

# Climate and Disaster Vulnerability Index for measurement of Resilience

**Briefing on the Concept on Climate & Disaster Vulnerability Index**

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# The Concept

- \* Disaster and Climate Vulnerability resulted in different parts of Bangladesh prompted UN System to design programs related to this
- \* Under UNDAF Pillar 5 OUTCOME 1 is to develop resilience against such vulnerability – **Resilience to Adapt to Risk**

# Understanding the Concept

At the outcome level it means ensuring reduction of vulnerability for people living in areas who are threatened by climate change and natural disasters. CDVI should be able to track changes in the vulnerability.

- \* Disaster and climate risks are considered constant while vulnerability differs in an area based on characteristics of the household. Many of the UNDAF outputs are designed to build a degree of resilience or develop coping capacity among the people in order to withstand onslaught of natural disasters and climate change. Therefore, a vulnerability index shall take into cognizance the impacts due to climate change on different households facing the same disaster.

# Outputs for Outcome 1

- \* 5.1 Resilience to adapt with risk
  - \* 5.1.1 Sectoral policies and plans for Climate Change adaptations and DRR
  - \* 5.1.2 Communities/Local capacity building on DRR and CC Adaptations
  - \* 5.1.3 Communities, Local and National government have greater capacity to respond and provide basic services in emergencies and early recovery
  - \* 5.1.4 Communities, local and national government have better access to knowledge on DRR and CCA impacts and early recovery for better decision making

# UN Agencies and Outputs under Outcome 1

- \* Outputs under Outcome 1 and their indicators
- \* Sectoral policies and plans for Climate Change adaptations and DRR
  - \* UNDP, UNICEF, UNESCO, FAO, WHO, UNWOMEN, and IOM.
- \* Communities/Local capacity building on DRR and CC Adaptations.
  - \* UNDP, UNICEF, WFP, UNESCO, WHO, FAO and UNWOMEN

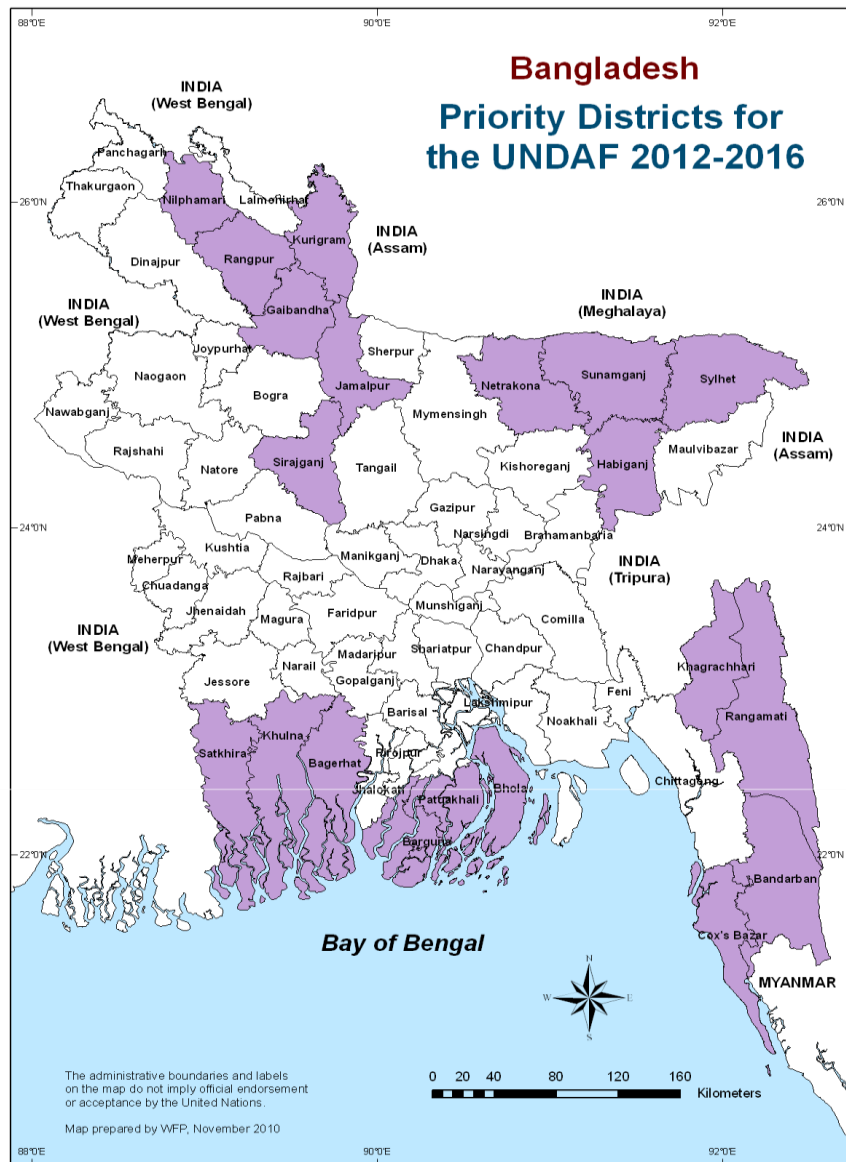
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- \* Communities, Local and National government have greater capacity to respond and provide basic services in emergencies and early recovery.
  - \* UNDP, UNICEF, WFP, UNFPA, WHO, IOM, UNESCO and FAO.
- \* Communities, local and national government have better access to knowledge on CCA impacts for better decision making.
  - \* UNDP, IOM, WHO, UNHCR, UNSECO, FAO, UNEP and UNWOMEN.

# Objectives

- \* This concept is an attempt to find such an index which can be used by UNDAF to monitor its progress and also by policy makers and project designers to ensure that UNDAF succeeds in achieving its targeted outcome. The index would also provide a relative scale of vulnerability by districts so that interventions can be organized according to the vulnerability in these districts.

# UNDAF Districts





# Data collected

- \* Cyclone shelter database by union (DMB/CDMP)
- \* District-wise deaths and affected persons by diarrhea by month and by year (1998-2012) (WHO)
- \* District-wise monthly malaria affected persons for 13 districts (WHO)
- \* District wise percentage of targeted communities, local and national authorities who are aware of the impact of climate change on their respective communities and/or sectors (CDMP)

# continued

- \* Total CRA completed in CDMP first phase
- \* Number of unions and municipalities in 09 Sidr affected districts.
- \* Operation information of WFP (by union)
- \* District wise number of rural communities with disaster/climate resilient habitats and community assets
- \* DISTRICT WISE number of Unions in disaster prone areas with developed community based risk reduction & CC adaptation action plans

# continued

- \* District wise number of disaster rescue and evacuation volunteers
- \* District wise number of district DMCs with a resourced disaster response plan
- \* Flood data by thana – vulnerability by area by degree (WFP)
- \* Literacy, population by district census data

# continued

- \* Land classification by district (low to high)
- \* Crop, livestock, poultry data for district from 1990 to 2010 by district
- \* HIES data for 2010 from all districts

# GoB Budget data 2006-2010

- \* Ministry of Health & Family Welfare
- \* Food Division
- \* Disaster Management & Relief Division
- \* Ministry of Agriculture
- \* Ministry of Fishery & Animal Resources
- \* Ministry of Environment & Forest
- \* Ministry of Land Ministry of Water Resources

# UN data (budget)

- \* FAO – projects similar to outcome 1 since 2007
- \* UNDP – projects similar to activities in output 1 since 2007
- \* WFP – projects similar to activities in output 1 since 2007

# Variables for the Index

- \* Allocation of GOB budget into district by combining a) population at risk, b) total population, c) agricultural land
- \* Similarly we did the division of UN budgets for the districts where it had operations since 2006.

## Indicators:

- a) Percent of households affected by flood (data obtained from HIES 2010 survey)
- b) Percent of households affected by drought and erratic rainfall patterns (data obtained from HIES 2010 survey)
- c) Percent of households suffered from reduction in consumption due to natural disasters (data obtained from HIES 2010 survey)
- d) Percent of households experienced loss in production due to natural disasters (data obtained from HIES 2010 survey)
- e) Percent of households affected by erosion (data obtained from HIES 2010 survey)
- f) Percent of households affected by cyclones, tornadoes, earthquake, etc. (data obtained from HIES 2010 survey)
- g) Percent of households suffered from crop losses due to pest attacks (data obtained from HIES 2010 survey)
- h) Percent of households experienced losses due to animal diseases (data obtained from HIES 2010 survey)
- i) Percent of households lost income due to natural disasters (data obtained from HIES 2010 survey)
- j) Percent of households lost asset due to natural disasters (data obtained from HIES 2010 survey)
- k) Percent of households suffered from malaria (in selected malaria infested districts); (data obtained from WFP)
- l) Percent of households suffered from diarrhea (data obtained from WFP)
- m) Degree of agricultural non-diversity in a district (data obtained from BARI/UIU study)



# Hypotheses

- \* UN output depends on risk to population, GOB expenditure, population, land area
- \* UN expenditure depends on UN output, GOB expenditure, population, land area

And

vulnerability is affected by risk to population, gob expenditure, UN expenditure, UNDAF priority districts, etc.

# Elements of the Vulnerability Index

1. Of the 13 variables initially listed in paragraph 16 above, the Principal Component Analysis retained 11 of these variables in the index. PCA dropped diarrhea and malaria data from the analysis. Using the smallest AIC values and with eigenvalues greater than 1, four principal components were extracted from this list correlated variables. The index is therefore, given as
2. 
$$CDVI = \sum_{i=1}^{11} w_i V_i$$

(1)
3. where,  $w_i$  is the weight of the  $i^{th}$  measure of vulnerability,  $V_i$  is the measure of vulnerability obtained using HIES/BARI/WFP data. The weights for each of these indicators variables are determined using PCA and are given in the following table.

\* This is based on Akaike Information Criteria (AIC) and eigenvalues (Filmer & Pritchett, 2001).

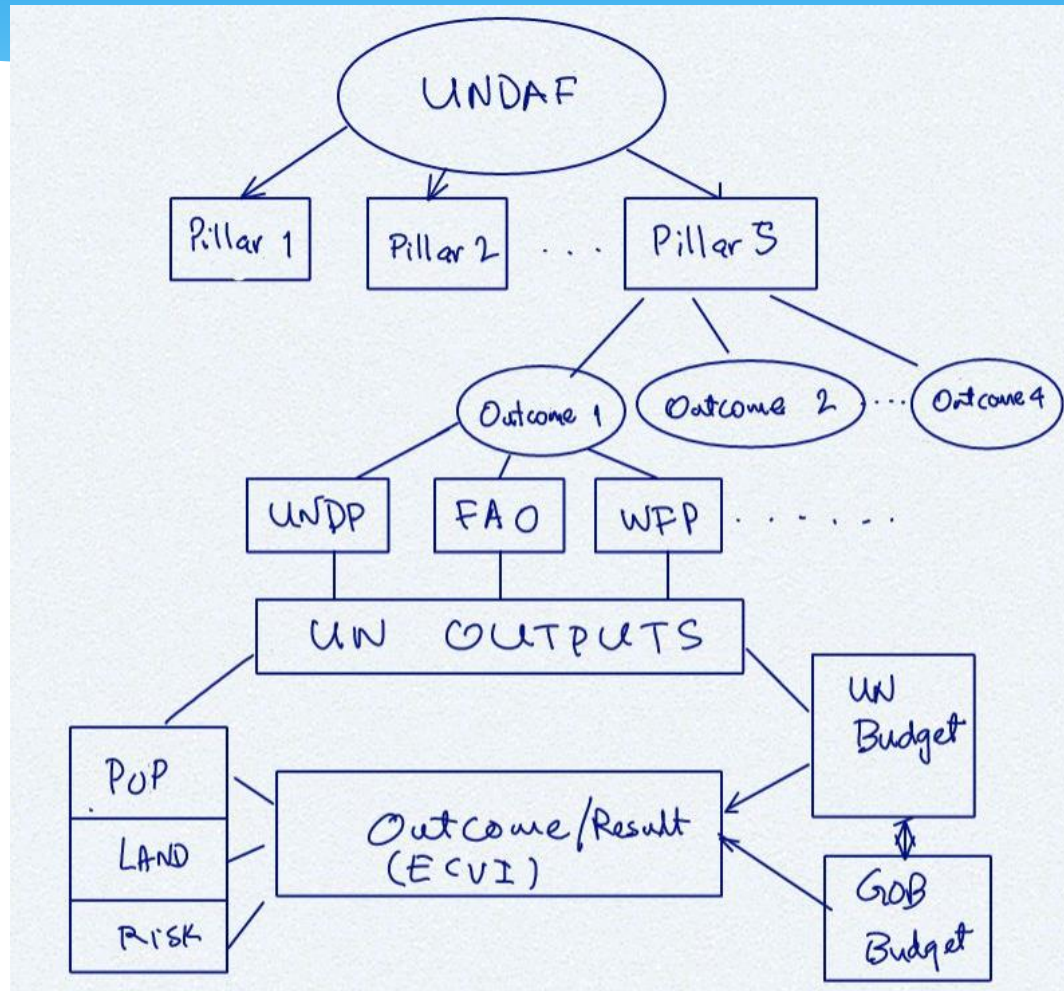
# Creation of CDVI using PCA

<b>Data</b>	<b>Wgt</b>	<b>Variable</b>	<b>Description</b>
HIES	10.0%	pccycloneplus	Cyclone, tornado and earthquake
HIES	10.1%	pcerosion	Erosion
HIES	5.1%	pcdrought	Drought
HIES	8.4%	pcanimaldis	Animal diseases
HIES	7.5%	pcflood	Flood
HIES	4.6%	pcpestoncrop	Pest on crop
HIES	7.5%	pclossinc	Lost income due to disaster
HIES	7.1%	pclossfoodc	Reduced food consumption due to disaster
HIES	7.5%	pclossfoodp	Reduced food production due to disaster
HIES	6.4%	pclossasset	Lost asset due to disaster
WHO	8.7%	pcdiarrhea5	Diarrhea (5 years average)
WHO	10.5%	pcmalaria08	Malaria (13 district data)
BARI	5.9%	adi2010	Agri diversity index by district

# CDVI for UNDAF districts

dist	divcode	distcode	CDVI
Bagerhat	40	1	165.69
Bandarban	20	3	210.33
Barguna	10	4	19.08
Bhola	10	9	83.41
Cox's Bazar	20	22	47.02
Gaibandah	55	32	255.83
Habiganj	60	36	102.53
Jamalpur	30	39	136.39
Khagrachhari	20	46	88.46
Khulna	40	47	280.76
Kurigram	55	49	85.85
Netrokona	30	72	222.87
Nilphamari	55	73	58.48
Patuakhali	10	78	63.61
Rangamati	20	84	116.57
Rangpur	55	85	131.92
Satkhira	40	87	301.52
Seraiganj	50	88	22.55
Sunamganj	60	90	183.73
Sylhet	60	91	111.84

# Conceptual Framework



# Estimation

undafoutput	Coeff	St Err	z	P>  z	95% C. I.	
bmin10	-2.70E-01	0.070176	-3.85	0	-0.40804	-0.13296
risk	34.59115	16.53297	2.09	0.036	2.187113	66.99518
popbsx11	2.45E-05	7.72E-06	3.18	0.001	9.42E-06	3.97E-05
area11	0.030356	0.007005	4.33	0	0.016626	0.044085
_cons	-20.2316	17.28617	-1.17	0.242	-54.1119	13.64866
-----+-----						
bunsys10						
bmin10	1.02E-02	0.007414	1.37	1.70E-01	-4.37E-03	0.024695
undafoutput	0.125667	0.032431	3.87	0	0.062103	0.189231
popbsx11	4.21E-06	1.02E-06	4.11	0	2.20E-06	6.21E-06
_cons	-4.11635	2.053148	-2	0.045	-8.14045	-0.09226
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CDVI						
bmin10	0.046447	0.022734	2.04	0.041	0.001889	0.091005
bunsys10	-0.87086	0.579291	-1.5	0.133	-2.00625	0.264528
khulna	19.74834	6.806895	2.9	0.004	6.407075	33.08961
undaf	13.19332	5.592627	2.36	0.018	2.231974	24.15467
_cons	10.24355	6.14581	1.67	0.096	-1.80202	22.28912

Endogenous variables: undafoutput bunsys10 CDVI

Exogenous variables: bmin10 risk popbsx11 area11 khulna undaf

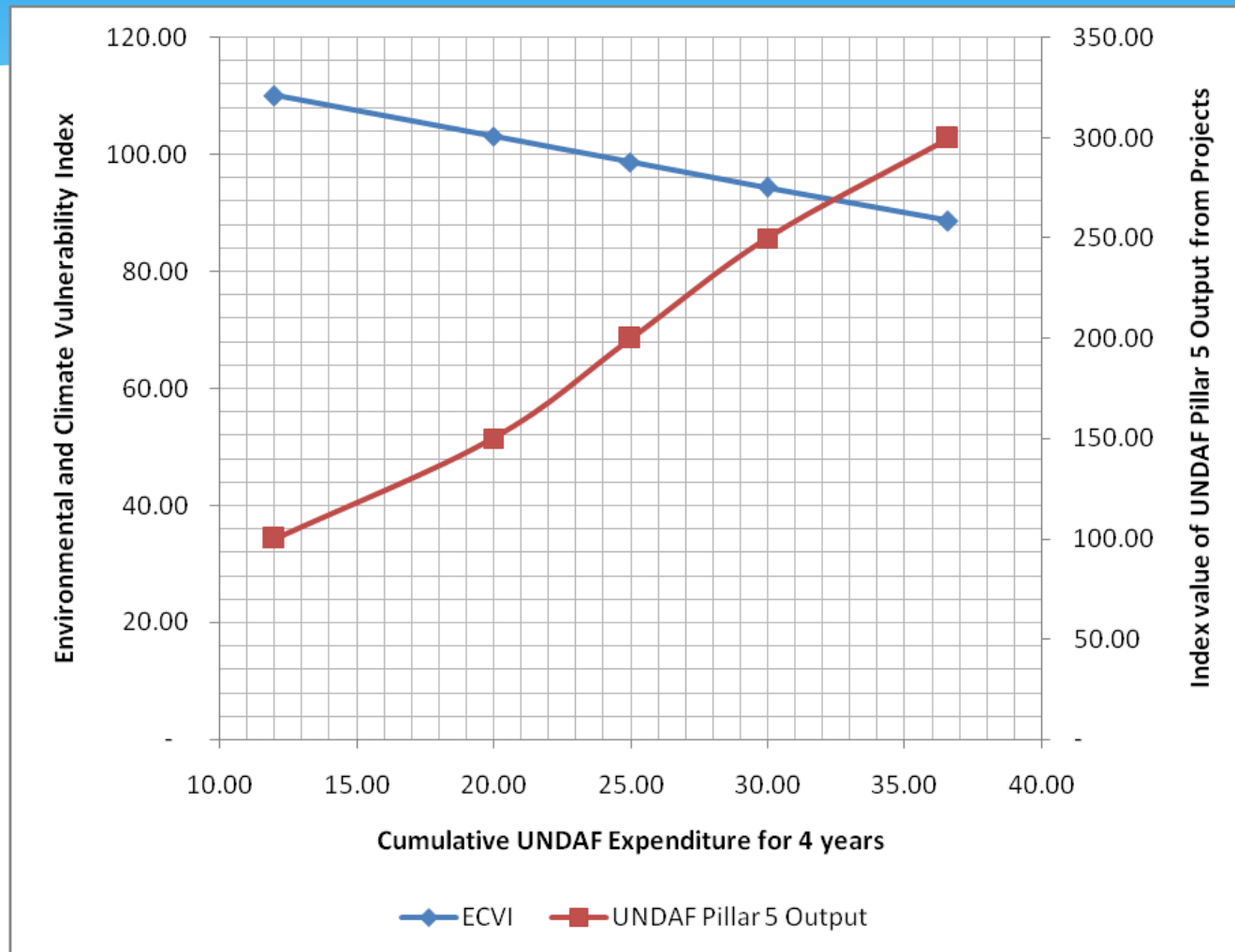
# CDVI in 2016

	bunsys10	CDVI	undafoutput
2016 LEVEL	12.08	100.00	100.00
	39.86		300

	UN Budget	CDVI	UNDAF OUPUT INDEX
calibration	12.08	100.00	100.00
prediction	37.21	88.66	

MODE PREDICTIONS on CDVI

# CDVI and UNDAF Activities





# UNDAF output and CDVI

