No.

Dar es Salaam City Council

The United Republic of Tanzania

Dar es Salaam

Transport Policy and System Development

Master Plan

Technical Report 10

Geographic Information System

June 2008

JAPAN INTERNATIONAL COOPERATION AGENCY

PACIFIC CONSULTANTS INTERNATIONAL

CONSTRUCTION PROJECT CONSULTANTS

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Chapter 1 Introduction

A variety of data/information has been collected in the Dar es Salaam Transport Policy and System Development Master Plan from government agencies and relevant agencies in addition to various surveys conducted by the Study team. These collected data have been compiled/integrated in the numerical format or in the format of geographical data, so called Geographic Information System (GIS) format, for farther analysis.

In this master plan study, GIS has been developed not only as a database but also as one of the planning tools. The primary objective of this GIS development effort is for the master plan, at the same time it is expected to be used for further planning activities by the people concerned in the field of urban and urban transportation planning of Dar es Salaam.

GIS provides a means of integrating information to understand issues and problems faces in Dar es Salaam region today such as uncontrolled urbanization and traffic congestion. GIS shall help organize data regarding these problems and to understand their spatial relationships. These understandings shall lead to more sensitive and intelligent decision-making.

This report presents the basic feature of the GIS including data structure, definitions and attributes first. Consequently application of this GIS is presented, that is, “development constraints analysis” and “urbanization simulation”. This simulation technique is useful to predict future urbanization areas in accordance with the population increase in future, then, provides important planning parameters with the traffic simulation models.

Chapter 2 Dar es Salaam GIS

2.1 General Feature

GIS provides excellent means to acquire, store, manage and, above all, geographically integrate large amounts of information from multi-disciplinary information sources. Further, it is an excellent tool for visualizing and analyzing urban and urban transport planning data to find out trends, inter-dependencies, inter-relationship such as accessibility of facilities, availability of modes of transportation.

GIS is highly recognized as a potential tool for developing surveillance activities. Advantages of GIS are seen in many aspects when compared to conventional methods used in transportation planning and management. Some of the advantages and tools can be enumerated as shown below.

1) Overlay

GIS facilitates overlay of different kinds of information such as transportation network, census, land use and socio-economy. This helps in identifying interrelationships and trends in a particular phenomenon and can be used in planning and decision making through multi-criteria modeling.

2) Query

GIS allows making queries in spatial domain that is not supported in other databases. These queries can be made to find out a suitable location for new facilities serving a given number of sub-ward/ward with defined access time or distance.

3) Buffer

Buffer analysis can be carried out to define the area to be considered to influence a person's activities or impact zones of vector breeding sites, where control activity needs to be strengthened, etc.

4) Network

This is a suitable analysis procedure for locating efficient route for various facilities, locating bus stops, or identifying walking distance area using road network.

5) Statistics

GIS provides statistical analysis similar to most of other database systems, but its direct linkage to geographical location provides additional meaning and better interpretation to statistical interference.

Thus, GIS software[1] offers many tools for visualizing, creating, managing and analyzing GIS database in the planning process of the Master Plan. The JICA study team developed GIS application tools as shown below;

- Data exchange routine(s) between multiple data sources and GIS database;
- GIS user interface(s) for analyzing and presenting natural condition;
- GIS user interface(s) for analyzing and presenting land use;
- GIS user interface(s) for predicting future urbanization and future planning parameters; and,

GIS database structure will also be considered to restore the data in time-related form at the same location but with either historical or future year values (planning parameters).

[1] ArcGIS is used for this master plan study. ArcGIS is a product of ESRI (Environmental System Research Institute, Inc.).

2.2 Data Structure and Definitions

A GIS database set have been developed for the Master Plan Study. The one is the GIS covering whole Dar es Salaam area. This GIS database will be used as a comprehensive planning tool for Dar es Salaam (called Dar es Salaam GIS: DSM-GIS).

DSM-GIS includes following information;[2]

- Administrative boundary;
- Natural condition;
- Land use;
- Utilities;
- River;
- Transport Network;
- Place name; and
- Raster information.

Data format retrieved from GIS database will be directory connected to the other key planning tools including JICA-STRADA[3] for strategic transport modeling and VISSIM[4] for microscopic simulation models.

Table 2.2.1 provides detailed information of data included in the database.

[2] DSM-GIS data prepared with projected coordination system "UTM37S" and datum "WGS84".
[3] STRADA is a transportation modeling software developed by JICA. It is a strategic transport model tool, namely, four-step procedure.
[4] VISSIM is one of the transportation modeling tools provided by PTV Ltd., Germany.

Table 2.2.1 DSM-GIS Data Structure

DATA No.	Level 1	Level 2	Level 3	Type	Main Attribute data (Field Name: Attribute)
01	00_DSM_GIS	01_Boundary	01a_Region	Polygon	Pop_Census: Population (2002) Cal_area: Area (m^2) Pop_den_ha: Population density(person/ha) (2002)
02			01b_Municiparity	Polygon	Ditto
03			01c_WARD	Polygon	Ditto
04			01d_SubWARD	Polygon	Ditto
05			01e_UGB_Outline	Polygon	Outline of Urban Growth Boundary
06			01f_UGB_Grid	Polygon	Grid data(1km*1km) of Urban Growth Boundary
07		02_Natural Condition	02a_Contour_all	Line	Contour: Sea level (2m pitch)
08			02b_Contour_10M	Line	Contour: Sea level (10m pitch)
09			02c_Contour_20M	Line	Contour: Sea level (20m pitch)
10			02d_Erosion	Polygon	JST_constr: Erosion areas identified by JICA study team
11			02e_Flood	Polygon	Flood river: Flood areas identified by JICA study team
12			02f_Forest	Polygon	Forest reserve designated in SUDP
13			02g_Swamp	Polygon	Swampy areas identified by SUDP
14			02h_Geology	Polygon	Soil condition from Geological survey map(1963) prepared by Geological survey division (Code_NM: Soil Type name)
15		03_Landuse	03a_Landuse_2007	Polygon	DSM landuse type identified by JICA Study Team ("Residential area", "Other urban area", "Vacant/ Agriculture", "Waterbody", "Military", "Industry")
16			03b_Landuse_SUDP	Polygon	Land use plan by SUDP (Strategic Urban Development Planning Framework)
17			03c_Land_constraint_SUDP	Polygon	DSM land constraint condition identified in SUDP
18			03d_SUDP_CIUP_Unplanned residential	Polygon	Unplanned residential area identified by CIUP and SUDP
19		04_Utility	04a_UtilityPlan(Water)_SUDP	Polygon	Future water supply plan prepared by SUDP
20		05_River	05a_River2007	Line	DSM river network
21		06_Transport	06a_Roadnet2007	Line	The number of lane(s) Distance (m) Management entity Road condition (Paved/ Unpaved) Road name
22			06b_Railnet2007	Line	Tanzania Rail Corporation (TRL) Tanzania-Zambia Rail
23			06c_Network Dataset	Line	Road network for network analysis
24			06d_Roadnet2030	Line	Road network plan (target year 2030) CLASS_NM: Road Class (Y2030) ANODE: Start node number BNODE: End node number Proj_No: JST Proposed project number

Table 2.2.1 DSM-GIS Data Structure (continued)

DATA No.	Level 1	Level 2	Level 3	Type	Main Attribute data (Field Name: Attribute)
25		07_Placename	07a_Placename	Point	Major city/ town/ village (s) location
26		08_Raster	08a_DSM_DEM_original	Raster	Digital Elevation Model for DSM
27			08b_slope_200mgrid	Raster	
28			08c_slope_aspect_200mgrid	Raster	Slope(%) data for DSM (cell size:200m*200m)
29			08d_Flow_accumulation	Raster	Result of water flow accumulation analysis for DSM river network
30		09_Others	09a_3Dshot_JPG	Raster	3D Images of DSM region
31			09b_DSM_Mesh1km_poly	Polygon	Mesh polygon for Urban Development Constraints Analysis (1km*1km)
32		10_collected data	10a_SRTM_download_data	Raster	Downloaded SRTM 90m DEM data
33			10b_DSM_map_1_2500	Vector (CAD)	DSM City center area detailed AutoCAD map data (Scale 1:2500)
34			10c_Scanned Urban area Map	Raster	Scanned DSM Urban area image with coordinate system.

Source: JICA Study Team

Chapter 3 Urban Development Constraints Analysis

3.1 Objective and Concept of the Analysis

The objective of this analysis is to identify “suitable areas” or “likely areas” for future urban expansion, turning it the other way, which is equivalent to identification “unsuitable areas” for urban development including housing and other social and economic activity purposes.

The unsuitable areas will be identified as physically difficult areas to be developed in terms of natural condition such as flood and landslide. Based on the baseline condition map (natural condition map) prepared by SUDP, which indicates several hazardous areas, the JICA study team has conducted the field survey and collected other data source to confirm the information.

The primary parameters to explain degree of “unsuitability” or difficulty in developing the area include :

- flood possibility including historical flooding information;
- drainage difficult areas (lands relatively lower than the surrounding areas);
- erosion/landslide/slope
- soil condition (soft soil)
- forest (Conservation area); and
- swamp area

In fact, Dar es Salaam has been developed in rather flat plain/hilly area up to the sea level of 60m. The areas of less than 5m sea level and riverbed areas are recognized as the unsuitable areas in general, however, some recent urban developments are seen in such unsuitable areas.

All of above primary parameters are collected in various formats. These data were modified and manipulated into GIS format for integrated spatial analysis. Figure 3.1.1 to 3.1.6 shows primary parameters in GIS format.

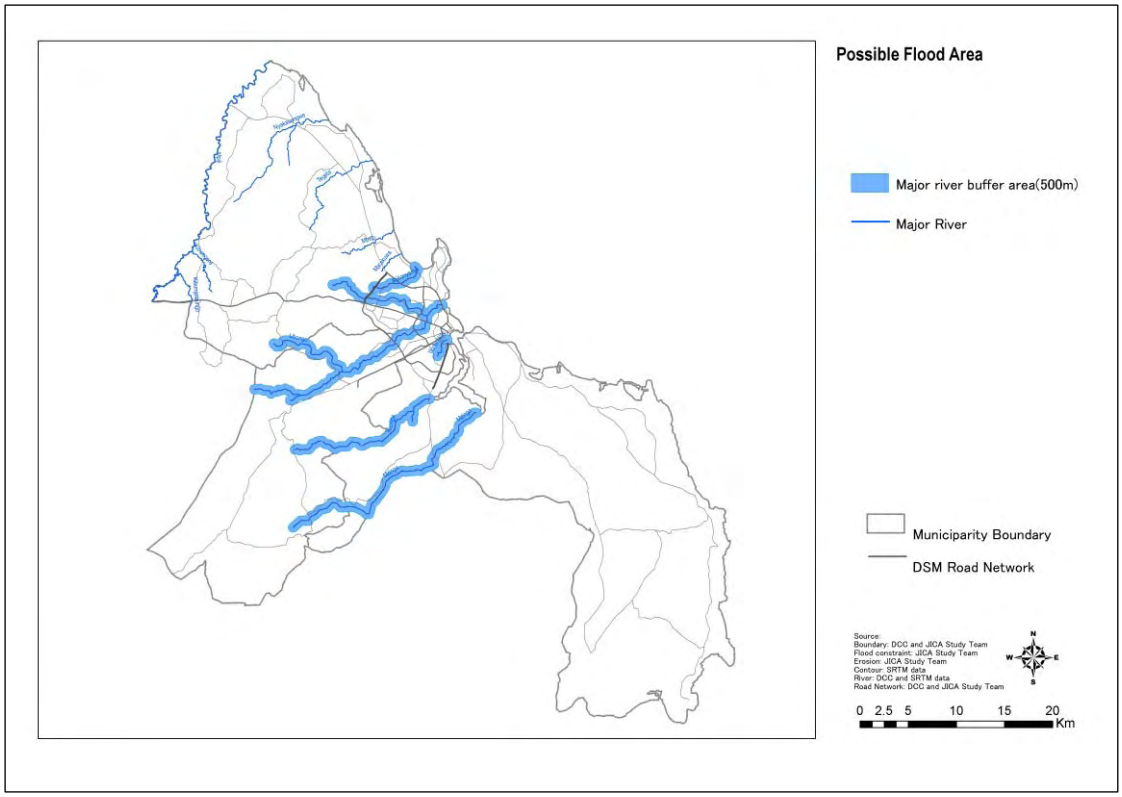

Figure 3.1.1 Potential Flood area

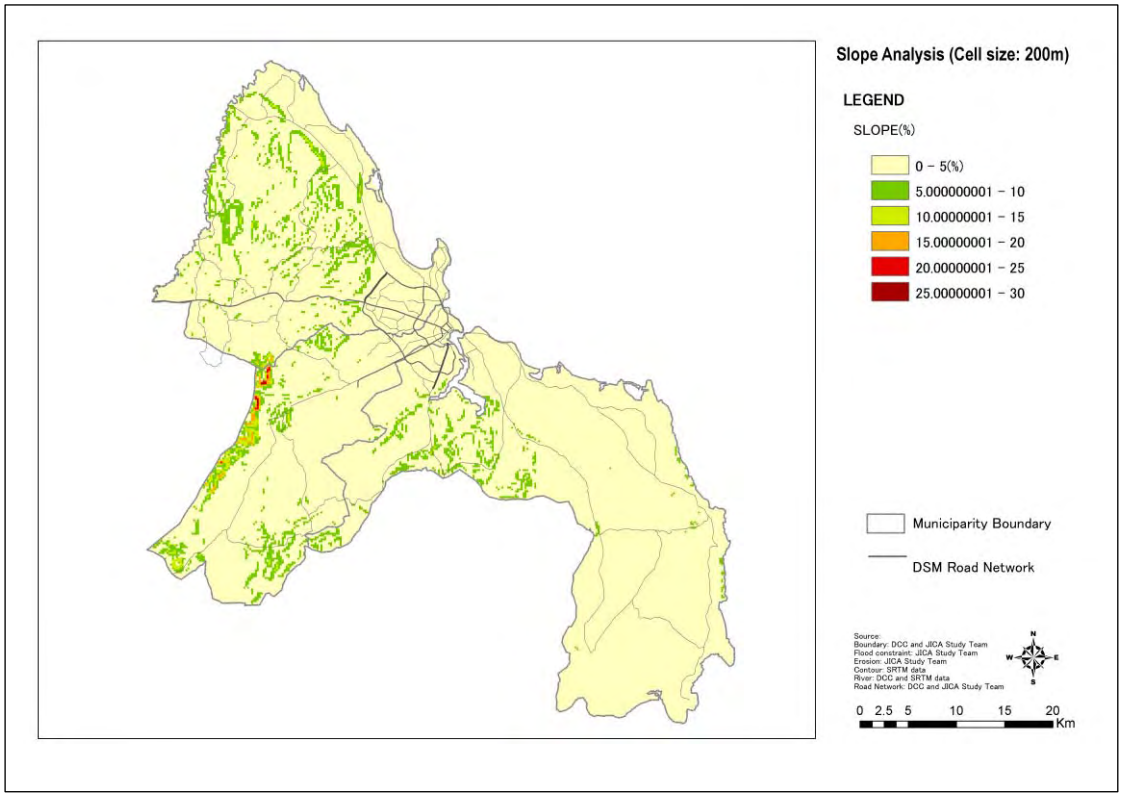

Figure 3.1.2 Slope Analysis

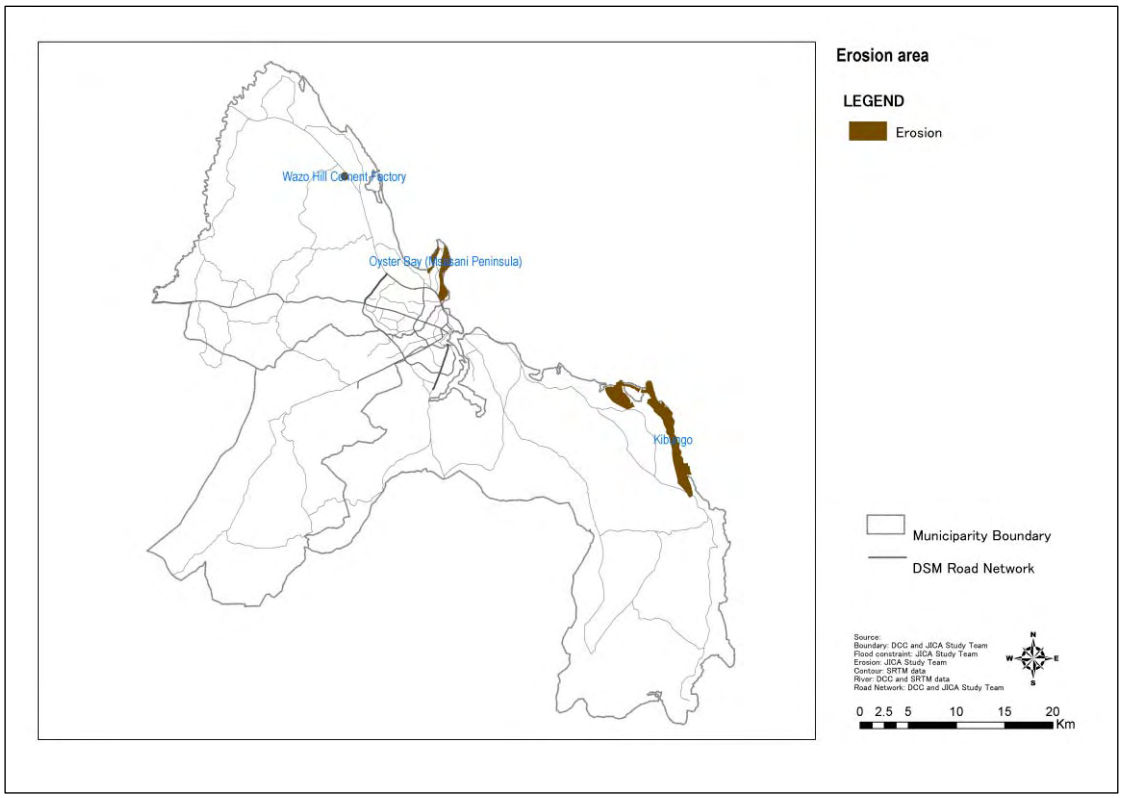

Figure 3.1.3 Erosion area

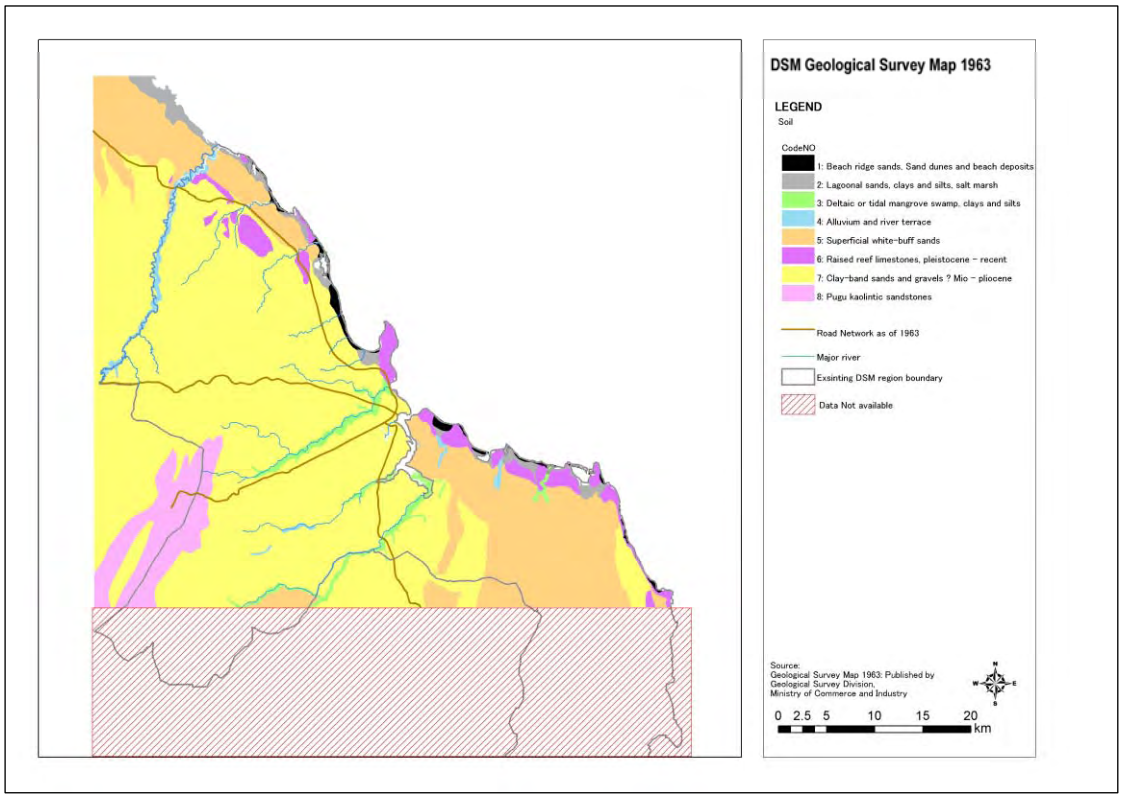

Figure 3.1.4 Soil condition

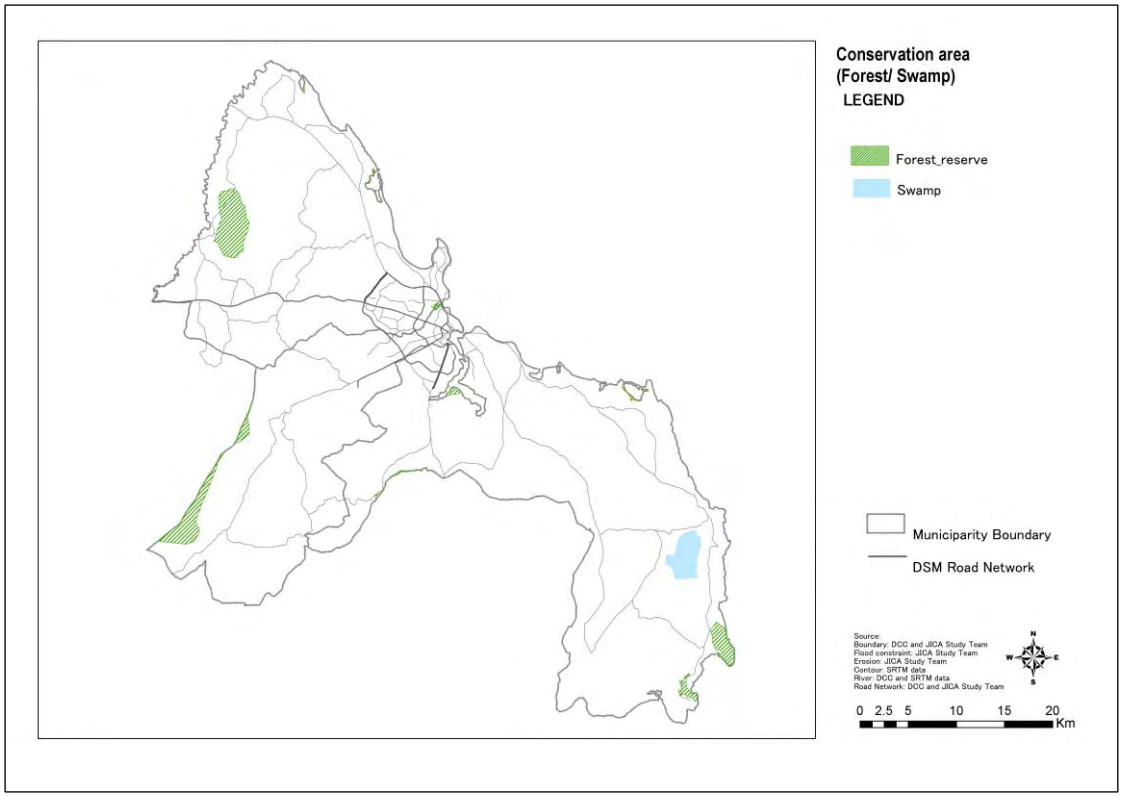

Figure 3.1.5 Conservation area (Forest/ Swamp)

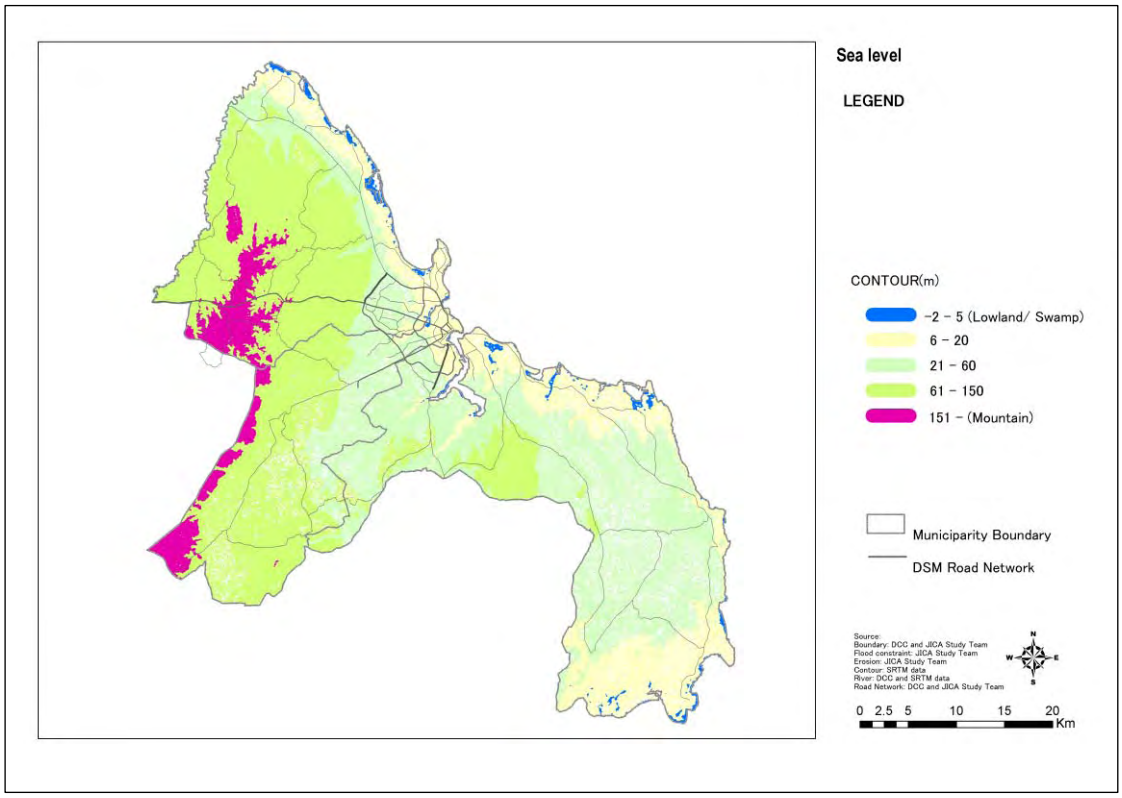

Figure 3.1.6 Sea Level Analysis

Table 3.1.1 Clarification of Parameters for Urban Development Constraint Analysis

(Natural Environment)

Criteria for development constraint	Identified method (Data source)
Possible Flood area	Result of historical flood information and field survey
Drainage difficult areas	Calculation of Slope (%) with Digital elevation model(DEM) using SRTM[5] data
Erosion/ landslide	Field survey and DEM analysis (slope/ aspect)
Soil condition	SUDP, 1963 Geology survey and field survey
Forest	SUDP and Satellite Imagery
Swamp	SUDP and Satellite Imagery
Sea level	Contour analysis using SRTM data

Beside, parameters for natural condition which mentioned above, other development constraint factors are also surveyed and analyzed.

Table 3.1.2 Clarification of Parameters for Urban Development Constraint Analysis

(Other than Natural Environment)

Criteria for development constraint	Identified method
Military area	SUDP, hearing and existing topographic map
Airport area	Satellite Imagery and existing topographic map
Existing industrial area	SUDP and existing topographic map

An overall evaluation on "Development Constraints" is made by overlaying with the above (10) categories of the assessment and integrated into Figure 3.1.7.

In addition to prepare all of parameters, the JICA study team prepared SUDP land development constraint data in GIS format to compare both data. Figure 3.1.8 shows the SUDP land development constraints, while Figure 3.1.7 shows the updated land development constraints map by the JICA study team. The unsuitable areas indicated in Figure 3.1.7 are relatively small than that of SUDP.

In the consequent master plan planning phase in this master plan study, the information depicted in Figure 3.1.7 (JICA's updates) was used as a global guideline for the spatial development in future.

[5] The Shuttle Radar Topography Mission (SRTM) obtained elevation data on a near-global scale to generate the most complete high-resolution digital topographic database of Earth. SRTM consisted of a specially modified radar system that flew onboard the Space Shuttle Endeavour in February of 2000. SRTM is an international project spearheaded by the National Geospatial-Intelligence Agency (NGA) and the National Aeronautics and Space Administration (NASA).

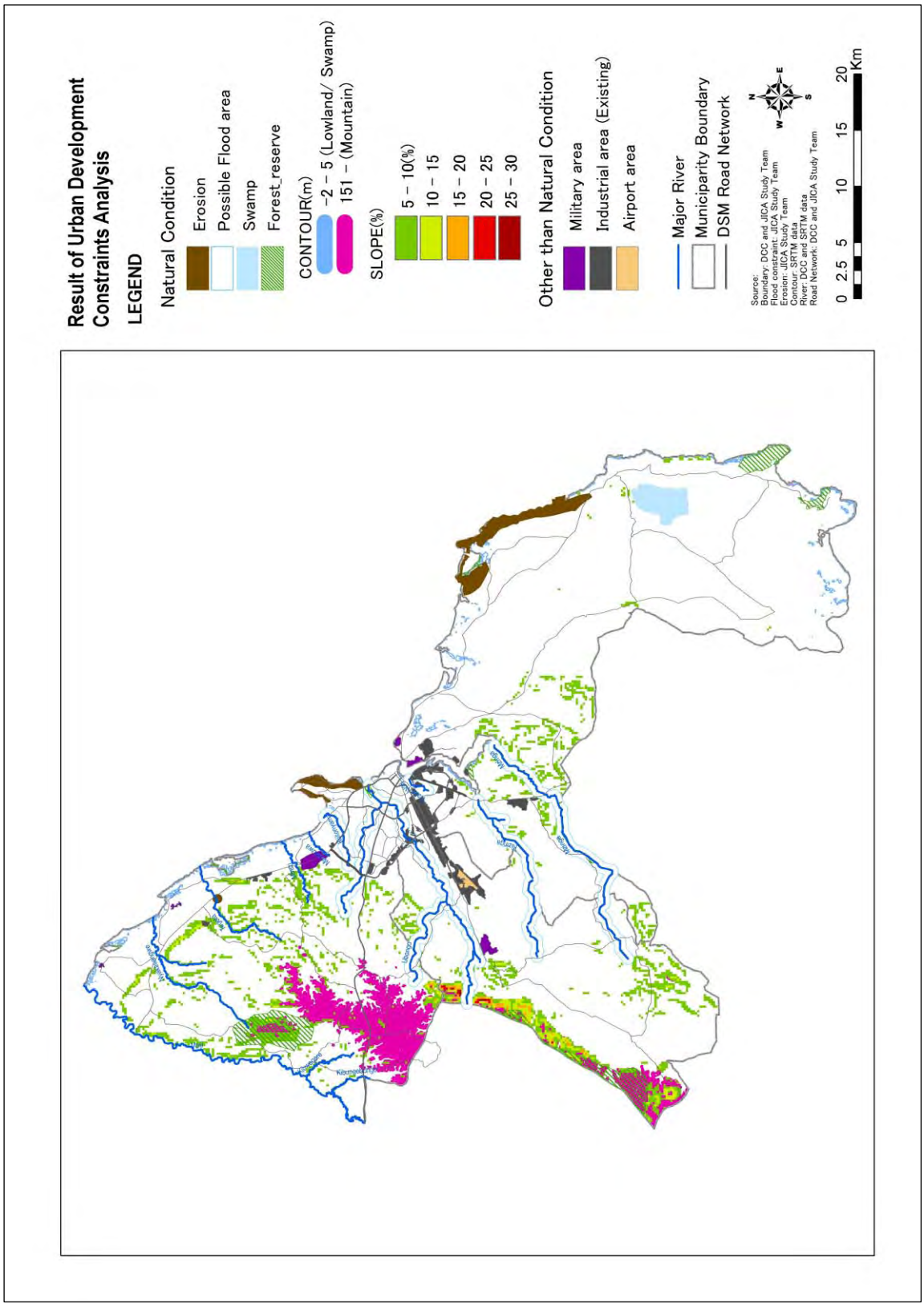

Figure 3.1.7 Updated Unsuitable Area Map (JICA)

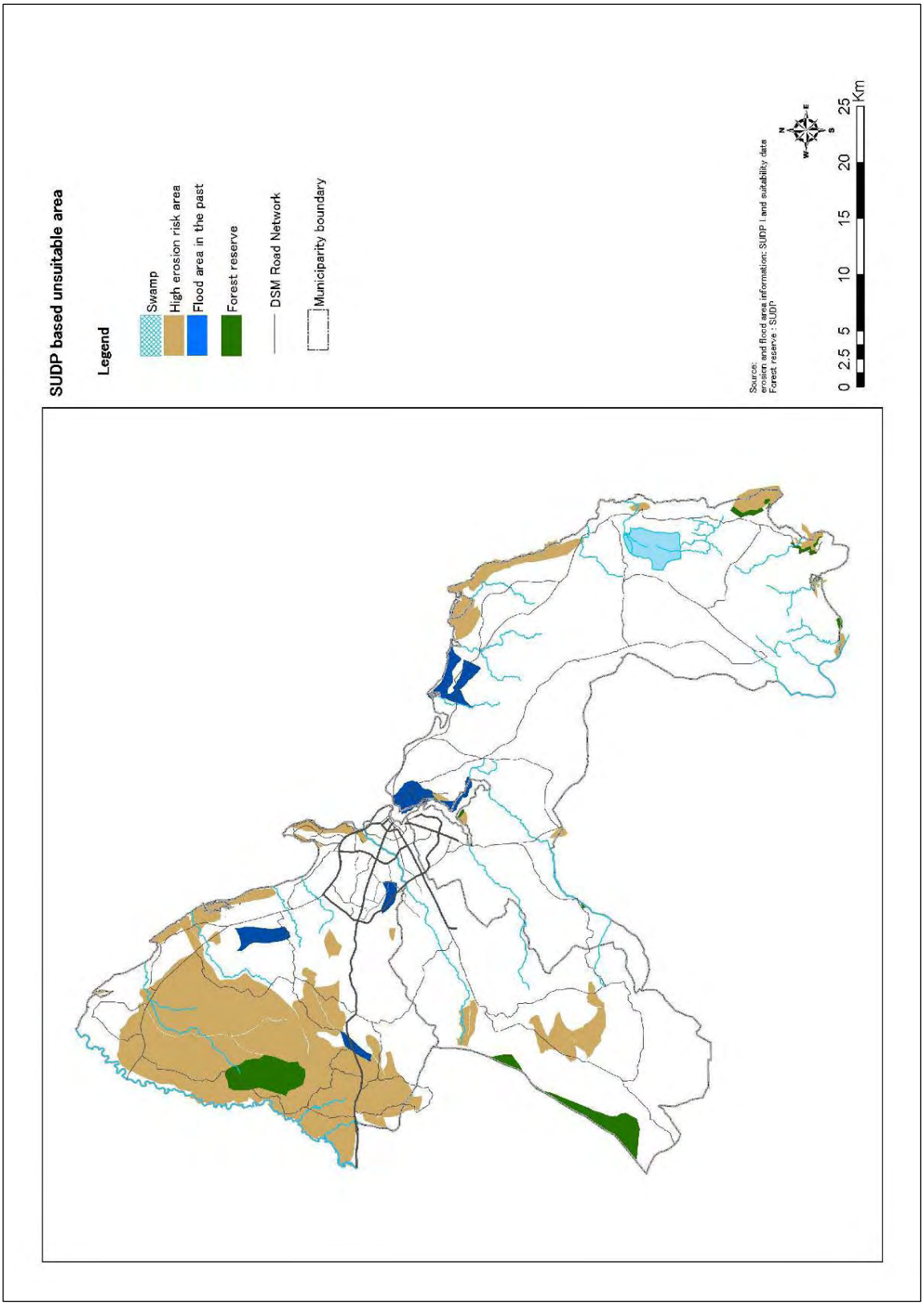

Figure 3.1.8 SUDP based unsuitable area

Chapter 4 Urbanization Simulation

4.1 Concept of Urbanization Simulation

Given an arithmetical model, the geographic analysis allows users to study land development potentials in the real world process. The GIS technology contributes this process by providing tools, which can be combined with meaningful sequences to develop new models.

In this urbanization simulation, urban development potentials are evaluated followed by "*Urban Development Constraints Analysis*" which explained previous section.

The potential of land in terms of urban development (for housing and commercial uses) shall be explained by various factors. Such factors include:

- accessibility to major roads;
- availability of utility services;
- accessibility to public services;
- accessibility to work place; and
- accessibility to major urban functions (for commercial, business and social activities).

On the other hand, negative factors for urban development include:

- Hazardous conditions (which are identified in the previous section);
- Other development constraint factors, such as military area and airport area and
- Traffic congestion (lower mobility).

By using these indicators, likely developed areas (potential areas to be newly developed in future) can be identified.

4.2 Methodology

The potential analysis is made based on a grid system (or can be called a mesh system) which is artificially developed square polygons (imaginary spatial unit to know characteristics of the area by each grid) to cover the whole Dar es Salaam. The potential of land is expressed based on this grid system, that is, each square polygon has a value in accordance with the potential of urban development of its location.

For this study, a 1km^2 grid system was prepared as shown in Figure 4.1.1 (Total number of grid is 1,835). The parameters to explain the development potential for its analysis showed in Table 4.1.1.

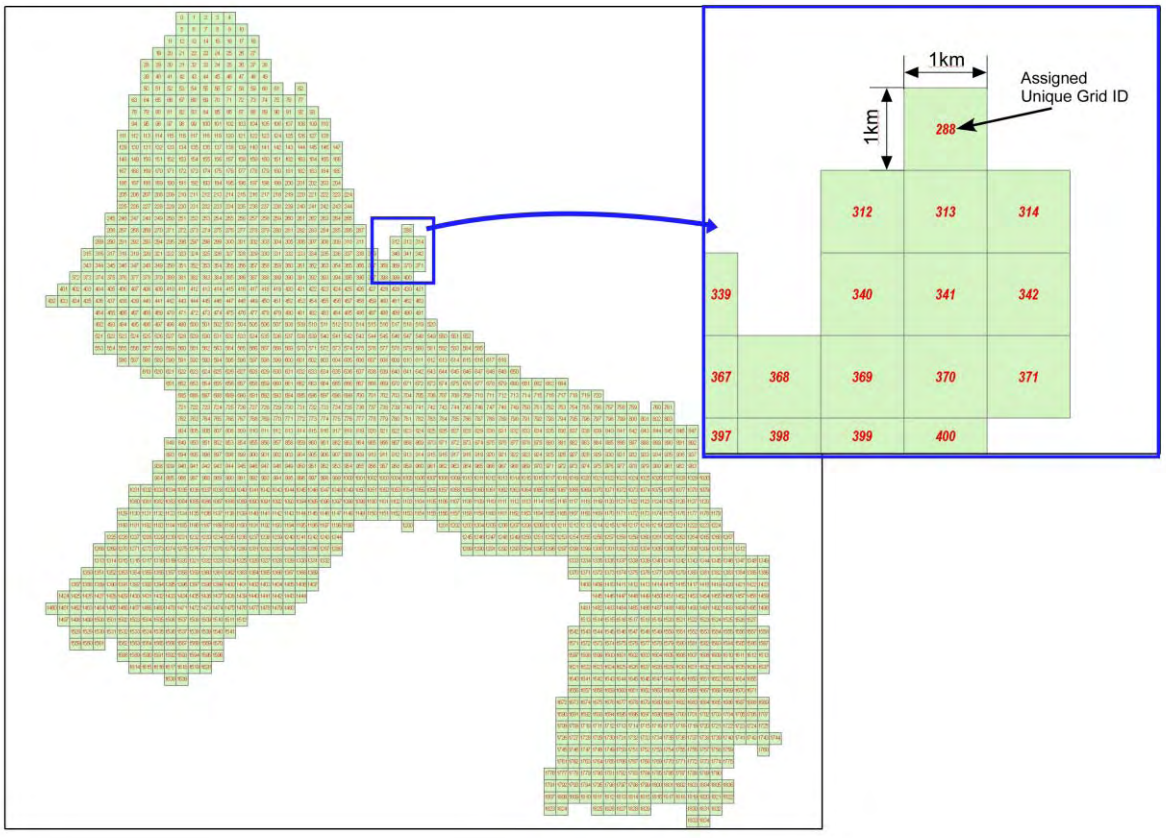

Figure 4.1.1 Prepared Grid System of Dar es Salaam

Table 4.1.1 Parameters for preliminary potential analysis

No.	Type of Factor	Parameters
1	Positive factors	Accessibility to Morogoro Road
2	Positive factors	Accessibility to CBD
3	Positive factors	Accessibility to 6-lane road
4	Positive factors	Accessibility to 4-lane road
5	Positive factors	Accessibility to 2-lane road (paved)
6	Positive factors	Accessibility to 2-lane road (unpaved)
7	Positive factors	Time distance(15 min.) from CBD
8	Positive factors	Time distance(30 min.) from CBD
9	Positive factors	Time distance(45 min.) from CBD
10	Positive factors	Time distance(60 min.) from CBD
11	Positive factors	Accessibility to Water supply
12	Negative factors	Flood possibility
13	Negative factors	Forest area
14	Negative factors	Erosion area
15	Negative factors	Swamp area
16	Negative factors	Existing Industrial area
17	Negative factors	Sea level less than 6m
18	Negative factors	Sea level more than 150m
19	Negative factors	Slope(%)
20	Negative factors	Military area
21	Negative factors	Airport area
22	Negative factors	Industrial area

Classified values (integers) are given to express unique condition of each grid, for example, higher positive values to narrower road buffer, while negative values to the hazardous areas. Figure 5.2 shows a conceptual calculation method of value of each grid (called Scoring System). In the Figure 5.2 there are two elements to indicate the potential, namely, the road buffer and the flood area. The road buffer is classified in terms of distance from the roads, namely 1km buffer and 2km buffer in the Figure. The values inside the road buffer are positive, say, 2 points for inside the 1km buffer and 1 point for the area between 1km and 2km. The flooding areas have negative values, say, -3.

Potential value of each grid is calculated as a sum of these values as shown in Figure 4.1.2. Finally every grid has unique value to express its development potential.

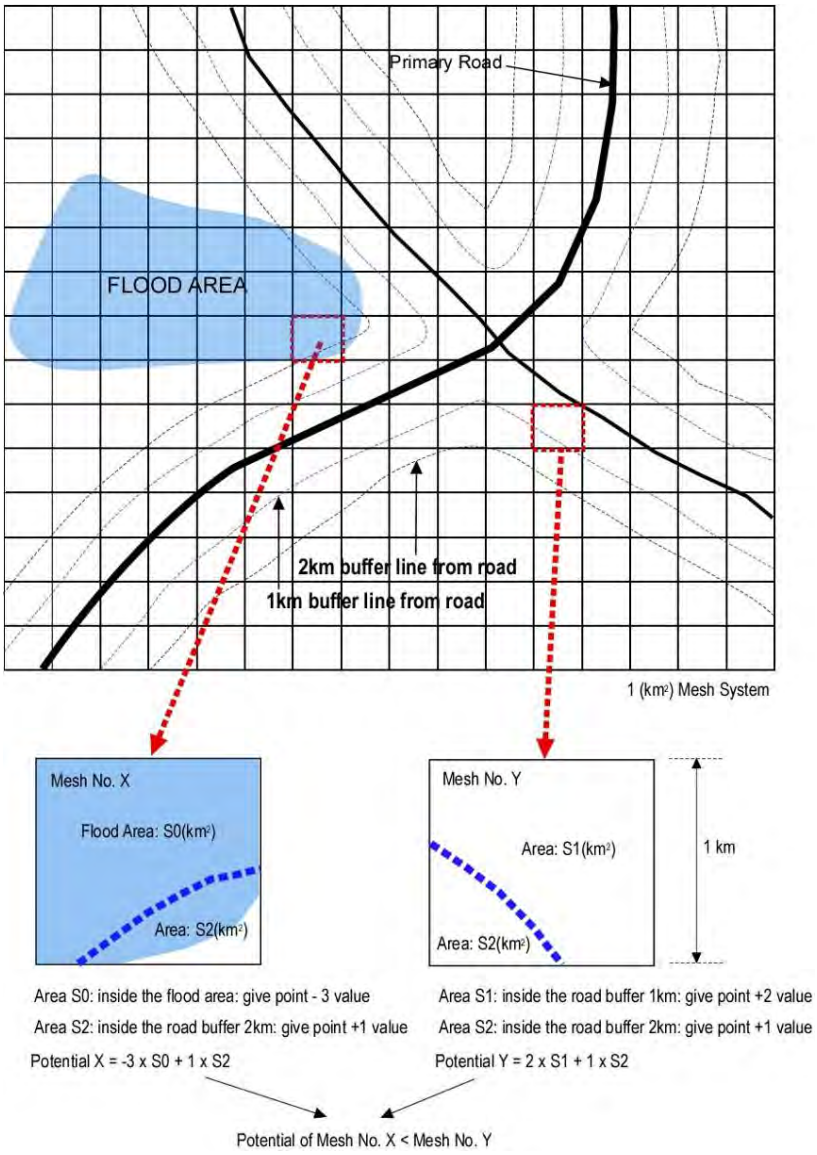

Figure 4.1.2 Concept of Scoring System

By sorting the grids by order of the potential value, sequential numbers are given to each grid, which shows the development potential in terms of order. It is assumed that urban development will be made in accordance with this ordering system. Figure 4.1.3 in the next section shows an application of this scoring system to simulate the year 2007 urbanization.

4.3 Simulation Result

(1) Simulated Existing Urbanization

Figure 4.1.3 shows an application of the scoring system in Year 2007 (existing condition). The red shaded area shows a simulated urbanization area based on the scoring method, while the blue shaded area shows the exiting urbanized area. This scoring system explains the existing urbanization pattern.

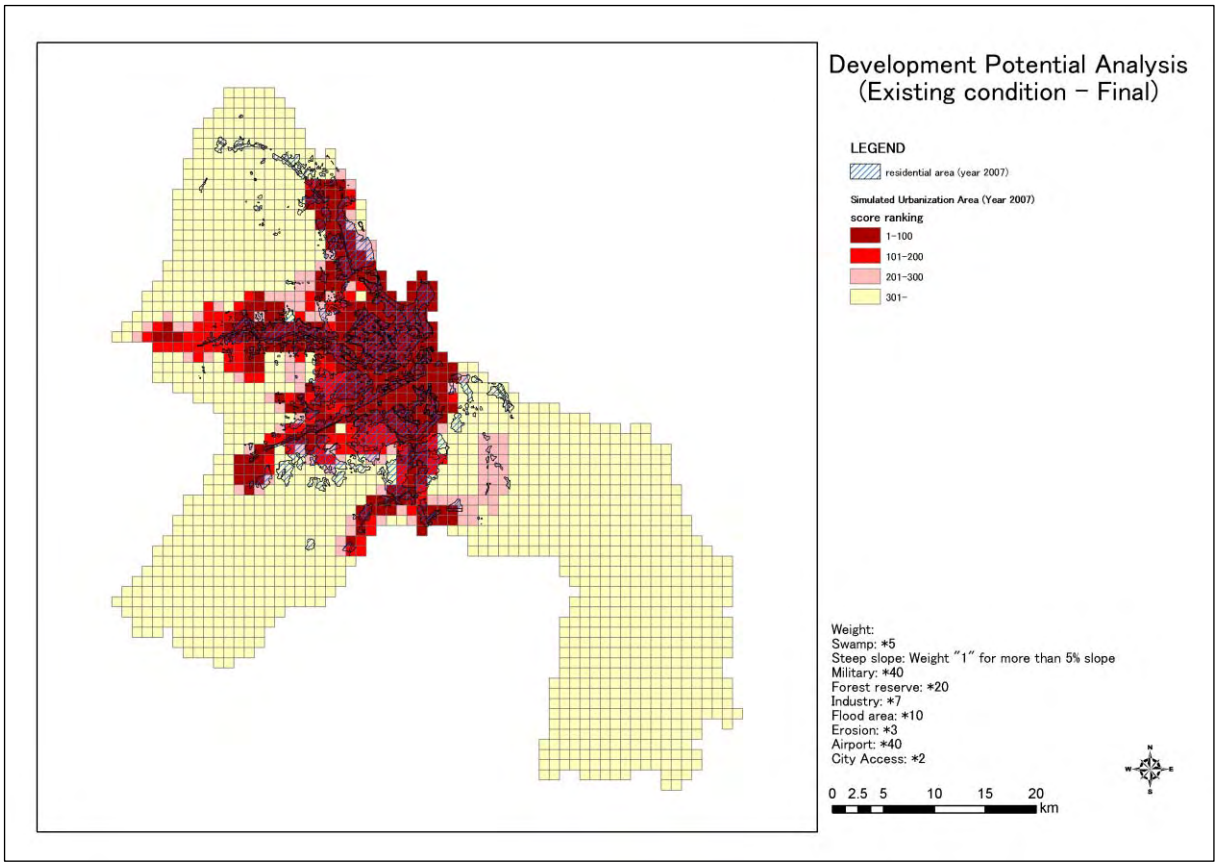

Figure 4.1.3 Simulated Urbanization Area in 2007 and Exiting Urbanization Area

(2) Simulated Future Urbanization

The future urbanization potential, aiming at the year 2030 was simulated with the same model developed in previous section. For this simulation model, 2- type of road network are taken into consideration as new factors, in addition to the basic urban data.

Figure 4.1.4 shows result of simulated urbanization in year 2030 in "Trend Case" using GIS model which explained in previous section.

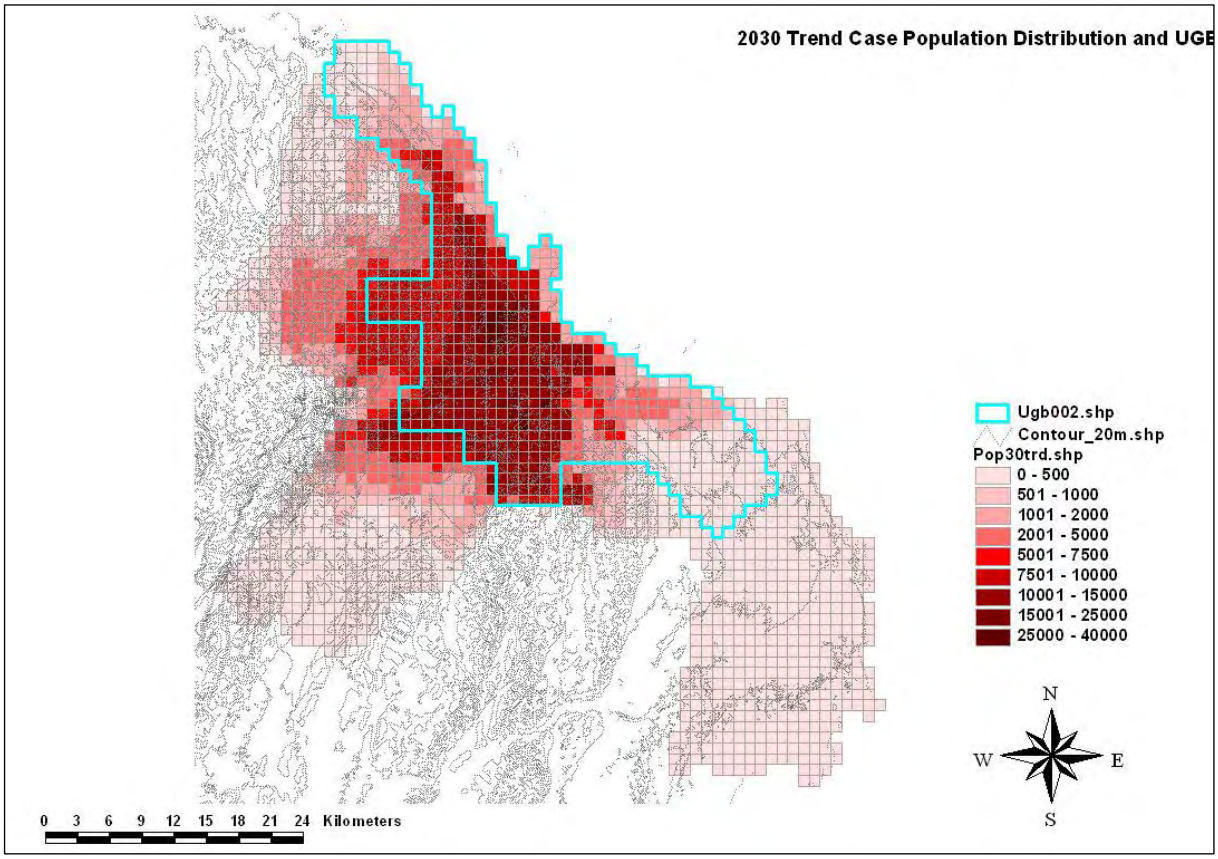

Figure 4.1.4 Simulated Future Urbanization Area (Trend Case)

Figure 4.1.5 shows result of simulated urbanization in year 2030 in "Controlled Urbanization Case".

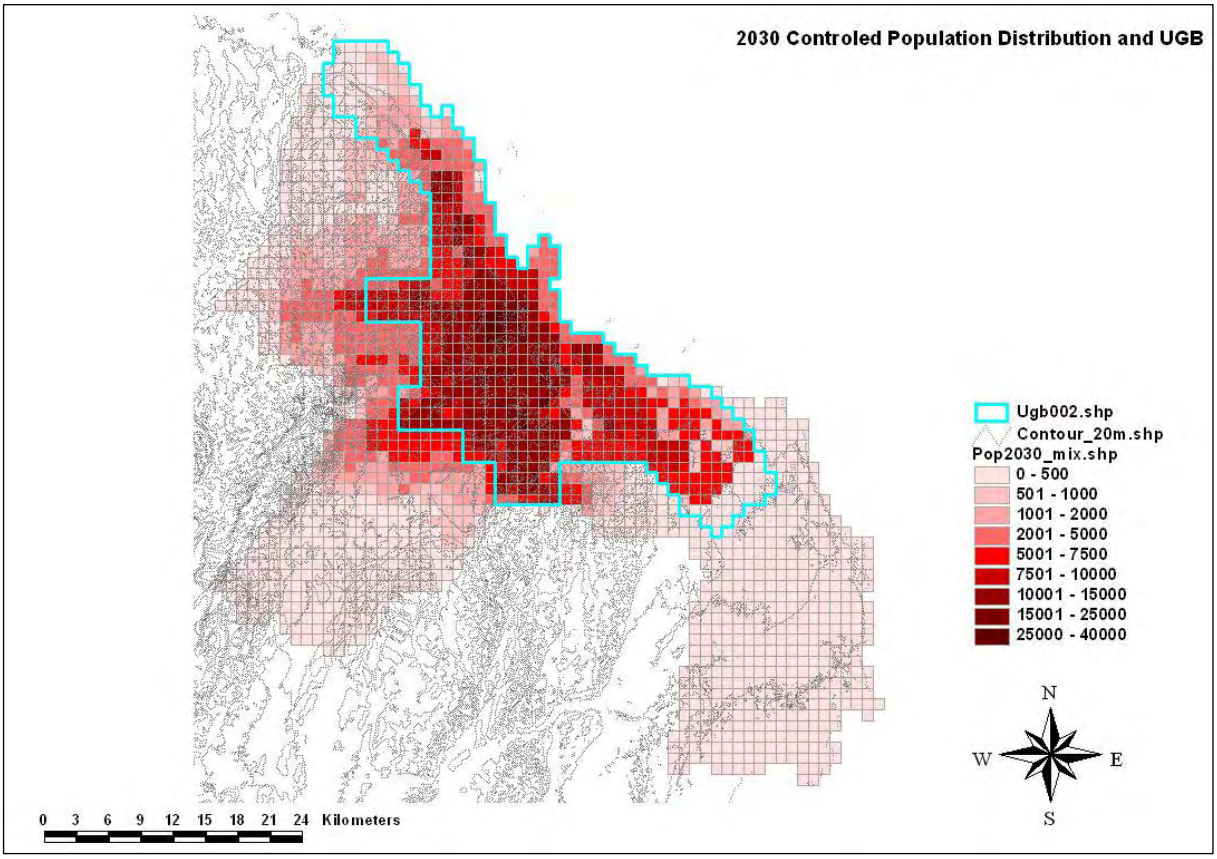

Figure 4.1.5 Simulated Future Urbanization Area (Controlled Case)

Appendix

GIS Data Description

Appendix GIS Data Description

DATA No.01	Folder Name: 00_DSM_GIS¥01_Boundary¥01a_Region

Name of file	dar_region.shp	
Description	Regional boundary for Dar es Salaam region	
Source	DCC	
Topology	Polygon	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
Pop_Census	Number	Data from Population Census 2002
Cal_area	Number	Calculated area with ArgGIS (unit= square meter)
RegionNM	String	Region name
RegionCD	Number	Region code from Census 2002
Pop_den_ha	Number	Population density 2002 (Field “Pop_Census”/ (“cal_area”/10000))

DATA No.02	Folder Name: 00_DSM_GIS¥01_Boundary ¥01b_Municipality

Name of file	District.shp	
Description	Municipality (District) boundary in Dar es Salaam region	
Source	DCC	
Topology	Polygon	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
JST_Munici	String	Name of Municipality
JST_Mun_CD	Number	Code number of Municipality from Census 2002
Pop_TTL	Number	Municipality Population from Population Census 2002
Pop_UBN		Municipality Urban Population from Population Census 2002
Pop_RRL		Municipality Rural Population from Population Census 2002
Cal_area	Number	Calculated area with ArcGIS (unit= square meter)
Pop_den_ha	Number	Population density(ha) 2002 (=Field “Pop_TTL”/(“cal_area”/10000))

Attribute : JST_Mun_CD

Attribute value	Description
1	Kinondoni Municipality
2	Ilala Municipality
3	Temeke Municipality

DATA No.03	**Folder Name: 00_DSM_GIS¥01_Boundary ¥ 01c_WARD**

Name of file	**WARD01.shp**
Description	WARD boundary in Dar es Salaam region with Population 2002
Source	DCC
Topology	Polygon

Shape file Attributes

Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
JST_Munici	String	Municipality Name
JST_WARD	String	WARD Name from Census2002
JST_WADCD	String	Code number of WARD from Census 2002
JST_MUN_CD	String	Code number of Municipality from Census 2002
REGIO_CD	String	Code number of Region from Census 2002
REGION_NM	String	Region Name
WARD_NM	String	WARD Name from DCC
UBN_RRL_CD	String	Rural WARD="1", Urban WARD="2", Mixed WARD="3" from Census2002
UBN_RRL_NM	String	WARD Category Name (Rural/ Urban/ Mixed)
POP2002TTL	Number	Total Number of WARD Population from Census2002
POP2002UBN	Number	Total Number of Urban area Population by WARD from Census2002
POP2002RRL	Number	Total Number of Rural area Population by WARD from Census2002
Cal_area	Number	Calculated WARD polygon area with ArcGIS (unit= square meter)
Pop_den2002		Population density(ha) 2002 (=Field "Pop2002TTL"/ ("cal_area"/10000))

Attribute : JST_Mun_CD

Attribute value	Description
1	Kinondoni Municipality
2	Ilala Municipality
3	Temeke Municipality

DATA No.04	**Folder Name: 00_DSM_GIS¥01_Boundary ¥01d_SubWARD**

Name of file	**SWARD_VLG.shp**	
Description	SubWARD boundary in Dar es Salaam region with Population 2002	
Source	DCC (JICA Study Team modified)	
Topology	Polygon	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
AREA	Number	Area (ArcGIS Internal calculation)
PERIMETER	Number	Perimeter (ArcGIS Internal calculation)
MUNICIPALI	String	Municipality Name from DCC
WARD	String	WARD Name from DCC
SUBWARD	String	SubWARD Name from DCC
JST_MUN_CD	String	Code number of Municipality from Census 2002
JST_MUNICI	String	Municipality Name from Census2002
JST_WARD	String	WARD Name from Census2002
JST_VLG_CD	String	SubWARD (or Village) Code from Census2002
JST_VLG	String	SubWARD (or Village) Name from Census2002
JST_VLG_PO	Number	SubWARD (or Village) Population from Census2002
MEMO_JST	String	Memo from JICA Study Team regarding this SubWARD polygon creation
POP_DEN02	Number	Population densityby SubWARD (Unit=person/ha), ([JST_VLG_PO]/ ([areacalc]/10000))
JST_WARD_C	String	WARD code from Census2002
areacalc	Number	Calculated SubWARD polygon area with ArcGIS (unit= square meter)

***Note:**
Some of SubWARD polygons are combined with several SubWARDS. Please refer field “MEMO_JST”

DATA No.05	**Folder Name: 00_DSM_GIS¥01_Boundary ¥01e_UGB_Outline**

Name of file	**UGB_OutLn.shp**	
Description	Outline of Urban Growth Boundary	
Source	JICA Study Team	
Topology	Polygon	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
ID	Number	ID number
UGB	Number	UGB flag

DATA No.06	**Folder Name: 00_DSM_GIS¥01_Boundary ¥01e_UGB_Grid**

Name of file	**UGB_Grid.shp**	
Description	Urban Growth Boundary (1km*1km Grid version)	
Source	JICA Study Team	
Topology	Polygon	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
ID	Number	Internal Number
GRIDID	Number	Grid ID (Correspond to field “FID” in “dsm_1k_grid_rv.shp”)
UGB	Number	UGB flag

DATA No.07	**Folder Name: 00_DSM_GIS¥02_Natural Condition ¥ 02a_Contour_all**

Name of file	**Contour_DSM.shp**	
Description	Contour data (2m pitch), calculated by ArcGIS	
Source	SRTM 90m Digital Elevation Data (SRTM: NASA Shuttle Radar Topographic Mission)	
Topology	Line	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
ID	Number	Unknown Field from original data
CONTOUR	Number	Contour (Unit: m)

DATA No.08	**Folder Name: 00_DSM_GIS¥02_Natural Condition ¥02b_Contour_10M**

Name of file	**Contour_10M.shp**	
Description	Contour data (10m pitch), calculated by ArcGIS	
Source	SRTM 90m Digital Elevation Data (SRTM: NASA Shuttle Radar Topographic Mission)	
Topology	Line	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
ID	Number	Unknown Field from original data
CONTOUR	Number	Contour (Unit: m)

DATA No.09	**Folder Name: 00_DSM_GIS¥02_Natural Condition ¥02c_Contour_20M**

Name of file	**Contour_20M.shp**	
Description	Contour data (20m pitch), calculated by ArcGIS	
Source	SRTM 90m Digital Elevation Data (SRTM: NASA Shuttle Radar Topographic Mission)	
Topology	Line	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
ID	Number	Unknown Field from original data
CONTOUR	Number	Contour (Unit: m)

DATA No.10	**Folder Name: 00_DSM_GIS¥02_Natural Condition ¥02d_Erosion**

Name of file	**JST_Erosion.shp**	
Description	DSM Erosion area data	
Source	SUDP and JST field survey	
Topology	Polygon	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
Name	String	Erosion area name
JST_constr	String	Description of land constraint

DATA No.11	**Folder Name: 00_DSM_GIS¥02_Natural Condition¥ 02e_Flood**

Name of file	**Flood_JST.shp**	
Description	DSM Flood area (500m buffer area from selected major rivers)	
Source	SUDP, Dar es Salaam Road Development Plan Study(1995) by JICA and JST field survey	
Topology	Polygon	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
Category	String	Category of River (="Major River")
RIVNAME	String	Name of the river
Floodriver	String	Flood river Flag (Yes/No)
BUFF_DIST	Number	Buffer distance from the river center line

DATA No.12	**Folder Name: 00_DSM_GIS¥02_Natural Condition ¥02f_Forest**

Name of file	**Forest_reserve.shp**	
Description	DSM Forest Reserve area	
Source	SUDP Framework data	
Topology	Polygon	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
Type	String	Land type (="Forest")

DATA No.13	**Folder Name: 00_DSM_GIS¥02_Natural Condition ¥ 02g_Swamp**

Name of file	**02g_Swamp.shp**	
Description	DSM Swamp area	
Source	SUDP Framework data	
Topology	Polygon	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
Category	String	Land Category ="Swamp")

DATA No.14 **Folder Name: 00_DSM_GIS¥02_Natural Condition ¥02h_Geology**

Name of file	**Geology_1963.shp**
Description	GIS-ready geological condition data(1963)
Source	Geologycal Survey of Tanganyika paper map (Compiled and Published by Geological Survey Division, Dodoma, 1963)
Topology	Polygon

Shape file Attributes

Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
CodeNO	Number	Geological Type Code (“1” to “7”) (refer below)
Code_NM	String	Geological Type Name

Attribute : CodeNO and Code_NM

Attribute value (CodeNO)	Attrinute value (Code_NM)
1	Beach ridge sands, Sand dunes and beach deposits
2	Lagoonal sands, clays and silts, salt marsh
3	Deltaic or tidal mangrove swamp, clays and silts
4	Alluvium and river terrace
5	Superficial white-buff sands
6	Raised reef limestones, pleistocene - recent
7	Clay-band sands and gravels ? Mio - pliocene
8	Pugu kaolintic sandstones

DATA No.15 **Folder Name: 00_DSM_GIS¥03_Landuse ¥03a_Landuse_2007**

Name of file	**Existing_LU.shp**
Description	Existing Landuse data prepared by JST
Source	SUDP, aero photo and other several maps
Topology	Polygon

Shape file Attributes

Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
RIVNAME	String	River name (Limited)
Category	String	Category Name for Waterbody polygon (“River” or Swamp)
LU_NM	String	Landuse category Name (refer below)
LU_CD	Number	Landuse Category Code (“1” to “6”) (refer below)
Cal_area	Number	Area of Polygon, calculated with ArcGIS (unit = square meter)

Attribute : CodeNO and Code_NM

Attribute value (LU_CD))	Attribute value (LU_NM)
1	Residential area
2	Other Urban area
3	Vacant/ Agriculture
4	Waterbody
5	Military
6	Industry

DATA No.16	**Folder Name: 00_DSM_GIS¥03_Landuse ¥03b_Landuse_SUDP**

Name of file	**SUDP_Framework.shp**	
Description	SUDP Framework data provided by DCC	
Source	SUDP	
Topology	Polygon	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
ID_	String	Unknown field from original data
NAME1_	Number	Unknown field from original data
Name2_	String	For Figure “SUDP Framework” (correspond field = “Name2NM”)
PARTS_	Number	Unknown field from original data
POINTS_	Number	Unknown field from original data
LENGTH_	Number	Unknown field from original data
AREA_	Number	Unknown field from original data
PROPUSE	String	Unknown field from original data
CODE_NUM	String	Code for Land Suitability (from DCC)
Name2NM	String	Code description for Field “Name2_”
CD_desc1	String	Code description for Field “CODE_NUM”
Code	String	Code number from SUDP Annex 1 Table 4: Land suitability
Zone	String	Zone number from SUDP Annex 1 Table 4: Land suitability
Location	String	Spatial Location area name from SUDP Annex 1 Table 4: Land suitability
EXI_Landus	String	Present Landuse Name from SUDP Annex 1 Table 4: Land suitability
Constraint	String	Constraint name from SUDP Annex 1 Table 4: Land suitability
Utility	String	Utility Service level from SUDP Annex 1 Table 4: Land suitability

DATA No.17	Folder Name: 00_DSM_GIS¥03_Landuse ¥03c_Land_constraint_SUDP

Name of file	SUDP_Framework_Hazard.shp	
Description	DSM Hazard condition (data from SUDP framework)	
Source	SUDP	
Topology	Polygon	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
ID_	String	Unknown field from original data
NAME1_	Number	Unknown field from original data
Name2_	String	For Figure "SUDP Framework" (correspond field = "Name2NM")
PARTS_	Number	Unknown field from original data
POINTS_	Number	Unknown field from original data
LENGTH_	Number	Unknown field from original data
AREA_	Number	Unknown field from original data
PROPUSE	String	Unknown field from original data
CODE_NUM	String	Code for Land Suitability (from DCC)
Name2NM	String	Code description for Field "Name2_"
CD_desc1	String	Code description for Field "CODE_NUM"
Mining	String	Land area related to "Mining"
Mining_Ite	String	Name of mining item(s)
Code	String	Code number from SUDP Annex 1 Table 4: Land suitability
Zone	String	Zone number from SUDP Annex 1 Table 4: Land suitability
Location	String	Spatial Location name from SUDP Annex 1 Table 4: Land suitability
EXI_Landus	String	Present Landuse Name from SUDP Annex 1 Table 4: Land suitability
Constraint	String	Constraint name from SUDP Annex 1 Table 4: Land suitability
Utility	String	Utility Service level from SUDP Annex 1 Table 4: Land suitability
***Note:**		
Layer file "SUDP_Framework_LandConstraint_SUDP.lyr is Legend file for this shp.file		

DATA No.18	Folder Name: 00_DSM_GIS¥03_Landuse ¥03d_CIUP_SUDP_Unplanned_residential

Name of file	CIUP_SUDP_Unplanned_res .shp	
Description	Unplanned residential area(SubWARD) by CIUP and SUDP	
Source	CIUP and SUDP report	
Topology	Polygon	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
JST_MUNICI	String	Municipality Name
JST_WARD	Number	WARD Name
JST_VLG_CD	String	SubWARD code from Census2002
JST_VLG_PO	Number	Population by SubWARD from Census2002
POP_DEN02	Number	Population density 2002 by SubWARD (Unit: person/ha)
JST_WARD_C	Number	WARD code from Census2002
Areacalc	Number	Polygon area (calculated with ArcGIS, Unit: square meter)
CIUP_MTAA	String	0: SUDP Unplanned area, 1: CIUP Unplanned MTAA

DATA No.19	**Folder Name: 00_DSM_GIS¥04_Utility ¥ 04a_UtilityPlan_SUDP**

Name of file	**Water_supply02.shp**	
Description	SUDP Water supply plan for DSM	
Source	SUDP report	
Topology	Polygon	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
Cal_area	Number	Polygon area, calculated with ArcGIS
WTR_SPLY	String	Water supply plan "Long-term water supply" or "Short-term water supply"

DATA No.20	**Folder Name: 00_DSM_GIS¥05_River ¥05a_RIVER2007**

Name of file	**River00.shp**	
Description	DSM River network	
Source	DCC data and SRTM data	
Topology	Line	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
Category	String	River category by JST "Major river" or "other river"
RIVNAME	String	River name for major river

DATA No.21	**Folder Name: 00_DSM_GIS¥06_Transport ¥06a_Roadnet2007**

Name of file	**Dar_Road.shp**	
Description	DSM Road network year 2007	
Source	DCC data and JST Field survey	
Topology	Line	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
FNODE_	Number	Arcinfo internal use (cannot use)
TNODE_	Number	Arcinfo internal use (cannot use)
LPOLY_	Number	Arcinfo internal use (cannot use)
RPOLY_	Number	Arcinfo internal use (cannot use)
LENGTH	Number	Arcinfo calculated length (cannot use)
DARCOR_	Number	Arcinfo internal use (cannot use)
DARCOR_ID	Number	Arcinfo internal use (cannot use)
RD_CATEGOR	String	Road category name (source unknown)
Management	String	Road management entity name
RD_Name	String	Road name
Pavement	String	Pavement condition “Paved” or “Unpaved”
Lanes_1	String	Number of lanes as of 2007 (2/4/6(Under construction))
Network	Number	JST Road network by lane (1/2/4/6)
JST_RD_CAT	String	Road category by JST “Trunk road” “Other major road”
TANRDS_CAT	String	TANROADS road categoru (not complete) “Paved Regional Road” “Paved Trunk Road” “Unpaved Regional Road” “Unpaved Trunk Road”
Cal_length	Number	Line length, calculated with ArcGIS

DATA No.22	**Folder Name: 00_DSM_GIS¥06_Transport ¥06b_Railnet2007**

Name of file	**DSM_Railnet01.shp**	
Description	DSM Road network 2007	
Source	DCC AutoCAD data (Scale 1:2500)	
Topology	Line	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
Name	String	Name of polyline (=”railway”)

DATA No.23	**Folder Name: 00_DSM_GIS¥06_Transport ¥06c_NetworkDataset**

Name of file	**Sim_Net00.shp**	
Description	Road network for Network Analysis	
Source	DCC data	
Topology	Line	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
FNODE_	Number	Arcinfo internal use (cannot use)
TNODE_	Number	Arcinfo internal use (cannot use)
LPOLY_	Number	Arcinfo internal use (cannot use)
RPOLY_	Number	Arcinfo internal use (cannot use)
LENGTH	Number	Arcinfo calculated length (cannot use)
DARCOR_	Number	Arcinfo internal use (cannot use)
DARCOR_ID	Number	Arcinfo internal use (cannot use)
RD_CATEGOR	String	Road category name (source unknown)
Management	String	Road management entity name
RD_Name	String	Road name
Pavement	String	Pavement condition “Paved” or “Unpaved”
Lanes_1	String	Number of lanes as of 2007 (2/4/6(Under construction))
Network	Number	JST Road network by lane (1/2/4/6)
JST_RD_CAT	String	Road category by JST “Trunk road” or “Other major road”
TANRDS_CAT	String	TANROADS road categoru (not complete) “Paved Regional Road” “Paved Trunk Road” “Unpaved Regional Road” “Unpaved Trunk Road”
Cal_length	Number	Line length, calculated with ArcGIS
Rd_ubn_sim	Number	Road network for Network analysis (as of July 2007) “2”: 2-lane, “4”: 4-lane, “6”: 6-lane(Under Construction) “888”: other road for road network

DATA No.24	**Folder Name: 00_DSM_GIS¥06_Transport ¥06d_Roadnet2030**

Name of file	**hwy2030.shp**	
Description	Road network plan (Target year 2030)	
Source	JICA Study Team	
Topology	Line	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
FNODE_	Number	Arcinfo internal use (cannot use)
TNODE_	Number	Arcinfo internal use (cannot use)
LPOLY_	Number	Arcinfo internal use (cannot use)
RPOLY_	Number	Arcinfo internal use (cannot use)
LENGTH	Number	Arcinfo calculated length (cannot use)
MANAGEMENT		Management Entity
RD_NAME		Road Name
PAVEMENT		Pavement Condition
NETWORK		
JST_RD_CAT		Road category by JICA Study Team Expressway/ Other Major Road/ Trunk road)
TANRDS_CAT		Road category by TANROADS (Expressway/ Paved regional Road/ Paved Trunk Road/ Unpaved regional Road/ Unpaved Trunk Road/ non)
FUTURE		New/ Existing
CLASS_NM		Road Class Name (Expressway/ ramps/ special/ sub-urban/ urban)
BRT		No BRT/ Type 1/ Type 2/ Type 3
FTR_LANE		No. of future lanes (6/4/2/1)
CLASS		
NO_RIVER		
DIR		“1” or “2”
ANODE		Node Number (Start Node)
BNODE		Node Number (End Node)
FTR_EXT		0/ 1/ 2/ 3/ 4/ 6
BRT_2030		0/ 1/ 2
SZONE		Sper Zone Number (1 to 16)
COST		“1” or “0”
LANDUSE		0/ 1/ 2/ 3
GROWTHB		Urban Growth Boundary Flag (“1”= Inside/ “0”=Outside)
Z015_PRO		JST Proposed Project Number as of DF/R
Z015_LANE		Number of Proposed lanes (target year 2015)
LINKNO		Link No.
Z030STATUS		0 Existing/ 1 New/ 2 Existing/ 2 New/ 2 Widening/ 4 Existing/ 4 New/ 4 Widening/ 6 Existing/ 6 new/ 6 Widening
Z015STATUS		0 Existing/ 1 Existing/ 2 Existing/ 2 New/ 2 Widening/ 4 Existing/ 4 New/ 4 Widening/ 6 Existing/ 6 new/ 6 Widening
PRIORITY		“2015” or “2030”
Proj_ID		Proposed project ID (final ID)

DATA No.25	**Folder Name: 00_DSM_GIS¥07_Placename ¥07a_Placename**

Name of file	**Major_place.shp**	
Description	Name of Major place	
Source	TANROADS roadnetwork and JST field survey	
Topology	Point	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number
Shape	Geometry	Feature geometry
Place_NM	String	Name of place
Region	String	Region (“DSM” or “Other”)

DATA No.26	**Folder Name: 00_DSM_GIS¥08_Raster ¥08a_DSM_DEM_original**

Name of file	**Dsm_dem1**	
Description	Digital Elevation Model for Dar es Salaam region	
Source	SRTM 90m DEM data	
Topology	Raster	
Raster information		
SDTS raster type		Grid cell
Cell size	X:	119.051304m
	Y:	119.051304m

DATA No.27	**Folder Name: 00_DSM_GIS¥08_Raster ¥08b_slope_200mgrid**

Name of file	**Slp200mpct**	
Description	Calculated slope(%) in DSM region	
Source	SRTM 90m DEM data	
Topology	Raster	
Raster information		
SDTS raster type		Grid cell
Cell size	X:	200m
	Y:	200m

DATA No.28	**Folder Name: 00_DSM_GIS¥08_Raster ¥08c_aspect_200mgrid**

Name of file	**asp200m**	
Description	Calculated slope aspect in DSM region	
Source	SRTM 90m DEM data	
Topology	Raster	
Raster information		
SDTS raster type		Grid cell
Cell size	X:	200m
	Y:	200m

DATA No.29	**Folder Name: 00_DSM_GIS¥08_Raster ¥08d_flowaccumulation**

Name of file	**Dsm_fa**	
Description	Calculated water flow (part of source data for “river00.shp”)	
Source	SRTM 90m DEM data	
Topology	Raster	
Raster information		
SDTS raster type		Grid cell
Cell size	X:	119.051304m
	Y:	119.051304m

DATA No.30	**Folder Name: 00_DSM_GIS¥09_Others ¥09a_3D_shot_JPG**

Name of file	**Dar_3D_001.jpg, WS000001.jpg**
Description	3D image and animation of DSM region (for presentation purpose)
Source	SRTM 90m DEM data and Dar es Salaam GIS data

DATA No.31	**Folder Name: 00_DSM_GIS¥09_Others ¥ 09b_DSM_Mesh1km_poly**

Name of file	**dsm_1k_grid_rv.shp**	
Description	DSM 1km*1km GRID polygon for development potential analysis	
Source	SRTM 90m DEM data	
Topology	Polygon	
Shape file Attributes		
Field Name	Type	Description
FID	OID	Internal feature number (GRID ID)
Shape	Geometry	Feature geometry
ID	Number	Sequential number

DATA No.32	**Folder Name: 00_DSM_GIS¥10_Collected data ¥10a_SRTM_download_data**

Name of file	**Asciito_z_441(raster)**	
Description	Downloaded SRTM 90m DEM data	
Source	SRTM 90m DEM data	
Raster information		
SDTS raster type		Grid cell
Cell size	X:	0.000833
	Y:	0.000833
Coordinate System		Clarke_1866

DATA No.33	**Folder Name: 00_DSM_GIS¥10_Collected data ¥10b_DSM_map_1_2500**

Description	DSM City-center area detailed map data (Scale: 1: 2500)
Source	DCCa
Format	AutoCAD(DWG)
Note: Please refer codelist file “Codelist.xls”) in the same folder	

DATA No.34	**Folder Name: 00_DSM_GIS¥10_Collected data ¥10c_Scanned Urbanarea map**

Name of file	**Rectifydsm_25011.tif**
Description	DSM Urban area map with coordinate system
Source	Unknown
Format	Geotiff