Uses of The Climate and Climate-related Hazard Information in The Adaptation Strategies for Development and Spatial Planning Assessments

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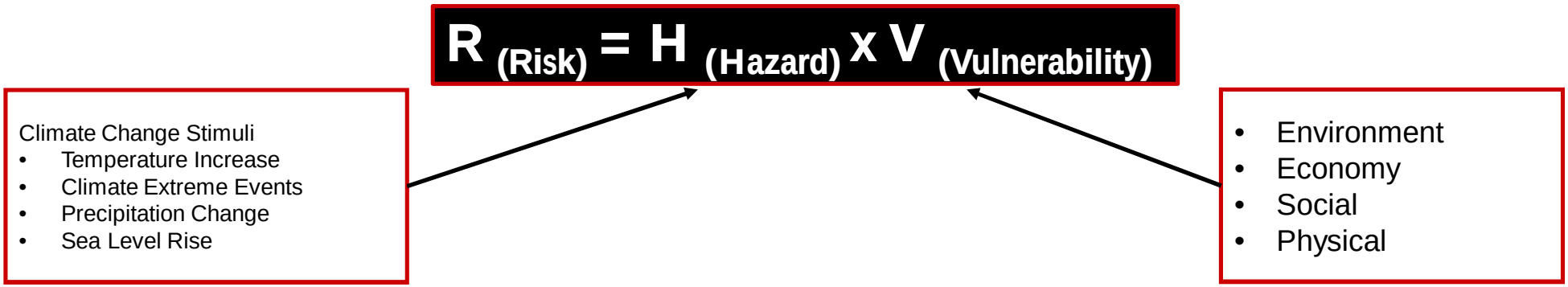
Climate Change Risk

- Based on IPCC AR-5, assessment of **climate change risk** is used as an approach to the **adaptation of climate change**
- Risk is defined as the potential for consequences when something of values is at stake and the outcome is uncertain, recognizing the diversity of values (IPCC AR-5, 2014)
- In the disaster management community, the disaster risk is defined as the probability of adverse consequences or potential losses as a result of **interaction between natural and man-made hazard with vulnerability condition** (ISDR, 2004)



Climate Change Risk (ii)

Vulnerability can be identified as a function of **character**, **magnitude**, and **level of climate variation** to which a system is exposed, having **sensitivity** and **adaptive capacity**.

Where :

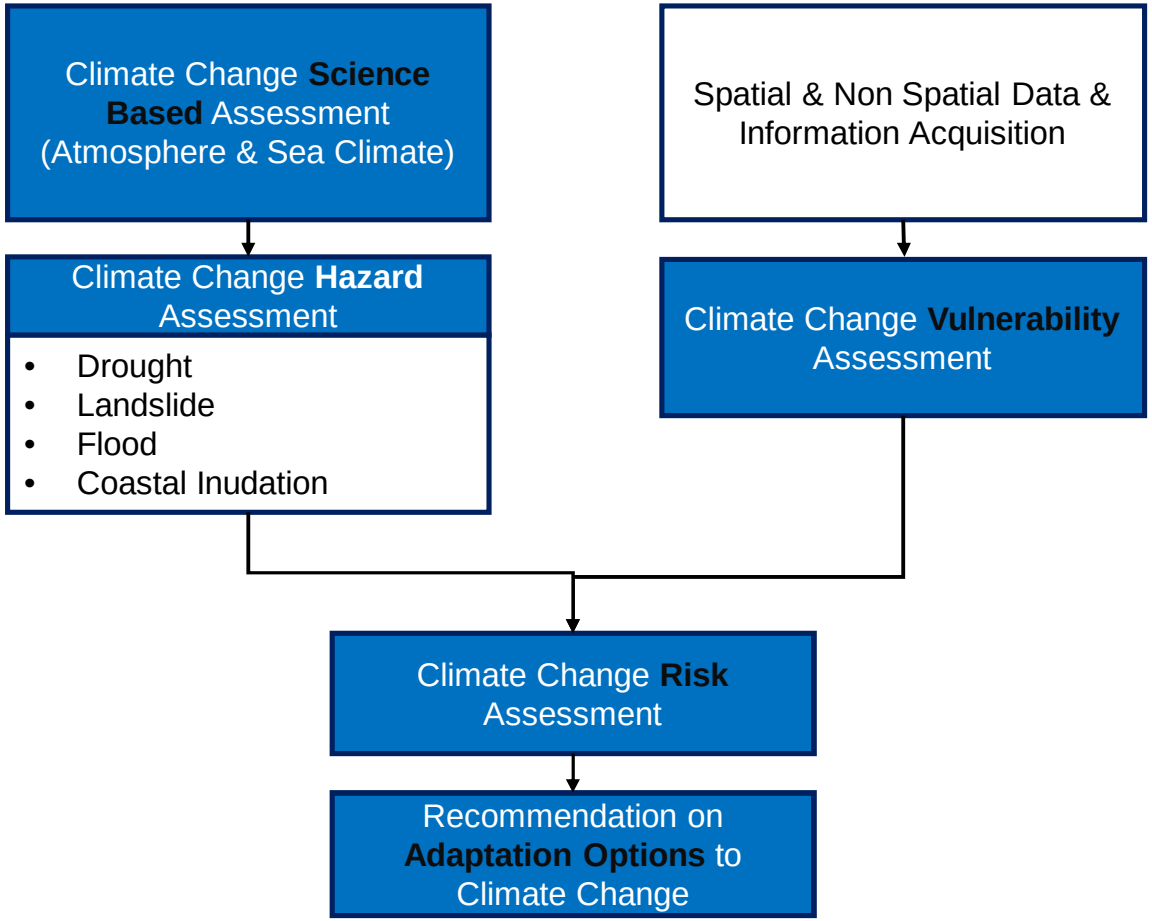
V : vulnerability

E : exposure

S : sensitivity

AC : adaptive capasity

Framework of The Climate Change Risk and Adaptation Assessment

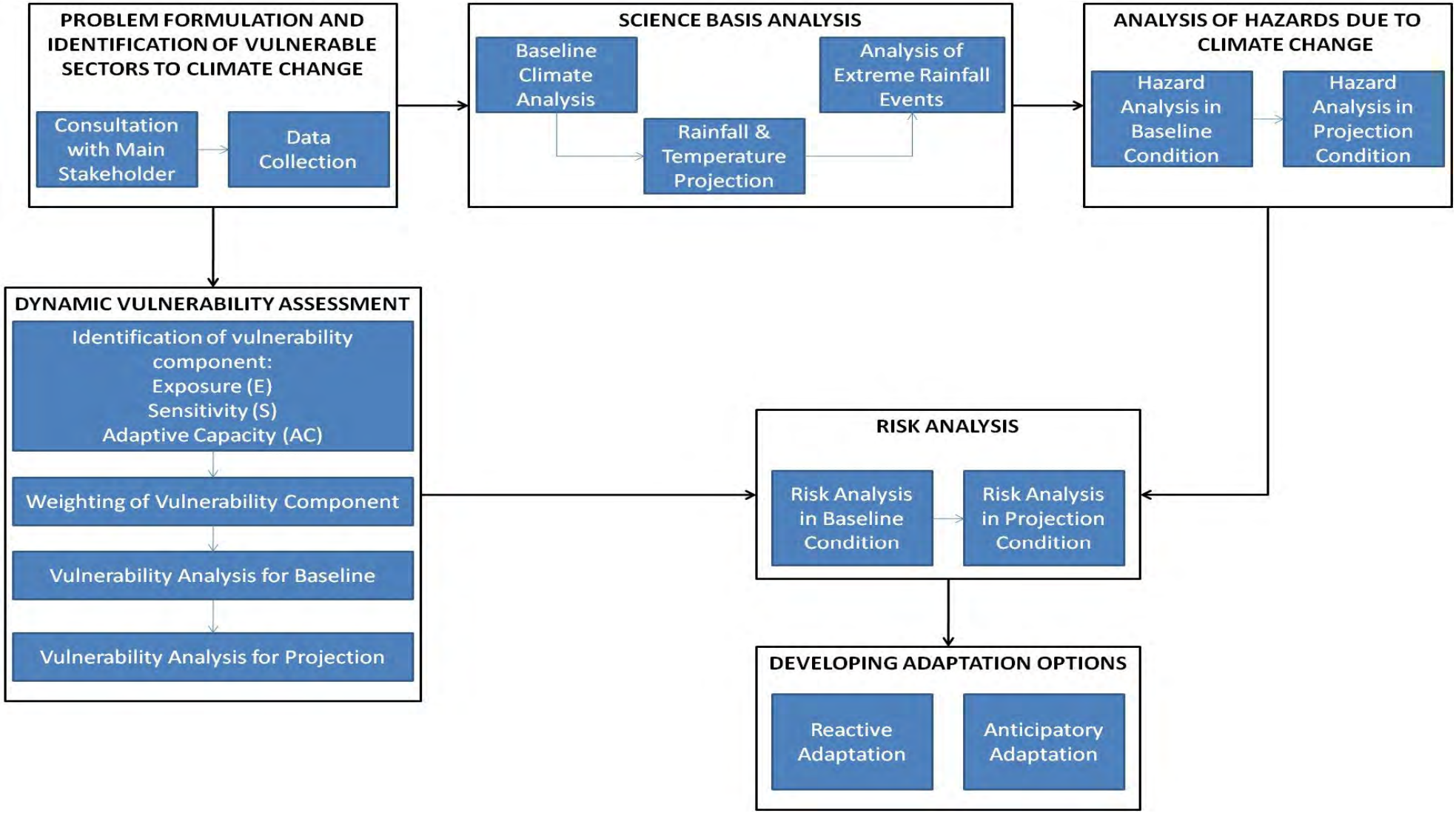


Framework for Policy Study

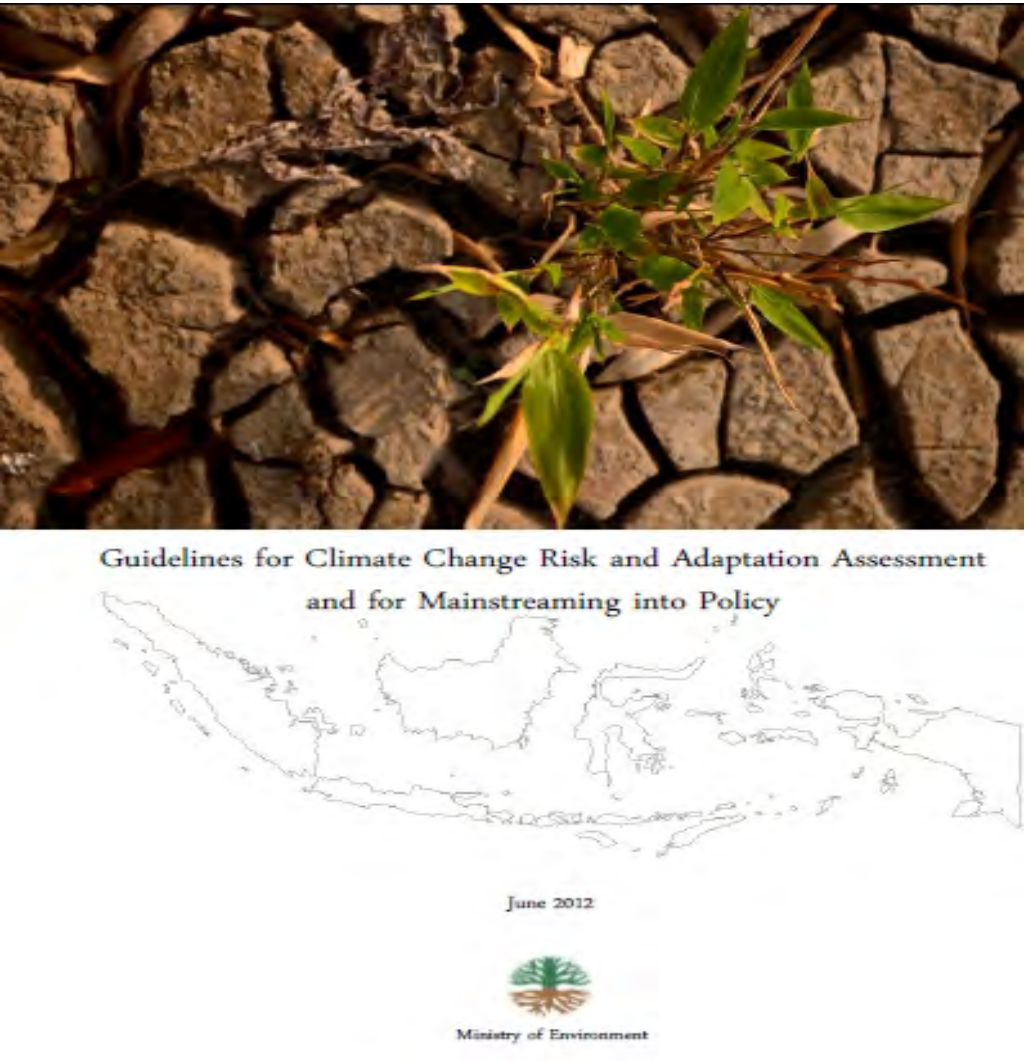
National Development Planning System is whole set of development planning activities that produce multiple development plans in long term, medium term, and yearly terms that will be implemented by central and local governments (Law 25/ 2004)

INTEGRATION OF CLIMATE CHANGE ADAPTATION IN DEVELOPMENT PLANNING

Climate Risk Assessment Process



Guidelines for Climate Change Risk and Adaptation Assessment and for Mainstreaming into Policy



- Science Basis Analysis
  - Baseline climate analysis
  - Rainfall and temperature projection
  - Sea level rise analysis and projection
- Hazard Analysis due to Climate Change
- Vulnerability Assessment
- Risks Analysis
- Developing Adaptation Options
- Policy Mainstreaming
- Prioritization of Adaptation Options
- Compatibility Analysis

Hazard Analysis Model and VA Indicators

Hazard Type	Method/Model	Main Parameters
Agriculture	Crop production decline	Crop productions Crop yields Harvest area
Water: Flood	HECRAS	Rainfall SLR Soil type Land use change
Water: Landslide	GEOSLOPE	Rainfall Soil type Land use change
Water: Shortage	Water balance	Rainfall Temperature Soil type Land use change
	Water budget	Total Run-Off Population Land use
	FEM WATER	Aquifer geometry Permeability Groundwater storage
Coastal: Inundation	Cumulative Inundation model and scenario	Storm surge La Nina Tide Wind wave SLR
Health: Dengue, Malaria, Diarrhea	Regression and correlation model	Rainfall Temperature Incidence rate

Hazard Type	VA Components	Indicators
Agriculture: Crop Production Decline	Exposure	Size of agricultural area (D) Number of people working in agriculture (D)
	Sensitivity	Size of non-irrigated field (D) Farmer's income (D) Topography
	Adaptive capacity	Irrigation network (D) Education level (D) Share of Agriculture Sector in GDRP
Water: Flood and Landslide	Exposure	Urban population density (population per urban area) (D) Land use (D)
	Sensitivity	Function and status of critical infrastructure (D)
	Adaptive capacity	People's welfare (housing type, income per capita) (D) Drainage (flood) or road (landslide) network (D)
Water: Shortage	Exposure	Demand for water provision (D)
	Sensitivity	Type of water resources Water quality
	Adaptive capacity	People's welfare (housing type, income per capita) (D) PDAM network (As proxy to access to drinking water (D)
Coastal: Inundation	Physical vulnerability	Elevation Slope Land use (D)
	Social vulnerability	Urban population density (population per urban area) (D)
	Economic vulnerability	Critical infrastructure (D)

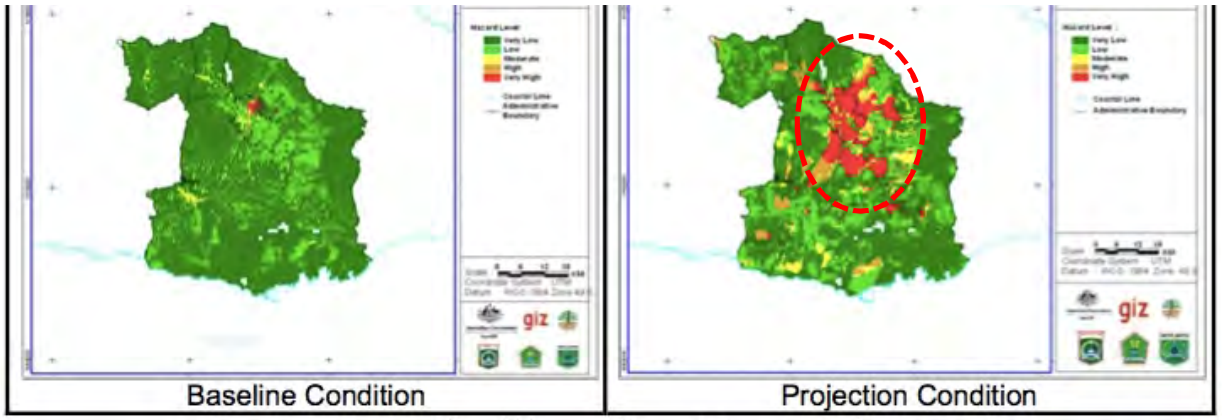
Source: Ministry of Environment (2012)

Case Study:
Greater Malang

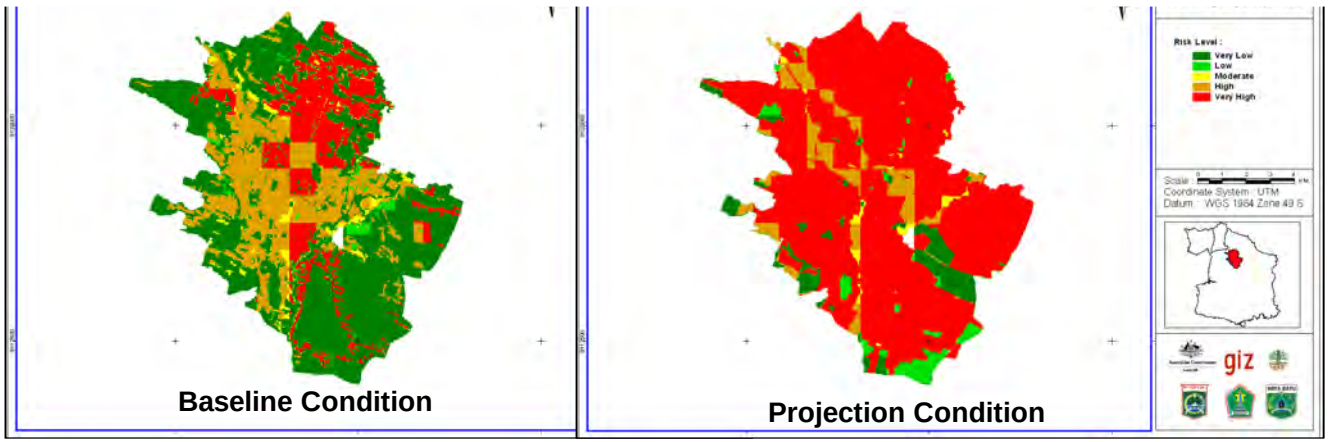
- Water Sector
- Agriculture Sector
- Health Sector

Risk and Hazard Assessment in Greater Malang - Flood

HAZARD ASSESSMENT: GREATER MALANG



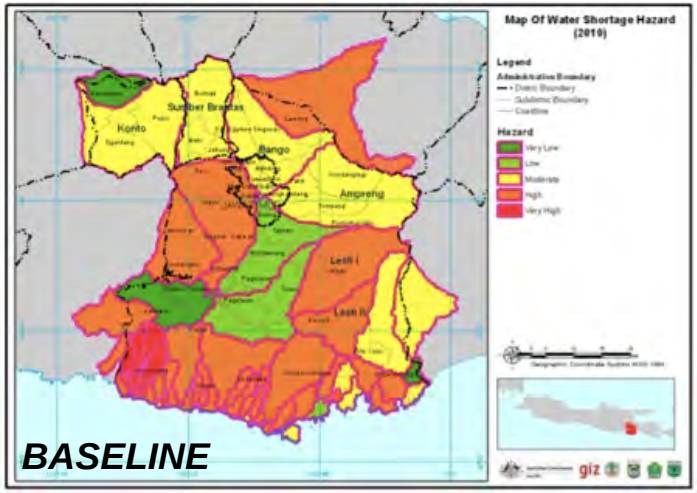
RISK ASSESSMENT: MALANG CITY

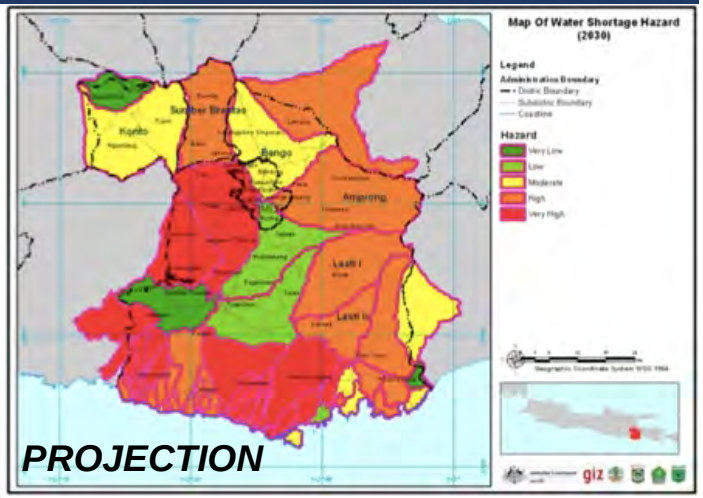


Source: Ministry of Environment (2012)

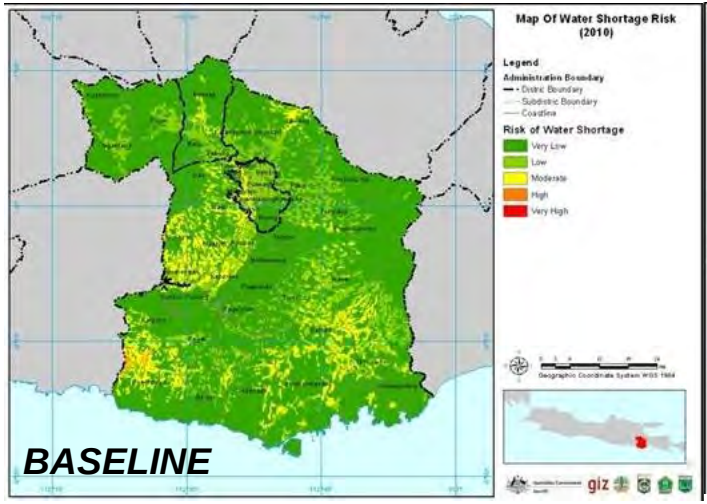
Risk and Hazard Assessment in Malang – Water Shortage

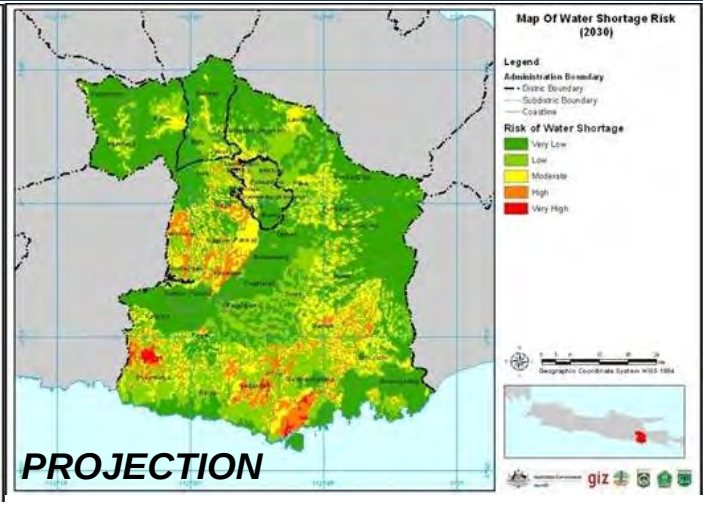
HAZARD ASSSESSMENT





RISK ASSSESSMENT





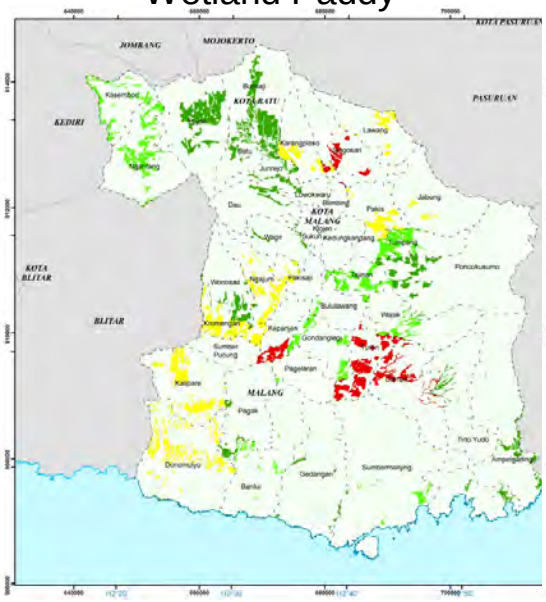
1, Very Low
2, Low
3, Moderate
4, High
5, Very High

Source: Ministry of Environment (2012)

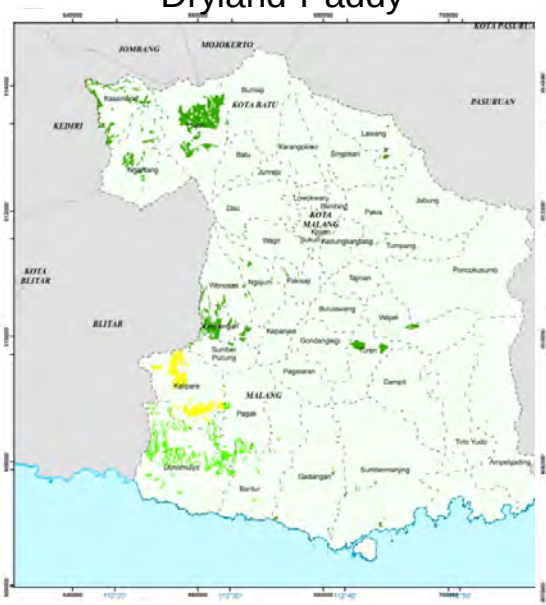
Risk and Hazard Assessment in Greater Malang - Agriculture

HAZARD ASSESSMENT

Wetland Paddy

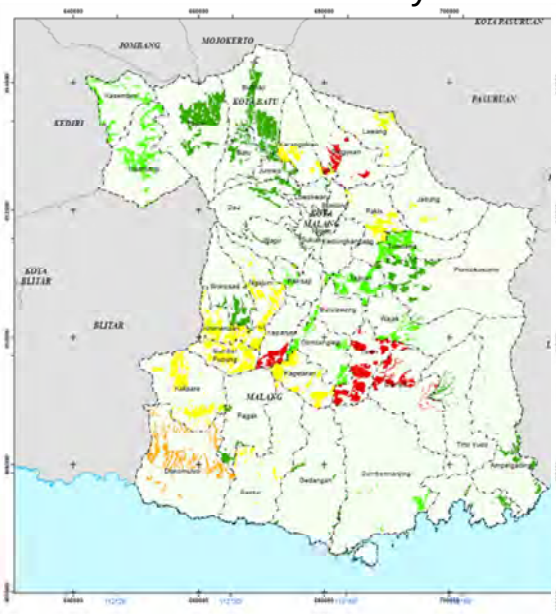


Dryland Paddy

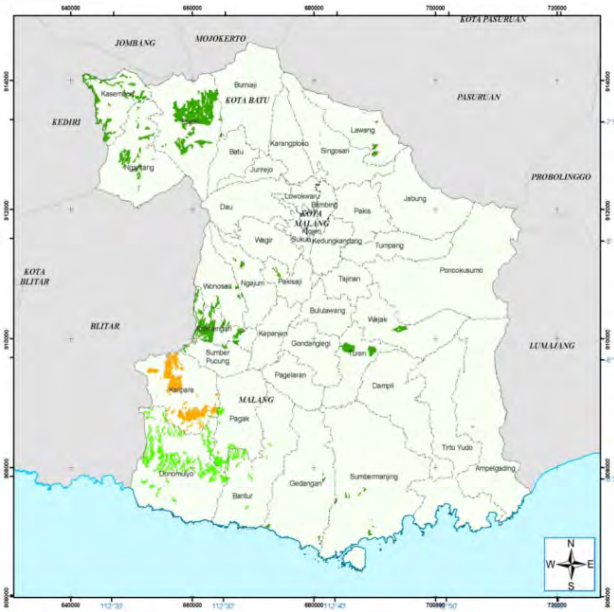


RISK ASSESSMENT

Wetland Paddy



Dryland Paddy



1, Very Low
2, Low
3, Moderate
4, High
5, Very High

Projection (2030)

Source: Ministry of Environment (2012)

Samples of Adaptation Measures (UNFCCC, 2008)

Sector	Reactive Adaptation	Anticipatory Adaptation
Water resource	• Protection of groundwater resources • Improved management and maintenance of existing water supply systems • Protection of water catchment areas • Improved water supply • Groundwater and rainwater harvesting and desalination	• Better use of recycled water • Conservation of water catchment areas • Improved system of water management • Water policy reform including pricing and irrigation policies • Development of flood controls and drought monitoring
Agriculture	• Erosion control • Dam construction for irrigation • Changes in fertilizer use and application • Introduction of new crops • Soil fertility maintenance • Changes in planting and harvesting times • Switch to different cultivars • Educational and outreach programs on soil and water conservation and management	• Development of tolerant/resistant crops (to drought, salt, insect/pests) • Research and development • Soil-water management • Diversification and intensification of food and plantation crops • Policy measures, tax incentives / subsidies, free market • Development of early warning systems

Source: Ministry of Environment (2012)

Objectives of Climate Change Integration to Development Planning

Source: Ministry of Environment (2012)

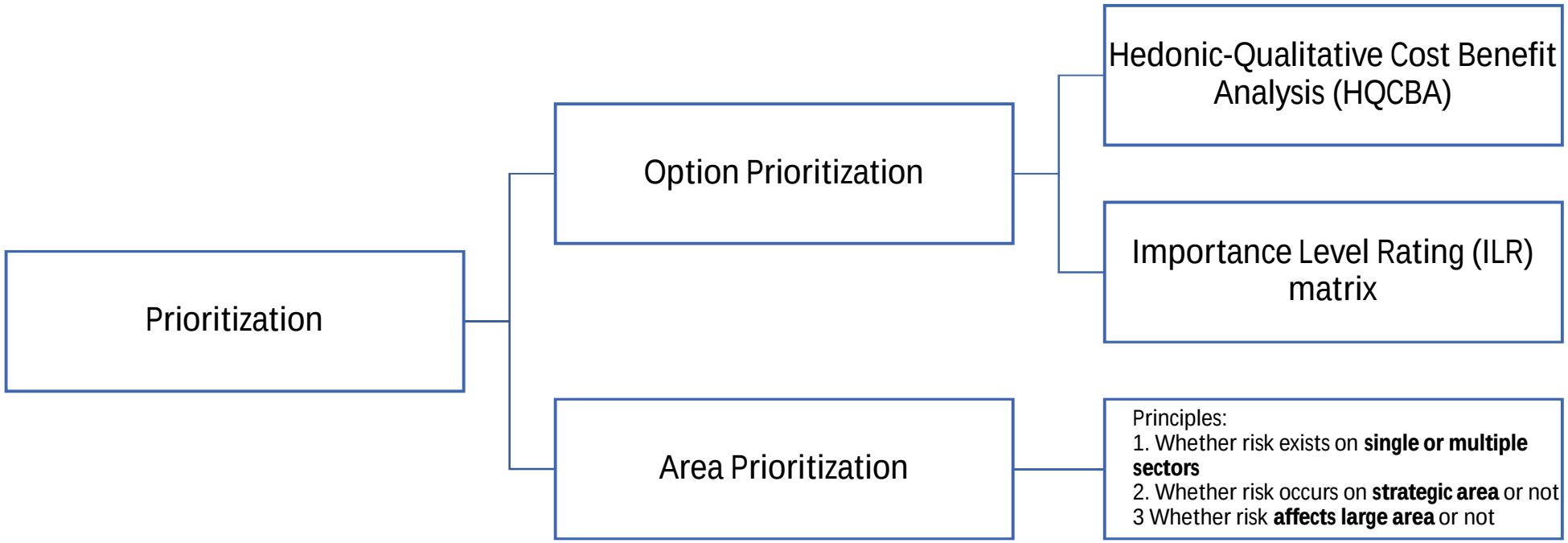
Climate Change Integration Process into Development Planning Program

Key Points and Strategies :

- Assuring **local development planning agencies** are being **informed by the relevant outputs** of impact and vulnerability assessments
- **Strengthening environmental and sectoral institutions** in order to be able to address the complexities in addressing and coordinating the implementation of adaptation action
- **Effective tools and frameworks** for developing, disseminating and building capacity for adaptation and integrating it into policy at all levels

Source: Ministry of Environment (2012)

Prioritization of Adaptation Options



Source: Ministry of Environment (2012)

Compatibility Analysis

- Compatibility analysis compares **adaptation options** with government program side by side along with **its location, risk level, and importance level**.
- The compatibility assessment will recommend on **what adaptation strategies need** to be mainstreamed into future government planning and programs and how.

Source: Ministry of Environment (2012)

Compatibility Matrix between Climate Change Adaptations and Programs in Annual Plan

No	Adap-tation Option	Pro-gram 2012	Compatibility of the program	Location of the program	Location of high risk level	Compatibility of the location	Importance level of the options	Recommendation upon the incompatibilities	Mainstreaming of the recommendation
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(case-A)	(*)	(*)	Proposed option by expert is compatible to the program	(*)	(*)	Location of high level of risk is compatible to one of the program	4-5	This option is NOT necessary to be followed up (i.e. the program is necessarily to be implemented)	
(case-B)	(*)	(*)	Proposed option by expert is compatible to the program	(*)	(*)	Location of high level of risk is compatible to one of the program	1-3	Re-discuss (elaborate) the level of importance: • If it is still less important, then the program is NOT necessarily to be implemented • If it is raised to be more important then it becomes case-A	
(case-C)	**(*)**	**(*)**	**Proposed option by expert is compatible to the program**	**(*)**	**(*)**	**Location of high level of risk is NOT compatible to one of the program**	**4-5**	**Elaborate whether location of the program would be recommended to be changed or added with one of high risk**	• **Next annual program of the local government** • **Endorse to cen-tral government** • **Endorse to Donor (ICCTF)**
(case-D)	(*)	(*)	Proposed option by expert is compatible to the program	(*)	(*)	Location of high level of risk is NOT compatible to one of the program	1-3	Elaborate in 2 levels: 1. See case-B 2. If yes, then it becomes case-C	
(case-E)	**(*)**	**(*)**	**Proposed option by expert is NOT compatible to the program**	**(*)**	**(*)**		**4-5**	**Elaborate to make sure whether this option is still being most important.** **If it is OK then provide recommendations as a new program** **(Note: be aware with the related nomenclature of program)**	• **Next annual program of the local government** • **Endorse to the central government** • **Endorse to Donor (ICCTF)**
(case-F)	(*)	(*)	Proposed option by expert is NOT compatible to the program	(*)	(*)		1-3	Re-discuss (elaborate) the level of importance: • If it is still less important, then the option is NOT necessarily to be followed up • If it is raised to be more important, then it becomes case-E	

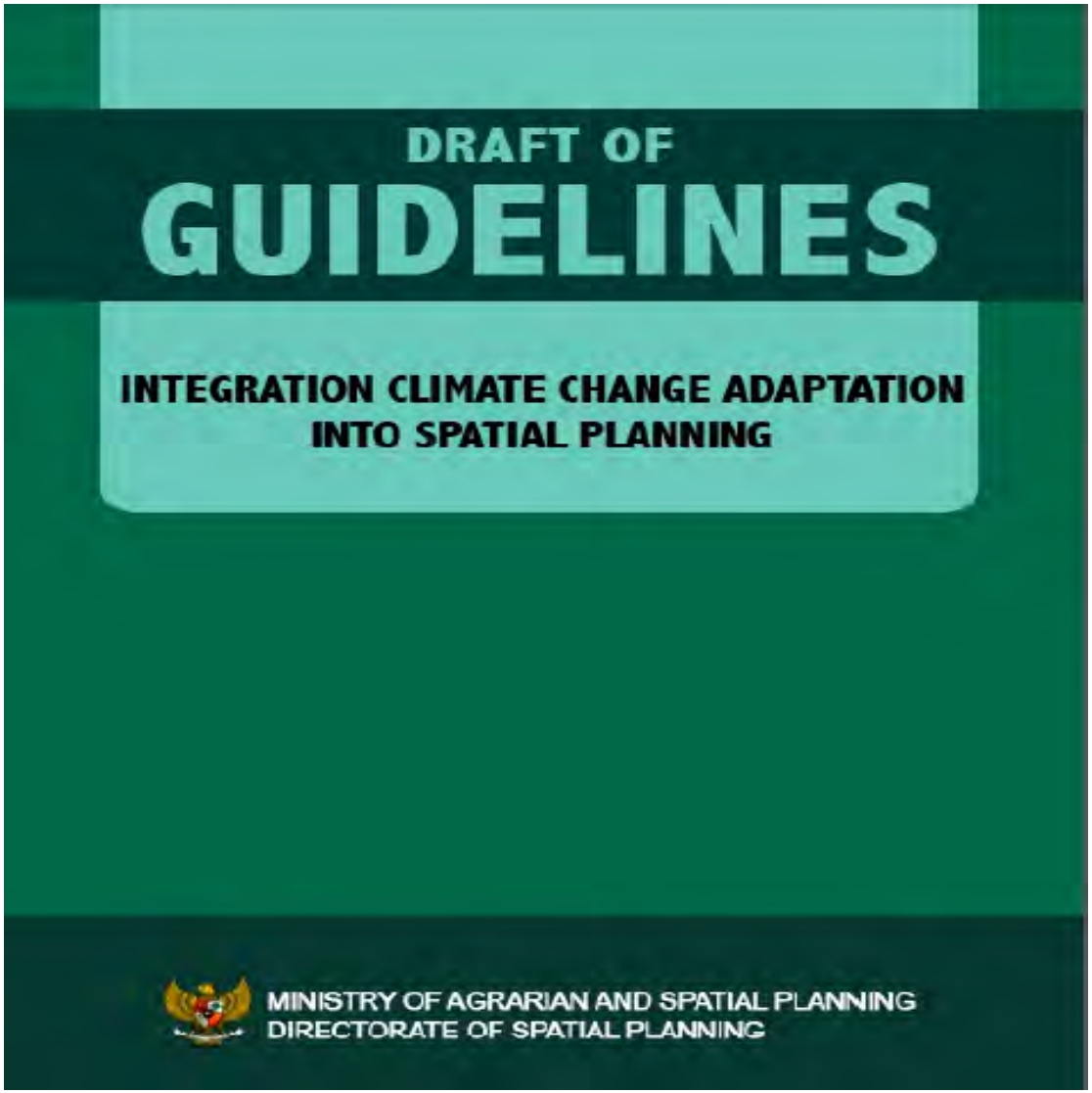
Note: (*) Filled prior to the workshop by the KRAPI team:

Source: Ministry of Environment (2012)

INTEGRATION OF CLIMATE CHANGE ADAPTATION IN SPATIAL PLANNING

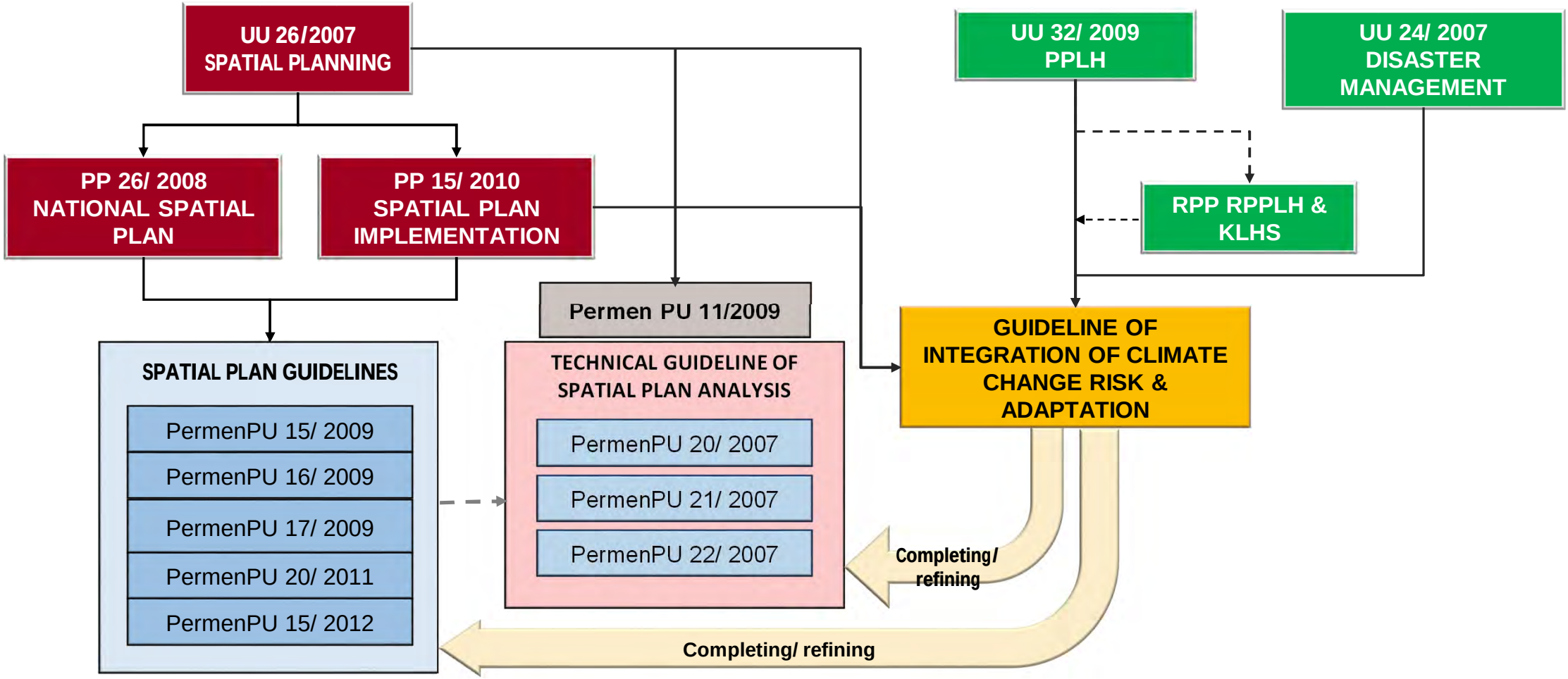
CCRAA: CCA Policy Recommendations for East Java

CCRAA: Guideline for Integration into Spatial Planning

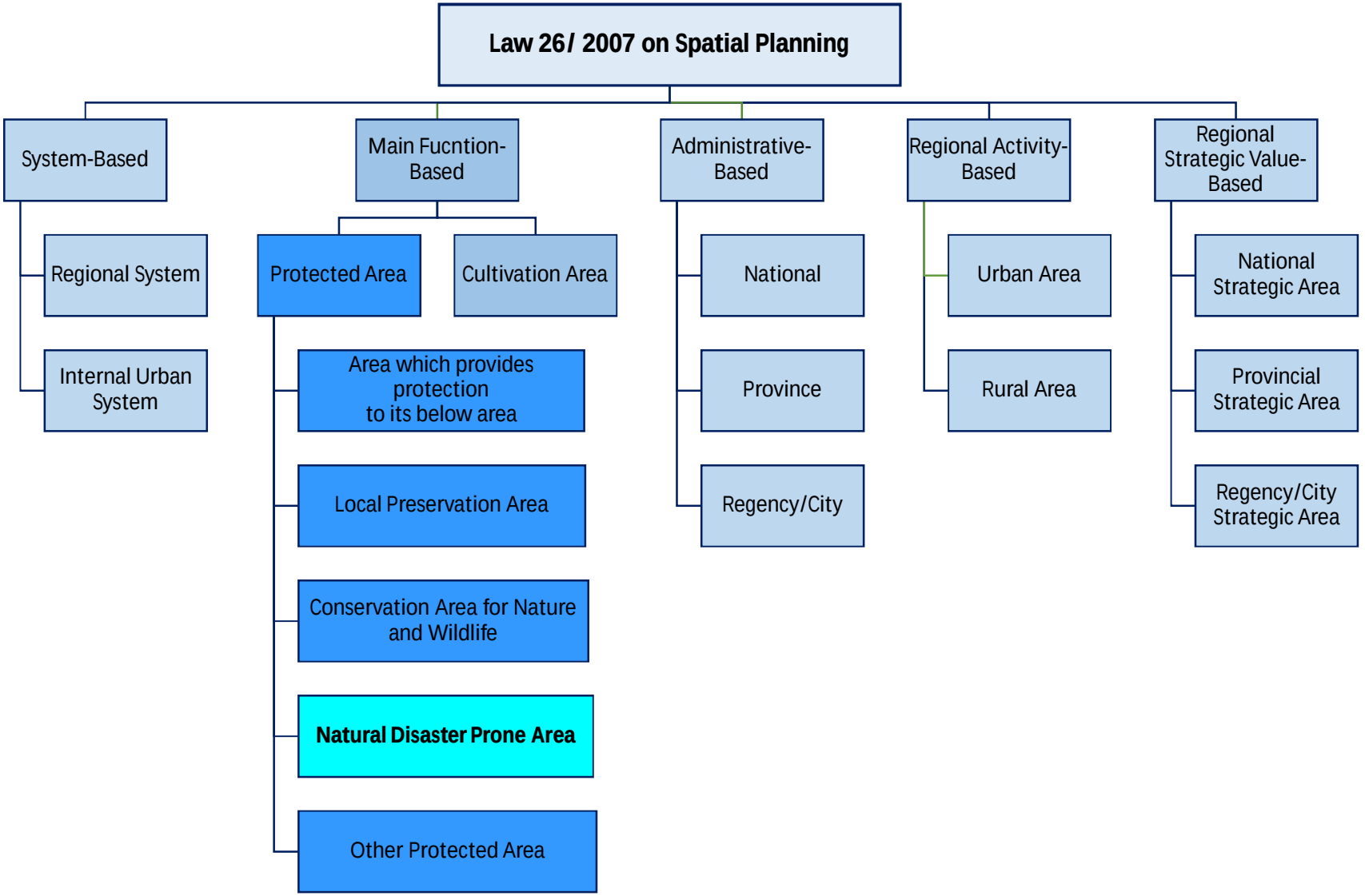


Source: Ministry of Agrarian and Spatial Planning (2015)

Legal Aspect for Integrating Climate Change Adaptation into Spatial Planning

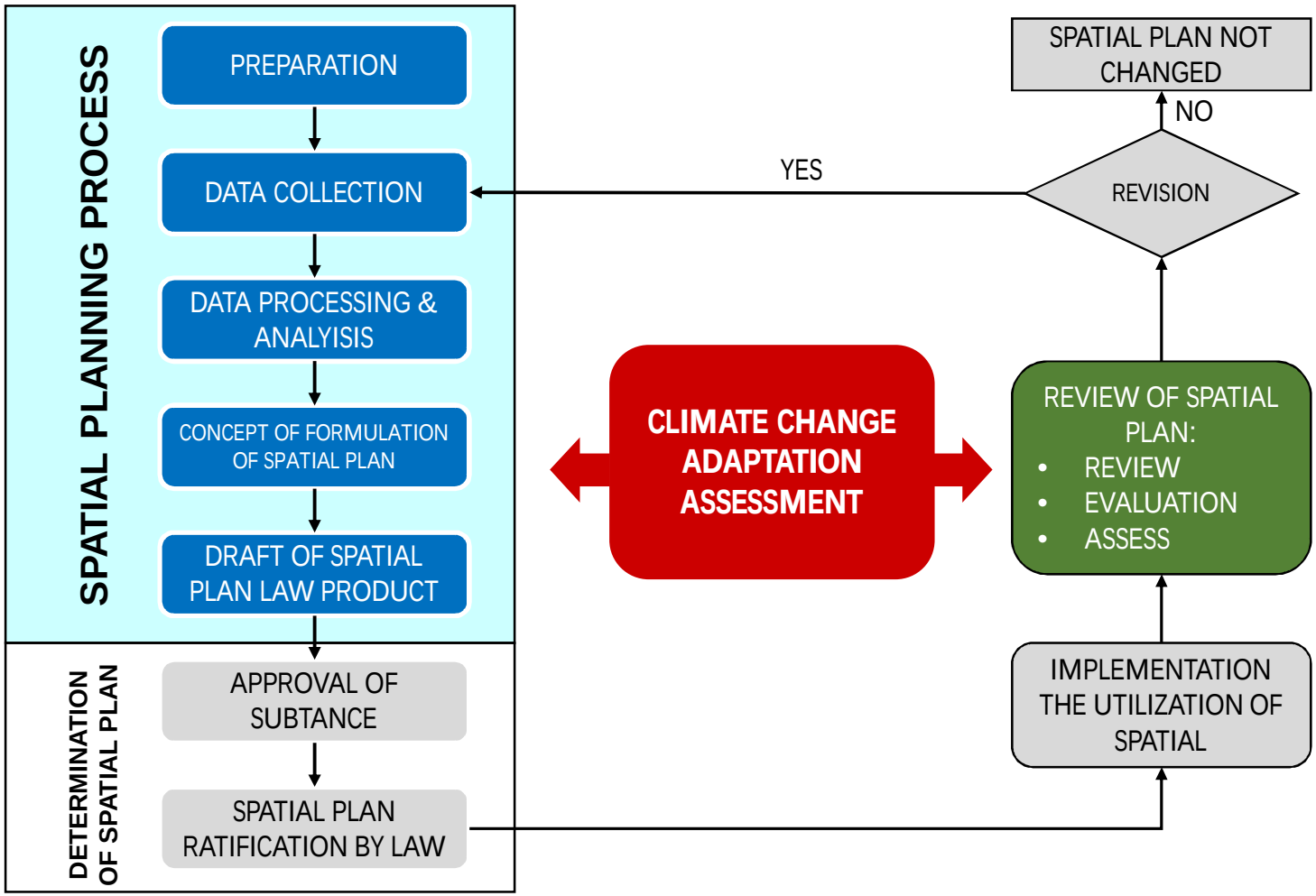


Source: Ministry of Agrarian and Spatial Planning (2015)



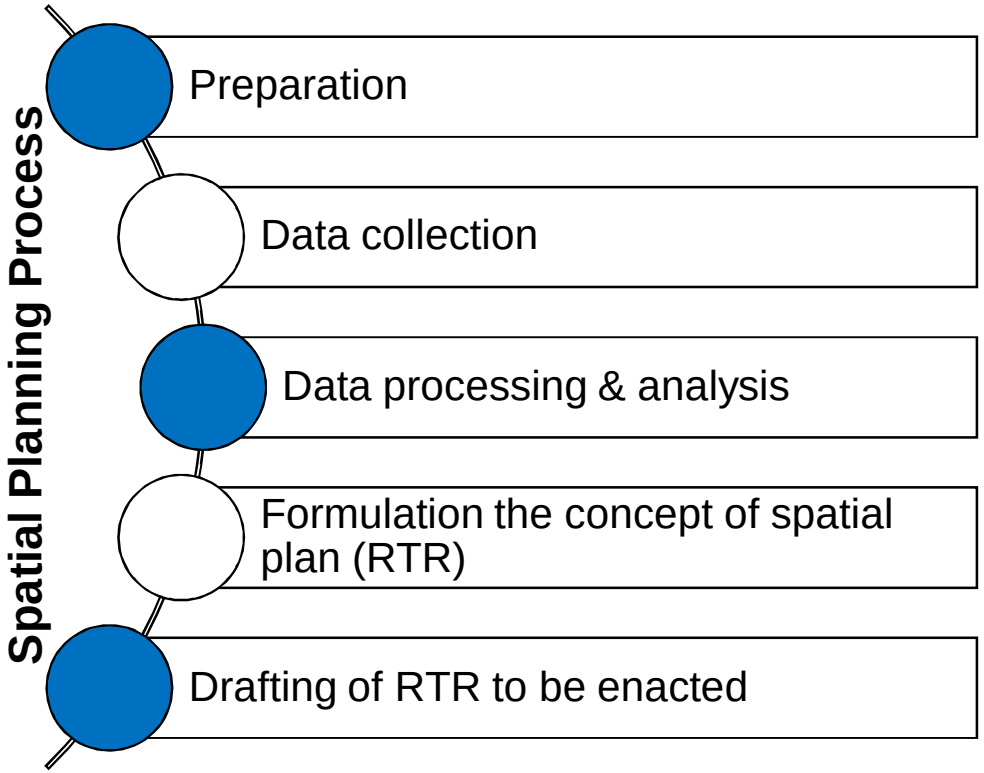
Source: Ministry of Agrarian and Spatial Planning (2015)

Concept of Integration of Climate Change Adaptation Into Spatial Planning



Source: Ministry of Agrarian and Spatial Planning (2015)

Integration into Spatial Planning Process

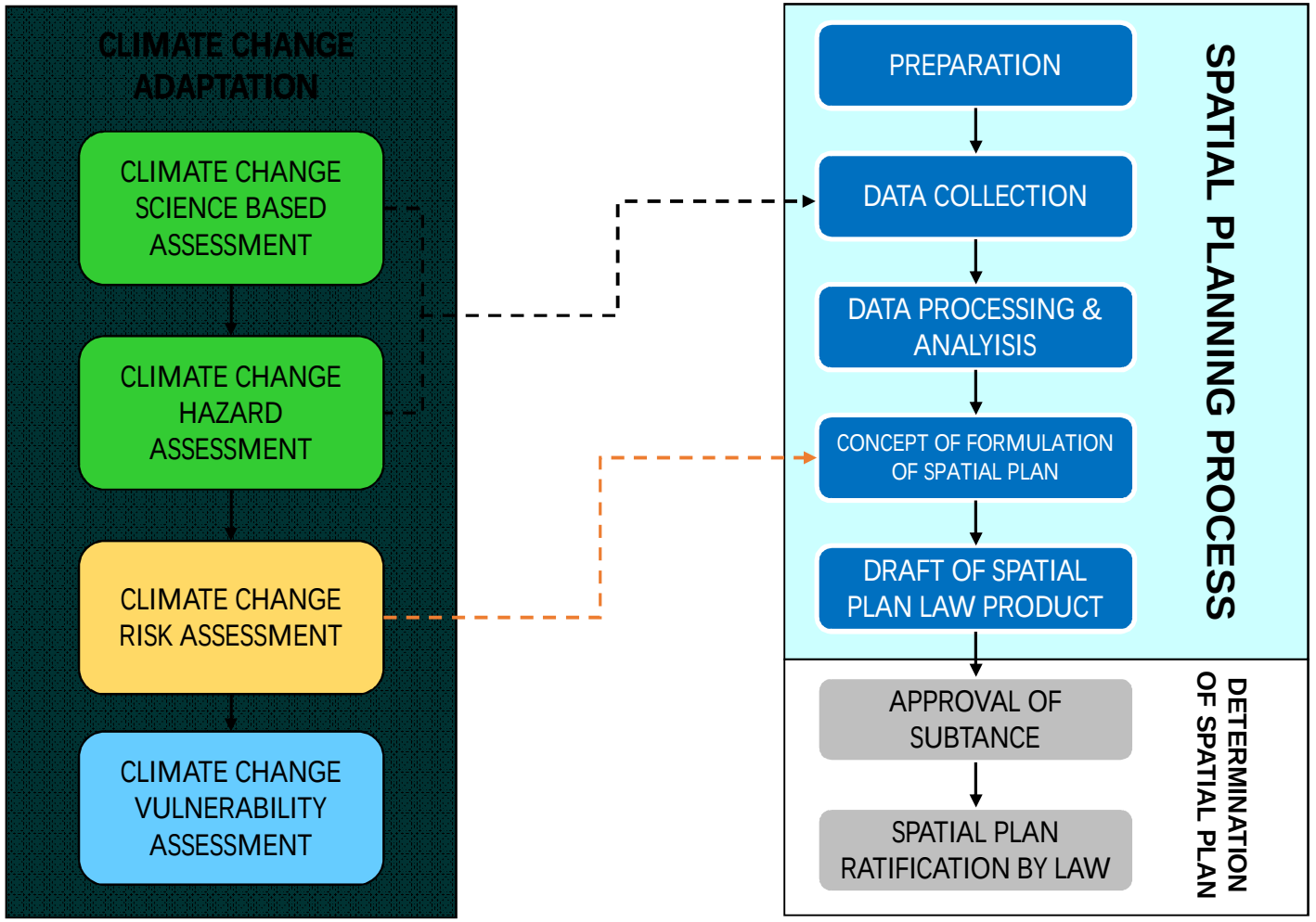


Integration of Climate Change Adaptation into Spatial Planning

The Collection of Data and Information	Data Processing and Analysis
Climate Science Basis	**Climate Change Vulnerability Assessment**
Climate Change Hazard	**Climate Change Risk Assessment**

Source: Ministry of Agrarian and Spatial Planning (2015)

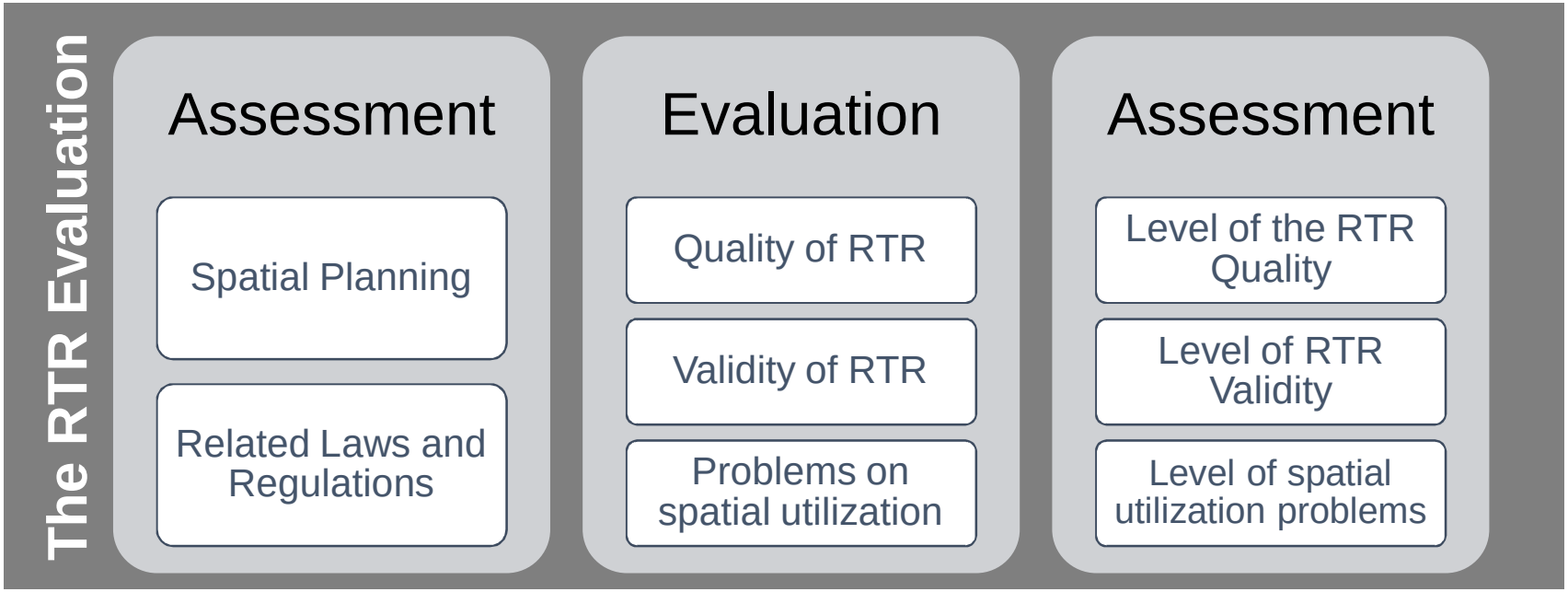
Integration Concept of Climate Change Adaptation in The Spatial Planning Process



Source: Ministry of Agrarian and Spatial Planning (2015)

Spatial Plan Evaluation Process

- The RTR Evaluation is an attempt to review the **suitability between the RTR and development needs** considering to the development of strategic environment and internal dynamics, as well as the implementation of spatial utilization



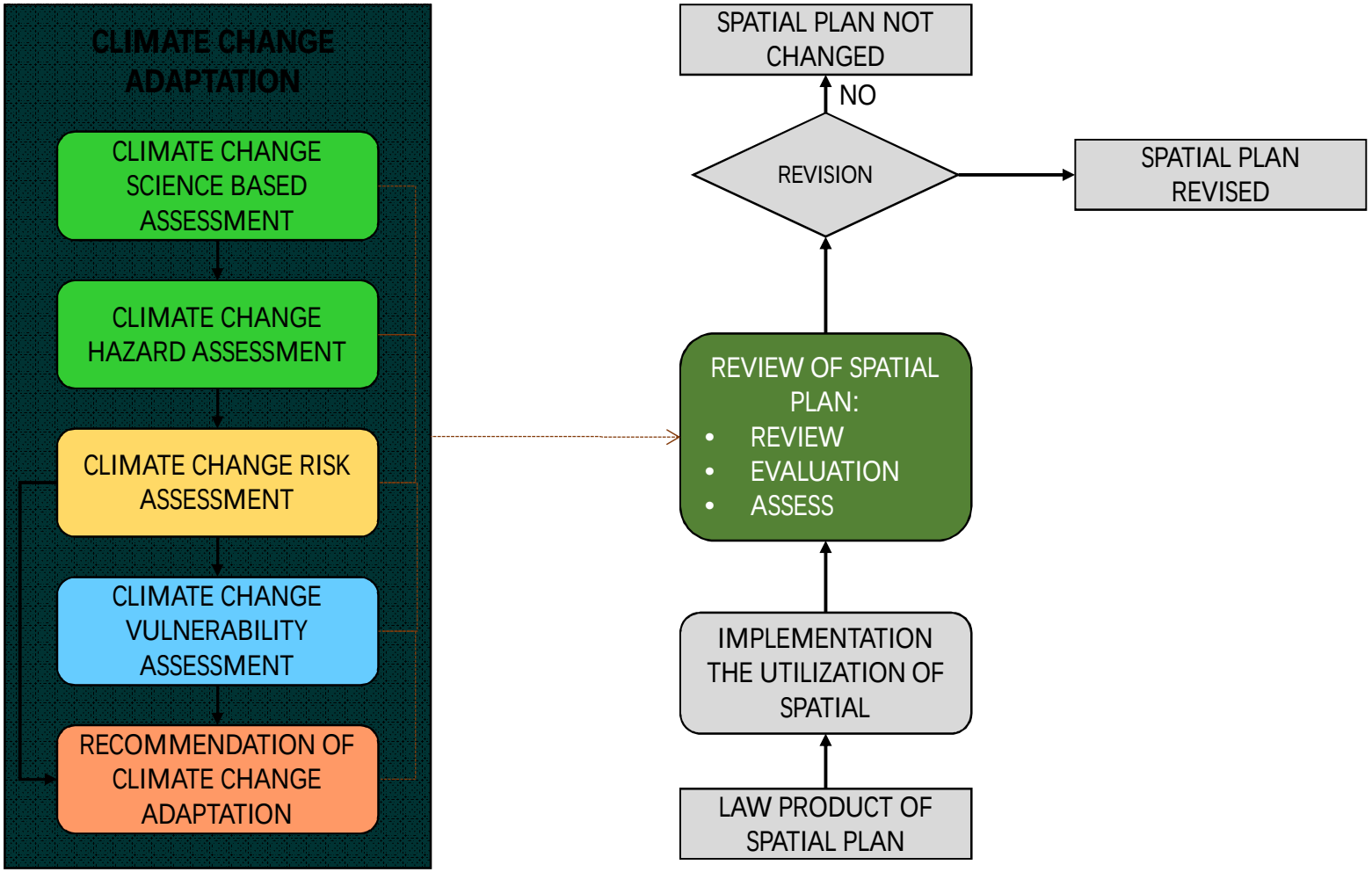
Source: Ministry of Agrarian and Spatial Planning (2015)

Integration into Spatial Plan Evaluation Process

- Climate Change Adaptation Assessment in the RTR review is performed to **provide inputs** to the evaluation process of RTR.
- In the review of RTR, the Climate Change Adaptation Assessment can be performed in **the whole to produce the final outputs** in the form of Formulation of Climate Change Adaptation Efforts.

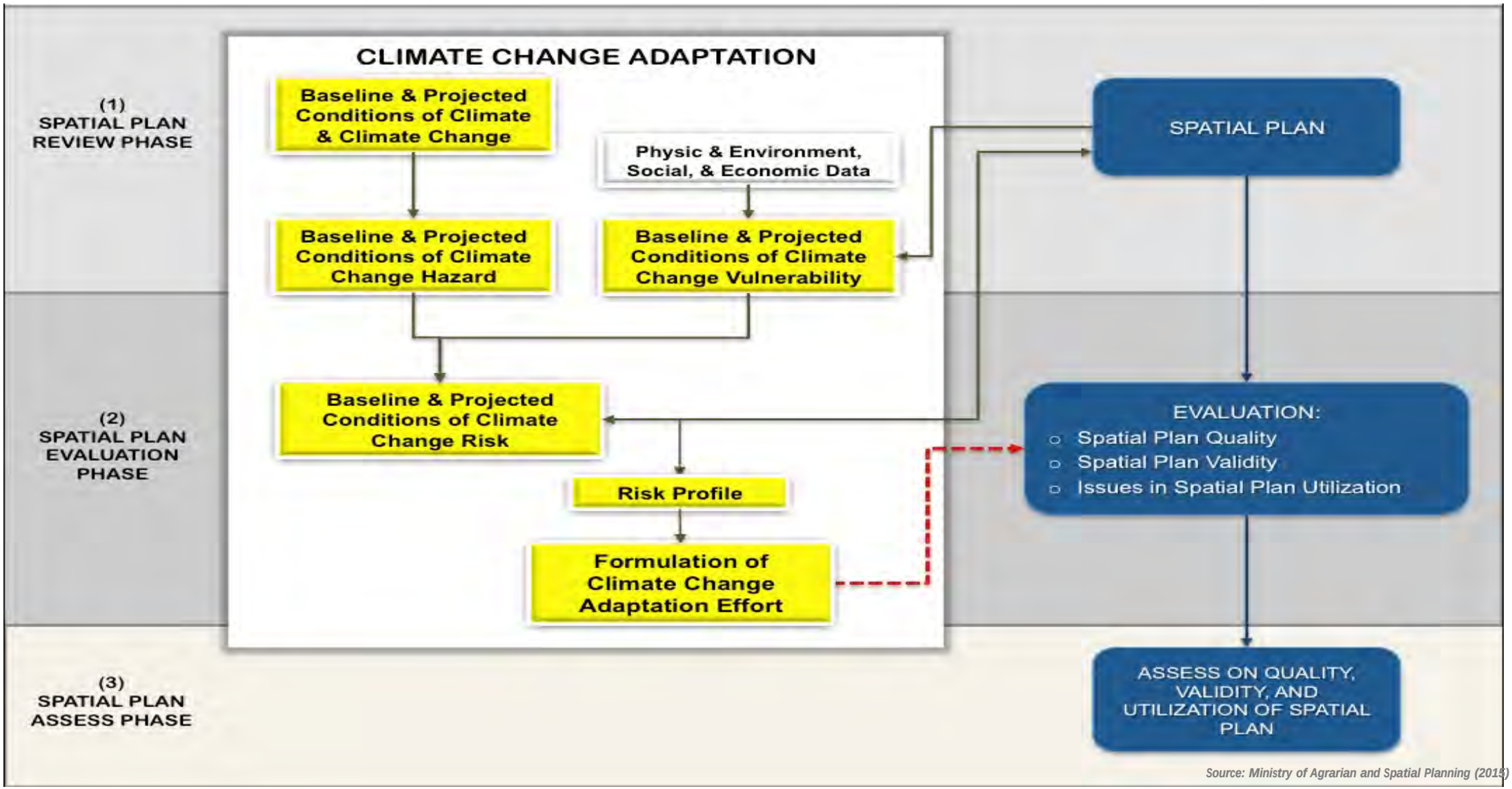
Source: Ministry of Agrarian and Spatial Planning (2015)

Concept of Integration of Climate Change Adaptation into The Evaluation of Spatial Planning



Source: Ministry of Agrarian and Spatial Planning (2015)

INTEGRATION OF CLIMATE CHANGE ADAPTATION ASSESSMENT INTO EVALUATION PROCESS OF SPATIAL PLANNING



Source: Ministry of Agrarian and Spatial Planning (2018)

Climate Change Science Basis Assessment Result as Input for Data and Information Collection of Spatial Planning Development

Baseline and Projected Climate Change Science Based Assessment: Surface Temperatur and Rainfall (Atmosphere Climate)

CLIMATOLOGY DATA

COLLECTING DATA AND INFORMATION ON THE SPATIAL PLANNING PROCESS

Data & Information

- Administrative Area
- **Physiography**
- Land Use
- Spatial Alocation
- Disaster Prone Area
- Social & Demographic
- Facilities
- Infrastructure
- Economic Growth
- Fiscal Capacity
- Institutional
- Spatial Planning Policies
- Sectoral Development Policies
- Aspirations of the people

Source: Ministry of Agrarian and Spatial Planning (2015)

Specification and Utilization of Science Basis Assessment Data in The Data and Information Collection for Spatial Planning

NO	CLIMATE COMPONENT	RESULT DATA	DATA/INFORMATION SPECIFICATION	UTILIZATION	PROVIDER
a.	**Atmospheric Climate**	Rainfall (Baseline & Projection)	▪ Average rainfall per time unit (depend on physical and environmental analysis requirements, its could be daily, monthly, and annual). Data is presented in spatial grid, with minimum data length is 30 years for baseline condition and continued 30 years for projection period. ▪ Especially for projection condition data is result from downscaling of several global climate model from IPCC (Intergovernmental Panel for Climate Change) with certain climate change scenario (for example: SRES on AR-4 and RCP on AR-5). ▪ The unit used is millimeters (mostly : mm) ▪ Data Presentation: table, graph and rainfall spatial distribution map	▪ Illustration of atmospheric climate characteristic as one of consideration of development activities in mainland which is embodied in spatial planning ▪ Input for physical and environmental analysis in spatial planning development (Example: determination of protected area analysis, land capability analysis, land suitability analysis, hydro-meteorological hazard assessment etc.	▪ Meteorology, Climatology, and Geophysic Agency (Badan Meteorologi, Klimatologi, dan Geofisika, BMKG) ▪ National Institute of Aeronautics and Space (Lembaga Antariksa dan Penerbangan Nasional, LAPAN) ▪ National Research Institute (BPPT, LIPI etc) ▪ Geospatial Information Agency (Badan Informasi Geospasial, BIG) ▪ Universities that have competence in meteorology, climatology, and oceanography fields
		Surface Temperature (Baseline & Projection)	▪ Average surface temperature per time unit (depend on analysis requirements, its could be daily or monthly). Data is presented in spatial grid, with minimum data length is 30 years for baseline condition and continued 30 years for projection period. ▪ Especially for projection condition data is result from downscaling of several global climate model from IPCC (Intergovernmental Panel for Climate Change) with certain climate change scenario (for example: SRES on AR-4 and RCP on AR-5). ▪ The unit used is Celcius degree (mostly : ^{0}C) ▪ Data Presentation: table, graph and spatial distribution map.		

Source: Ministry of Agrarian and Spatial Planning (2015)

NO	CLIMATE COMPONENT	RESULT DATA	DATA/INFORMATION SPECIFICATION	UTILIZATION	PROVIDER
b.	**Ocean Climate**	Sea Surface Level (Baseline & Projection)	▪ Sea Surface Level in the study area and its change per time unit (annual, decade). ▪ The unit used is centimeter (mostly : cm) ▪ Data and Information Presentation: table, graph and map.	▪ Illustration of ocean climate characteristic and its change as one of consideration of development activities in mainland and coastal area which is embodied in spatial planning ▪ Input for physical and environmental analysis in spatial planning development , especially in coastal and marine spatial planning	▪ Ministry of Maritime and Fisheries Affairs ▪ Geospatial Information Agency (Badan Informasi Geospasial, BIG) ▪ Meteorology, Climatology, and Geophysic Agency (Badan Meteorologi, Klimatologi, dan Geofisika, BMKG) ▪ National Institute of Aeronautics and Space (Lembaga Antariksa dan Penerbangan Nasional, LAPAN) ▪ National Research Institute (BPPT, LIPI, etc) ▪ Universities that have competence in metodology, climatology, and oceanography fields
		Sea Surface Temperature (Baseline & Projection)	▪ Average sea surface temperature per time unit (depend on analysis requirements, its could be daily or monthly). Data is presented in spatial grid, with minimum data length is 30 years for baseline condition and continued 30 years for projection period. ▪ Especially for projection condition data is result from downscaling of several global climate model from IPCC (Intergovernmental Panel for Climate Change) with certain climate change scenario (for example: SRES on AR-4 and RCP on AR-5). ▪ The unit used is Celcius degree (mostly : ^{0}C) ▪ Data Presentation: table, graph and map of rainfall spatial distribution by time, example: ^{0}C/10 years ▪ Data and Information Presentation: table, graph and map.		

Source: Ministry of Agrarian and Spatial Planning (2015)

Climate Change Hazard Assessment Result as Input for Data and Information Collection of Spatial Planning Process

Baseline & Projected Climate Change Hazard Map:

- Drought
- Landslide
- Flood
- Coastal Inudation

COLLECTING DATA AND INFORMATION ON THE SPATIAL PLANNING PROCESS

Data & Information

- Administrative Area
- Physiography
- Land Use
- Spatial Alocation
- **Disaster Prone Area**
- Social & Demographic
- Facilities
- Infrastructure
- Economic Growth
- Fiscal Capacity
- Institutional
- Spatial Planning Policies
- Sectoral Development Policies
- Aspirations of the people

Source: Ministry of Agrarian and Spatial Planning (2015)

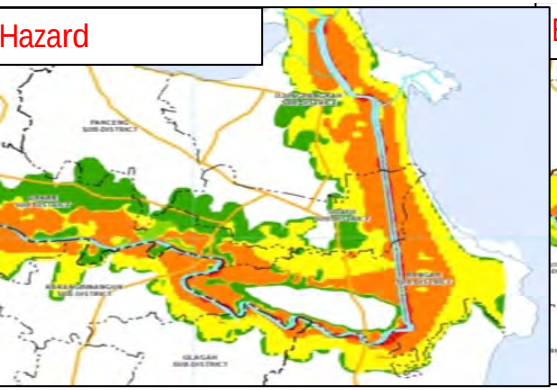
Specification and Utilization of Hazard Assessment Data in The Data and Information Collection for Spatial Planning

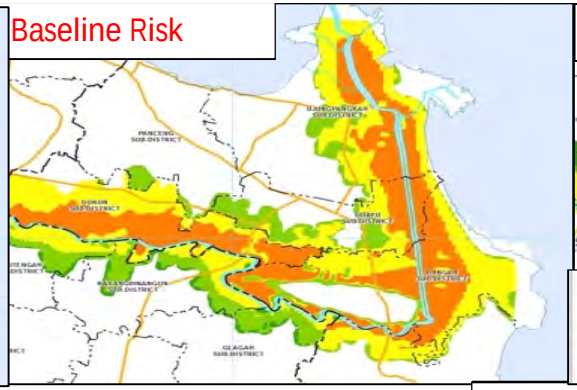
NO	HAZARD	RESULT DATA	DATA/INFORMATION SPECIFICATION	UTILIZATION	PROVIDER
1.	Coastal Inundation Hazard	Coastal inundation hazard distribution map on baseline and projection condition	• Illustrates coastal inundation hazard potential which triggered by natural factor combination that affected by climate change and climate variability such as global sea level rise, storm surge, La Nina, monsoon and flood on baseline and projection condition. • Coastal inundation hazard level classification is based on flow depth that represent the damage / loss level posed • Data and Information Presentation: Coastal Inundation Hazard Level Distribution Map • The necessary information scale adjusted to the accuracy of available data and spatial planning scale	• Provide an overview of disaster condition in planning area on baseline and projection condition. • As an Input for physical and environmental analysis in spatial planning development, especially in carrying capacity analysis. Hazard area could be used as constraint factor in the region determinations for cultivated activities. • As an input to complete Disaster-Prone Region analysis which is part of physical and environmental analysis.	• Ministry of Maritime and Fishery Affairs • BNPB • BIG • Alternative data sources: BPPT, LIPI, Universities that have competence in meteorology, climatology, and oceanography fields
2.	Flood Hazard	Flood hazard distribution map on baseline and projection condition	• Illustrates flood hazard potential due to rivers overflow on baseline and projection condition • Flood Hazard Level based on two factors i.e flood intensity and flood frequency. Flood intensity is represented by flow depth to show damage level that may arise and flood frequency is the possibility of flood occurrence within specified time • Data and Information Presentation: Flood Hazard Level Distribution Map • The necessary information scale adjusted to the accuracy of available data and spatial planning scale	• Provide an overview of disaster condition in planning area on baseline and projection condition. • As an Input for physical and environmental analysis in spatial planning development, especially in carrying capacity analysis. Hazard area could be used as constraint factor in the region determinations for cultivated activities. • As an input to complete Disaster-Prone Region analysis which is part of physical and environmental analysis.	• Large River Basin Center, Ministry of Public Work and Housing • BNPB • BMKG • BIG • Alternative data sources: BPPT, LIPI, Universities that have competence in disaster management, water resource engineering, hydrology, meteorology and climatology fields
3.	Drought Hazard	Drought hazard distribution map on baseline and projection condition	• Illustrates meteorological drought hazard which is degree of dryness relative to normal or mean conditions as statistic reference value on baseline and projection condition	• Provide an overview of disaster condition in planning area on baseline and projection condition. • As an Input for physical and	• BMKG • Ministry of Agriculture • BNPB

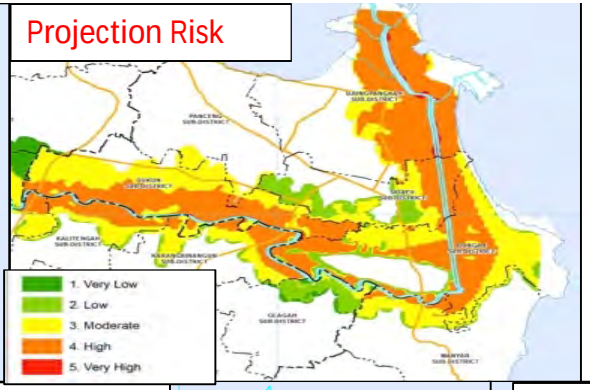
Source: Ministry of Agrarian and Spatial Planning (2015)

NO	HAZARD	RESULT DATA	DATA/INFORMATION SPECIFICATION	UTILIZATION	PROVIDER
			• Meteorogical drought hazard level classification based on magnitude of deviation from mean rainfall accumulation value on three and six moth period, and length of dry days when the rainfall less than 2 mm threshold. • Data and Information Presentation: Meteorological Drought Hazard Level Distribution Map • The necessary information scale adjusted to the accuracy of available data and spatial planning scale	environmental analysis in spatial planning development, especially in carrying capacity analysis. Hazard area could be used as constraint factor in the region determinations for cultivated activities. • As an input to complete Disaster-Prone Region analysis which is part of physical and environmental analysis.	• BIG • Alternative data sources: BPPT, LIPI, Universities that have competence in disaster management, meteorology, climatology, and hydrology fields
4.	Landslide Hazard	Landslide hazard distribution map on baseline and projection condition	• Description: Landslide (related to climate change) is land movement triggered by extreme rainfall (more than 60 mm/day). • Landslide Hazard Level classification obtained from standardizations indicators i.e.: 1) Slope, 2) Land Use, 3) Geological Condition, and 4) Rainfall frequency in the study area. • As a reference for landslide hazard map is Indonesian National Sandard (Standar Nasional Indonesia, SNI) to build Susceptibility to Landslide Map (SNI 13-7124-2005). • Data and Information Presentation: Landslide Hazard Level Distribution Map • The necessary information scale adjusted to the accuracy of available data	• Provide an overview of disaster condition in planning area on baseline and projection condition. • As an Input for physical and environmental analysis in spatial planning development, especially in carrying capacity analysis. Hazard area could be used as constraint factor in the region determinations for cultivated activities. • As an input to complete Disaster-Prone Region analysis which is part of physical and environmental analysis.	• PVMBG-ESDM • National Research Instiitute (BPPT, LIPI, dsb) • BNPB • BIG • Alternative data sources: BPPT, LIPI, Universities that have competence in disaster management, meteorology, climatology, geology and hydrology fields

Source: Ministry of Agrarian and Spatial Planning (2015)



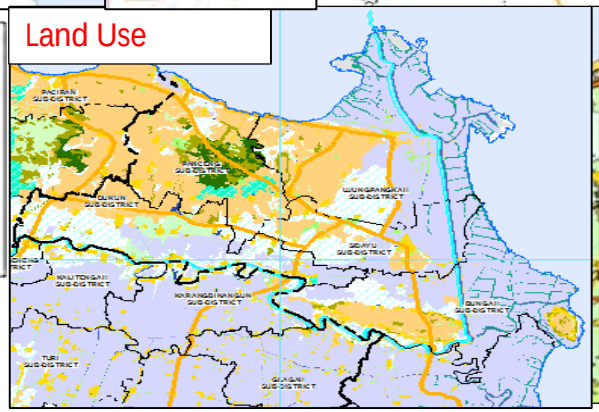




ZONE 1 :

- Kab. Gresik: Kec. Ujungpangkah, Sidayu, Bungah Manyar, Dukun
- Kab. Lamongan: Kec. Kalitengah, Karangbinangun, Glagar

An Example of Risk based Adaptation on Spatial Planning (Bengawan Solo Watershed)



Adaptation Options on Spatial Structure	
Structure	**Adaptation Option**
Primary Arteri Road	Flood Proofing on the road part
Primary Collector Road	Flood Proofing on the road part
Highway	Flood Proofingon the road part

Adaptation Options on Spatial Pattern	**Pattern**	**Adaptation Option**
	Agricul-ture land	• Development of Early Warning System • Development of water inundation proof rice seed
		• Development of river dike • Development of ponds and dams
	Settle-ment	• Controlling settlements in inundation areas • Flood-proofing on housing
		Combination of structural and vegetation protection
		Development of settlements out of inundation areas

Source: Ministry of Agrarian and Spatial Planning (2015)

THANK YOU