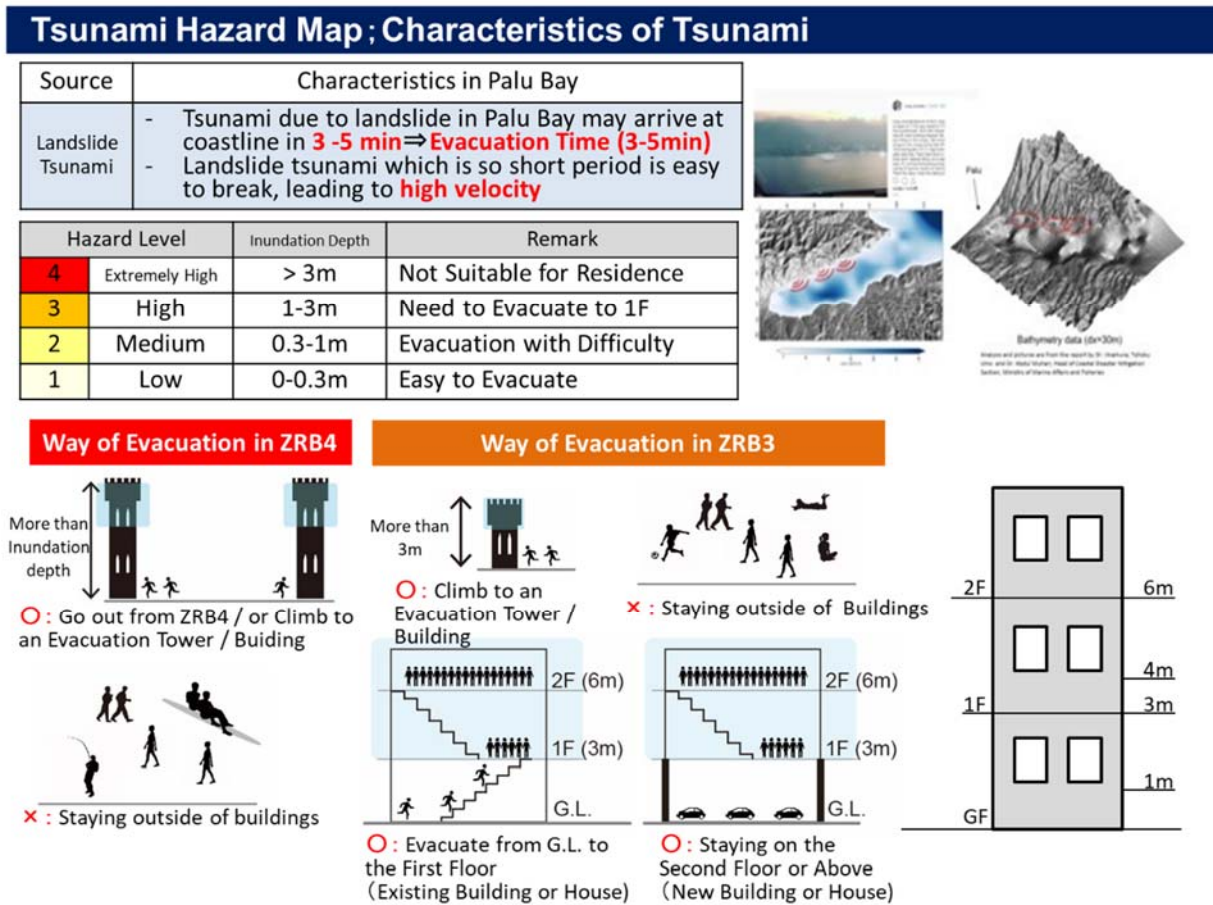
Source: Copernicus <https://emergency.copernicus.eu/mapping/list-of-components/EMSR317>

Figure 3-17 Disaster Damage by Tsunami and Earthquake on September 28, 2018



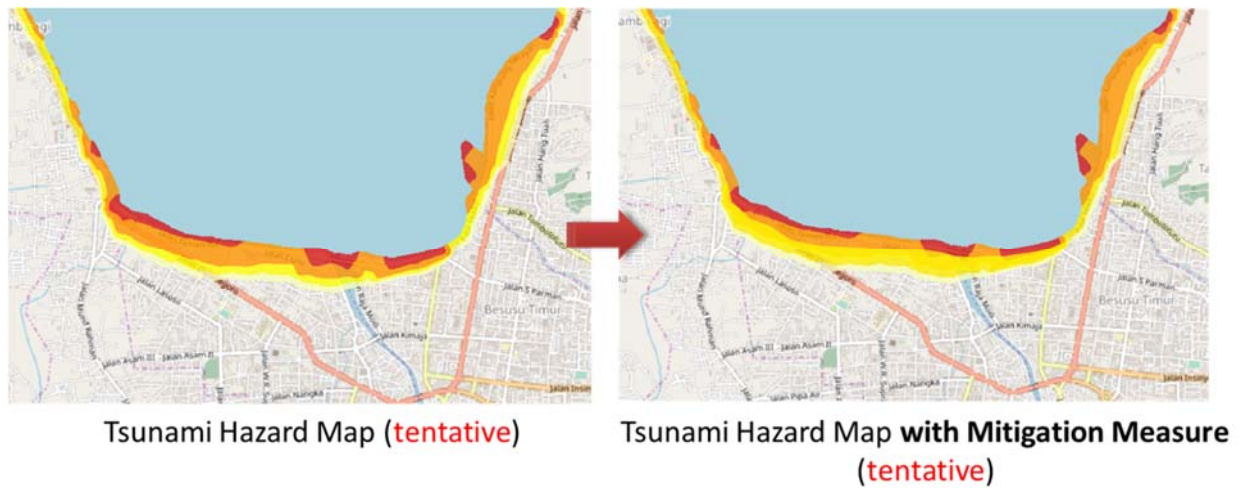
Source: JICA Study Team based on ZRB Map and Damage Data from Copernicus <https://emergency.copernicus.eu/mapping/list-of-components/EMSR317>

Figure 3-18 ZRB Map and Disaster Damage in 2018 and ZRB Map



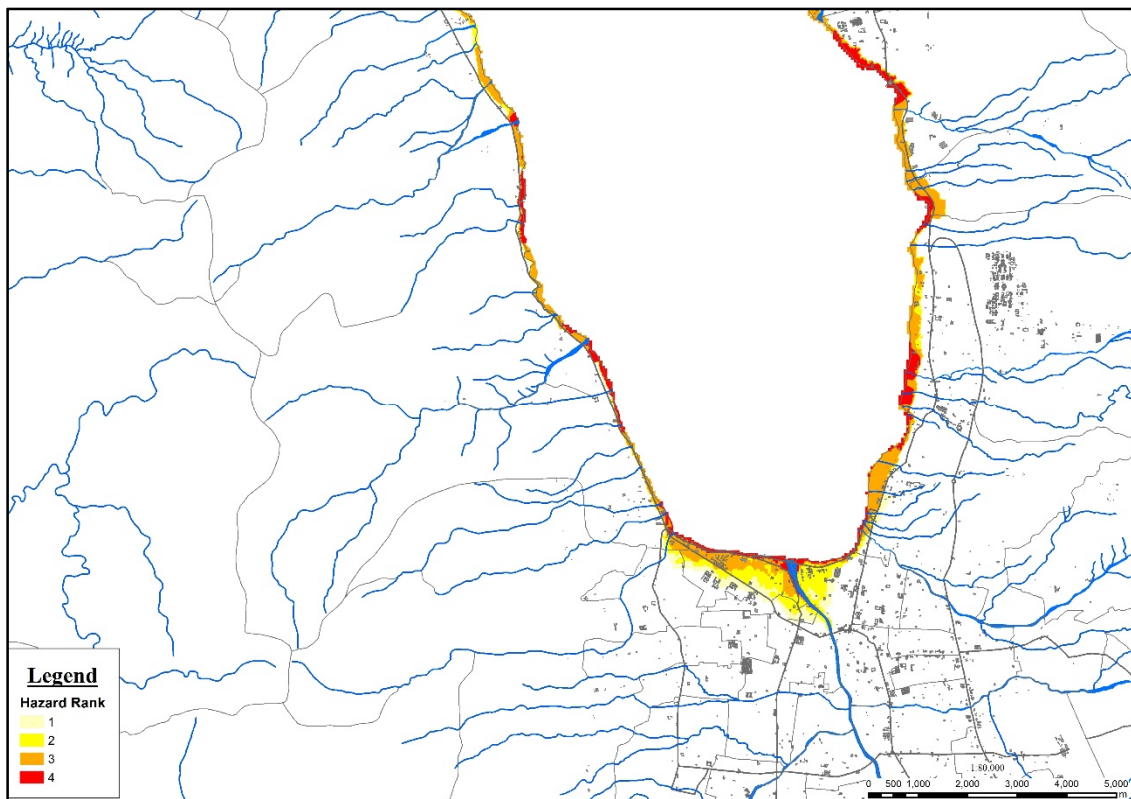
Source: JICA Study Team

Figure 3-19 Tsunami Characteristics in Palu Bay and Ways of Evacuation



Source: JICA Study Team

Figure 3-20 Draft Tsunami Hazard Map With and Without Mitigation Measure



Source: JICA Study Team Version 0827, 2019

Figure 3-21 Hazard Map for Tsunami (Based on 2018 Tsunami Disaster)

(3) Approaches to Development of Alternative Scenarios of Spatial Structure

1) Approach (1): Considering Major Factors for Inducing Spatial Development

The perspectives for the examination of Reconstruction Policy are provided in the previous section. Next, major infrastructure which determines the spatial structure of the Palu Bay Southern Coastal Area will be examined to consider alternative scenarios of spatial use in the area. To do so, different development patterns of infrastructure need to be examined.

a) Bridge at the Mouth of the Palu River

- Should a bridge be reconstructed at the river mouth or not?
- If a bridge will be constructed, where should be its location?
- What type of bridge will be reconstructed? (Road bridge with footpath/ foot bridge/ functions, etc.)

b) Coastal Road

- Should a coastal road be reconstructed or not?
- If the coastal road will be reconstructed, where should be its location?
- What type of road will be reconstructed? (Roadway/ promenade/functions, etc.)

c) Elevated Road

- Should an elevated road be constructed or not?

2) Approach (2): Considering Effectivity of Land Use Control

It is necessary to prepare spatial concepts by considering how to enhance the effectiveness of land use control. Since the effectiveness of land use control depends on the size of the areas to be covered, it is necessary to reduce the area for the purpose through the following measures:

- Constructing parks and planting trees on areas prohibited for development
- Constructing elevated road together with nurturing mangroves in tidal flat, and tree planting in coastal areas

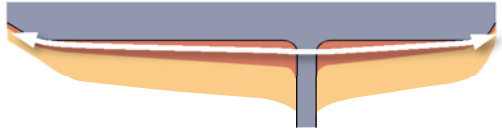
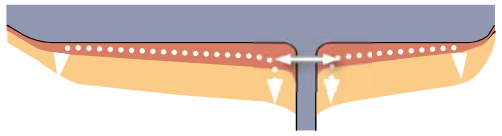
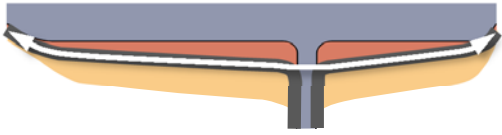
(4) Eleven Scenarios for Cases A to D: Spatial Structure of Palu Bay Southern Coastal Area

In order to consider different combination of infrastructure development and land use control, eleven alternative scenarios of spatial structure are prepared and categorized into the following:

- Case A: Case of Reconstruction of Palu IV Bridge (as a road bridge with footpath) at the Mouth of Palu River
- Case B: Case of Reconstruction of Palu IV Bridge as a foot bridge
- Case C: Case of Reconstruction of Palu IV Bridge (as a road bridge with footpath) Set Back from the River Mouth
- Case D: Case of No Reconstruction of Palu IV Bridge

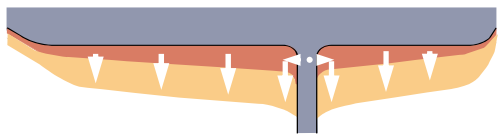
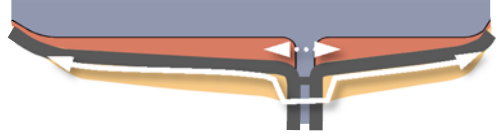
For each of these cases, different development scenarios of spatial structure are prepared for the Palu Bay Southern Coastal Area as shown in Table 3-13 through Table 3-16.

Table 3-13 Case A: Three Scenarios of Spatial Structure with Reconstruction of Palu IV Bridge (Road Bridge with Footpath) at the Palu River Mouth (Scenarios 1, 2 and 3)

<p>Scenario 1: Construction of a Road Bridge with Footpath and Existing Coastal Road</p> 	<p>To mitigate tsunami damage by designating large area of the coastal zone as ZB4 (Red Zone). <u>With reconstruction of Palu IV Bridge (road bridge with footpath) and connecting it to the existing coastal road, the southern coastal area of Palu Bay will be used for through traffic.</u></p> <p>Due to the limited capacity of local government on land use and building control, the coastal areas will be gradually redeveloped along the rehabilitated coastal road and land use will come back to the pre-disaster situation. This case is the worst scenario to be prevented in the recovery and reconstruction from the earthquake-tsunami disaster 2018 in Palu.</p> <p>→<u>Build Back NOT Better Case</u></p>
<p>Scenario 2 : Construction of a Road Bridge with Footpath and Promenade</p> 	<p>To mitigate tsunami damage by designating large area of coastal zone as ZB4 (Red Zone). <u>The access of the reconstructed bridge (road bridge with footpath) to the existing coastal road is restricted, and the bridge will be used to connect communities in both sides of Palu River. Traffic cannot pass through the coastal road in ZRB4 (Red Zone) and this coastal road will be used as a promenade for pedestrians in a park.</u></p> <p>By transforming the coastal road into a park, construction activities in Red Zone will be strictly prohibited and land use control by local government will be strengthened. The functional status of the coastal road will be downgraded from the status similar to provincial road, and the traffic function of roads crossing the Palu River should be enhanced to supplement the reduced traffic function in the coastal area.</p> <p>→<u>Build Back Better BY CONTROL</u></p>
<p>Scenario 3: Construction of a Road Bridge with Footpath and Elevated Road</p> 	<p>To reduce evacuation time and distance and minimize tsunami damage by construction of elevated road. The construction of elevated road will reduce the area of ZRB4 (Red Zone) and local government's effort required for land use and building control. (Development of a park, event and commercial use of Red Zone will be examined separately.)</p> <p><u>With the reconstruction of a bridge (road bridge with footpath) at Palu River mouth and construction of a road on the elevated road, the coastal road along the southern area of Palu Bay will be used for through traffic.</u></p> <p>The southern area protected by elevated road will become ZRB3 (Orange Zone) where reconstruction of housing of ruko type will be permitted and construction of commercial facilities will be partially allowed.</p> <p>→<u>Build Back Better BY ELEVATED ROAD and CONTROL</u></p>

Source: JICA Study Team

Table 3-14 Case B: Two Scenarios of Spatial Structure with Reconstruction of Palu IV Bridge for Pedestrians (Scenarios 4 and 5)

<p>Scenario 4: Construction of Foot bridge</p> 	<p>To mitigate tsunami damage by designating large area of coastal zone as ZB4 (Red Zone). <u>The bridge will be reconstructed as a foot bridge with the restricted access to the existing coastal road and used to connect communities in both sides of Palu River. Traffic cannot pass through the coastal road in ZRB4 (Red Zone) and this coastal road will be used as a promenade for pedestrians in a park.</u></p> <p>By transforming the coastal road into a park, construction activities in Red Zone will be strictly prohibited and land use control by local government will be strengthened. The functional status of the coastal road will be downgraded from the status same as provincial road and the traffic function of roads crossing the Palu River should be enhanced to supplement the reduced traffic function in the coastal area.</p>
<p>Scenario 5: Construction of a Foot bridge and Set-back Elevated Road</p> 	<p>In addition to a foot bridge, a bridge for vehicles and pedestrians outside ZRB4 will be constructed in order to prevent car access to ZRB4 areas, and an elevated road will be constructed as well.</p> <p>To reduce evacuation time and distance and minimize tsunami damage by construction of elevated road. The construction of elevated road will reduce the area of ZRB4 (Red Zone) and local government's effort required for land use and building control. (Development of a park, event and commercial use of Red Zone will be examined separately.)</p> <p><u>With construction of an elevated road, the coastal road along the southern area of Palu Bay will be used for through traffic.</u></p> <p>The southern area protected by elevated road will become ZRB3 (Orange Zone) where reconstruction of housing of ruko type will be permitted and construction of commercial facilities will be partially allowed.</p>

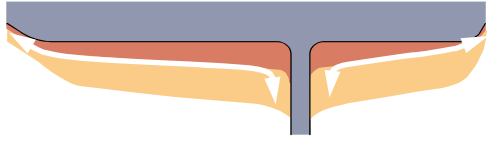
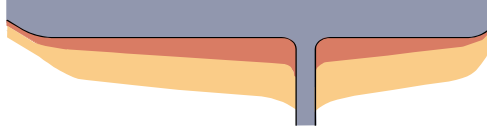

Source: JICA Study Team

Table 3-15 Case C: Three Scenarios of Spatial Structure with Reconstruction of Palu IV Bridge Set Back from the River Mouth (Scenarios 6, 7 and 8)

<p>Scenario 6: Construction of Set-back Bridge and Road</p>	<p>To mitigate tsunami damage by designating large area of coastal zone as ZB4 (Red Zone). Palu IV Bridge will be reconstructed as a road bridge with footpath being set back from the river mouth. The east-west coastal road will be constructed on the border between ZRB3 (Orange Zone) and ZRB2 (Yellow Zone), and connected to the bridge for through traffic which will be used to pass through the previous coastal road.</p> <p>The coastal road in ZRB4 (Red Zone) will not be reconstructed and the coastal space in ZRB4 zone will be restored as a park for pedestrians.</p> <p>Due to the limited capacity of local government on land use and building control, the space along the reconstructed east-west road will be gradually redeveloped and land use might come back to the pre-disaster situation.</p>
<p>Scenario 7: Construction of Set-back Bridge</p>	<p>To mitigate tsunami damage by designating large area of coastal zone as ZB4 (Red Zone). A bridge will be constructed with setback toward upstream, and connected to the roads in ZRB3 (Orange Zone) so as not to divide communities in both sides of the Palu River.</p> <p>The existing coastal road in ZRB4 will not be reconstructed and the road will be used as promenade for mainly pedestrians in a park. By transforming the coastal road into a park, construction activities in Red Zone will be strictly prohibited and land use control by local government will be strengthened.</p> <p>Due to the lack of reconstruction of the east-west coastal road and the bridge connected to the road, the traffic function of other roads crossing the Palu River should be enhanced to supplement the reduced traffic function in the coastal area.</p>
<p>Scenario 8: Set-back Bridge and Elevated Road</p>	<p>To construct the east-west coastal road and elevated road connected to the bridge setback (road bridge with footpath) to upstream.</p> <p>To reduce evacuation time and distance, and minimize tsunami damage by construction of elevated road. The construction of elevated road will reduce the area of ZRB4 (Red Zone) and local government's effort required for land use and building control. (Development of a park, event and commercial use of Red Zone will be examined separately.)</p> <p>With reconstruction of the bridge at a safer area and construction of an elevated road, the coastal road along the southern area of Palu Bay will be used for through traffic continuously.</p> <p>The southern area protected by elevated road will become ZRB3 (Orange Zone) where reconstruction of housing of ruko type will be permitted and construction of commercial facilities will be partially allowed.</p>

Source: JICA Study Team

Table 3-16 Case D: Three Scenarios of Spatial Structure Without Reconstruction of Palu IV Bridge (Scenarios 9, 10 and 11)

<p>Scenario 9: Construction of a Coastal Road and No Construction of a Road Bridge</p> 	<p>This scenario is without reconstruction of a road bridge. To mitigate tsunami damage by designating large area of coastal zone as ZB4 (Red Zone). <u>The east-west coastal road will be constructed on the border between ZRB3 (Orange Zone) and ZRB (Yellow Zone).</u></p> <p>The coastal road in ZRB4 (Red Zone) will not be reconstructed and the coastal space in ZRB4 zone will be restored as a park for pedestrians; however, there is a risk that land use becomes to the pre-disaster situation. Due to the limited capacity of local government on land use and building control, the space along the reconstructed east-west road will be gradually redeveloped and land use might come back to the pre-disaster situation. Since the bridge will not be reconstructed, the traffic function of roads crossing the Palu River should be enhanced.</p>
<p>Scenario 10: No Construction of a Road Bridge and Coastal Road</p> 	<p>This scenario is without reconstruction of a road bridge. To mitigate tsunami damage by designating large area of coastal zone as ZB4 (Red Zone). By transforming the coastal road into a park, construction activities in Red Zone will be strictly prohibited and land use control by local government will be strengthened.</p> <p>Since the bridge and the coastal road will not be reconstructed, the traffic function of roads crossing the Palu River should be enhanced.</p>
<p>Scenario 11: Construction of a Road and Elevated Road and No Construction of a Road Bridge</p> 	<p>This scenario is without reconstruction of a road bridge. To reduce evacuation time and distance, and minimize tsunami damage by construction of elevated road. The construction of elevated road will reduce the area of ZRB4 (Red Zone) and the local government's effort required for land use and building control.</p> <p>Since the bridge will not be reconstructed, the traffic function of roads crossing the Palu River should be enhanced.</p> <p>The southern area protected by elevated road will become ZRB3 (Orange Zone) where reconstruction of housing of ruko type will be permitted, and construction of commercial facilities will be partially allowed.</p>

Source: JICA Study Team

(5) Evaluation Criteria: Concepts of Spatial Use of Palu Bay Southern Coastal Area

In order to evaluate eleven scenarios on implementability, the following criteria concerning cost, effectiveness, and impact on development induction are proposed. The cost criteria involve the construction cost of infrastructure and structural measures, such as elevated road, as well as cost of non-structural measures including development of park and green planting, the relocation cost based on the number of households to be relocated, and the cost for land use control. It is important to estimate land use control cost for monitoring and demolition of illegal construction, since those non-structural measures are not costless. The impact on development induction is an adverse effect of development of the road and bridge that work to promote reconstruction and development of housing and other commercial facilities within high disaster risk area. These two negative factors are compared with the effectiveness of disaster risk reduction and safety, whether or not the proposed risk reduction measure is able to reduce the disaster risk without incurring too much cost or burden. Structural measures are assumed to be more effective than non-structural measures. The results of evaluation are presented in Table 3-17.

- **Cost for Constructing Infrastructure**
- **Cost for Constructing Disaster Risk Mitigation Measures** (including elevated road, development park and green planting)
- Number of Households for Resettlement due to Constructing Infrastructure (Cost)
- Number of Households for Resettlement due to Structural Mitigation Measures (including Elevated road) (Cost)
- Number of **Households for Resettlement** and Cost of **Leasing Land** for Making Parks and Tree Planting for Effective Land Use Control (Cost)
- Effectiveness of **Land Use Control and Structural Measures** for Disaster Risk Reduction
- Impacts of **Inducing Prohibited Land Use** (e.g., residential or commercial use)

Table 3-17 Comparative Evaluation of Alternative Scenarios of Spatial Structure in Palu Bay Southern Coastal Area

Scenario	Infrastructure Development		Disaster Risk Mitigation Measures		Cost			Relocation Cost		Impacts on Development Induction	Effectiveness for Disaster Risk Mitigation/Safety
	Bridge at the Mouth of Palu River	East-West Coastal Road	Structural Measures: Tsunami Dike	Park and Tree Planting for Land Use Control	Infrastructure Development Cost	Elevated road Construction Cost	Land Use Regulation (Soft Measure Implementation)	Relocation for Infrastructure Development	Relocation for Park and Tree Planting for Land Use Control		
1	Road Bridge with Footpath	Existing Road	No	No	Low	-	High	Low	Low	High	Low
2	Road Bridge with Footpath	No (Promenade)	No	Yes	Low	-	Mid	Low	High	Mid	Mid
3	Road Bridge with Footpath	Elevated Road	Yes	No	Mid	High	Low	Low	Low	High	High
4	Foot Bridge	No (Coastal Access Roads)	No	Yes	Low	-	Mid	Low	High	Mid	Mid
5	Foot Bridge and Road Bridge with Footpath	East-West Coastal Road (Elevated Road)	Yes	No	High	High	Low	Low	Low	Mid-High	High
6	Setback Bridge	Setback East West Coastal Road	No	Yes	High	-	High	High	High	High	Low-Mid
7	Setback Bridge	No (Coastal Access Roads)	No	Yes	Mid	-	Mid	Mid	High	Low-Mid	Mid
8	Setback Bridge	Setback East West Coastal Road	Yes	No	High	High	Low	High	Low	High	High
9	No Bridge at the River Mouth	Setback East West Coastal Road	No	Yes	High	-	Mid	High	High	Low	Mid
10	No Bridge at the River Mouth	No	No	Yes	Low	-	Mid	Low	High	Low	Mid-High
11	No Bridge at the River Mouth	East-West Coastal Road (Elevated Road)	Yes	No	Low	High	Low	High	Low	Mid	High

Source: JICA Study Team

(6) Detailed Assessment of Three Scenarios of Spatial Structure and Land Use Pattern

Among the eleven scenarios described in the previous sections, three scenarios of Case A: Reconstruction of Palu IV Bridge, are evaluated in detail here. Case A is most likely to be implemented because the importance of the Palu IV Bridge for traffic function and its significance as a symbol of the reconstruction of Palu are well recognized, and Satgas is working on the reconstruction in

collaboration with the JICA Output 3 Team. Thus, the spatial structure and land use patterns corresponding to three cases of Case A are further examined in this section.

1) Spatial Structure of Three Scenarios

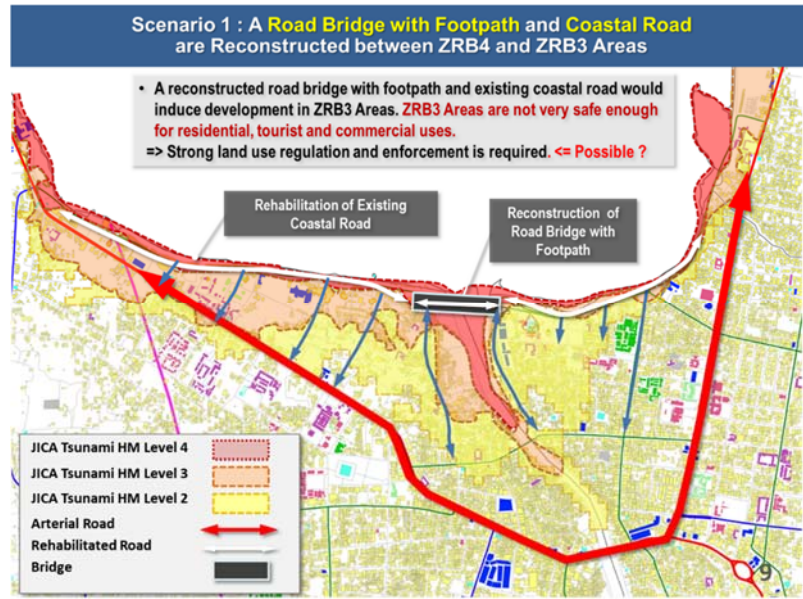
(i) Scenario 1: Reconstruction of a Road Bridge with Footpath and Coastal Road

In Scenario 1, a road bridge with footpath and coastal road are reconstructed between ZRB4 and ZRB3. This scenario aims to restore the spatial structure prior to the disaster in 2018. The coastal road and the Palu IV Bridge will play an important logistics function for the traffic movements between the eastern side of the Palu River, especially Pantoloan Port, and the western side up to Donggala. However, this traffic route will be located in the tsunami high risk area, and it is anticipated that this will encourage reconstruction and development of housing and commercial facilities, just like before the disaster. Because any structural measure is not planned in this scenario, the primary risk reduction method is land use control prohibiting any type of development in ZRB4 and new construction in ZRB3. The question is whether or not the local government can enforce the land use regulation effectively through building permit process and monitoring. The cost for infrastructure development is not high, while high cost and effort for strong land use enforcement are required. The effectiveness for disaster risk reduction is rather low for this scenario.

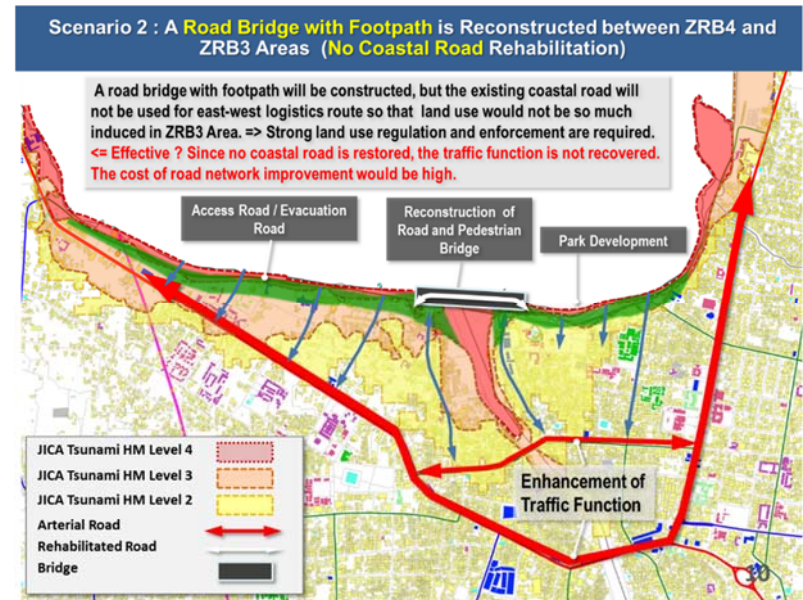
(ii) Scenario 2: Reconstruction of a Road Bridge with Footpath Without Coastal Road

Unlike Scenario 1, only a road bridge is reconstructed without rehabilitation of the coastal road in Scenario 2. Parks and green open space will be developed along the coast to prevent development in tsunami high risk areas and also for purposes of disaster risk mitigation. The bridge will be used only for community service in both sides of the river. The strict land use regulations will be imposed for the high risk areas of ZRB3. Furthermore, the previous coastal road will be used as a promenade for pedestrians or bikers in the park, and access roads to the park and coast which work as evacuation routes will be developed. Because the coastal road will not be reconstructed, the traffic function of the existing arterial roads and the bridges crossing the Palu River should be strengthened to support the smooth traffic movements in east-west direction. The cost for infrastructure development is not high, but middle to high level cost for land use regulation and relocation for park development are required. The effectiveness for disaster risk reduction is middle level, and certain level of development will be promoted by the reconstruction of the bridge and development of park.

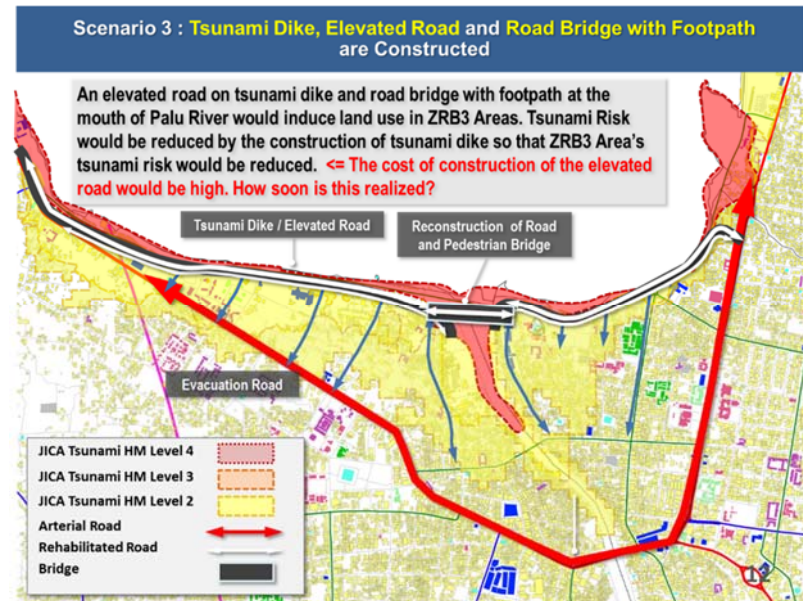
Scenario 1: Reconstruction of a Road Bridge with Footpath and Coastal Road



Scenario 2: Reconstruction of a Road Bridge with Footpath without Coastal Road



Scenario 3: Construction of Elevated Road and a Road Bridge with Footpath



Source: JICA Study Team

Figure 3-22 Detailed Analysis of Three Scenarios

(iii) Scenario 3: Construction of Elevated Road and a Road Bridge with Footpath

With the reconstruction of a road bridge with footpath, an elevated road will be constructed along the coast as structural measure for disaster risk reduction. Hence, Scenario 3 is the most effective in the reduction of disaster risk, though the cost of elevated road construction is relatively high and it needs some time to be completed. Before the completion of the construction of the elevated road, strong land use control is also required and development can be induced in the coastal area because the safety level of the area will increase by the development of elevated road.

2) Analysis of Alternative Land Use Patterns for Scenarios 1- 3 (Case of Reconstruction of Palu IV Bridge)

To conduct further analysis of land use patterns of the three scenarios, different combinations of disaster risk mitigation measures and land use policy are suggested. First, the three alternative scenarios take different combinations of disaster mitigation measures, namely, structural measure (elevated road) and non-structural measure (tree planting / land use), as discussed in the previous section. Here, land use as non-structural measure can include two approaches: land use change and land use regulation.

The analysis in this section examines different patterns of land use for each of the three scenarios, by applying different land use regulations from restrictive to active, to ZRB3 and ZRB2. The land use regulations on ZRB3 focus on residential / commercial use of land, whether or not residential use is allowed, and whether new development is allowed or the existing residential use only is accepted. The land use on ZRB is concerned with the intensity of development, whether low intensity or medium intensity development is allowed. Table 3-18 summarizes the choice of disaster risk mitigation measures and infrastructure development, and a choice of disaster risk mitigation measures for each sub-scenario.

a) Disaster Risk Mitigation Measures

- Structural Measure: Elevated road construction
- Non-Structural Measures:
 - Tree planting for reduction of the force of tsunami
 - Land use
 - ✓ Land use change, e.g., developing a park (which is also effective to reduce the effort on land use control)
 - ✓ Land use regulations, e. g., restriction on residential use and building regulations

b) Land Use Regulations for ZRB3 and ZRB2

- Land use regulations for ZRB3
 - Restrictive : To impose restrictive land use regulations by prohibiting new

residential use and new non-residential use in ZRB3

- Moderate / Promotive: To impose restrictive land use regulations by prohibiting new development of residential use but allowing new non-residential use in ZRB3 / To allow NEW development of residential and non-residential use in ZRB3
- Land use regulation for ZRB2: Level of intensity of development
 - Low: Only low intensity development is allowed.
 - Middle: Moderate intensity development is allowed.

Table 3-18 Alternative Land Use Patterns for Scenarios 1- 3 (Case of Reconstruction of Palu IV Bridge)

Infrastructure	Disaster Risk Mitigation Measures		Scenario 1		Scenario 2		Scenario 3			
Infrastructure	Road		East-West Coastal Road		-		East-West Coastal Road			
	Bridge		Road Bridge with Footpath		Road Bridge with Footpath		Road Bridge with Footpath			
Disaster Risk Mitigation Measures	Structural Measures	Elevated Road		-		-		Elevated Road		
	Non-Structural Measures	Tree Planting		Tree Planting		Tree Planting		Tree Planting		
		Land Use Change		Park Development		Park Development		Park Development		
		Land Use Regulations		Restrictive	Promotive	Restrictive	Promotive	Moderate	Promotive	
		ZRB3	Residential	Existing	✓	✓	✓	✓	✓	✓
				New	-	-	-	-	-	✓
			Commercial	Existing	✓	✓	✓	✓	✓	✓
				New	-	✓	-	✓	✓	✓
		ZRB2 (Intensity)	Residential	Existing	Low	Low	Low	Low	Low	Mid
	New			Low	Low	Low	Low	Low	Mid	
Commercial	Existing		Low	Low	Low	Low	Low	Mid		
	New		Low	Low	Low	Low	Low	Mid		

Notes: Low = Low Intensity Development is allowed. Mid = Medium Intensity Development is allowed.

Source: JICA Study Team

(i) Different Land Use Patterns for Scenario 1

In Scenario 1 in which a **Road Bridge with Footpath and Coastal Road** are reconstructed, two land use patterns of ① **Restrictive** and ② **Promotive** land use for ZRB3 are suggested.

① Land Use Pattern 1A: Restrictive Land Use for Scenario 1

The Restrictive Land Use Pattern 1A prohibits new development of residential use and non-residential use of ZRB3, considering tsunami risk in the coastal area. Thus, ZRB3 is used as restrictive commercial zone. Existing residential and non-residential buildings are allowed. They can be used as

tsunami evacuation shelters. The permitted buildings in ZRB3 should meet the building design requirements suggesting “Ruko Type” with enhanced design of foundation and structure for earthquake resistance. ZRB4 is preserved as protected area for DRR purpose where urban use is not permitted and where park development and tree planting are conducted. All structures in ZRB4 are relocated. The development intensity of ZRB2 is low. In this land use pattern, only existing non-commercial facilities such as PGM and Mercure Hotel, are allowed to exist.

② Land Use Pattern 1B: Promotive Land Use for Scenario 1

The Promotive Land Use Pattern 1B prohibits new residential use and new important facilities, but allows new development of non-residential use in ZRB3. Thus, ZRB3 is used as promotive commercial zone. These non-residential buildings should be used for tsunami evacuation shelter and meet the building design requirements suggesting “Ruko Type” with enhanced design of foundation and structure for earthquake resistance. ZRB4 is preserved as protected area for DRR purpose where urban use is not permitted and where park development and tree planting are conducted. All structures in ZRB4 are relocated. The development intensity of ZRB2 is low. In this land use pattern, in addition to existing non-commercial facilities, such as PGM and Mercure Hotel, new development of commercial and tourism facilities can be allowed. Thus, the current development direction for tourism and waterfront city can be still maintained in this case.

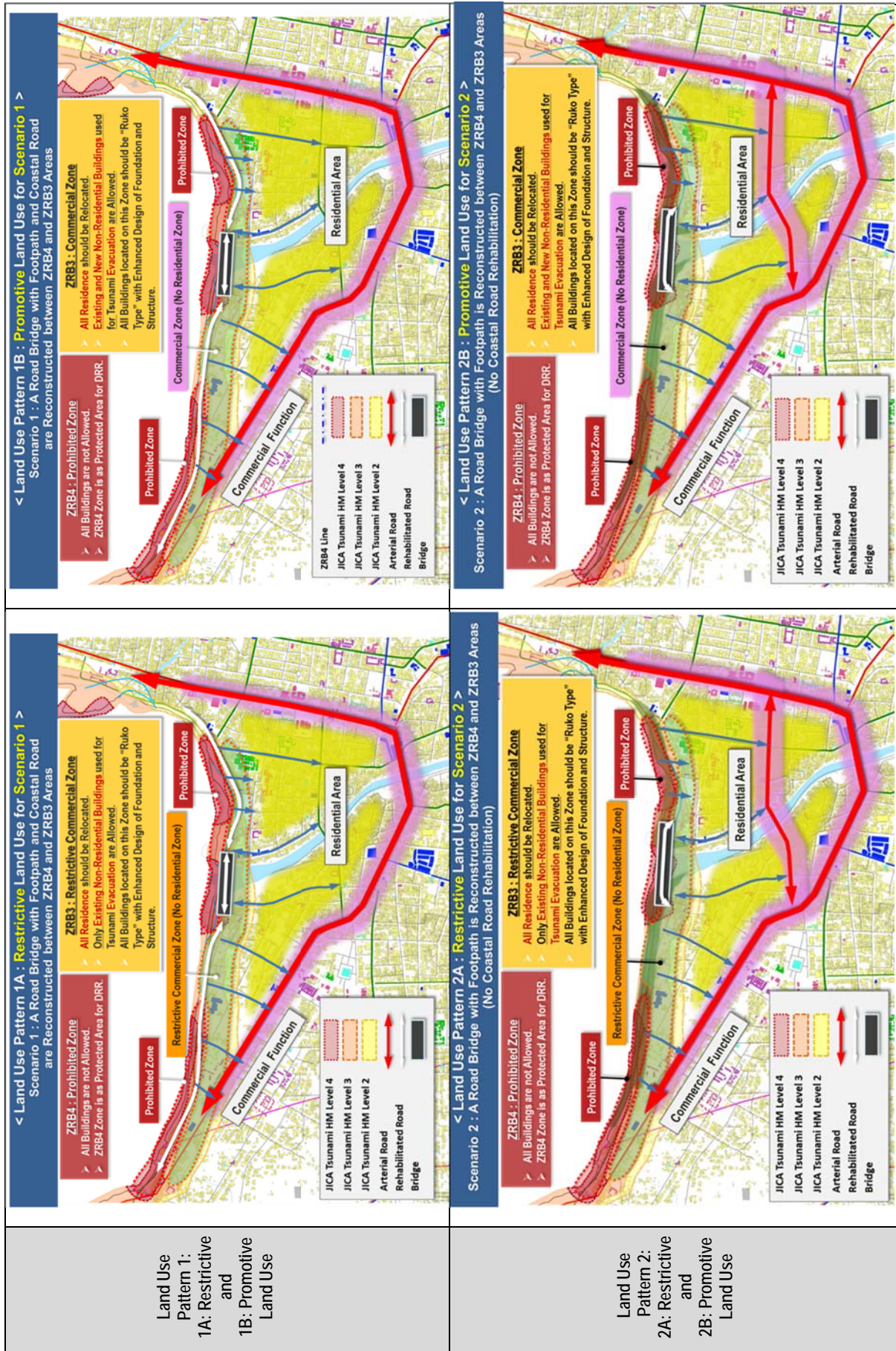
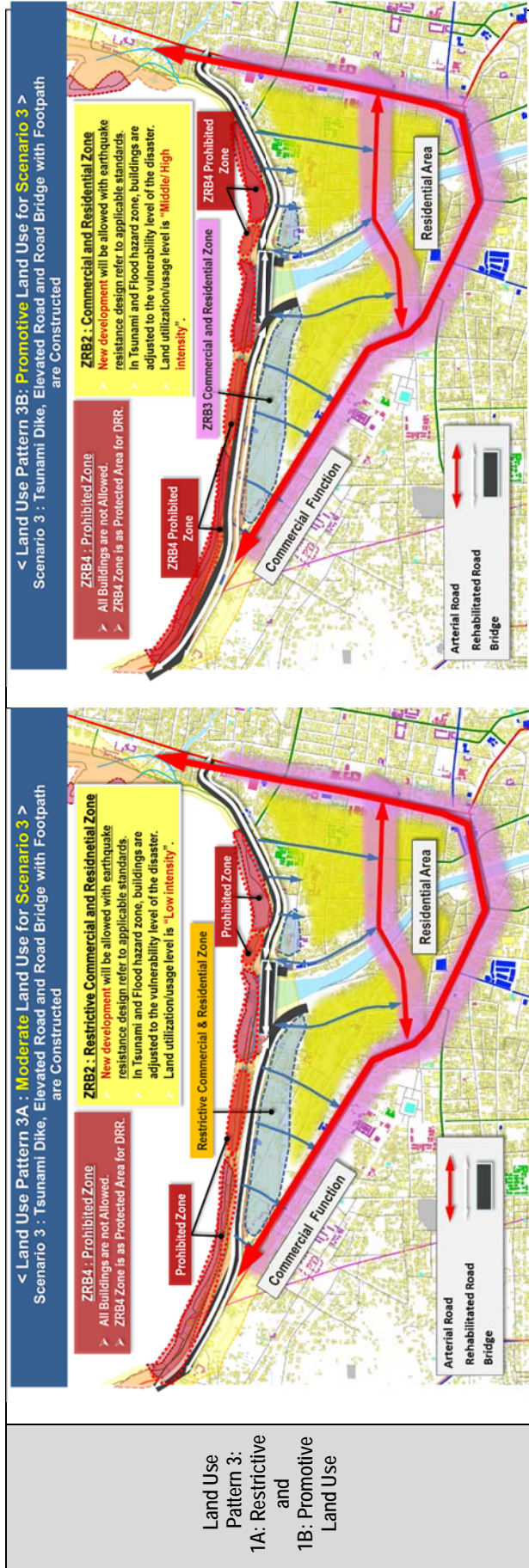


Figure 3-23 Land Use Patterns

Source: JICA Study Team



Source: JICA Study Team

Figure 3-24 Land Use Patterns

(ii) Different Land Use Patterns for Scenario 2

In Scenario 2 in which a **Road Bridge with Footpath** is reconstructed without a coastal road, two land use patterns of ① **Restrictive** and ② **Promotive** land use for ZRB3 are suggested.

① Land Use Pattern 2A: Restrictive Land Use for Scenario 2

The Restrictive Land Use Pattern 2A prohibits new development of residential use and non-residential use of ZRB3. Thus, ZRB3 is used as restrictive commercial zone. Existing residential and non-residential buildings are allowed and they can be used as tsunami evacuation shelters. The permitted buildings in ZRB3 should meet the building design requirements, suggesting “Ruko Type” with enhanced design of foundation and structure for earthquake resistance. ZRB4 is preserved as protected area for DRR purpose where park development and tree planting are conducted. All structures in ZRB4 are relocated. The development intensity of ZRB2 is low. In this land use pattern, only existing non-commercial facilities, such as PGM and Mercure Hotel, are allowed to exist.

② Land Use Pattern 2B: Promotive Land Use for Scenario 2

The Promotive Land Use Pattern 1B prohibits new development of residential use and important facilities but allows new development of non-residential use in ZRB3. Thus, ZRB3 is used as promotive commercial zone. These non-residential buildings should be used as tsunami evacuation shelters and meet the building design requirements suggesting “Ruko Type” with enhanced design of foundation and structure for earthquake resistance. ZRB4 is preserved as protected area for DRR purpose where park development and tree planting are conducted. All structures in ZRB4 are relocated. The development intensity of ZRB2 is low. In this land use pattern, in addition to existing non-commercial facilities such as PGM and Mercure Hotel, new development of commercial and tourism facilities can be allowed. Thus, the current development direction for tourism and waterfront city can be still maintained in this case. The coastal area can be developed as attractive commercial and tourism spots by developing park and commercial facilities altogether.

(iii) Different Land Use Patterns for Scenario 3

In Scenario 3 in which **Elevated Road and Road Bridge with Footpath** are reconstructed, two land use patterns of ① **Moderate** and ② **Promotive** land use for ZRB2 are suggested.

① Land Use Pattern 3B: Promotive Land Use for Scenario 3

Same as Pattern 3A, Promotive Land Use Pattern 3B allows the construction of new development for residential and non-residential purposes in ZRB3. ZRB3 area protected by elevated road will become ZRB2, and unprotected ZRB3 area will remain only outside the elevated road. Thus, ZRB3 area which can be usable will literally disappear in this case. ZRB2 will become middle/high intensity commercial and residential zone. In this zone, new development will be allowed with earthquake resistance design that refers to applicable standards. In tsunami and flood hazard zone, buildings are adjusted to the vulnerability level of the disaster.

ZRB4 located only in unprotected area by elevated road is preserved as protected area for DRR purpose where park development and tree planting are conducted. All structures in ZRB4 are relocated. In this pattern 3B, the coastal area can accommodate any type of development and can play the function of an urban center like before the disaster.

② Land Use Pattern 3A: Moderate Land Use for Scenario 3

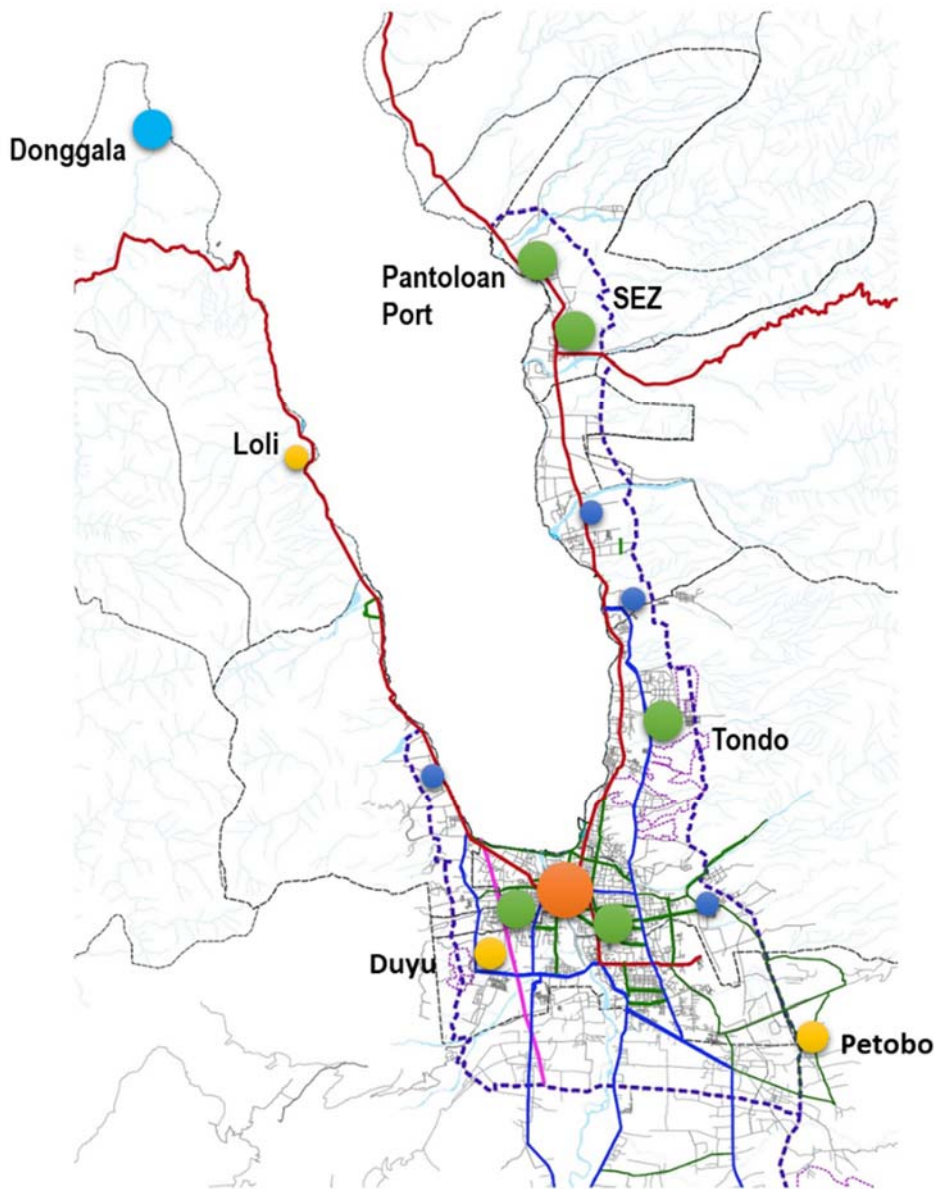
The Moderate Land Use Pattern 3A allows the rehabilitation and reconstruction of existing buildings of residential use, and existing and new non-residential purposes in ZRB3. ZRB3 area protected by elevated road will become ZRB2 and unprotected ZRB3 area will remain only outside the elevated road. Thus, ZRB3 area which can be usable will literally disappear in this case. The ZRB2 will become low intensity commercial and residential zone. In this zone, new development will be allowed with earthquake resistance design that refers to applicable standards. In tsunami and flood hazard zone, buildings are adjusted to the vulnerability level of the disaster.

ZRB4 which is located only in unprotected area by elevated road is preserved as protected area for DRR purpose where park development and tree planting are conducted. All structures in ZRB4 are relocated.

3-4-3 Palu Bay Eastern Inland Area

(1) Background: The Characteristics of the Area and Existing Development Plan

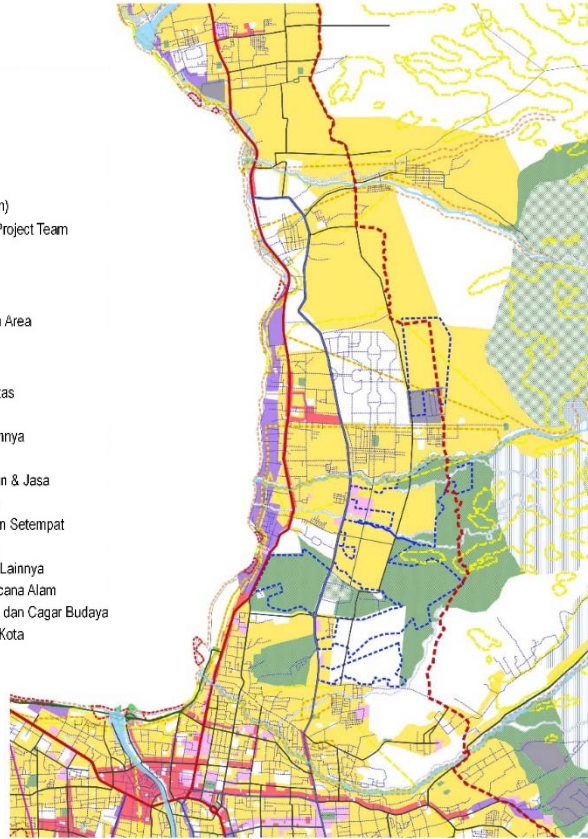
This section is focused on the formulation of a spatial concept for the eastern coastal area of Palu City, in particular Tondo-Talise Area. There are important urban centers in the eastern coastal area of Palu, including Pantoloan Port, SEZ, and Tondo Area along Jl. Trans Sulawesi as shown in Figure 3-25. Tondo is identified as an urban sub-center in Palu City RTRW 2010-2030. In the area, Tadulalo University campus, government offices, and CitraLand have been developed. Permanent relocation sites are planned to be developed in Tondo-Talise Area. A master plan was prepared in 2018 before the disaster for this area to develop as a new center (see Figure 3-26 and Figure 3-27 for land use plan in the RTRW and master plan for the area, respectively).



Source: JICA Study Team

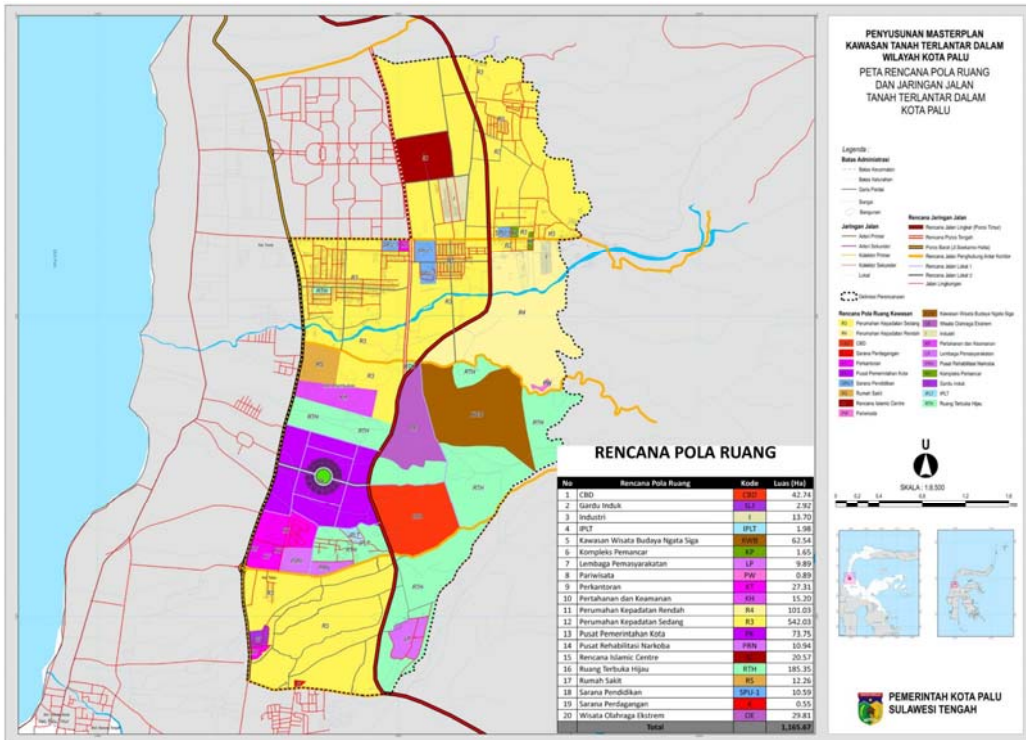
Figure 3-25 Urban Centers in Palu and Surrounding Area

- Legend
- Road
- National Road
 - Provincial Road
 - District/City Road
 - Outer Ring Road (Plan)
- Multi-Hazard Map by JICA Project Team
- Level 2
 - Level 3
 - Level 4
 - Permanent Relocation Area
- Land Use
- Hutan Lindung
 - Hutan Produksi Terbatas
 - Kawasan Industri
 - Kawasan Lindung Lainnya
 - Kawasan Pariwisata
 - Kawasan Perdagangan & Jasa
 - Kawasan Perkantoran
 - Kawasan Perlindungan Setempat
 - Kawasan Perumahan
 - Kawasan Peruntukan Lainnya
 - Kawasan Rawan Bencana Alam
 - Kawasan Suaka Alam dan Cagar Budaya
 - Ruang Terbuka Hijau Kota



Source: Palu City RTRW 2010-2030

Figure 3-26 Land Use Plan of the Eastern Coast in Palu City RTRW 2010-2030

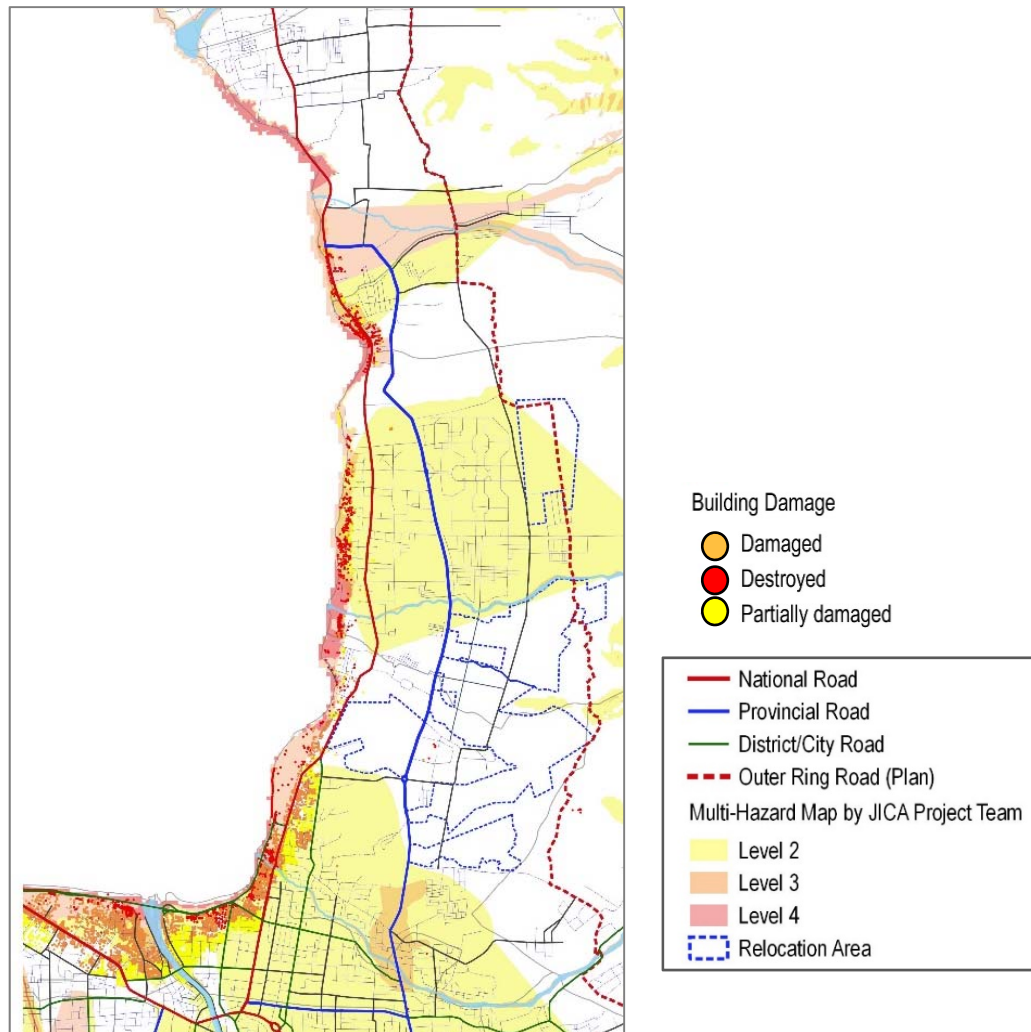


Source: Peta Rencana Pola Ruang dan Jaringan Jalan Tanah Terlantar Dalam Kota Baru, Penyusunan Masterplan Kawasan Terlantar dalam Wilayah Kota Palu

Figure 3-27 Master Plan for Tondo-Talise Area

(2) Disaster Damage, Disaster Characteristics and Disaster Hazard

The damage caused by tsunami and the multi-hazard map JICA Study Team are presented in Figure 3-28. Tsunami risk areas are identified along the coast; however, the ZRB4 areas are found in several locations only. There are ZRB3 areas of sediment disaster from the hillside to the coastal area around the Tadulako University campus and the rivers of Liangga and Bulubiongga. The tsunami damage is found in tsunami ZRB areas. However, most of the areas with destroyed buildings are categorized as ZRB3. The permanent relocation sites are found in safe areas with no or less disaster risk.



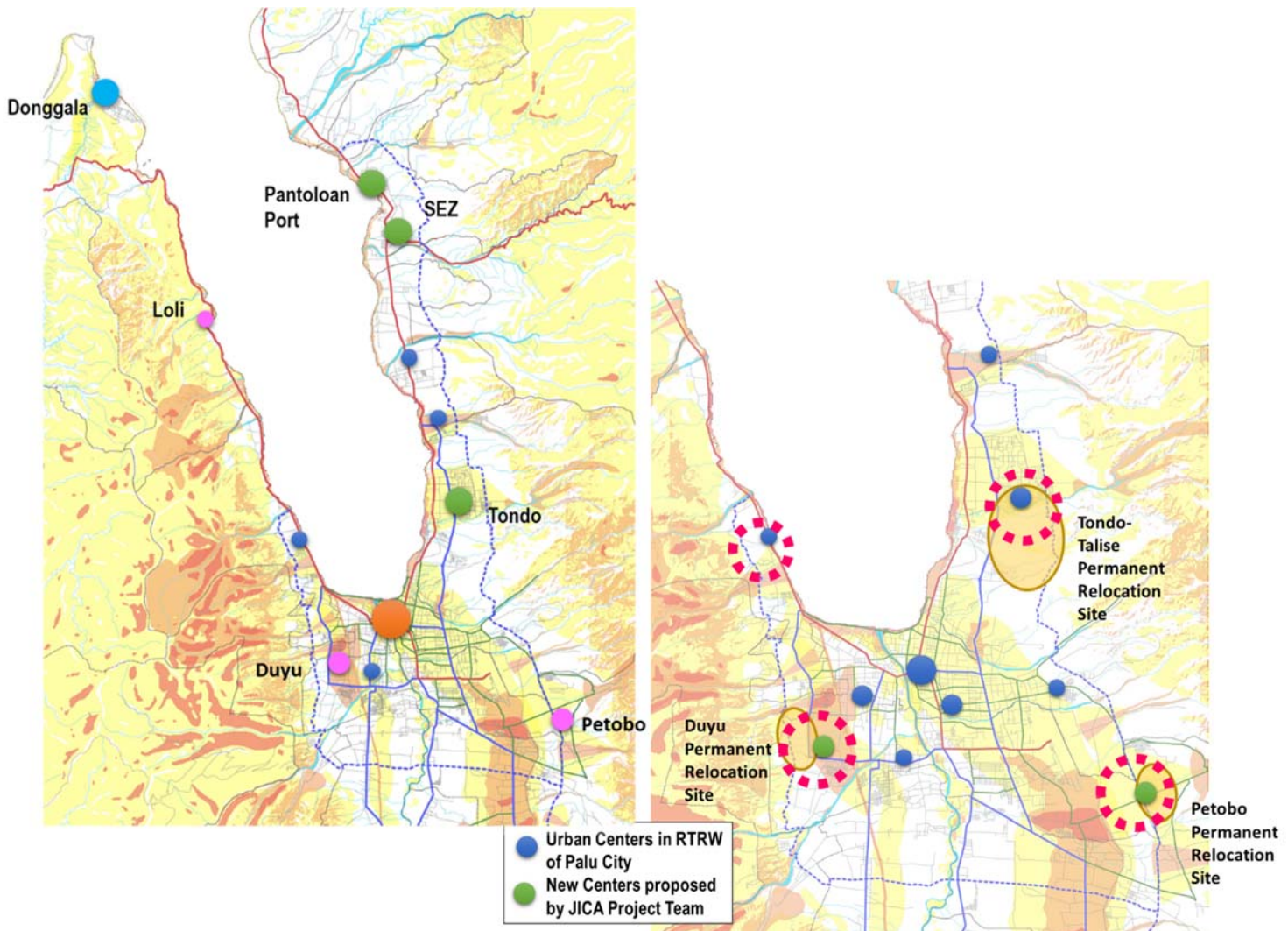
Source: JICA Study Team based on ZRB Map and Damage Data from Copernicus <https://emergency.copernicus.eu/mapping/list-of-components/EMSR317>

Figure 3-28 Disaster Damage and Multi-Disaster Hazard Map by JICA Study Team for Eastern Coastal Area in Palu

(3) Alternative Scenario of Spatial Structure for Palu Bay Eastern Inland Area

As discussed, the eastern coastal area is an important sub-urban center to promote development in the eastern side up to Pantoloan Port. Developing this eastern coastal area with less disaster risk aims to reduce development pressure on the CBD area, including the southern coastal area where disaster

risk is relatively high.



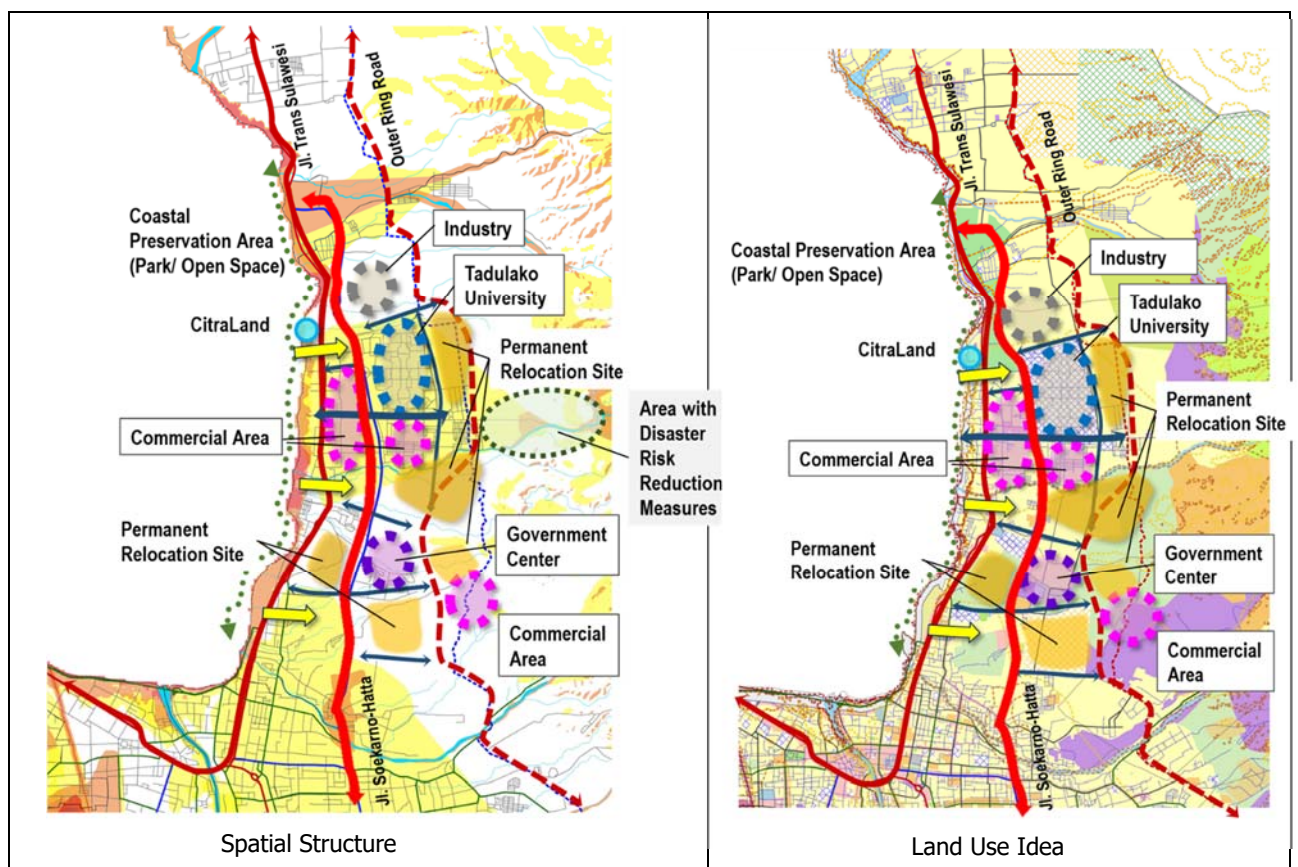
Source: JICA Study Team

Figure 3-29 Urban Centers and ZRB in Palu and Surrounding Area

Spatial structure and land use idea are proposed for Palu Western Coast Area and Pantoloan Area as presented in Figure 3-30 and Figure 3-31, respectively.

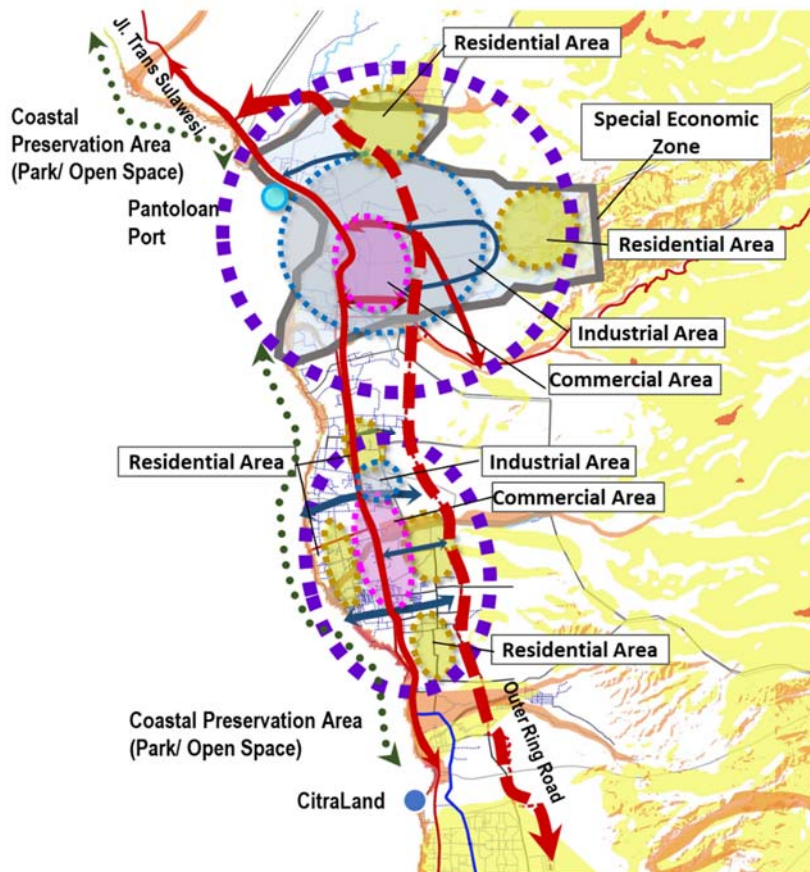
- Land Use Policy for ZRB4 and 3 Areas:
 - To preserve ZRB4 area as protected area and to prohibit the use of the land
 - To preserve the coastal area as park / open space
 - To reduce tsunami risk in ZRB3 and 4 by structural measure
 - To introduce land use and building regulations for ZRB3 and 4, which conditionally allow to use ZRB3 for the existing residential buildings and existing and new non-residential facilities with the requirements for the building regulations, but to prohibit use of ZRB3 for new important facilities and any type of high risk facilities.
 - To implement disaster risk mitigation measures in ZRB3 area of sediment disaster

- Strategy for Spatial Development
 - To develop the eastern coastal area as a new center in an integrated manner, including development of permanent relocation sites and new roads
 - To promote development along Jl. Soekarno-Hatta as a main corridor and to promote relocation of the residents, government offices, and commercial facilities to this area
 - To develop Pantoloan Area with SEZ as an urban center and a local service center between Jl. Trans Sulawesi and the Outer Ring Road in Palu Utara
 - To develop the Outer Ring Road up to Pantoloan Port



Source: JICA Study Team

Figure 3-30 Spatial Structure and Land Use Idea Proposed for Palu Bay Eastern Coast Area



Source: JICA Study Team

Figure 3-31 Spatial Structure Proposed for Pantoloan Area

3-4-4 Palu Bay Western Coastal Area

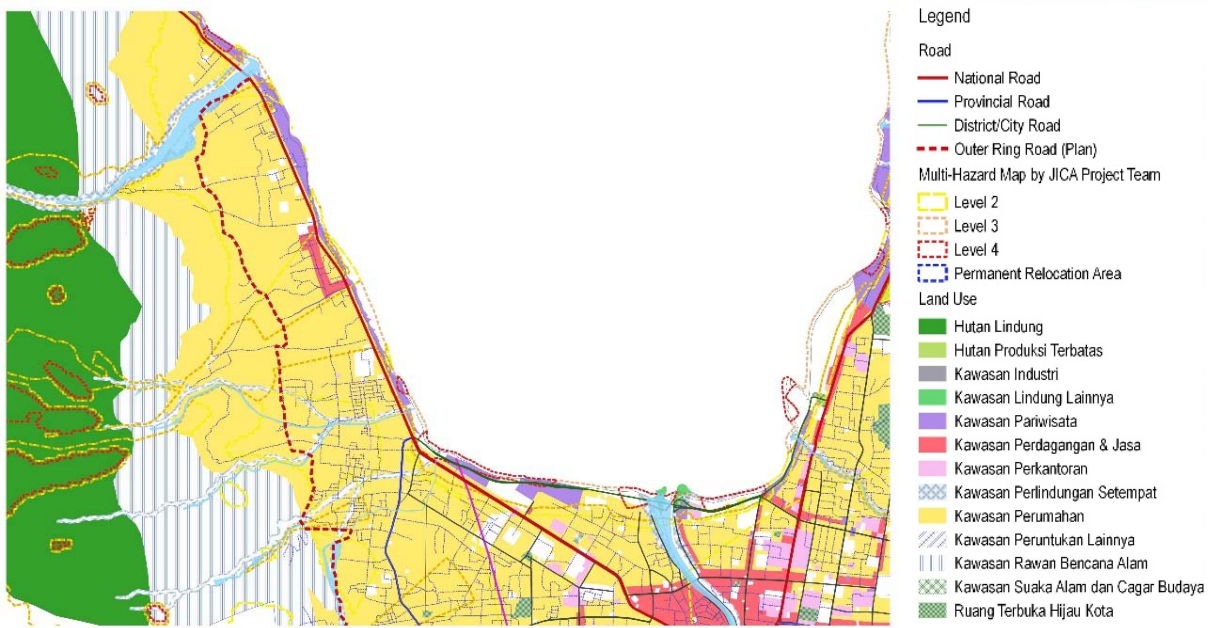
(1) Background: The Characteristics of the Area and Existing Development Plan

The western coastal area in Palu has been developed along Jl. Trans Palu Donggala connecting Palu and Donggala. In Palu City RTRW 2010-2030, the coastal area is designated as tourism area, including the area of Swiss-Belhotel and the southern area of the Buluri River (see Figure 3-32). A local service center is identified in Tipo area for commercial and service use. Residential and tourism developments have been proceeding in the hillside areas.

(2) Disaster Damage, Disaster Characteristics and Disaster Hazard

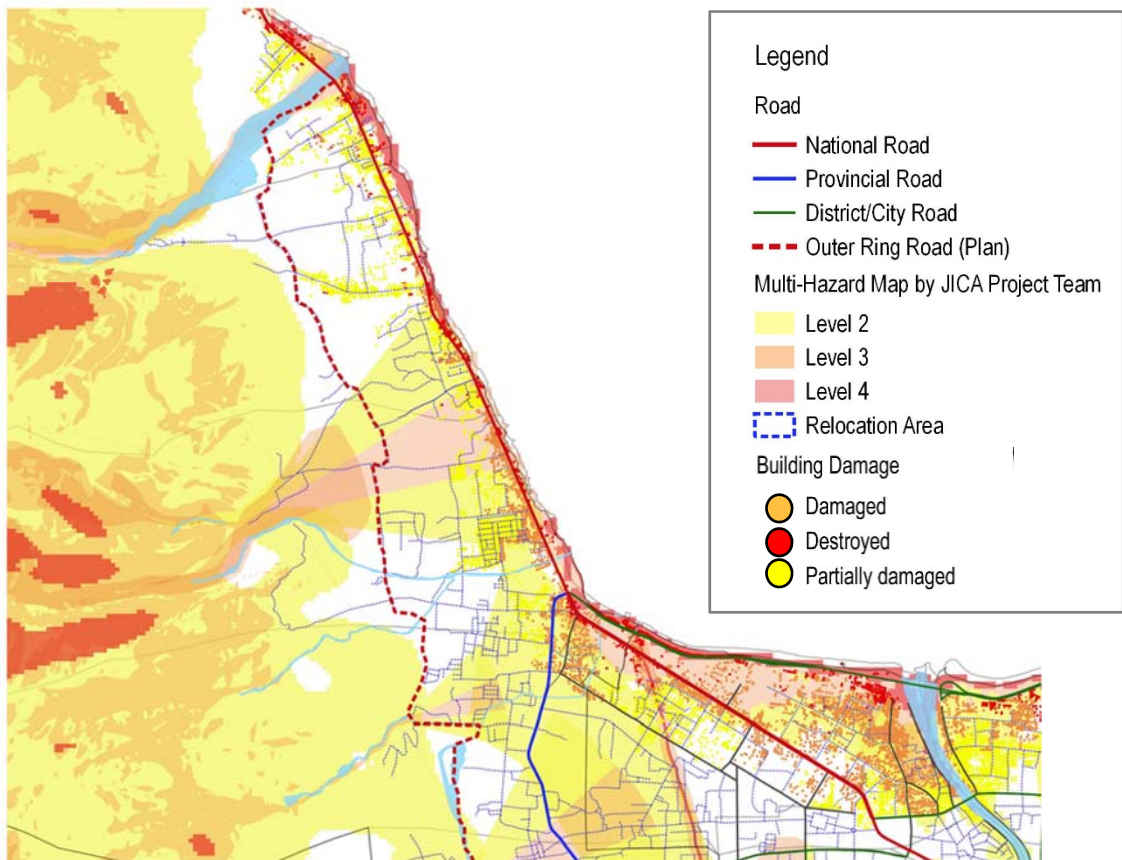
The disaster damage by tsunami and multi-hazard map JICA Study Team is shown in Figure 3-33. The destroyed (or completely damaged) buildings are found along the coast and the road.

Tsunami disaster risk is determined along these coastal areas on the hazard map, though ZRB4 is identified in the area next to Swiss Belhotel. Tsunami risk is not present in some areas where building damage is found. Sediment disaster risk is present in hillside areas.



Source: Palu City RTRW 2010-2030

Figure 3-32 Land Use Plan for Palu Bay Western Coast Area in Palu City RTRW 2010-2030



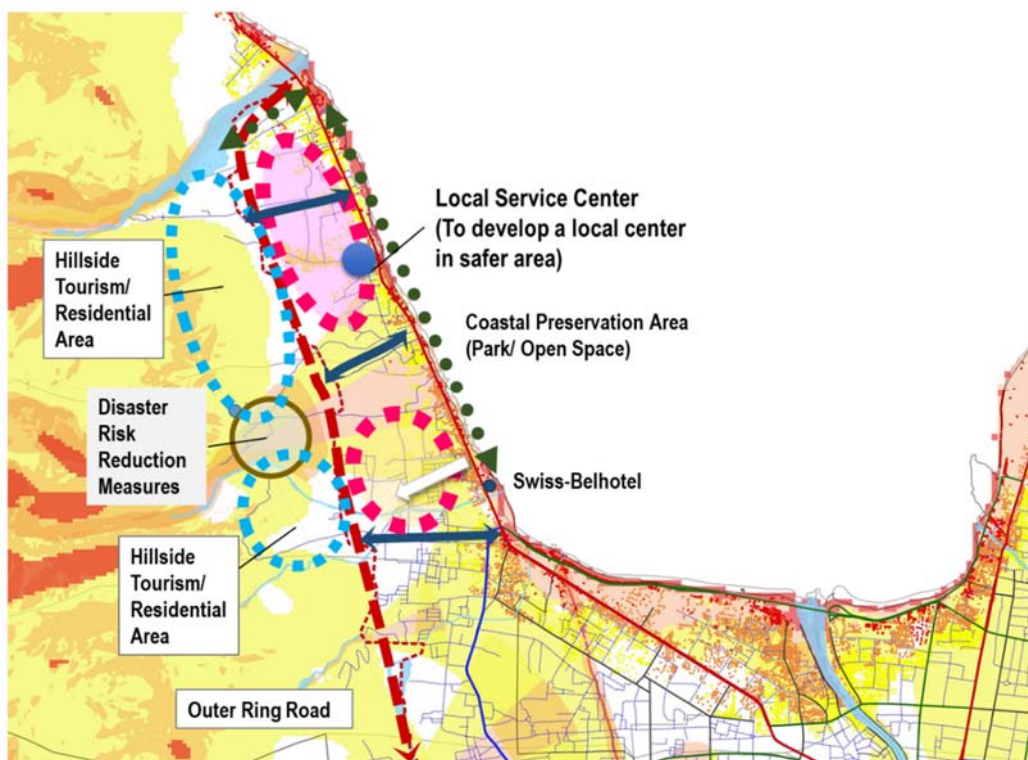
Source: JICA Study Team based on ZRB Map and Damage Data from Copernicus <https://emergency.copernicus.eu/mapping/list-of-components/EMSR317>

Figure 3-33 JICA Study Team's Disaster Damage and Multi-Hazard Map of Palu Bay Western Coastal Area in Palu City

(3) Alternative Scenario of Spatial Structure for Palu Western Coast Area

Spatial structure and land use idea are proposed for Palu Western Coast Area as presented in Figure 3-34 and Figure 3-35.

- Land Use Policy for ZRB4 and 3 Areas:
 - To preserve ZRB4 area as protected area and to prohibit the use of the land
 - To preserve the coastal area regardless of disaster risk as park / open space
 - To reduce tsunami risk in ZRB3 by structural measure
 - To introduce land use and building regulations for ZRB3 and 4, which conditionally allow to use ZRB3 for the existing residential buildings and existing and new non-residential facilities with the requirements for the building regulations, but to prohibit use of ZRB3 for new important facilities and any type of high risk facilities.
 - To implement disaster risk mitigation measures in ZRB3 area of sediment disaster
- Strategy for Spatial Development
 - To develop the Outer Ring Road to promote development along ORR while controlling the development of the coastal area



Source: JICA Study Team

Figure 3-34 Spatial Structure Proposed for Palu Western Coast Area

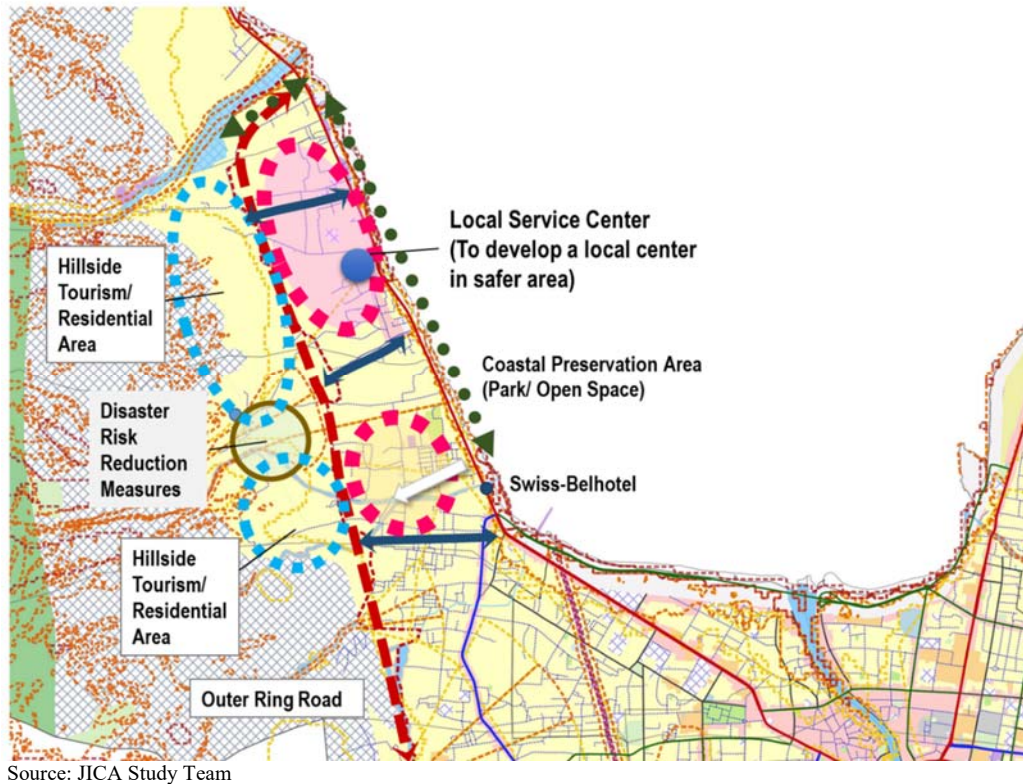
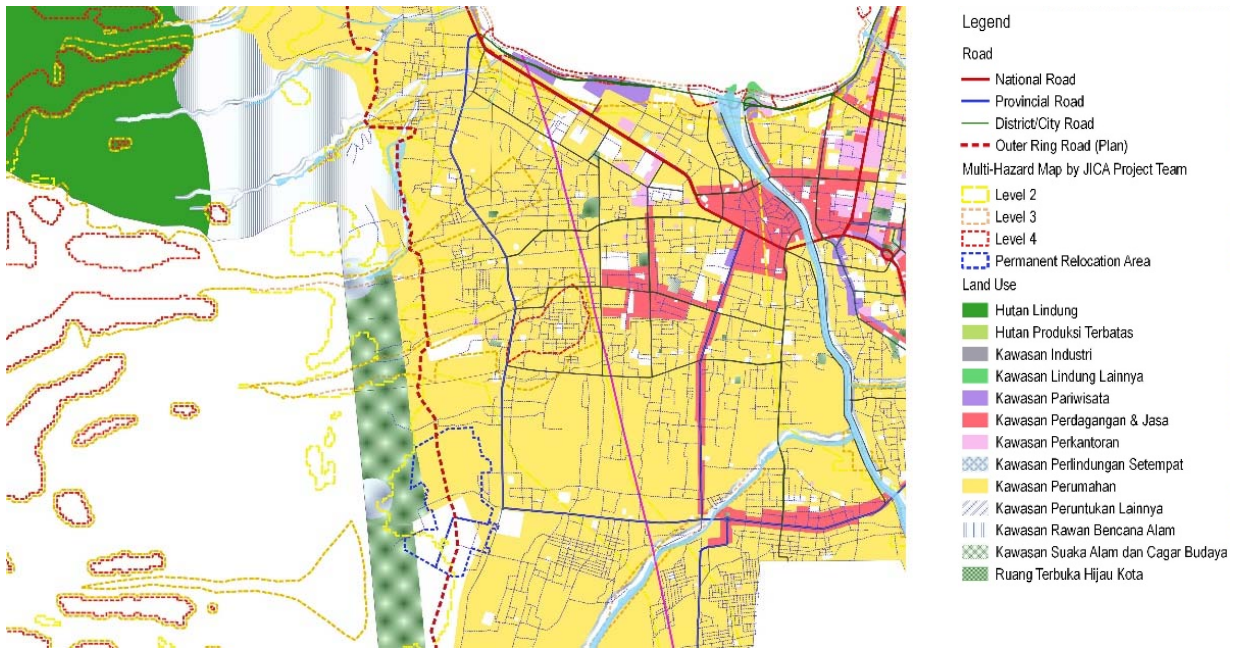


Figure 3-35 Land Use Idea Proposed for Palu Western Coast Area

3-4-5 Nalodo-Affected Area in Western Part of Palu

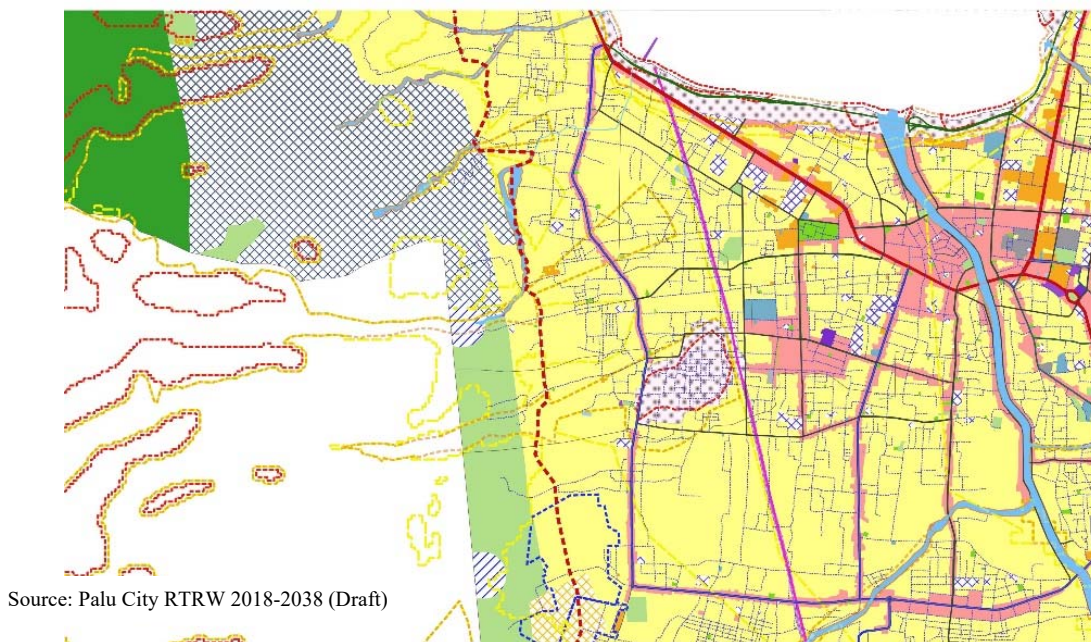
(1) Background: The Characteristics of the Area and Existing Development Plan

The Nalodo-affected area in the western part of Palu, Balaroa is a residential area in the middle of the urban area where residents are not farmers but office workers. The Balaroa area and the area where the Palu-koro fault passes through are identified as residential area in RTRW 2010-2030 and also in draft RTRW 2018-2038, except the area directly affected by the Nalodo as shown in Figure 3-36 and Figure 3-37.



Source: Palu City RTRW 2010-2030

Figure 3-36 Land Use Plan for the Balaroa and the Palu-Koro Active Fault Area in RTRW 2010-2030



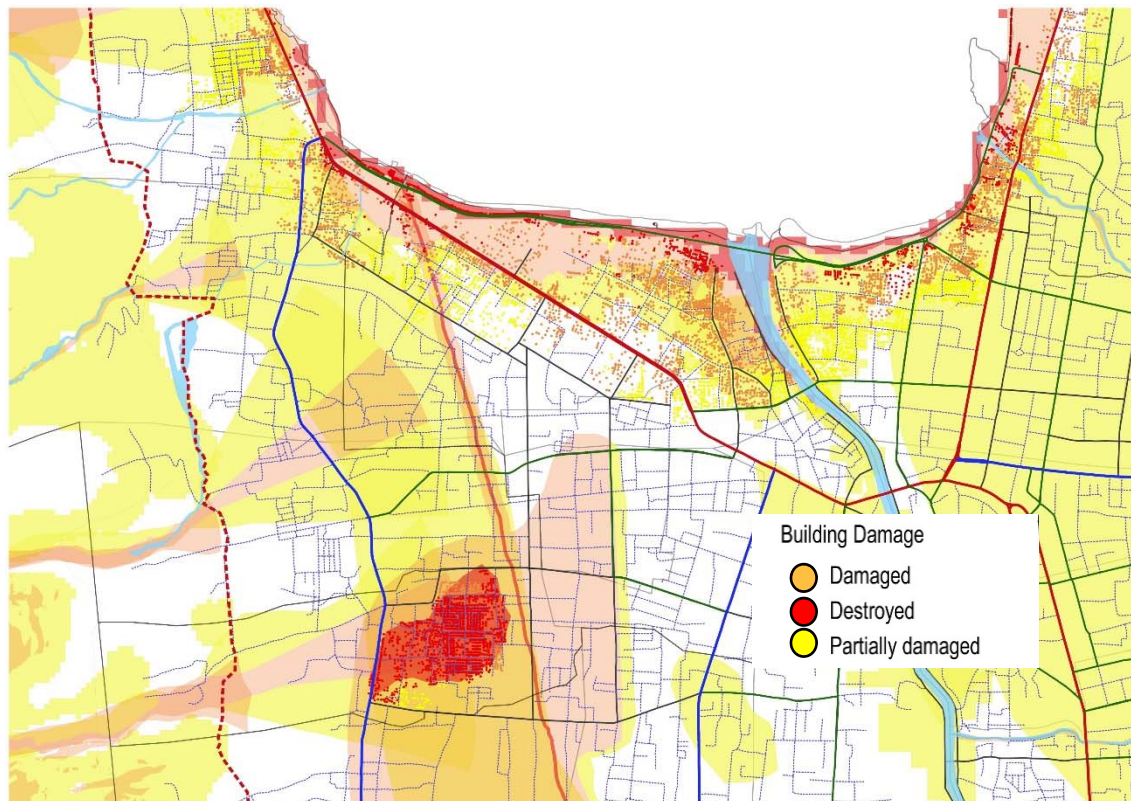
Source: Palu City RTRW 2018-2038 (Draft)

Figure 3-37 Land Use Plan for the Balaroa and the Palu Koro Fault Area in Draft RTRW 2018-2038

(2) Disaster Damage, Disaster Characteristics and Disaster Hazard

The damage caused by Nalodo in Balaroa Area is shown in Figure 3-38. The damage is concentrated in the Balaroa Area; however, the damage around the Palu Koro fault is not shown on the map.

According to the multi-hazard map JICA Study Team, the Nalodo-affected area is identified as ZRB4, and the areas surrounding the Balaroa Area and its southern part are designated as ZRB3.



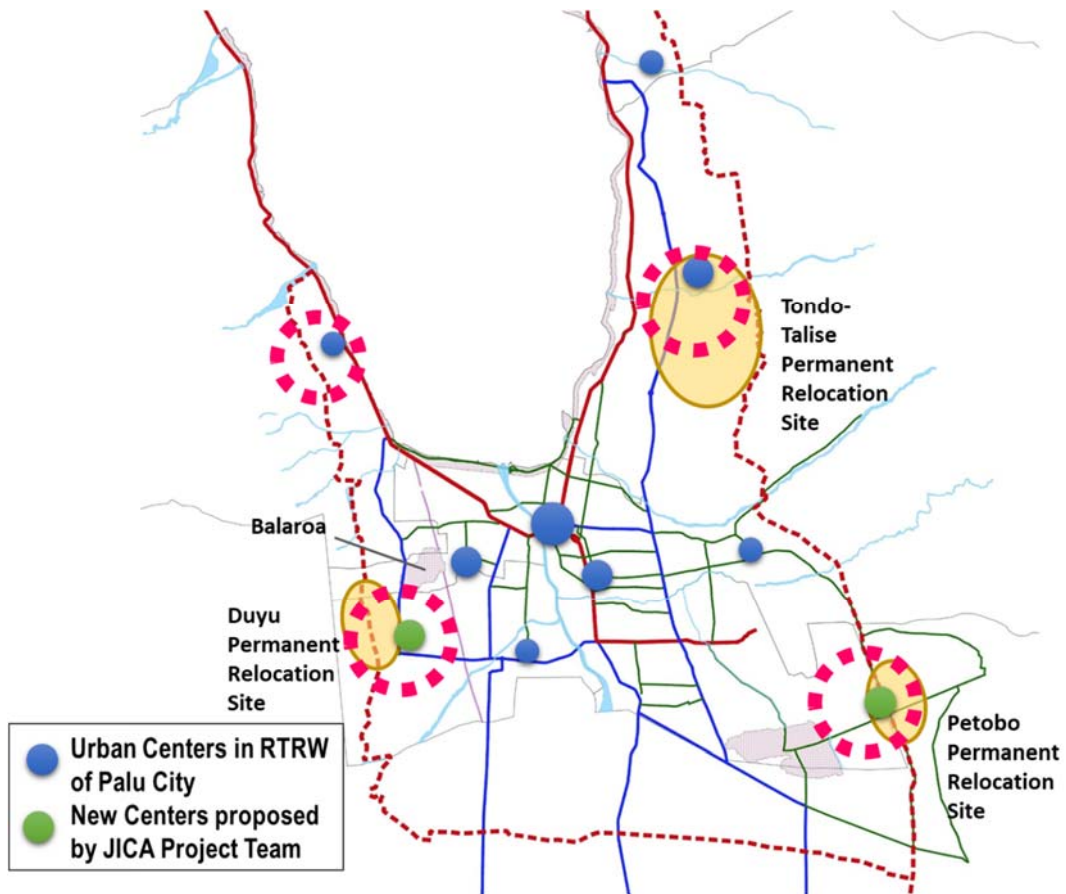
Source: JICA Study Team based on ZRB Map and Damage Data from Copernicus <https://emergency.copernicus.eu/mapping/list-of-components/EMSR317>

Figure 3-38 Damage by Nalodo in Balaroa Area

(3) Reconstruction Policy and Alternative Scenarios of Spatial Structure for the Nalodo-Affected Area in Western Part of Palu

1) Land Use Policy for ZRB4 and ZRB3 in Nalodo-Affected Area in Western Part of Palu

In order to consider the reconstruction policy and alternative scenarios of spatial structure for the Nalodo-affected area in the western part of Palu, the distribution of urban centers in Palu is examined as shown in Figure 3-39. In addition to the urban centers in the draft RTRW 2018-2033 for Palu City, new urban sub-centers are proposed around the permanent relocation sites of Duyu and Petobo. A new urban subcenter is suggested in the south-western part of Palu near Duyu permanent relocation site, where the relocation from Balaroa is planned and which has access to the Inner Ring Road and proposed Outer Ring Road.



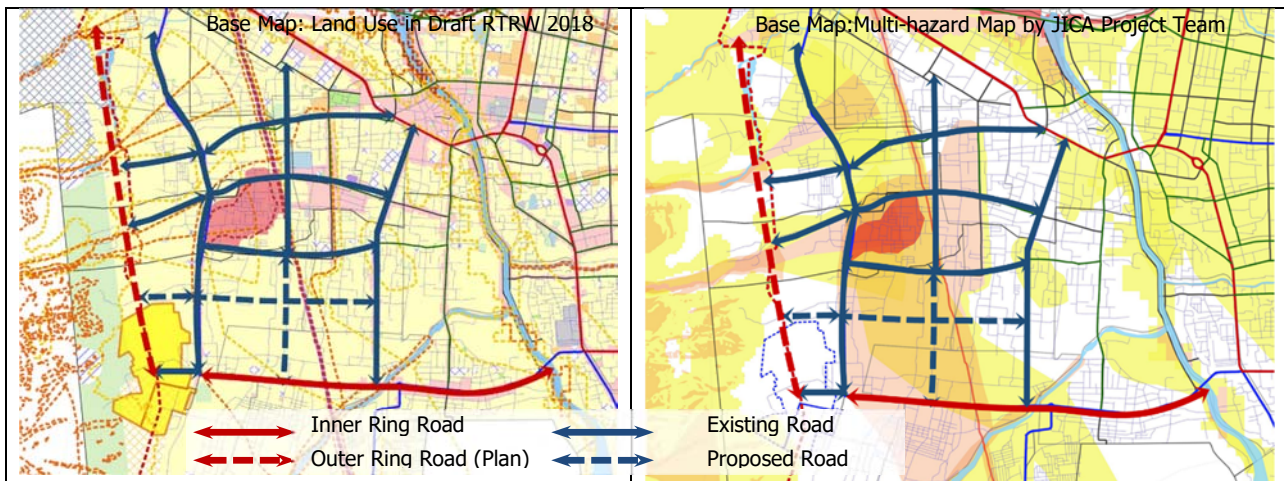
Source: JICA Study Team

Figure 3-39 Urban Centers in Palu

The land use policy for the Nalodo-affected area in Western Part of Palu is proposed as follows:

- ZRB4 for Nalodo:
 - To restrict the use of the Red Zone (ZRB4 due to liquefaction landslide/ fault) and preserve this area as open space / park (memorial facility might be allowed to be built).
- ZRB3 for Nalodo:
 - To allow the ZRB3 area for residential use by rehabilitation of the existing residential facilities, with the conditions of implementation of disaster risk mitigation measures for Nalodo and continuous efforts for disaster education and awareness raising
 - To allow the use of ZRB area for new development of non-residential facilities, with the condition of implementation of disaster risk mitigation measures for Nalodo, such as facilities for agri-processing, workshops, factories, and warehouses.
- Risk Area of Sediment Disaster:
 - To conduct disaster risk mitigation measures, such as channel groove for the hillside areas, in the west of Balaroa with the risk of sediment disaster
- To improve water supply in the hillside area.

- To improve a road network around Balaroa Area (see Figure 3-40)



Source: JICA Study Team

Figure 3-40 Proposed Road Network in Balaroa Area

2) Alternative Scenarios Based on Land Use Options for ZRB3 in Balaroa Area

The following three types of land use options were formulated for ZRB3 in Balaroa Area:

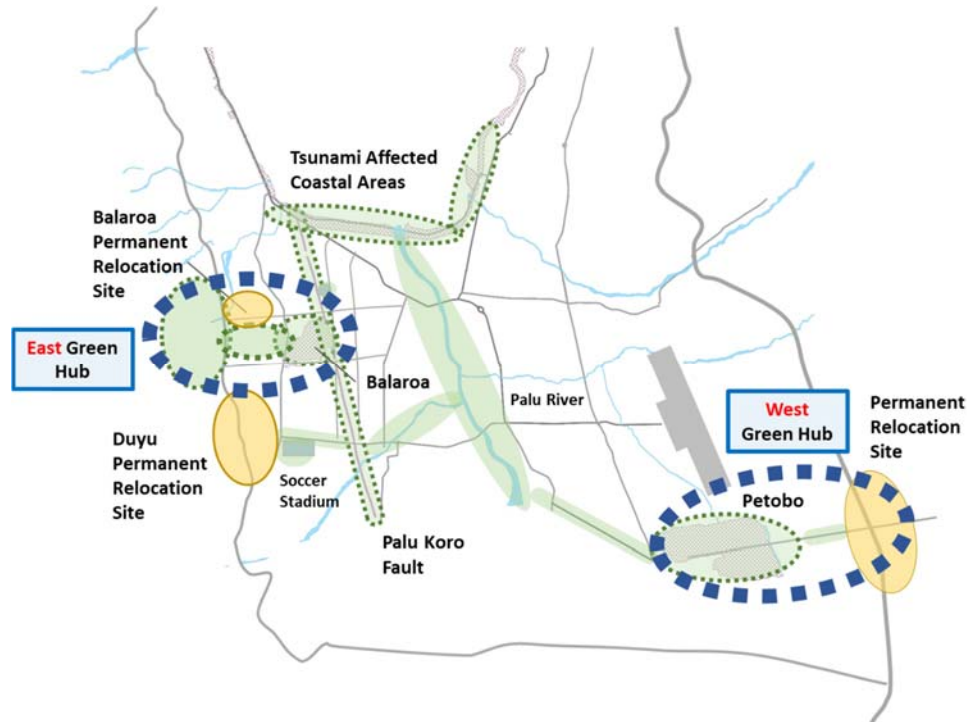
- Alternative Scenario – Land Use Option 1: Promoting Livestock Raising and Less Intensive Agriculture for ZRB3 Area
- Alternative Scenario – Land Use Option 2: Promoting Light Industry for ZRB3 Area
- Alternative Scenario – Land Use Option 3: Continuation of Maintaining Residential Areas (by Rehabilitation of Residential Houses and Absorbing Additional Residential Houses)

(i) Alternative Scenario- Land Use Option 1 for ZRB3 Area in Balaroa : Balaroa Green Urban Village

A concept of Balaroa Green Urban Village is proposed as a land use option as presented in Figure 3-41 and Figure 3-42. This concept proposes to develop green networks connecting parks and open spaces which will be developed in the Nalodo-affected area in Balaroa, in the buffer zone of the Palu Koro Fault, and in existing parks and open space and rivers. The development policy is proposed as follows:

- To develop a park and green open space in ZRB4 areas of Balaroa Nalodo-affected area and in the buffer zone of the Palu Koro Fault, making these as green hubs in the western part of Palu. Spring water will be used for development of waterpark in Balaroa. A pedestrian path and cycling road will be developed along the Palu Koro Fault.
- To connect these green hubs with the existing parks, open space, the Palu River and other rivers for development of Green Network in Palu Metropolitan Area

- To preserve the western hillside of Balaroa as farming land or green space and connect it with the park in Balaroa by a pedestrian path. To develop a marché or michino-eki (roadside market) along the Outer Ring Road
- To control new development of residential use in the ZRB3 area in the south of Balaroa and use this area for urban agriculture and livestock farming, making it as an Urban Village hub



Source: JICA Study Team

Figure 3-41 Green Network Concept in Palu

(ii) Alternative Scenario - Land Use Option 2 for ZRB3 Area in Balaroa Light Industry Center

The second land use option proposes a concept of Balaroa Light Industry Center as an alternative scenario as illustrated in Figure 3-42. In this concept, the Balaroa area will be developed as light industry center, taking advantage of its proximity to the urban centers and the Outer Ring Road.

- To use ZRB3 area in the south of Balaroa Nalodo-affected area as residential and light industry mixed zone as Balaroa Light Industry Center. To allow development of light industry factories, craft and art workshops, warehouses, and other related facilities with the condition of implementation of disaster risk mitigation measures such as strengthened structure.
- To develop a park and green open space in ZRB4 area of Balaroa Nalodo-affected area and to develop green space with pedestrian path and cycling road in the buffer zone of the Palu Koro Fault.

(iii) Alternative Scenario – Land Use Option 3: Continue Maintaining Residential Areas (by Rehabilitation of Residential Houses and Absorbing Additional Residential Houses)

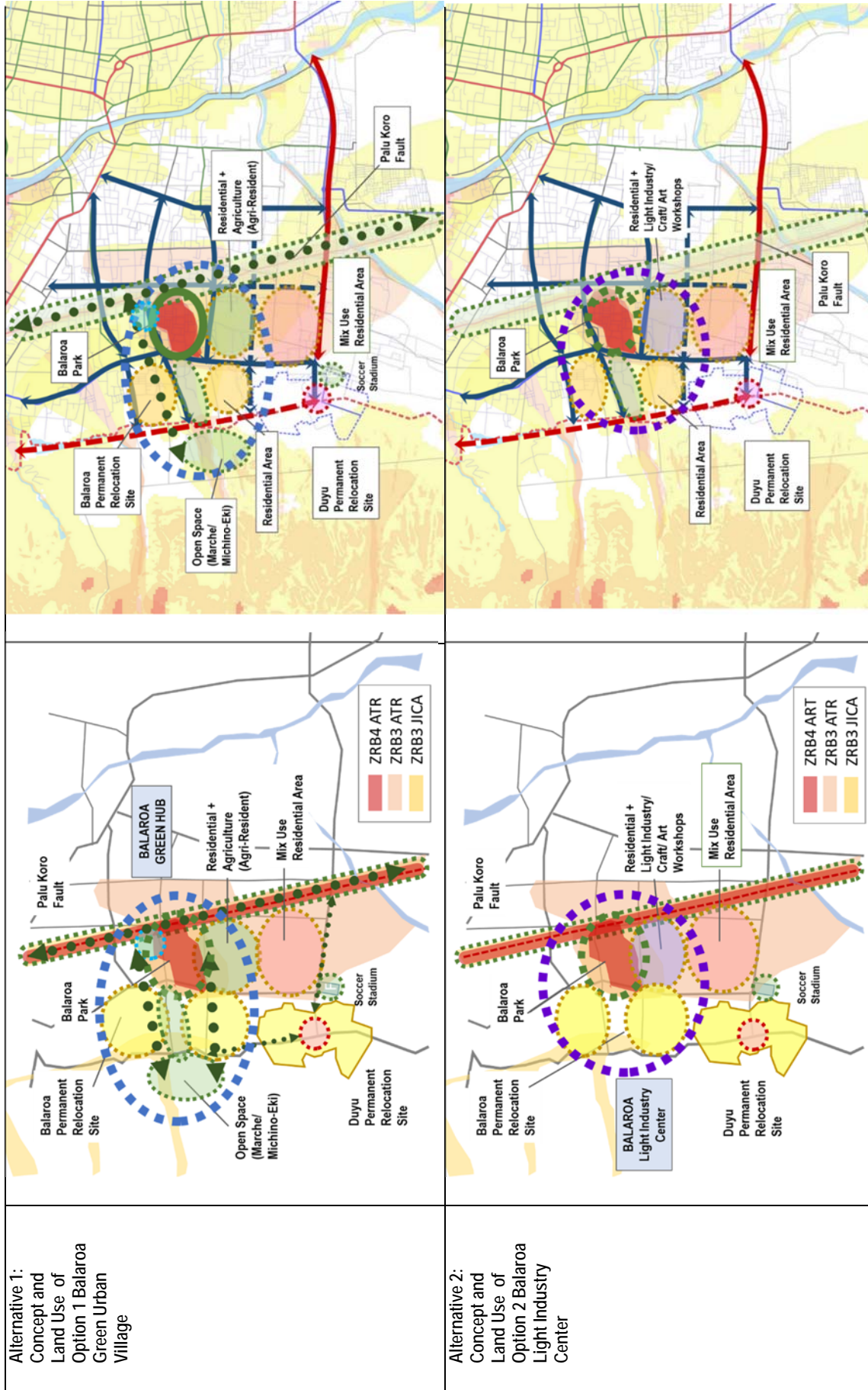


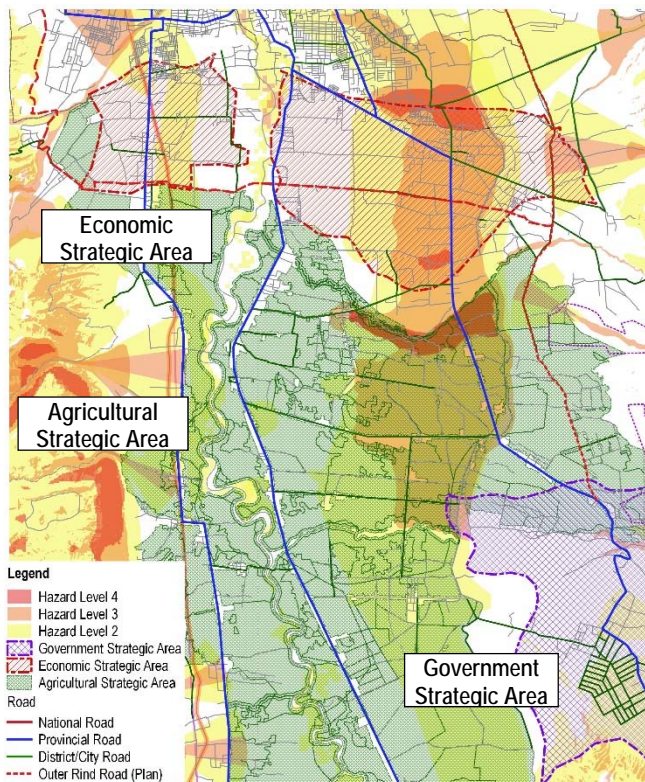
Figure 3-42 Alternative Scenarios 1 and 2 for Balaroa

Source: JICA Study Team

3-4-6 North Eastern Area of Nalodo-Affected Area in Sigi Regency

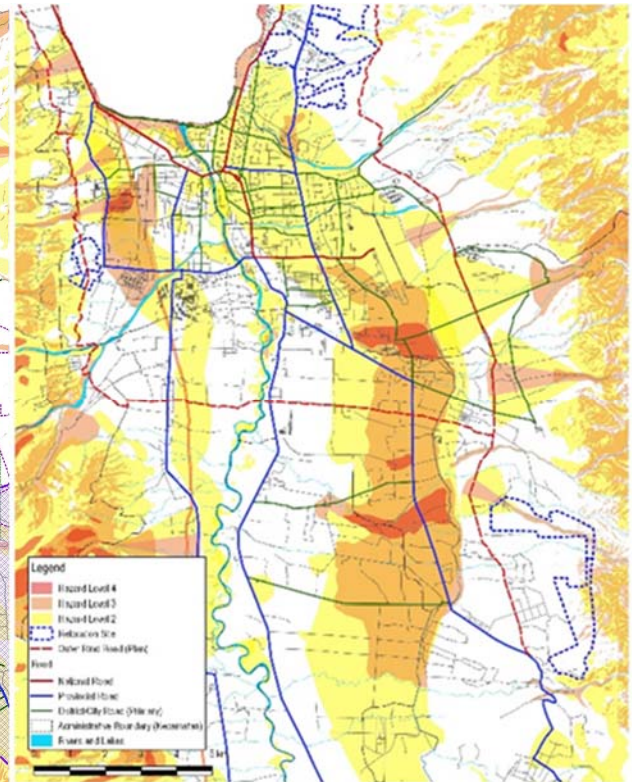
(1) Characteristics of the Area and Existing Development Plans for Sigi-Biromaru Area

The Nalodo-affected areas in Sigi are identified as the economic and agricultural strategic areas in Sigi Regency Spatial Plan (RTRW) 2010-2030. The Outer Ring Road has been developed in the eastern side of the provincial road, passing through the Nalodo-affected areas and reaches the Sigi Regent Office in the south.



Source: Sigi RTRW 2010-2030

Figure 3-43 Biromaru Area in RTRW 2010-2030

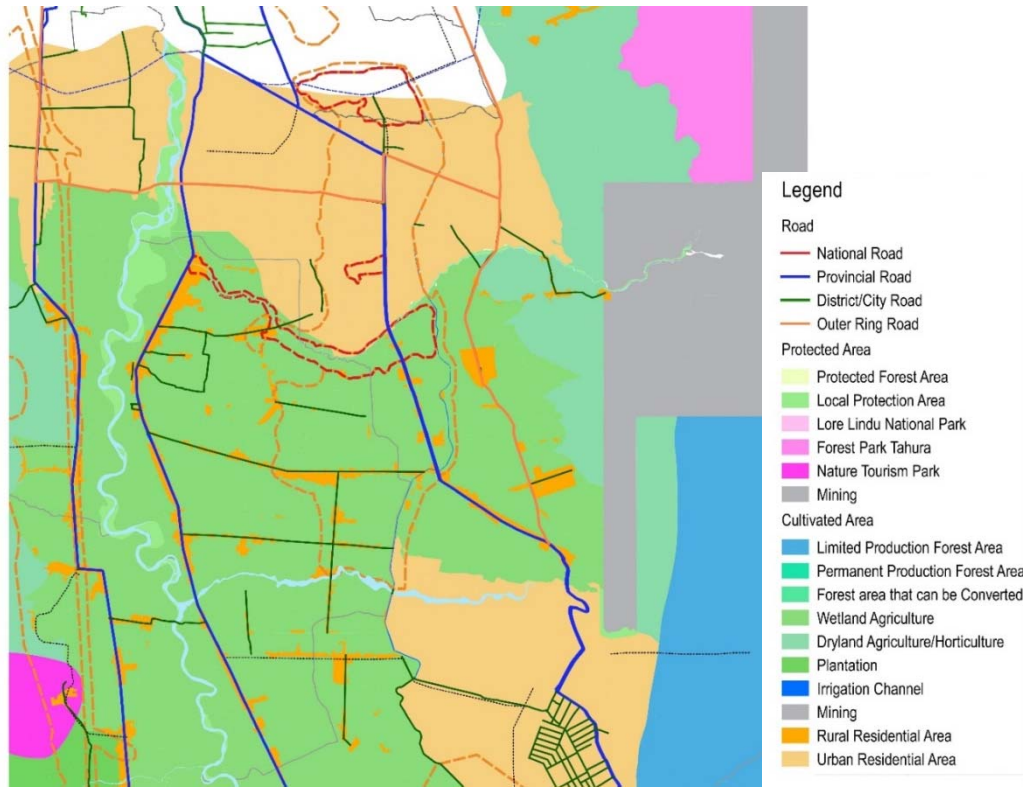


Source: JICA Study Team

Figure 3-44 Biromaru Area in Palu Metropolitan Area

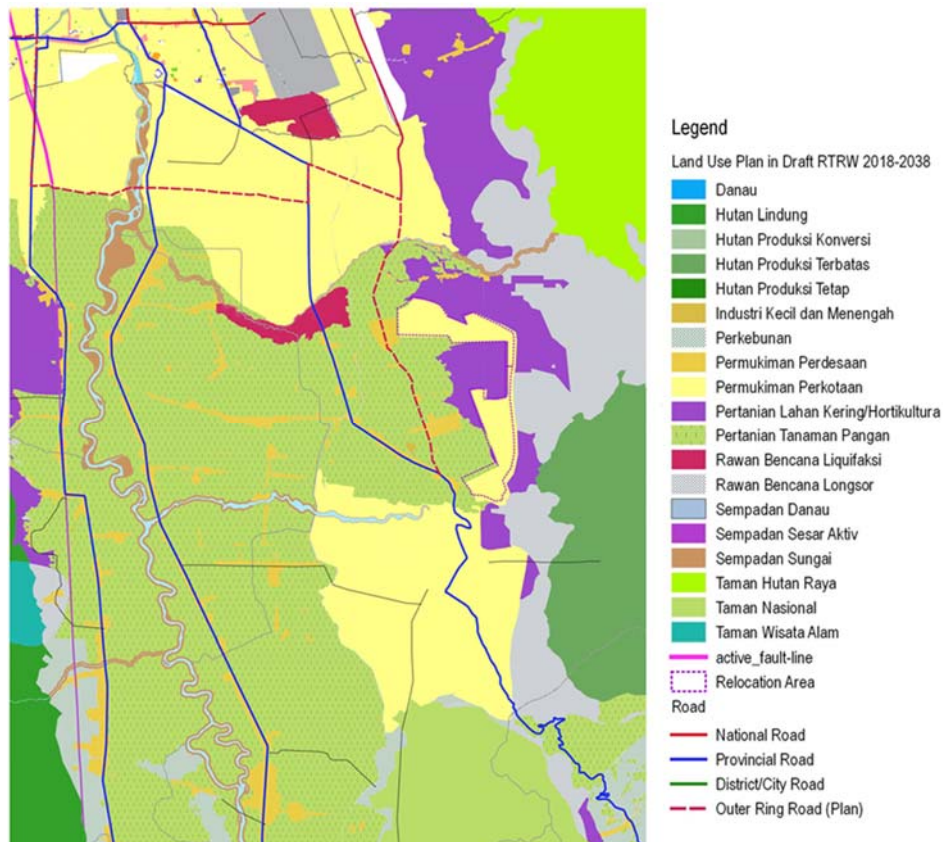
The land use plan in Sigi RTRW 2010-2030 proposed urban residential use and agricultural land use for wetland agriculture (paddy) for this area. The urbanization is expected to reach the north border of Jono Oge Nalodo-affected area as shown in Figure 3-45.

For promotion of agriculture, the Gumbasa irrigation scheme was developed in Sigi and Palu to provide water to paddy fields in the area. However, due to the disaster, 26.7 km of main channels have been damaged out of 36.0 km. Also, 42.7 km of secondary channels have been damaged out of 55.0 km. Because of these 5,000 farmers lost access to water. Irrigable land lost reached 2,190 ha out of 8,180 ha (14 ha in Petobo; 1,788 ha in Jono Oge; and 388 ha in Sibalaya). Rehabilitation of these channels is planned by ADB and JICA (see Figure 3-47).



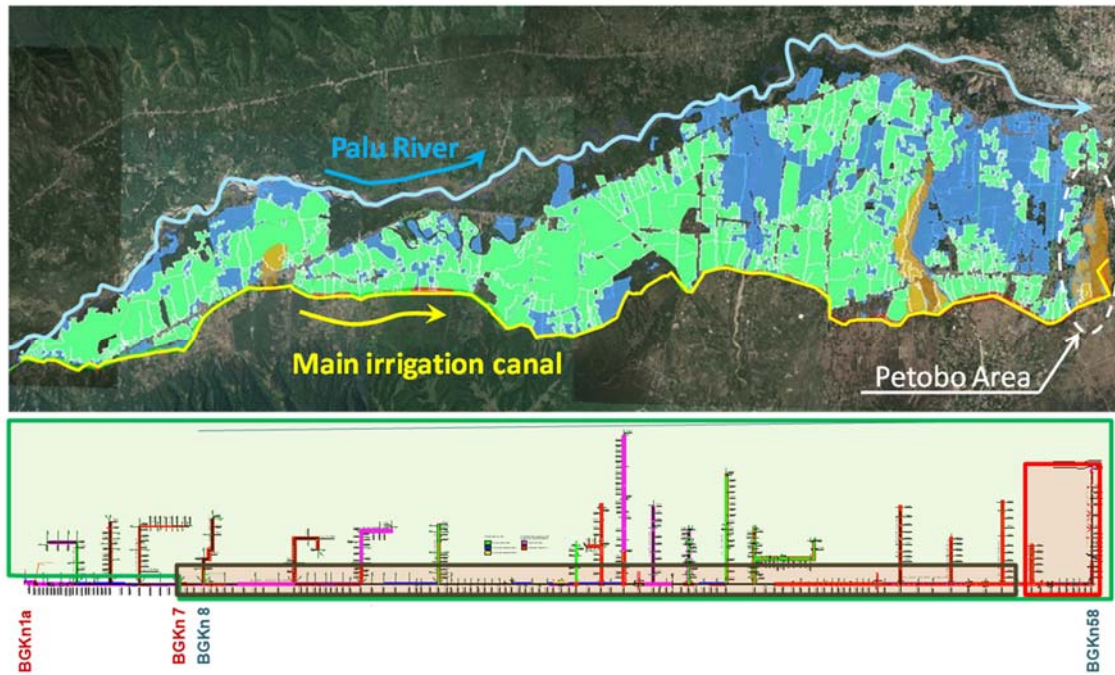
Source: Sigi Regency RTRW 2010-2030

Figure 3-45 Land Use Plan in RTRW 2010-2030



Source: Sigi Regency Draft RTRW 2018-2038

Figure 3-46 Land Use Plan in RTRW 2018-2038



Source: JICA Study Team

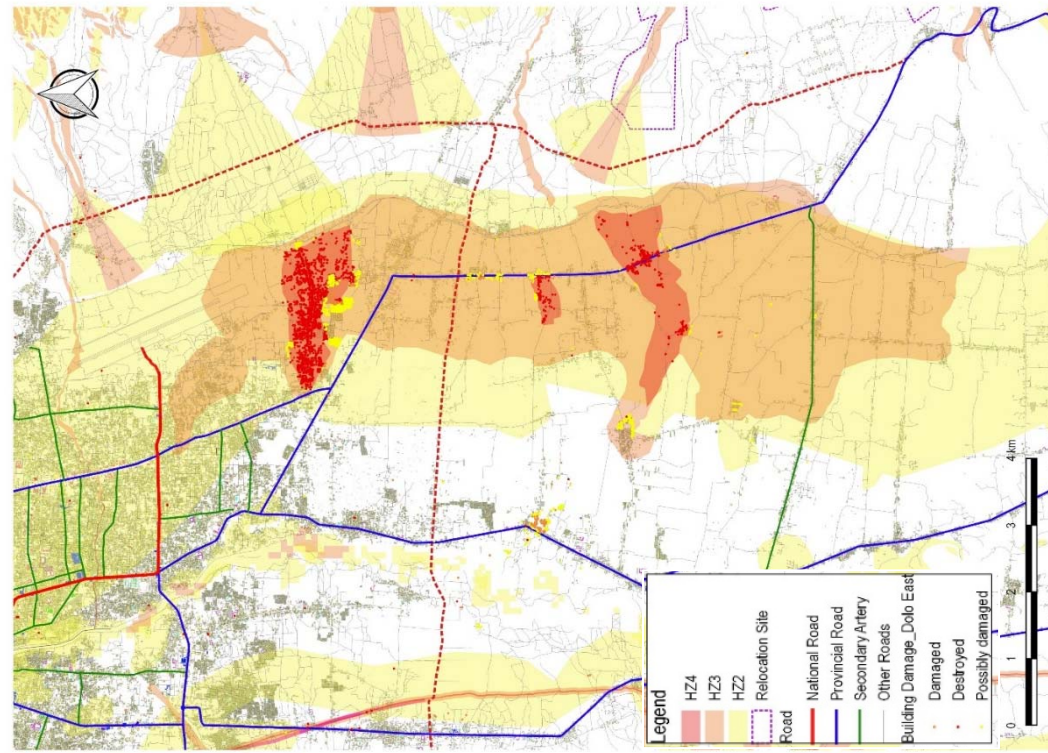
Figure 3-47 Gumbasa Irrigation Networks

(2) Disaster Damage, Disaster Characteristics and Disaster Hazard

The damage by Nalodo in Petobo was significant because the area was already urbanized at that time. Meanwhile, the damaged buildings in Sigi were mostly observed along the provincial road.

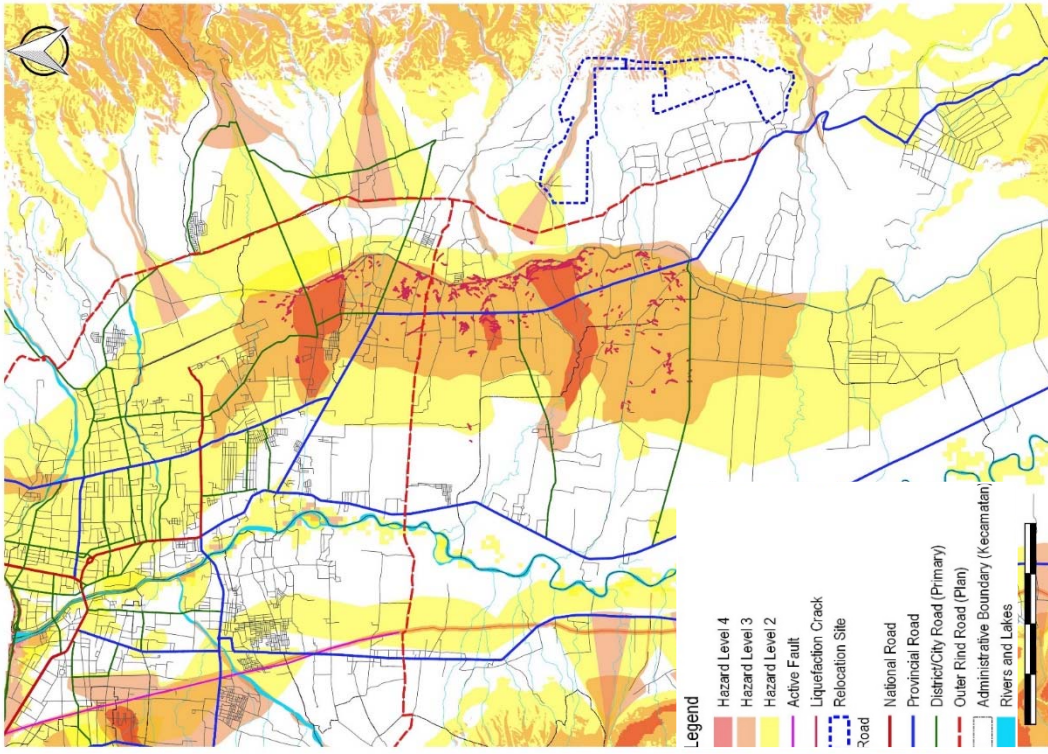
In the ZRB Map by ATR, the Nalodo-affected areas are categorized as ZRB4; the large area surrounding ZRB4 is categorized as ZRB3. In particular, ZRB3 includes vast area in Sigi Biromaru including farm lands (see

Figure 3-48). On the other hand, the draft multi-hazard map by JICA Study Team identifies smaller areas for ZRB3 in Figure 3-49. Thus, it is important to consider how to use this large area of ZRB3 in reconstruction policy.



Source: JICA Study Team based on ZRB Map and Damage Data from Copernicus <https://emergency.copernicus.eu/mapping/list-of-components/EMSR317>

Figure 3-48 Building Damage by Disaster and Hazard Levels



Source: JICA Study Team

Figure 3-49 Draft Multi-Hazard Map JICA Study Team

(3) Reconstruction Policy for the Nalodo-Affected Sigi-Biromaru Area

The reconstruction policy for the Nalodo-affected area of Sigi-Biromaru focuses on land use policy of ZRB4 and ZRB3 areas, considering future urbanization and agricultural use. Based on land use recommended in ATR's ZRB Map, the proposed policy for ZRB4 and ZRB3 are summarized as follows:

1) Urbanization

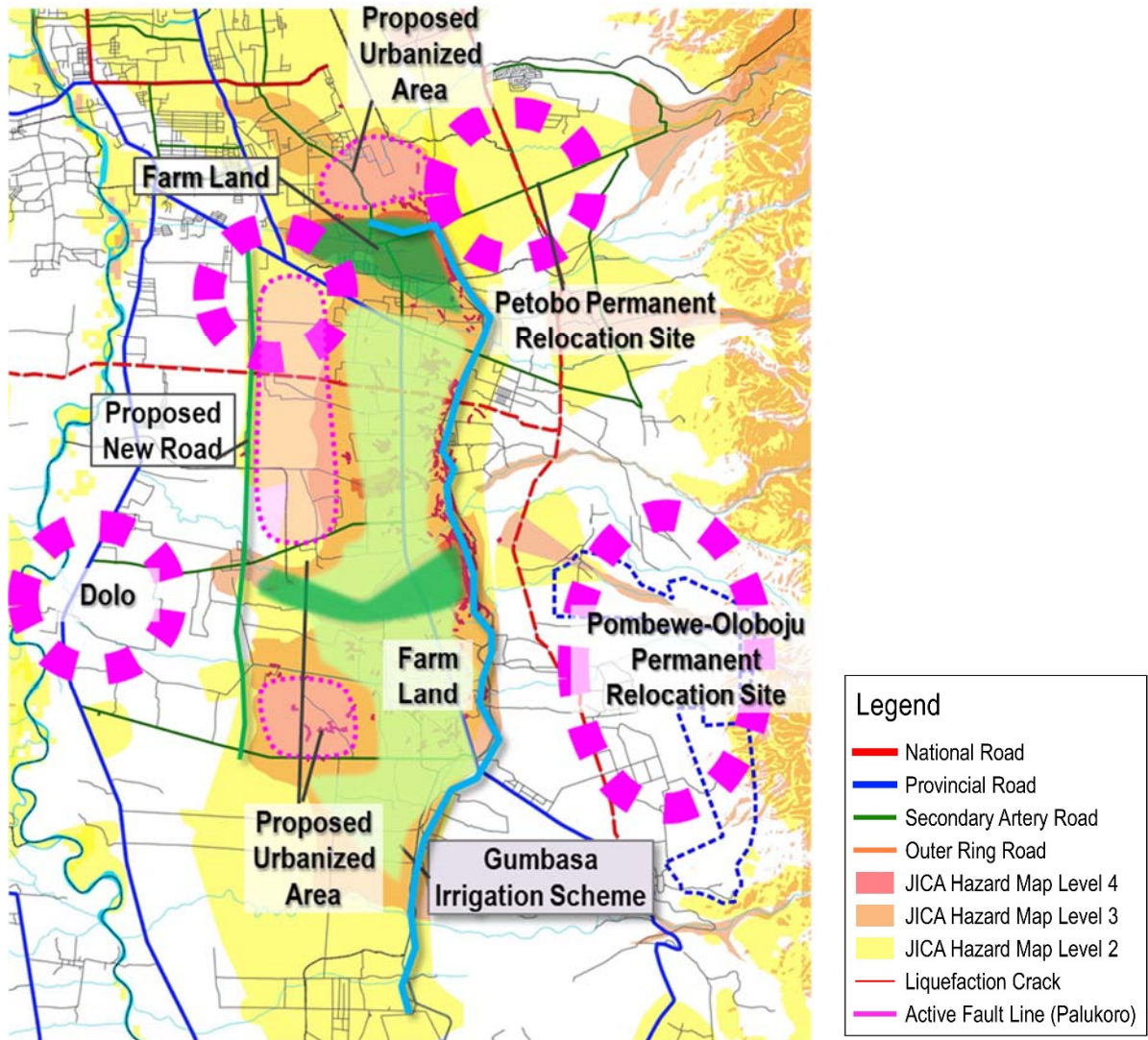
Sigi, especially the areas adjacent to Palu City is urbanizing and expects future population growth, as discussed in the section on the analysis of demographic trend. ZRB4 area is not recommended for urbanization due to high risk of disaster, as the ZRB map suggested. Urbanization can be allowed for ZRB3 areas with implementation of disaster risk mitigation measures.

- ZRB4: NOT recommended for urbanization
- ZRB3: With disaster mitigation measures, the area can be used for urbanization.

2) Non-Urban Use:

The recommended non-urban land use for ZRB4 includes protected area, open space and agriculture. A memorial park may be developed in part of ZRB4 area. On the other hand, ZRB3 is recommended for agricultural use such as farming, plantation, forestry and aquaculture. Wetland agriculture, such as paddy, is possible in this area as long as the groundwater level is maintained low, since wet agriculture and use of irrigation water could increase the risk of liquefaction in the future. Hence, monitoring mechanism should be installed to detect effect of wet agriculture on the groundwater level. The examination of the land use policy for agricultural use of the ZRB areas should be well coordinated with the formulation of a rehabilitation plan and project for Gumbasa Irrigation Scheme.

- ZRB4: Protected area, open space, and agriculture, plantation, forestry, and aquaculture
- ZRB3: Protected area, agriculture, plantations, forestry, and aquaculture



Source: JICA Study Team

Figure 3-50 Proposed Land Use Direction in the Northern Part of Sigi Regency

(4) Approaches to the Development of Alternative Scenarios of Spatial Structure

There are two important factors to be considered in the formulation of alternative scenarios of spatial use for the Nalodo-affected area in Sigi, namely:

- Major infrastructure: Road which would determine spatial structure and guide urbanization direction, including
 - Jl. Poros Palu-Palolo (existing)
 - Outer Ring Road (existing)
 - New Road
- Land Use:
 - Area to be Urbanized

➤ Agricultural Area

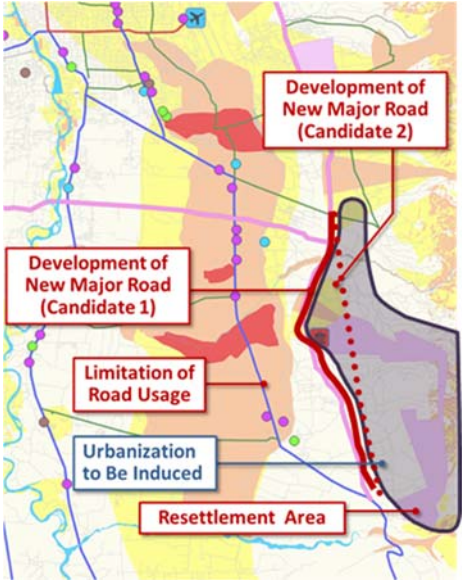
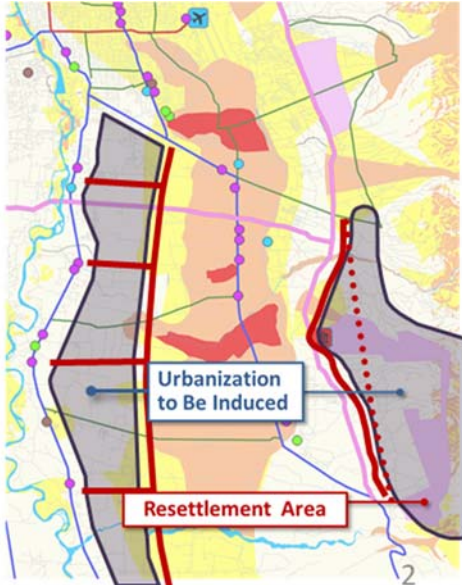
By examining different combinations and patterns of the two factors, the following section will propose four alternative scenarios of spatial structure.

(5) Alternative Scenarios of Spatial Structure for Nalodo-Affected Areas of Sigi

Four alternative scenarios of spatial structure for Nalodo-affected areas of Sigi, including land use policy, are presented in Table 3-19, Table 3-20 and Table 3-21.

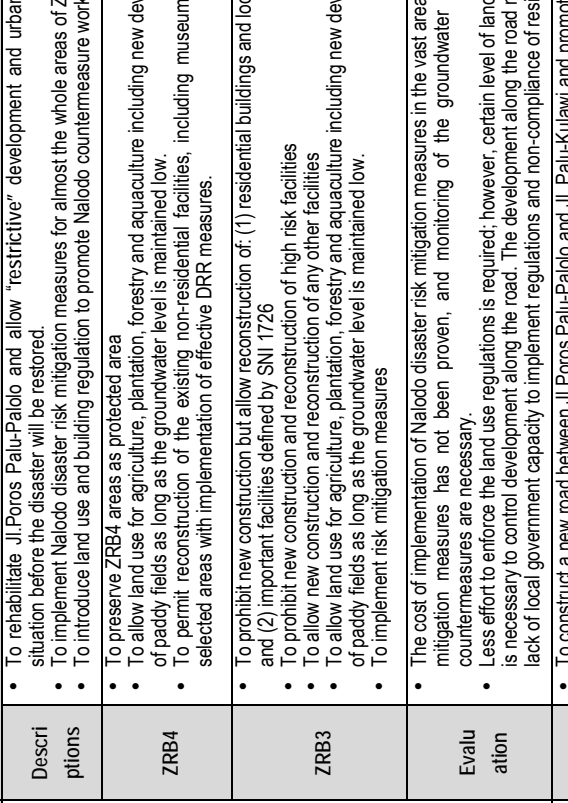
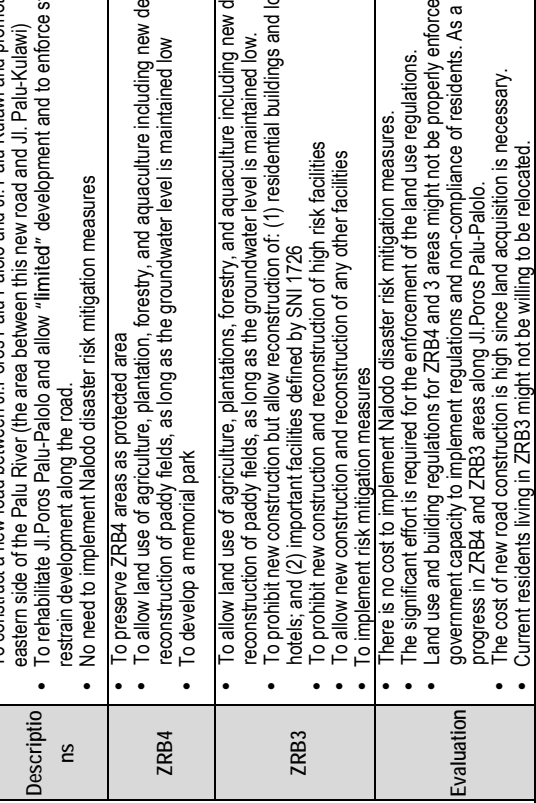
Table 3-19 Four Alternative Scenarios of Spatial Structure for Nalodo-Affected Areas of the Northern Part of Sigi Regency

Scenario 1: Urbanization Along the Present Major Road	Scenario 2: Urbanization of the East Side of the Palu River
<ul style="list-style-type: none"> • Rehabilitation and improvement of "Jl. Poros Palu-Palolo" function. • To allow urbanization along "Jl. Poros Palu-Palolo" as before. 	<ul style="list-style-type: none"> • Jl.Poros Palu-Palolo with use control. • Develop new trunk road on the east side of Palu River. • Relocation of government function to the new road side. • Promote urbanization between existing road and new road on the east side of the Palu River

Scenario 3: Urbanization of the Mountain Side	Scenario 4 : Urbanization on the East Side of the Palu River and Mountain Side
<ul style="list-style-type: none"> • Jl.Poros Palu-Palolo with use control. • Enhancement of existing mountain roads (or develop new roads) in university and permanent residential areas. • Relocation of government function to hillside and promote urbanization. 	<ul style="list-style-type: none"> • Jl.Poros Palu-Palolo with use control. • Rearrange urban development sites on the east side of Palu River and hillside, applying scenario 2 and scenario 3.
	

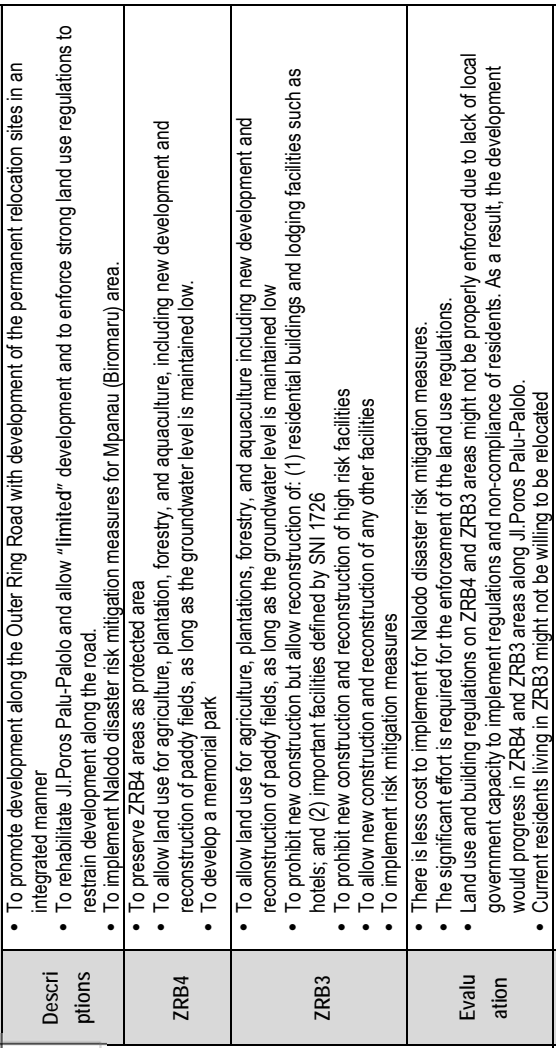
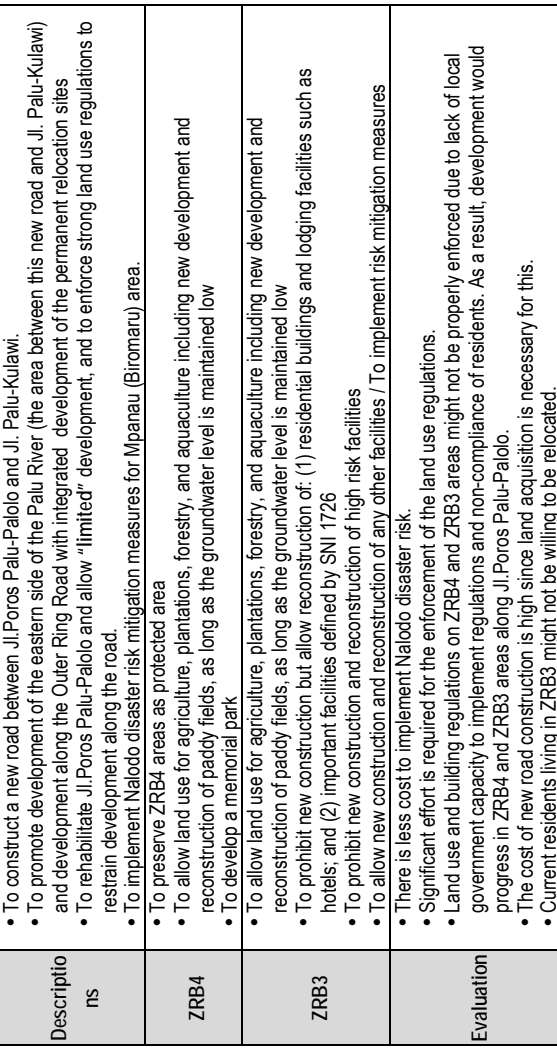
Source: JICA Study Team

Table 3-20 Land Use Pattern and Land Use Policy for Alternative Scenarios 1 and 2 in the Northern Part of Sigi Regency

Land Use Pattern	Land Use Policy
	<p>• To rehabilitate Jl.Poros Palu-Palolo and allow "restrictive" development and urbanization along the road. The situation before the disaster will be restored.</p> <p>• To implement Nalodo disaster risk mitigation measures for almost the whole areas of ZRB4 and ZRB3.</p> <p>• To introduce land use and building regulation to promote Nalodo countermeasure work.</p> <p>• To preserve ZRB4 areas as protected area</p> <p>• To allow land use for agriculture, plantation, forestry and aquaculture including new development and reconstruction of paddy fields as long as the groundwater level is maintained low.</p> <p>• To permit reconstruction of the existing non-residential facilities, including museums and memorial facilities, in selected areas with implementation of effective DRR measures.</p> <p>• To prohibit new construction but allow reconstruction of: (1) residential buildings and lodging facilities such as hotels; and (2) important facilities defined by SNI 1726</p> <p>• To prohibit new construction and reconstruction of high risk facilities</p> <p>• To allow new construction and reconstruction of any other facilities</p> <p>• To allow land use for agriculture, plantation, forestry and aquaculture including new development and reconstruction of paddy fields as long as the groundwater level is maintained low.</p> <p>• To implement risk mitigation measures</p> <p>• The cost of implementation of Nalodo disaster risk mitigation measures in the vast area is high. The effect of the risk mitigation measures has not been proven, and monitoring of the groundwater level and the effect of the countermeasures are necessary.</p> <p>• Less effort to enforce the land use regulations is required; however, certain level of land use and building regulations is necessary to control development along the road. The development along the road might not be controlled due to lack of local government capacity to implement regulations and non-compliance of residents.</p>
	<p>• To construct a new road between Jl.Poros Palu-Palolo and Jl. Palu-Kulawi and promote development of the eastern side of the Palu River (the area between this new road and Jl. Palu-Kulawi)</p> <p>• To rehabilitate Jl.Poros Palu-Palolo and allow "limited" development and to enforce strong land use regulations to restrain development along the road.</p> <p>• No need to implement Nalodo disaster risk mitigation measures</p> <p>• To preserve ZRB4 areas as protected area</p> <p>• To allow land use of agriculture, plantation, forestry and aquaculture including new development and reconstruction of paddy fields, as long as the groundwater level is maintained low</p> <p>• To develop a memorial park</p> <p>• To allow land use of agriculture, plantations, forestry, and aquaculture including new development and reconstruction of paddy fields, as long as the groundwater level is maintained low.</p> <p>• To prohibit new construction but allow reconstruction of: (1) residential buildings and lodging facilities such as hotels; and (2) important facilities defined by SNI 1726</p> <p>• To prohibit new construction and reconstruction of high risk facilities</p> <p>• To allow new construction and reconstruction of any other facilities</p> <p>• To implement risk mitigation measures</p> <p>• There is no cost to implement Nalodo disaster risk mitigation measures.</p> <p>• The significant effort is required for the enforcement of the land use regulations.</p> <p>• Land use and building regulations for ZRB4 and 3 areas might not be properly enforced due to lack of local government capacity to implement regulations and non-compliance of residents. As a result, development would progress in ZRB4 and ZRB3 areas along Jl.Poros Palu-Palolo.</p> <p>• The cost of new road construction is high since land acquisition is necessary.</p> <p>• Current residents living in ZRB3 might not be willing to be relocated.</p>
<p>Scenario 1: Urbanization along the Present Major Road</p>	<p>Scenarions</p>
<p>ZRB4</p>	<p>ZRB4</p>
<p>ZRB3</p>	<p>ZRB3</p>
<p>Evaluation</p>	<p>Evaluation</p>

Source: JICA Study Team

Table 3-21 Land Use Pattern and Land Use Policy for Alternative Scenarios 3 and 4 in the Northern Part of Sigi Regency

Land Use Pattern	Land Use Policy
 <p>Scenario 3: Urbanization to the Mountain Side</p>	<p>Descriptions</p> <ul style="list-style-type: none"> To promote development along the Outer Ring Road with development of the permanent relocation sites in an integrated manner To rehabilitate Jl.Poros Palu-Palolo and allow "limited" development and to enforce strong land use regulations to restrain development along the road. To implement Nalodo disaster risk mitigation measures for Mpanau (Biromaru) area. <p>ZRB4</p> <ul style="list-style-type: none"> To preserve ZRB4 areas as protected area To allow land use for agriculture, plantation, forestry, and aquaculture, including new development and reconstruction of paddy fields, as long as the groundwater level is maintained low. To develop a memorial park <p>ZRB3</p> <ul style="list-style-type: none"> To allow land use for agriculture, plantations, forestry, and aquaculture including new development and reconstruction of paddy fields, as long as the groundwater level is maintained low To prohibit new construction but allow reconstruction of: (1) residential buildings and lodging facilities such as hotels; and (2) important facilities defined by SNI 1726 To prohibit new construction and reconstruction of high risk facilities To allow new construction and reconstruction of any other facilities To implement risk mitigation measures <p>Evaluation</p> <ul style="list-style-type: none"> There is less cost to implement for Nalodo disaster risk mitigation measures. The significant effort is required for the enforcement of the land use regulations. Land use and building regulations on ZRB4 and ZRB3 areas might not be properly enforced due to lack of local government capacity to implement regulations and non-compliance of residents. As a result, the development would progress in ZRB4 and ZRB3 areas along Jl.Poros Palu-Palolo. Current residents living in ZRB3 might not be willing to be relocated
 <p>Scenario 4: Urbanization to the Eastern Side of the Palu River and to the Mountain Side</p>	<p>Descriptions</p> <ul style="list-style-type: none"> To construct a new road between Jl.Poros Palu-Palolo and Jl. Palu-Kulawi To promote development of the eastern side of the Palu River (the area between this new road and Jl. Palu-Kulawi) and development along the Outer Ring Road with integrated development of the permanent relocation sites To rehabilitate Jl.Poros Palu-Palolo and allow "limited" development, and to enforce strong land use regulations to restrain development along the road. To implement Nalodo disaster risk mitigation measures for Mpanau (Biromaru) area. <p>ZRB4</p> <ul style="list-style-type: none"> To preserve ZRB4 areas as protected area To allow land use for agriculture, plantations, forestry, and aquaculture including new development and reconstruction of paddy fields, as long as the groundwater level is maintained low To develop a memorial park <p>ZRB3</p> <ul style="list-style-type: none"> To allow land use for agriculture, plantations, forestry, and aquaculture including new development and reconstruction of paddy fields, as long as the groundwater level is maintained low To prohibit new construction but allow reconstruction of: (1) residential buildings and lodging facilities such as hotels; and (2) important facilities defined by SNI 1726 To prohibit new construction and reconstruction of high risk facilities To allow new construction and reconstruction of any other facilities / To implement risk mitigation measures <p>Evaluation</p> <ul style="list-style-type: none"> There is less cost to implement Nalodo disaster risk. Significant effort is required for the enforcement of the land use regulations. Land use and building regulations on ZRB4 and ZRB3 areas might not be properly enforced due to lack of local government capacity to implement regulations and non-compliance of residents. As a result, development would progress in ZRB4 and ZRB3 areas along Jl.Poros Palu-Palolo. The cost of new road construction is high since land acquisition is necessary for this. Current residents living in ZRB3 might not be willing to be relocated.

Source: JICA Study Team

(6) Evaluation of Alternative Spatial Scenarios for Nalodo-Affected Area in Sigi Regency

The four alternative spatial scenarios are evaluated in terms of cost, adverse impacts and effectiveness for DRR as presented in Table 3-22. The same evaluation criteria for the Palu Bay Southern Coastal Area are adopted.

Table 3-22 Evaluation of Alternative Spatial Scenarios for the Nalodo-Affected Area in Sigi Regency

Scenario	Infrastructure Development		Disaster Risk Mitigation Measures	Park and Tree Planting for Land Use Control	Cost			Relocation Cost		Impacts on Development Induction	Effectiveness for Disaster Risk Mitigation/Safety
	Rehabilitation of Jl. PorosPalu-Palolo	Construction of New Road			Infrastructure Development Cost	Cost of DRR Measures	Land Use Regulation (Soft Measure Implementation)	Relocation for Infrastructure Development	Relocation for Park and Tree Planting for Land Use Control		
1	Yes	No	Yes (Full)	Yes	Medium	High	Low	Low	Low	High	High
2	Yes	Yes	No	Yes	High	None	High	High	High	Low	Medium
3	Yes	No	Yes (Partially)	Yes	Medium	Low	High	Low	High	Medium	Medium
4	Yes	Yes	Yes (Partially)	Yes	High	Low	High	High	High	Medium	Medium

Source: JICA Study Team

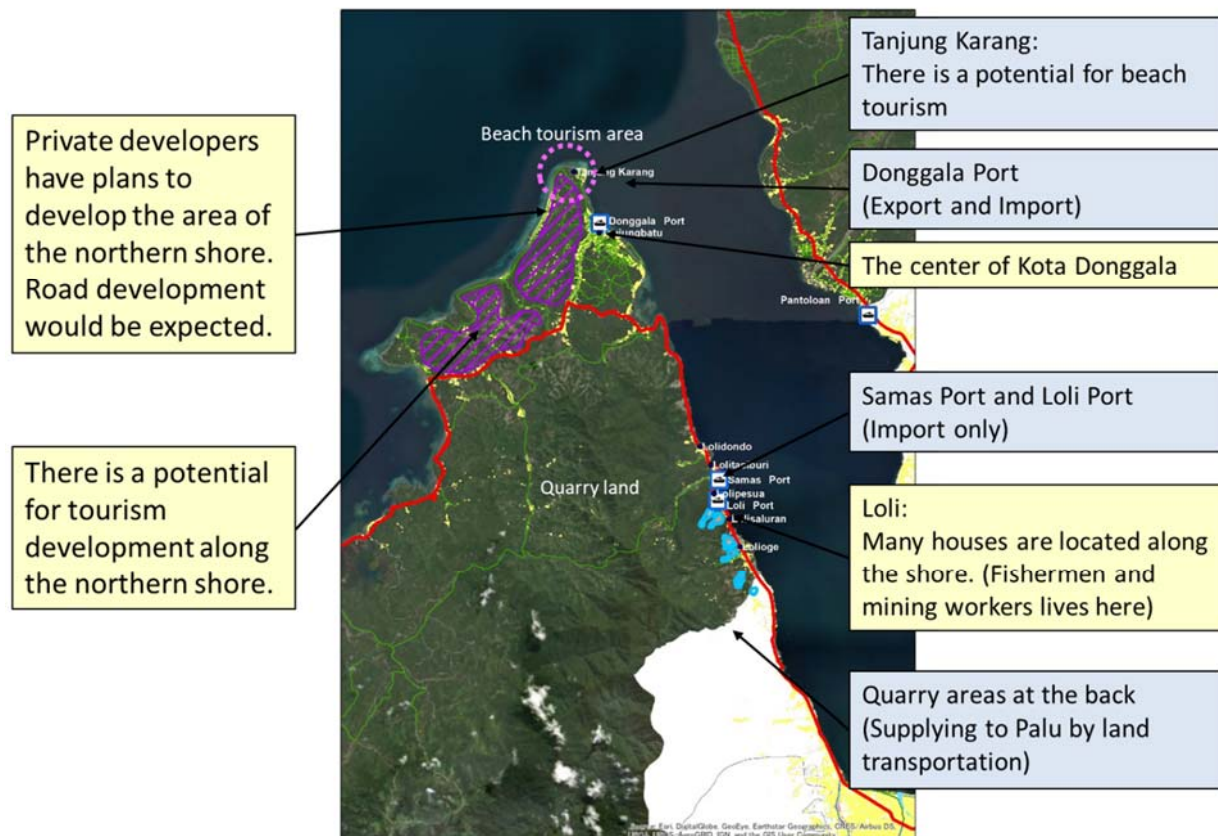
3-4-7 Sub-District Banawa, Donggala Regency

(1) Background: The Characteristics and Development Potential of Banawa Area

The formulation of a basic spatial concept for Banawa Sub-district, which is located at the northern tip of the western area of Donggala Regency, is focused on the two areas, Kota Donggla and Loli Area. Kota Donggala is the administrative and commercial center of Donggala Regency, where the Donggala Port is located. Tourist beach resort area is located in Tanjung Karang and the northwestern shore and surrounding areas have a potential for tourist development and urbanization.

Loli Area includes fishing villages located along Jl. Poros Palu-Mamuju about 10 to 15 km away from Kota Donggala. There are private container ports in the area. Mountains in some places in Loli Area are very close to the shore, and quarrying is active in the hillside areas.

Due to severe damage caused by tsunami, reconstruction policies are expected to be developed for the two areas as the foundation of the revision of RTRW and formulation of RDTR. The characteristics and development potential of Banawa are presented in Figure 3-51.



Source: JICA Study Team

Figure 3-51 Characteristics and Development Potential of Banawa Area

The population of Donggala Regency was 299,174 in 2017, as presented in Table 3-23. Its population annual growth rate 2010-2017, 1.09%, was lower than that of the province, 1.71%. Banawa Subdistrict had the largest population among all subdistricts in Donggala, which was 33,788 in 2017; however, its population annual growth rate 2010-2017, 0.76%, was lower than the other kecamatans in the western side of the kabupaten. In Kec. Banawa, Tanjung Batu and Boya, two villages near Donggala Port, had the highest population density of 58 and 53 persons / ha, respectively.

Table 3-23 Population of Banawa Subdistrict

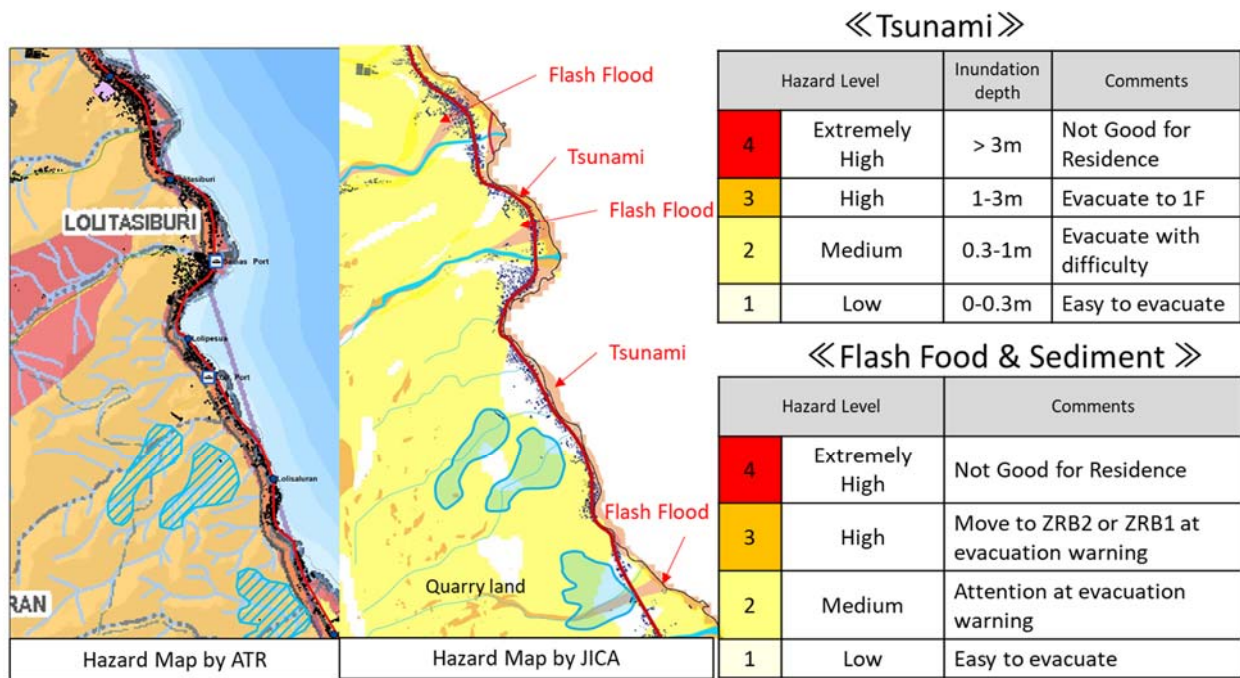
	Area (km ²)	Population (Persons)		Annual Growth Rate	Population Density 2017 (persons /km ²)
		2010	2017		
Donggala	5,276	277,236	299,174	1.09%	57
Kecamatans in Western Side					
Banawa	99.04	32,042	33,788	0.76%	341
Rio Pakawa	872.16	21,821	24,850	1.87%	28
Pinembani	402.61	5,817	7,038	2.76%	17
Banawa Selatan	430.67	23,450	25,367	1.13%	58
Banawa Tengah	74.64	10,061	10,950	1.22%	147

Sources: 2010 Data: Hasil Sensus Penduduk 2010; 2017 Data: Kabupaten Donggala Dalam Angka 2018

(2) Disaster Damage and Disaster Hazards

1) Disaster Hazards of Loli Area

Disaster hazard maps of ATR and JICA Study Team are presented in Figure 3-52. During the 2018 disaster, in Loli Area, the houses on the coast side of the main road were affected by the tsunami, while houses along the river flowing from the mountain side were affected by flash flood and sediment disasters. The hazard map by JICA shows some high risk areas of flash flood and tsunami. On the other hand, the ATR's ZRB map indicates the high risk areas of sediment disaster.



Source: JICA Study Team

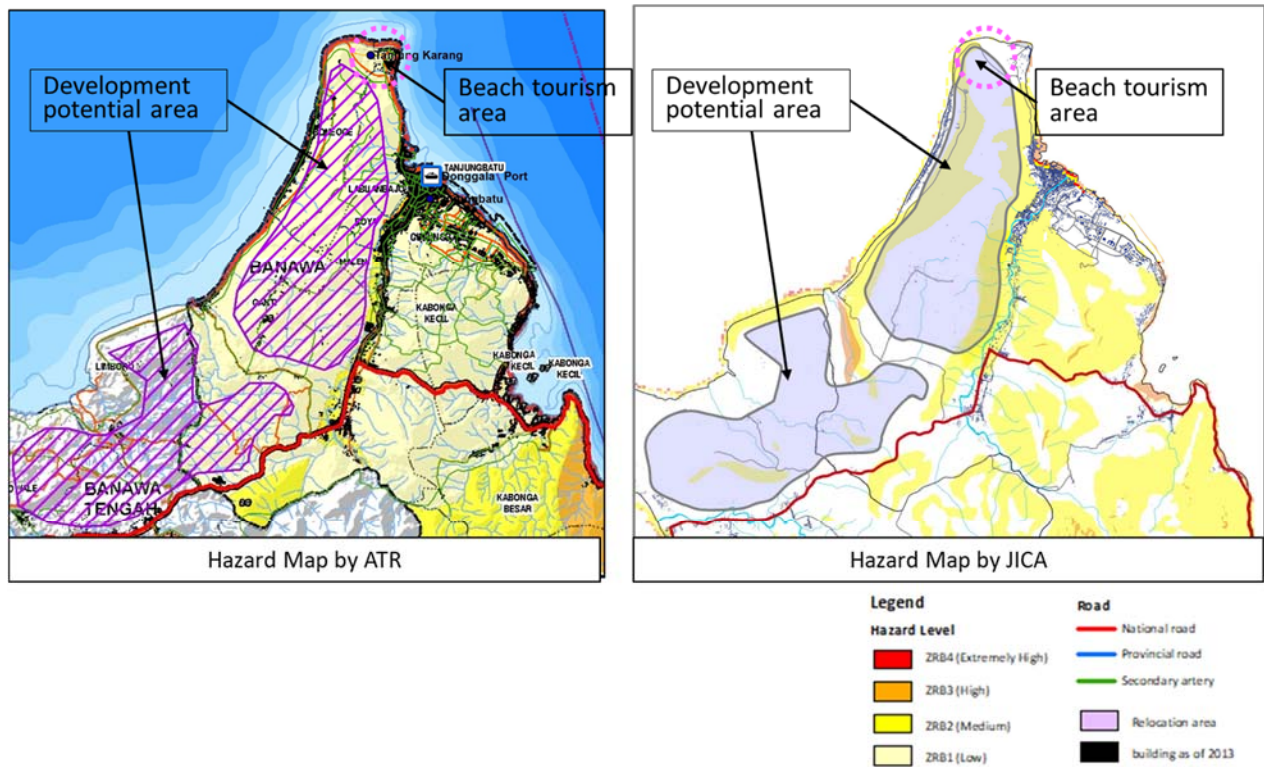
Figure 3-52 Disaster Hazards of Loli Area

2) Disaster Hazards of Kota Donggala Area

Some coastal areas of Kota Donggala, including Donggala Port, were damaged by tsunami. However, the hazard level of tsunami and landslide in the coastal areas and inland areas of Kota Donggala Area is relatively low as shown in Figure 3-53. In fact, beach resorts of Tanjung Karang were not affected by tsunami. The inland area in Boneoge and Labuan Bajo is relatively flat and free from the disaster risk of tsunami and sediment disaster so that the development potential of this area is high.

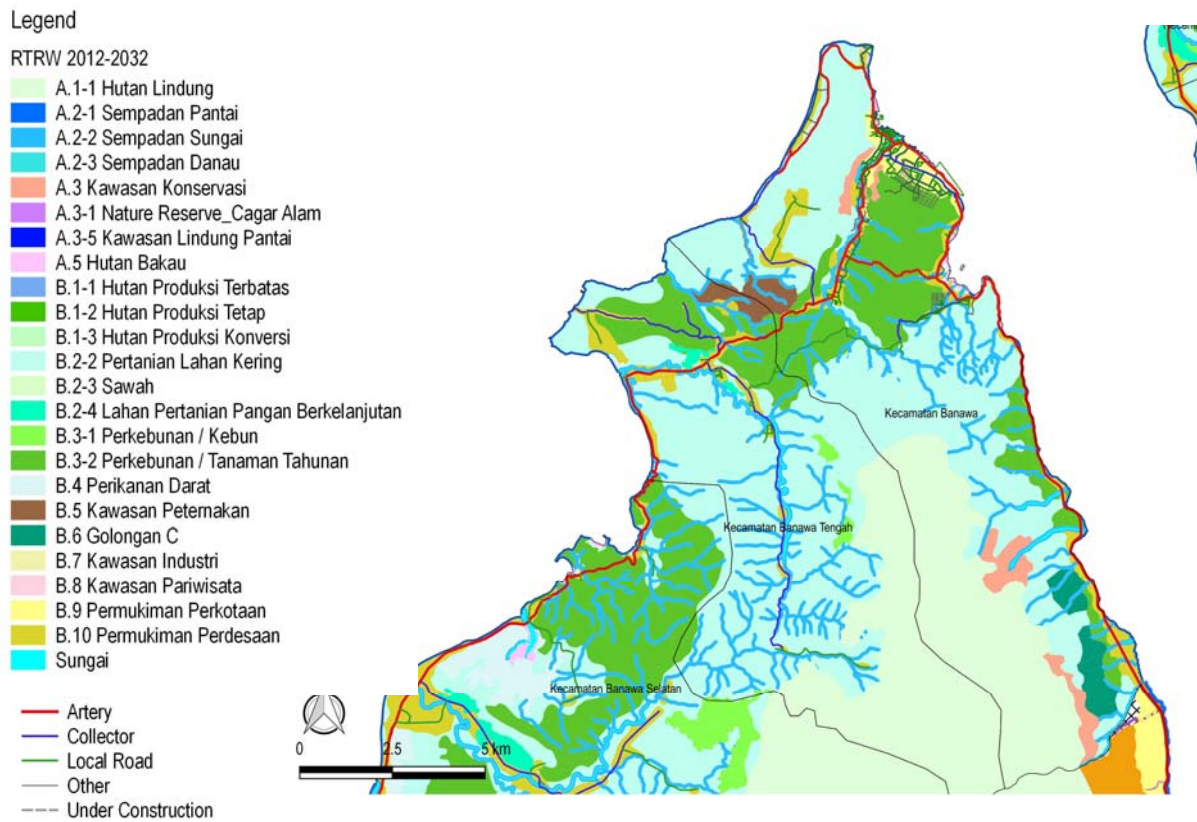
(3) Development Plan for Banawa Sub-District

Land use plans in Donggala Regency 2012 – 2032 and in unapproved draft Detailed Spatial Plan (RDTR for Banawa Sub-District in 2015) are shown in Figure 3-54 and Figure 3-55. According to the land use plans, the residential area is planned near the coast and along the river. The inland area is not planned for urban land use.



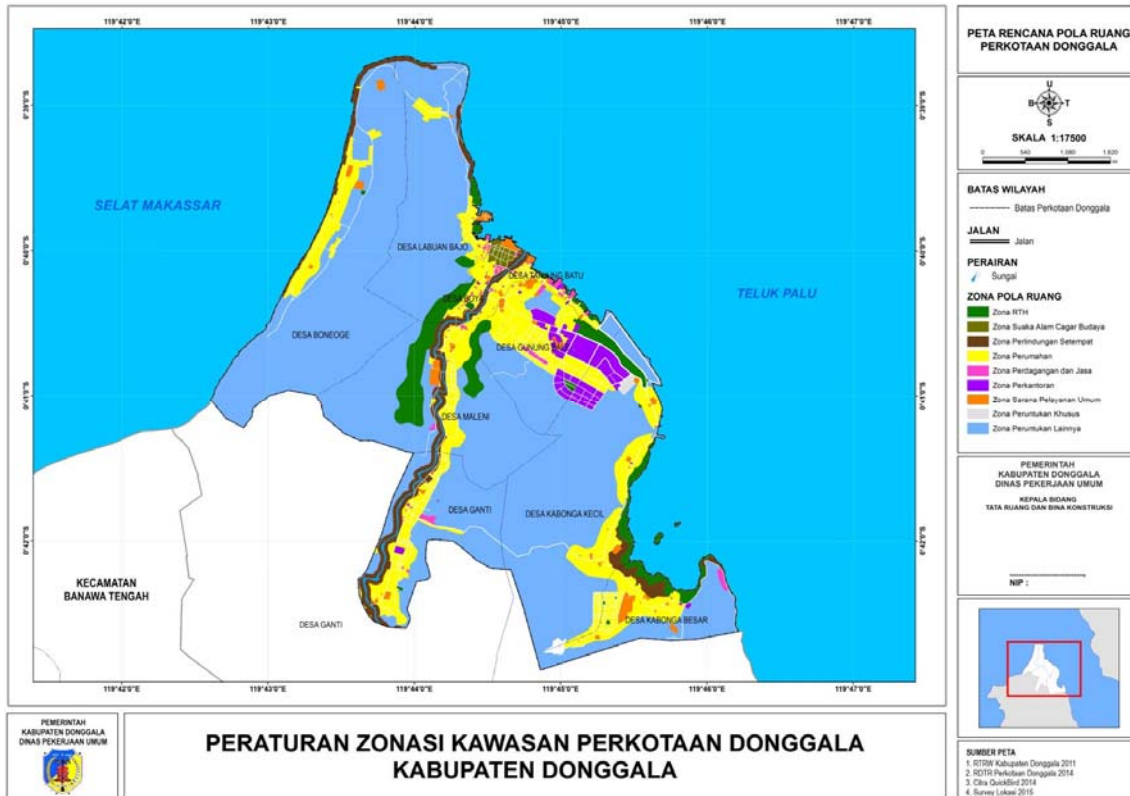
Source: JICA Study Team

Figure 3-53 Disaster Hazards of Kota Donggala Area



Source: Donggala Regency RTRW 2012-2032

Figure 3-54 Land Use Plan in Donggala Regency RTRW 2012-2032



Source: RDTR Kota Donggala 2015 (Not Approved)

Figure 3-55 Land Use Plan for Kota Donggala in RDTR Kota Donggala 2015 (Not Approved)

(4) Development Ideas for Palu Bay Western Area

Preliminary development ideas are proposed for Kota Donggala Area and Loli Area as follows:

1) Loli Area

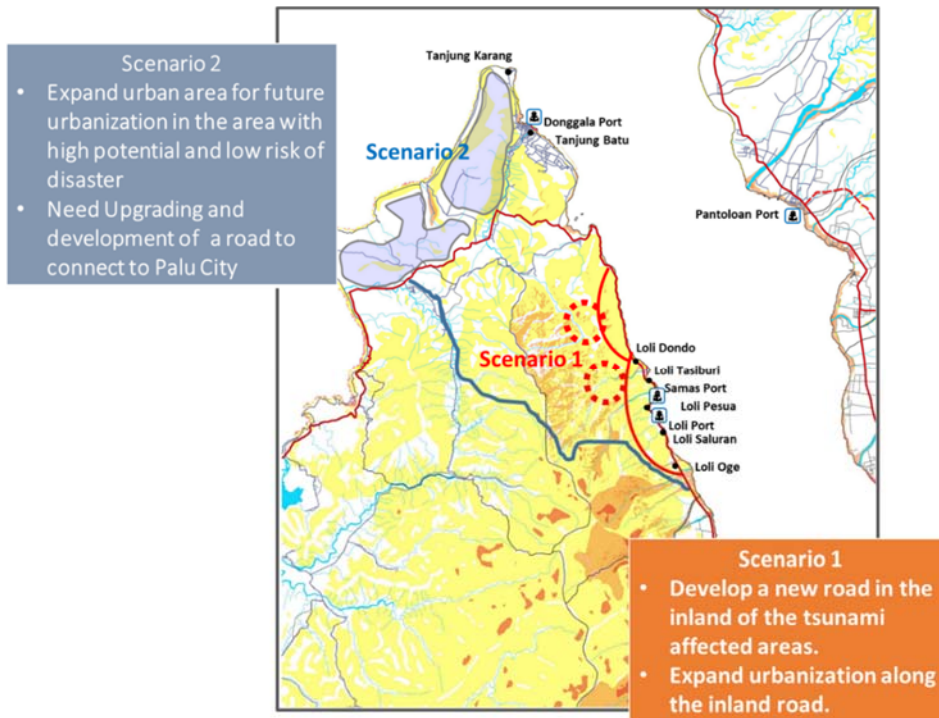
Due to the high risk of tsunami in the coastal area, it is necessary to promote relocation from the coastal area with high tsunami risk and development of settlement in safer area. Therefore, the following two ideas are suggested for Loli Area.

- To develop a new road in the inland of the tsunami-affected areas
- To expand urbanization along the inland road

2) Kota Donggala (Scenario 2)

Kota Donggala needs to secure the area for future urbanization because it is expected to be developed as the administrative and commercial center of the Regency of Donggala. Thus, the following two ideas are suggested for Kota Donggala.

- To expand urban area (future urbanization) in the place with high development potential and low risk of disaster
- To upgrade and develop a road to connect to Palu City
- These development ideas for Loli and Kota Donggala are presented in Figure 3-56



Source: JICA Study Team

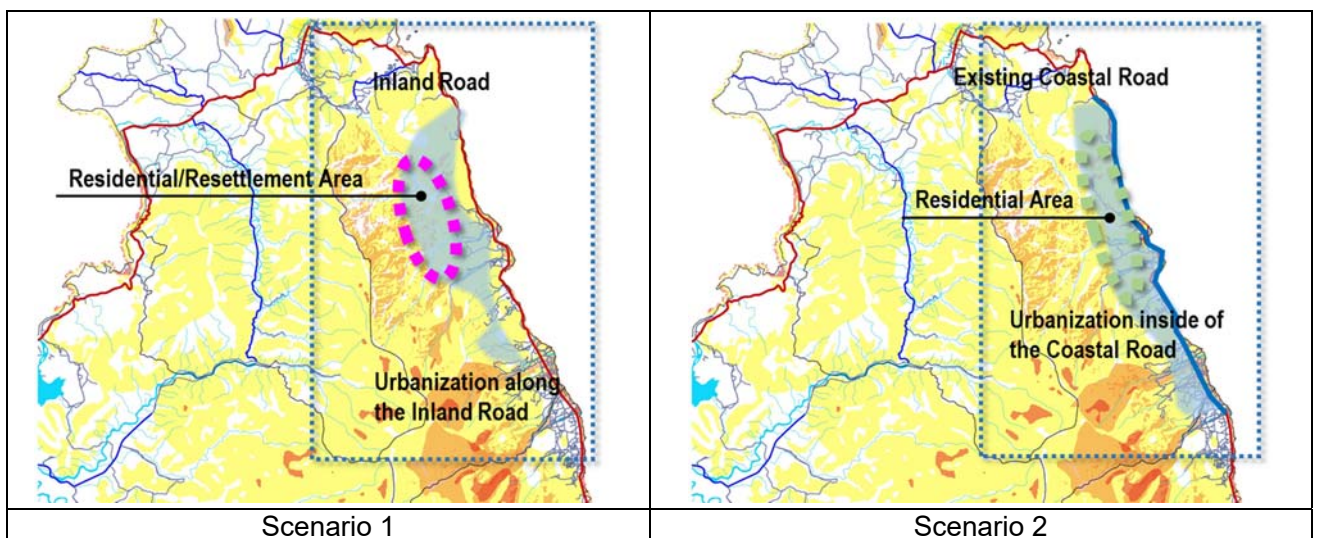
Figure 3-56 Development Ideas for Banawa Sub-District

(5) Alternative Scenarios of Spatial Structure for Banawa Sub-District

1) Loli Area

For further analysis, two spatial concepts including spatial structure and land use pattern are compared. The two alternative scenarios for Loli Area are proposed:

- Scenario 1: To develop new road and residential area in inland area
- Scenario 2: To maintain Current Spatial Structure and control urbanization



Source: JICA Study Team

Figure 3-57 Two Alternative Scenarios of Spatial Structure for Loli Area in Banawa Sub-District

(iv) Scenario 1: To develop new road and residential area in inland area

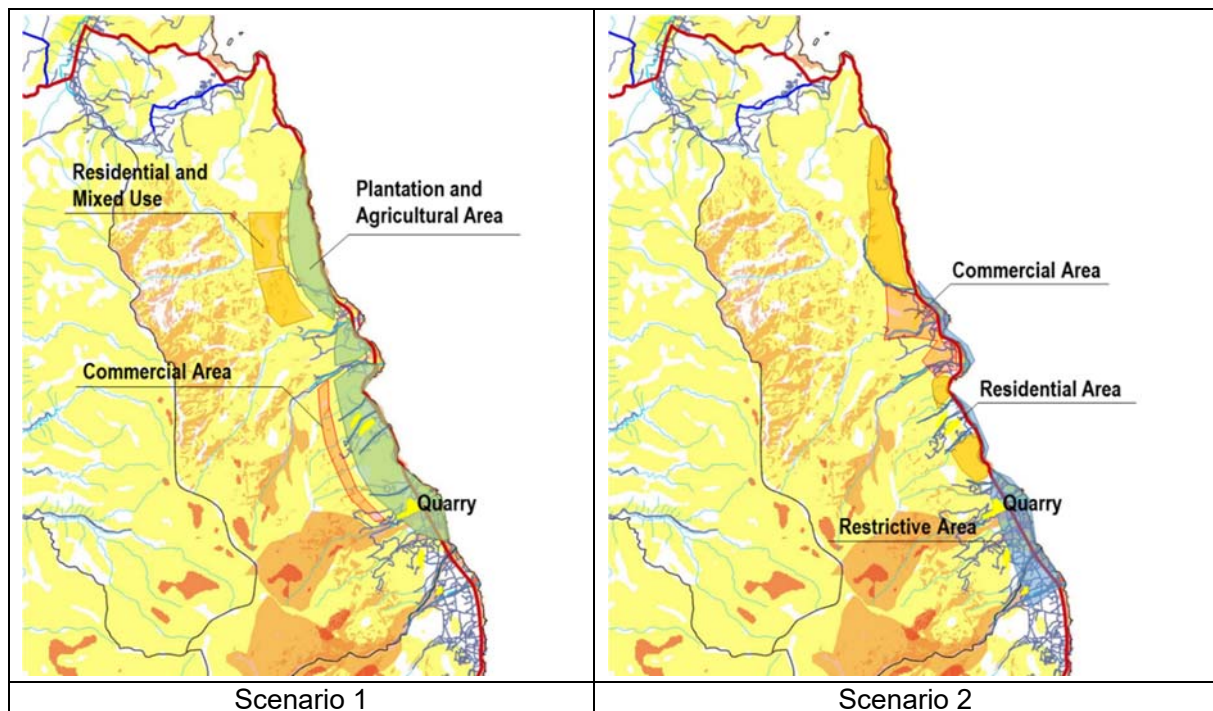
The spatial concept of Scenario 1 is described as follows and the proposed land use pattern is presented in Figure 3-58.

- New road is developed in the inland of the tsunami-affected areas.
- Coastal area is designated as plantation and agriculture area to restrict urbanization near the disaster risk area (ZRB4).
- Residential area is developed in the safer location along the new inland road and promote urbanization in the inland area.

(v) Scenario 2: To maintain current spatial structure and control urbanization

The spatial concept of Scenario 2 is described as follows and the proposed land use pattern is presented in Figure 3-58.

- Existing coastal road can be used.
- Promote urbanization in the inland area of the coastal road.
- Outside of the coastal road and disaster risk area are used restrictively.



Source: JICA Study Team

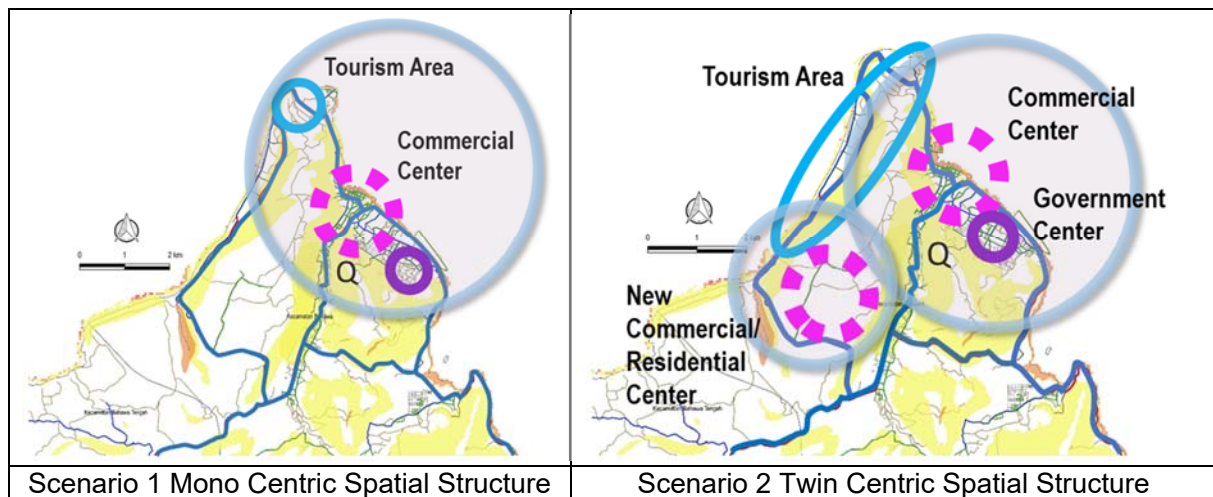
Figure 3-58 Land Use Pattern for Two Alternative Scenarios of Spatial Structure for Loli Area

2) Kota Donggala (Scenario 2)

For further analysis, two spatial concepts including spatial structure and land use pattern are compared. The two alternative scenarios for Kota Donggala are proposed:

- Scenario 1 Mono Centric Spatial Structure: To maintain the current spatial structure

- Scenario 2 Twin Centric Spatial Structure: To develop a new center in the inland area



Source: JICA Study Team

Figure 3-59 Two Alternative Scenarios of Spatial Structure for Kota Donggala

(i) Scenario 1: Mono Centric Spatial Structure

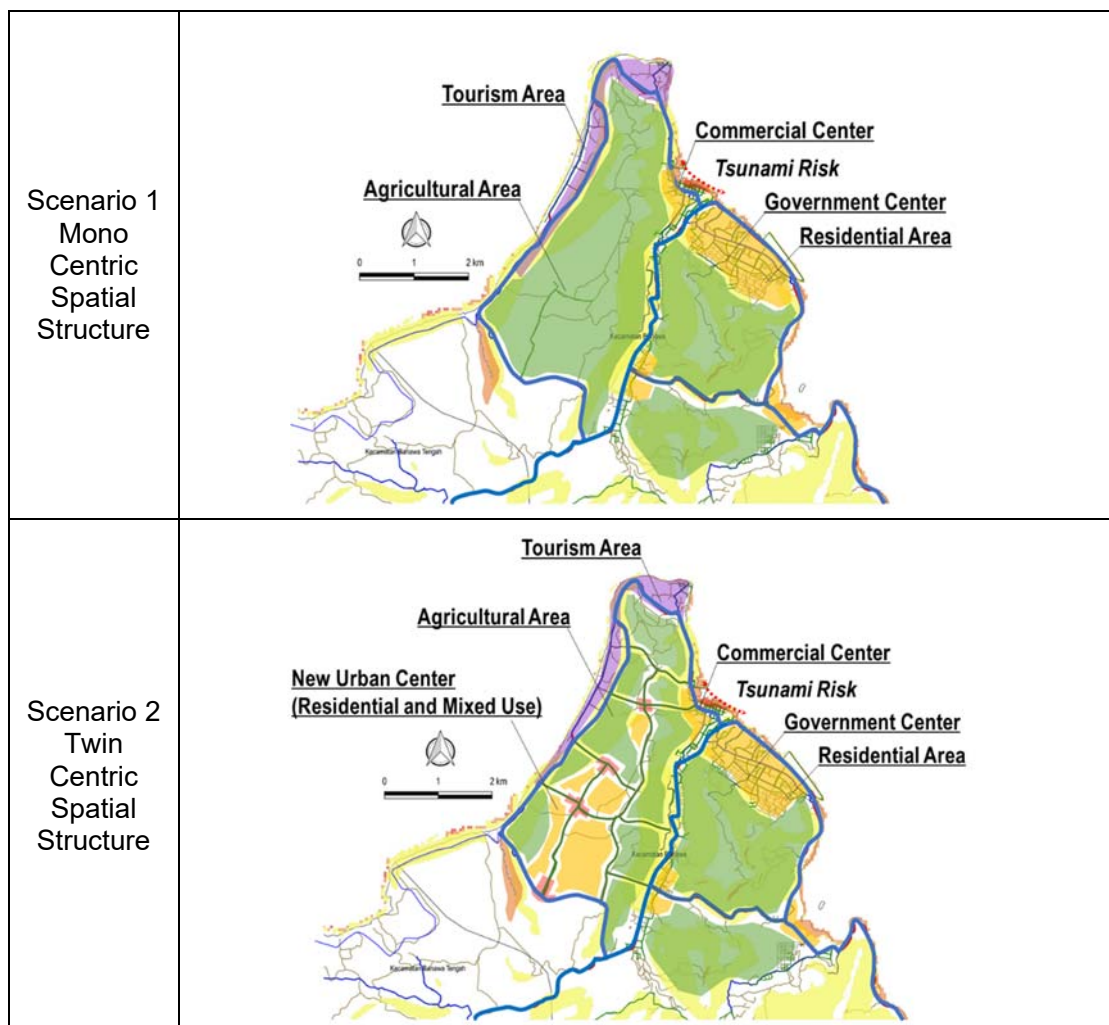
The spatial concept of Scenario 1 is described as follows and the proposed land use pattern is presented in Figure 3-60.

- The urban center of Kota Donggala is maintained and expanded along the coastal line. The tourism area will be developed.
- Though tsunami risk is not very high, ZRB3 area is found in some places. Land use and building regulations and Early Warning System should be introduced and evacuation sites and roads need to be specified for ZRB3.

(ii) Scenario 2: Twin Centric Spatial Structure

The spatial concept of Scenario 2 is described as follows and the proposed land use pattern is presented in Figure 3-60.

- New urban center will be developed in the inland area to promote development of new residential areas in safer places.
- Land use and building regulations and early warning system should be introduced, and evacuation sites and roads need to be specified for ZRB3.



Source: JICA Study Team

Figure 3-60 Land Use Pattern for Two Alternative Scenarios of Spatial Structure for Kota Donggala

3-5 Community Dialogues

In the three preparatory joint coordination workshops held with local governments, ATR and the JICA Study Team from March until May 2019, the importance to involve the community in spatial planning process was pointed out in order to listen to peoples' voice due to significance of impacts of the disaster and spatial planning on them, especially to those residing in the Red Zone. Therefore, community dialogues were held in the affected villages (kelurahan) in Palu and Sigi in June and July 2019, with the initiatives of the Departments of Spatial Planning and Land Affairs in Palu City and Sigi Regency in collaboration with the JICA Study Team and Bantek consultants.

In June and July 2019, community dialogues were held in the following 15 locations in Palu and Sigi, and attended by a total of 577 people. The meeting rooms at urban village offices were used for community dialogues. The dialogues were held by dividing the participants into groups such as fisherfolk, business persons, street vendors, community leaders, residents of temporary shelters, etc.

In the community dialogues, questions related to the condition of the residents' lives, jobs, and infrastructure projects that will be implemented were discussed in order to collect any concern and

intensions from communities. At the same time, their understanding about ZRB map formulated by ATR was confirmed. In the meetings, opinions were raised about the lack of information on ZRB maps and disaster hazards, as well as the potential impact and concerns about livelihoods, especially after relocation. The results of community dialogues were shared with the local governments and Bantek consultants as important inputs to formulate the spatial plans and propose the regulations. The results of the discussion and questions for discussion are attached in Appendix.

Table 3-24 Overview of Community Dialogues Conducted in Palu and Sigi

	Target Area	Date	No. of Participants
1	Talise Village, Palu	18 June, 2019	42
2	Lere Village, Palu	19 June, 2019	31
3	West Besusu Village, Palu	20 June, 2019	41
4	Silae Urban Village, Palu	26 June, 2019	40
5	Balaroa Urban Village, Palu	27 June, 2019	39
6	Petobo Village, Palu	29 June, 2019	43
7	Sigi Biromaru Sub-District, Sigi	4 July, 2019	63
8	Dolo Sub-district, Sigi	6 July 2019	64
9	Duyu Urban Village, Palu	22 July 2019	29
10	Donggala Kodi Village, Palu	23 July, 2019	25
11	Buluri Urban Village, Palu	24 July, 2019	34
12	Pantoloan Urban Village, Palu	24 July, 2019	41
13	Panau Urban Village, Palu	25 July, 2019	30
14	Tondo Urban Village, Palu	26 July, 2019	22
15	Mamoro Barat Urban Village, Palu	26 July, 2019	33
	Total		577

Source: JICA Study Team

Table 3-25 Summary of Community Dialogues in Palu and Sigi

Location	Talise	Lere	Besusu Barat
Date	18 June 2019	19 June 2019	20 June 2019
Dialogue Groups	<ul style="list-style-type: none"> ① Fisherfolk : 11 persons ② Salt Farmers : 9 persons ③ Street Vendors : 5 persons ④ Business Owners : 4 persons ⑤ Community Leaders : 7 persons 	<ul style="list-style-type: none"> ① Fisherfolk: 8 persons ② Street Vendors: 3 persons ③ Hunrata & Business: 3 persons ④ Community Leaders: 7 persons 	<ul style="list-style-type: none"> ① Yellow Rice Sellers: 3 persons ② Street Vendors: 7 persons ③ Business Owners: 7 persons ④ Fisherfolk: 2 persons ⑤ Community Leaders: 14 persons
Total Participants	42 persons (except representatives of Gov. & JICA)	31 persons (except representatives of Gov. & JICA)	41 persons (except representatives of Gov. & JICA)
			
Location	Silae	Balaroa	Petobo
Date	26 June 2019	27 June 2019	29 June 2019
Dialogue Groups	<ul style="list-style-type: none"> ① Huntara : 6 persons ② Street Vendors : 6 persons ③ Business Owners :None ④ Community Leaders I: 7 persons ⑤ Community Leaders II: 8 persons 	<ul style="list-style-type: none"> ① Shelter Forum Balaroa: 3 persons ② Religious, Traditional, Youth, LPM, Task Force : 7 people ③ Neighborhood Associations (RW / RT) and Task Force Chair: 5 people ④ Neighborhood Associations (RW / RT): 9 people 	<ul style="list-style-type: none"> ① Temporary Shelter: 3 people ② Neighborhood Associations (RW / RT Chairpersons), Religious Leaders, Residents: 10 people ③ Customary Figures, Urban Village Head, Residents, Kamtibmas: 5 people ④ Neighborhood Associations (RW / RT), Youth Leaders, Residents: 7 people ⑤ LPM Chairperson, Neighborhood Associations (RW / RT), and residents: 12 people

Total Participants	40 persons (except representatives of Gov. & JICA)	39 persons (except representatives of Gov. & JICA)	43 persons (except representatives of Gov. & JICA)
			
Location	Duyu	Donggala Kodi	Buluri
Date	22 July 2019	23 July 2019	24 July 2019
Dialogue Groups	<ul style="list-style-type: none"> ① Business Persons : 5 persons ② Farmers : 2 persons ③ Neighborhood Associations (RW / RT), Residents: 7 persons ④ Neighborhood Associations: 5 persons ⑤ Neighborhood Associations, Women's Figure, Residents: 7 persons 	<ul style="list-style-type: none"> ① Business Persons: 8 persons ② & ③ Neighborhood Associations : 2 people ④ Traditional Leaders/ Neighborhood Associations (RW / RT): 6 persons ⑥ Women and Youth: 3 people 	<ul style="list-style-type: none"> ① Business Persons: 9 people ② Fisherfolk: 5 people ③ Temporary Shelter: 6 people ④ Neighborhood Associations : 1 person ⑤ Community/ Women's/ Youth Leaders, etc.: 10 people
Total Participants	29 persons (except representatives of Gov. & JICA)	25 persons (except representatives of Gov. & JICA)	34 persons (except representatives of Gov. & JICA)
			
Location	Pantoloan	Panau	Tondo
Date	24 July 2019	25 July 2019	26 July 2019
Dialogue Groups	<ul style="list-style-type: none"> ① Temporary Shelter : 17 persons ② Fisherfolk : 7 persons ③ Business Persons : 5 ④ Neighborhood Associations: 5 persons ⑤ Traditional/ Community/ Women's Leaders, Youth: 9 persons 	<ul style="list-style-type: none"> ① Temporary Shelter: 4 persons ② Fisherfolk : 6 people ③ Business Persons: 6 people ④ Neighborhood Associations (RW / RT): 7 people ⑤ Traditional/ Community/ Women's Leaders, etc.: 7 persons 	<ul style="list-style-type: none"> ① & ⑤ Temporary Shelter and Neighborhood Associations/ Traditional /Community Leaders: 11 people ② Farmers: 6 people ③ Business Persons: 5 people ④ Fisherfolk: 4 people
Total Participants	43 persons (except representatives of Gov. & JICA)	30 persons (except representatives of Gov. & JICA)	26 persons (except representatives of Gov. & JICA)
			
Location	Mamboro Barat	Sigi-Biomaru	Dolo
Date	26 July 2019	4 July 2019	6 July 2019
Dialogue Groups	<ul style="list-style-type: none"> ① Temporary Shelter : 3 persons ② Fisherfolk : 7 persons ③ Business Persons : 5 persons ④ Neighborhood Associations (RW / RT): 5 persons ⑤ Community / Women's/ Youth Leaders, others: 17 persons 	<ul style="list-style-type: none"> ① Temporary Shelter: 8 persons ② Farmers : 7 people ③ Business Persons: 12 people ④ Neighborhood Associations (RW / RT), Business, Traditional / Religious/ Women's Leaders, Youth: 21 people ⑤ Neighborhood Associations (RW / RT), Traditional/ Religious Leaders: 12 people 	<ul style="list-style-type: none"> ① Temporary Shelter: 8 people ② Farmers: 8 persons ③ Business persons: 6 persons ④ and ⑤ Neighborhood Associations (RW / RT Chairpersons), Traditional / Religious/ Women's Leaders, Youth: 32 people
Total Participants	37 persons (except representatives of Gov. & JICA)	63 persons (except representatives of Gov. & JICA)	64 persons (except representatives of Gov. & JICA)



Source: JICA Study Team

Chapter-4 Technical Support for ATR, PUPR and Local Governments in the Refinement and Utilization of Land Use Regulations and Building Structural Requirements for Detailed Spatial Planning

4-1 Approach and Contents of Output 2's Support for ATR and Local Governments

The JICA Study Team had prepared concepts and concrete methods for setting boundaries for different disaster types and different ZRB levels, and for refining additional regulations (land use regulations and building structure requirements) corresponding to different disaster types and different ZRB levels. The JICA Study Team had individual meetings with the ATR and local governments to explain and discuss these concepts and concrete methods to be used for spatial planning based on DRR.

4-2 Objectives of this Chapter

The objectives of this chapter are as follows:

- To provide detailed explanation of methodology, surveys, and analysis for the refinement of the ZRB Map, especially ZRB4 boundaries
- To present refined ZRB Map and refined/detailed ZRB4 areas where relocation of residents is recommended
- To propose land use regulations and building structural regulations necessary for disaster risk reduction (DRR) in areas with identified disaster hazard levels on the ZRB Map
- To propose a practical method for integration of standard spatial plans and ZRB-based spatial plans

This chapter discusses approaches and detailed steps for identifying land use regulations and building structural requirements necessary for disaster risk reduction (DRR) to be incorporated by detailed spatial planning in the post-disaster contexts. In particular, it focuses on how to formulate land use regulations and building structural requirements based on disaster hazard levels for different disaster types.

4-3 Three Ways to Achieve Disaster Risk Reduction (DRR)

There are three ways to realize DRR-based spatial development, namely: Avoidance, Mitigation and Acceptation.

- Avoidance aims to prevent, stop or do not start any activity or land use which might increase disaster risks.
- Mitigation intends to develop or establish any building structures or physical changes to reduce disaster risks, such as control or impose requirements of building structures or construct infrastructure for minimization of hazard risks (structural and non-structural measures).
- Acceptation is to live with disaster risks by accepting these and certain level of potential damage that they will cause, and prepare for future disasters, for example, by promoting emergency response actions supposing disasters would come.

Figure 4-1 below illustrates these three ways to achieve DRR in tsunami-risk areas.

Land use control and development prohibition are considered measures categorized under the Avoidance approach. For the Mitigation approach, elevated road development, mangrove plantation along shorelines, and other structural measures to reduce tsunami risks are suggested. Furthermore, evacuation road development and imposing strict structural requirements could be considered mitigation measures against tsunami hazard. These measures could be considered as strategical structural solutions for tsunami risk reduction, and also countermeasures to cope with tsunami hazard while accepting certain level of the hazard. Under the Acceptation approach, early warning system operation, preparation of hazard maps, and publicizing hazard maps to communities, and disaster prevention education are important.

As explained above, the Avoidance, Mitigation and Acceptation approaches or ways need to be considered to have an integrated, and not a one-by-one (individual), solution for DRR.



Source: Prepared by JICA Expert

Figure 4-1 Three Ways for DRR: Avoidance, Mitigation and Acceptation

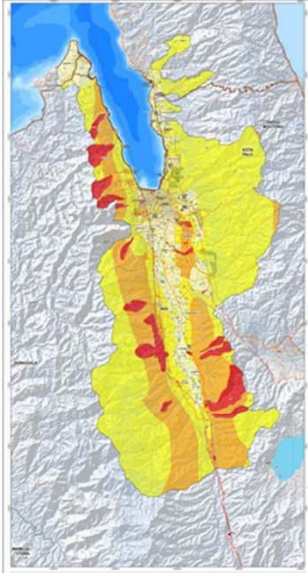
4-4 Refinement of ZRB Maps

4-4-1 Background of Refinement of ZRB Maps, Land Use Regulations, and Building Structure Requirements for Each ZRB Level

In December 2018, the Indonesian government announced the creation of a disaster-prone zone map (Zona Rawan Bencana or ZRB map) of Palu City and its surrounding areas. This ZRB map (Figure 4-2) shows four disaster risk areas (ZRB areas) that correspond to the hazard levels if each disaster type. For each ZRB area, certain policies on land use regulations and building structure requirements are described for each disaster type.

The boundaries for this ZRB map are set on a scale of 1 / 100,000. However, these boundaries are not detailed enough, and the ZRB map does not provide any details of land use regulations or building structural requirements, except identifying the existing standards of SNI1726 to refer to, for each ZRB level. Therefore, it is necessary to refine the ZRB map boundaries, as well as give further information on the required land use and building regulations for each ZRB level so that this map can be used for

detailed spatial planning considering disaster hazards and risks.



Zone and Typology	Definition/ Criteria	Post Disaster Spatial Direction (Provision on the use of space/area)
ZRB 4	4L: Zone experiencing Massive Liquefaction (After Earthquake) (Such as: Petobo, Balaroa, Jono Oge, Lolu and Sibalaya) 4T: Tsunami Prone Buffer Zone (Sempadan Pantai), Minimum 100-200 m from the Highest Tide Spot (200m for Lere, West Besusu and Talise). 4S: Palu Koro Active Fault Line Buffer Zone, 0-10 m (Active Fault Deformation Hazard Zone) 4G: Soil Movement Hazard Zone Level "High" (Post Earthquake) Earthquake Hazard Zone Level "High"	<ul style="list-style-type: none"> Prohibited (not allowed) to rebuild and new development. Existing houses in this zone are recommended to be relocated. Prioritized to be used as protected area, open green space (RTH) and monument.
ZRB 3	3S: Palu Koro Active Fault Line Buffer Zone (<i>Sempadan patahan aktif</i>), 10-50 m 3L: Liquefaction Hazard Zone "Very High" 3T: ZRB Tsunami "High" (KRB III) – Outside the Tsunami Prone Buffer Zone (<i>sempadan pantai</i>) 3G: Soil Movement Hazard Zone level "High" Earthquake Hazard Zone Level "High"	<ul style="list-style-type: none"> It is prohibited to build new residential houses and important & high-risk facilities (according to SNI 1726, including hospitals, schools, meeting venue, stadiums, energy centers, telecommunication centers) Reconstruction of residential houses should be reinforced according to applicable standards (SNI 1726) In area that has not been built yet and inside the Liquefaction zone "very High" or Soil Movement Hazard Zone level "High", priority is given as protected area (<i>kawasan lindung</i>) or non-built cultivation area (agriculture, plantations, forestry).
Meaning of the Criteria 4 L └── Type of Disaster └── ZRB Zone Level Type of Disaster S: Fault Line (<i>Sempadan Sesar</i>) T: Tsunami L: Liquefaction (<i>Likuifaksi</i>) G: Soil Movement Hazard (<i>Gerakan Tanah</i>) B: Flooding (<i>Banjir</i>)	ZRB2	<ul style="list-style-type: none"> New development will require earthquake resistance design refer to applicable standards (SNI 1726) In Tsunami and Flood hazard zone, buildings are adjusted to the vulnerability level of the disaster. Land utilization/usage level "Low intensity".
	ZRB1	<ul style="list-style-type: none"> New development will require earthquake resistance design, refer to applicable standards (SNI 1726) Land utilization/usage level "Low to Medium Intensity"

Source: ATR, ZRB Map for Palu and Surrounding Areas, as of December 2018

Figure 4-2 ATR's ZRB Map for Palu and the Surrounding Areas with Definitions and Spatial Directions of ZRBs

4-4-2 Basic Approach in Formulating Land Use Regulations and Building Structural Requirements for Disaster Risk Reduction (DRR)

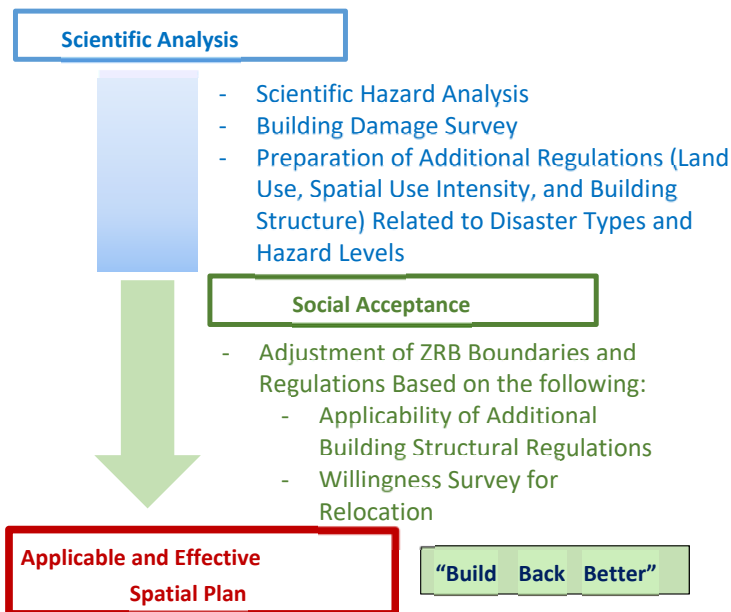
For purposes of DRR, spatial plans based on well-defined ZRB boundaries should indicate land use regulations and building structural requirements corresponding to disaster type and disaster hazard levels, along with structural measures. Two important principles in the formulation of regulations on land use and buildings for DRR are "scientific analysis" and "social acceptance". (See Figure 4-3 and Figure 4-4.)

"ZRB boundaries" and "additional regulations" that underlie DRR should be based on scientific analysis. On the other hand, in order to realize "Build Back Better (BBB)", applicability and socially acceptable costs of DRR regulations are also important. In other words, DRR regulations are required to be adjusted from the viewpoints of scientific analysis and social acceptability.



Source: Prepared by JICA Expert and JICA Study Team

Figure 4-3 Two Principles in Spatial Planning for DRR



Source: Prepared by JICA Expert and JICA Study Team

Figure 4-4 Basic Approach Using the Two Principles in Spatial Planning Based on DRR

4-4-3 Important Points in Formulation of Land Use Regulations and Building Structural Requirements Based on ZRB Map

(1) Four Levels in ZRB Map for Formulating Detailed Spatial Plans

The formulation of detailed spatial plans for DRR should follow the following two points:

- Four ZRB levels are used to designate four zones (ZRB1, ZRB2, ZRB3, and ZRB4) for preparing ZRB map in the post-disaster contexts, while three ZRB levels are used in pre-disaster contexts in Indonesia.
- General policies of regulations on land use and building structure for ZRB1 through ZRB4 are shown in Table 4-1.

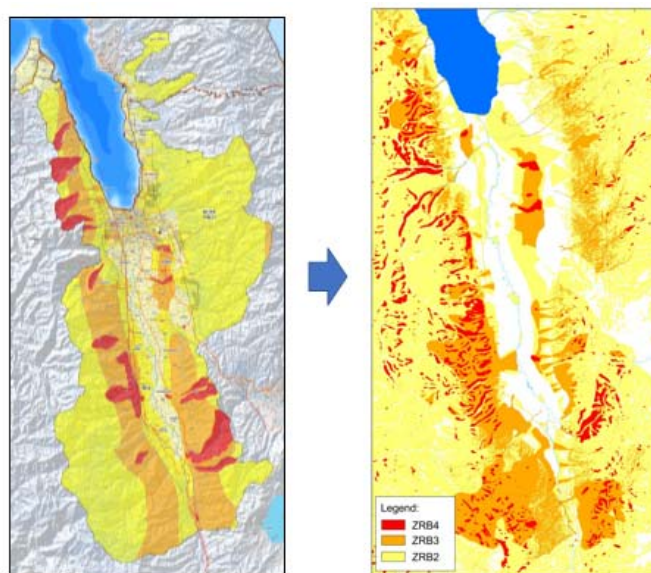
Table 4-1 Description of ZRB Levels and Corresponding Regulations on Land Use and Building Structure

ZRB Level	Name of Zone	Basic Policies of Land Use and Building Structure Regulations for DRR
4	Prohibited Zone	All land uses, except for conservation, are prohibited and relocation is recommended.
3	Limited Zone	New construction of residential buildings, important buildings and high-risk facilities is prohibited, while reconstruction of residential buildings is conditionally permitted.
2	Controlled Zone	There are no prohibitions on land use, but certain restrictions are imposed.
1	Development Zone	There are no land use prohibitions, and less restrictive than ZRB2.

Source: ATR, ZRB Map for Palu City and Its Surrounding Areas, as of December 2018

(2) Refinement of Boundaries of ZRB1 through ZRB4

Prior to the refinement of ZRB map boundaries, detailed hazard maps¹ were prepared by scientific data and analysis. Consequently, a refined ZRB map was generated based on the ZRB map compiled by ATR (December 2019). By using the boundaries on the hazard maps, the boundaries of ATR’s ZRB map were refined. See the refined ZRB map in Figure 4-5.



Sources: (Left Side): ATR, ZRB Map for Palu and Surrounding Areas, as of December 2018
(Right Side) Prepared by JICA Expert and JICA Study Team

Figure 4-5 ZRB Map Refined by the JICA Study Team

(3) Refinement of Land Use Regulations and Building Structural Requirements for Each ZRB Level and Disaster Type

The ZRB map sets additional DRR regulations for each disaster type and hazard level. When regulations are too strict for local residents to accept, it would be difficult to implement and operate these regulations. When refining land use regulations and building structural requirements that respond to ZRB1 areas ~ZRB4 areas, it is important to make the regulations acceptable to local residents.

It is necessary to proceed with the above-mentioned "refining of the ZRB map" and "refining of the

¹ The hazard map is prepared by physical evaluation and classification of areas by disaster type and hazard level.

land use regulations and building structural requirements for each ZRB level" in parallel.

4-4-4 Refinement of ZRB Boundaries on the ZRB Map

(1) Policies for Setting ZRB Boundaries

The ZRB map stipulates land use regulations (policies on new construction and reconstruction of different kinds of buildings) and building structural requirements corresponding to ZRB areas classified by disaster type and hazard level. It is important to obtain social consensus, as the regulations shown on the ZRB map (classification and regulation) will be included in the spatial plan and will eventually have legal regulatory power after the approval at the local parliament. The JICA Study Team has repeatedly pointed out the need to carry out residents' intention to relocate surveys and community dialogues so that regulations on ZRB areas will be acceptable to local residents.

Relocation of residents in ZRB4 areas is recommended. This policy suggests restriction on residential land use of ZRB4 areas, where residents should be relocated to safer areas or permanent relocation sites (HUNTAP). If this policy is implemented in a forceful manner without agreement of the residents or provision of proper compensation, it is considered as a serious violation of human rights. Therefore, ZRB4 boundaries should be carefully delineated considering social acceptance.

Analysis and evaluation of ZRB4 boundaries should be made not only by conducting scientific analysis, but also considering social aspects as illustrated in Figure 4-4. For the scientific analysis, instead of using a hazard map with scale of 1:25,000 (smaller-scale), a larger-scale 1:5,000 map should be utilized so that building footprints can be identified for evaluation.

For considering social aspects, people's intention to relocate should be determined as the basis of evaluation. It is necessary to conduct community dialogues in highly disaster-affected areas for getting consensus on relocation and other issues.

(2) ZRB1 / ZRB2 / ZRB3

In areas where ZRB1, ZRB2, and ZRB3 regulations are applied, certain restrictions are imposed on residents' building activities, agricultural activities, etc. Therefore, it is necessary to give consideration to minimize the impact of these regulations on the local residents and strive to reach consensus among them. Furthermore, when delineating ZRB1, ZRB2, and ZRB3 areas, it is recommended to set the boundaries of hazard maps based on scientific grounds and to establish regulations in consideration of social and economic impacts. To this end, the JICA Study Team repeatedly pointed out the need for dialogue with residents, especially about relocation.

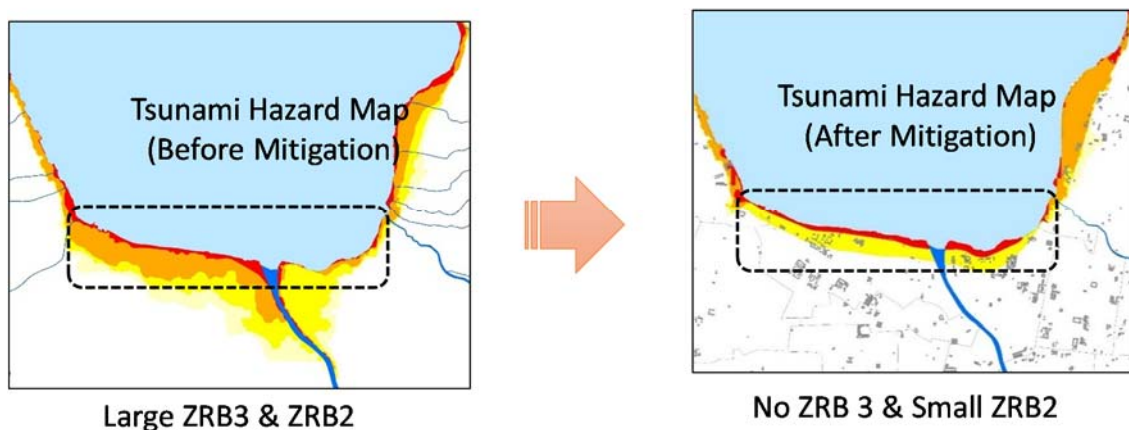
(3) ZRB4

Since ZRB4 areas are not habitable and relocation is recommended, both scientific and social aspects should be considered when setting ZRB4 boundaries. As a scientific analysis, a building damage survey was conducted to investigate building damages and living situations. The survey results were submitted to the Indonesian government as the basis for determining the boundaries of ZRB4. Finally, the JICA Study Team recommended that it is necessary to conduct a survey of the residents' intention regarding relocation, analyze the social acceptability of the boundaries, and set the boundaries of ZRB4 through

dialogue with residents.

(4) Method of Changing ZRB Levels on the ZRB Map

The setting of ZRB areas for each disaster type is based on disaster hazard levels. However, it can be expected that the disaster hazard levels will be lowered by implementing structural measures for DRR. Therefore, it is possible to change (lower) ZRB levels of certain areas on the ZRB map depending on the effects of implemented DRR structural measures.



Source: Prepared by JICA Expert Team and JICA Study Team

Figure 4-6 Ways to Change ZRB Levels

4-4-5 Lessons Learnt from Sri Lanka's Case of Forced Eviction from Tsunami-Affected Coastal Areas

The 2004 Indian Ocean Tsunami caused devastated damages in wide coastal areas of Sri Lanka. In response to this tsunami disaster, the Sri Lankan government decided and implemented forced relocation of the residents from the area of 100-200 m from the shoreline to inland relocation sites. Please see the detailed situations of this case in Table 4-2.

However, this forced eviction of residents from the tsunami-affected coastal areas has been severely criticized by the international community and NGOs for human rights abuses. See the reasons behind the criticisms given by UN Habitat's publication "Forced Evictions: Global Crisis, Global Solutions".

«Reference» An Example of Violation of Human Rights

The “right to choose the living environment and place” is a fundamental human right that everyone can have. Therefore, any government entity cannot take this basic human right away from people by enforcing relocation, even if their dwelling areas are designated as high disaster-risk and hazard-level areas. Instead, the government has only one option: to give warning, recommendations and caution to the target people and community. However, in case majority of people or communities agree with such a relocation policy, the government can restrict people’s activities in those high disaster-risk areas. The relocation enforced by the government is considered as violations of human rights.

Governments that conducted forced relocation have been criticized by UN, NGOs, media, etc. (e.g., UN criticized the case of relocation by Sri Lankan Government after the 2004 Indian Ocean Tsunami)

Source: Forced Evictions: Global Crisis, Global solutions / UN Habitat. 2011

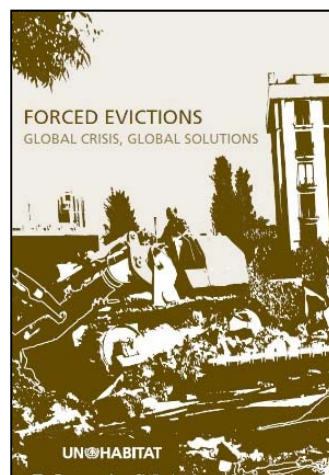


Table 4-2 Sri Lanka’s Case of Forced Eviction from the Coastal Areas Affected by the 2004 Indian Ocean Tsunami

Aspects of the Case	Description of Aspects
Principal Cause of Eviction	➤ After the 2004 Indian Ocean Tsunami, buffer zones of 100~200 meters of the mean high water line were set to restrict any construction.
Eviction Process and Its Effects	<ul style="list-style-type: none"> ➤ The government has set a coastal buffer zone, where reconstruction of residential buildings is not permitted, and the residents within this zone should be relocated. ➤ The designation of the buffer zone created 100,000 people displaced, and those who had no right of reconstruction of their residential buildings have to be relocated to inland shelters. ➤ The communities affected by the designation of the buffer zones were not consulted about relocation. Moreover, a task force for reconstruction did not include any community people at all. ➤ While individual households were forced to relocate, hotels and other commercial enterprises were permitted to continue operation in the coastal buffer zones.
Impacts/ Results	➤ After it had been criticized by the international community, in 2006 the government revoked the buffer zone policy, allowing 11,000 people to continue to live on the coast.

Source: Prepared by JICA Expert based on “The Forced Evictions: Global Crisis, Global solutions / UN Habitat. 2011”

4-4-6 ZRB Areas for Active Faults: Learning from Practices of Other Countries

(1) ATR’s 2019 ZRB Map

ATR’s ZRB Map generated in October 2019 stipulates the ZRB4 and ZRB3 areas for active faults as follows:

- ZRB4 areas for active fault area are set within 10 m from the active fault line (in both sides).
- ZRB3 areas for active fault area are set within 10~50 m from the active fault line (in both sides).

(2) Other Countries’ Regulations on Active Fault-Affected Areas

Other countries prone to earthquakes and disasters related to active faults, including US, Taiwan and New Zealand, have done different practices from Indonesia as follows:

- 1) Alquist-Priolo Earthquake Fault Zoning Act, State of California, US
 - New construction and large reconstruction must not be allowed within 15 m from the mark of the active fault. *Large reconstruction* means the reconstruction of more than half of the original buildings.
 - Residential buildings of 2 or less stories are allowed even within 15 m from the mark of the active fault.
- 2) Case in Taiwan
 - New construction of public buildings and facilities must not be allowed within 15 m from the mark of active fault.
 - However, houses lower than 7 m with 2 or less stories can be allowed even within 15 m from the mark of active fault.
- 3) Case in New Zealand
 - The New Zealand government recommends that local governments should set additional regulations on construction activities within 20 m from the mark of active fault.

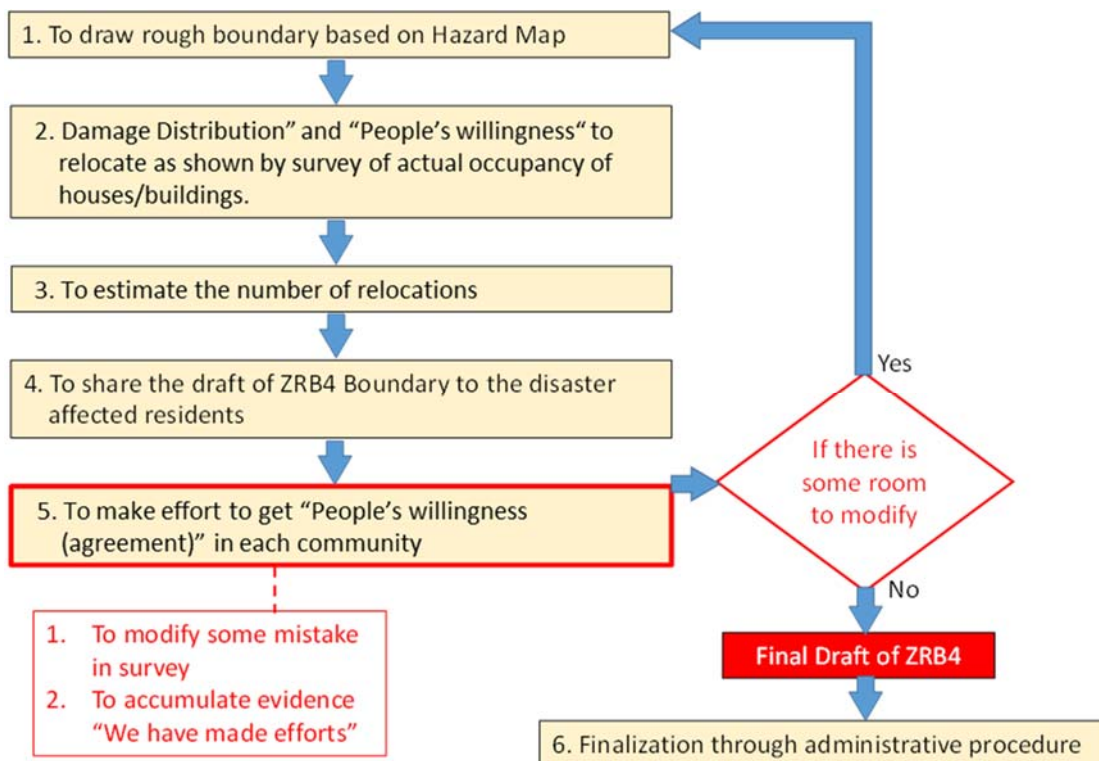
4-5 Methodology for Setting of ZRB4 Boundaries

4-5-1 Overview of Procedure for Setting ZRB4 Boundaries

ZRB4 boundaries should be finalized not only by scientific analysis but also by consideration of social aspects, particularly on people's intention to relocate. Setting of ZRB4 boundaries should be conducted in accordance with the following steps and as illustrated in Figure 4-7:

- 1st Step: Rough boundaries of ZRB4 areas should be drawn as tentative delineation based on the boundaries of Hazard Level 4 on the hazard maps prepared by the JICA Study Team.
- 2nd Step: Study and evaluate the tentative ZRB4 boundaries. The ZRB4 boundaries should be modified based on the results of two surveys: Building Damage Survey and Survey on People's Intention to Relocate.
- 3rd Step: The tentatively drafted ZRB4 boundaries at the 1st Step above should be revised based on results of the building damage survey (scientific analysis) and living situation survey (social analysis). Afterward, the number of households who agree to relocation from the revised ZRB4 areas should be determined.
- 4th Step: The revised ZRB4 boundaries should be shared with the communities. Public consultations, community dialogues, meetings with individual residents, or any other discussion opportunities should be organized to obtain consensus on the ZRB4 boundaries among communities and residents. As a result, it is expected that the affected people's intention are all reflected in the setting of ZRB boundaries.
- 5th Step: To finalize the ZRB4 boundaries, data regarding people's intention to relocate should be collected among residents in ZRB4 areas. In this survey, people's intention is basically considered as residents' acceptance of relocation. Where the consensus on the

ZRB boundaries cannot be obtained, the tentative ZRB4 boundaries should be further revised till the agreement of the affected people are obtained. Then the ZRB4 boundaries are finalized.



Source: Prepared by JICA Expert

Figure 4-7 Recommended Procedure for Setting ZRB4 Boundaries

4-5-2 Surveys for Setting Boundaries of Areas to be Relocated (ZRB4 Boundaries)

The following two data shall be collected to draw ZRB4 boundaries.

- Spatial distribution of building damages due to disaster
- People's intention to relocate as indicated by survey of actual occupancy of houses/buildings

Spatial distribution of building damages is necessary data to conduct scientific analysis and evaluation for the refinement of ZRB4 boundaries. If the ZRB4 regulations suggest people's relocation, a "basic human right to allow people to choose their own living environment" should be considered. For protecting the human rights of residents, the boundaries of ZRB4 should be carefully defined. Disaster hazard maps should be utilized as a scientific basis to delineate areas of ZRB1 through ZRB3. However, if the scale of hazard maps is only 1:25,000, such hazard maps are not so useful to identify footprints or perimeters of buildings in ZRB4 areas. It is necessary to conduct a survey to collect and assess building damages for the purpose of analysis and evaluation of buildings which are standing on the edges or nearby candidate boundaries of ZRB4 areas. If "no damage" or "partially damaged" buildings are identified within the ZRB4 areas, this situation could induce serious social problem or conflict, including possible issue on human rights violation.

On the other hand, results of Survey on People's Intention to Relocate are necessary data to examine social aspects. In principle, it is important to collect all necessary information and data concerned with relocation, whether or not local people are willing to be relocated, and other relevant issues such as compensation, livelihood, and protection of property rights in the ZRB4. Providing unofficial or less verified data and information to the local people should be avoided, so as not to confuse the residents. The following two-step survey procedure should be adopted for the Survey on People's Intention to Relocate.

- First Step (Setting refined ZRB4 boundaries): The data on people's living situation should be collected as supporting data to evaluate whether existing buildings should be included in the ZRB4 area or not. Survey result showing that people are still living in a certain building after the disaster indicates that these people may have strong opposition or less willingness to relocate. However, it is not possible to determine the people's willingness or actual intention to live in the affected area from this survey result.
- Second Step (ZRB4 boundaries almost finalized): In order to finalize ZRB4 boundaries, a particular survey should be conducted to examine the extent of agreement to relocation can be obtained from all the people and residents who have dwellings and properties within the ZRB4 area.

(1) Target Areas of Building Damage Survey

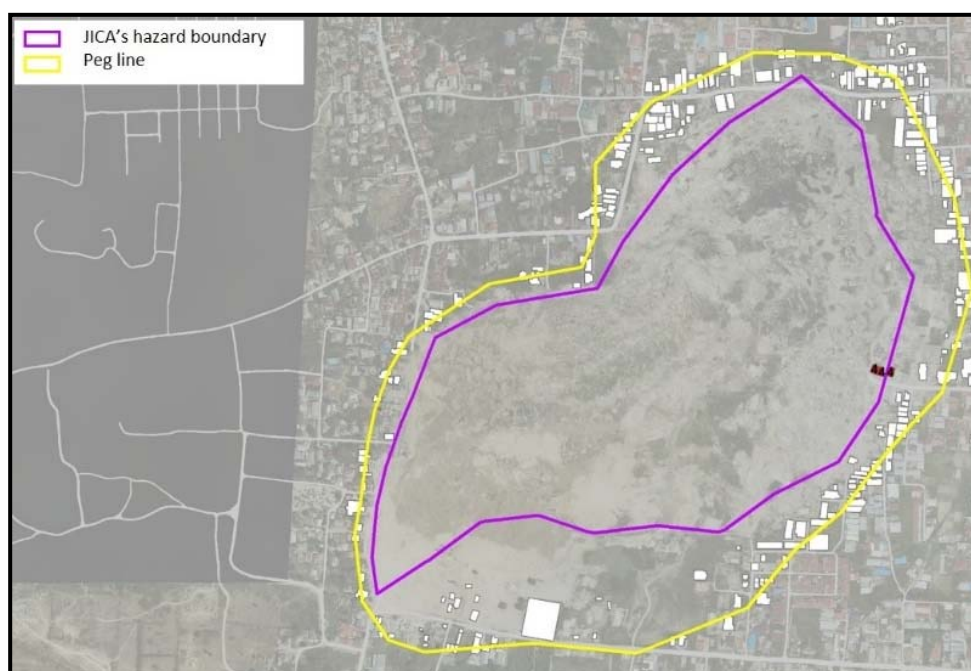
JICA Study Team has assisted the Indonesian government to conduct the first step, or People's Living Situation Survey. When ZRB4 boundaries are mostly finalized, it is necessary to conduct a survey to examine the acceptance level of relocation from all the residents in the ZRB4 zones, including those who currently stay in shelters or temporary housing (Hunian Sementara or HUNTARA).

As described in Figure 4-7, Hazard Level 4 lines of the refined hazard map should be used as a reference to define the ZRB4 boundaries. Besides, the "peg lines" was selected as the ZRB4 boundary candidate, which has been set by ATR/BPN for the initial reference, including the potential areas with future disaster risk. The areas delineated by the peg lines are much larger than the Hazard Level 4 areas defined by JICA Study Team. There is a large number of existing buildings between the peg lines and the boundaries for Hazard Level 4 set by JICA Study Team. Many of these buildings have only very small damages from the disaster (either in "no damage" or "partially damaged" categories in the survey). Thus, it was easily assumed that this large number of buildings are still habitable after the disaster. Adopting the peg lines as ZRB4 boundaries means that these people living in still habitable buildings are asked to be relocated, and such activity could be considered as a violation of human rights.

JICA Study Team had serious concern on the consequences of the delineation of ZRB4 areas by the peg lines, which could trigger major opposition or protest by the affected people and communities when such ZRB4 boundaries would be explained to them. Their consensus on ZRB4 areas could not be obtained and the ZRB4 boundaries could not be finalized for quite some time. Because of these concerns, JICA Study Team had provided additional assistance to the Indonesian government to

conduct two (2) surveys: Building Damages and Survey on Living Situation),² within the target areas delineated by the peg lines in ATR's October 2019 ZRB Map.

Thus, the areas between JICA's hazard boundaries and the peg lines were selected as the survey target areas in Nalodo-affected and Active Fault-affected Areas. Particularly, the survey targets in the Active Fault-Affected Areas were limited to the buildings in the ZRB4 areas defined by the peg lines (10 m on both sides from the fault line). In Palu City, all the buildings located in the ZRB4 areas of the Active Fault Area delineated by the peg lines were surveyed, but the survey targets in Sigi Regency were limited to the buildings in the Active Fault Areas near roads. There were many buildings within the coastal tsunami ZRB4 areas defined by the peg lines. Therefore, the survey was conducted from the shoreline towards inland direction for efficient survey operation. Furthermore, there were no buildings located within Hazard Level 4 of sediment disaster areas so that the survey was not conducted.



Source: Prepared by JICA Expert and JICA Study Team

Figure 4-8 Target Area of Building Damage Survey (The buildings marked with white color were covered by the building damage survey.)

(2) Building Damage Survey

On-site assessment should be conducted for each building to identify the damage level of its structures. It is not recommended to rely on satellite photo imagery or aerial photo imagery for evaluation of building damage levels. It is necessary to inspect both outside and inside damages of buildings. Building damages are categorized into seven (7) levels as described in Table 4-3.

² This survey is the survey on actual occupancy of houses/buildings.

Table 4-3 Building Damage Categories Used in Building Damage Survey by JICA Study Team

Category	Description
1. No Damage (Undamaged)	<p>If a house meets all the conditions below</p> <ul style="list-style-type: none"> ➤ Occupants are able to live without discomfort ➤ Occupants are able to withstand the occurrence of another or future earthquakes in the building. ➤ No need to repair ➤ Roof is not damaged or a little broken ➤ Foundation is not damaged or a little broken ➤ Floor is horizontal or a little unaligned ➤ No wall damage or damage is limited to little cracks ➤ Without subsidence
2. Partially Damaged	If a house is inhabitable after minor repair (or not categorized to any of the other six categories)
3. Largely Damaged	<p>If a house meets one of the conditions below</p> <ul style="list-style-type: none"> ➤ Occupants are able to live, but repair is necessary because of discomfort or in preparation for next earthquake (Damaged, but there is one or more rooms that can be use as living space) ➤ Roof is largely broken. (Possible to be repaired without replacement) ➤ Foundation is largely broken. (Possible to be repaired without replacement) ➤ Floor is largely unaligned. out of horizontal (Possible to be repaired without replacement) ➤ One or more walls are largely broken (Possible to be repaired without replacement)
4. Completely Destroyed	<p>If a house meets one of the conditions below</p> <ul style="list-style-type: none"> ➤ Cannot be used as living space ➤ Possibility to collapse when another or future earthquakes occur. ➤ It is necessary to demolish and rebuild in order to repair ➤ Roof is completely broken (Impossible to repair) ➤ Foundation is completely broken (Impossible to repair) ➤ Floor is completely unaligned (Impossible to repair) ➤ One or more walls are completely broken (Impossible to repair)
5. Rebuilt	If a house has been rebuilt
6. Demolished	Demolition is confirmed by the surveyors on site as the buildings were already lost after the disaster. The demolished category includes buildings which were under construction before the disaster occurrence.
7. Vanished	Buildings that vanished after the disaster can be recognized by comparison of satellite pictures of pre- and post-disaster cases.

Source : Prepared by JICA Expert and JICA Study Team

(3) People's Intention-to-Relocate Survey

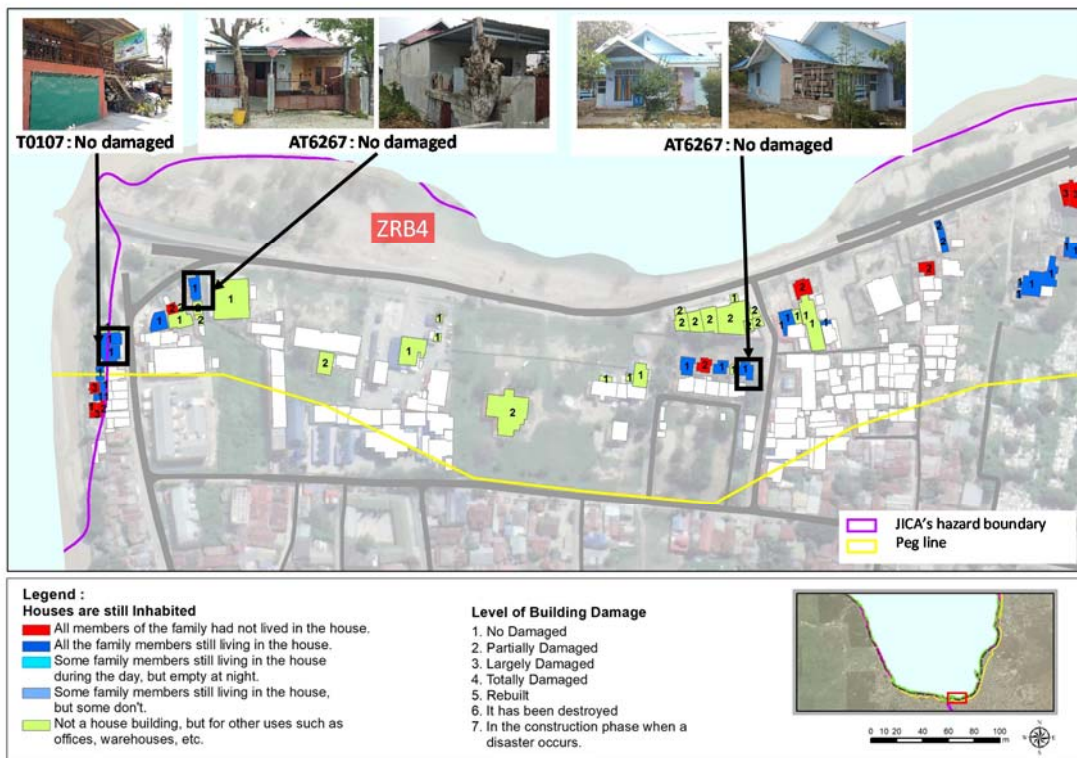
Data on intention-to-relocate are to be gathered through interviews of village leaders and residents, as well as by conducting a household survey targeting disaster-affected residents. However, it is difficult to conduct interviews or surveys before setting final draft boundaries of ZRB4 areas. Therefore, an alternative way for conducting such surveys can be done by focusing on the actual situation of “whether people are currently living in the houses within the affected areas or not,” in order to understand people’s opposition against relocation. The survey on “Presence of Actual Occupants” is done to identify whether people are still living in the disaster-affected areas; therefore, the survey should be conducted by visual inspections and by interviewing the people still living in the affected areas. Actual occupants in the survey are categorized into the five (5) as described in Table 4-4.

Table 4-4 Categories of Actual Occupants

Categories to Describe Actual Occupancy in Buildings
1. All members of the household still live in the residential building in the disaster-affected area.
2. No member of the household lives in the residential building in the disaster-affected area.
3. Some household members still live in the residential building in the disaster-affected area only in daytime, but no one stays there at night.
4. Some household members still live in the residential building in the disaster-affected area.
5. The building is for non-residential use, such as an office or warehouse.

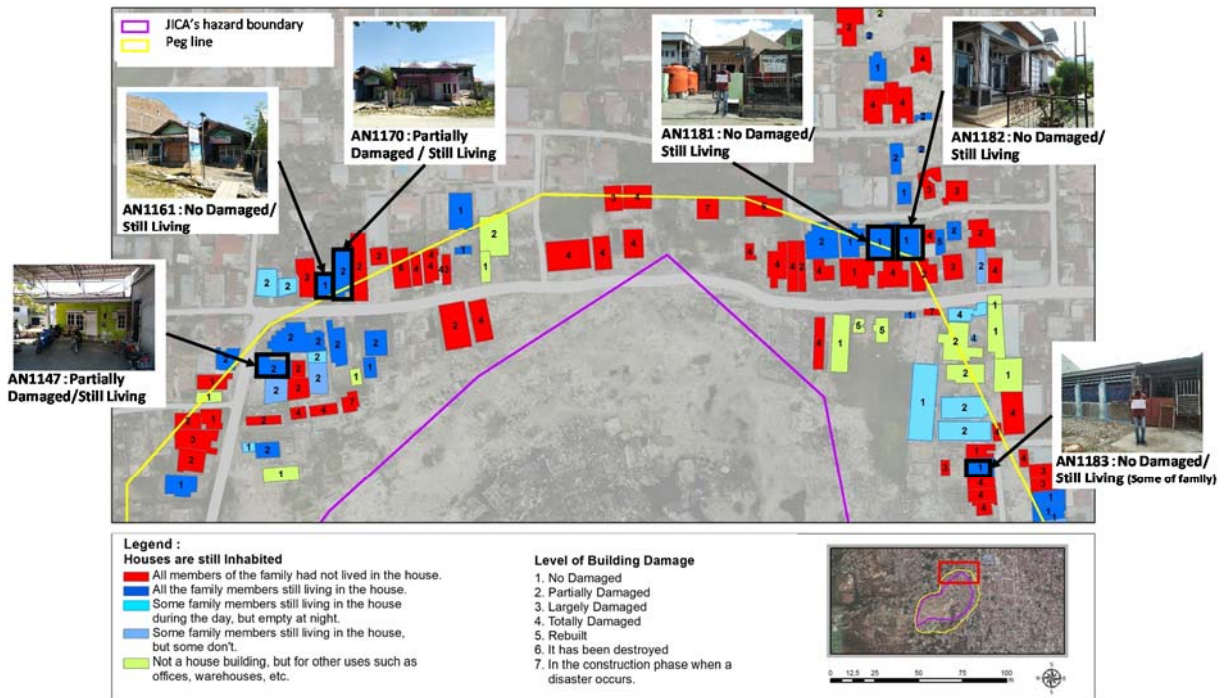
Source : Prepared by JICA Expert

An example of the building damage survey results is presented in Figure 4-9.



Source: JICA Study Team

Figure 4-9 Example of Survey Results of "Building Damage" and "Actual Occupancy" in Coastal Areas of Palu City



Source: Prepared by JICA Expert and JICA Study Team

Figure 4-10 Examples of Survey Results of “Building Damage” and “Actual Occupancy” in Nalodo-Affected Areas

4-5-3 Four-Step Process for Setting ZRB4 Boundaries

According to Figure 4-11, the four steps for setting ZRB4 boundaries are as follows:

(1) Draw Rough ZRB4 Boundaries Based on Hazard Map

Based on the hazard map boundaries prepared by scientific analysis, tentative draft ZRB4 boundaries are determined as the first step.

(2) Examine Tentative ZRB4 Boundaries by Conducting a Building Damage Survey

Tentative ZRB4 boundaries should be set, according to the results of the Building Damage Survey and the following three boundaries:

- Close to JICA Study Team’s Hazard Level 4 boundaries
- Within the peg lines and 100 m Buffer Zone boundaries for tsunami
- From the Nalodo ZRB4 boundaries by the JICA Study Team

Paying attention to the instructions mentioned above, the rough ZRB4 boundaries are revised, considering the results of the Building Damage Survey as described hereafter:

1) Case of Residential Buildings

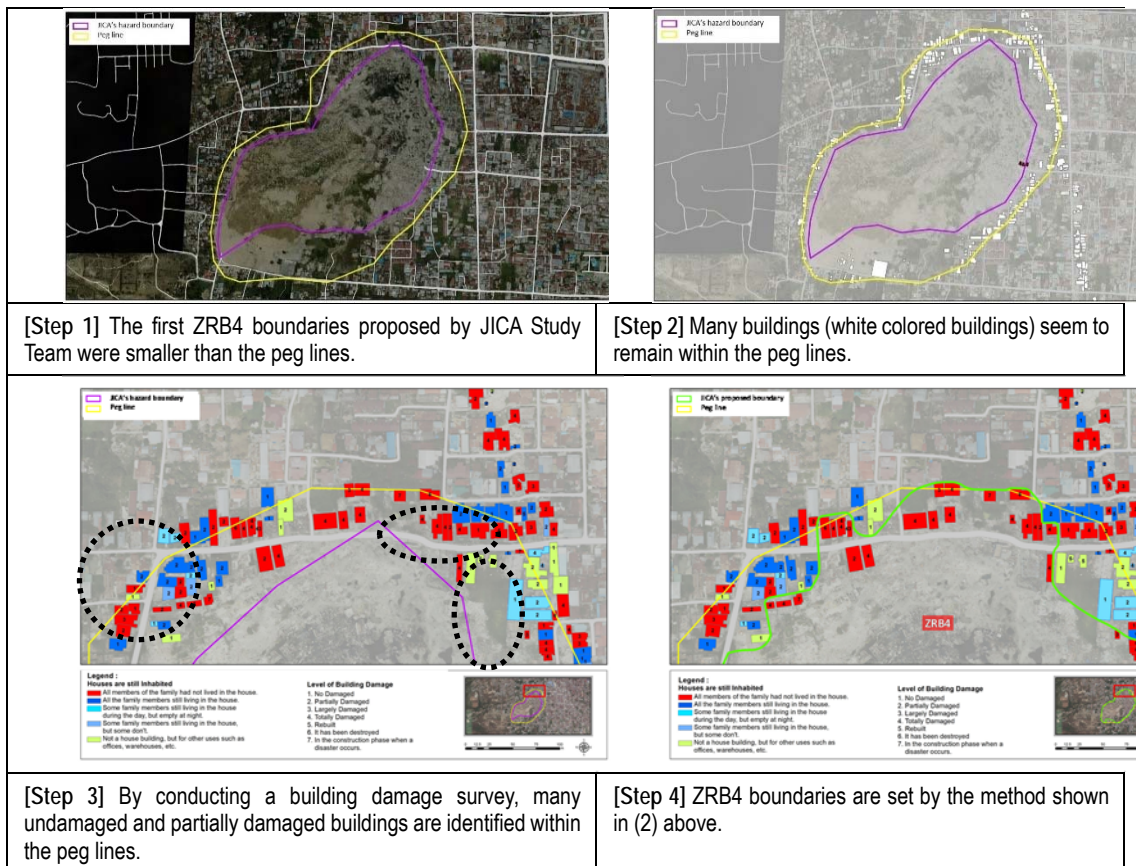
The following criteria should be applied to determine ZRB4 boundaries.

- Priority 1: The buildings of BDR 1 (No Damage) and BDR 5 (Rebuilt) are not included in ZRB4 in principle.

- Priority 2: The buildings of BDR 4 (Completely Destroyed) and BDR 6 (Demolished) are included in ZRB4 in principle. However, those buildings should not be included in ZRB4 if drawing a ZRB4 boundary. It would pose difficulty in including those buildings because of their proximity to the buildings of BDR 1 or BDR 5.
- Priority 3: The buildings of BDR 2 (Partially Damaged) are not included in ZRB4 in principle. However, they should be included in ZRB4 only if drawing a ZRB4 boundary. It would pose difficulty in excluding those buildings from the ZRB4 is because of their proximity to the buildings of BDR 4 or 6.
- Priority 4: The buildings of BDR 3 (Largely Damaged) are included in ZRB4 in principle. However, it should not be included in ZRB4 if drawing a ZRB4 boundary. It would pose difficulty in including those buildings because of their proximity to the building of BDR 1, BDR 2 or BDR 5.

2) Case of Non-Residential Buildings

- Same criteria for residential use buildings are applied to buildings for economic activities such as restaurants, shops and workshops, etc.
- Buildings for other uses, not mentioned above, are included in ZRB4.



Source: Prepared by JICA Expert

Figure 4-11 Four Steps in Determining ZRB4 Boundaries

(3) Estimate the Number of Households to Be Relocated

It is necessary to examine the number of households within the tentative ZRB4 boundaries which will be relocated. After this is estimated, the government should ensure relocation sites and decide the conditions of relocation. The Indonesian government should consider the following for the implementation of relocation.

- “Forced relocation” should be avoided, and relocation should be implemented based on agreement with residents.
- The residents of residential buildings in ZRB4 areas should be relocated to permanent relocation sites (HUNTAP) within a certain duration (within 3 years or so) after the completion of HUNTAP.
- Allocation of land in HUNTAP should also include all land owners of offices, commercial space, housing development site, etc. within ZRB4 areas.
- An appropriate amount of compensation should be provided to land owners in ZRB4 areas, if the size of the provided house or site is much smaller than the land they owned in ZRB4 areas.

(4) Share Draft ZRB4 Boundaries with Disaster-Affected Residents / Make Effort to Build Consensus Among Communities

Publicizing the proposed ZRB4 zones is important obligation of the government to ensure administrative accountability in a series of democratic procedure. The period of public review should take sufficient time. The local governments need to explain the proposed ZRB4 areas to each village as many times as possible. They should also ensure the provision of opportunities for consultation in which stakeholders, including residents, can ask questions or say opinions about the proposal.

If there is some room to modify the proposed ZRB4 boundaries, the survey should be conducted and the ZRB4 boundaries should be revised again. Potential cases requiring modification are as follows:

- Boundaries are not appropriate because of mistakes in the survey or in drawing the boundaries
- Boundaries should be modified by the confirmation of people’s intention to relocate
- Boundaries should be moved a little because of land ownership issues.
- Some buildings should be included or excluded from ZRB4 areas depending on the boundaries of blocks /quarters or roads.

«Reference»

Consensus building in relocation areas with high risk of tsunami after the 2011 earthquake and tsunami disaster in Japan

1. Higashi-Matsushima City

- The city government formulated “Reconstruction Plan” by the 9th month after the disaster.
- The city government involved more than 2,000 people to make the plan.
- The residents could choose relocation or reconstruction during planning there
- The city government held public consultations more than 400 times.
- The city government has been constructing 717 building lots and 1,101 houses.

2. Kamaishi City

- The city government held public consultation meetings 168 times.
- The residents could choose relocation or reconstruction during planning
- The city government has constructed 1,056 building lots and 1,316 houses



Both cities allowed the residents to choose relocation or reconstruction.

Both cities think that the most important matter is to achieve a consensus with residents.

The governments supported construction of relocation sites and provided residents with financial assistance for relocation or reconstruction.

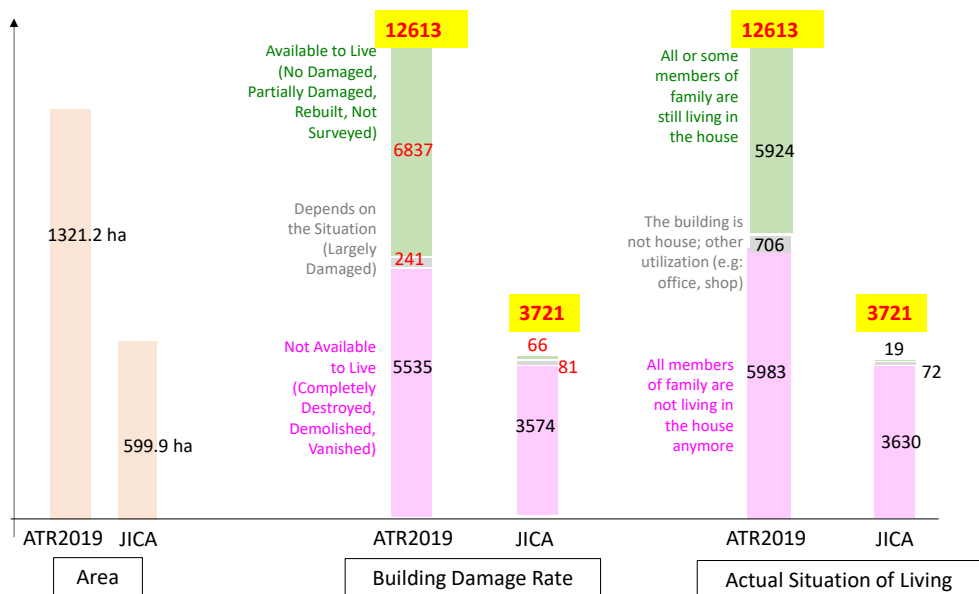


Figure 4-12 Consensus Building for Relocation After the Tsunami in 2011 in Japan (Left: Higashi-Matsushima City / Right: Kamaishi City)

4-6 Results of Setting ZRB4 Boundaries

4-6-1 Comparison Between the ZRB Map of October 2019 by ATR and the ZRB4 Boundaries Proposed by JICA Study Team

The comparison between the ZRB Map generated in October 2019 (peg lines by BG) and JICA Study Team's proposed ZRB4 boundaries is shown in Figure 4-13 through Figure 4-16. The total area of ZRB4 areas recommended by JICA Study Team is 72% smaller than that of the ZRB Map of October 2019 by ATR. The number of buildings with No Damage and Partially Damaged classifications in the ZRB4 areas identified by JICA Study Team is about 99% smaller than that of the ZRB Map of October 2019 by ATR. In fact, many of the houses with less damage are actually being occupied by residents.



Source: Prepared by JICA Expert and JICA Study Team

Figure 4-13 Comparison of ZRB4 Areas of ATR's ZRB Map and JICA Study Team's Proposed ZRB4 Areas: Building Damage Situation and Actually Occupied Buildings in ZRB4 Areas

Total	Total		Palu		Sigi		Donggala	
	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA
Area (ha)	1321.2	599.9	704.9	312.1	293.5	286.4	322.8	1.4

Palu	Tsunami		Seismic Fault		Balarooa		Petobo	
	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA
Area (ha)	396.3	80.8	60.6	0.8	54.5	49.8	193.5	180.7

Sigi	Jono Oge		Lolu		Sibalaya		Sidondo Satu	
	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA
Area (ha)	201.3	195.6	31.3	23.3	60.9	60.2	0	7.3

- ※1 ATR's proposal for ZRB 4 is 100m Buffer Zone for Tsunami, and Peg Line for other disasters except for Tsunami
- ※2 The area of Peg line of Seismic fault area is calculated with within 10m both sides of the fault line in Palu. The area of JICA's proposed ZRB4 boundary of Seismic fault area is calculated within the 400m from coastal line besides the range of 10m both sides of the fault line.
- ※3 JICA proposal of ZRB4 does not include Kinta village of Petobo. If including Kinta village, JICA' area will increase 2.2 ha
- ※4 JICA Team has confirmed that ATR has determined the Jono Oge's ZRB4 boundary with Peg line (north, east and south areas) together with utilizing the JICA proposed line (west line) as of December 11th. So, area (ha) of Jono Oge is calculated within the latest boundary.

Source: Prepared by JICA Expert and JICA Study Team

Figure 4-14 Comparison Between ZRB4 Areas of ATR's ZRB Map and JICA Study Team's Proposed ZRB4 Areas: Sizes of ZRB4 Areas

Total	Total		Palu		Sigi		Donggala	
	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA
Building Damage Rate								
Available to Live (No Damaged, Partially Damaged, Rebuilt, Not Surveyed)	6837	66	2116	36	171	30	4550	0
Depends on the Situation (Largely Damaged)	241	81	217	76	23	5	1	0
Not Available to Live (Completely Destroyed, Demolished, Vanished)	5535	3574	4608	3044	615	530	312	0
Total	12613	3721	6941	3156	809	565	4863	0

Palu	Tsunami		Seismic Fault		Balaraoa		Petobo	
	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA
Building Damage Rate								
Available to Live (No Damaged, Partially Damaged, Rebuilt, Not Surveyed)	1531	4	130	0	141	5	314	27
Depends on the Situation (Largely Damaged)	82	7	37	0	25	16	73	53
Not Available to Live (Completely Destroyed, Demolished, Vanished)	1683	414	126	4	1286	1193	1513	1433
Total	3296	425	293	4	1452	1214	1900	1513

Sigi	Jono Oge		Lolu		Sibalaya		Sidondo Satu	
	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA
Building Damage Rate								
Available to Live (No Damaged, Partially Damaged, Rebuilt, Not Surveyed)	41	10	73	2	57	18	0	0
Depends on the Situation (Largely Damaged)	7	4	7	0	9	1	0	0
Not Available to Live (Completely Destroyed, Demolished, Vanished)	284	274	201	135	130	120	0	1
Total	332	288	281	137	196	139	0	1

- ※1 ATR's proposal for ZRB 4 is 100m Buffer Zone for Tsunami, and Peg Line for other disasters except for Tsunami
- ※2 The area of Peg line of Seismic fault area is calculated with within 10m both sides of the fault line in Palu. The area of JICA's proposed ZRB4 boundary of Seismic fault area is calculated within the 400m from coastal line besides the range of 10m both sides of the fault line.
- ※3 JICA proposal of ZRB4 does not include Kinta village of Petobo. If including Kinta village, JICA' area will increase 2.2 ha. JICA proposal of ZRB4 does not include Kinta village of Petobo. If including Kinta village, JICA's "Available to Live", "Not Available to Live" and "Depend on the Situation" will increase 15, 17 and 11 respectively.
- ※4 JICA Team has confirmed that ATR has determined the Jono Oge's ZRB4 boundary with Peg line (north, east and south areas) together with utilizing the JICA proposed line (west line) as of December 11th. So, area (ha) of Jono Oge is calculated within the latest boundary.

Source: Prepared by JICA Expert and JICA Study Team

Figure 4-15 Comparison Between ZRB4 Areas of ATR's ZRB Map and JICA Study Team's Proposed ZRB4 Areas: Building Damage Situation in ZRB4 Areas

Total	Total		Palu		Sigi		Donggala	
	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA
Actual Situation of Living								
All or some members of family are still living in the house	5924	19	1300	14	78	5	4546	0
The building is not house; other utilization (e.g: office, shop)	706	72	619	35	84	37	3	0
All members of family are not living in the house anymore	5983	3630	5022	3107	647	523	314	0
Total	12613	3721	6941	3156	809	565	4863	0

Palu	Tsunami		Seismic Fault		Balaraoa		Petobo	
	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA
Actual Situation of Living								
All or some members of family are still living in the house	1003	2	91	0	73	1	133	11
The building is not house; other utilization (e.g: office, shop)	492	9	35	1	41	7	51	18
All members of family are not living in the house anymore	1801	414	167	3	1338	1206	1716	1484
Total	3296	425	293	4	1452	1214	1900	1513

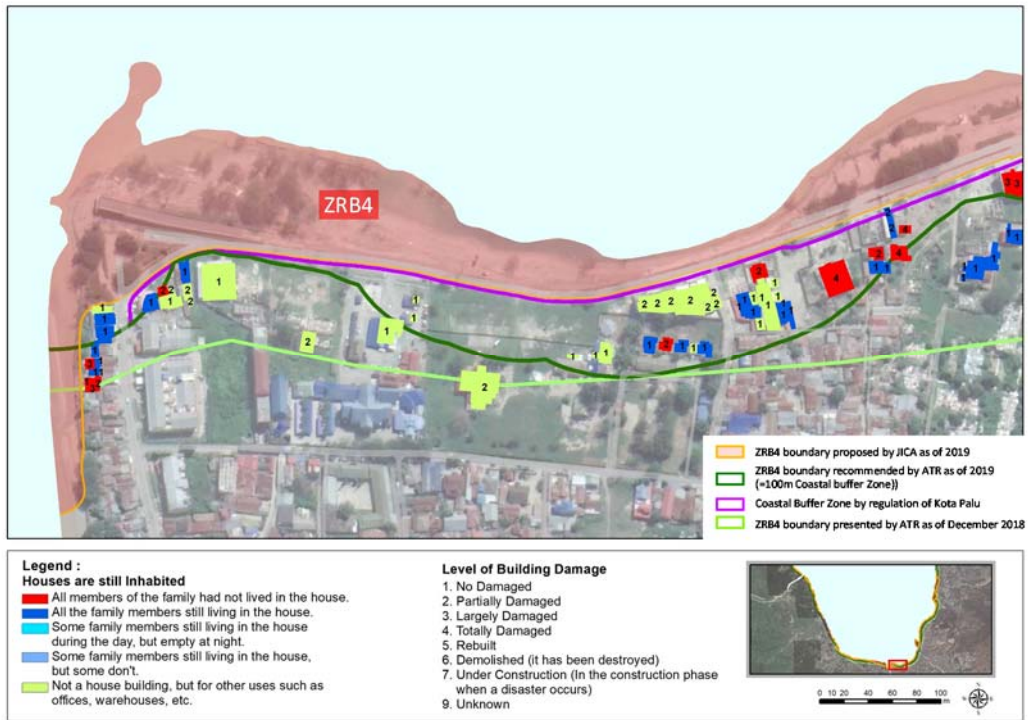
Sigi	Jono Oge		Lolu		Sibalaya		Sidondo Satu	
	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA	ATR2019	JICA
Actual Situation of Living								
All or some members of family are still living in the house	10	0	32	0	36	5	0	0
The building is not house; other utilization (e.g: office, shop)	25	15	40	8	19	14	0	0
All members of family are not living in the house anymore	297	273	209	129	141	120	0	1
Total	332	288	281	137	196	139	0	1

- ※1 ATR's proposal for ZRB 4 is 100m Buffer Zone for Tsunami, and Peg Line for other disasters except for Tsunami
- ※2 The area of Peg line of Seismic fault area is calculated with within 10m both sides of the fault line in Palu. The area of JICA's proposed ZRB4 boundary of Seismic fault area is calculated within the 400m from coastal line besides the range of 10m both sides of the fault line.
- ※3 JICA proposal of ZRB4 does not include Kinta village of Petobo. If including Kinta village, JICA' area will increase 2.2 ha. JICA proposal of ZRB4 does not include Kinta village of Petobo. If including Kinta village, JICA's "All or some members of family are still living in the house", "All members of family are not living in the house anymore" and "The building is not house; other utilization (e.g: office, shop)" will increase 36, 4 and 3 respectively
- ※4 JICA Team has confirmed that ATR has determined the Jono Oge's ZRB4 boundary with Peg line (north, east and south areas) together with utilizing the JICA proposed line (west line) as of December 11th. So, area (ha) of Jono Oge is calculated within the latest boundary.

Source: Prepared by JICA Expert and JICA Study Team

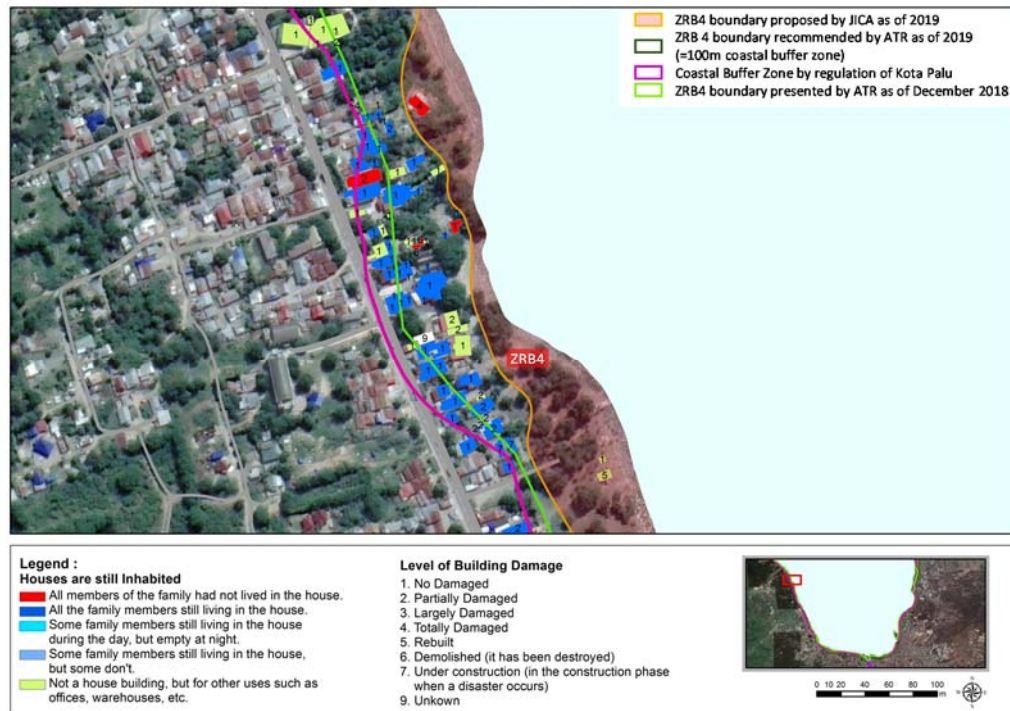
Figure 4-16 Comparison Between ZRB4 Areas of ATR's ZRB Map and JICA Study Team's Proposed ZRB4 Areas: Actually Occupied Buildings in ZRB4 Areas

4-6-2 Tsunami ZRB4 Boundaries



Source: Prepared by JICA Expert and JICA Study Team

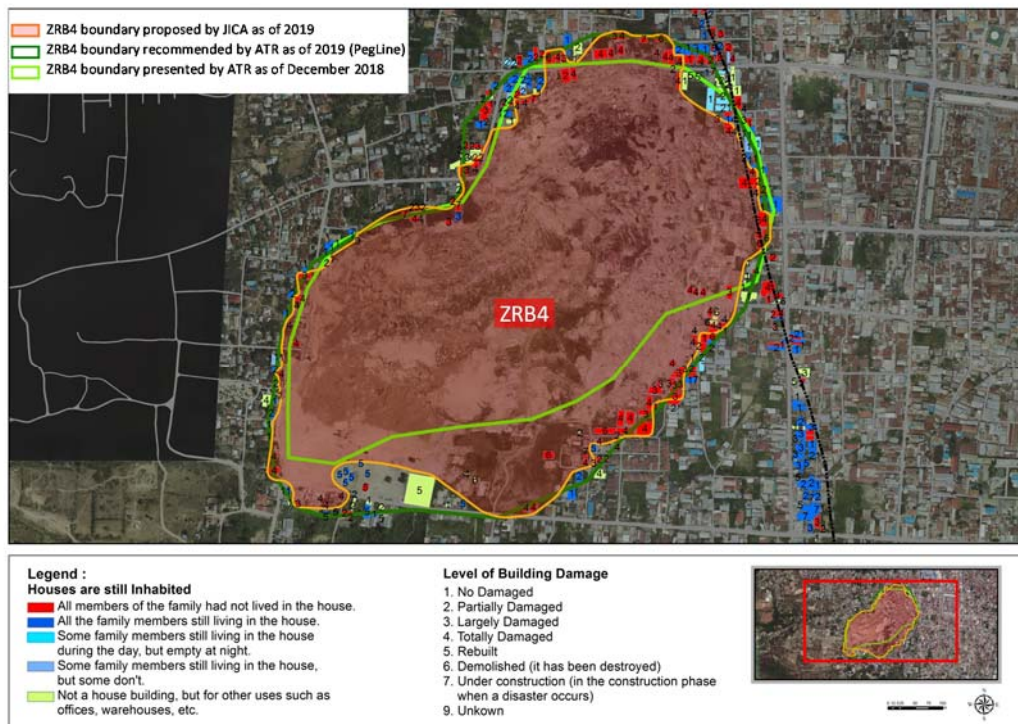
Figure 4-17 Tsunami ZRB4 Areas Proposed by the JICA Study Team, in Comparison with ATR' ZRB Map in Besusu Barat, Southern Coastal Area of Palu City



Source: Prepared by JICA Expert and JICA Study Team

Figure 4-18 Tsunami ZRB4 Areas in Bururi Coastal Area of Palu City

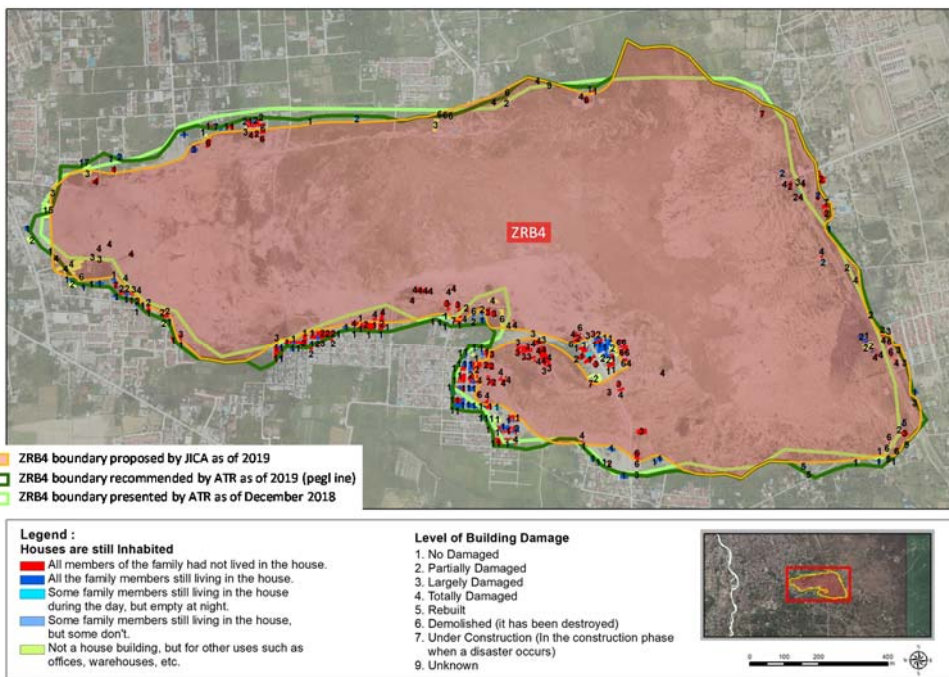
4-6-3 Nalodo ZRB4 Boundaries



Note: Peg Lines (ZRB4 Boundaries recommended by ART in 2019) are displayed in green. However, where the green lines are not visible, they overlap with ZRB4 Boundaries recommended by JICA Study Team in 2019.

Source: Prepared by JICA Expert and JICA Study Team

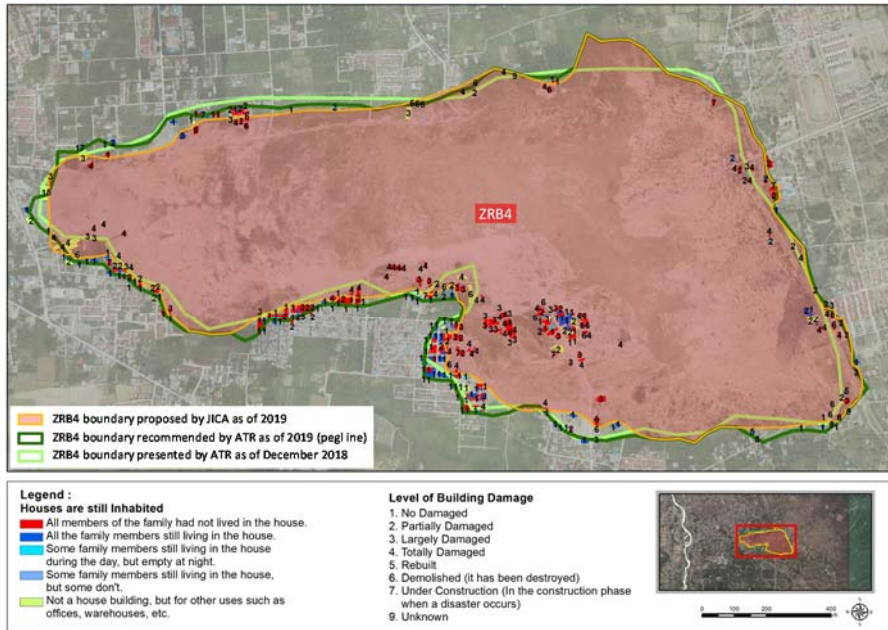
Figure 4-19 Nalodo ZRB4 Areas in Balaroa Area of Palu City



Note: Peg Lines (ZRB4 Boundaries recommended by ART in 2019) are displayed in green. However, where the green lines are not visible, they overlap with ZRB4 Boundaries recommended by JICA Study Team in 2019.

Source: Prepared by JICA Expert and JICA Study Team

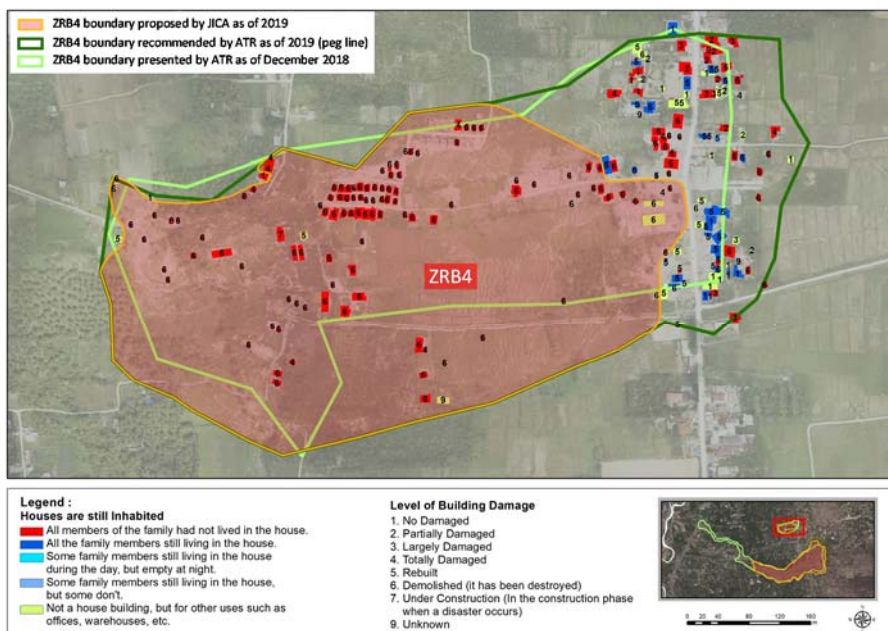
Figure 4-20 Nalodo ZRB4 Areas in Petobo Area of Palu City (excluding Kinta Village)



Note: Peg Lines (ZRB4 Boundaries recommended by ART in 2019) are displayed in green. However, where the green lines are not visible, they overlap with ZRB4 Boundaries recommended by JICA Study Team in 2019.
 Source: Prepared by JICA Expert and JICA Study Team

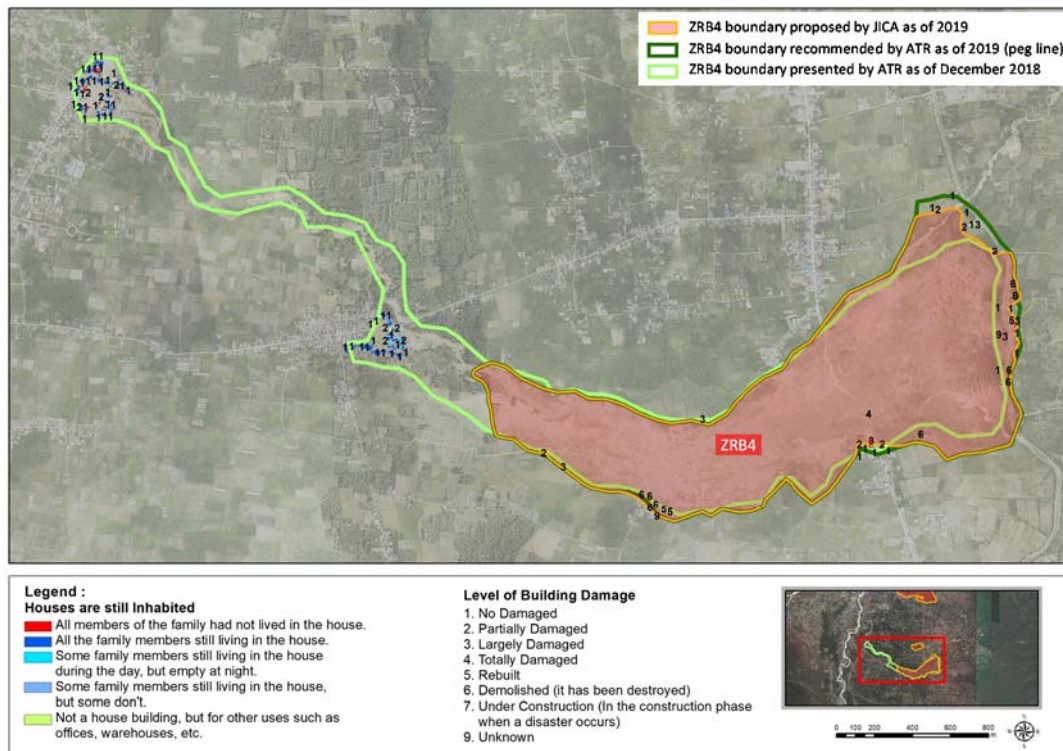
Figure 4-21 Nalodo ZRB4 Areas in Petobo Area of Palu City (including Kinta Village)

Nalodo did not occur in Kinta Village but mudflow caused by Nalodo struck the area. From a scientific point of view, Kinta Village should not be included in ZRB4, but from the economic point of view, it would be inefficient to maintain infrastructure in Kinta Village. Therefore, an alternative is to include Kinta Village in ZRB4 area.



Note: Peg Lines (ZRB4 Boundaries recommended by ART in 2019) are displayed in green. However, where the green lines are not visible, they overlap with ZRB4 Boundaries recommended by JICA Study Team in 2019.
 Source: Prepared by JICA Expert and JICA Study Team

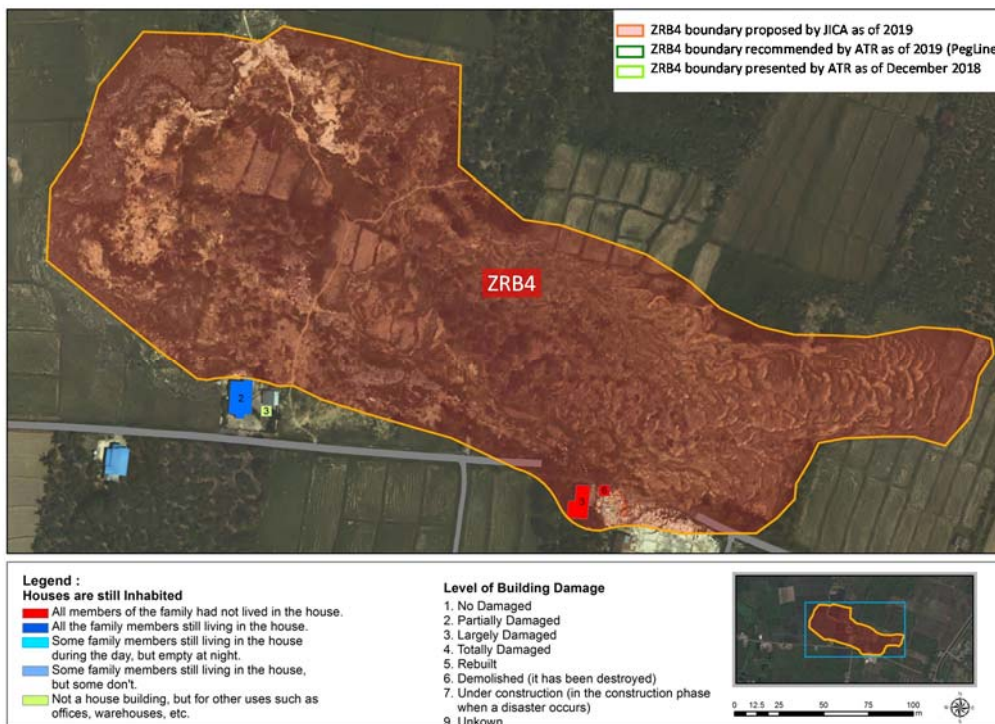
Figure 4-22 Nalodo ZRB4 Map in Lolu Area of Sigi Regency



Note: Peg Lines (ZRB4 Boundaries recommended by ART in 2019) are displayed in green. However, where the green lines are not visible, they overlap with ZRB4 Boundaries recommended by JICA Study Team in 2019.

Source: Prepared by JICA Expert and JICA Study Team

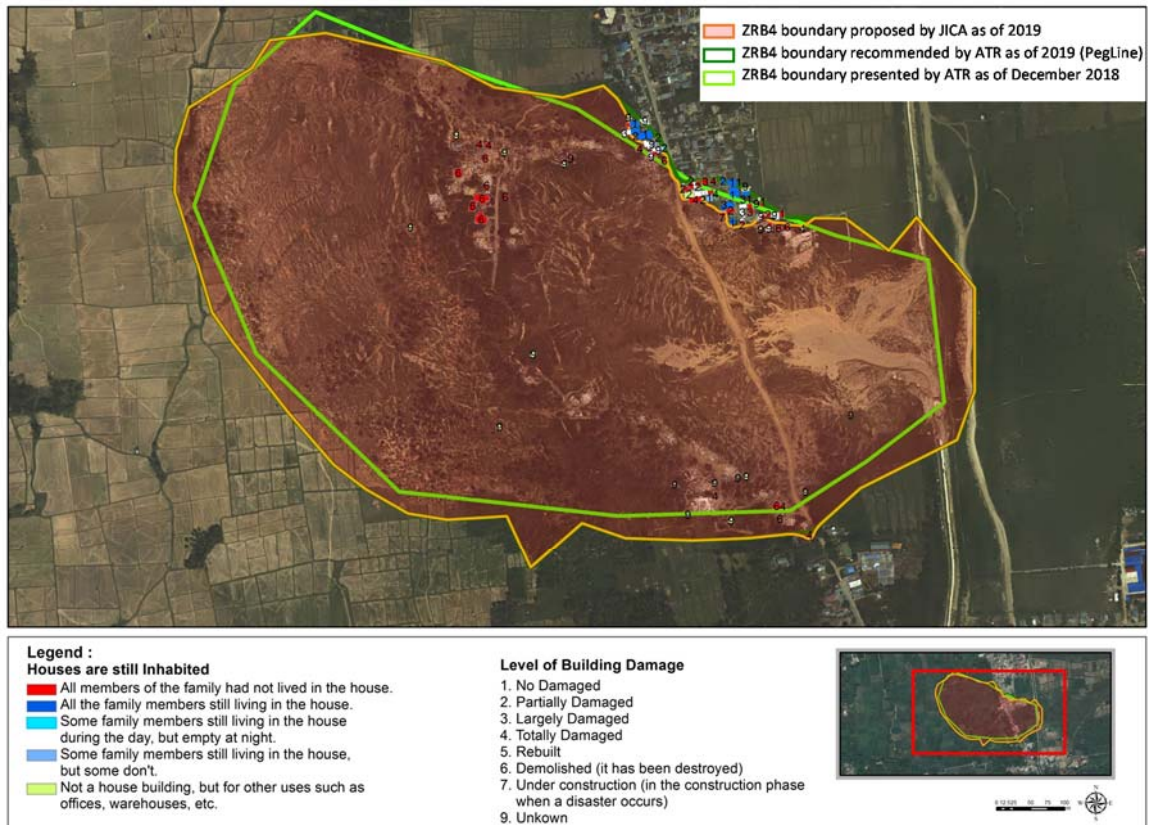
Figure 4-23 Nalodo ZRB4 Areas in Jono Oge Area of Sigi Regency



Note: Peg Lines (ZRB4 Boundaries recommended by ART in 2019) are displayed in green. However, where the green lines are not visible, they overlap with ZRB4 Boundaries recommended by JICA Study Team in 2019.

Source: Prepared by JICA Expert and JICA Study Team

Figure 4-24 Nalodo ZRB4 Areas in Sidondo1 Area of Sigi Regency



Note: Peg Lines (ZRB4 Boundaries recommended by ART in 2019) are displayed in green. However, where the green lines are not visible, they overlap with ZRB4 Boundaries recommended by JICA Study Team in 2019.
 Source: Prepared by JICA Expert and JICA Study Team

Figure 4-25 Nalodo ZRB4 Areas in Sibalaya Area of Sigi Regency

4-6-4 Sediment Disaster ZRB4 Boundaries

The Hazard Level 4 areas of sediment disaster are located in deep mountain areas. According to interviews with village leaders and local government agencies, there were no buildings in Hazard Level 4 area. Therefore, all areas with sediment disaster Hazard Level 4 category were defined as ZRB4.

4-6-5 Flooding ZRB4 Boundaries

The situation on flooding is different from other disasters caused by earthquake. It is possible to secure evacuation time because potential occurrence of flood is predicted when there is heavy rainfall. Therefore, areas prone to flooding do not need to be designated as ZRB4 areas.

4-6-6 Active Fault ZRB4 Boundaries

There was a large number of buildings with no damage or only partially damaged in areas within 10 meters from the seismic active fault line identified as Active Fault ZRB4 areas in December 2018.

Considering such condition, soft grounds are distributed in the northern area along the fault line according to the micro-zonation map and PSA map provided by BMKG shown in Figure 4-27.

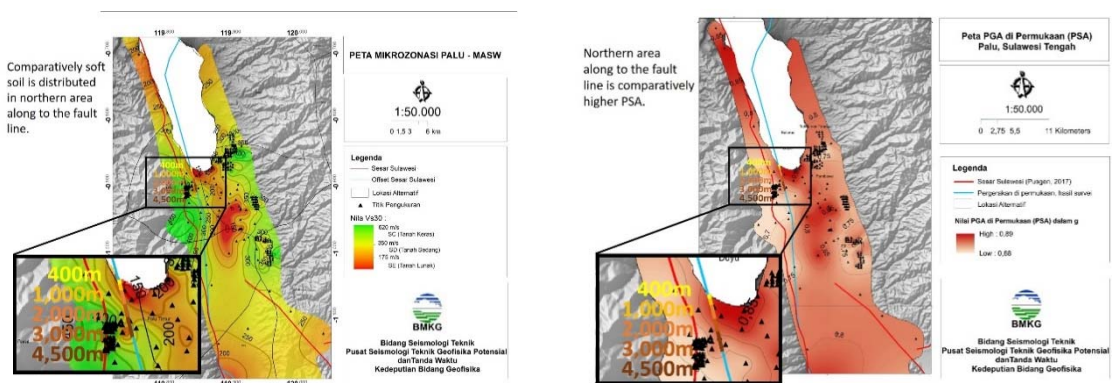
Furthermore, the results of the Building Damage Distribution Survey within 10 m from the active fault line, at the point of 400 m inland from the coastal area, show that (as illustrated in Figure 4-27) the areas do not include Building Damage Categories of 1 (No damage), 2 (Partially damaged), and 5

(Rebuilt). Through the above survey results, it is recommended that appropriate ZRB zoning boundaries should be proposed.

ATR's Plan (ZRB as of December 2018)		JICA's Plan	
ZRB4	"Within 10m of Both Side from the Fault Line"	ZRB4	"Within 400m from the Coastal Line and within 10m of Both Side from the Fault Line"
ZRB3	"10m – 50m of Both Side from the Fault Line"	ZRB3	"Within 10m of Both Side from the Fault Line"
ZRB2	N/A	ZRB2	"10m – 50m of Both Side from the Fault Line"

Source: JICA Expert based on ATR's December 2108 ZRB Map and JICA Study Team's ZRB Map

Figure 4-26 Comparison of Active Fault's ZRB Boundaries for Different Hazard Levels



Source: BMKG

Figure 4-27 Microzonation Map and PSA Map Prepared by BMKG



Note: ZRB4 Boundaries presented by ATR as of December 2018 are displayed in light green. However, where the light green lines are not visible, they overlap with ZRB4 Boundaries recommended by ATR as of 2019 (peg line).
 Source: Prepared by JICA Expert and JICA Study Team

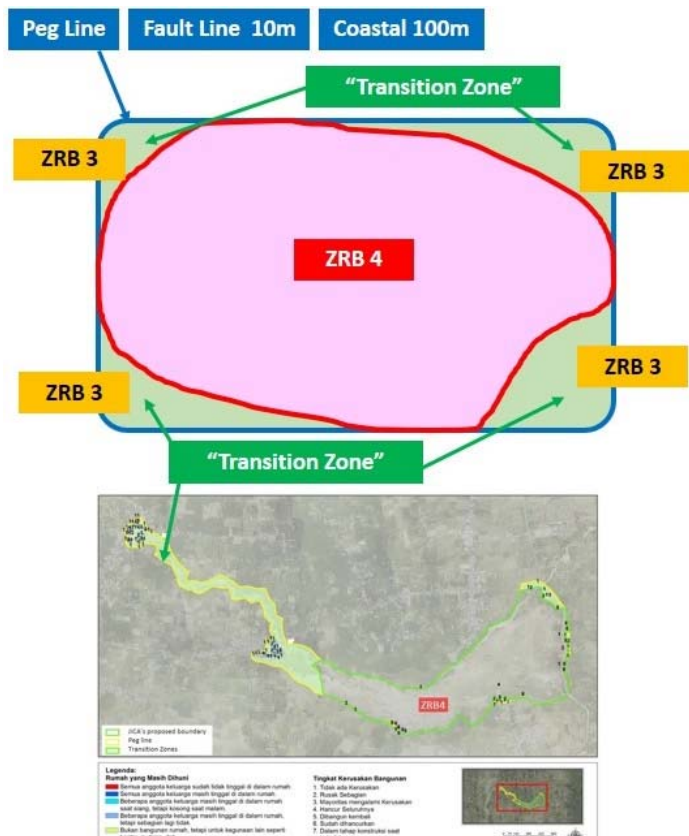
Figure 4-28 Active Fault Line's ZRB Areas in Palu City

4-7 Transition Zones

4-7-1 Need for Setting Transition Zones

Gap areas found between ATR's ZRB4 boundaries and JICA Study Team's ZRB4 boundaries are designated as transition zones. Residents inside ATR's ZRB4 boundaries have been advised by local governments to relocate to permanent relocation sites (HUNTAP). On the other hand, for those who live in transition zones, the government should provide opportunities for them to be able to choose one of the following two options: 1) relocate to permanent relocation sites, or 2) receive Stimulation Fund for damaged buildings.³ In the transition zones, additional regulations for ZRB3 on land use and building structure should be applied.

³ The Government of Indonesia guarantees the right of residents in ZRB4 areas by relocating them to permanent relocation sites (HUNTAP) as support for disaster victims. Other victims are guaranteed the right to receive Stimulation Funds according to their building damages. If the ZRB4 boundaries are changed according to JICA Study Team's proposal, the residents in the gap areas between the ZRB4 boundaries (announced by ATR in October 2019) and the ZRB4 proposed by the JICA Study Team (transition zones shown in Figure 4-29) will lose the right to relocate to HUNTAP.



Source: Prepared by JICA Expert and JICA Study Team

Figure 4-29 Transition Zones and Right to Select Permanent Relocation Site (HUNTAP) or Receive Stimulus Fund to Repair Damaged Buildings

4-7-2 Results of Setting Transition Zone Boundaries

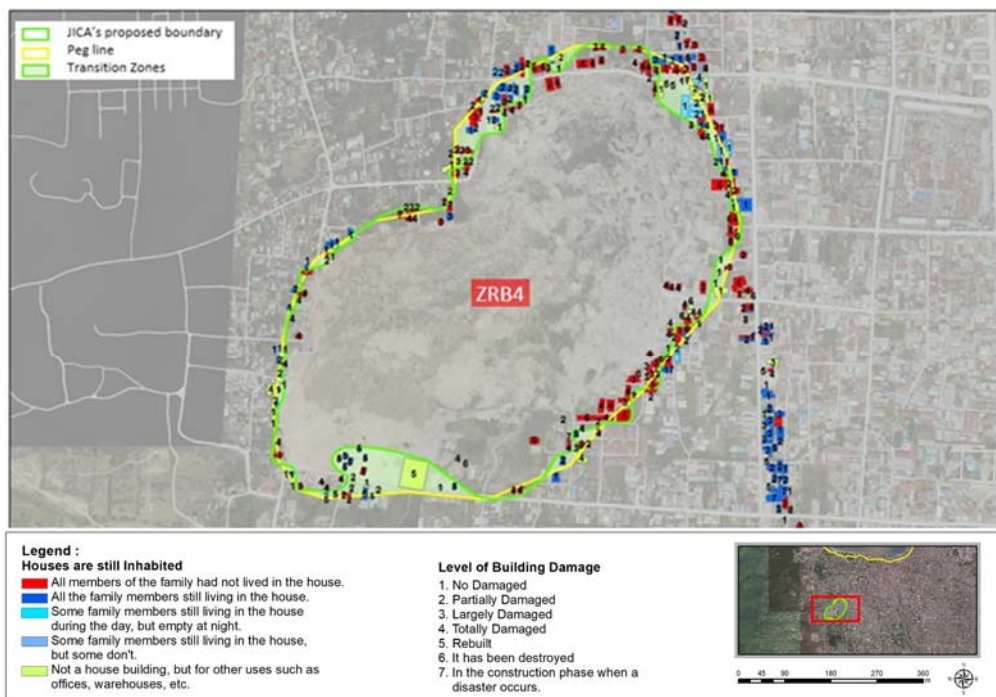
(1) Transition Zones in Tsunami-Affected Coastal Areas



Source: Prepared by JICA Expert and JICA Study Team

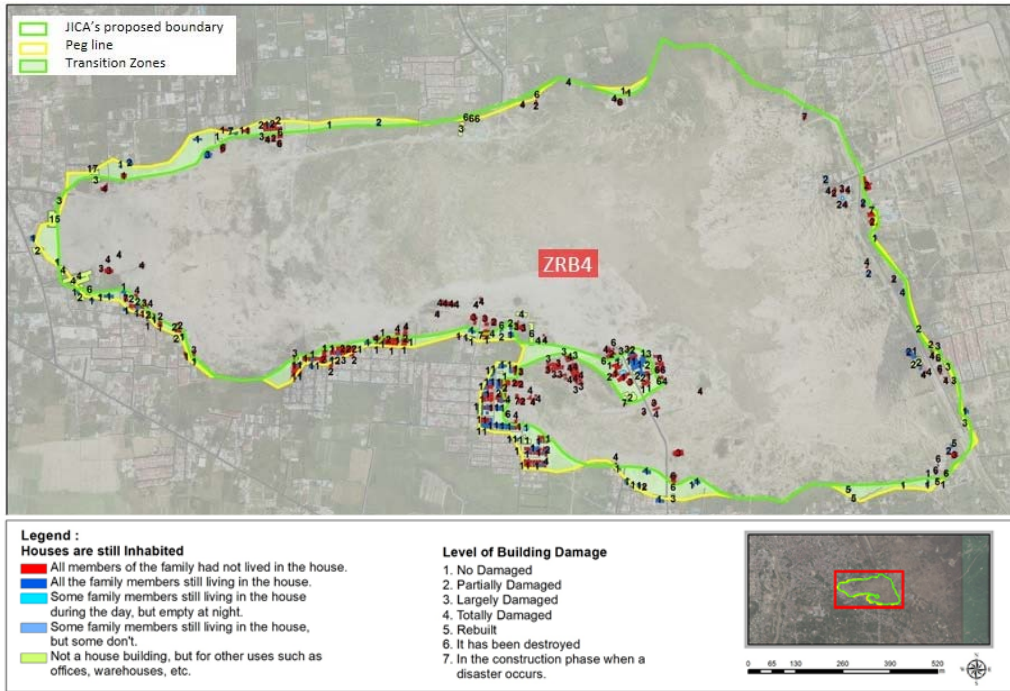
Figure 4-30 Transition Zones in Coastal Area of Palu City

(2) Transition Zones in Nalodo-Affected Areas



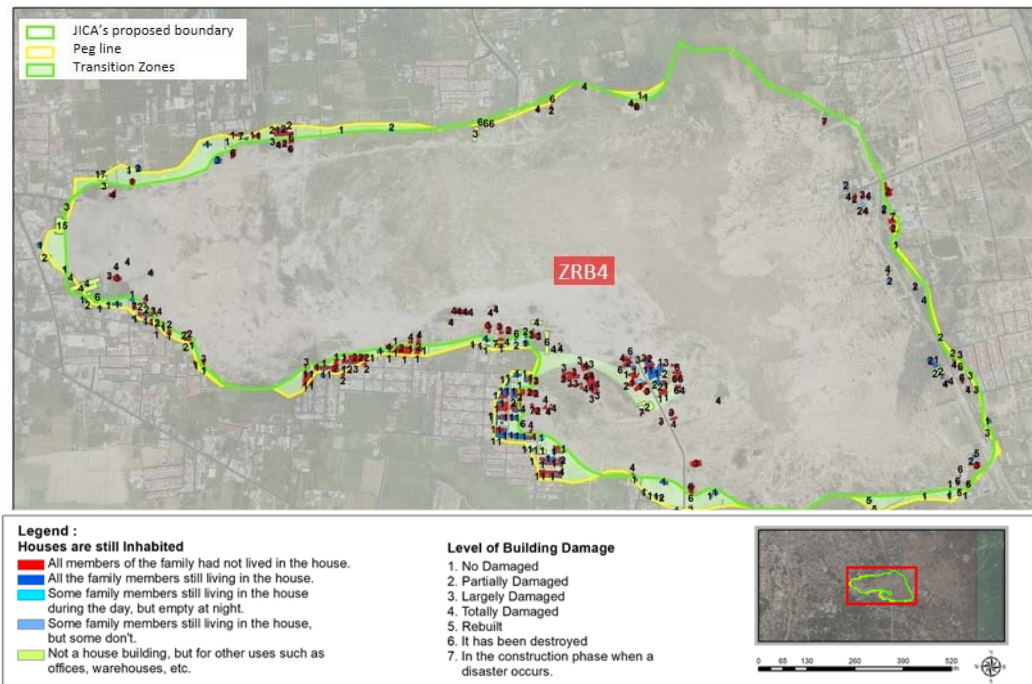
Source: Prepared by JICA Expert and JICA Study Team

Figure 4-31 Nalodo Transition Zones in Balaroa Area of Palu City



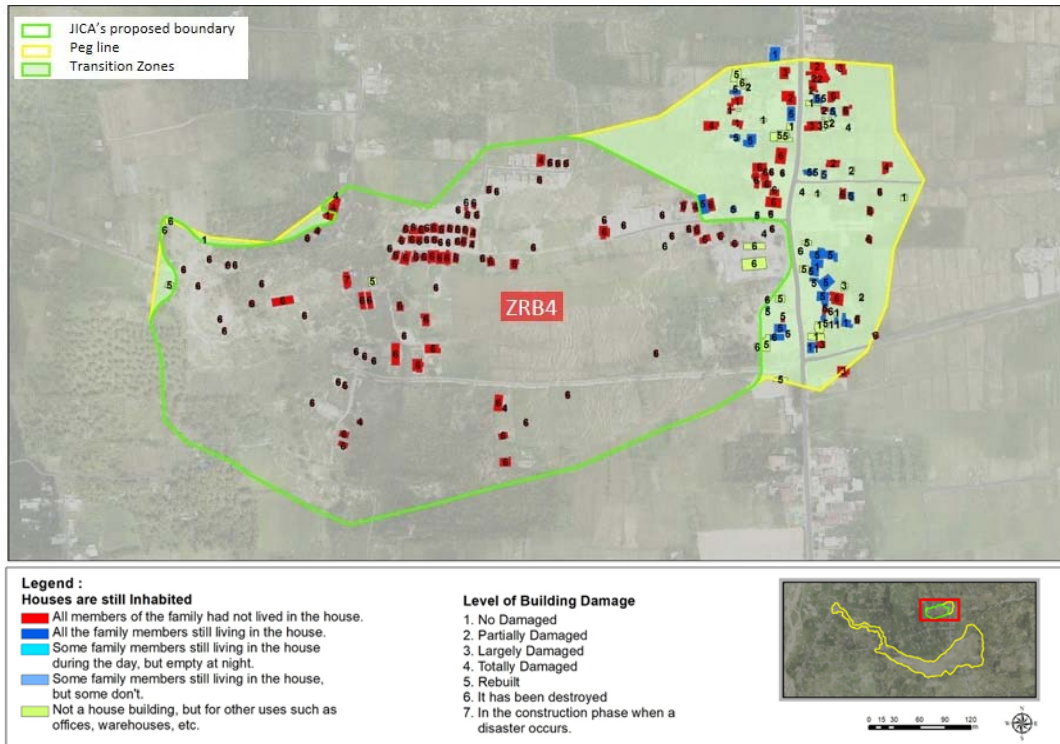
Source: Prepared by JICA Expert and JICA Study Team

Figure 4-32 Nalodo Transition Zones in Petobo Area of Palu City (excluding Kinta village)



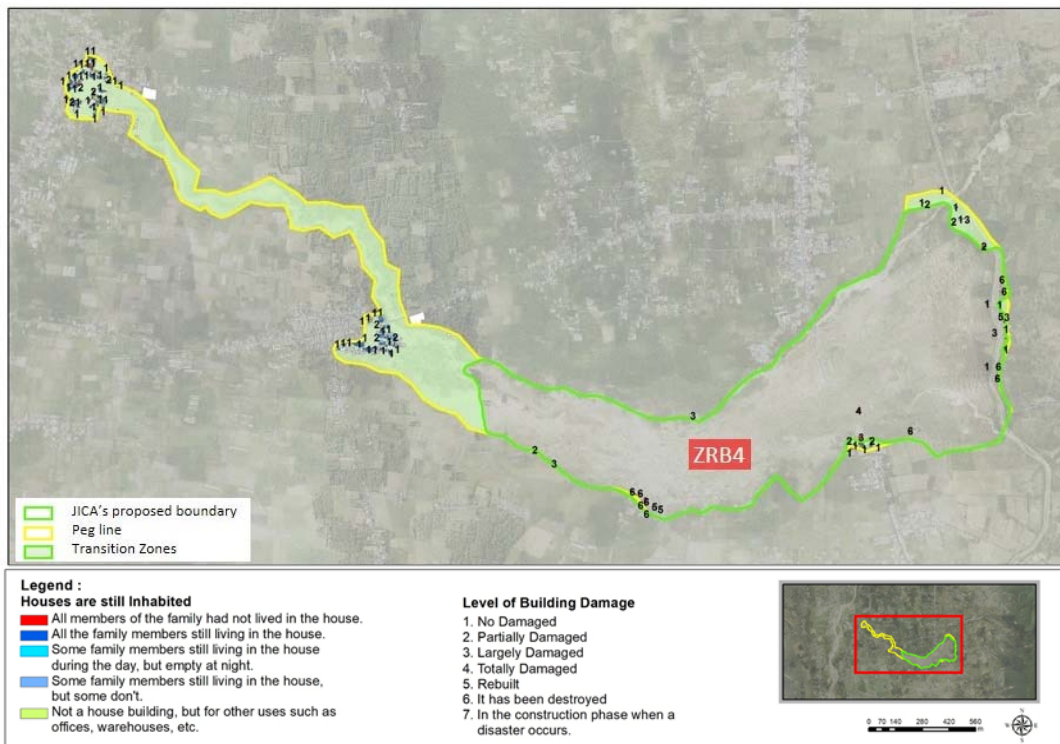
Source: Prepared by JICA Expert and JICA Study Team

Figure 4-33 Nalodo Transition Zones in Petobo Area of Palu City (including Kinta village)



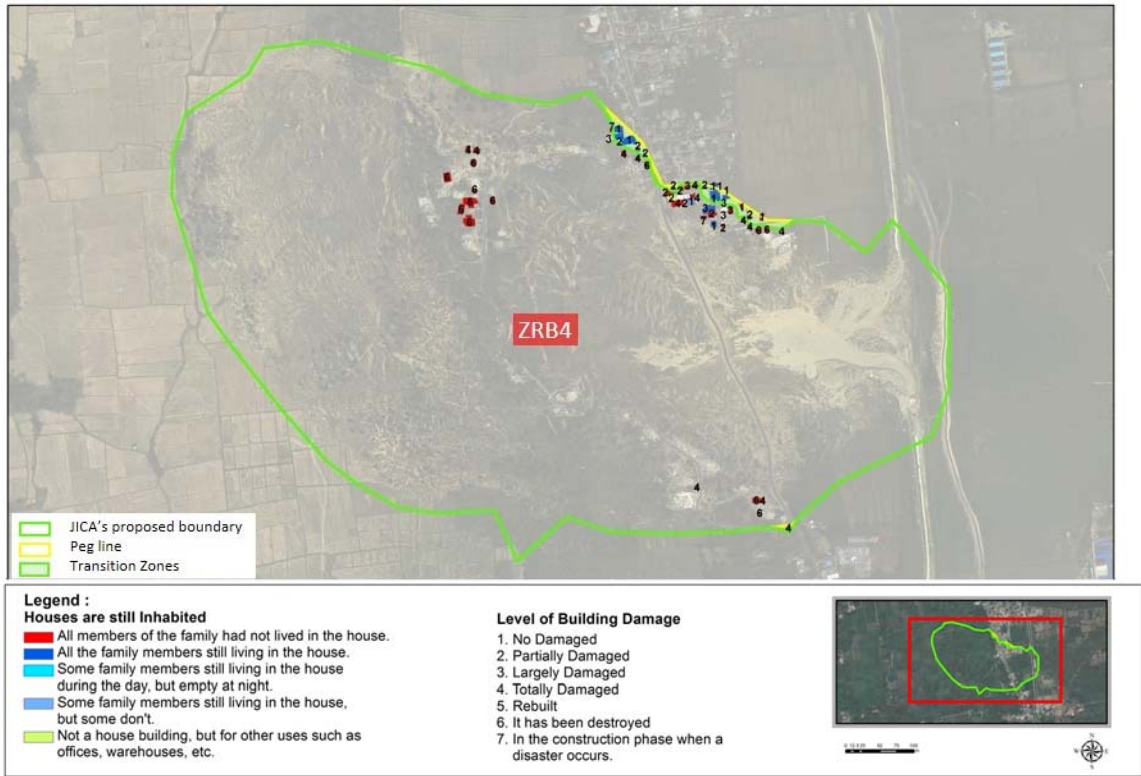
Source: Prepared by JICA Expert and JICA Study Team

Figure 4-34 Nalodo Transition Zones in Lolu Area of Sigi Regency



Source: Prepared by JICA Expert and JICA Study Team

Figure 4-35 Nalodo Transition Zones in Jono Oge Area of Sigi Regency



Source: Prepared by JICA Expert and JICA Study Team

Figure 4-36 Nalodo Transition Zones in Sibalaya Area of Sigi Regency

(3) Transition Zones for Active Fault Areas



Source: Prepared by JICA Expert and JICA Study Team

Figure 4-37 Active Fault Transition Zones in Palu City

4-8 Relocation Policies for JICA Study Team's ZRB4 Areas and Transition Zones

The following relocation policies are recommended for the ZRB4 areas proposed by the JICA Study Team and for the transition zones, or the gap areas explained above.

<<ZRB4 Areas Proposed by the JICA Study Team>>

- Disaster hazards in ZRB4 areas should be explained to the residents to gain their understanding.
- “Forced relocation” should be avoided, and relocation should be implemented based on agreement with residents.
- The residents of residential buildings in ZRB4 areas should be relocated to permanent relocation sites (HUNTAP) within a certain duration (within 3 years or so) after the completion of construction of HUNTAP.
- Allocation of land in HUNTAP should also cover all land owners of offices, commercial space, housing development site, etc. within ZRB4 areas.
- An appropriate amount of compensation should be provided to land owners in ZRB4 areas, if the size of the provided house or site in HUNTAP is much smaller than the land they owned in ZRB 4 areas.

<<Transition Zones>>

- Some residents who live in the transition zone have already registered for HUNTAP or they have willingness to relocate. On the other hand, some residents do not want relocation. Therefore, the residents in the transition zones should be able to choose, either relocation to HUNTAP or receive the Stimulation Fund.
- Aside from the residents, the government should provide relocation sites in HUNTAP to all land owners of offices, commercial space, housing development site, etc. in the transition zones.
- The government should provide appropriate amount of compensation if the size of houses or sites in HUNTAP are smaller than those in the transition zones.

4-9 Setting of Buffer Zone Boundaries

4-9-1 Coastal Buffer Zones

Indonesian government regulations stipulate that a coastal buffer zone should be set up in the coastal area in consideration of human's safety and environmental conservation. The legal basis for coastal buffer zones is twofold:

- The national legislations (Presidential Regulation No. 51/2016 and Minister of KKP Regulation No. 21/2018)
- Local regulations on spatial planning approved by local governments

According to the Presidential Regulation No. 51/2016, the areas within at least 100 m from the shore lines should be considered as “Coastal Buffer Zones,” with certain regulations to be set together.⁴

⁴ Article 31 of Minister of KKP Regulation No. 21/2018 stipulates the necessity to formulate disaster-resilient building codes if residential, industrial, and commercial buildings and public infrastructure are located in Coastal Buffer Zones.

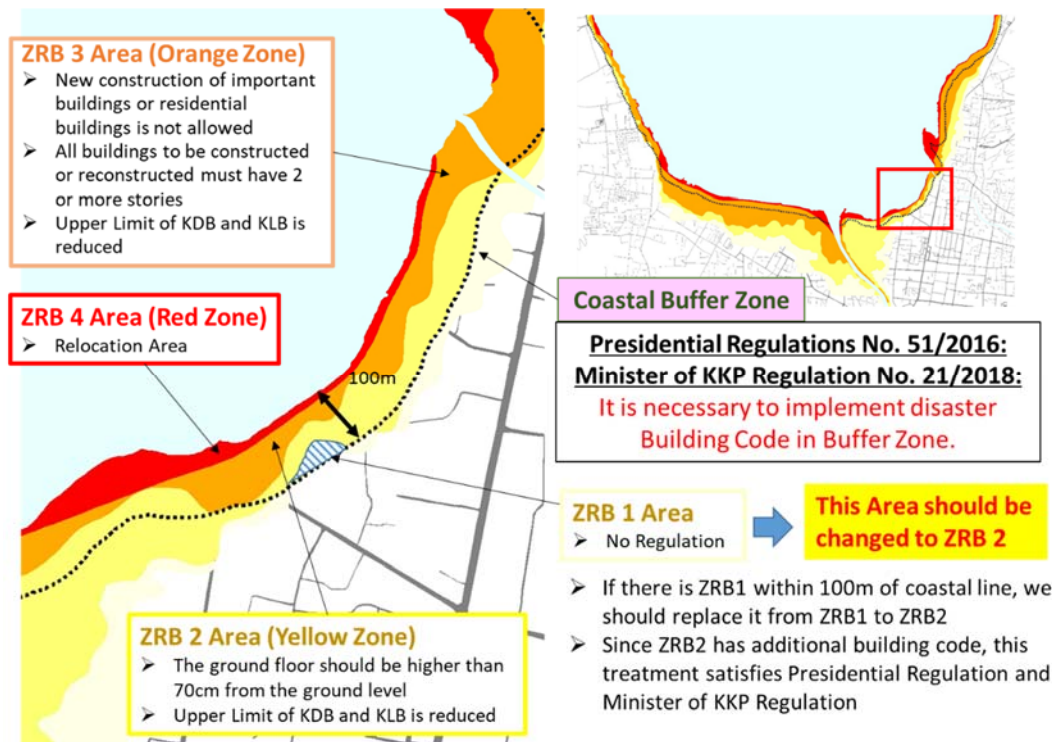
At the same time, these two central government regulations stipulate the obligation of enforcement of regulations for disaster-resilient building structural requirements.⁵

The results of the Survey on Building Damages indicate that the majority of the existing buildings within the Coastal Buffer Zones were rarely damaged by the tsunami disaster. (For instance, there are 1,531 available (usable) buildings within the 100 m Coastal Buffer Zones in Palu. On the other hand, there are 920 available (usable) buildings in the Coastal Buffer Zone designated by the Palu City Regulation No.6/2011 on Building.)

If the coastal buffer zone is set with single uniform land use regulation, it might cause some problems on DRR. Therefore, the regulations to be applied within the Coastal Buffer Zones should be set separately for each of the ZRBs in accordance with respective conditions of ZRB4, ZRB3 and ZRB2. If there is ZRB1 within 100 m of the coastal line, such area should be re-designated as ZRB2. Since ZRB2 has additional requirements on building structure, this treatment satisfies the Presidential Regulation and Minister of KKP Regulation. In addition, ZRB lines should be modified when a new Hazard Map is made.

Considering these, it was proposed by the JICA Study Team to overlay ZRB4 areas, ZRB3 areas, and ZRB2 areas on the coastal buffer zone and set regulations for each ZRB area. See Figure 4-38.

⁵ Article 21 of Presidential Regulations No. 51/2016 delineates that determination of Coastal Buffer Zone for disaster-prone coastal area can be less than the calculation's result with obligation to implement disaster requirement of building structures. Moreover, Article 30 of Minister of KKP Regulation No. 21/2018 stipulates that in case that the result of calculation method, as stated in this Minister Regulation, includes or exceeds the area of settlements, industry, economic centers and other public infrastructures, then the determination of Coastal Buffer Zone is obligated to implement disaster requirements of the building structure.



Source: Prepared by JICA Expert and JICA Study Team

Figure 4-38 Methods to Apply Different ZRB Areas (ZRB4 / ZRB3 / ZRB2) Within Coastal Buffer Zone

4-9-2 Setting of River Buffer Zones

In the riverside areas, the current legislation (Minister of Public Works and Public Housing Regulation No. 28/2015) stipulates that river buffer zones should be set for the functional conservation of rivers, as described below. The performance criteria for River Buffer Zone require to take measures in order to limit the activities for conservation of the river function, to conserve the river environment optimally, and to prevent pollution of river water. However, specific contents such as regulations are not mentioned.

When “River Buffer Zones” are set by complying with the national legislation of the Government Regulation No. 38/2011, these zones should be considered as “nature reserved and nature conservation” area or the areas for similar use or purpose. Thus, development or construction of any building should not be allowed. For example, the RDTR ITBX (draft version) of Donggala Regency proposes that possible land use within the River Buffer Zones “ponds, urban forests, community forests, green parks, artificial tourist facilities, and others” (with certain conditions to apply) and rebuilding or reconstruction of houses are prohibited under the regulations. Enforcement of such regulations and conditions could cause a major violation of basic human rights if private properties and land ownership are established within River Buffer Zones and appropriate compensation measures are not proposed.

When a River Buffer Zone should be set, the regulations should be applied, taking the flood hazard map into consideration.

Table 4-5 National Ministerial Regulations on Determination of River Borderline and Lake Borderline

Category	With Dike	Without Dike
City Area	Determined at least 3 (three) meters from the outer edge of the embankment, along the river channel	The depth of river is ≤ 3 meters: at least 10 meters from the left and right edges of the riverbed along the river channel.
		The depth of river is ≥ 3 until 20 meters: at least 15 meters from the left and right edges of the riverbed along the river channel.
		The depth of river is > 20 meters: at least 30 meters from the left and right edges of the riverbed along the river channel.
Rural Area	Determined at least 5 (five) meters from the outer edge of the embankment, along the river channel	[Big River] The width of the watershed is > 500 km ² : at least 100 meters from the left and right edges of the riverbed along the river channel.
		[Small River] The width of the watershed is ≤ 500 km ² : at least 50 meters from the left and right edges of the riverbed along the river channel.

Source: Minister of PUPR Regulation No. 28/2015

Table 4-6 Palu City Regulations on Buildings Concerning Buffer Zones for Coasts and Rivers

Category	With Dike	Without Dike
City Area	The depth of river is < 3 meters: at least 10 meters from the left and right edges of the riverbed along the river channel.	The depth of river is < 3 meters: at least 15 meters from the left and right edges of the riverbed along the river channel.
	The depth of river is from 3 until 20 meters: at least 20 meters from the left and right edges of the riverbed along the river channel.	The depth of river is from 3 until 20 meters: at least 25 meters from the left and right edges of the riverbed along the river channel.

Source: Palu City Regulation No.6/2011 on Buildings

4-10 Additional Regulations Based on ZRB Levels for Different Disaster Types

4-10-1 Outline of Additional Regulations Based on ZRB Levels

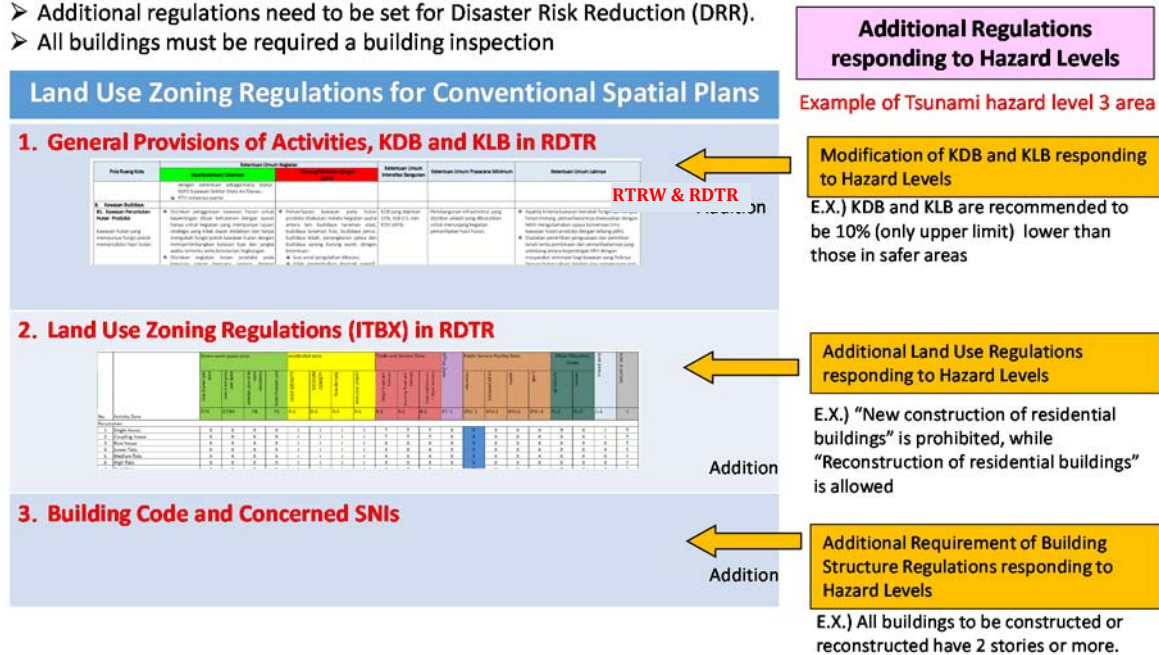
It is important to identify how to make a comprehensive spatial plan by taking all concerned disaster hazards into consideration. The JICA Study Team proposed the following additional three types of regulations to be considered in relation to different ZRB levels for different disaster types in formulating detailed spatial plans for DRR:

- Criteria on Intensity of Spatial Utilization (Building Coverage Ratio - KDB, Floor Area Ratio - KLB, etc.)
- Additional Regulations for Land Use
- Additional Requirements for Building Structure

Land use zoning regulations including land use, KDB and KLB are set under the General Provision on Zoning Regulations (KUPZ) in RTRW. A land use map in RTRW is formulated on a scale of 1:25,000 for city and 1:50,000 for regency. Land use zones in the General Provision are further subdivided into land use subzones which are controlled with particular KDB, KLB, building height, and green space ratio in the Zoning Regulations (PZ) in RDTR. The regulations on land use subzones in PZ stipulate land and building use in ITBX table (a list of permitted/ limited/ with conditions/ prohibited buildings by land use subzone) which is indispensable in the issuance of a building permit. A 1:5,000 land use map is prepared for RDTR. Building standard regulations can be set with requirements on building structure for each type of buildings and with designated SNI. For the sake of development control and human life protection, necessary regulations by disaster type and ZRB levels should be set in addition to the standard regulations as noted above. In the areas with high ZRB levels, additional regulations should be set as summarized below.

In Hazard Levels 4 & 3 Areas

- Additional regulations need to be set for Disaster Risk Reduction (DRR).
- All buildings must be required a building inspection



Source: Prepared by JICA Expert and JICA Study Team

Figure 4-39 How to Set Additional Regulations for Land Use and Building Structure

4-10-2 Contents of Additional Regulations on Land Use and Building Structure for DRR

The contents of additional regulations are shown below. (Refer to Appendices for detailed regulations for each disaster.)

4-10-3 Regulations on Intensity of Spatial Utilization (Building Coverage Ratio, Floor Area Ratio, etc.)

In order to strategically induce land use in areas with lower ZRB levels (lower hazard levels), it is proposed to set lower building coverage ratios and floor area ratios in areas with higher ZRB levels than in areas with lower ZRB levels.

Table 4-7 Intensity of Space Utilization (Building Coverage Ratios and Floor Area Ratios)

ZRB Level	Details of Intensity of Space Utilization (Building Coverage Ratios and Floor Area Ratios)
ZRB1	➢ No additional regulations
ZRB2	➢ 5% lower than those for ZRB 1
ZRB3	➢ 5% lower than those for ZRB 2
ZRB4	➢ N/A

Source: Prepared by JICA Expert and JICA Study Team

4-10-4 Additional Land Use Regulations for DRR

It is proposed to provide strict land use regulations (concerning building uses) for areas with higher ZRB levels in order to strategically induce land use in areas with lower ZRB levels (hazard levels).

Table 4-8 Additional Land Use Regulations

ZRB Level	Details of Land Use Regulations Concerning Building Uses
ZRB1	➤ No additional regulations
ZRB2	➤ No additional regulations
ZRB3	<ul style="list-style-type: none"> ➤ New construction of the following buildings is prohibited, but reconstruction is allowed: <ul style="list-style-type: none"> - Residential buildings - Building with living rooms and bedrooms (e.g., hotels) for human occupancy - Important buildings (e.g., schools, fire fighter and police stations, religious buildings, hospitals and other necessary facilities in emergency situation) ➤ New construction of high-risk facilities is prohibited, and reconstruction is prohibited (e.g., fuel storage tanks; buildings and non-building structures containing explosive, toxic, or hazardous materials) ➤ New construction of other buildings is allowed, and reconstruction is allowed.
ZRB4	<ul style="list-style-type: none"> ➤ All buildings are prohibited. ➤ New construction and reconstruction of infrastructure are allowed. ➤ New construction and reconstruction of agricultural facilities are allowed under certain conditions.

Source: Prepared by JICA Expert and JICA Study Team

4-10-5 Additional Requirements for Building Structure for DRR

It is proposed to tighten structural requirements for buildings in areas with higher ZRB levels (hazard levels). It is also proposed that all buildings be inspected when constructing or reconstructing.

Table 4-9 Additional Requirements for Building Structure for DRR

ZRB Level	Details of Additional Requirements for Building Structure for DRR
ZRB1	➤ No additional regulations are applied.
ZRB2	<p><Tsunami></p> <ul style="list-style-type: none"> ➤ The ground floor of buildings should be higher than 70 cm from the ground level.
ZRB3	<p><Active Fault></p> <ul style="list-style-type: none"> ➤ Foundation of building should be strengthened enough to resist shear force. <p><Tsunami></p> <ul style="list-style-type: none"> ➤ Buildings should satisfy the following conditions: <ul style="list-style-type: none"> - Buildings should have a reinforced concrete structure. - Building should have 2 or more stories - Rooms for residential or lodging use should not be on the ground floor - Requirements for tsunami loads are defined by RSNI3 1727:2018. - Hedges, ditches, slopes, mounds and/or berms should be used for protecting buildings. - Evacuation routes and vertical shelters should be provided for buildings. <p><Nalodo ></p> <ul style="list-style-type: none"> ➤ Buildings should satisfy the following conditions: <ul style="list-style-type: none"> - Equipped with water wells - Foundations of buildings should have an RC material slab structure. - Non-engineered buildings should satisfy minimum requirements for specifications. ➤ Engineered buildings should be designed according to SNI1726 with additional seismic forces using Risk Category of one level above as per building use. ➤ Building height should be shorter than 4 times the length of building width. <p><Flood ></p> <ul style="list-style-type: none"> ➤ Buildings should have 2 or more stories. <p><Sediment Disaster ></p> <ul style="list-style-type: none"> ➤ Buildings should be constructed with reinforced concrete retaining walls against direction of sediment flow. It should satisfy the following conditions: <ul style="list-style-type: none"> - Concrete retaining walls should have sufficient thickness. - Rebar should satisfy the minimum size and pitch.

ZRB Level	Details of Additional Requirements for Building Structure for DRR
	<ul style="list-style-type: none"> ➤ Buildings should have no openings in the direction of sediment flow. Buildings should be equipped with emergency exits for evacuation in the opposite direction of sediment flow. ➤ Cutting or filling of earth should be less than 5 m in height and retained by RC (reinforced concrete) walls.
ZRB4	➤ N/A

Source: Prepared by JICA Expert and JICA Study Team

4-10-6 Land Use Regulations in ZRB3 Areas

Reconstruction of residential and non-residential buildings (offices and retail functions, etc.) are allowed with the enforcement of additional regulations for ZRB3 areas in order to protect people's life and property in ZRB3 areas, as shown in Table 4-10. On the other hand, new construction of non-residential buildings is allowed although new construction of residential buildings, important facilities, and high-risk facilities is prohibited.

Table 4-10 Regulations on Residential and Non-Residential Buildings in ZRB3 Areas

	New Construction	Reconstruction
Residential Buildings, Important Buildings, and Dangerous Buildings	NO	OK
Other Buildings (Office, Commercial Use, etc.)	OK	OK

Source: Prepared by JICA Expert and JICA Study Team

In principle, ZRB3 areas are not recommended for residential use. Thus, people who are currently living in ZRB3 areas should consider to reconstruct their houses in safer areas designated as ZRB2 or ZRB1. Under such circumstance, these ZRB3 areas may become less populated in the future due to less inflow if new construction of both residential and non-residential buildings are banned. The enforcement of such restriction on development should result in reduction of real estate development or investment, or there could be no land sales. This implies the decline of land value, and as a result, the current land owners of the concerned ZRB3 areas will lose opportunities to sell their land so that these people would not have a chance to earn moving cost from the sale of land for their relocation to other places. Thus, they should be forced to live in the same less populated ZRB3 areas, in spite of their desire for relocation. Because of such serious concern, the ZRB3 regulation is crafted to allow new constructions of building for non-residential uses, such as offices and commercial purposes, for the protection of opportunity of resale of land and land value in the ZRB3 areas.

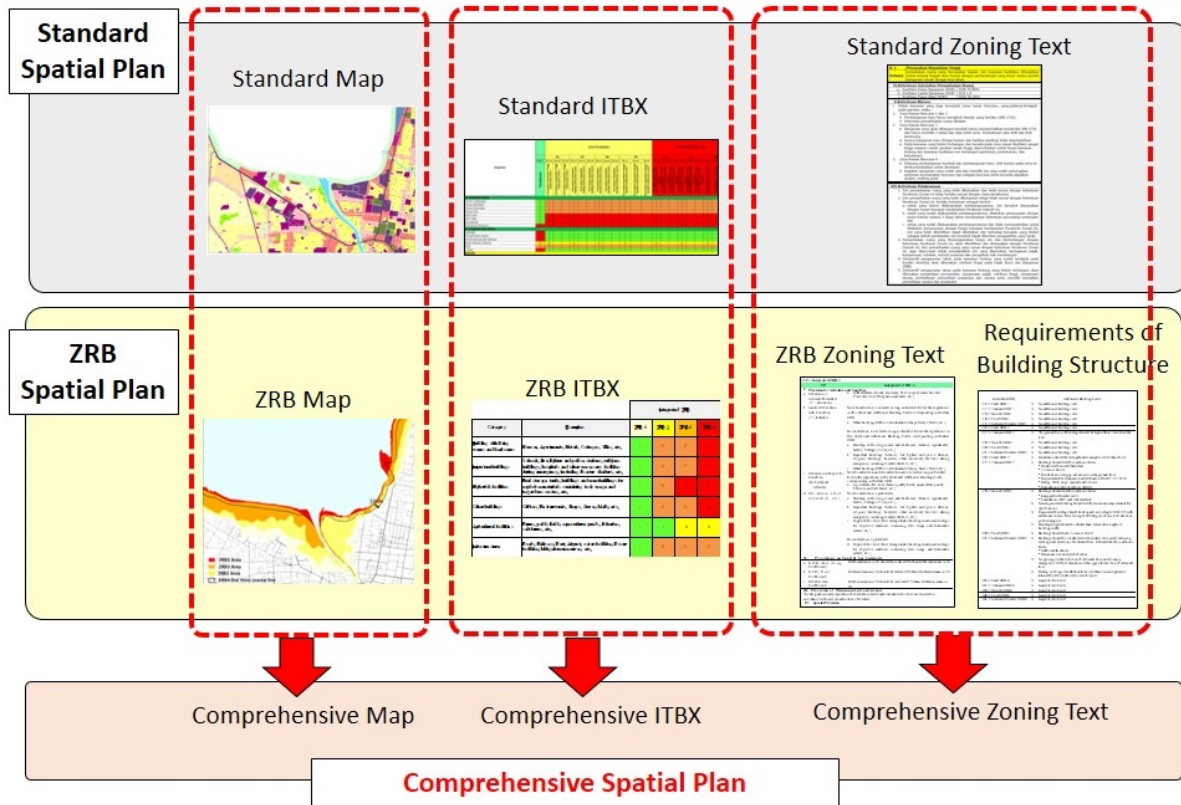
The regulations for ZRB3 are designed, assuming that safety of people's lives is more important than land and other assets. The regulations strategically implement development to reduce the area's population step-by-step.

4-11 Method for Integration of Standard Spatial Plan and ZRB-Based Spatial Plan

4-11-1 Overview of Method That Integrates Standard Spatial Plan and ZRB-Based Spatial Plan

To reflect additional regulations on land use and building structure responding to different ZRB levels in the conventional/standard spatial plans, the following three ways of integration are proposed (See Figure 4-40):

- Integration of “a Standard Land Use Zoning Plan Map” and “ZRB Map”
- Integration of “a Standard ITBX Table” and “a ZRB-based ITBX Table”
- Integration among “Standard Zoning Text,” “ZRB-based Zoning Text,” and “Additional Building Regulations”



Source: Prepared by JICA Expert and JICA Study Team

Figure 4-40 Integration of Standard Spatial Plan and ZRB-Based Spatial Plan

4-11-2 ZRB-Based ITBX Table

The conventional ITBX Table suggests which are “permissible land uses and activities (I)”, “restricted land uses and activities (T)”, “conditionally permitted land uses and activities (B)”, or “prohibited land uses and activities (X)” for each land use zoning category. However, such conventional ITBX Table cannot express differences in land use and building structure regulations responding to ZRB level or hazard level by different disaster type for DRR. The definitions of ITBX are as shown in Table 4-11.

Table 4-11 Definitions of ITBX

Symbol	Definition
I (Ijin)	Permissible Land Uses and Activities The activities and land use have characteristics in accordance with the planned spatial allocation.
T (Terbatas)	Limited Permissible Land Uses and Activities The land use and activities are limited by certain conditions, including: a) operating restrictions, b) space intensity restrictions, c) restrictions on the amount of use.
B (Bersyarat)	Conditionally Permissible Land Use Activities It is necessary to get a permit for an activity or land use for satisfying certain requirements which can be in the form of general requirements and special requirements. These requirements are needed because the utilization of the space has a large impact on the surrounding environment.
X (Tidak)	Non-Permissible Land Uses and Activities The land use and activities are not in accordance with the planned land use and can have a significant impact on the surrounding environment. The land use and activities may not be permitted in the concerned zone.

Source: JICA Study Team

Therefore, a “ZRB-based ITBX Table” is created in order to show the relationship between different types of buildings and additional regulations on land use and building structures by disaster type and hazard level. Land use categories (building use categories) in the additional regulations for DRR are classified into 6 types, and ITBX is specified for each ZRB level, as shown in Figure 4-41.

			Integrated ZRB			
	Category	Examples	ZRB 1	ZRB 2	ZRB 3	ZRB 4
1	Building with Living Rooms and Bedrooms	Housse, Apartments, Hotels, Cottages, Villas, etc.	I	T	T	X
2	Important Buildings	Schools, Fire Fighter and Police Stations, Religions Buildings, Hospitals and Other Necessary Facilities during Emergency, including Disaster Shelters, etc.	I	T	T	X
3	High-risk Facilities	Fuel Storage Tanks, Buildings and Non-Buildings for Explosive Materials containing Toxic Usage and Hazardous Wastes, etc.	I	T	X	X
4	Other Buildings	Offices, Restaurants, Shops, Stores, Malls, etc.	I	T	T	X
5	Agricultural Facilities	Farms, Wetland Paddy Fields, Aquaculture Ponds, Fisheries, Salt Farms, etc.	I	I	B	B
6	Infrastructure	Roads, Railways, Port, Airport, Water Facilities, Power Facilities, Mitigation Measures, etc.	I	T	T	T

Source: Prepared by JICA Expert

Notes: I: Permitted, T: Limitedly Permitted, B: Conditionally Permitted, X: Not Permitted.

Figure 4-41 ZRB-Based ITBX Table

(1) Integration of the Standard ITBX Table and the ZRB-Based ITBX Table

In order to incorporate ZRB-based additional regulations in the standard spatial plans, it is recommended to prepare a “Comprehensive ITBX Table” by integrating a standard ITBX Table and a ZRB-based ITBX Table.

The Comprehensive ITBX Table is prepared by adding columns corresponding to ZRB2 and ZRB3

for each of the related land use zoning codes. For example, in the case of High-Density Residential Zone (R2), High-Density Residential Zone in ZRB2 Areas and High-Density Residential Zone in ZRB3 Areas need to be added in the Comprehensive ITBX Table, as shown in Figure 4-42. In the Comprehensive ITBX Table, symbols of I, T, B, and X indicate which land uses are permitted (I), which land uses are restrictedly permitted (T), which land uses are conditionally permitted (B), or which land uses are prohibited (X) in the High-Density Residential Zone in ZRB2 Areas.

For making more codes for these additional zoning categories, the method of writing zone codes for Zone Management Technique (Teknik Pengaturan Zonasi) is used.⁶

Item of Standard ITBX: R2, R3

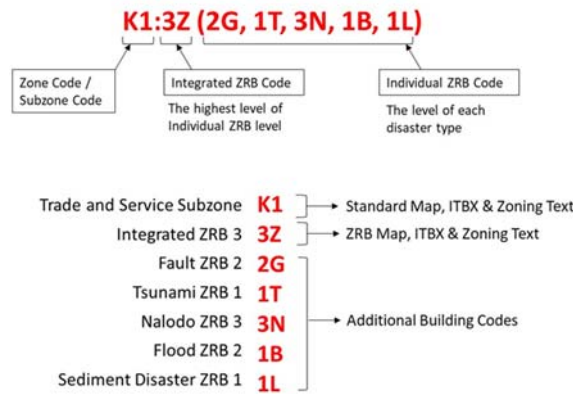
Item of Comprehensive ITBX: R2:1Z, R2:2Z, R2:3Z, R3:1Z, R3:2Z, R3:3Z

No	Comprehensive ITBX	Residential Zone															Commercial and Service Zone								
		R2			R3			R4			R5			K1			K2			K3					
		R2:1Z	R2:2Z	R2:3Z	R3:1Z	R3:2Z	R3:3Z	R4:1Z	R4:2Z	R4:3Z	R5:1Z	R5:2Z	R5:3Z	K1:1Z	K1:2Z	K1:3Z	K2:1Z	K2:2Z	K2:3Z	K3:1Z	K3:2Z	K3:3Z			
		Green Open Space Zone															Commercial and Service Zone								
		Residential Zone															Commercial and Service Zone								
		RTH-7															K1, K2, K3								
		Tomb															City-Scale Commercial & Service of Hazard Level 1, 2, 3								
		High-Density Residential of Hazard Level 1, 2, 3															BWP-Scale Commercial and Service of Hazard Level 1, 2, 3								
		Medium-Density Residential of Hazard Level 1, 2, 3															Sub-BWP-Scale Commercial and Service of Hazard Level 1, 2, 3								
		Low-Density Residential of Hazard Level 1, 2, 3															Sub-BWP-Scale Commercial and Service of Hazard Level 1, 2, 3								
		Very Low-Density Residential of Hazard Level 1, 2, 3															Sub-BWP-Scale Commercial and Service of Hazard Level 1, 2, 3								
		GREEN OPEN SPACE																							
		HOUSING																							
		1 Environmental Park																							
		2 Village Park																							
		3 District Park																							
		4 City Park																							
		5 City Forest																							
		6 Green Line																							
		7 Tomb																							
		8 Planted Mangrove																							
		1 Single Residential House																							
		2 Custom home																							
		3 Cluster area																							
		4 Dormitory/ Boarding House																							
		5 Vertical Residential or Flats																							
		6 Nursing home																							
		7 Orphanage																							

Source: Prepared by JICA Expert and JICA Study Team

Figure 4-42 Comprehensive ITBX Table Integrating the Conventional ITBX Table and ZRB-Based ITBX Table

⁶ This method is described in the Guideline of RDTR (Ministry of ATR Regulation No. 16/ 2018).

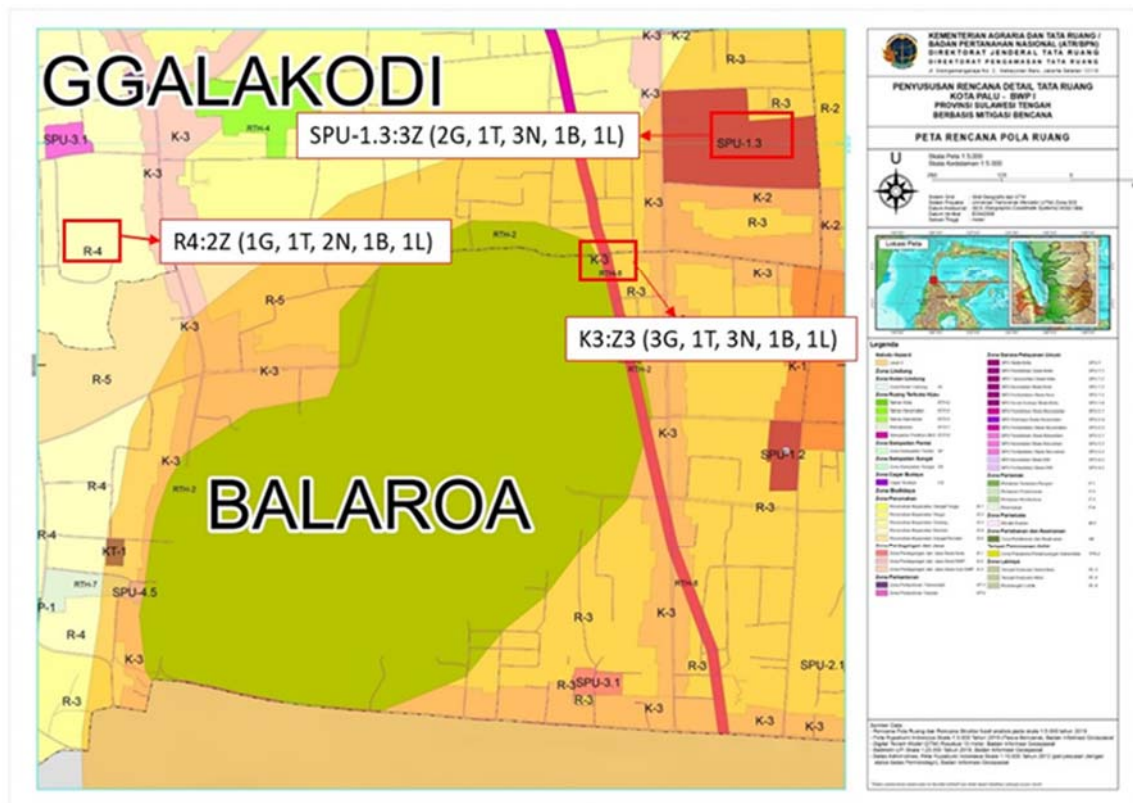


Source: Prepared by JICA Expert and JICA Study Team

Figure 4-43 Ways to Integrate Land Use Subzone Codes with ZRB Codes

4-11-3 Integration of Standard Land Use Zoning Map and ZRB Map

In order to use the Comprehensive ITBX Table, it is necessary to overlay a ZRB map (of multiple layers of disaster types) over a standard land use zoning map. Such an overlaid map is like Figure 4-44. The overlaid map also utilizes land use subzones related to hazard levels and disaster types.



Source: Prepared by JICA Expert and JICA Study Team

Figure 4-44 Overlaying of ZRB Map on Standard Land Use Zoning Plan Map

4-11-4 Zoning Texts Reflecting ZRB Map

It is necessary to create the contents of the additional regulations of ZRB2, ZRB3, and ZRB4 as zoning texts corresponding to the comprehensive ITBX table. Furthermore, it is needed to reflect the

ZRB regulations in zoning texts by combining the following three types of zoning texts.

- Standard zoning texts
- Zoning texts on intensity of spatial utilization corresponding to ZRB2 and ZRB3, and zoning texts on land use regulations corresponding to ZRB2 and ZRB3
- ZRB-related zoning texts regarding building structure requirements corresponding to ZRB2 and ZRB3

R2:3Z (2G, 1T, 3N, 1B, 1L)

Zoning Text of R2

R-2 High-Density Housing Zone
 Refer to ITBX table for Provisions for Activities and Land Use

I. Provision for Activities and Land Use
 a. Maximum lot area: 10,000 m²
 b. Limited Utilization with Condition (T = terraces)
 Activities in Green Space below are limitedly permitted with such condition:
 - Community Park
 - Maximum Area: 1,250 m²
 - 2,500 people are served within single unit
 - Operational Hour: 07:00-21:00
 - Park Village
 - Maximum Area: 9,000 m²
 - 9,000 people are served within 1 single unit
 - Operational Hour: 07:00-21:00
 - Sub-Office
 - Maximum Area: 24,000 m²
 - 120,000 people are served within 1 single unit
 - Operational Hour: 07:00-21:00
 - City Park
 - Maximum Area: 144,000 m²
 - 480,000 people are served within 1 single unit
 - Operational Hour: 07:00-21:00

2. Trade and service facility refers to SN 03-1733.2004 on Procedure for Residential Area Planning in Urban Area. Activities in Trade and Service Zone below are limitedly permitted such condition:
 - Restaurant and Diner
 - Maximum Area: 350 m² (with standard 1.4 m²)
 - 1 unit can serve one neighborhood and hamlet (RT and RW)
 - Operational Hour: 07:00-21:00
 - Mini-market
 - Maximum Area: 200 m² (Average Mini-market Usage)
 - 1 unit can serve one neighborhood and hamlet (RT and RW)
 - Operational Hour: 07:00-21:00
 - Community Shop
 - Maximum Area: 3,000 m² (if it is not merged with single house)
 - 1 unit can serve one neighborhood and hamlet (RT and RW)
 - Operational Hour: 07:00-21:00

Zoning Text of 3Z

3Z (Integrated ZRB 3)
I. Provision for Activities and Land Use
 a. Infrastructure (Roads, Railways, Port, Airport, water facilities, Power facilities, Mangrove measures, etc.)
 b. Limited Utilization with Condition (T = terraces)
 New Construction is allowed as long as buildings follow the regulations in this street and Additional Building Codes corresponding individual ZRB.
 a. Other buildings (Offices, Restaurants, Shops, Stores, Malls, etc.);
 Recreational is allowed as long as buildings follow the regulations in this street and Additional Building Codes corresponding individual ZRB.
 a. Building with living rooms and bedrooms (Houses, Apartments, Hotels, Cottages, Villas, etc.);
 b. Important buildings (Schools, fire fighter and police stations, religious buildings, hospitals, other necessary facilities during emergency, including disaster shelters, etc.); buildings (Offices, Restaurants, Shops, Stores, Malls, etc.);
 c. Utilization with specific Condition (B= beryarai, Teritena)
 New Construction and reconstruction are allowed as long as buildings follow the regulations in this street and Additional Building Codes corresponding individual ZRB.
 a. Agricultural facilities (farms, paddy fields, aquaculture ponds, fisheries and salt farms, etc.)
 d. Utilization is Not Allowed (X, etc.)
 a. Building with living rooms and bedrooms (Houses, Apartments, Hotels, Cottages, Villas, etc.);
 b. Important buildings (Schools, fire fighter and police stations, religious buildings, hospitals, other necessary facilities during emergency, including disaster shelters, etc.);
 c. High-risk facilities (Fuel storage tanks, buildings and non-buildings for explosive materials containing toxic usage and hazardous wastes, etc.);
 Recreational is prohibited
 d. High-risk facilities (Fuel storage tanks, buildings and non-buildings for explosive materials containing toxic usage and hazardous wastes, etc.);
II. Provisions on Spatial Use Intensity
 a. KOB (Building KOB maximum in 3Z should be reduced 5% than KOB Coefficient)
 b. KLB (Floor KLB maximum in 3Z should be reduced 5% than KLB maximum in 2Z)
 c. KDH (Green Coefficient minimum in 3Z should be increased 5% than KDH maximum in 2Z)
III. Provision of Minimum Infrastructure
 The designation and preparation of evacuation routes and evacuation facilities are required in accordance with corresponding type of disaster.
IV. Special Provision
 For high risk areas, structural and non-structural mitigation measures should be designed and implemented. For detail, please see "Mitigation Measures Notes".

Zoning Text of 2G, 1T, 3N, 1B, 1L

Additional Building Codes	Additional Building Codes
Flood	Tsunami
< 2G > Tsunami ZRB 1	< 2G > Tsunami ZRB 1
< 3Z > Flood ZRB 2	< 3Z > Flood ZRB 2
< 3Z > Flood ZRB 3	< 3Z > Flood ZRB 3
< 4G > Fault ZRB 4	< 4G > Fault ZRB 4
< 1T > Tsunami ZRB 1	< 1T > Tsunami ZRB 1
< 2T > Tsunami ZRB 2	< 2T > Tsunami ZRB 2
< 3T > Tsunami ZRB 3	< 3T > Tsunami ZRB 3
< 4T > Tsunami ZRB 4	< 4T > Tsunami ZRB 4
< 1N > Nisob ZRB 1	< 1N > Nisob ZRB 1
< 2N > Nisob ZRB 2	< 2N > Nisob ZRB 2
< 3N > Nisob ZRB 3	< 3N > Nisob ZRB 3
< 4N > Nisob ZRB 4	< 4N > Nisob ZRB 4
< 1B > Flood ZRB 1	< 1B > Flood ZRB 1
< 2B > Flood ZRB 2	< 2B > Flood ZRB 2
< 3B > Flood ZRB 3	< 3B > Flood ZRB 3
< 4B > Flood ZRB 4	< 4B > Flood ZRB 4
< 1L > Sediment Disaster ZRB 1	< 1L > Sediment Disaster ZRB 1
< 2L > Sediment Disaster ZRB 2	< 2L > Sediment Disaster ZRB 2
< 3L > Sediment Disaster ZRB 3	< 3L > Sediment Disaster ZRB 3
< 4L > Sediment Disaster ZRB 4	< 4L > Sediment Disaster ZRB 4

Zoning Text of Additional Building Codes

Standard Zoning Text

Comprehensive Zoning Text

Source: Prepared by JICA Expert

Figure 4-45 Method to Prepare Zoning Texts Corresponding to Comprehensive ITBX Table Reflecting ZRB Map

Chapter-5 Technical Support for Strategic Environmental Assessment (SEA) of General Spatial Plans (RTRW) and Detailed Spatial Plans (RDTR)

5-1 Approach and Contents of Technical Assistance of Output 2 for ATR and Local Governments

JICA Study Team had discussion with the departments for spatial planning and environment in the local governments, and with Bantek consultants to give advice on the regulations to be followed, design of meetings, and selection method of priority issues on sustainable development.

JICA Study Team put emphasis on information dissemination, including the involvement of stakeholders and the general public in the SEA preparation process. Most of the Bantek consultants agreed to expand the list of stakeholders to be invited to the meetings.

JICA Study Team suggested that the Bantek consultants and the local governments hold the second public consultation for SEA before this goes through the validation process, in accordance with the environmental regulations. All the local governments held the second consultation sessions for SEA, but the attendance of the general public was not achieved. The participants of the public consultations included academics and NGOs in the Working Team selected by the local governments, and a wide range of government officers from national, provincial, sub-district, and village offices.

5-2 Legal Framework for SEA

The Law on Protection and Management of the Environment (EPMA No. 32/2009) defines requirements of SEA, Environmental Impact Assessment (EIA), monitoring, and environmental auditing.

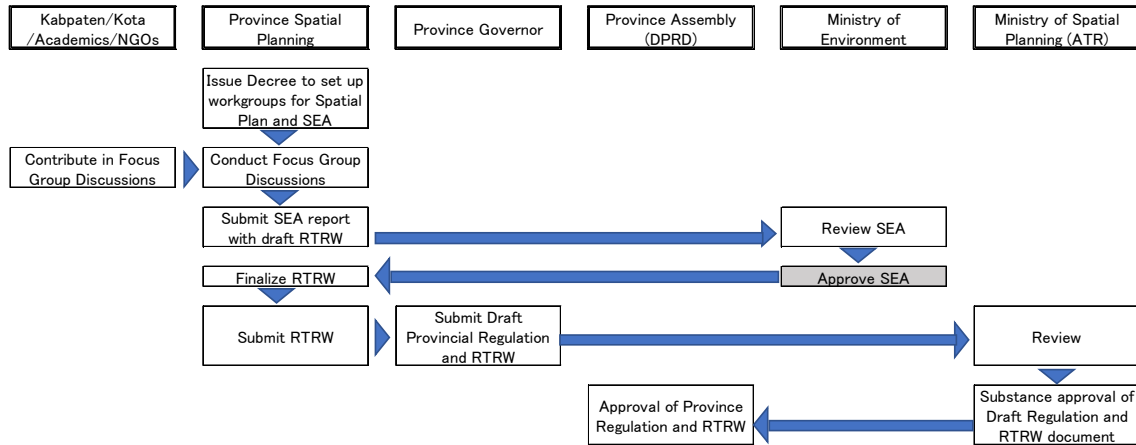
In 2011, the draft General Guidelines for Strategic Environmental Study (Draft Pedoman Umum Kajian Lingkungan Hidup Strategis) was published by the Deputy for Environmental Management, Ministry of Environment. The Article 2 (2) a. of the Government Regulation No. 46/2016 on the Procedures for Operating Strategic Environmental Study defined that SEA must be implemented in the preparation or evaluation of spatial plans and detailed spatial plans.

The Ministry of Environment and Forestry Regulation No. 69/2017 defined the contents and process of SEA in further detail. The Article 39 of the Ministry Regulation states that the validity period of the SEA is the same as the validity period of the Plan.

5-3 Preparation and Approval Process of SEA for Spatial Plans

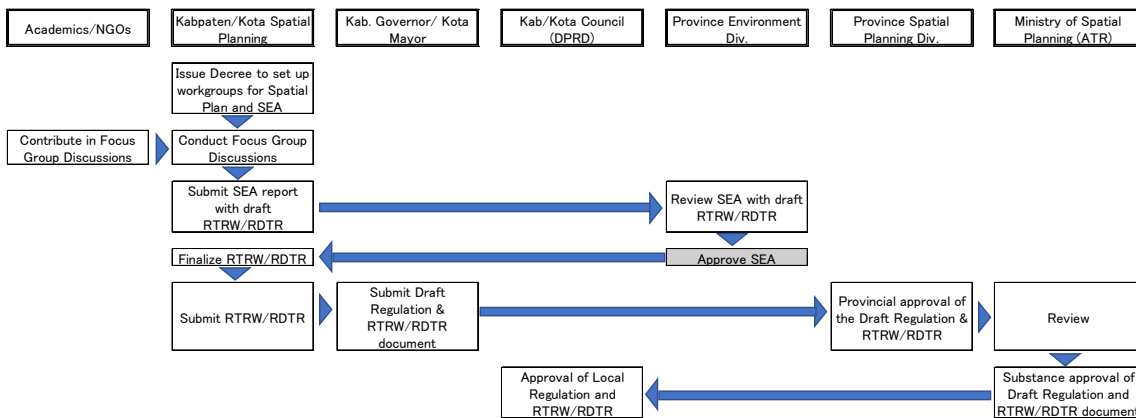
The players and steps in the preparation and approval of SEA for spatial plans are shown in Figure 5-1 and Figure 5-2.

A SEA report should be submitted with the draft spatial plan for approval. SEA reports for provincial spatial plans are approved by the Ministry of Environment and Forest in Jakarta. On the other hand, SEA reports for spatial plans of regencies and cities are approved by the Department of Environment in the Province.



Source: JICA Study Team

Figure 5-1 Players and Steps in SEA for Provincial Spatial Plan



Source: JICA Study Team

Figure 5-2 Players and Steps in SEA for Regency / City Spatial Plans

5-4 Required Contents of SEA

According to Article 35 (2) of the Ministry Regulation No. 69/2017, the SEA report must contain information listed in Table 5-1.

Table 5-1 Information Required in the SEA Report

a.	The legal basis of the Plan that needs a SEA;
b.	Methods, techniques, series of steps and results of the study of the impact of the Plan on the environment;
c.	Methods, techniques, series of steps and results of the formulation of alternatives of the Plan;
d.	Consideration, content, and consequences of recommendations for improvement of decision-making on the Plan that integrate the principles of sustainable development;
e.	Result of recommendations from the SEA that must be included in the improvement of policies and Plans;
f.	Record of implementation of community participation and SEA information disclosure;
g.	SEA quality assurance results;
h.	Executive summary.

Source: Article 35 (2) of the Ministry Regulation No. 69/2017

Based on the steps above, the study of the impact of the plan on the environment must at least contain the information listed in Table 5-2.

Table 5-2 Analysis Required in the Study on the Impacts of the Spatial Plan

- a. Carrying capacity of the environment to accommodate development;
- b. Estimation of impacts and risks on living environment;
- c. Impacts on the performance of ecosystem services;
- d. Efficient use of natural resources;
- e. Level of vulnerability and adaptive capacity to climate change; and
- f. Level of resilience and potential of biodiversity.

Source: Article 23 (4) of Ministry Regulation No. 69/2017

Alternatives of the plan will be developed based on considerations of aspects listed in Table 5-3.

Table 5-3 Aspects to Be Considered in Development of Alternatives

- a. Greater benefits;
- b. Smaller risk;
- c. Certainty of safety and well-being of vulnerable communities; and
- d. More effective mitigation of impacts and risks.

Source: Article 26 (2) of Ministry Regulation No. 69/2017

The selection of preferred alternatives is carried out by considering issues listed in Table 5-4.

Table 5-4 Issues to Be Considered in the Selection of Preferred Alternatives

- a. National mandates, interests or policies that must be secured;
- b. Socio-political situation;
- c. Government institutional capacity;
- d. Community capacity and awareness;
- e. Awareness of global condition, global policies and contribution in the global society;
- f. Market conditions and investment potential.

Source: Article 26 (3) of Ministry Regulation No. 69/2017

The issues to be considered in making recommendations are listed in Table 5-5.

Table 5-5 Issues to Be Considered in Making Recommendations

- a. Consist with achieving national sustainable development goals (sustainable development goals);
- b. Possibility of scientific uncertainty from the results of SEA review;
- c. Consistent with the application of principles of environmental protection and management; and
- d. Consistent with the application of general principles of good governance.

Source: Article 29 and Appendix VI of Ministry Regulation No. 69/2017

Appendix VI of the Regulation also provides examples of SEA recommendations for spatial plans as shown in Table 5-6.

Table 5-6 Examples of SEA Recommendations for Spatial Plans

		Province	Regency	City
	Space Pattern	Strengthening the	Strengthening the	Improvement of

RTRW	Plan	protection of the region's main provincial ecosystem service providers	protection of the region's main ecosystem service providers	allotment of urban buffer zones and green open space
	Directions for Use of Space	-	-	Improvement of criteria for city space utilization based on carrying capacity
RDTR	Infrastructure Network Plan	-	Improvement of location and network structure	Improvement of location determination of infrastructure alignment and network design.
	Provisions on the Use of Space	-	Determination of standards for environmental quality and tolerance limits for environmental damage in the planning area	Prohibition of certain types of businesses and / or activities in one location block
	Zoning Regulations	-	Refinement of location suitability standards so as not to exceed the carrying capacity of the environment.	Improvement of KDB and KLB standards for certain locations to match the carrying capacity of the environment.

Source: Article 29 and Appendix VI of Ministry Regulation No. 69/2017

5-4-1 Detailed Steps in Preparing SEA Report

Based on the law, regulations, guidelines, and expert knowledge of Indonesian consultants, the steps in preparing SEA documents for spatial plans are identified in Table 5-7.

Table 5-7 Detailed Steps in Preparing SEA Report

No.	Step	Proof of Administrative Completeness	Potential JICA Intervention
1	Preliminary Meeting of the Working Team (POKJA) regarding overview of the preparation of SEA, and explanation of its roles and functions.	Minutes, Attendance, Decree to set up the Working Team (POKJA)	Assistance or guidance on the process, i.e., coordination of tasks of POKJA and preparation of working schedule.
2	Potential stakeholder involvement about sustainable development issues	Meeting materials disseminated, Attendance, Minutes signed by representatives of the stakeholders,	Assistance in data collection, understanding the existing conditions, and in the selection of sustainable development issues to focus on disaster risk reduction.
3	Review of the results from 1st FGD, Scoping and assessment of sustainable development issues	Documentation of the review and scoping	
4	POKJA selects the most important sustainable development issues	Meeting materials, Minutes, Attendance	
5	Identification of the content of the draft Plan that has the potential impact on the environment	Documentation of the draft Plan, review and scoping of the potential impacts	Assistance in reviewing the draft Plan
6	Comparison of the potential impacts and the most important sustainable development issues.	Results of the comparison and identification of sustainable development issues	Assistance in analysis of the impacts of the draft Plan

No.	Step	Proof of Administrative Completeness	Potential JICA Intervention
	Identification of the contents of the draft Plan that need to be further assessed.		
7	Detailed assessment of the impacts in the draft Plan from 6 perspectives	Results of the assessment	
8	POKJA considers alternatives to refine the draft Plan	Meeting materials , Minutes including selected alternatives, Attendance	Assistance in development of alternatives
9	POKJA formulates Recommendations for Improving the draft Plan	Meeting materials , Minutes including the recommendations, Attendance	Assistance in coming up with recommendations
10	Potential stakeholder involvement in the assessment of results, drafting alternatives and coming up with recommendations	Meeting materials disseminated, Attendance, Minutes of Results of Public Consultation signed by stakeholder representatives	Assistance and guidance in preparing the meeting format, including the identification of participants, structure of the meeting, and agenda, and technical assistance for drafting alternatives and recommendations
11	Simultaneous POKJA meetings for both Spatial Plan and SEA Report by SEA POKJA on recommendations Filling out of the Quality Assurance form as required by Articles 31 to 34 of Ministry Regulation No. 69, 2017	Filled out Quality Assurance Form (Appendix VIII of Ministry Regulation No. 69, 2017) Meeting materials , Minutes including the results of integration and signed by both POKJA, Attendance	Assistance in ideas for integration of recommendation from SEA into spatial plans
12	Documentation (Finalizing the SEA Report)	SEA Final Report and Executive Summary	Monitoring the progress to prevent unnecessary delay
13	Validation	Environment Department submits validation application letter with the SEA document and draft Spatial Plan. POKJA is expected to explain the results to the Validation Officer.	Monitoring the progress to prevent unnecessary delay

Source: JICA Study Team

5-5 Process of SEA Preparation

Table 5-8 shows the process of preparation of SEA done by four local governments. JICA Study Team assisted the Bantek consultants and the local governments as described in Table 5-8. All the SEA documents for the spatial plans were validated on conditions.

The regular process of preparing a spatial plan takes 2 years. After identification of the sustainable development issues and selection of the priority issues, the draft Spatial Plan is prepared in the first year. Then, the SEA study is done in the second year.

At the occurrence of the earthquake in September 2018, Palu City was about to finish the first year

of revision of the RTRW. Therefore, there was already the draft RTRW for Palu City, but no SEA preparation was done yet before the start of the JICA Project.

In this Central Sulawesi case, it was an urgent task to incorporate disaster recovery, as well as disaster risk mitigation and reduction projects and policies in the spatial plans. Therefore, ATR tasked the Bantek consultants to complete the RTRWs and RDTRs with the local governments' regulations (peraturan daerah) within six months.

JICA Study Team had discussion with the departments for spatial planning and environment in the local governments, and with the Bantek consultants to give advice on the regulations to be followed, design of meetings, and selection method of priority issues on sustainable development.

JICA Study Team put emphasis on the information dissemination, including the involvement of stakeholders and the general public in the SEA preparation process. Most of the Bantek consultants agreed to expand the list of stakeholders to be invited to the meetings.

JICA Study Team suggested that the Bantek consultants and the local governments to hold the second public consultation for SEA before it would go through the validation process, in accordance with the environmental regulations. All the local governments held the second consultation sessions for SEA, but the attendance of general public was not achieved. The participants of the public consultations included academicians and NGOs in the Working Team selected by the local governments, and a wide range of government officers from national, provincial, sub-district, and village offices.

The various meetings proceeded in a style in which the Bantek consultants first explained the materials, followed by question-and-answer and discussion, and in principle the attendees were encouraged to speak at least once. In most cases, the comments and questions from the attendees were to provide information on the issues and policies of the organizations and government agencies to which they belonged, and to confirm the position of these in the materials and SEA.

The SEA needed to be validated before the validation process of the spatial plans. This time shortage affected the SEA preparation process in each local government. As a result, all the SEA documents received validation from the validation committee with conditions that officially required administrative documents to be submitted after the validation.

Table 5-8 Preparation Stages of SEA and Technical Inputs by the JICA Study Team

NO	STAGE/PHASE	JICA ASSISTANCE	PROVINCE	PALU	SIGI	DONGGALA
1	Preliminary Meeting of the POKJA Team regarding overview of SEA document preparation, explanation of the roles and functions of the Working Team.	Since Bantek consultants were not dispatched yet, advised local government staff about the necessary steps, sample decrees, and legal requirements.	2019/07/1 (RTRW)	2019/7/2, 2019/7/11 (RDTR)	2019/7/31 (RTRW & RDTR)	2019/6/28 (RTRW & RDTR)
2	Pre-Public Consultation to identify stakeholders to be invited for first	Attended the meeting and made record of discussion and attendants. Discussed and advised	-	2019/8/27 (RTRW)	-	-

NO	STAGE/PHASE	JICA ASSISTANCE	PROVINCE	PALU	SIGI	DONGGALA
	public consultation	Bantek consultants and local governments in the technical screening of sustainable development issues and in selecting priority issues				
3	First public consultation (FGD) for <u>Networking Sustainable Development Issues</u>	Encouraged the Bantek consultants and the local governments to invite the general public to the consultations, following the JICA Guidelines. Attended in the meetings and made records of discussion and attendants. Give advice to Bantek consultants about technical implementation	2019/4/25 (RTRW)	2019/7/25 (RDTR)	2019/7/31 (RTRW & RDTR)	2019/7/2 (RTRW)
				2019/8/29 (RTRW)		2019/7/3 (RDTR)
4	Screening of sustainable development issues	Involved in the screening stage and discussion about which method to use in Ministry Regulation	2019/4/25 (RTRW)	2019/7/25 (RDTR)	2019/7/31 (RTRW & RDTR)	2019/7/2 (RTRW)
				2019/8/29 (RTRW)		2019/7/3 (RDTR)
5	Determination of the most strategic sustainable development issues assessed and identified by the working team	Involved in the scoring stage and discussed about which method to use in Ministry Regulation	2019/4/25 (RTRW)	2019/7/25 (RDTR)	2019/9/18 (RTRW & RDTR)	2019/7/30 (RTRW)
				2019/8/29 (RTRW)		2019/10/10 (RTRW & RDTR)
6	Determination of the most priority sustainable development issues assessed and identified by the Working Team	Involved in the scoring stage and discussed about which method in Ministry Regulation they will use	2019/25/4 (RTRW)	2019/7/25 (RDTR)	2019/9/18 (RTRW & RDTR)	2019/7/30 (RTRW)
				2019/8/29 (RTRW)		2019/10/10 (RTRW & RDTR)
7	<u>Receiving the Draft Spatial Plan.</u> Identification of content material in the Plan that has the potential to cause negative impacts on the environment	Involved in the process of identifying the impacts and advised the Working Team on the method to use.	-	2019/9/18 (RDTR BWP3&2)	-	2019/9/16 (RTRW)
				190919 (RDTR BWP 1 &4)		
8	Impact analysis of the effects of the results of Sustainable Development Issues, Priority with PPP Material Content that have an impact on the environment to determine the PPP that needs to be	Assisted the Bantek consultants and the local government in impact analysis and selection of PPPs for further assessment	-	2019/10/9 (RDTR)	2019/9/18 (RTRW & RDTR)	2019/9/16 (RTRW)
				2019/10/28 (RTRW)		2019/10/10 (RTRW & RDTR)

NO	STAGE/PHASE	JICA ASSISTANCE	PROVINCE	PALU	SIGI	DONGGALA
	further assessed					
9	SEA content review	-	Internal activity by Bantek consultants			
10	Preparation of Alternatives	Assisted the Bantek consultants and local governments in making alternatives and recommendations based on Ministry Regulation	-	2019/10/09 (RDTR)	2019/10/10 (RTRW & RDTR)	2019/10/29 (RTRW)
				2019/10/28 (RTRW)		2019/11/8 (RDTR)
11	Formulation of Recommendations for Improving PPPs		-	2019/10/9 (RDTR)	2019/10/10 (RTRW & RDTR)	2019/10/29 (RTRW)
				2019/10/28 (RTRW)		2019/11/8 (RDTR)
12	Second public consultation	Encouraged the Bantek consultants and local governments about participation of the general public in the consultation, following the JICA Guidelines Attended the meeting and made record of discussion and attendants' list	2019/8/21 (RTRW)	2019/10/29 (RTRW)	2019/10/10 (RTRW & RDTR)	2019/10/29 (RTRW)
				2019/10/10 (RDTR)		2019/11/08 (RDTR)
13	Quality Assurance (Integration of SEA Results in Spatial Plan)	-	Internal activity by Bantek consultants			
14	Documentation (Finalizing the SEA Report)	-	Internal activity by Bantek consultants			
15	Validation	Assisted the local government (Donggala) in discussion with the Provincial staff about preparation for validation Monitored the Provincial Environment Office to be updated with the validation process of Kab/Kota SEA Attended the validation meeting and made record of discussion and attendants' list	2019/10/30	2019/10/30 (RTRW)	2019/10/29 (RTRW)	2019/10/29 (RTRW)
				2019/11/18 (RDTR for 4 BWP)	2019/11/19 (RDTR)	2019/11/19 (RDTR)

Source: JICA Study Team

5-5-1 Central Sulawesi Province

(1) Members of the SEA Working Team

The SEA Working Team who drafted the 3 SEA documents (revision of Central Sulawesi provincial

spatial plan, draft regulation of Central Sulawesi Province concerning direction of provincial zonation regulation, and KSP RTR of Palu disaster areas and surroundings) were nominated as shown in Table 5-9. The team was headed by the Provincial Environmental Agency, with the Office of Highways and Spatial Planning as the secretary. The members included representatives from various government branches, a mining company, and NGOs working on issues on local society and environment. Said expert team comprised the consultants hired directly by the Province.

Table 5-9 Member of the SEA Working Team, Central Sulawesi Province

Head of the Team	Head of the Central Sulawesi Provincial Environmental Agency
Secretary	Secretary of the Office of Highways and Spatial Planning of Central Sulawesi Province
Members	<ol style="list-style-type: none"> 1. Head of Regional Legal Products Division of the Provincial Secretariat of Law of Central Sulawesi Province 2. Head of the Natural Resources Development Section, Development Administration Bureau and SDA Regional Secretariat of Central Sulawesi Province 3. Head of Section for Technical Planning of Rivers, Beaches, Lakes and Raw Water, Cipta Karya and Water Resources of Central Sulawesi Province 4. Head of the Section for the Control of Space Utilization, the Office of Highways and Spatial Planning of Central Sulawesi Province 5. Head of Economic Planning Sub-Sector II, Bappeda of Central Sulawesi Province 6. Head of Program Subdivision of Housing, Settlement and Land Areas of Central Sulawesi Province 7. Head of Planning and Environmental Impact Assessment Section, Environmental Agency of Central Sulawesi Province 8. Head of Forest Planning and Utilization Section, Central Sulawesi Provincial Forestry Service 9. Head of Forest Area Consolidation Section (BPKH) Region XVI Palu BPDAS 10. Head of the Section of Natural Resources Conservation (BKSDA) of Central Sulawesi Province UPTD TAHura 11. KPH Dolanggo Tambunu 12. Citra Palu Minerals 13. Merah Putih Foundation 14. Indonesian Environment Forum (WALHI)
Experts (consultants hired by the Province)	<p>Dr. Ir. Muhd. Nur Sangadji, DEA. (Chair)</p> <p>Nur Edy, SP., M.Sc., Ph.D. (Member)</p> <p>Nursalam SP., M.Si. (Member)</p> <p>Abd. Rahman, S.Hut., M.Sc. (Member)</p> <p>Mauludi Kurniawan, S.Si., M.Sc. (Surveyor and Data Processing)</p> <p>Muhammad Musbah, S.Si., M.Si. (Surveyor and Data Processing)</p>

Source: Provincial Decree (unsigned copy obtained by JICA Study Team on June 18, 2019)

(2) Sustainable Development Issues

The public consultation to discuss priority issues on sustainable development in the Province was held on April 25, 2019 at the meeting room of the Highways and Spatial Planning Office of Central

Sulawesi Province. The attendants were the SEA Working Team (POKJA), related agencies in the Central Sulawesi Province, stakeholders (NGOs and Universities) and facilitators / resource persons.

According to the official minutes, the following 7 issues were selected as the priority issues of sustainable development in Central Sulawesi Province.

1. Land conversion
2. Threats of natural disasters
3. Pollution and environmental damage
4. Economic and development gaps between regions
5. Lack of public and environmental health
6. Lack of economic infrastructure
7. Lack of human resources

(3) Validation of SEA Report for RTRW Province

JICA Study Team monitored the progress of the development and approval process of the Provincial SEA Report. On October 30, 2019, the validation of the Provincial SEA Report was completed.

5-5-2 Palu City

(1) Members of the SEA Working Team

The Working Team of Palu City was headed by the Spatial and Land Management Office, and the Environmental Agency was one of the members. The Bantek consultant team hired by ATR assisted the group. (Table 5-10)

Table 5-10 Members of the SEA Working Team, Palu City

Coordinator	1. Head of Spatial and Land Management Office
Vice coordinator	2. Head of Environmental Office
Secretary	3. Head of Division for Planning and Utilization of Space, Office of Spatial Planning and Land
Members	4. Head of Housing and Settlements Office 5. Head of Public Works 6. Head of Division of Law, City Secretary 7. Head of Division of Planning of BAPPEDA 8. Head of Division for Information and Data of BAPPEDA 9. Head of Division for Destination of Tourism, Tourism Office 10. Head of Division for Rehabilitation and Reconstruction, BPBD 11. Head of Section for Monitoring and Evaluation of Spatial Planning and Land Office 12. Head of Section for Planning and Utilization of Space in the Spatial Planning and Land Office 13. Head of Section for Landscaping, Environmental Office 14. Head of Section for Inventory and Environmental Assessment, Environmental Office 15. Head of Section for Spatial Planning and Land Office 16. Head of Sub-Section for Program Planning, Health Office

Support Team	Bantek consultant team
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Source: City Decree (undated copy obtained by JICA Study Team on June 18, 2019)

(2) Sustainable Development Issues

1) RTRW

The discussion on the most strategic sustainable development issues in planning of RTRW Palu held on August 29, 2019 selected the issues listed in Table 5-11.

Table 5-11 List of the Most Strategic Sustainable Development Issues in RTRW of Palu City

No .	Sustainable Development Issues	Most Strategic Sustainable Development Issues
A. Environment Issues		
1	Water Pollution	Treatment of factory wastewater released in the environment Water pollution Seawater intrusion
2	Domestic Waste	Problem with management of garbage transport, and garbage dumping in empty land Garbage dumping in wilderness area Need for managed landfill site near settlements
3	Degraded Air Quality	Swallow business in residential areas Air pollution in KEK area, Type C mining areas, and settlements
4	Degraded Groundwater Quantity	Groundwater quantity is getting scarce
5	Lack of Sanitation Infrastructure	Lack of clean water facilities Lack of infrastructure related to drainage system, wastewater treatment, waste management, water management and other systems
6	Disaster	Disaster-prone (earthquakes, liquefactions and tsunamis) Landslides Low public knowledge on disaster Lack of information on traffic signs
7	Coastal Issues	Disaster-prone (earthquakes, liquefactions and tsunamis) Landslides Low public knowledge on disaster
B. Economic Issues		
1	Decreased Income and Loss of Livelihoods	Decreased income and loss of livelihoods especially street vendors, fishermen, and traders after the disaster
2	Development of City Facilities	Memorial park plans have not been accommodated Development of marine region tourism Development of international standard port and depot terminal
3	Increased Prices of Staples	High price of staples
C. Social Issues		
1	Crime and Drugs	Increase in crime rate Widening social gap Mining issues Lack of employment Violence on women and children Proliferation of slums Drug use/addiction as a result of job loss
2	Not Yet Optimal Spatial Planning and Special Facilities	Not yet optimal population control and resettlement in disaster-prone areas City parks and buildings encroaching roads' right-of-way (ROW) Traffic congestion Degradation of cultural sites Transfer of areas (kawasan) in several places Lack of public facilities Need to explore local wisdom Damage caused by disasters on residential buildings Uncoordinated activities of street vendors
3	Poverty	Lack of employment due to businesses that have not re-opened Loss of post-disaster jobs

No	Sustainable Development Issues	Most Strategic Sustainable Development Issues
		Poverty Lack of education and children don't have access to school due to the distance and some children only finish elementary school
4	Post-Disaster Community Discomfort	There is no information related to disaster risks Post-disaster community discomfort Post-disaster education does not exist yet Lack of disaster information Lack of disaster evacuation facility Discomfort and insecurity in local communities regarding relocation

Source: Official minutes of the meeting, August 29, 2019

2) RDTRs

On July 25, 2019, discussions on the most strategic sustainable development issues were held for all four target areas of the RDTR. Since each area was handled by a different Bantek team, the style and wordings in the RDTR differed from each other.

Table 5-12 List of the Most Strategic Sustainable Development Issues in RDTRs in Palu City

No.	BWP I	BWP II	BWP III	BWP IV
I	Environment Issues			
1	Waste management	Flood	Domestic solid waste	Pollution of environment from the Panau power plant
2	Degrading quality of river and sea water	Household waste management	Domestic liquid waste	Lack of coastal vegetation
3	Medical waste disposal	Liquefaction	Mining activities	Beach abrasion
4	B3 (toxic and hazardous) waste management	Groundwater	Degrading river water quality	Damage to coastal ecosystems
5	Degrading air quality and noise pollution	Waste disposal	Water availability	Potential for disaster-prone faults, earthquakes, tsunamis, liquefaction, landslides and floods
6	Land degradation	Violation of space utilization (regulations on land use and space use)	Management of coastal borders	Degradation of water sources
7	Management of animal livestock	Land use change	Risk of natural disaster (Earthquake, Flood, Tsunami, Liquefaction)	Potential for changing river morphology (The river water flow is decreasing and people start using river buffer zones. Especially an issue in BWP IV.)
8	Disaster risks	Existence of 2 faults (Palu – Koro fault)	Erosion	Presence of some informal settlers and growing informal settlement around Industrial Estates and SEZs
9	Drinking water resources infrastructure	-	-	-
10	Utilization of water resources	-	-	-
11	River sedimentation	-	-	-
12	Post-mine land damage	-	-	-
13	Changes in the function of productive land	-	-	-
14	Management of coastal borders	-	-	-
II	Economic Issues			
1	Allocation of space for new businesses	Economic activity	Allocation of space for new businesses	Tourism potential
2	Ownership of business assets	Loss of livelihood	Loss of place of business	Local economic potential

No.	BWP I	BWP II	BWP III	BWP IV
3	Livelihood changes	Road that has not been paved	Potential of post-disaster tourism	Economic growth potential around SEZ
4	Loss of place of business	Limited land and employment	-	-
5	Decreased income among residents	-	-	-
6	Construction of post-disaster infrastructure networks	-	-	-
III	Social Issues			
1	Decrease in community welfare	Unclear administrative boundaries	Decrease in community welfare	Decrease in community welfare after the disaster
2	Public anxiety about designation of post-disaster land	Increased violence against women and children	Psychological disorder	Increased poverty rate after the disaster
3	Psychological disorder	Theft cases	Potential post-disaster problems (loss of jobs)	Restoration of areas, especially those affected by disasters
4	Potential post-disaster problems	Evacuation route and evacuation point	-	-
5	Changes in the social order after the disasters	Rehabilitation and reconstruction	-	-
6	Loss of place of residence	Education	-	-
7	Disruption of the function and role of family because families stayed together in camp	-	-	-
8	Adaptation to new settlements	-	-	-
9	Legal uncertainty of land status in ZRB4 and Huntap	-	-	-
10	Rebuilding disaster-affected buildings	-	-	-

Source: JICA Study Team based on minutes of meetings

(3) SEA Process and Validation of SEA Report for RTRW Palu

JICA Study Team succeeded to widen the list of stakeholders to be invited. It suggested to hold in separate days the meeting for the preparation of spatial plan and that for SEA, though without success.

JICA Study Team continued the provision of technical assistance, and the SEA Report for the RTRW was reviewed by the Validation Committee on October 30, 2019. The SEA Report for the RTRW was validated on conditions, in order to complete the process of RTRW formulation in time.

Table 5-13 JICA Study Team's Assistance in the Stages of SEA for RTRW of Palu

Stage	Situation	JICA Assistance	Response of Bantek and Working Team
2. Pre-Public Consultation for identification of stakeholders to be invited in first public consultation	<ul style="list-style-type: none"> List of stakeholders was too small. The method to be used for public consultation was not clear. 	<ul style="list-style-type: none"> Advised to invite wider range of stakeholders to join the screening process Discussed and advised Bantek and the local government on technical screening of sustainable development issues by showing the legal base and rules of Environment Ministry so that priority issues can be selected. 	<ul style="list-style-type: none"> Made an agreement with the Working Team about the list of stakeholders (by adding media, academe, public figures, and groups of people affected by Nalodo) Followed JICA Study Team's advice on the screening method. Bantek said that using social media would be difficult in collecting opinions of the public

Stage	Situation	JICA Assistance	Response of Bantek and Working Team
		<ul style="list-style-type: none"> Advised to use social media to invite the general public to give the issues. 	without technical preparation.
3. First public consultation	<ul style="list-style-type: none"> This stage was carried out together with the Public Consultation for Spatial Plan. SEA presentation was given limited time after the meeting on the spatial plan. 	<ul style="list-style-type: none"> The JICA Study Team gave an advice on an alternative way to organize public consultations. In the next stage, the SEA meeting would be done in a separate in day 	<ul style="list-style-type: none"> Bantek consultants said that FGD or public consultation will be held in one day, depending on the instructions of their company and ATR due to limited time and budget.
7, 8, 10 & 11. Working Team and Bantek conducted FGD (Identification of PPP impacts on the environment, alternatives and recommendations) (Oct. 10, 2019)	<ul style="list-style-type: none"> With time constraints, Bantek decided to go through several stages in 1 day, gathering together the Working Team and JICA Study Team. 	<ul style="list-style-type: none"> Assisted the Working Team and Bantek in the discussion for better understanding the meeting materials. 	<ul style="list-style-type: none"> Working Team, JICA Study Team and Bantek had active discussion to produce inputs and suggestions.
12. Second public consultation RTRW (Oct. 29, 2019)	<ul style="list-style-type: none"> Participants asked for more detailed content included in RTRW. Stakeholders provided inputs to important PPPs that need to be studied for the formulation of alternatives and recommendations. 	<ul style="list-style-type: none"> Attended the meeting and made record of discussion. 	<ul style="list-style-type: none"> Based on the inputs of the meeting, Bantek improved its alternative studies and recommendations in preparation for validation next day.
15. Validation stage (Oct. 30, 2019)	<ul style="list-style-type: none"> It was decided that the fulfilment of administrative requirements for SEA validation, including notes/minutes on the integration of the SEA into the RTRW document, will adhere to the decision of the validation for fast-track preparation of the RTRW. Bantek was given 10 days to make improvement after validation was given on conditions. 	<ul style="list-style-type: none"> Attended the validation meeting and made record of discussion. 	<ul style="list-style-type: none"> Bantek to submit the following documents for approval of the Validator: the revised SEA documents, the administrative requirements for validation.

Source: JICA Study Team

(4) SEA Process and Validation of SEA Reports for RDTRs in Palu City

The Bantek consultants started the process with little involvement of the Working Team. JICA Study Team explained the importance of the Working Team and succeeded to improve their coordination.

JICA Study Team did not agree to the meeting design in which discussions for the 4 areas were held simultaneously, requiring the Working Team to be divided into four. Furthermore, Bantek consultants decided to hold the only one SEA Focus Group Discussion on the same day after finishing the 4 RDTR discussions.

The JICA Study Team continued the technical assistance, and the SEA Reports for RDTRs were finally reviewed by the Validation Committee on November 18, 2019. These were validated on conditions, so that the process of RDTR formulation development completed on its time frame.

Table 5-14 JICA Study Team Assistances in the Stages of SEA for RDTRs of Palu

Stage	Situation	JICA Assistance	Response of Bantek and Working Team
<p>2. Pre-Public Consultation for identification of stakeholders to be invited to first public consultation</p>	<ul style="list-style-type: none"> This stage was carried out together with the Public Consultation for Spatial Plan. SEA presentation was given limited time after finishing the meeting on Spatial Plans. 	<ul style="list-style-type: none"> Advised to invite wider range of stakeholders to join the screening process Advised to use social media and local newspaper, radio or TV to invite the general public to give the issues. Advised that for the next stage, SEA would be held in 1 day without other activities. 	<ul style="list-style-type: none"> Made an agreement with the Working Team about the list of stakeholders Local government agreed with JICA Study Team's proposal and instructed the Bantek consultants to follow this advice for next SEA activities.
<p>3. First public consultation</p>	<ul style="list-style-type: none"> There were 4 Bantek consultants for RDTRs of Palu. The first public consultation on the screening of sustainable development issues for the 4 RDTRs was held simultaneously, requiring the Working Team to be divided into 4. Because of limited time, the Bantek consultants utilized one day for screening sustainable development issues and in selecting the priority ones. 	<ul style="list-style-type: none"> Involved in the scoring of issues. Advised that the idea of dividing the Working Team in 4 groups was not effective, and results would not be optimized. 	<ul style="list-style-type: none"> The Bantek consultants said that the Working Team will be divided in two groups for next activities which would be held in one day.
<p>7. Identification of PPP content that had the potential to cause impact on the environment</p>	<ul style="list-style-type: none"> SEA experts from Bantek reviewed each of the Policies, Plans and Programs in the draft Spatial Plans (RTRW & RDTRs) with the Working Team. It took much time and confused the Working Team. The SEA expert started explanation with the policies, then continued to discuss each plan related to spatial structure and pattern. The Bantek consultants only provided discussion of Policies and Plan, not the Program because the spatial plan had not been finished yet. 	<ul style="list-style-type: none"> Involved in the issue identification stage. Advised the Bantek consultants about how to make the work time effective and efficient: <ul style="list-style-type: none"> Showed the Policies and Plans that will have negative impact on the environment. Presented the reason why certain policies and the plan will have negative impact on the environment. Open discussion if the Working Team had other opinions. This stage could not be completed if there would be no presentation of Policies, Plan and Programs. Advised the Bantek consultants and Working Team that the next stage must be completed with the programs to be presented, and this must be held in one day before Public Consultation 2. 	<ul style="list-style-type: none"> Local government and the Bantek consultants agreed to change their method to make the Working Team understand better the SEA contents. The Bantek consultants and local government agreed to arrange the next one- or two-day meeting before Public Consultation 2. The Bantek consultants said that there would be no more budget remaining for next activities, but the local government committed to share their budget.
<p>10, 11. Alternatives and recommendations</p>	<ul style="list-style-type: none"> The Bantek consultants provided all materials, identification of PPPs*, alternatives and recommendations in one day with 4 BWP**. 	<ul style="list-style-type: none"> Provided technical advice on the form of map overlays for each PPP that had been identified to have environmental impacts Found that compilation of Alternative lists and 	<ul style="list-style-type: none"> Bantek continued to follow the rules in deciding the danger areas as agreed with other teams.

Stage	Situation	JICA Assistance	Response of Bantek and Working Team
	<ul style="list-style-type: none"> The contents of alternatives and recommendations were provided only in table form, and not with maps. Thus, the Working Team asked that the overlay map KRP*** to be shown with SEA analysis. The Working Team was not sure and had different opinions about ZRB4 and buffer zone in coastal area. Some residents agreed to be relocated, some others do not want to be relocated because of economic considerations. The local government might not be able to relocate commercial buildings and others from ZRB4. 	<p>recommendations based on problem factors needed further enhancement..</p> <ul style="list-style-type: none"> Advised that alternatives had to be taken in the form of structural mitigation measures, such as SNI 1726 earthquake resistant buildings, tsunami disaster adaptation buildings, and several building functions as evacuation points. 	<ul style="list-style-type: none"> Working Team agreed with JICA SEA expert, in addition to the form of tables and matrices that the Bantek consultants also needed to make and display the results of the overlay of the PPP map in the SEA analysis. Working Team also gave opinion to Bantek consultants about application of the SNI 1726 standard.
12. Public Consultation 2 (Oct. 10, 2019)	<ul style="list-style-type: none"> SEA activities carried out together with the RDTR team (4 teams in 1 day) Bantek had coordinated with the Ministry of Environment regarding the obligation to carry out Public Consultation 2 (PC2). Bantek insisted that the Ministry said that PC2 would not be necessary if there were FGDs regarding the results of the SEA. 	<ul style="list-style-type: none"> Advised the Bantek consultants that the essence of PC2 was to hear and receive opinions related to the results of the SEA from the public or wider range of stakeholders, such as academicians, NGOs, the community and others. FGD would involve only the Working Team. FGD, therefore, could not replace public consultation. 	<ul style="list-style-type: none"> The Working Team said that the SEA activities would not be focused if these were carried out mixed together with the RDTR discussions. Respecting above opinion, Bantek's SEA team carried out SEA FGD after RDTR discussion was finished.
15. Validation Stage (Nov. 18, 2019)	<ul style="list-style-type: none"> It was decided that the fulfilment of administrative requirements for SEA validation, including notes/minutes of integration of the SEA into the RDTR document, would follow the decision of validation to fast track the preparation of the RDTR. Bantek was given 10 days to make improvement after validation was given on conditions. 	<ul style="list-style-type: none"> Attended the validation meeting and made record of discussion. 	<ul style="list-style-type: none"> Bantek consultants would submit the following documents for approval of the Validator: revised SEA documents, and the administrative requirements for validation.

* PPP : Policy, Plan, Program

** BWP : Urban Areas (Bagian Wilayah Perkotaan)

*** KRP : Policy, Plan, Program (Kebijakan, Rencana, Program)

Source: JICA Study Team

5-5-3 Sigi Regency

(1) Decree on SEA Working Team

According to the draft Decree, 12 regency-level government staff are nominated as the Chair and the Members of the Working Team.

Table 5-15 SEA Working Team Composition for the Revision of Sigi Regency's RTRW and RDTR

No.	Head/Members and Office	Position
1	Head of Environmental Office, Sigi Regency	Chair
2	Head of Public Works and Housing Agency, Sigi Regency	Secretary
3	Head of Spatial Planning and Community Development, Sigi Regency	Member
4	Head of Legal Section of Regional Secretariat, Sigi Regency	Member
5	Head of Economic Planning, Regional Development and Infrastructure Members of the Regional Planning, Research and Development Agency, Sigi Regency	Member
6	Head of Licensing Services Division, One Door Integrated Investment and Licensing Office, Sigi Regency	Member
7	Head of Prevention and Preparedness Section, Regional Disaster Management Agency, Sigi Regency	Member
8	Head of the Environment Control, Pollution and Damage Division, Environmental Agency, Sigi Regency	Member
9	Head of Spatial Planning Section, Public Works and Housing Agency, Sigi Regency	Member
10	Head of Spatial Evaluation Section, Public Works and Housing Agency, Sigi Regency	Member
11	Head of Section for Environmental Impact Planning and Studies, Environmental Agency, Sigi Regency	Member
12	Head of Section for Complaints and Settlement of Environmental Disputes, Environmental Agency, Sigi Regency	Member

Source: Draft Decree obtained by the JICA Study Team

(2) Sustainable Development Issues

1) RTRW

On October 10, 2019, discussions were held and four priority strategic sustainable development issues were selected as listed in Table 5-16.

Table 5-16 Priority Strategic Sustainable Development Issues in RTRW of Sigi Regency

1	Degradation of protected areas
2	Regional development disparities
3	Health service not optimized
4	Potential natural disaster threats

Source: Official minutes of the meeting October 10, 2019, translated by the JICA Study Team

2) RDTR

For the RDTR of Sigi central area, the following six issues were selected on October 10, 2019 as priority strategic issues for sustainable development.

Table 5-17 Priority Strategic Issues for Sustainable Development in RDTR Sigi Regency

1.	Construction of permanent housing in Pombewe
2.	Earthquake-prone areas and land movement
3.	Liquefaction and Nalodo-prone areas
4.	Flood-prone areas
5.	River pollution due to illegal mining
6.	Damaged / disconnected drinking water facilities and irrigation networks

Source: Official minutes of the meeting dated October 10, 2019, translated by the JICA Study Team

(3) SEA Process and Validation of SEA Reports for RTRW and RDTR in Sigi Regency

The Bantek consultants held one meeting on September 18, 2019 for discussing sustainable development issues and the impact of the spatial plan on the environment, without involving the Working Team (Pokja for SEA). JICA Study Team explained the importance of the Working Team's

participation and succeeded to change their coordination approach.

JICA Study Team reviewed the meeting materials prior to the actual meetings in October 10, 2019.

JICA Study Team continued the technical assistance, and both the SEA Reports for the RTRW and for RDTR were reviewed by the Validation Committee on October 29 and November 19, 2019 respectively. Both documents were validated on conditions, so that the processes of RTRW and RDTR development completed on the time.

Table 5-18 JICA Study Team Assistance in the Stages of SEA, RTRW and RDTR, Sigi

Stage	Situation	JICA Assistance	Response of Bantek and Working Team
3. Public Consultation 1	<ul style="list-style-type: none"> Both of the Bantek consultants for RTRW and RDTR provided sustainable development issues based only on the results of their study and some data/documents and on JICA's Community Dialogues. Even the SEA expert presented the results of scoring sustainable development without the involvement of the Working Team 	<ul style="list-style-type: none"> Advised that participants from the Regency and the Bantek consultants must be involved in the Working Team on screening sustainable development issues. Advised the Bantek consultants about the method of scoring sustainable development issues. Instructed the Bantek consultants that the SEA stages must involve stakeholders and the Working Team 	<ul style="list-style-type: none"> Sigi Regency and the Bantek consultants agreed to invite stakeholders and the Working Team considering suitable timing.
5. – 8. FGD (Parallel with FGD 4 RTRW & RDTR)	<ul style="list-style-type: none"> Tried to finish several SEA stages in 1 day without involving the Working Team (strategic sustainable development issues, priority sustainable development issues, identification of the PPP which have environmental impact, and the effect of PPP on priority issues) As a result, the Working Team and the Environment Office refused to recognize the meeting and ordered to redo the stage. 	<ul style="list-style-type: none"> During the meeting, gave opinion that the Working Team must be involved in the formulation of Priority Sustainable Development Issues. Advised that in the next meeting design, one day would be dedicated for SEA, without activities for other issues. 	<ul style="list-style-type: none"> The Bantek consultants insisted that FGD or public consultation would be held in one day, depending on the instruction from their company and ATR, mentioning about their limited budget. The Working Team requested that all stages of the SEA must be carried out again from the beginning, in coordination with the Environmental Office (the Head of SEA Working Team) The Bantek consultants tried to hold a meeting for SEA Working Team in the second week of October, but coordination with the Working Team or the Planning Office had not started yet as of October 1, 2019. The Bantek consultants promised to share the materials prior to the meeting for review by JICA Study Team
9-12. Public Consultation 2 (Oct. 10, 2019)	<ul style="list-style-type: none"> Bantek consultants continued the SEA stage in their manner, even after coordinating with the Environmental Department. and 	<ul style="list-style-type: none"> JICA Study Team confirmed that the SEA stages that were carried out were appropriate 	<ul style="list-style-type: none"> The academicians in the Working Team complained that the

Stage	Situation	JICA Assistance	Response of Bantek and Working Team
	<p>be involved with the Working Team.</p> <ul style="list-style-type: none"> Only the RDTR Team explained about the SEA Alternatives and Recommendations, not the RTRW Team. Bantek consultants did not succeed in the discussions with the participants because the latter did not understand the results of the SEA. 	<ul style="list-style-type: none"> JICA Study Team pointed out again, that involvement of the Working Team was very important. JICA Study Team also gave advice that the essence of public consultation was having discussion and agreement on the results of the SEA (Alternatives and Recommendations) with wide range of participants. Gave technical advice for developing alternatives and recommendations on SEA, and provided sample SEA documents. 	<p>participants received only the results.</p> <ul style="list-style-type: none"> Bantek Team said that they did their best in all stages, and if there were opinions given, they would still consider them. RTRW Bantek Team wanted to request samples of the validated SEA document from JICA SEA Expert.
<p>15. SEA of RTRW Validation Stage (Oct. 29, 2019)</p>	<ul style="list-style-type: none"> It was decided that the fulfilment of administrative requirements for SEA validation, including notes/minutes of integration of the SEA in the RTRW document, would follow the decision during validation to fast track the preparation of the RTRW. The validators required various improvement on the draft SEA document, such as its format. Bantek was given 10 days to make improvement after validation was given on conditions. 	<ul style="list-style-type: none"> Attended the validation meeting and made record of discussion. 	<ul style="list-style-type: none"> Bantek would submit the following documents for approval of the Validator: revised SEA documents and the administrative requirements for validation.
<p>15. SEA of RDTR Validation stage (Nov. 19, 2019)</p>	<ul style="list-style-type: none"> It was decided that the fulfilment of administrative requirements for SEA validation, including notes/minutes of integration of the SEA in the RDTR document, would follow the decision of validation to fast track the preparation of the RDTR. It was found that SEA had to be improved to the level of detail according to the RDTR document Bantek was given 10 days to make improvement after validation was given on conditions. 	<ul style="list-style-type: none"> Attended the validation meeting and made record of discussion. 	<ul style="list-style-type: none"> Bantek would submit the following documents for approval of the Validator: revised SEA documents, and administrative requirements for validation.

Source: JICA Study Team

5-5-4 Donggala Regency

(1) Decree on SEA Working Team

The decree was signed on June 28, 2019. It nominated the largest Working Team among the four local governments as shown in Table 5-19. The Working Team is structured with a Steering Committee

with 18 members, supported by the Social Work Group (3 members), Economic Work Group (9 members), and Environmental Work Group (10 members).

Table 5-19 Composition of the Working Team, SEA Donggala

Steering Committee	1.	Regent	Government of Donggala Regency	Steering
	2.	Vice Regent	Government of Donggala Regency	Steering
	3.	Regional Secretary	Regional Secretariat of Donggala	Person in charge
	4.	Head of Regional Development Planning Agency	Development Planning Agency at Sub-National Level, Donggala Regency	Chair
	5.	Head of General Working and Office Arrangement	General Work Service and Space Arrangement, Donggala Regency	Vice Chair
	6.	Head of Environment Office	Environmental Services, Donggala Regency	Member
	7.	Head of Disaster Management Agency	Regional Disaster Management Agency, Donggala Regency	Member
	8.	Head of Housing, Residential Area and Land	Department of Housing Settlement and Residential Area, Donggala Regency	Member
	9.	Head of Transportation Service	Department of Transportation, Donggala Regency	Member
	10.	Head of Capital and Planting Services Integrated One Door Service	Integrated Capital Investment and One Stop Service, Donggala Regency	Member
	11.	Head of Social Department	Social Services, Donggala Regency	Member
	12.	Head of Tourism Service	Government Tourism Office Donggala Regency	Member
	13.	Head of Food, Horticulture and Plantation Plants	Food Plant, Horticulture and Plantation Department, Donggala Regency	Member
	14.	Head of Micro, Small and Medium Business Cooperative Corporation	Micro, Small and Medium Business Cooperative Services, Donggala Regency	Member
	15.	Head of Community and Village Empowerment Department	Community and Village Empowerment Department, Donggala Regency	Member
	16.	Head of Health Department	Public Health Office, Donggala Regency	Member
	17.	Head of Labor and Transmigration	Manpower and Transmigration Department, Donggala Regency	Member
	18.	Head of Land Office	Land Office, Donggala Regency	Member
Social Work Group	1.	Head of Social Culture Office	Development Planning Agency at Sub-National Level, Donggala Regency	Coordinator
	2.	Head of Field and Poor Fakir Handling	Social Services, Donggala Regency	Member
	3.	Head of Economic Empowerment Village Community and Infrastructure	Community and Village Empowerment Department, Donggala Regency	Member
Economic Work Group	1.	Head of Economic Affairs	Development Planning Agency at Sub-National Level, Donggala Regency	Coordinator
	2.	Head of Empowerment and Development of Cooperative and Micro Businesses	Small and Medium Business Cooperative Departments Donggala Regency	Member
	3.	Head of Tourism Destination, Tourism Department	Government Tourism Office Donggala Regency	Member
	4.	Head of Industrial Affairs	Industry and Service Trading, Donggala Regency	Member
	5.	Head of Plantation	Food Plant, Horticulture and Plantation Department, Donggala Regency	Member
	6.	Head of Traffic Fields	Department of Transportation Donggala Regency	Member

	7.	Division Head of Aquaculture Management and Empowerment	Fisheries Service, Donggala Regency	Member
	8.	Head of Integrated One Door Service	Integrated Capital Investment and Service, Donggala Regency	Member
	9.	Head of Section Land Control and Empowerment	Land Office, Donggala Regency	Member
Environmental Work Group	1.	Head of Environmental Planning	Environmental Services, Donggala Regency	Coordinator
	2.	Head of Spatial Planning	General Work Department and Administration , Donggala Regency	Member
	3.	Head of Infrastructure and Territory	Development Planning Agency at Sub-National Level, Donggala Regency	Member
	4.	Head of Settlement Area	Housing, Residential Area and Land Department, Donggala Regency	Member
	5.	Head of Field Prevention and Fire Extinguisher	Regional Disaster Management Agency Donggala Regency	Member
	6.	Head of the Field of Marina Development	General Work Department and Space Arrangement, Donggala Regency	Member
	7.	Head of Cipta Karya	General Work Service and Space Arrangement, Donggala Regency	Member
	8.	Head of Water Resources	General Work Service and Space Arrangement, Donggala Regency	Member
	9.	Faculty of Engineering	TADULAKO University	Member
	10.	Environmental Notice	WALHI (local NGO)	Member

Source: Decree, 188.45 /0371/DPUPR, signed June 28, 2019

(2) Sustainable Development Issues

Preliminary discussions for RTRW and RDTR were held in early July 2019. The results are described in the following part.

In addition, between July 9 and July 11, 2019, a few focus group discussions (FGDs) for the RTRW were held to obtain wider input on the issues.

1) RTRW

Preliminary discussion for the RTRW on July 2, 2019 selected the Strategic Issues for Sustainable Development in the RTRW for Donggala Regency as listed in Table 5-20.

Table 5-20 Sustainable Development Issues for RTRW in Donggala Regency

No.	Sustainable Development Issues
1	The existence of land conflicts between communities, e. g., customary land with forestry
2	The absence of zoning of disaster prone area
3	There is no determination of LP2B land.
4	The planned development road has not been included in the RTRW.
5	Road accessibility is still lacking.
6	A port is needed for transportation services.
7	Sis Abdul Aziz Palu Airport is in the vulnerable zone.
8	Clean water
9	The need for residential land so that employees can live in Donggala, not in Palu
10	The need for structuring the Old City
11	Mining companies that obtained IUPs but they are not on the map
12	The rapid development of oil palm plantations

13	Licensing and permits (for mining industry and oil palm plantations) which are not in accordance with the RTRW
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Source: Minutes of Discussion, obtained by JICA Study Team on July 5th, 2019

2) RDTR

The minutes of the preliminary discussion for RDTR on July 3, 2019 contained 2 lists of Strategic Issues for Sustainable Development in the RDTR for Donggala Regency given in Table 5-21 and Table 5-22.

Table 5-21 Sustainable Development Issues for RDTR in Donggala Regency

1. Socio-cultural independence
2. Environmental pollution
3. Self-reliance of SMEs in economic development
4. Disaster mitigation
5. Public service infrastructure
6. Management of drainage
7. ASN (local government) capacity (quantity and quality)
8. Drinking water supply
9. Management of transportation systems
11. Availability of electrical energy
10. Waste management
12. Utilization of land

Source: Minutes of Discussion, obtained by JICA Study Team on July 4, 2019.

Table 5-22 Sustainable Development Issues in Donggala Regency

No.	Sustainable Development Issues
1	Urban area is in disaster-prone area.
2	Ground subsidence in the coastal area because of the earthquake (down lift)
3	Transfer of land functions
4	Tourism arrangement not yet organized (there are 6 potential points of travel)
5	Land and sea transportation not optimal
6	Sand mining
7	Hilly region (rain water runs off directly to sea because of an indication of liquefaction)
8	Environmental carrying capacity (DDL 0 for agricultural land) must be secured.
9	RTH (green open space) is still lacking.
10	Clean water
11	Anticipation of land for alternative settlement for population development
12	SDA (natural resource) has not been exploited
13	Development of buildings BTS (Cell phone base)
14	Problems with relocation of affected community
15	Not yet optimal border conservation (coast, riverside, road area, etc.)
16	Digital-based development
17	Drainage channels
18	Sanitation
19	Buildings are built with their backs facing the sea
20	Slum home environment
21	Uninhabitable houses
22	Narrow road in the urban area
23	Port is lacking optimal function
24	River tours

No.	Sustainable Development Issues
25	Licensing issues (for mining and plantation industry)
26	Perfect management

Source: Minutes of Discussion, obtained by JICA Study Team on July 4th

(3) SEA Process and Validation of SEA Reports for RTRW and RDTR in Donggala Regency

JICA Study Team assisted the local government and the Bantek consultants in the preparation of the decree for organizing the Working Team for SEA (SK Pokja SEA) and, later on, in coordinating with the Working Team.

JICA Study Team continued the provision of technical assistance, and both SEAs for RTRW and RDTR were reviewed by the Validation Committee on October 29 and November 19, 2019, respectively. Both documents were validated on conditions, so that the processes of RTRW and RDTR formulation completed on time.

Table 5-23 JICA Study Team Assistance in the Stages of SEA, RTRW and RDTR in Donggala

Stage	Situation	JICA Assistance	Response of Bantek and Working Team
1. Preparation of Decree Establishing the Working Team	<ul style="list-style-type: none"> Local governments wanted to know what the decree should look like. 	<ul style="list-style-type: none"> Provided sample decrees on organizing a Work Team for SEA as requested. 	<ul style="list-style-type: none"> Local government could promptly made a decree on SEA Working Team based on the examples
1. First Kick-off for RTRW and RDTR Teams	<ul style="list-style-type: none"> Bantek team did not prepare stakeholder invitation list The Regency raised the sustainable development issues during the Focus Group Discussion, which was made minutes before the activity, without screening process with stakeholders. 	<ul style="list-style-type: none"> Attended the meeting and made a record of discussion and attendants. Provided the meeting record to the Bantek consultants and pointed out the issue selection process. 	<ul style="list-style-type: none"> The Regency made an official minutes following the results from Bantek.
1 - 8. SEA Stage RTRW Team	<ul style="list-style-type: none"> Discussion on SEA was always done together with FGD RTRW. The official minutes was prepared without agreement of the Working Team. When the Bantek held the FGDs, the Working Team was not involved, even in the screening of sustainable development issues. 	<ul style="list-style-type: none"> Advised Bantek SEA Expert to make communication with Environment Office which was the Head of the Working Team. For better coordination, requested the Bantek consultants to invite JICA Study Team to every SEA activities, including meeting with Regency Environment Offices. Advised the Bantek consultants that the Working Team is an important point when validation is carried out. In fact, one of the questions of the validator was on how far 	<ul style="list-style-type: none"> Bantek SEA experts followed the advice of JICA Study Team.

Stage	Situation	JICA Assistance	Response of Bantek and Working Team
		the Bantek was involved with the Working Team.	
10-12. SEA Stage of RTRW Team (Alternatives, Recommendations and Public Consultation 2)	<ul style="list-style-type: none"> • Second Public Consultation was implemented without advanced provision of the information on the draft alternatives and recommendations • Second Public Consultation for SEA was planned together with Focus Group Discussion for RTRW. 	<ul style="list-style-type: none"> • Attended the consultation meeting and made record of discussion. • Provided technical assistance in preparation for the validation phase. 	<ul style="list-style-type: none"> • Bantek recorded the results of responses from the second public consultation. • Bantek made improvements in preparation for the validation phase.
5 – 12, SEA Stage of RDTR Team (Strategic sustainable development issues, priority SD Issues, PPP impact, alternatives, recommendations and public consultation 2)	<ul style="list-style-type: none"> • Stages 5-12 were covered just in 1 day, including the second public consultation. • Working Team involvement was limited to 1 day, only in the provision of input. • Working Team did not have time for discussion with the Bantek consultants. 	<ul style="list-style-type: none"> • Attended the consultation meeting and made record of discussion. • Provided technical assistance in preparation for the validation phase. 	<ul style="list-style-type: none"> • Bantek recorded the results of responses from the second public consultation. • Bantek made improvements in preparation for the validation phase.
15. SEA of RTRW Validation (Oct. 29)	<ul style="list-style-type: none"> • It was decided that the fulfilment of administrative requirements for SEA validation would follow the decision of validation to fast track the preparation of the RTRW. • Bantek was given 10 days after the validation meeting to improve the SEA documents based on the comments from the validation meeting. 	<ul style="list-style-type: none"> • Attended the validation meeting and made record of discussion. 	<ul style="list-style-type: none"> • Bantek would submit the following documents for approval of the Validator: revised SEA documents and administrative requirements for validation.
15. SEA of RDTR Validation (Nov. 19)	<ul style="list-style-type: none"> • It was decided that the fulfilment of administrative requirements for SEA validation would follow the decision of validation to fast track the preparation of the RDTR. • It was found that SEA needed to improve the level of detail according to the RDTR document; and SEA did not describe well aspects of participation of stakeholders and Working Team. 	<ul style="list-style-type: none"> • Attended the validation meeting and made record of discussion. 	<ul style="list-style-type: none"> • Bantek would submit the following documents for approval of the Validator: revised SEA documents and the administrative requirements for validation.

Source: JICA Study Team

5-5-5 Recommendations on the Process and Results of SEA for Spatial Planning

JICA Study Team made the following recommendations on the process and contents of the SEA for spatial planning.

- Discussion on comparison of alternatives should be promoted in the SEA process by following relevant laws, regulations and guidelines on spatial planning and SEA for spatial planning.
- The participation of a wide range of people, including women and youth, should be promoted in the processes of spatial planning and SEA.
- Various DRR measures proposed by the JICA Study Team should be incorporated in the spatial plans to reduce impacts of future development and mitigate disaster risk in society and the environment from the viewpoint of SEA.
- The number of people to be relocated should be minimized by applying the JICA Study Team's ZRB4 and ZRB3 areas inside the Coastal Buffer Zones set by ATR and Bantek consultants.

Chapter-6 Formulation of a Reference Manual (Guidelines) for Spatial Planning Based on Disaster Hazard and Risk Assessment

6-1 Background of Formulation of the Guidelines

In this technical assistance, a “Reference Manual (Guidelines) for Formulation of RTRW and RDTR Based on Disaster Hazard and Risk Assessment” was prepared, which summarizes the necessary contents and methodologies for formulating spatial plans that contribute to disaster risk reduction.

The current RTRW and RDTR guidelines for spatial planning (ATR Ministerial Decree No. 1/2018 and No. 16/2018) cover general items such as land use classification, infrastructure and urban facilities in planning; however, there is no detailed instruction or explanation of the analysis and setting of land use regulations for disaster hazard and high-risk areas such as landslides, floods, tsunamis and earthquakes. In terms of land use classification, the guidelines suggest that coastal areas and riverside areas with high disaster hazard and risks are designated as conservation areas, and areas with disaster risks in urbanized areas are designated as strategic areas. It also states that it is possible to determine specific land use for these areas with the building regulations in response to disasters such as seismic standards and a particular green cover ratio. However, due to the lack of sufficient explanations, it is difficult to analyze disaster hazards and risks and propose land use regulations according to the level of each disaster hazard and risk within a city, based on the current spatial planning guidelines. Therefore, the current spatial planning guidelines do not meet the need to prepare plans for areas with high risk of various disasters such as earthquakes, tsunamis, and volcanic eruptions.

To strengthen the effort to address disaster risk reduction in spatial planning, ATR prepared a draft version of the “Guidelines for Spatial Planning Based on Disaster Hazard and Risk” in 2019, and asked JICA Study Team to review it. Though the guidelines provide a framework to comprehensively address the five disaster hazards and risks in spatial planning, there is a need for improvement in the assessment of hazards and the setting of regulations in spatial plans for their implementation. Therefore, the JICA Study Team prepared a reference manual based on the draft guidelines of the ATR.

6-2 Review of the Guidelines for Spatial Planning

6-2-1 Review of the Existing Guidelines of Spatial Planning

(1) Review of the Guidelines for General Spatial Plans (RTRWs) for Province, Regencies, and Cities

The Guidelines for Formulation of General Spatial Plans (RTRWs) for Province, Regencies and Cities (ATR Ministerial Decree No. 1/2018) stipulate to conduct analysis of potential of natural disaster including landslides, floods, tsunamis, geological natural disasters and other natural disasters, and analysis of disaster risk reduction during the preparation of RTRWs.

In RTRWs, the land use is divided into protected areas and cultivated areas. It provides that high risk areas of disaster should be allocated as protected areas, and if the high risk area is not designated as protected area, disaster evacuation routes and spaces should be determined, and specific zoning

regulations can be applied, by overlying with a land use plan (see Table 6-1).⁷ A disaster prone area can be also designated as a strategic area. The Guidelines require to prepare a disaster prone map, which shows areas of high disaster risk, and the level of disaster risk is indicated by a color gradient.

Nevertheless, there is no detailed explanation or practical advice on the analysis of disaster risk or selection of disaster risk reduction measures, and how to determine the land use or zoning regulations for high disaster risk areas. Therefore, it is very difficult for local governments or consultants to formulate RTRWs that contribute to improved resilience of regencies or cities, based on the guidelines.

Table 6-1 Treatment of Disaster-Prone Areas in RTRWs

Protected Area	Cultivated Area
<ul style="list-style-type: none"> • Local protected areas for shorelines and river border: <ul style="list-style-type: none"> ➢ Tsunami disaster-prone areas • High disaster-prone areas, such as: <ul style="list-style-type: none"> ➢ Land movement-prone area, including land slide ➢ Volcano eruption-prone area; and/or ➢ Active fault in earthquake-prone area 	<ul style="list-style-type: none"> • Special provisions for disaster-prone areas in zoning regulations • Evacuation routes and space

Source: JICA Study Team based on ATR Ministerial Decree No. 1/2018

(2) Review of the Guidelines for Detailed Spatial Plans (RDTRs) for Regencies and Cities

According to the Guidelines on the formulation of Detailed Spatial Plans (RDTRs) for Regencies and Cities (ATR Ministerial Decree No. 16/2018), RDTR can specify disaster mitigation and adaptation measures, including climate change adaption and zoning regulations for disaster-prone areas, based on the RTRW and its general provision. In the zoning regulations, provisions of activity and land utilization (ITBX), building requirements such as seismic structure, a minimum green coverage ratio, and maximum building coverage ratio, can be determined for disaster-prone areas.

The guidelines provide the rules for setting coastal buffer zones, river buffer zones, and temporary and permanent evacuation sites. However, these setting rules for coastal and river buffer zones in RDTR are not necessarily based on the assessment of disaster hazard or risk of tsunami or flooding. Moreover, no rules or methodologies are described to determine land use and building regulations for disaster-prone zones, especially in cultivated areas. Thus, new guidelines are necessary to develop detailed spatial plan and to set up zoning regulations for disaster risk reduction.

Table 6-2 Planning Criteria for Coastal and River Buffer Zones in RDTR

Zone	Planning Criteria	Reference
Coastal Buffer Zone	The land along coastal line, which the width is proportional with the type and coastal physical condition, should be minimum of 100 meters from highest tide to the land. The calculation of coastal buffers must be adjusted with the character of topographic, biophysical, hydro-oceanography, coastal, socioeconomic needs, and other related provisions.	Presidential Regulation No. 51 / 2016 on Border of Coastal Setback
River Buffer Zone	For the non-embankment river, the riparian area is determined: <ul style="list-style-type: none"> (i) At least 10 meters from the left and right banks of trough along the river, while the depth of the river is less than or equal to 3 meters. (ii) At least 15 meters from the left and right bank of trough along the river, while the depth of the river is less than or equal to 20 meters. 	Minister of Public Works No. 28/PRT/M/2015 On Stipulation of Riparian Area and

⁷ The land use regulation accompanying RTRW is called the general provision or general zoning regulations (Ketentuan Umum Peraturan Zonasi or KUPZ), which defines basic land use policy. Zoning regulations (PZ) in RDTR provide detailed regulations of land use and building requirements.

	(iii) At least 30 meter from the left and right bank of trough along the river, while the depth of the river is less than or equal to 20 meters. For embankment river, the riparian area is determined at least 3 meters from the edge of the dike along the river.	Lake Border
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Source: ATR Ministerial Decree No. 16/2018 (unofficial translation).

6-2-2 Review of the Draft Guidelines for Spatial Plan Based on Disaster Risk Reduction

(1) Objectives and Overview of the Draft Guidelines

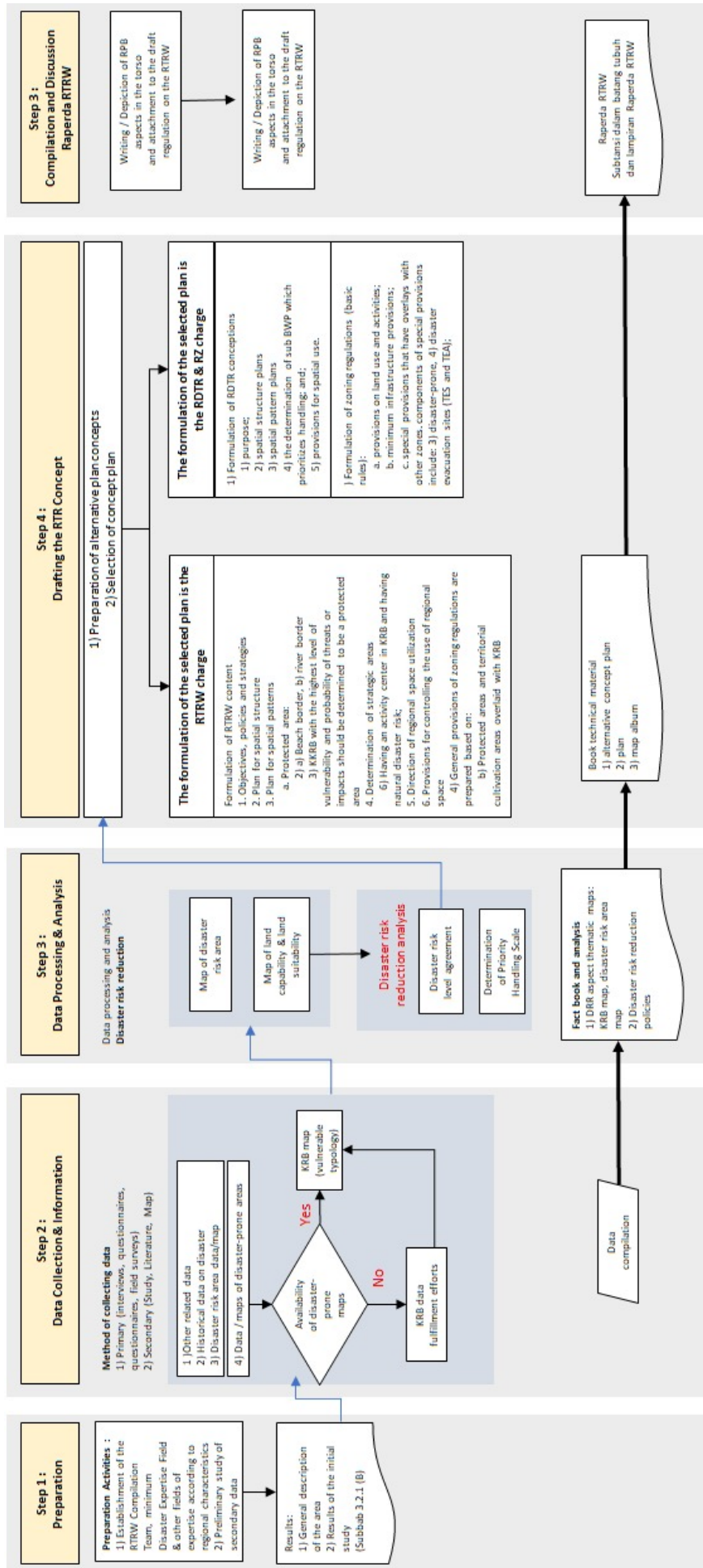
The draft “Guidelines for Spatial Plan Based on Disaster Risk Reduction” aims to improve the existing guidelines for preparing spatial plan related to disaster risk reduction by indicating the methodologies for disaster analysis, including data requirements and analysis and to strengthen the formulation of spatial plan for disaster risk reduction, including regulations on disaster-prone areas in RTRWs for provinces, regencies, and cities and RDTRs.

The guidelines cover mainly three components as follows:

- General provisions: understanding of disasters and the implications on spatial plan and basics in strengthening the spatial planning with disaster risk reduction provisions.
- Technical provisions: data collection, data analysis and formulation of spatial plans for disaster risk reduction.
- Planning procedures: involvement of stakeholders in the process of drafting spatial plans.

(2) Process of Spatial Planning Based Disaster Risk Reduction

The process of spatial plan formulation for disaster risk reduction is presented in Figure 6-1. Table 6-3 describes activities and expected outputs of each step.



Source: ATR. Draft Guidelines for Spatial Plan Based on Disaster Risk Reduction (unofficial translation)

Figure 6-1 The Process of Spatial Planning Based on Disaster Risk Reduction

Table 6-3 Steps and Outputs of Spatial Planning Based on Disaster Risk Reduction

No.	Stage	Disaster Risk Reduction Aspects	
		Activities	Expected outputs
1	Preparation	Understanding physical characteristics and disaster	1) The involvement of related disaster experts based on physical characteristics of the region 2) General description about region/area related to disaster area
2	Data & Information Collection	1) Collecting data/information about historical disasters 2) Data & map collection: disaster-prone areas, disasters risk and other relevant data 3) Effort to fulfil the needs of the data	1) Data and map compilation 2) Data of physical characteristics of the area 3) Data/nformation about historical disasters 4) A map of disaster-prone area 5) A map of disaster risk area
3	Data Processing and Analysis	Formulating the levels of disaster risk substance which agreed by stakeholders	1) Identification of disaster risk factors 2) Agreement of disaster risk level
4	Preparing the Concept of RTR	Formulation of DRR substance in RTR	DRR substance in RTR
5	Preparation and Discussion on Local Government Regulation (Perda)	Disaster risk reduction aspect in the draft of Raperda	1) Disaster-related items in the preparation of Perda 2) Related parties about disaster risk reduction involved in drafting of Perda

Source: ATR. Draft Guidelines for Spatial Plan Based on Disaster Risk Reduction (unofficial translation)

1) Disaster Data and Information

Disaster-related data and maps, including disaster hazard maps to be used for spatial planning, can be obtained from relevant agencies as follows:

- National Disaster Management Agency (BNPB) for all types of hazard maps
- Meteorology, Climatology and Geophysical Agency (BMKG), mainly for earthquake, tsunami and floods
- Center of Volcanology and Geological Hazard Mitigation (PVMBG-ESDM), mainly for earthquake, tsunamis, land moving, and the volcano
- River basin organization (Balai Besar Wilayah Sungai), the Ministry of Public Works and Public Housing, especially for floods map
- Research institutions or other relevant institutions in the field of disaster (BPPT, Lapan, LIPI, and universities)

Major data providers and validators are summarized by type of disaster hazard in Table 6-4. The additional data collection, such as historical disaster records, is suggested to improve hazard maps in cooperation with relevant authorities.

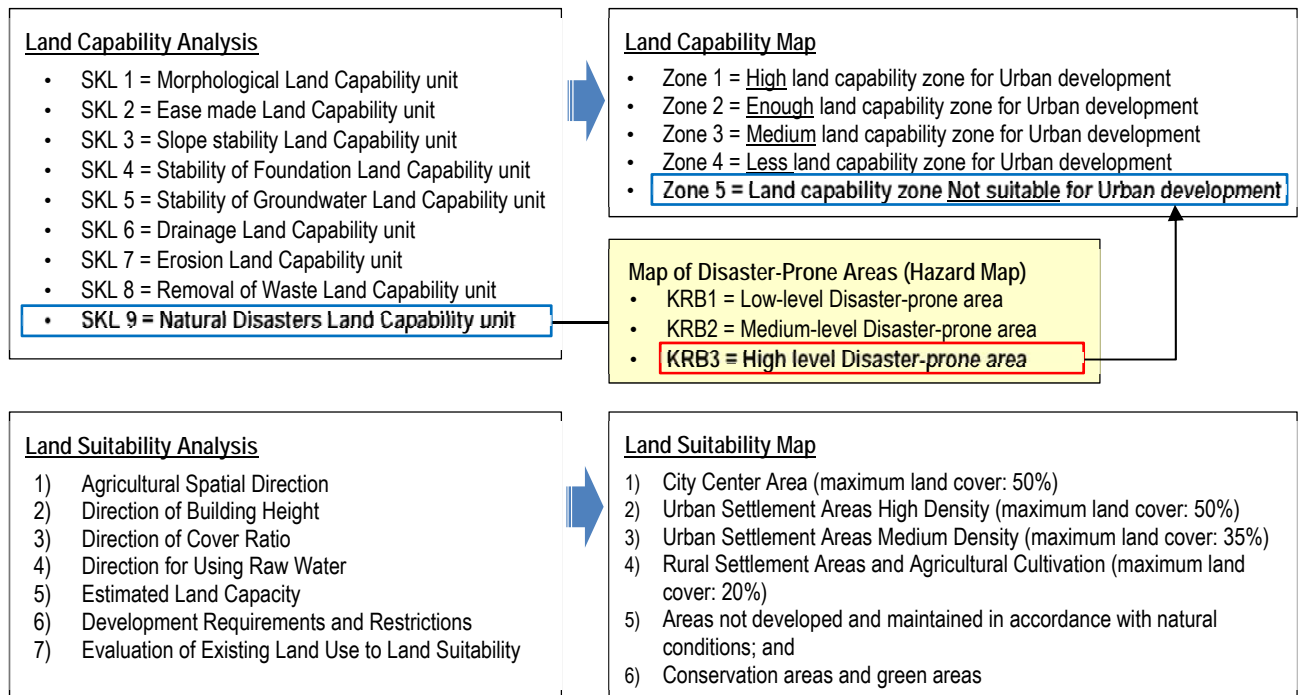
Table 6-4 Providers and Validators of Disaster-Related Data

No.	Type of Disaster Hazard	Data Providers	Data Validators
1.	Earthquake	BMKG, Pusgen, Universities	PVMBG, BG
2.	Tsunami	BMKG, Pusgen, Universities	PVMBG, BG
3.	Land Movement	BMKG, Pusgen, Universities	PVMBG, BG
4.	Volcanic	PVMBG, BG	
5.	Flood	PUPR, BMKG, BIG, Universities	PUPR (BBWS)

Source: ATR. Draft Guidelines for Spatial Plan Based on Disaster Risk Reduction (unofficial translation)

2) Data Processing and Analysis

To develop the spatial plan based on disaster risk reduction, land capability analysis and land suitability analysis are proposed in the Guidelines. Maps of disaster-prone areas or hazard maps are used as inputs for land capability analysis with the other data-related eight themes. As a result, land is classified into five zones in the analysis.



Source: ATR. Draft Guidelines for Spatial Plan Based on Disaster Risk Reduction (unofficial translation)

Figure 6-2 Land Capability Analysis and Land Suitability Analysis

Disaster-prone areas are categorized into three levels in accordance with the levels of hazard of each disaster. The disaster-prone areas with the high disaster risk (HRB 3) are designated as Zone 5 land capability zone not suitable for urban development, i.e., protected area in a land capability map. The other two disaster-prone areas with low and medium disaster risk are categorized into specific zones through land capability analysis. The Guidelines provide information of permissible land use, infrastructure and facilities by zone and type of disaster hazard in Group Attachments III: Technical Provision of DRR: The structure of space and the spatial plan.

The land use regulations with disaster risk reduction measures for the two zones are examined from evaluation of land capability analysis, land suitability analysis, existing land use, proposed vision, spatial structure, land use plans, and other factors, such as social, economic, institutional and financial aspects.

3) Formulation of Spatial Plan Based on Disaster Risk Reduction

Based on the data analysis, a spatial plan for disaster risk reduction is formulated. Table 6-5 summarizes disaster risk reduction substance reflected in the components of spatial plan.

In the section of policies and strategies, three approaches are considered in disaster risk reduction, relocation, adaptation and protection that contribute to reduction of risk and vulnerability and

improvement of capacity. Adaptation actions include engineering measures, improvement of building structures, as well as adoption of early warning system, among others.

Table 6-5 Disaster Risk Reduction Substance in Spatial Plans

Components of RTR	Disaster Risk Reduction Substance
1. Purpose	<ul style="list-style-type: none"> • Reflect disaster risk reduction efforts on financial aspect
2. Policies and Strategies	<ol style="list-style-type: none"> 1) Areas of protection/control 2) Establishment of the activities in disaster-prone areas 3) Development/Improvement of DRR infrastructure
3. Spatial Structure Plan (Infrastructure Development)	<ol style="list-style-type: none"> 1) Infrastructure systems for disaster risk reduction 2) Feasibility of components
4. Spatial Pattern Plan (Land Use)	<ol style="list-style-type: none"> 1) Protected Area: Disaster-prone areas (by disaster hazard type) 2) Cultivation Area: Feasibility of land use of disaster-prone areas (by disaster hazard type) 3) Evacuation space allocation, temporary shelter and relocation sites
5. Space Usage	<ul style="list-style-type: none"> • Indications of the structural mitigation program & non-structural mitigation
6. Control of Space usage	<ol style="list-style-type: none"> 1) Zoning regulation <ul style="list-style-type: none"> • Classification of disaster-prone zones and land use (Allowed, Allowed with condition, Not allowed) • Intensity of the space usage • Special Provision: Construction/Engineering requirements, condition of vegetation, etc. 2) Minimum infrastructure/ Facilities 3) Incentive-disincentive devices in restricted areas

Source: ATR. Draft Guidelines for Spatial Plan Based on Disaster Risk Reduction (unofficial translation)

Table 6-6 presents examples of infrastructure system for disaster risk reduction to be proposed in a spatial structure plan. To add specific land use regulations for disaster-prone areas, overlay zones corresponding to disaster-prone areas can be proposed with a specific code as shown in Table 6-7

. For each disaster-prone area, zoning regulations, including 1) land use activities (allowed/ allowed with conditions/ not allowed); 2) intensity of the land use; 3) minimum infrastructure and facilities; and 4) special provisions (provisions of engineering or building requirements, conditions of vegetation, etc.) can be determined additionally.

Table 6-6 Examples of Infrastructure Systems for Disaster Risk Reduction in a Spatial Structure Plan

No.	Hazard Type	Infrastructure Network System for Disaster Risk Reduction
1.	Earthquake	-
2.	Tsunami	Barrier and wave breaker
3.	Land moving (including landslides)	Building that anchors the avalanche
4.	Volcanic	Construction of lava control (dike)/'sabo'
5.	Flood	Flood Control Building (normalization, 'Sudetan', Embankment, folder system, pumps, channels, reservoirs/flood retention in outdoor flood, channel etc), terracing, dam, lake

Source: ATR. Draft Guidelines for Spatial Plan Based on Disaster Risk Reduction (unofficial translation)

Table 6-7 Overlay Code Based on Classification of Disaster-Prone Areas by Type of Disaster

No	Disaster	Classification of KRB (Disaster-Prone Areas)	Overlay Zoning Code	No	Disaster	Classification of KRB (Disaster-Prone Areas)	Overlay Zoning Code
1	Earthquake	High	G3	5	Flash flood	High	BB3
		Medium	G2			Medium	BB2
		Low-very low	G1			Low-very low	BB1
2	Tsunami	High	T3		River floods	High	BS3
		Medium	T2			Medium	BS2
		Low-very low	T1			Low-very low	BS1
3	Vulnerability Land Movement	High	L3		Coastal floods	High	BP3
		Medium	L2			Medium	BP2
		Low-very low	L1			Low-very low	BP1
4	Volcanic	High	GA3		City Flood	High	BK3
		Medium	GA2			Medium	BK2
		Low-very low	GA1			Low-very low	BK1

Source: ATR. Draft Guidelines for Spatial Plan Based on Disaster Risk Reduction (unofficial translation)

4) Public Consultation and Community Participation

The Guidelines state the importance of stakeholder involvement in spatial planning based on disaster risk reduction. The following stakeholders to be involved in the process are listed:

- Government and local governments as a compiler of the spatial plan
- Data Authorities to issue a map of disaster-prone areas
- Data Authority for mapping (Geospatial Information Agency or BIG); and
- Local citizens who are directly affected by the activities of spatial planning, institutions, academicians, and professional associations with interest in disaster studies.

The Guidelines underscore the needs of local citizens and community participation, to build “mutual agreement among stakeholders on an acceptable “Disaster Risk Level” by considering the potential of resources and economy as well as inputs from various aspects of the development plan.”⁸ In other words, a community consensus must be reached on the level of disaster that can be tolerated, to decide which level of disaster-prone areas can be used for cultivated areas and which level of disaster-prone areas should be regulated as protected areas, i.e., non-development zones. Furthermore, community participation is indispensable for relocation, as pointed out in Annex 21: The Criteria of Resettlement. In the proposed process, two public consultations involving communities are scheduled at the stages of data collection and selection of a concept plan.

(3) Hazard Map and Land Use Regulations

The Guidelines provide the classification of hazard levels and general recommendation on land use by disaster risk of earthquake, tsunami, earth movement (including landslides), volcanic risk, and flood. Hazard maps and disaster-related data and information are provided by relevant agencies as shown in Table 6-4. The Guidelines suggest three levels of hazard (high, medium, and low) to delineate areas on

⁸ ATR. Guidelines for Spatial Plan Based on Disaster Risk Reduction (draft) (unofficial translation). Table 17 Forms and Target of Activities to Strengthen Disaster Risk Reduction Substances in the Process of RTR Preparation, page 56.

hazard maps, and propose land use regulations for each level of hazard of different type accordingly.

As discussed in section 6-2-2 2) Data Processing and Analysis, High Risk Areas (high disaster-prone areas) are not recommended for cultivated areas but designated as protected areas. Medium and Low Risk Areas only are used, and these are categorized as cultivated areas. The Guidelines provide the general and special provisions for the disaster-prone areas by type of disaster hazard and hazard levels, including for protected areas and cultivated areas. The classification of disaster areas and suggested land use by disaster type are summarized in Table 6-8. An example of special provisions for tsunami disaster-prone areas is presented in Table 6-9.

Table 6-8 Classification of Disaster-Prone Areas and Suggested Land Use by Disaster Type

No.	Hazard Type	Disaster-Prone Areas	General Pattern of Land Use
1.	Earthquake	<ol style="list-style-type: none"> 1) High risk area: MMI > Scale VII, the acceleration of land > 0, 30 g 2) Medium risk area: MMI Scale V-VII, the acceleration of land 0,20 g-0, 30 g 3) Low risk area: MMI < Scale V, the acceleration of land < 0, 20 g 	<ul style="list-style-type: none"> • Disaster-prone areas can be used as residential areas with introduction of building codes
2.	Tsunami	<ol style="list-style-type: none"> 1) High risk area : inundation depth > 3 m 2) Medium risk area: inundation depth 1 m-3 m 3) Low risk area: inundation depth < 1 m 	<ol style="list-style-type: none"> 1) High risk areas are not recommended for residential or with engineering design (planting mangroves or retaining tsunami dike for run-up)
3.	Movement of Earth (including landslides)	<ol style="list-style-type: none"> 1) High risk area: a high vulnerability to earthworks occurred. Large earthworks to small frequent and tend to increase 2) Medium risk area: a mean susceptibility to earthworks occurred. The large or small soil movements may occur especially in frontier areas with the river valley, escarpment, cutting roads, cliffs, and disturbed slopes 3) Low risk area: rare earth movement, unless it gets disturbances in the slope, especially on the river bank 	<ol style="list-style-type: none"> 1) High risk area: 1) not used for settlements (conservation), if disturbs transportation, it needs geological engineering design, 2.) If it is high requirement, then buiding can be limited or the requirement of geotechnical and geology engineering should be met. 2) Medium risk area: Only used in limited or meet the requirement conditional (such as the high-motion area), limited and conditional cultivation activities 3) Low risk area: low cultivation activities, and can be used for residential and other cultivation activities.
4.	Volcanic	<ol style="list-style-type: none"> 1) High risk area: could be affected by hot cloud, lava flows, lava gutter, incandescent rocks, pebbles, and/or toxic gases. Often called the heat clouds ($V = 150-250 \text{ km/h}$; 300° to 500° c; in Merapi Mountain can be up to 15 km), the flow of lava, lava run-down, and pebbles while leaving incandescent rocks ($V = 5-10 \text{ m/HR}$; $600^\circ - 1000^\circ \text{ c}$), and/or toxic gases. Radius 'KRB' III 3-5 km 2) Medium risk area: potentially get hot clouds, lava flow, incandescent rocks, lava avalanches, heavy ash rain, hot mud rain, lava flows, and/or toxic gas). Radius 4-8 km (along the river flow/valley 12-15 km). 3) Low risk area: potentially get the run-off of lava, demolished falling materials, lava in the form of rain, and/or water with high acidity. When it enlarges, the eruption of this potentially effect to hot cloud and demolished the falling material as a thick ash, as well as leaving incandescent rocks. Radius > 10 km (along river flow/valley that has the upstream towards the peak of volcanic.) If the eruption is higher, this area can experience the explosion called the <i>heat clouds of expansion</i> and Ashes Plots. 	<ol style="list-style-type: none"> 1) High risk area is not recommended for residential use.
5.	Flood	<ol style="list-style-type: none"> 1) High risk area 2) Medium risk area 3) Low risk area Flood disaster risk - refers to SNI 8197: 2015	Effort for the restriction of land use in order to maintain balance of the ecosystem

Source: ATR. Draft Guidelines for Spatial Plan Based on Disaster Risk Reduction (unofficial translation)

Table 6-9 Special Provisions for Tsunami Disaster-Prone Areas by Level of Hazard

Disaster Prone Area	Intensity of Space Usage	Technical Requirements for Construction	Minimum Infrastructures/ Facilities	Vegetation	Licensing Requirements	Prohibited Activities
Low (T1)	<ul style="list-style-type: none"> The width of Open Green Space (RTH) in border of beach, at least 100 m from the highest tide Area with plants- approximately 90%-100%; Blocks of housing and public facilitation with low density (5-20%) 	<ul style="list-style-type: none"> Buildings with height above tsunami inundation height with reinforced poles or backs 		<ul style="list-style-type: none"> Plants suitable for coastal areas, such as mangroves, and others Local vegetation that has been tested for resilience and suitability in the coastal conditions 		
Medium (T2)	<ul style="list-style-type: none"> The width of RTH in border of beach is at least 100 m from the highest tide. Area with plants of approximately 90%-100% 	<ul style="list-style-type: none"> Buildings with height above tsunami inundation height with reinforced poles or backs New buildings designed as vertical evacuation spaces must have structures that can withstand tsunami forces and earthquake shocks Build forest, ditches, slopes, and berm specifically designed to resist debris caused by waves 	<ul style="list-style-type: none"> High building prepared with evaluation route and vertical evacuation space 	<ul style="list-style-type: none"> Plants suitable for coastal areas, such as mangroves, and others Local vegetation that has been tested for resilience and suitability in the coastal conditions 	<ul style="list-style-type: none"> Building licenses through technical recommendations from the experts with experiences in the fields of coastal and structural engineering 	<ul style="list-style-type: none"> Important facilities and infrastructures such as hospital, government office, police office, electricity/gas, etc. Hazardous facilities containing hard and chronic toxic materials, explosive or chemical substances
High (T3)	<ul style="list-style-type: none"> The width of RTH in border of beach is at least 100 m from the highest tide. Area with plants of approximately 90%-100% 	<ul style="list-style-type: none"> Existing building must be rebuilt with reinforced poles or backs above tsunami inundation height Build forest, ditches, slopes, and berm specifically designed to resist debris caused by waves 	<ul style="list-style-type: none"> Existing multi-story buildings are required to provide a vertical evacuation route and space with a building structure that can withstand tsunami forces and earthquake shocks 	<ul style="list-style-type: none"> Plants suitable for coastal areas, such as mangroves, and others Local vegetation that has been tested for resilience and suitability in the coastal conditions 		<ul style="list-style-type: none"> New development activities are not allowed.

Source: ATR. Guidelines for Spatial Plan Based on Disaster Risk Reduction (draft) (unofficial translation). Annex 24 Specific provisions of tsunami disaster-prone areas.

6-2-3 Issues with the Draft Guidelines

The Guidelines provide a comprehensive framework to formulate spatial planning based on disaster risk reduction, by clarifying necessary data and maps related to disaster, data analysis, disaster risk reduction measures, and general and spatial provisions for disaster-prone areas. There is, however, a need for improvement in the assessment of hazards and setting of regulations in spatial plans for their implementation since introducing regulations to control development of disaster-prone areas, such as relocation, could bring about socially and economically enormous impact on the community. The main issues with the draft Guidelines are listed below.

- There is no description of the difference of spatial planning in pre-disaster and post-disaster contexts.
 - Spatial planning process in post-disaster context significantly differs from the spatial planning process in pre-disaster context, in terms of time constraint, social and political pressures, community circumstances, etc. The peculiarity of post-disaster context that need special attention should be explained in the Guidelines, such as

trade-offs between speed and community participation, consensus building, transparency, and decision making in situations with limited data and information.⁹

- There is no explanation of the necessity and method of setting up “Non-Development Zones (Red Zones)” required in post-disaster context.
 - In the Guidelines, disaster-prone areas with high disaster risk (KRB 3) are designated as protected areas or non-development zones (red zones). The disaster-prone areas with high risk are determined based on hazard maps from relevant agencies. The determination of non-development zones is, however, a sensitive and controversial decision since all development activities are prohibited and relocation of residents is recommended. A consensus and acceptance of the community are indispensable to enforce the non-development zones. Failure to do so may result in legal disputes and compensation issues. The delineation of non-development zones should be adjusted to local situations by reflecting opinions of residents and the local government. Thus, more detailed explanations on the process and important considerations in establishing non-development zones should be added to the Guidelines.
- In non-development zones, it is necessary to relocate existing residents. However, there is no sufficient description of the importance of dialogue with residents for this purpose.
 - Although the importance of community involvement in relocation is briefly mentioned in the Guidelines, the need for dialogue with the residents should be given more emphasis with required actions and important concerns such as understanding of disaster hazard risk, possible disaster risk reduction measures, need for opinion survey, provision and development of relocation site, land ownership issue, and compensation. It is essential to understand that relocation will not be successful without a consensus and involvement of the residents.
- The Guidelines do not provide clear descriptions of what kind of structural measures for DRR should be taken for each disaster type. It does not address how to determine where to apply such structural measures for disaster reduction.
 - Structural measures for disaster risk reduction are not clearly specified for each disaster type. It might be difficult to select appropriate structural measures without sufficient information and available choices of structural measures in terms of characteristics, effectiveness, cost, maintenance and operation requirements, and necessary adjustments on regulations on land use and building structure. It should be noted that the installation of some structural measures, such as tsunami dikes, that could reduce disaster risks lead to the relaxation of land use regulations.

⁹ This topic is discussed in detail in Chapter 7.

- There is not enough explanation of land use regulations and building structure requirements as non-structured measures for DRR by disaster type and hazard level.
 - The Guidelines provide general and specific provisions on land use regulations and building structure requirements for each disaster type and hazard level. However, those regulations are not directly applied for particular disaster-prone areas, but for zones which are decided through land capability analysis. Thus, the process of determination of land use regulations is not straightforward and easily applicable. It is recommended to indicate clearly land use regulations and building structure requirements for each disaster type and hazard level directly applied to the disaster-prone areas.

6-3 Objectives of the Guidelines

The purpose of this draft guidelines is to outline methodologies, necessary analysis and planning contents of spatial plan based on the assessment of disaster hazard and risk supported by scientific analysis and data, in order to reduce disaster risk and promote the development of resilient cities and regions. Recently, studies and researches on disaster and recovery have progressed in Indonesia. Nevertheless, the methods and procedures to reflect the knowledge on disaster hazards and risks in spatial planning have not been well-organized yet, and the guidelines for spatial planning are not yet developed in this respect.

Therefore, based on the experiences and lessons learned from the activities in this technical cooperation project, such as surveys on disaster hazards and support for spatial planning in Palu City, Sigi Regency and Donggala Regency, the JICA Study Team came up with this draft reference manual. This “Draft Reference Manual for Spatial Planning and Formulation of RDTR Based on Disaster Hazard and Risk Assessment (Draft Guidelines)” compiled the methodologies for spatial planning based on disaster hazard and risk maps and the approach to set up land use regulations. It is intended to complement the existing spatial planning guidelines and strengthen the disaster risk reduction aspect of spatial planning.

Upon receipt of the draft guidelines, ATR will evaluate the contents and conduct revision to improve the guidelines.

6-4 Contents of the Guidelines

The draft Guidelines for spatial planning based on disaster hazard and risk is composed of the following:

- Chapter 1 INTRODUCTION
 - 1.1 Background and Objectives of the Guidelines
 - 1.2 Contents and Structure of the Guidelines
 - 1.3 Definition of ZRB and DRR
 - 1.4 Methodology in Spatial Planning Based on ZRB
- Chapter 2 SPATIAL PLANNING AND DRR
 - 2.1 General Understanding on DRR (Disaster Risk Reduction)
 - 2.2 Basic Approach for Formulation of Spatial Plan Based on ZRB
 - 2.3 Basic Principles for Formulation of Spatial Plan Based on ZRB
 - 2.4 Main Activities in the Formulation of Spatial Plans by Utilizing ZRB Maps
 - 2.5 Procedure of Spatial Planning Based on DRR
- Chapter 3 MAKING OF HAZARD MAP
 - 3.1 Collection of Data Related to Disasters and Hazards
 - 3.2 Formulation of Hazard Map
- Chapter 4 DISASTER RISK REDUCTION (DRR) ANALYSIS
 - 4.1 Data Collection for Formulation of Disaster Risk Maps
 - 4.2 Making of Disaster Risk Maps
 - 4.3 Disaster Risk Reduction Analysis with Mitigation Measures and Spatial Development Policy
- Chapter 5 MAKING OF ZRB MAP
 - 5.1 Policy for Setting ZRB Boundaries
 - 5.2 ZRB4 Boundary Set-up
 - 5.3 Transition Zones Set-up
 - 5.4 Buffer Zone Boundary Set-up
 - 5.5 ZRB Rank Change and Disaster Risk Mitigation Measures
- Chapter 6 ADDITIONAL REGULATIONS BASED ON ZRB
 - 6.1 Outline of Additional Regulations Based on ZRB
 - 6.2 Contents of Additional Regulations
- Chapter 7 METHOD FOR INTEGRATION OF STANDARD SPATIAL PLAN AND ZRB-BASED SPATIAL PLAN
 - 7.1 Overview of Method for Integration of Standard Spatial Plan and ZRB-Based Spatial Plan
 - 7.2 ZRB-Based ITBX Table
 - 7.3 Integration of “Standard ITBX Table” and “ZRB-based ITBX Table”
 - 7.4 Integration of “Standard Land Use Zoning Plan Map” and “Multi-Disaster Hazard Maps”
 - 7.5 Zoning Texts for Comprehensive ITBX Table

Chapter-7 Evaluation and Recommendations on the Spatial Plans Formulated by Local Governments and Approved by ATR

7-1 Introduction

This section presents the results of evaluation on the contents and planning processes of the following spatial plans that were revised and formulated for Palu City, Sigi Regency and Donggala Regency after the earthquake in September 2018. The evaluation was based on information obtained by the JICA Study Team through the spatial planning support activities (Output 2 activities) in this technical cooperation.

- Palu City RTRW
- RDTRs in Palu City
- Sigi Regency RTRW
- Bora RDTR in Sigi Regency
- Banawa RDTR in Donggala Regency

7-2 Viewpoints for Evaluation

The spatial plans formulated after the earthquake were evaluated from viewpoints based on the concepts and ideas of BBB, DRR, and resilience presented in “Master Plan for Recovery and Reconstruction in Central Sulawesi Province” and “Sendai Framework for Disaster Reduction 2015-2030” as follows:

- Will BBB be realized by implementing “the spatial plans integrating DRR”? (Does it increase resilience?)”, “Are the DRR measures effective in increasing resilience?”
- To answer the above questions, the evaluations were conducted based on the following four perspectives.
 - Is DRR integrated into the spatial plan? What kind of DRR measures are integrated into the spatial plans?
 - Are the “information on disaster hazards and risks” used to develop DRR measures in the spatial planning process scientifically examined?
 - Are the DRR measures incorporated in the spatial plans financially feasible for the government?
 - Are the DRR measures incorporated in the spatial plan acceptable to the people? Was the spatial plan with DRR measures developed with community participation? Is the developed “spatial plan with DRR measures” realistic and acceptable to the community?

7-3 Evaluation of the Contents of Spatial Plans and Planning Process in Palu City, Sigi Regency and Donggala Regency¹⁰

7-3-1 Evaluation of the Contents and Planning Process of RTRW for Palu City

Viewpoints on the Evaluation	Evaluation Results
<p>➤ <u>Viewpoints on the Overall Evaluation:</u> Will the BBB be realized by implementing the formulated “spatial plan integrating DRR”? Will it increase resilience? Will the DRR measures proposed in the plan be effective in increasing resilience?</p>	<p><u>Overall Evaluation</u></p> <ul style="list-style-type: none"> • The RDTRs were formulated for the entire Palu City along with the RTRW. Though the DRR measures are included in the Palu City RTRW, there are no detailed descriptions of these; only in the RDTRs. Hence, resilience of Palu City is expected to be enhanced by implementing the Palu City RTRW together with the RDTRs. • The evaluation of effectiveness of the DRR measures is examined in “Evaluation of the Contents and Planning Process of the RDTRs.”
<p>➤ Are DRR measures integrated into the spatial plan? What kind of DRR measures are integrated into the spatial plans?</p>	<p><u>DRR by Land use planning and land use regulation</u></p> <ul style="list-style-type: none"> • The land use plan map (1/25,000) of the RTRW for Palu City indicates the major land use categories and designates the ZRB4 areas as disaster risk areas for each disaster type according to the ZRB Map October 2019 Version by ATR, as follows. • Since the RTRW land use map presents the disaster hazard areas and the major land use categories separately, it is necessary to overlay the land use categories on the ZRB map to clearly indicate the disaster hazard and regulations. • <u>Tsunami ZRB4 Area / Coastal Buffer Zone: Sempadan Pantai</u> : In principle, only certain facilities should be allowed in a non-development zone. However, residential and commercial buildings are allowed according to the land use classification, provided that they have structural requirements that can resist coastal hazards and have a minimum green cover of 70% and a maximum building coverage of 30%. • <u>Flood ZRB4 Area / River Buffer Zone: Sempadan Sengai</u> • <u>Nalodo ZRB4 Area:</u> Although classified as urban green open space on the land use plan map, the proposed local regulation allows the construction of buildings with structural requirements resistant against disasters, a minimum green coverage of 70% and a maximum building coverage of 30%. • <u>Landslide ZRB4 Area / Landslide Disaster Risk Zone</u> • <u>Active Fault ZRB4 Area / Active Fault Buffer Zone</u> : According to the local regulation, residential and commercial building construction is allowed according to the land use classification, as long as the building has disaster-response structure, a minimum green coverage of 70% and a maximum building coverage of 30%. In addition, certain facilities are allowed to be constructed. • ZRB3, ZRB2, and ZRB1 areas are not marked on the land use plan map and are not mentioned in the general provision. They are to be regulated in the RDTRs developed for the entire Palu City.

¹⁰ The latest contents of the spatial plans which were obtained by the JICA Study Team by the end of February in 2020 were evaluated in this section.

Viewpoints on the Evaluation	Evaluation Results
	<p><u>Structural Measures for DRR</u></p> <ul style="list-style-type: none"> The Palu City RTRW describes five types of infrastructure development programs for disaster-prone areas. One of them is an infrastructure project for disaster mitigation, but there are no details on what kind of structural measures are to be proposed. The RDTRs, which cover the entire Palu City area, are supposed to examine and define the programs.
➤ Is the “information on disaster hazards and risks” used to develop DRR measures in the spatial planning process scientifically examined?	<ul style="list-style-type: none"> This is examined in “Evaluation of the contents and planning process of the RDTRs.”
➤ Are the DRR measures incorporated in the spatial plans financially feasible for the government?	<ul style="list-style-type: none"> This is examined in “Evaluation of the contents and planning process of the RDTRs.”
➤ Are the DRR measures incorporated in the spatial plan acceptable to the people? Was the spatial plan with DRR measures developed with community participation? Is the developed “spatial plan with DRR measures” realistic and acceptable to the community?	<ul style="list-style-type: none"> This is examined in “Evaluation of the contents and planning process of the RDTRs.”

Source : JICA Study Team

7-3-2 Evaluation of the Contents and Planning Process of RDTRs for Palu City

Viewpoints on the Evaluation	Evaluation Results
<p>➤ <u>Viewpoints on the Overall Evaluation:</u> Will the BBB be realized by implementing the formulated “spatial plan integrating DRR”? Will it increase resilience? Will the DRR measures proposed in the plan be effective in increasing resilience?</p>	<p><u>Overall Evaluation</u></p> <ul style="list-style-type: none"> The coastal buffer zone (100 meters from the shoreline) is used as the ZRB 4 area in the tsunami ZRB map utilized in the RDTRs for Palu City, which is not necessarily formulated based on scientific evidence. It is a challenge to enhance tsunami disaster resilience in the tsunami-affected areas due to various problems on DRR implementation caused by land use regulations and building structure requirement regulations. However, if the coastal elevated road is constructed, the tsunami hazard level in the ZRB 3 areas inland from the road will be lowered, thus increasing the tsunami disaster resilience in the areas. The resilience of Petobo area to Nalodo disaster can be improved by rehabilitating the Gumbasa irrigation system, lining its main channel, monitoring the groundwater level in the area around the system, and managing the irrigation water volume.
<p>➤ Are DRR measures integrated into the spatial plan? What kind of DRR measures are integrated into</p>	<p><u>DRR of tsunami by land use planning and land use regulations</u></p>

Viewpoints on the Evaluation	Evaluation Results
<p>the spatial plans?</p>	<ul style="list-style-type: none"> • The tsunami ZRB4 areas are designated as coastal buffer zones, with a width of 100 meters from the coastline, where relocation of houses is strongly recommended. • Within the coastal buffer zones, buildings with a green cover ratio of 70% or more and a building coverage ratio of 30% or less can be used for various purposes such as restaurants, supermarkets, shopping centers, stores, financial institutions, fitness centers, real estate agencies, guest houses, budget hotels, etc. (This is conditionally permitted building use in the ITBX matrix). • The 100-meter wide coastal buffer zones include areas of very high tsunami disaster risk where the inundation depth of the recent tsunami exceeded 3 meters and areas of next highest tsunami disaster risk where the inundation depth of the recent tsunami was between 1 and 3 meters. • The coastal buffer zones should be established as an area where no development of any kind is allowed. However, since the buffer zones contain a mixture of all ZRB4, ZRB3, and ZRB2 areas, implementing uniform regulations would not improve the resilience of this zone. <p><u>DRR by Structural Measures (Tsunami)</u></p> <ul style="list-style-type: none"> • The RDTRs include the construction of an "elevated road" (about 4 km long) in the southern coastal area of Palu Bay. However, ATR's policy is not to change (reduce) the area of the coastal buffer zones until the elevated road is constructed. In addition, there is no policy on what to do with the ZRB category of the areas of the inland side of the elevated road (whether to keep it as ZRB4 area, lower it to ZRB3 or ZRB2). <p><u>DRR by Structural Measures (Nalodo)</u></p> <ul style="list-style-type: none"> • Petobo area, located in the southeast of Palu City, is considered to have experienced the Nalodo disaster due to the high groundwater level, partly caused by the irrigation water brought by the Gumbasa Irrigation System. • Important structural measures for DRR in Petobo include the concrete lining of the inner side of the main channel to prevent water infiltration from the main channel into the groundwater layer in the rehabilitation of the Gumbasa Irrigation System in Sigi Regency • The risk of Nalodo occurrence is reduced by monitoring the groundwater level in the surrounding areas of the Gumbasa irrigation system and adjusting the groundwater level so that it does not go above a certain height by reducing the amount of irrigation water from the Gumbasa irrigation system if necessary. • This groundwater monitoring will also need to be done in and around Petobo area in Palu, to provide input for the adjustment of irrigation water volume for the Gumbasa irrigation system on the Sigi Regency side. <p><u>Restricting land use and restraining infrastructure development as Nalodo's DRR</u></p> <ul style="list-style-type: none"> • A large ZRB3 area of Nalodo stretches to the west of Palu City in the Balaroa area and to the south of the Balaroa area. In ZRB3 area, no new construction of houses or important public facilities is allowed. The residential use

Viewpoints on the Evaluation	Evaluation Results
	<p>has been considered for the south of the Balaroa area; however, due to the Nalodo disaster hazard, it is important to have DRR measures that provide disincentives to control development by withholding access roads, power supply, and water supply to the area.</p> <ul style="list-style-type: none"> The DRR measures have not yet been incorporated in the RDTRs for Palu City in a clear manner.
<p>➤ Is the “information on disaster hazards and risks” used to develop DRR measures in the spatial planning process scientifically examined?</p>	<ul style="list-style-type: none"> The RDTRs for Palu City are formulated based on ATR’s ZRB Map October 2019 Version. The scientific basis of this ZRB map is weak in some points. <p><u>Tsunami ZRB map</u></p> <ul style="list-style-type: none"> The areas up to 100 meters from the shoreline are designated as tsunami ZRB4 areas, which are much larger than the areas that recorded 3-meter inundation depth obtained from the trace survey of the current tsunami. As a result, the areas where there are many buildings that were not severely damaged by the tsunami (“no damage” or “partial damage”) are also designated as coastal buffer zones, and relocation of houses is strongly recommended. Non-residential buildings located within the coastal buffer zones can be used as evacuation shelters or meeting points by satisfying the new disaster safety and disaster risk mitigation guidelines. <p><u>Nalodo ZRB Map</u></p> <ul style="list-style-type: none"> The Geological Agency (BG) and JICA Study Team discussed and coordinated on the basis of scientific evidence and decided to adopt the Nalodo ZRB map prepared by the BG. On the other hand, the Nalodo ZRB4 boundary line adopted by ATR in the Map October 2019 Version is based on the pegs placed by the BG after observing the ground flexures and distortions in the field, and that boundary is not suitable for the boundary of the ZRB4 area (the boundary to divide the ZRB3 and ZRB4 areas), according to the BG. The Nalodo ZRB4 areas set by ATR are slightly larger than the areas by JICA Study Team and the BG. The ATR seemed to be aiming to ensure resilience by setting larger ZRB4 areas and promoting resettlement.
<p>➤ Are the DRR measures incorporated in the spatial plans financially feasible for the government?</p>	<ul style="list-style-type: none"> The tsunami DRR measure, “coastal elevated roads” indicated in the RDTRs will be implemented with JICA assistance. The DRR measures for Nalodo, such as rehabilitation of Gumbasa irrigation system, lining of main canal and development of drainage of irrigation water in Sigi district, will be implemented with ADB and JICA assistance.
<p>➤ Are the DRR measures incorporated in the spatial plan acceptable to the people? Was the spatial plan with DRR measures developed with community participation? Is the developed “spatial plan with DRR measures” realistic and acceptable to the community?</p>	<ul style="list-style-type: none"> In the planning process of the RDTRs for Palu City, Focus Group Discussion (FGD) and Public Consultations (PC) were held along the stages of planning. The FGD meetings were attended by relevant government officials, while the PCs were attended by university researchers and NGOs in addition to the government officials (but only heads of subdistricts or kecamatan). Even at PC meetings, there was no participation of the representatives of the community or the residents themselves. This seems to be standard

Viewpoints on the Evaluation	Evaluation Results
	<p>practice in the spatial planning process that has been conducted for many years.</p> <ul style="list-style-type: none"> • Under these circumstances, it can be said that the residents had little opportunity to get direct information from the government agencies about the ZRB map and the contents of the spatial plans. This point was also confirmed in the community dialogues (held in six locations in Palu City for 236 participants) conducted by the JICA Study Team with the Spatial Planning Bureau in the tsunami and Nalodo-affected areas in June 2019. • As mentioned above, the content of the ZRB maps and spatial plans (land use regulations and building structure requirements in ZRB4 and ZRB3 areas) have not been sufficiently explained to the residents. The strict regulations and the seismic standards (SNI 1726) to be applied to reconstruction of buildings in 100-meter wide coastal buffer zones, which are for DRR of tsunami, and in the ZRB3 areas for all disaster types will not be easily accepted by the residents. In particular, since many areas in the 100-meter-wide coastal buffer zones were not severely damaged by the tsunami, residents in the zones will continue to live in their original houses, although they will secure the right to a permanent relocation site. But relocation will not be realized.

Source : JICA Study Team

7-3-3 Evaluation of the Contents and Planning Process of Sigi Regency RTRW

Viewpoints on the Evaluation	Evaluation Results
<p>➤ <u>Viewpoints on the Overall Evaluation:</u> Will the BBB be realized by implementing the formulated “spatial plan integrating DRR”? Will it increase resilience? Will the DRR measures proposed in the plan be effective in increasing resilience?</p>	<p><u>Overall Evaluation</u></p> <ul style="list-style-type: none"> • In the RTRW of Sigi Regency, the land use regulations are proposed for ZRB 4 areas only. Because the Sigi RTRW does not indicate the locations and land use regulations for ZRB 3, ZRB 2, and ZRB 1 areas, resilience in Sigi Regency would not be sufficiently enhanced by the RTRW alone. However, at the same time, the Bora RDTR was prepared. The discussion on the land use regulations to improve resilience is presented in one section of the Bora RDTR. • On the other hand, the proposed DRR structural measures for Nalodo are limited to the planning area of the Bora RDTR, which does not necessarily improve the resilience of Nalodo risk areas throughout Sigi Regency.
<p>➤ Are DRR measures integrated into the spatial plan? What kind of DRR measures are integrated into the spatial plans?</p>	<p><u>DRR by land use planning (Induction of Urban Land Use)</u></p> <ul style="list-style-type: none"> • The ZRB3 area is stretched out in the target area of the Bora RDTR, and set up the land use plan to induce urban use in the ZRB2 and ZRB1 areas other than the ZRB3 area. <p><u>DRR by land use regulations</u></p> <ul style="list-style-type: none"> • The land use plan map of the Sigi Regency RTRW shows the disaster risk areas (ZRB4 areas) of Nalodo, active faults, landslides, and floods overlaid on the main land use categories. • The RTRW indicates the land use regulations only for ZRB4 areas of different disaster types.

Viewpoints on the Evaluation	Evaluation Results
	<p><u>DRR by Structural Measures (Nalodo)</u></p> <ul style="list-style-type: none"> • While rehabilitating the Gumbasa irrigation system, the inner side of the main channel will be lined with concrete to prevent water infiltration from the main channel into the groundwater layer. • The groundwater level will be monitored in the surrounding areas of the Gumbasa irrigation system and if necessary, the amount of irrigation water from the irrigation system will be reduced to adjust the groundwater level so that it does not rise above a certain height. The risk of Nalodo occurrence will be reduced by taking these measures. • The amount of irrigation water in the main channel will be adjusted by draining the irrigation water to the Paneki River. For this purpose, the river channel of the Paneki will be improved.
➤ Is the “information on disaster hazards and risks” used to develop DRR measures in the spatial planning process scientifically examined?	• This is examined in “Evaluation of the contents and planning process of the Bora RDTR in Sigi Regency.”
➤ Are the DRR measures incorporated in the spatial plans financially feasible for the government?	• This is examined in “Evaluation of the contents and planning process of the Bora RDTR in Sigi Regency.”
➤ Are the DRR measures incorporated in the spatial plan acceptable to the people? Was the spatial plan with DRR measures developed with community participation? Is the developed “spatial plan with DRR measures” realistic and acceptable to the community?	• This is examined in “Evaluation of the contents and planning process of the Bora RDTR in Sigi Regency.”

Source : JICA Study Team

7-3-4 Evaluation of the Contents and Planning Process of Bora RDTR in Sigi Regency

Viewpoints on the Evaluation	Evaluation Results
<p>➤ <u>Viewpoints on the Overall Evaluation:</u> Will the BBB be realized by implementing the formulated “spatial plan integrating DRR”? Will it increase resilience? Will the DRR measures proposed in the plan be effective in increasing resilience?</p>	<p><u>Overall Evaluation</u></p> <ul style="list-style-type: none"> • The Bora RDTR in Sigi Regency includes structural measures for DRR, land use regulations, and building structure requirement regulations for high risk areas of liquefaction landslides (Nalodo). Disaster resilience is expected to increase if these measures are carried out properly. • However, since the ZRB 4 and ZRB 3 areas are designated a little wider than those shown on the ZRB map created by the JICA Study Team based on scientific methods and evidence, it may not be possible for the local government to obtain sufficient agreement with the residents of said areas. There is also the possibility that the induction of development in disaster-safe areas will not progress very

	<p>well as expected. As a result, disaster resilience may not improve.</p> <ul style="list-style-type: none"> • Therefore, residents’ understanding and agreement on regulations for ZRB areas and DDR structural measures are needed to increase disaster resilience in target areas.
<p>➤ Are DRR measures integrated into the spatial plan? What kind of DRR measures are integrated into the spatial plans?</p>	<p><u>DRR by Land Use Plans (Induction of Urban Land Use)</u></p> <ul style="list-style-type: none"> • Bora RDTR includes a policy to induce development in ZRB2 areas and ZRB1 areas, avoiding ZRB4 areas and ZRB3 areas in order to accommodate urban sprawl from Palu City and urbanization in Sigi Regency. • In order to induce urban land use, it is necessary to develop access roads, electricity supply, and water supply infrastructure in addition to the formulation of land use plans. <p><u>DRR by Land Use Regulations</u></p> <ul style="list-style-type: none"> • In ZRB3 areas, the reconstruction of residential buildings, important facilities, dangerous facilities, and other buildings is permitted, but new construction of those buildings is not permitted. <p><u>DRR by Structural Measures against Nalodo</u></p> <ul style="list-style-type: none"> • During the restoration of the Gumbasa irrigation system, the inside of the main canal should be lined with concrete to prevent water infiltration from the main canal into the groundwater layer. • It is necessary to monitor the groundwater level around the Gumbasa irrigation system, and adjust/reduce the amount of irrigation water from the Gumbasa irrigation system in order to keep the groundwater level below a certain level and reduce the risk of Nalodo outbreaks. • The amount of irrigation water in the main canal should be adjusted by draining the irrigation water to the Paneki River. For that purpose, the channel of the Paneki River should be improved.
<p>➤ Were the “information on disaster hazards and risks” used to develop DRR measures in the spatial planning process scientifically examined?</p>	<p><u>Nalodo ZRB Map</u></p> <ul style="list-style-type: none"> • Indonesia's Geological Agency (BG) and JICA Study Team decided to adopt a Nalodo ZRB Map created by BG after consultation and coordination based on scientific grounds. • On the other hand, the Nalodo ZRB4 boundaries adopted by ATR in October 2019 were based on piles struck by the Geological Agency by observing the distortion of the ground. However, its boundaries are not suitable as ZRB4 boundaries, according to the Geological Agency. • The Nalodo ZRB4 areas adopted by ATR are slightly larger than the areas designated by JICA Study Team and BG. Therefore, the ZRB4 areas of ATR in Jono Oge, Lolu and Sibalaya areas of Sigi Regency contain 135 undamaged or partially damaged buildings. On the other hand, there are only 18 undamaged or partially damaged buildings in the ZRB4 areas by the JICA Study Team and BG. • ATR seems to be aiming to increase resilience by setting the ZRB4 areas to a large size and relocating residents. However, ATR's ZRB map, which encourages residents of buildings that have not been or only partially damaged by the last Nalodo disaster to relocate, is considered to be less socially acceptable.

<p>➤ Are the DRR measures incorporated in the spatial plans financially feasible for the government?</p>	<ul style="list-style-type: none"> • In order to induce urban land uses in ZRB2 areas and ZRB1 areas by avoiding Nalodo's ZRB4 and ZRB3 areas, infrastructure development, especially access roads, is important. However, since the proposed roads are not national roads, it is difficult to get development budget for implementation. • Restoration and improvement of Gumbasa irrigation system and introduction of groundwater monitoring system will be supported by ADB, JICA and the Indonesian government.
<p>➤ Are the DRR measures incorporated in the spatial plan acceptable to the people? Was the spatial plan with DRR measures developed with community participation? Is the developed “spatial plan with DRR measures” realistic and acceptable to the community?</p>	<ul style="list-style-type: none"> • Focus Group Discussion (FGD) meetings and Public Consultation (PC) meetings were held at a series of spatial planning stages in the formulation of Bora RDTR in Sigi Regency. FGD meetings will be attended by relevant government officials. In addition, PC meetings were attended by university researchers and NGOs. However, only heads of subdistricts (Kecamatan), an administrative organization at the lower level of the Regency, were able to attend those meetings. In other words, there was no participation of residents’ representatives or residents themselves in PC meetings. Such participants are specified for the official spatial planning process. • From the above, it can be said that there were few opportunities for residents to directly obtain information from the government agencies regarding the contents of the ZRB maps and spatial plans. This was also confirmed in community dialogues (held at two locations in Sigi Regency for 126 participants) conducted by the JICA Study Team with the Sigi Regency Public Works Department in July 2019 in the Nalodo disaster-affected areas. • Also, in the target areas of Bora RDTR (widely occupied by Nalodo ZRB3 areas), residential buildings, important facilities, dangerous facilities, and other buildings are allowed to be rebuilt, but no new construction of buildings is allowed. So, it is expected that local economy might decline. Therefore, those land use regulations might not be acceptable to the residents and landowners in those ZRB3 areas.

Source : JICA Study Team

7-3-5 Evaluation of the Contents and Planning Process of Banawa RDTRs in Donggala Regency

Viewpoints on the Evaluation	Evaluation Results
<p>➤ <u>Viewpoints on the Overall Evaluation:</u> Will the BBB be realized by implementing the formulated “spatial plan integrating DRR”? Will it increase resilience? Will the DRR measures proposed in the plan be effective in increasing resilience?</p>	<p><u>Overall Evaluation</u></p> <ul style="list-style-type: none"> • The coastal buffer zones are set with a uniform width of 100 meters from the coastline, which are designated as ZRB 4 areas (non-development zones). Relocation of residents is required in the coastal buffer zones. • There are no areas that exceed the inundation depth (3 meters) of the last tsunami along the coast of Banawa area. They should be designated as a zone of ZRB 3 or less. In those areas, different land use regulations and building structure requirements should have been set depending on hazard levels, and more detailed DRR measures are applied. However, since such DRR measures are not incorporated in the formulated spatial plan, it is considered that the disaster resilience of the coastal areas might not be enhanced by the

	<p>implementation of this spatial plan.</p> <ul style="list-style-type: none"> The spatial plan includes development of a new airport and a new administrative center in an inland area, which could lead to increased resilience in the medium to long term (in 10-20 years).
<p>➤ Are DRR measures integrated in the spatial plan? What kind of DRR measures are integrated in the spatial plans?</p>	<p><u>DRR by Land Use Planning and Land Use Regulations</u></p> <ul style="list-style-type: none"> The coastal buffer zone is set 100 m wide from the coastline. There are no coastal areas in the Banawa area where the inundation depth of this tsunami exceeds 3 m. ZRB4 areas should not be set, from the viewpoint of disaster hazard, in these coastal areas. But ZRB4 areas are set in accordance with Presidential Decree (No.51 / 2016). Although many buildings have not been severely damaged by the last tsunami, the formulated Banawa RDTR strongly recommends to relocate residential buildings from the 100 m wide coastal buffer zones, but not many people will feel the need to relocate their residences due to disaster risk. Existing residents and businesses will have difficulty in complying with land use regulations and building requirements provided in the formulated spatial plan. As a result, disaster resilience in the region might not improve. The administrative center of the Banawa district (the capital of Donggala) will be relocated from the side facing Palu Bay to an inland area. The spatial plan is intended to develop a new Donggala airport, residential areas, commercial areas and parks. <p><u>DRR by Structural Measures</u></p> <ul style="list-style-type: none"> No structure measures for DRR have been proposed.
<p>➤ Were the “information on disaster hazards and risks” used to develop DRR measures in the spatial planning process scientifically examined?</p>	<p><u>Tsunami ZRB Map</u></p> <ul style="list-style-type: none"> The Tsunami ZRB4 boundaries are drawn 100m wide from the coastline, far exceeding the 3m inundation depth ranges obtained from the trace survey of the last tsunami. As a result, the areas where many buildings have not been severely damaged by the tsunami are also designated as part of the coastal buffer zones, and the relocation of residential buildings is strongly recommended.
<p>➤ Are the DRR measures incorporated in the spatial plans financially feasible for the government?</p>	<ul style="list-style-type: none"> The formulated spatial plan includes a plan to build a new administrative center in the Banawa district (the capital of Donggala Regency) in an inland location. The budget for infrastructure provision to develop this new administrative center cannot be easily secured from the development budgets of Donggala Regency Government and Central Sulawesi Provincial Government. This new administrative center project will be implemented in the medium to long term (in 10-20 years).
<p>➤ Are the DRR measures incorporated in the spatial plan acceptable to the people? Was the spatial plan with DRR measures developed with community participation? Is the developed “spatial plan with DRR measures” realistic and acceptable to the community?</p>	<ul style="list-style-type: none"> Focus Group Discussion (FGD) meetings and Public Consultation (PC) meetings were held at a series of spatial planning stages in the formulation of Banawa RDTR in Donggala Regency. FGD meetings will be attended by relevant government officials. In addition, PC meetings were attended by university researchers and NGOs. However, only heads of Districts (Kecamatan), an administrative organization at the lower level of the Regency, could attend those meetings. In other words, there was no participation of residents' representatives or residents themselves in PC meetings. Such participants are specified

	<p>for the holding of official spatial planning process.</p> <ul style="list-style-type: none"> • From the above, it can be said that there were few opportunities for residents to directly obtain information from the government agencies regarding the contents of the ZRB maps and spatial plans. • Also, since the coastal areas of the Banawa area have been largely unaffected by the last tsunami, residents and land owners in the designated coastal buffer zones will find it unacceptable to be strongly advised to relocate their residences.
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Source : JICA Study Team

7-4 Recommendations on the Spatial Plans Formulated by Local Governments and Approved by ATR¹¹

7-4-1 Recommendation for Palu City RTRW, Palu City RDTR, and Donggala Banawa RDTR: ZRB Map to Mitigate Tsunami Disaster

It is strongly recommended to create and utilize a Tsunami ZRB Map that takes into account scientific analysis and social impact when formulating Palu City RTRW, Palu City RDTRs, and Donggala Banawa RDTR. The October 2019 ZRB Map (ZRB map covering Palu City and its surroundings) was used as the basis for the formulation of spatial plans of the three local governments. In the Tsunami ZRB Map, coastal buffer zones, which is the belt-shaped areas of 100-meter width from the coastline, are designated as the Tsunami ZRB 4 areas. However, they are not based on scientific evidence, such as ground height, seafloor topography, and the results of any tsunami trace surveys.

In the ZRB 4 areas where the hazard level is the highest, housing relocation is recommended; and in the ZRB 3 areas where the hazard level is the next highest, regulations with strong land use and building structure requirements are proposed. It is important to set the regulation contents to be based on scientific evidence, as well as these to be socially acceptable. ZRB maps with such characteristics should be prepared and utilized for spatial planning. (This is equally important in the preparation of Nalodo ZRB Maps.)

On the other hand, regarding the designation of the coastal buffer zones, the width of 100 meters from the coastline is set as the buffer zone based on the Presidential Decree No. 51 / 2016 and the Decree of the Minister of Marine Affairs and Fisheries No. 21 / 2018. It is recommended that land use regulations and building structural requirements in line with scientifically developed and socially acceptable ZRB maps (consisting of ZRB 4 areas, ZRB 3 areas, and ZRB 2 areas) be specified inside the coastal buffer zones.

7-4-2 Recommendation for Palu City RDTRs: Changes to the Tsunami ZRB Map after Implementation of Proposed DRR Structural Measures

There is an elevated road planned in the southern coastal area of Palu Bay in the Palu RDTRs. Hence, it is necessary to adopt a policy that will enable changing the Tsunami ZRB Map (especially ZRB 4 and ZRB 3 areas) after the elevated road is constructed.

¹¹ These recommendations are based on the evaluation of the latest contents of the spatial plans which were obtained by the JICA Study Team by the end of February in 2020.

By setting the change policy in advance, various stakeholders (including residents) could prepare for possible land uses and socio-economic activities in the areas to be affected by the proposed elevated road.

In that case, it is recommended to disseminate the information to the residents in advance so that they can think of options, such as no relocation, before the completion of the elevated road for them to avoid any inconvenience.

7-4-3 Recommendation for Bora RDTR in Sigi Regency: Changes to the Nalodo ZRB Map after Implementing DRR Structural Measures

The Bora RDTR in Sigi Regency plans to incorporate DRR structural measures in the areas affected by Nalodo. The DRR structural measures planned to mitigate impacts of Nalodo include lining of the main channel in the restoration of the Gumbasa Irrigation System to prevent the infiltration of irrigation water into the groundwater layer. Another DRR structural measure is to distribute irrigation water from the main channel to the Paneki River to keep the groundwater level below a certain level, while monitoring the groundwater level in the area affected by the Gumbasa Irrigation System.

Furthermore, it is necessary to adopt a policy on how to change (or not to change) the Nalodo ZRB Map (especially ZRB 4 and ZRB 3 areas) when implementing DRR structural measures. This will allow a variety of stakeholders, including residents, to prepare for future possible land uses and socio-economic activities in the affected areas.

7-4-4 Recommendations for Bora RDTR in Sigi Regency: Land Use Regulations and Building Structure Requirements for Nalodo ZRB 3 Areas

The Bora RDTR in Sigi Regency has proposed land use regulations that allow reconstruction of residential buildings, important facilities, high-risk facilities, and other buildings in the Nalodo ZRB 3 areas, but prohibit new construction of buildings. This proposed regulation is fairly strict for local residents, landowners and private sectors. A regional economic decline is expected in the ZRB 4 areas. It is difficult to reduce the development pressure in the areas close to Palu City and Biromaru area, which is one of the government and commercial centers of Sigi Regency, unless development can be promoted in other relatively safe areas from disasters by providing infrastructure.

Although implementation of regulations is important to prepare for the recurrence of Nalodo disaster, this requires careful and tenacious explanation and discussion with local residents and business people. Moreover, flexibility in loosening or amending regulations should be considered. When the above land use regulations are relaxed, additional building structure requirements and further strict enforcement of those regulations may be necessary at the same time.

7-4-5 Recommendations for Palu City RDTRs, Sigi Regency Bora RDTR, Donggala Regency Banawa RDTR: Promotion of Certain Infrastructure Development to Induce Urban Land Uses

Palu City RDTRs and Sigi Regency Bora RDTR include strong restrictions on land uses in ZRB 3 areas. However, such land use regulations and building structure requirements for each ZRB area are not sufficient, and it is necessary to implement the following measures for infrastructure development:

In order to increase the effectiveness of land use regulations, such as prohibition of new construction of residential buildings, important facilities and dangerous facilities, in Nalodo ZRB 3 areas in Palu City RDTRs, the improvement of access roads in these areas should be suppressed.

In addition to land use regulations (such as prohibition of new construction of residential buildings, important facilities, high-risk facilities, and other buildings) in Nalodo ZRB 3 areas designated by Bora RDTR in Sigi Regency, it is necessary to put high priority to some infrastructure development, especially access road development, to induce urban land use to ZRB 2 and ZRB 1 areas around Nalodo ZRB 3 areas.

Chapter-8 Recommendations on Post-Disaster Spatial Planning Approach and Process in Indonesia

8-1 Recommendations for the Central Government Agencies

In this section, based on the experience of the activities of Output 2 “Support for Spatial Planning” and observation of the activities of other Outputs in this technical cooperation Project, the following recommendations are provided for the improvement of the overall spatial planning process in the post-disaster recovery and reconstruction phase in Indonesia. The recommendations in this section are specifically targeted at central government agencies that play a central role in the planning process for disaster recovery.

- Necessity of people’s participation, coordination and consensus making even under the peculiar situation of disaster recovery and reconstruction
- Recovery and reconstruction planning and ZRB mapping¹²
- Importance of continual updating of strategies for enhancing disaster resilience
- Importance of a long-term perspective in spatial planning for disaster resilience
- Necessity of support for the implementation of spatial planning

8-1-1 Necessity of People’s Participation, Coordination and Consensus Making Even under the Peculiar Situation of Disaster Recovery and Reconstruction

In spatial planning for post-disaster recovery and reconstruction, it is necessary to understand the unique situation of disaster recovery and reconstruction. Unlike normal spatial planning, there are strong political and social needs and pressure to make important decisions and plans in a short period of time during disaster recovery and reconstruction. However, at the same time, necessary information and accurate data to understand the situation are often lacking, and residents and organizations express various requests and conflicting opinions. In addition, spatial planning needs to be started when the local governments that are responsible for planning and communities are under the constraint of being victims of the disaster and having to cope with the increasing number of tasks and problems without

¹² The ZRB map shows the areas classified by disaster type and hazard level, and the corresponding land use regulations (new construction and reconstruction policies) and building regulations (building structure requirements) for each category.

sufficient resources and capacity.¹³

Planning for post-disaster recovery and reconstruction is often carried out in a “top-down” manner under “strong leadership” with an “emphasis on urgency.” In many cases, decisions are made “based on limited information within a deadline.” In the case of Central Sulawesi, the recovery and reconstruction M/P¹⁴ and the ZRB map had been formulated within three months after the occurrence of the disaster, which was made possible by strong leadership. Based on the recovery and reconstruction MP and unrefined ZRB map, major works of the official formulation of space plans were completed in about 4 months from July to October 2019 without sufficient opportunity for consultation with local residents.

The preparation of the ZRB map corresponding to different disaster types and disaster hazard levels is essential for spatial plans in the post-disaster contexts, and further for the formulation of recovery / reconstruction plans. It takes much time and efforts. However, even under the peculiar circumstances of rushing to formulate recovery and reconstruction plans after a disaster, it is important to pay attention to resident participation, coordination, consensus building, planning based on accurate information and objective analysis, and transparency. In particular, the relocation of residents from the red zones (ZRB4 areas), which have the highest hazard level shown on the ZRB map, and the land use regulations and building structure requirements in the orange zones (ZRB3 areas) will have a major impact on local residents and the local economy. Therefore, it is necessary to take time to encourage the participation of a wide range of residents, including vulnerable groups such as women and youth groups, and formulate recovery and reconstruction plans immediately after a disaster. This will make those plans more acceptable to various residents and business groups.

It is recommended to incorporate these points into the guidelines for detailed spatial planning (RTRD) based on DRR, especially considering disaster hazards and risks.

8-1-2 Recovery and Reconstruction Planning and ZRB Mapping

In the post-disaster recovery and reconstruction process, recovery and reconstruction plans and policies are often prepared in the early stage of the post-disaster period, prior to the spatial plans and land use plans required by law. In this case, the recovery and reconstruction M/P for Central Sulawesi Province was formulated in December 2018 by the relevant agencies led by Bappenas, including the ZRB map, which was a key element in the spatial planning process in this project. On the other hand, the formulation and revision process of spatial plans for the local governments started in July 2019. This section discusses issues related to the preparation of recovery and reconstruction M/P and ZRB map and the precautions to be taken during their preparation.

As discussed in (2) above, recovery and reconstruction plans are developed in an exceptional process in a short period of time and under unexpected and unique circumstances. In particular, decisions are made with an emphasis on urgency, without adequate information and data and coordination with the community. Later on, new information may come to light and the prepared plan may need to be revised, or needs and opinions of the residents may change as circumstances change. Therefore, plans and

¹³ This situation is described, as “compressed time.” Olshansky, R., L. D. Hopkins and L. A. Johnson. “Disaster and Recovery: Processes Compressed in Time.” *Natural Hazards Review* 13 (2012): 173-178.

¹⁴ Rencana Induk Pemulihan dan Pembangunan Kembali Wilayah Pascabencana Provinsi Sulawesi Tengah 2018

decisions that have significant impact on later spatial planning, such as recovery and reconstruction plans and ZRB maps prepared at the time of an emergency after a disaster, should be assumed to be subject for review or revision, and should not be positioned as final decisions, but a framework to indicate basic principle or directions. Meanwhile, it is necessary for the government and local residents to be flexible enough to assume some mistakes and revisions.

Although the JICA Information Collection Survey provided ATR with technical input on hazard map preparation, the ZRB map compiled by ATR in December 2018 based on the results of related organizations lacks sufficient information. No building damage survey was conducted, and no survey of residents' intention to relocate was carried out. However, the Indonesian government has identified the areas to be relocated (red zone, ZRB4 area) based on the unrefined ZRB map, decided a framework of the number of households to be relocated and a development framework of permanent relocation sites. After that, the Indonesian government has proceeded with the implementation of the prepared development framework of permanent relocation sites.

In this Project, which started from the beginning of 2019, the JICA Study Team conducted geological surveys and analyses of various disasters, conducted building damage surveys for getting scientific data, and refined hazard maps and ZRB maps. The JICA Study Team continued to provide those results to local governments, ATR and Bappenas, as well as to other relevant government institutions. In addition, in the course of the official formulation process of spatial plans, various opinions on the 2018 December ZRB map and concerns about the relocation of residents were raised by the local governments, local stakeholders, and experts, requesting the review and modification of the ZRB map.

However, the ATR, which is responsible for compiling the ZRB map, has made only minor changes without responding to most of the recommendations of the JICA Study Team regarding the refinement of the ZRB map and the requests from local governments and stakeholders to modify the ZRB boundaries. Eventually the spatial plans were formulated based on the 2019 October version of the ZRB map (almost the same as the 2018 December ZRB map).

8-1-3 Coordination of Recovery and Reconstruction Planning with Spatial Planning and Local Government Systems

Since rapid response is required in times of disaster and emergency response, recovery and reconstruction plans are often formulated at the initiative of the central government with support from the central government agencies and aid organizations depending on the extent of the disaster and damage. Spatial plans should be developed in accordance with the local government system of the country, taking into account the planning processes and procedures set forth in the relevant laws.

In Indonesia which has the decentralized government system, spatial plans are formulated by provinces, regencies, and cities, and finally have a legal basis with the approval of the local assembly. Therefore, if the spatial plan does not sufficiently reflect intentions of the local community and needs of the residents, or if consensus building is insufficient, it will take a long time to approve the formulated plan, and sometimes approval is difficult to obtain. At the time of a disaster, affected local governments are often busy providing support to the victims and responding to various emergencies, and often lack sufficient personnel and resources for planning due to being the victim of the disaster. Since the local government is the final decision maker for spatial plan, it is important to provide

information from an early stage and confirm the intentions of the local government on important issues that affect the spatial planning process. On the other hand, for example, the central government and aid agencies can offer necessary technical support to the affected local governments and coordinate among central government agencies and organizations and with donors. Recovery and reconstruction and spatial planning should proceed under a clear division of roles among central and local governments, donors, other aid agencies and NGOs, etc.

8-1-4 Importance of Continual Updating of Strategies for Enhancing Disaster Resilience

The objective of this Project was to enhance the disaster resilience of cities and local areas by developing spatial plans considering disaster hazards and risks in the post-disaster contexts. Specifically, elevated roads, land use regulations, and building structure requirements were proposed. In recent years, the concept of resilience, defined by international organizations such as the World Bank and UN Habitat, underlines the importance of adaptability and transformation as key words. When cities and local areas are perceived as socioecological systems, it is necessary to take into account not only material and engineering perspectives, but also social factors such as organizations, communities, institutions, and economies that make up the system, to strengthen their resilience.¹⁵

In line with this idea of resilience, resilient cities and local areas are not achieved by implementing structural measures, such as elevated roads, or introducing land use regulations, but rather by continuously working to strengthen resilience in order to adapt to changing communities, socioeconomic development and the situation of spatial use, and climate change and other risks. It is also a choice of each city to decide on their definition of resilience and how to achieve it. Therefore, continually every 10 or 20 years, it is essential to re-evaluate the effectiveness of the current structural measures and land use regulations, as well as problems in their implementation, along with the current approach on resilience, and make changes as necessary to adapt to the situation.

8-1-5 Need for Support for the Implementation of Spatial Planning: Awareness-Raising Activities and Training

In order to strengthen the resilience of a region or city, a spatial plan that incorporates structural measures and regulations for DDR should be implemented. To do so, it is important to systematically allocate budget and implement projects for structural measures such as embankment or dikes, and other infrastructure, as well as to steadily enforce land use regulations and building structure requirements. In particular, the implementation of land use regulations and building structure requirements requires technical support to local governments and the relevant private sector, as well as awareness-raising activities for residents.

Specific activities that need to be carried out include capacity building for local government officials on urban planning and development permits, training courses on building structure requirements for the building and construction industry, and education and awareness-raising activities for residents to deepen their understanding of disaster prevention and regulations. Therefore, it is recommended that ATRs, PUPR, and other relevant agencies provide local governments with the necessary support for

¹⁵ For resilience and social-ecological systems, Folke, C., S. R. Carpenter, B. Walker, M. Scheffer, T. Chapin, and J. Rockström. 2010. Resilience thinking: integrating resilience, adaptability and transformability. *Ecology and Society* 15(4): 20.

the realization of spatial planning

8-2 Recommendations for Local Governments

8-2-1 Introduction

In addition to the recommendations for the central government agencies with focus on the preparation for the next disaster as described in Section 8-1, this section provides recommendations for the local governments that are still facing various issues and obstacles in the process of the recovery from the 2018 Palu Disaster. The five recommendations are proposed for the local governments, in particular on ZRB areas, relocation sites, and communities severely affected by the disaster, as follows:

- Monitoring of ZRB areas
- Improvement of relocation sites and community support
- Formulation of evacuation plan and implementation of evacuation drills in ZRB 4 areas
- Examination of the use of ZRB 4 areas
- Revision of spatial plans five years after the approval

8-2-2 Monitoring of ZRB Areas

Monitoring needs to be carried out to ensure that the designated ZRB areas and regulations are understood and accepted by the residents and to evaluate the current status of ZRB areas. The land use regulations ban residential uses of ZRB 4 areas and construction of new buildings for residential uses in ZRB 3 areas due to high risk of disaster, namely tsunami and Nalodo. The permanent relocation sites have been developed to accept the residents from ZRB 4 areas.

Nevertheless, if the regulations are not accepted by residents, it is highly likely that high-risk land will be reused. This could be caused by insufficient explanation and understanding of disaster risk and the regulations on the ZRB areas, because the ZRB areas were determined in a short period of time after the disaster and participation of residents in the planning process of RTRW and RDTRs was relatively limited for time constraints and other reasons. In fact, not all residents completely agree with the strong regulations on ZRB areas and relocation decisions. People prefer to stay in the area for a variety of reasons despite high risk of disaster, such as because it is convenient for commuting to work or school, because they are attached to the area, or because of relocation issues. Once some residents come back and start living in the ZRB areas, it is difficult to prevent the others from coming back.

Thus, monitoring should be conducted to ensure the continuous enforcement of the regulations on ZRB areas, and explanations require to be given periodically to the residents to help them understand and be reminded of disaster risks. However, there would be a case that even if residents understand the high risk of disaster, some may choose to accept some level of risk and decide to stay in the ZRB areas. Meanwhile, disaster risk mitigation measures, such as the construction of elevated road, might be able to lower disaster risk of the area to a certain extent. In that case, based on the results of the monitoring, the designation and regulations of ZRB areas should be reviewed to determine if the modification is required when the spatial plan is revised in five years after the approval.

8-2-3 Improvement of Relocation Sites and Community Support

Currently, residents have started moving from ZRB 4 areas into permanent relocation sites (Huntap). It is important to improve the conditions of the permanent relocation sites since building a good living environment in the relocation sites will support the creation of the foundation of residents' lives and community development.

Residents who move into the permanent relocation sites are owners of land and houses in ZRB 4 areas. Stringent regulations imposed on the high risk areas of disaster to prohibit residential use of the land forced the residents to be relocated to the permanent relocation sites that are newly developed by the government on the locations away from the original residence in the ZRB areas. Because those relocation sites are developed on hillsides of Palu and Sigi, after the relocation, fishermen and farmers have to commute to the sea or their farms and children have to change their schools if they do not have means of transportation to go to school. In addition to housing units, social and commercial facilities, such as schools and clinics, playgrounds, mosques, community space, grocery stores, mini-marts, drug store, are necessary to be developed for improvement of liveability and supporting quality of life in the sites. The past experiences around the world show that maintaining the community in the original location is one of the key factors for successful relocation. However, it is unclear whether the previous community was taken into account in the relocation process and development of relocation sites.

It is necessary to improve social facilities, commercial facilities, along with housing, as well as access and transportation (e.g., establishment of mini-bus routes), to support the livelihood of residents, and to activate the community in the relocation sites, for the promotion of resettlement. The improvement of the relocation sites is essential to ensure people's compliance with the regulations of ZRB 4 area, by preventing the residents from going back to the original place. If the relocation sites are not well developed, the risk of reusing houses and land in ZRB 4 areas will increase.

8-2-4 Formulation of Evacuation Plan and Implementation of Evacuation Drill in ZRB 4 Areas

The formulation of an evacuation plan and implementation of evacuation drill are suggested for ZRB 4 areas to ensure that people can evacuate in case of a disaster. Although ZRB 4 areas are not allowed for residential use due to its high disaster risk, economic activities, such as fishing and agriculture, and use for parks, are permitted. In particular, coastal areas could be visited more people as time passes since the disaster, and if a park or memorial facility is developed. Therefore, an evacuation plan should be prepared for ZRB 4 areas with high disaster risk, including the designation of evacuation routes and temporary evacuation locations, and instalment of signage, and evacuation drill is recommended to be conducted at least once a year.

During the preparation of an evacuation plan for ZRB 4 areas, the compliance of the building structural requirements for disaster resilience should be assessed to determine if facilities or structures in ZRB 4 areas, such as a fishing or port facility, can be used as a temporary evacuation location. If a memorial park is planned to be developed in ZRB 4 areas, evacuation routes and sites with appropriate signage of those facilities and information of disaster risk should be incorporated into the plan in accordance with disaster type and risk. Prior to conducting evacuation drill, training should be provided

to facility and park staff who are expected to take a leading role during evacuation.

Since the designated ZRB4 area is larger than the area actually affected by the disaster, some residents may remain in the unaffected area within the ZRB 4 area. Meanwhile, the existing residences are allowed to remain in ZRB 3 areas with relatively high risk. These residents should be informed of the disaster risks and the need for relocation, and asked to participate in the evacuation drills.

8-2-5 Examination of the Use of ZRB 4 Areas

ZRB 4 areas are allowed to establish parks and memorial facilities, and to conduct certain types of agriculture with consideration for disaster risks, but no specific use of the area is being considered yet. Three years after the disaster, ZRB 4 area remains untouched, except for some agricultural activities that have resumed. Though the spatial plans including the land use regulations restricting the use of land for residential and other uses are about to be approved, there are still unsolved issues of land ownership regarding ZRB 4 areas. The farmers are still uncertain of what type of farming can be performed and at what intensity in ZRB 4 areas because specific instructions on cultivation activities have not been provided in the land use regulations so that farmers can adjust their farming practices and comply with the regulations.

Hence, it is necessary to consider the use of ZRB 4 areas by involving the previous residents and land owners, such as the construction of a memorial park to preserve the memory of the disaster and the installation of solar panels, and to provide the farmers with specific instructions on farming activities, specifically on ZRB 4 areas of Nalodo, which require monitoring of groundwater level. By examining the use of ZRB 4 areas and implementing a set of use policy, such as for a park, the unpermitted use of ZRB 4 areas with high disaster risks, such as residential use, is intended to be prevented and residents' understanding of disaster risk can be deepened.

8-2-6 Revision of Spatial Plans Five Years after the Approval

Under the current spatial planning system in Indonesia, the spatial plans, RTRW and RDTR, are reviewed every five years after the approval. The recommendations suggested in this section should be reflected in the review and revision of the spatial plans and regulations (see Figure 8-1).

At first, the designation of ZRB areas and regulations should be modified based on the monitoring of ZRB 4 areas as needed, at the timing of the review of the spatial plans. The regulations and designation of the ZRB areas were determined from the perspective to maximize safety rather than other factors, such as social acceptance and economic aspects. Due to insufficient consultation with residents at the planning stage, it is uncertain whether or not a consensus on the regulations was reached among residents. Meanwhile, people's perception on the acceptance of disaster risk may change over time and come to value other factors such as economic potentials or convenience more than disaster risk and safety. Disaster risk in ZRB areas needs to be re-assessed with the progress of research the risk and implementation of risk mitigation measures. Thus, review of the regulations on ZRB areas is indispensable to maintain effective control of the disaster risk in ZRB areas.

Secondly, necessary actions for improvement of the relocation sites should be added in the spatial plans based on the evaluation of the status of and analysis of issues with the relocation sites. It takes time to develop liveable environment and vibrant community. If necessary, programs and projects for

development of social facilities, access roads and infrastructure, and other supporting facilities, as well as community development should be proposed in the spatial plan.

Thirdly, the spatial plan is required to designate evacuation routes and evacuation spaces. The evacuation plan for ZRB 4 areas should be carefully examined to identify evacuation routes and evacuation spaces and the building structural requirements of the evacuation facilities in ZRB 4 areas need to be integrated into the zoning and building regulations in RDTRs.

Lastly, specific use of ZRB 4 areas should be described in the spatial plans. The current land use plan and zoning do not clearly indicate how to use ZRB 4 areas. After the relocation is completed and the residents' lives become stabilized, people's mind set and circumstance may become ready to discuss the usage of ZRB 4 areas. The spatial planning process should carefully design consultation sessions on the use of ZRB 4 areas by involving the former residents, land owners, experts on disaster, planners, and other stakeholders.

These five factors should be considered during the review of spatial plans and need to be reflected in the plans by modifying the land use and regulations, since this kind of continuous process involving the review and revision of spatial plans is expected to contribute to building a resilient city and region.

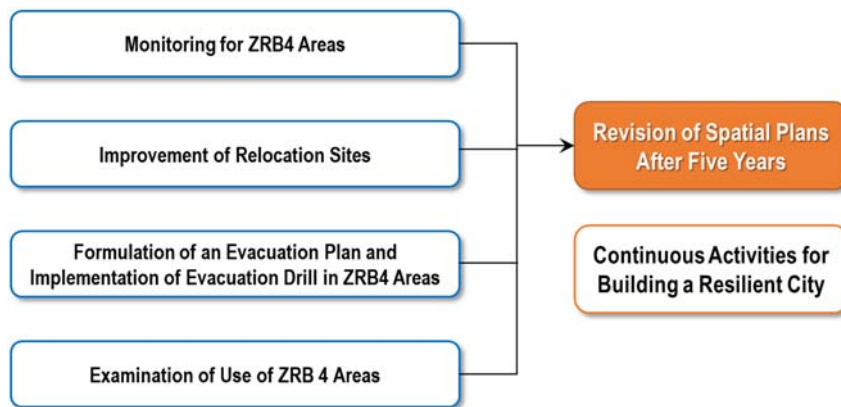


Figure 8-1 Factors to be considered in Revision of Spatial Plans

National Development Planning Agency (BAPPENAS)

**Project for Development of Regional
Disaster Risk Resilience Plan in Central
Sulawesi in the Republic of Indonesia**

**FINAL REPORT
(Volume IV)**

November 2021

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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Preface

In response to a request from the Government of Indonesia, the Japan International Cooperation Agency (hereinafter referred to as “JICA”) assisted on understanding the disaster situation and formulated a Reconstruction Master Plan. The assistance started by dispatching the first survey team to collect information on the disaster situation and emergency assistance in October 2018. In addition, discussions on future seamless recovery and reconstruction assistance measures were held with related Indonesian organizations, such as Bappenas. As a result, the Indonesian government requested JICA to implement a technical cooperation project for the recovery from the disaster, and it has been decided to implement this project (implementation period: December 2018 to November 2021): “Project for Development of Regional Disaster Risk Resilience Plan in Central Sulawesi in the Republic of Indonesia” (hereinafter referred to as “the Project”). JICA entrusted the Project to Yachiyo Engineering Co., Ltd., Oriental Consultants Global Co., Ltd., Nippon Koei Co., Ltd., Pacific Consultants Co., Ltd., and PASCO CORPORATION.

Regarding the assistance for formulating the Reconstruction Master Plan, after the first survey team was dispatched immediately after the disaster in October 2018. Naoto TADA, JICA Expert of Comprehensive Disaster Risk Reduction, BNPB, and Jun HAYAKAWA, JICA Expert of Integrated Water Resources Management, PUPR (hereinafter referred to as "JICA Experts"), led the formulation of the Reconstruction Master Plan. To continue the seamless and reliable knowledge transfer from this Reconstruction Master Plan formulation assistance, JICA experts also provided guidance to the study team of the Project. The Project cited some charts created by the JICA experts during the Reconstruction Master Plan formulation.

This final report summarizes the results of JICA experts and the study team’s activities in the Project, and the findings from Japanese experts who participated in Japanese Support Committee.

In addition, using a part of the Project results as basic data, in June 2019, during the implementation period of the Project, a Grant Agreement (G/A) was signed for “The Programme for the Reconstruction of Palu 4 Bridges in Central Sulawesi Province”, which is the core infrastructure in the disaster area. Furthermore, in January 2020 an ODA Loan Agreement (L/A) was signed for the “Infrastructure Reconstruction Sector Loan in Central Sulawesi”, to promote infrastructures reconstruction such as roads, bridges, irrigation facility, rivers, and reconstruction of public facility (hospital).

Final Report Structure

The final report consists of a summary, main report and appendix. The detail results of the project are described in the main report. The main report consists of Volume I to Volume V.

Summary (English)

* Essential part from summary (Outline and Recommendation) is translated to Bahasa Indonesia and included in the report.

Main Report (English)

Volume I	Outline of the Project
Volume II	Disaster Hazard Assessment and Hazard Map
Volume III	Formulation of Spatial Plan Based on Disaster Hazard and Risk Assessment
Volume IV	Resilient Infrastructure and Public Facilities
Volume V	Livelihood Recovery and Community Restoration

Appendix

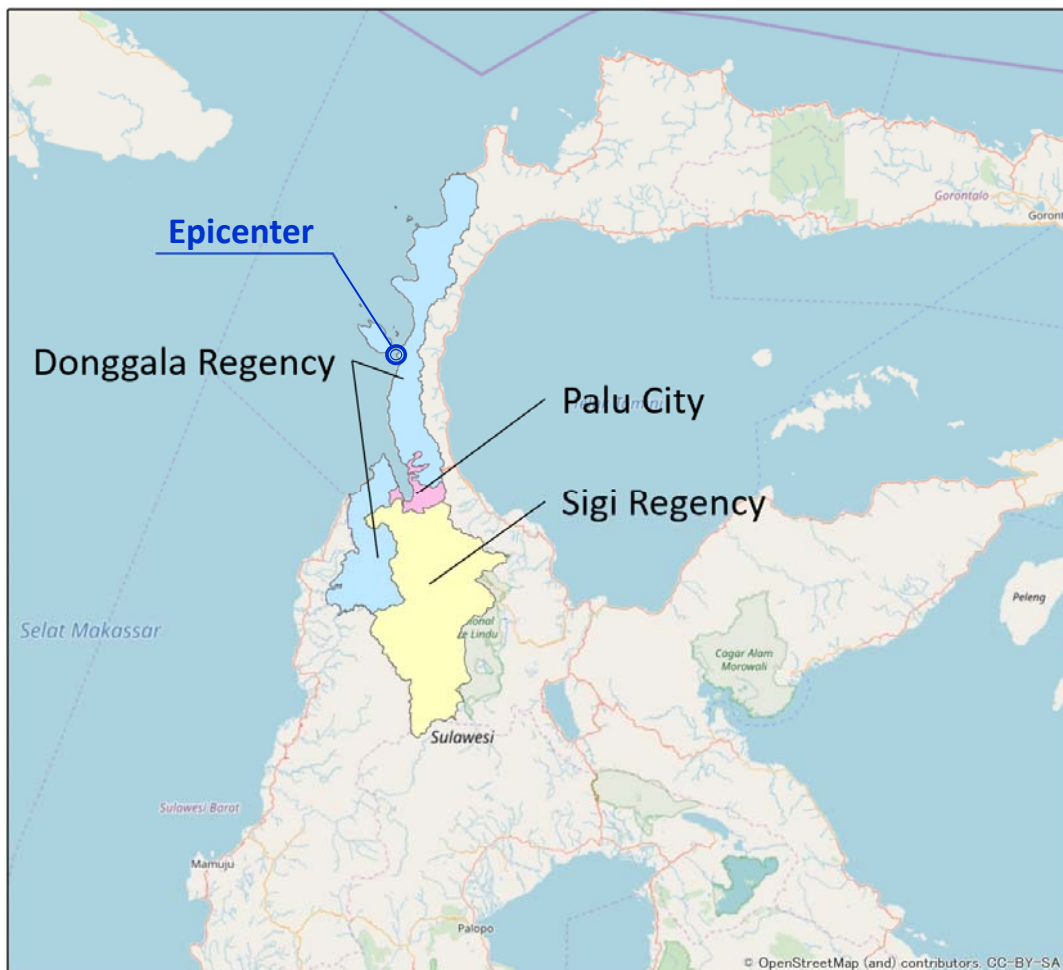
US Dollar \$ 1.00 = Indonesia Rupiah IDR 14,021.59 = Japanese yen ¥ 103.90 (February 2021)

Location Map of the Project Area

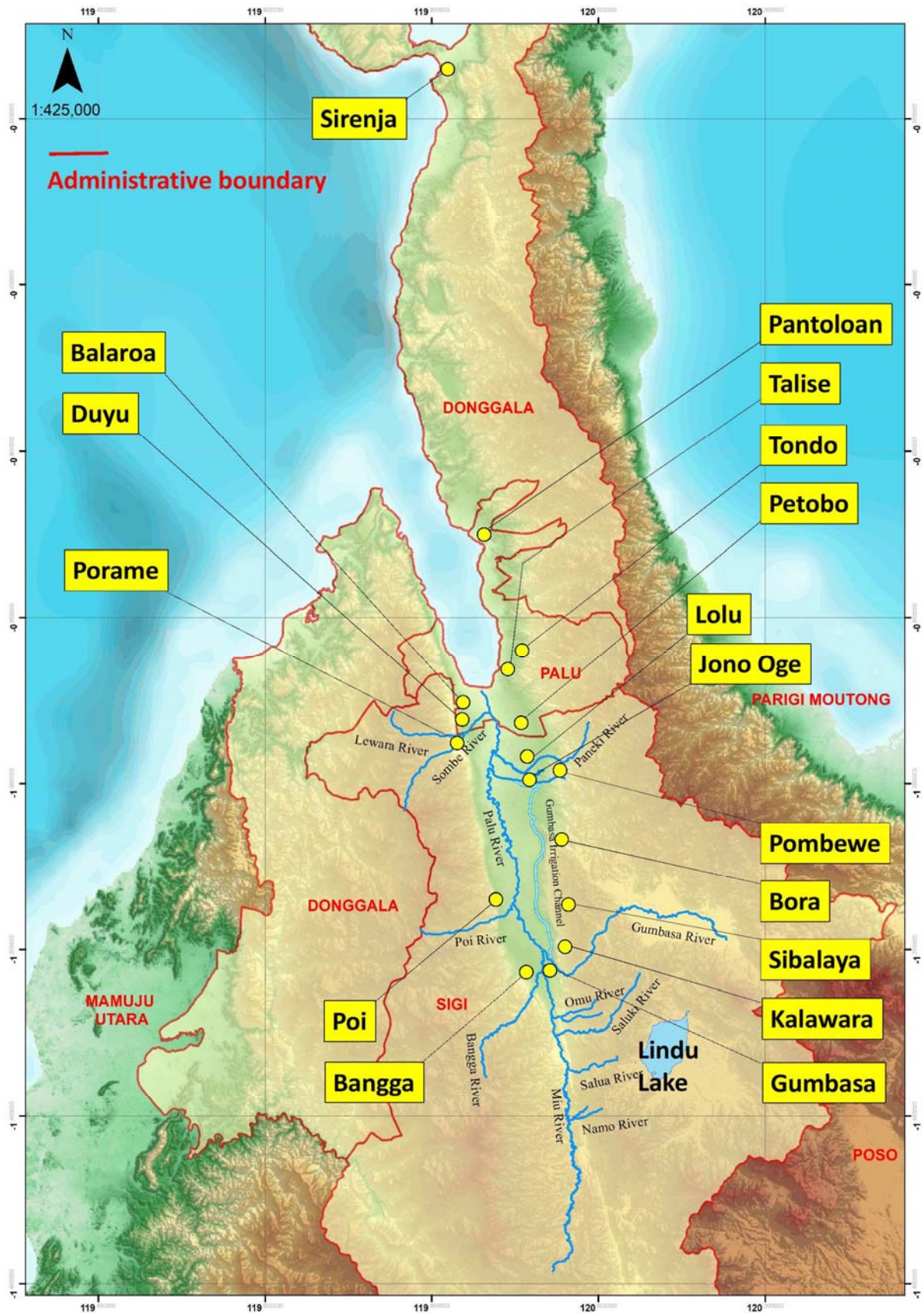
Location of Central Sulawesi Province



Location of Disaster Affected Area and Epicenter (Palu City, Sigi Regency and Donggala Regency)



Location of Target Area in the Project



Source: Prepared by JICA Study Team based on Data from the Geospatial Information Authority of Indonesia (BIG)

Lead-off Photos (1/7)

Damage Conditions



Condition of the Coastal Area of Palu Bay After the Disaster (Right Shore Side, Drone Shooting)



Condition of the Coastal Area of Palu Bay After the Disaster (Left Shore Side, Drone Shooting)

Lead-off Photos (2/7)

Damage Conditions



The Palu IV Bridge located at the Palu River Estuary was Collapsed by the Earthquake.



Collapsed Coastal Road along the Palu Bay



Damaged Buildings by Tsunami Inundation (100m to 450m from the Coast) (On the Right Shore of Palu Bay)



Damaged Port Facilities in the Palu Bay
(The Photo is SAMAS Container Jetty on the Left Shore of Palu Bay)



Damaged Road by Nalodo (Palu City)



Damaged in Sibalaya Area by Nalodo (Sigi Regency, Drone Shooting)

Lead-off Photos (3/7)

Damage Conditions



Damaged Caused by Floods and Landslides (Bangga River, Sigi Regency)



Sediment Disaster Caused by Debris Flow (Salua River, Sigi Regency)



Collapsed buildings by the Earthquake (Pal City)



Damaged Irrigation Facilities by Ground Deformation (Watergate of Gumbasa Irrigation, Sigi Regency)



Damaged in Sirenja Area by Inundation (Donggala Regency)



Evacuation Shelter Built in Balaroa District of Palu City After the Disaster

Lead-off Photos (4/7)

Stakeholder Discussions and Field Surveys



The First Joint Coordinating Committee (February 17, 2019)



Discussions with the Ministry of Land and Spatial Planning (ATR) and the National Land Agency (BPN) (March 21, 2019)



Discussions on Infrastructure Reconstruction Plans with the Ministry of Public Works and National Housing (PUPR) (February 18, 2019)



The Second Joint Coordinating Committee (August 6, 2019)



The Third Joint Coordinating Committee (December 11, 2019)



Discussion on the Japanese Support Committee (Nalodo) (March 25, 2019)