Urban Readiness Guideline: Interfacing of Urban
Vulnerability, Impact of Climate Change & COVID-19 Scenario

Presented by

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# Aim & Objectives

Aim of this study is to understand the **comparative urban status** of Bangladesh.

There are 3 objective for this study,

-to assess the **Ecological Suitability** of urban unit.

-to assess the **infrastructure-service suitability** of urban unit.

-to **interact** ecology and urban infrastructure-service suitability for understanding the existing urban scenario (Urban Readiness)

- to **test** this interactive matrix for explaining the scenario on ground.

According to BBS 2011 there were **484 upazila** with **506 urban centers** in Bangladesh. These urban centers included present **12** city corporation, **316** paurashava & **178** Upazila headquarters. To address the geographical overlapping and reduces the complexity this research redefine these upazila as growth center with different level of urban center. character of all 484 upazila/ growth center is quantified based on 18 ecological character and 11 existing infrastructure-services from urban planning point of view.

# Urban Readiness Workflow Diagram

There are **II** major steps in total work flow.

Step 01 : Data Sourcing (Pre processing) Step 02 : Data Formatting (Pre Processing) Step 03 : Data Translation (Pre Processing) Step 04 : Infrastructure-Service Suitability Step 05 : Ecological-Sensitivity Step 06 : Ecological-Suitability Step 07 : Determination of Aggregation method (Iso-Quant Curve) Step 08 : Urban Readiness Step 08 : Urban Readiness Matrix Step 10:SUG Step II : Policy Formulation



# Ecological Sensitivity Variables (18 nos.)

This study consider 18 Ecological phenomenon as Ecological sensitivity indicative variable.

From non-farm economic point of view, efficiency or productivity of an urban economic system is affected by this 18 ecological phenomenon in Bangladesh.

Urban centers in a growth center (upazila) is ecologically **more sensitive** then other if it has **higher concentration** of these ecological phenomenon

Hazardous Event Variables(8)	Flood Related Variable 07.River erosior 08.Seismic char 10.Drought inter	Flood Type 06.Inunda 1 intensity acter nsity	03.Tidal flood intensity 04.River flood intensity 05.Flash Flood intensity tion depth of flooding
Geology and Geographic Feature Variable (8)	Underground features Surface water related features 16.Area occupie	09.Soil sai Ground water 13.Arsenio 14.Area of 15.Area of 18.Area of d by Forest	linity 11.Depletion rate 12.Depletion acceleration rate c concentration ccupied by River & sea sore ccupied by Waterbody ccupied by Haowr t

Geographic	01.Contour generated altitude
Condition/	17.Land slope
State <b>(2)</b>	*

02.History of cyclone

#### Urban Ecological Sensitivity (Example: River Flood)

As example sensitivity calculation based on variable 04 :River Flood is presented in this slide.

Different severity level at different part of a growth assigned with center is sensitivity score presented below. Growth center sensitivity was calculated by area percentage and scaled in 0 to I.

Sensitivity score assigned for different intensity level is

Not flood prone	
Low River Flooding	2
Moderate River Flooding	3
Severe River Flooding	4



#### Urban Ecological Sensitivity (Example: River Flood)

For each growth center suitability score is assigned according to opposite of corresponding sensitivity presented score as below. Growth center suitability was calculated by scaling the score in 0

Suitability score assigned for different intensity level

Not flood prone	4
Low River Flooding	3
Moderate	2
River Flooding	2
Severe River Flooding	I





# Urban Ecological Sensitivity (18 Nos.)

A growth center (upazila) obtain a sensitivity score between 0 and 1. It is converted in to 0 to 100 scales for easy visualization. growth center (upazila) with higher sensitivity score is more sensitive from urban point of view.

Eco-Sensitivity Chart No. 01(a): Growth Center Ecological Sensitivity Statistics from Urban Prospective										
Sensitivity Index Score	Administrative Level	Growth Center	Total Population 2011	(%)	Urban Population 2011	(%)	Area (SqKm)	(%)		
6	District_HQ	5	1030417	0.72	283638	0.84	1757.81	1.21		
Score: 10 76 20 63	Paurashava_HQ	34	8389844	5.85	1539894	4.55	11202.36	7.70		
10.70-20.05	Upazila_HQ	28	3104335	2.17	297237	0.88	11363.07	7.81		
	Capital	1	8747042	6.10	8747042	25.86	305.8375	0.21		
F	City Corporation	5	3021825	2.11	1217023	3.60	883.733	0.61		
Score: 20.64.26.02	District_HQ	11	4530796	3.16	1264002	3.74	3849.565	2.64		
20.04-20.02	Paurashava_HQ	60	18294433	12.76	2910675	8.61	17215.77	11.83		
	Upazila_HQ	21	5536119	3.86	336290	0.99	6380.902	4.38		
	City Corporation	2	959810	0.67	407901	1.21	386.7671	0.27		
Score:	District HQ	15	6123374	4.27	1795656	5.31	4560.171	3.13		
26.03-30.37	Paurashava_HQ	62	18743371	13.08	2463047	7.28	17090.5	11.74		
	Upazila_HQ	42	8522874	5.95	583114	1.72	8406.553	5.78		
	City Corporation	1	3310027	2.31	3310027	9.79	171.1142	0.12		
Score:	District HQ	6	2451728	1.71	610240	1.80	2303.291	1.58		
30.38-35.09	Paurashava_11Q	36	9158485	6.39	1198530	3.54	14750.42	10.13		
	Upazila_HQ	26	5330346	3.72	344601	1.02	10686.2	7.34		
	City Corporation	5	2741151	1.91	2002301	5.92	911.1242	0.63		
Score:	District_HQ	16	5969009	4.16	1241563	3.67	5021.094	3.45		
35.10-45.98	Paurashava_HQ	71	19677716	13.73	2766763	8.18	19613.74	13.48		
	Upazila HQ	37	7679032	5.36	499680	1.48	8687.29	5.97		
Total		484	143321734	100	33819224	100	145547.3	100		





# Urban Ecological Suitability (18 Nos.)

- All growth centers obtain a suitability score between 0 and 1. It is converted in to 0 to 100 scales for easy visualization.
- growth center (upazila) with higher suitability score is more suitable from urban point of view.

Urban Suitability Chart No. 23(a): Growth Center Urban Suitability Considering Ecology										
Suitability Index Score	Administrative Level	Growth Center	Total Population 2011	(%)	Urban Population 2011	(%)	Area (SqKm)	(%)		
Scorer	District_HQ	5	1030417	0.72	283638	0.84	1757.81	1.21	]	
70 41 00 00	Paurashava_HQ	34	8389844	5.85	1539894	4.55	11202.36	7.70		
79.41 - 90.00	Upazila_HQ	28	3104335	2.17	297237	0.88	11363.07	7.81	1	
	Capital	1	8747042	6.10	8747042	25.86	305.84	0.21	]	
Saaraa	City Corporation	5	3021825	2.11	1217023	3.60	883.73	0.61	1	
5core:	District_HQ	11	4530796	3.16	1264002	3.74	3849.57	2.64	1	
/4.00 - /9.40	Paurashava_IIQ	60	18294433	12.76	2910675	8.61	17215.77	11.83	1	
	Upazila_HQ	21	5536119	3.86	336290	0.99	6380.90	4.38	1	
	City Corporation	2	959810	0.67	407901	1.21	386.77	0.27	1	
Score:	District_HQ	15	6123374	4.27	1795656	5.31	4560.17	3.13	1	
69.64 - 73.99	Paurashava_HQ	62	18743371	13.08	2463047	7.28	17090.50	11.74	1	
	Upazila HQ	42	8522874	5.95	583114	1.72	8406.55	5.78	1	
	City Corporation	5	2741151	1.91	2002301	5.92	911.12	0.63	1	
Score:	District HQ	16	5969009	4.16	1241563	3.67	5021.09	3.45	1	
65.00 - 69.63	Paurashava HQ	70	19385659	13.53	2730072	8.07	19330.84	13.28	1	
	Upazila_HQ	37	7679032	5.36	499680	1.48	8687.30	5.97	1	
	City Corporation	1	3310027	2.31	3310027	9.79	171.11	0.12	1	
Score:	District HQ	6	2451728	1.71	610240	1.80	2303.29	1.58	1	
54.00 - 64.99	Paurashava_HQ	37	9450542	6.59	1235221	3.65	15033.31	10.33		
	Upazila HQ	26	5330346	3.72	344601	1.02	10686.20	7.34	]	
Total		484	143321734	100	33819224	100	145547.31	100		



### Urban Infrastructure - service suitability variables (II Nos.)

This research consider 11 infrastructure-service variable to assess infrastructure-service suitability of urban centers in all growth center from economic point of view

capital indicative

variable

entrepreneurship indicative variable

> labour indicative variable

<u>19</u>. Education Health and Religious Services 20. Agriculture and Emergency Services 21. Rural Economy related Infrastructure 22.Water based Communication Services

23. Rail communication Services 24. Road Connectivity

<u>25</u>. Airport Proximity <u>26</u>. Seaport Proximity 27. Capital Proximity

**Social Service** indicator

Connectivity indicator

Location advantage

28. Administration level

29. Urban Population

#### Urban Infrastructure and Services Suitability (Example: Education, Health & Religious inf.)

As example for variable no 19: Education, Health & Religious services, this study assumes growth center with higher level of these service infrastructure has better access to the services.

Suitability score for growth center with different feature is given below.

College	1.89
Hospital	1.89
University	3.09
Vocational Institute	1.29
Community Clinic	0.69
Family Welfare Centre	0.69
High School	1.29
Madrasa	0.69
Mosque/Eidgah/Church	0.69
Primary School	0.69





# Urban Infrastructure and Services Suitability( 11 Nos.)

A growth center obtain a suitability score between 0 and 1. It is converted as 0 to 100 scales for easy visualization. Urban centers in growth center with higher infrastructure-service has higher level of preparedness against the impact of climate change.

	Map No. 24: Gro	wth Center Su	iitability Statist	ics Considerin	g Infrastructur	e and Services	i	
Suitability Score	Administrative Level	Growth Center	Total Population 2011	(%)	Urban Population 2011	(%)	Area (SqKm)	(%)
<b>6</b>	Capital	1	8747042	6.10	8747042	25.86	305.84	0.21
Score: 51.85 - 97.73	City Corporation	9	7436562	5.19	5819970	17.21	1811.10	1.24
	City Corporation	4	2596251	1.81	1117282	3.30	541.64	0.37
Score:	District_HQ	21	7956444	5.55	2213605	6.55	7160.56	4.92
38.17 - 51.84	Paurashava_HQ	42	15142785	10.57	2850980	8.43	11226.66	7.71
	Upazila_HQ	4	1072036	0.75	44758	0.13	965.15	0.66
	District_HQ	25	9622153	6.71	2275789	6.73	8166.98	5.61
Score: 30.70 - 38.16	Paurashava_HQ	113	31550951	22.01	4334847	12.82	32152.40	22.09
	Upazila_HQ	24	5897554	4.11	370371	1.10	7719.97	5.30
	District_HQ	7	2526727	1.76	705705	2.09	2164.39	1.49
Score: 24.43-30.70	Paurashava_HQ	86	21885160	15.27	2881618	8.52	26725.83	18.36
24/40-00/70	Upazila_HQ	61	13539450	9.45	866371	2.56	14515.07	9.97
Score: 14.41 - 24.42	Paurashava_HQ	22	5684953	3.97	811464	2.40	9767.89	6.71
	Upazila_IIQ	65	9663666	6.74	779422	2.30	22323.83	15.34
Total		484	143321734	100	33819224	100	145547.31	100



# **Urban Readiness**

Urban readiness of an urban system is a function of its infrastructure-service suitability and ecological sensitivity. Best possible way to represent this function is "Iso-Quant Curve." Urban centers in a growth center can have same urban readiness score with different combination of infrastructure-service & ecological condition.





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Matrix: 02 Urban Readiness Matrix and Growth Center of Bangladesh with Readiness Iso-quant Line

Ecological Suitability 00

50 55 60 65 70

40 45

Readines 10

100

85

90 95

75 80

# Urban Readiness (partial view)

Urban readiness score is a quantitative indication of urban centers sensitivity due to ecological phenomena including climate change considering the arrangement of infrastructure- service.



#### Urban Readiness (Graph & Statistics)

To understand the urban readiness of urban centers in growth center this guideline symbolized them into equal class interval of 5.





#### Urban Readiness (Absolute View in Map)

- -No growth center has urban readiness score **above 80.**
- -Capital (Dhaka) has highest readiness score which is only growth center between 75.00-79.99
- -There is no growth center with readiness score between 70.00-50.00
- -Khan Jahan Ali (KCC) has 2<sup>nd</sup> highest readiness score which is only growth center between **45.00-49.99**
- -Monpura (Bhola) has lowest readiness score which is only growth center between 05.00-09.99
- -All other 481 growth center have readiness score between 40.00-10.00



#### Urban Readiness (Comparative view in map)

To understand the **Spatial pattern** of Urban Readiness this guideline classified 483 growth center excluding Dhaka in to 5 classes. Urban centers with lower readiness score will be directly affected by the impact of climate change then other. But population displacement due to climate change in these area will affect the high score urban centers more harshly. This study can not estimate the magnitude of climate change impact, but it shows the relative impact at upazila level based on the available data. This study sagest that different policy guideline is necessary for different area based on their ecological setup as well as infrastructure-service status.

Readiness Chart no 01(a): Growth Center Readiness Statistics									
Urban Readiness Index	Growth Center	Total Population 2011	(%)	Urban Population 2011	(%)	Area (SqKm)	(%)		
Score: 75.93	1	87,47,042	5.75	87,47,042	20.55	305.84	0.21		
Score: 37.13 –49.99	14	1,92,72,647	12.67	1,58,10,543	37.14	3,125.53	2.14		
Score: 27.97 - 37.12	79	2,79,19,901	18.36	58,00,506	13.63	23107.14	15.84		
Score: 22.47 - 27.96	142	4,17,22,231	27.44	61,33,154	14.41	38,276.19	26.24		
Score: 17.33 -22.46	168	4,05,18,807	26.65	47,03,360	11.05	49,712.40	34.08		
Score: 9.45 - 17.32	80	1,38,88,148	9.13	13,71,661	3.22	31,326.05	21.48		
Total	484	15,20,68,776	100	4,25,66,266	100	1,45,853.15	100		





Plot.

08.

Urban Readiness Guideline: Interfacing of Urban Vulnerability, Impact of Climate Change & COVID-19 Scenario

# Spatial Urban Group (SUG)



Policy requirement for different SUGs to address the impact of climate change.



To understand the **Spatial pattern** of SUGs this guideline symbolized 484 growth center in to 8 different color of SUG.

Different SUG show different policy requirement from growth centers in different SUGs to address the impact of climate change.





### Urban Readiness Score and Night Illumination in Bangladesh 2022

Out come of urban readiness score is verified with illumination intensity index of upazila



## Urban Readiness Score and Employment Distribution in Bangladesh 2011

Out come of urban readiness score is overlaid with the number of non-farm employment and indirectly estimated GDP (FY 2011-12)



# Impact of Covid-19, Bangladesh & Urban Readiness Guideline



-First COVID 19 positive case identified in 8<sup>th</sup> March 2020.

-Since then Directorate General of Health Services (DGHS) publish daily statistics of identification and causality report up to **district** level.

-Data shows Dhaka and districts surrounding the capital is more expose to the pandemic.





#### COVID-19 positive cases from 50<sup>th</sup> to 100<sup>th</sup> day in Bangladesh on Geographic space

-As case study urban readiness data set are overlaid on pandemic data set to assess its **real world implication**.

-Data inputted against **64 district** among 484 growth center. All analysis were confined at district level considering data availability.

-The graph shows most of the **significant picks** corresponds with readiness picks.

#### Graph of COVID 19 Positive Cases (scaled) on 100 day & Urban Readiness 100 Dhaka 95 Chattogram Narayanganj Comilla Munshigar Gazipu Noakhali Rangpur Kishorgan District name Urban Readiness COVID 19 Positive case

COVID 19 positive case and urban readiness considering Chattogram as base

#### Table shows data of 10 districts with highest COVID-19 Positive Cases on 100<sup>th</sup> day from first identification

Rank	District	Total cases	Total cases (%)	New case	New case (%)	Slope (avg. increase /day)	Positive/10,000	Density (population/SqKM)	Readiness score
1	Dhaka	26,369	49.91	438	28.11	452.63	22.07	28,600	75.97
2	Chattogram	3,680	6.97	88	5.65	70.17	4.52	19,344	46.72
3	Naraynganj	3,011	5.70	41	2.6	46.26	10.21	12,994	38.04
4	Comilla	1,854	3.51	169	10.85	27.84	3.44	3,453	37.85
5	Munshiganj	1,558	2.95	60	3.85	24.19	10.77	2,317	18.09
6	Cox-Bazar	1,411	2.67	71	4.56	23.24	6.16	2,049	22.51
7	Gazipur	1,278	2.42	8	0.51	20.34	3.75	3,974	31.23
8	Noakhali	1,057	2.00	30	1.93	19.39	3.40	1,571	21.17
9	Mymanshing	878	1.66	23	1.48	13.17	1.78	1,557	43.60
10	Faridpur	734	1.39	39	2.50	9.56	4.21	1.233	32.72

#### 3 sate of district cluster based on COVID-19 positive cases increase by day (Slope) vs Urban Readiness on 100<sup>th</sup> day

All 3 district cluster shown on geographic

space

Spatial Distribution of Districts in Three Group

33

Map

**Three graph** below represents the **3 district cluster** separately.

All 3 cluster show positive co-relationship between pandemic and Urban readiness with different magnitude.

This case study shows that 40 out of 64 cases (62.50%), urban readiness can explain urban property or human Information urban activity of growth center in the form of pandemic.



COVID-19 positive cases from 50<sup>th</sup> to100<sup>th</sup> day in Bangladesh

लिहित दरता हीन करात ला होन्ह्र कर DDTA

# Impact of flood in August 2020, Bangladesh & Urban Readiness Guideline

### Flood in August 2020, Bangladesh

On 3rd august of 2020, FFWC published a flood map of **53,565.04** square kilometer inundated area including rivers and other water bodies. **340 growth centers** among 484 growth center are affected.

This Inundated area is divided by 1km x 1km grid to incorporated the inundation level and flood related sensitivity information.



### Flood in August 2020, Bangladesh Comparative Flooding Depth Sensitivity Index Observation

The map represent the cross-table observation in geographical space. There is no major dissimilarities among the flooding depth sensitive area of urban readiness study and inundated area on august 2020 flooding.

#### **Summery Table of Evaluation**

% of Area	Observation	% of Area	Evaluation	
16.55	Perfectly Identical			
36.22	Nearly Identical 84.98		Identical	
32.21	Moderately Identical			
12.60	Near Different	15.02		
2.41	Completely Different	15.02	Different	

Summery observation in the table shows there is 84.98% area that shows identical character specified in the flood sensitivity index of urban readiness study.



# Impact of climate change & & Urban Readiness Guideline

# Impact of sea level rise in Bangladesh

The map represent the area with altitude below 5m, 3m and 1.5m from Mean Sea Level (MSL). There are 13 district and 73 growth



Information 55

Map

Impacts of Sea Level Rise based on Aultitude

Ministry of Housing & Public Works

#### Impact of sea level rise on **soil salinity** of costal area in Bangladesh

Sea level rise will also impact the soil salinity problem in costal area. Intensity of salinity will increase and new area will face the problem.

Ground height	Nos of growt h center	Area of Growth Center (SqKM)	% of area in countr y	Total populatio n	% of Total populat ion in countr y	
3.01m- 5.00m	212	62,250.03	42.77	6,48,52,1 83	17.74	
1.51m- 3.00m	153	47,325.51	32.52	3,94,34,0 03	15.98	
1.50m and below	73	29,050.77	19.96	1,65,35,4 35	11.54	
Salinity affected	84 (Partia I)	32,225.30	22.14	2,52,33,2 74	17.61	Le
				•		Sal





#### Impact of rainfall anomaly (due to CC?) & flash flood in Bangladesh



The map represent the hydrological catchment area (watershed) of Haor in Bangladesh. In 2022 1,72,919.18 cubic meter of precipitation occurred in these area between march 23<sup>rd</sup> and October 24<sup>th</sup> and caused sever flash flood. Any anomaly in the rainfall can cause seriate problem in agriculture sector in this area. On the other hand it is a large amount of clean water that can the dry season solve the crises water in country.



# Daily Precipitation in Haor Catchment Area in 2022

Catchment area 41,427.27 Sqkm Amount of daily precipitation measured as cubic meter Total1,72,919.18 cubic meter between March 23<sup>rd</sup> and October 24<sup>th</sup>

> Data Source: GPM IMERG Late Precipitation L3 1 day 0.1 degree x 0.1degree; https://disc.gsfc.nasa.gov/datacollection/GPM\_3IMERGDL\_06.html



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