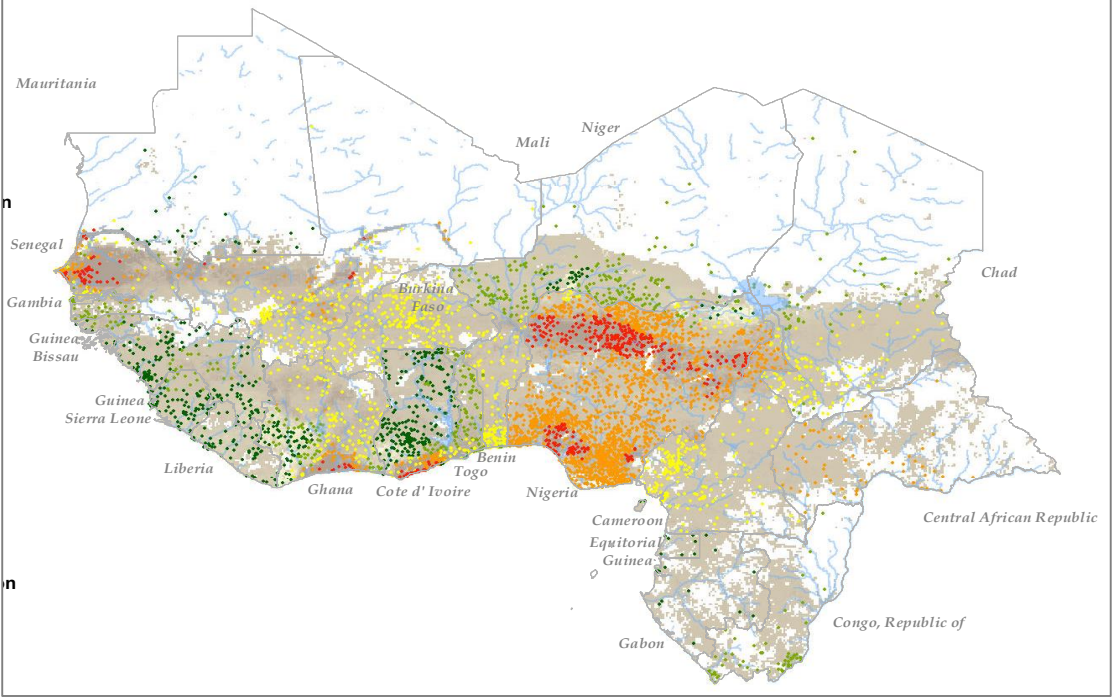
No substantial famine has ever occurred in any independent and democratic country with a relatively free press.”

Amartya Sen, *Democracy as a Universal Value*
Nobel Prize in Economics, 1998

“Wicked” Problems



TEDx

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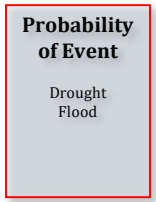
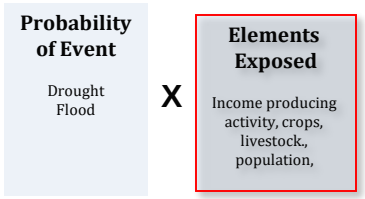
U.S. Army Research Laboratory


BICYCLE
RIDING
PROHIBITED
SEAFOOD
JOE'S


TONY & JOE'S


Probability of Event
Drought
Flood


Probability of Event
Drought
Flood
X
Elements Exposed
Income producing activity, crops, livestock., population,

Probablity of Event

Food shortages
Water shortages
Land unavailability
Disease outbreak
Migration

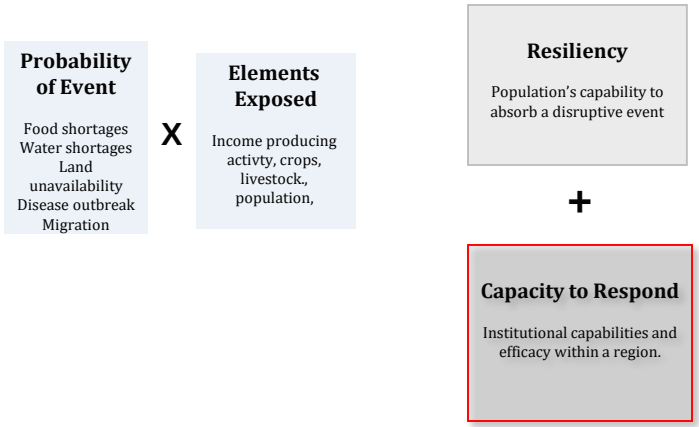
X

Elements Exposed

Income producing activty, crops, livestock., population,

Resiliency

Population's capability to absorb a disruptive event


Probability of Event
Food shortages
Water shortages
Land unavailability
Disease outbreak
Migration
X
Elements Exposed
Income producing activty, crops, livestock., population,
Resiliency
Population's capability to absorb a disruptive event
+
Capacity to Respond
Institutional capabilities and efficacy within a region.

Sample Taxonomy

Political Stress

Change in government
Ethnic division
Immigration surge
Boundary dispute

Social Stress

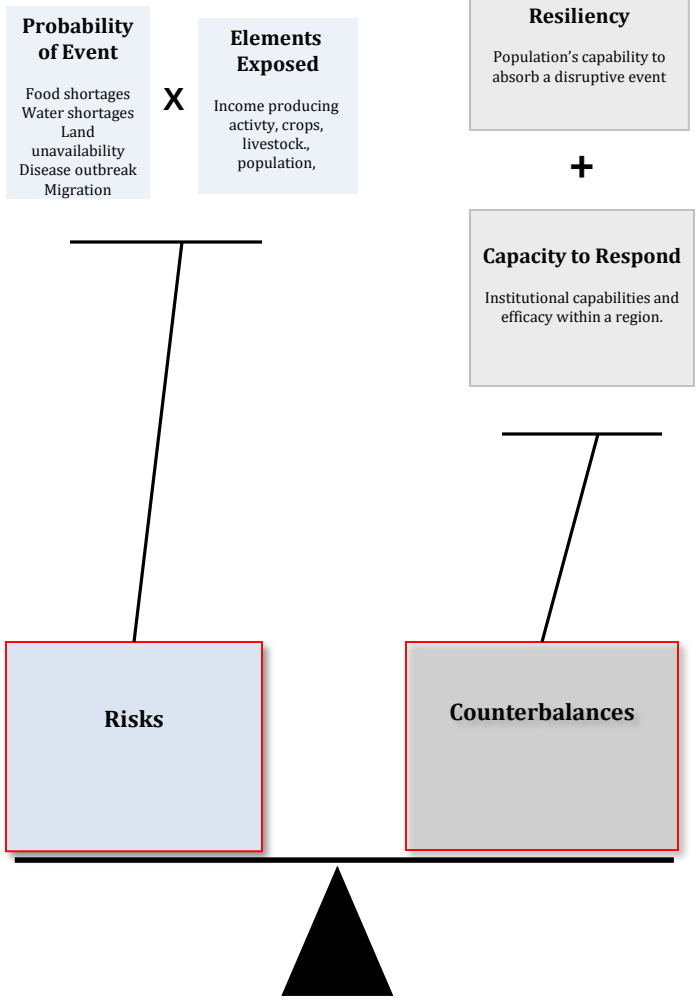
Gender disparity
Transportation loss
Disease susceptibility
Conflict history

Economic Stress

Rapid inflation
Currency crisis
Industry collapse
Trade disruption

Environmental Stress

Extreme weather events
Weather cycles
Water cycles
Contamination



Health

Infant mortality, disease prevalence, immunization, improved water access, etc.

Wealth

Land-use, access to markets, subsistence agriculture, income diversity, etc.

Education

Literacy rate, trained teachers, proximity to schools, etc.

Demographics

Dialects, religiosity, history of conflict, refugees, dependency ratio, median age, etc.

Governance

Aid, democracy index, military expenditures, presence of terrorism, etc.

Infrastructure

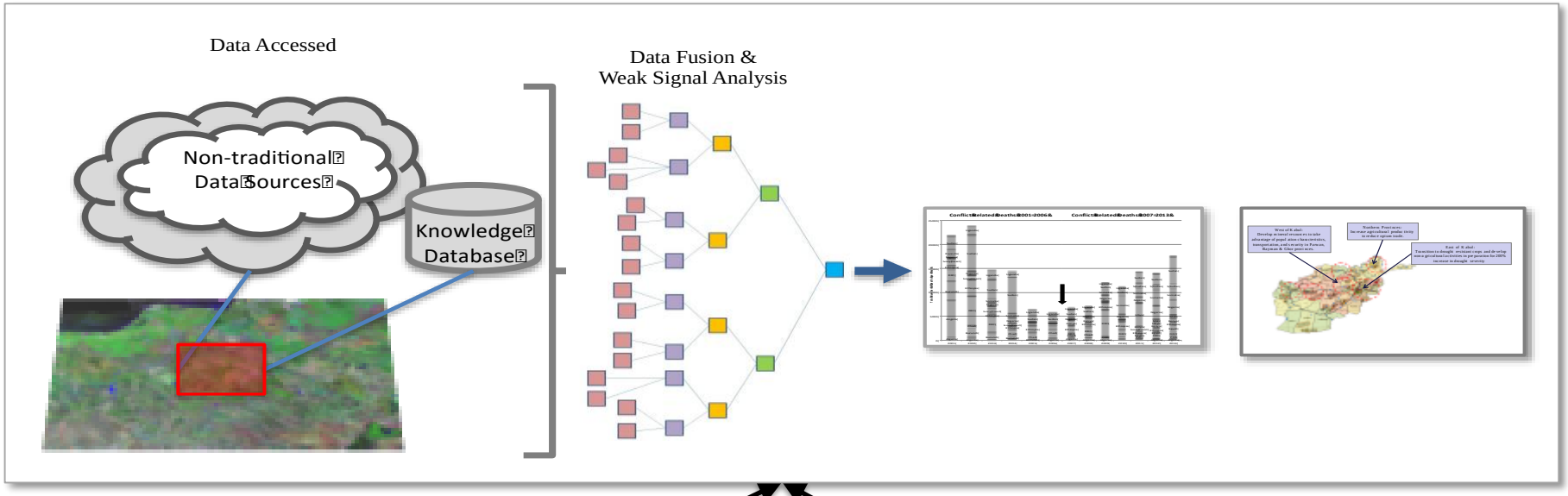
Urbanization, road access, communication, internet, transportation, etc.

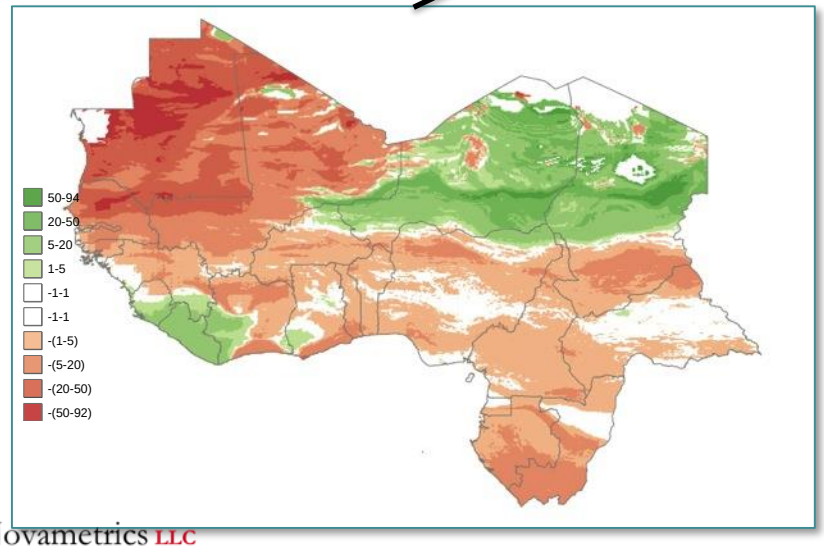
Natural Resources

Agriculture, timber, fishing, water resources, oil, minerals, narcotics, etc.,

Economics

Inflations, income, GDP growth, income diversity





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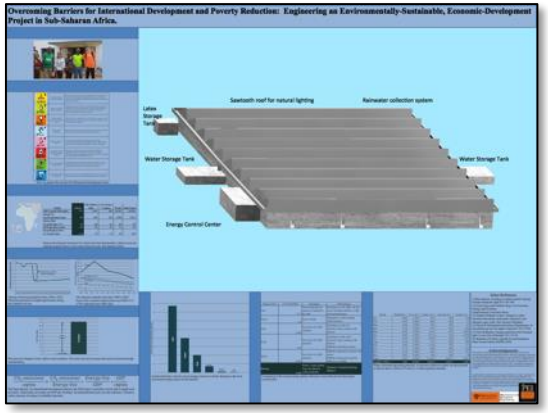
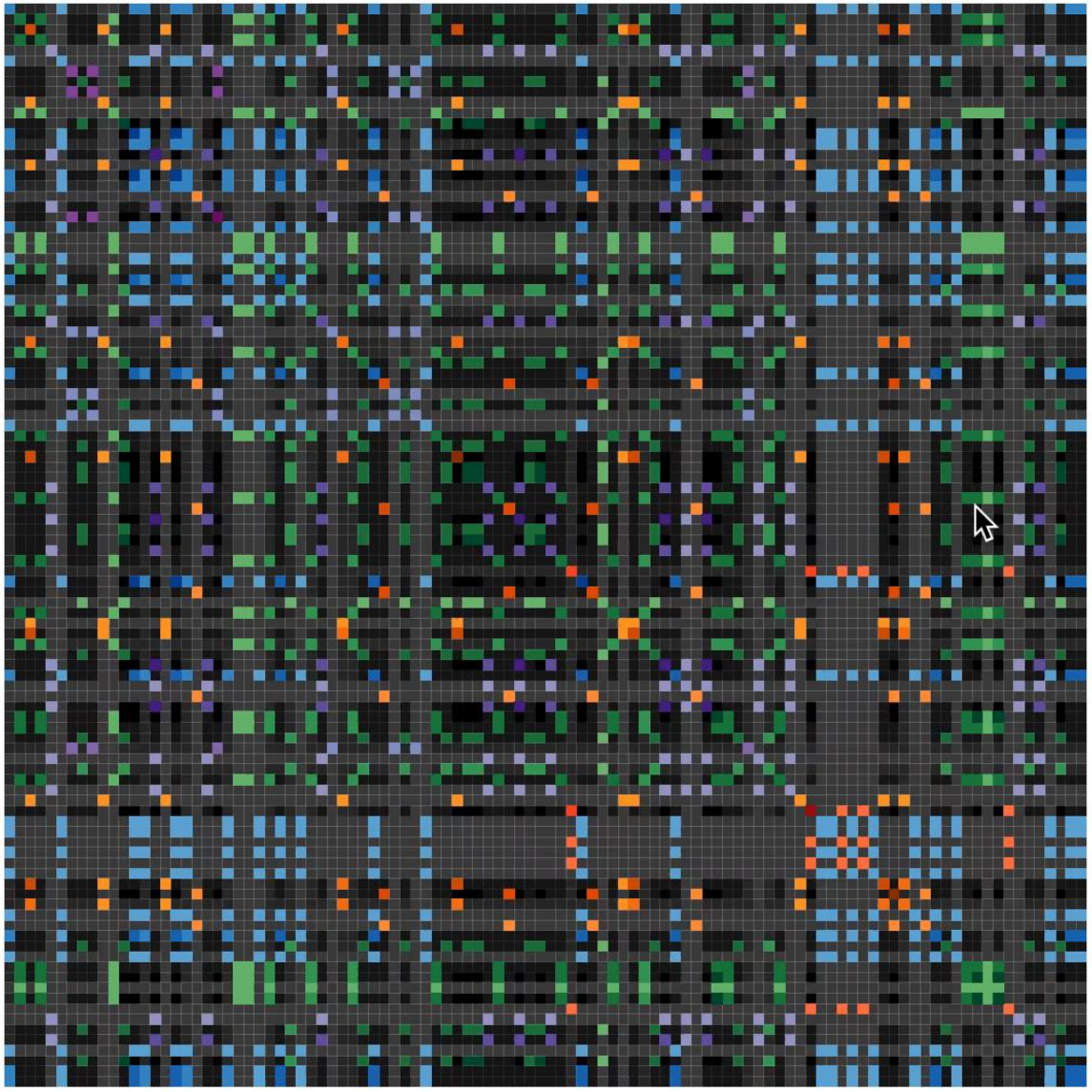
You cannot promote environmental stewardship without addressing the underlying problems that cause people to degrade the environment in the first place — many consider this to be poverty and conflict.



Random Order



Agriculture and Nutrition

Demographics and Labor

Education

Finance, Trade, and Economic Activity

Gender Parity

Government

Health

Infrastructure

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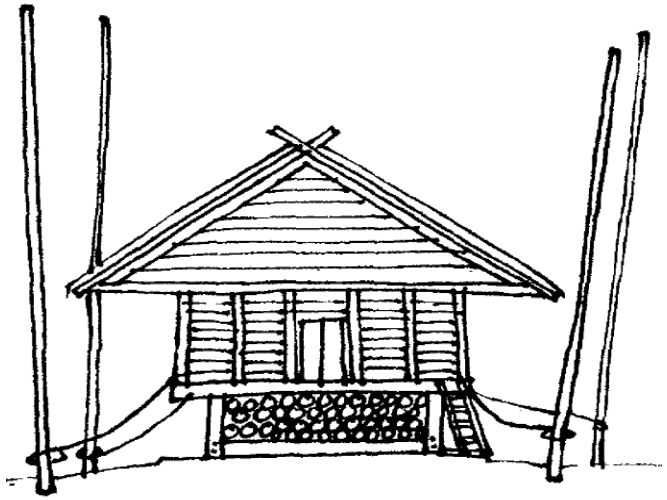
Adaptation



Bangkok
(mid-nineteenth century)

The Netherlands
(today)

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STOP

Sample Taxonomy

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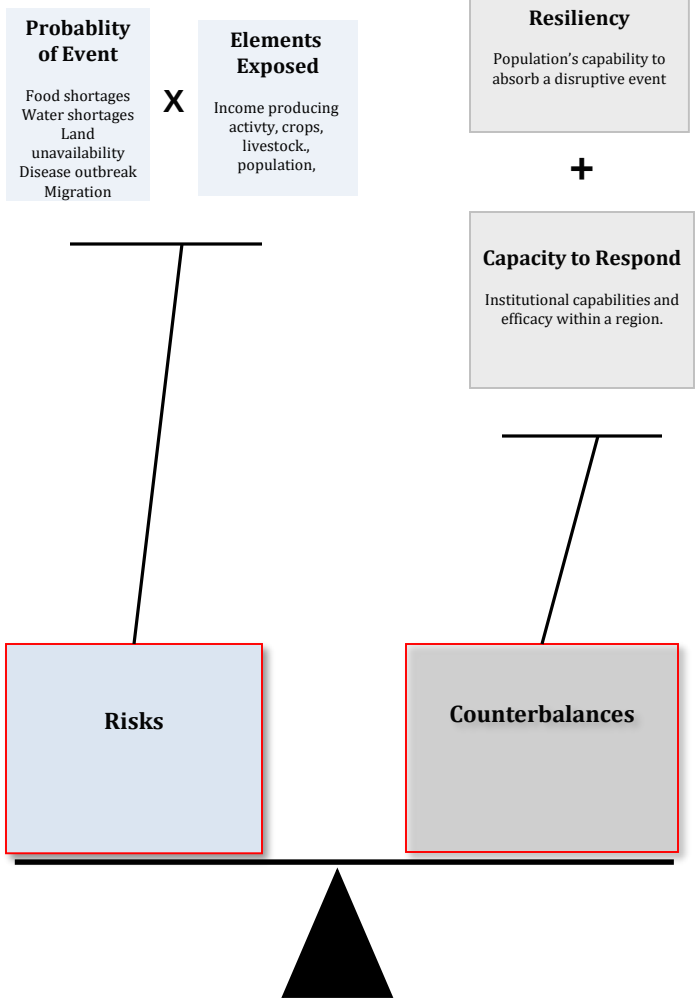

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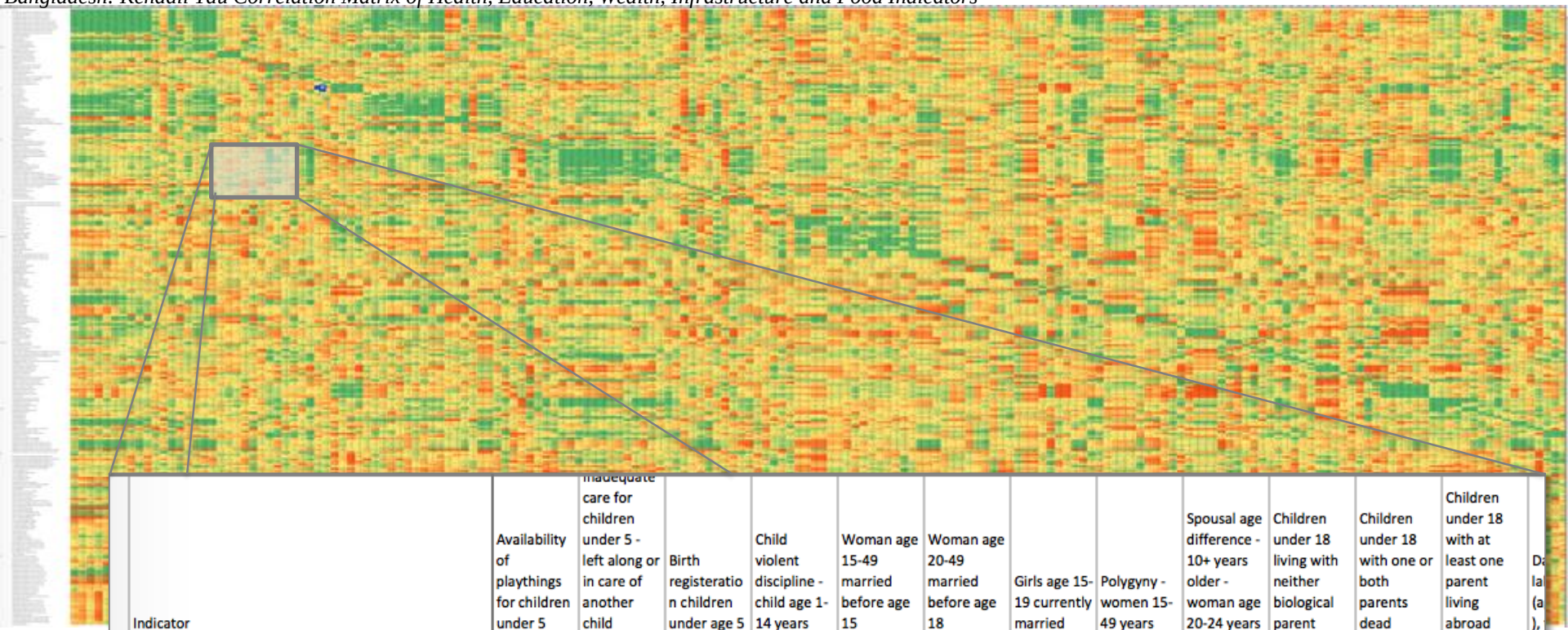
Economics

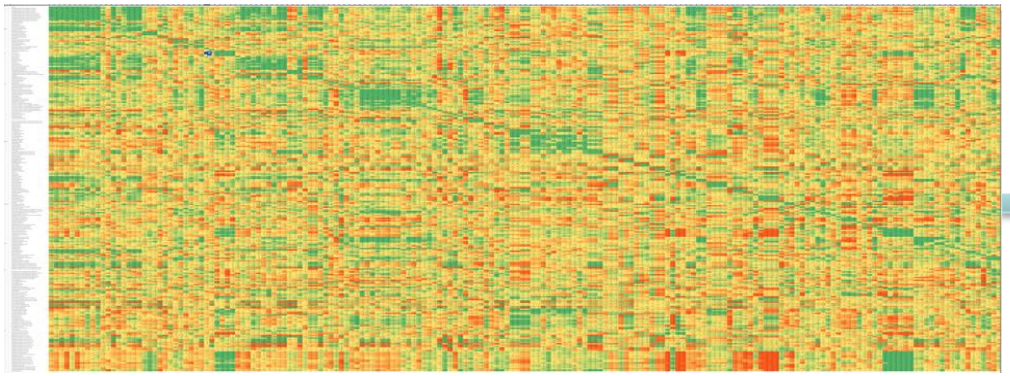
Inflations, income, GDP growth, income diversity

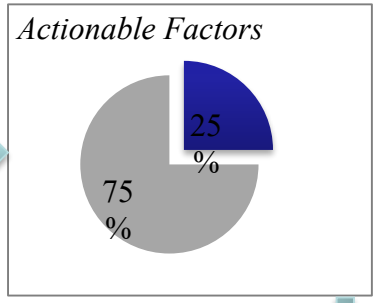
Bangladesh: Kendall Tau Correlation Matrix of Health, Education, Wealth, Infrastructure and Food Indicators

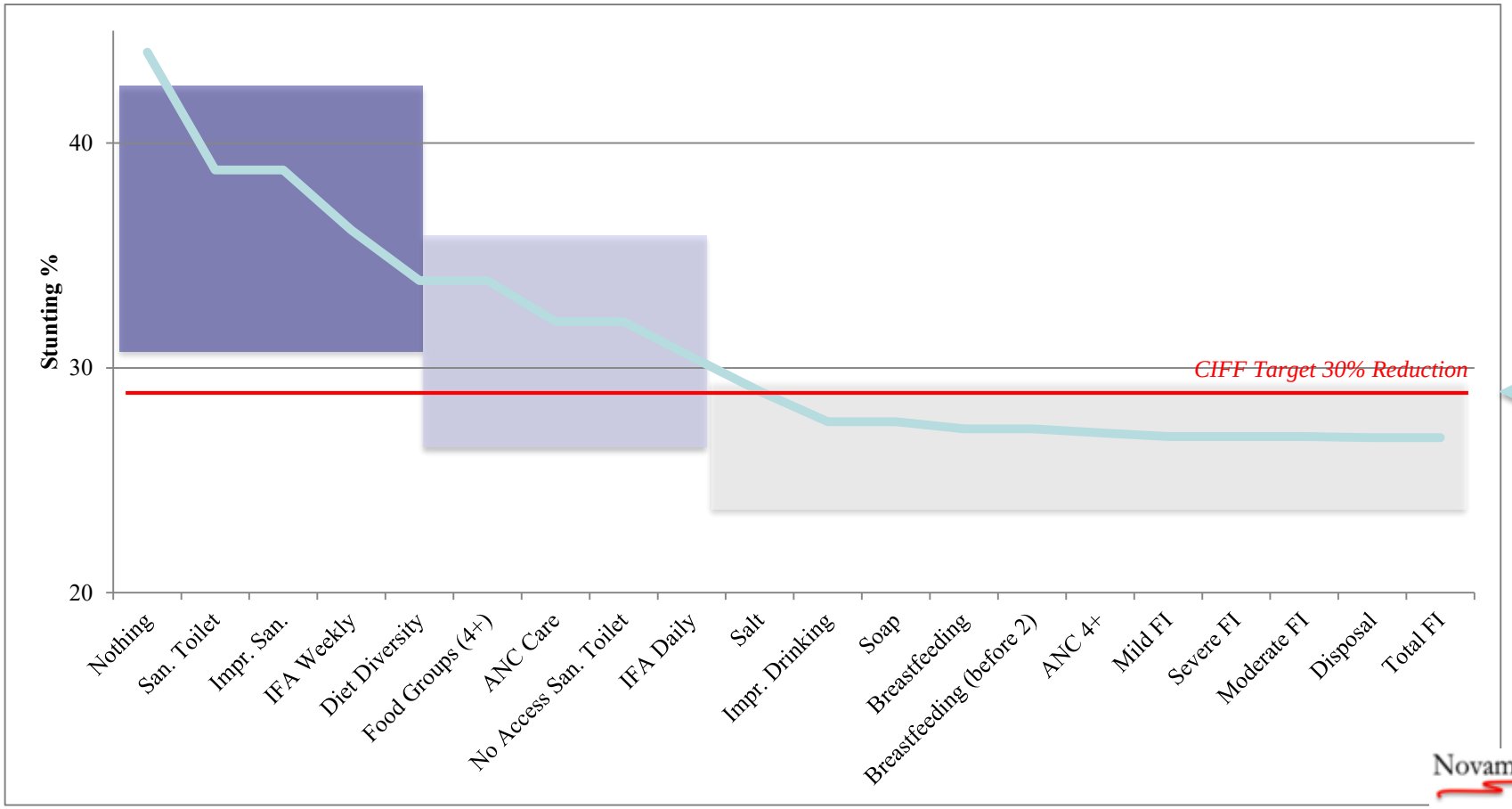


Indicator	Availability of playthings for children under 5	Inadequate care for children under 5 - left along or in care of another child	Birth registeration children under age 5	Child violent discipline - child age 1-14 years	Woman age 15-49 married before age 15	Woman age 20-49 married before age 18	Girls age 15-19 currently married	Polygyny - women 15-49 years	Spousal age difference - 10+ years older - woman age 20-24 years	Children under 18 living with neither biological parent	Children under 18 with one or both parents dead	Children under 18 with at least one parent living abroad	Da la (a),
Iodized salt consumption MICS	-0.01295	0.13214	0.04142	0.04604	0.19234	0.19124	0.28398	0.15414	-0.21525	0.17816	0.00432	-0.38294	
Ever breastfed MICS	-0.05112	0.13621	0.06583	0.2023	0.0305	-0.11121	0.02355	0.12717	-0.02019	0.00157	0.06589	0.16428	
Breastfed within one hour of birth	0.04577	0.1778	-0.09619	0.23546	0.20887	0.19687	0.20083	-0.063	-0.00673	0.11033	-0.20384	0.05766	
Children 0-23 months with age appropriate breastfeedin	0.32466	0.01872	-0.04321	-0.07208	-0.45024	-0.51292	-0.36565	-0.31286	0.25017	-0.36119	0.29191	0.44785	
Children age 0-23 months fed with a bottle with nipple	0.05439	0.0632	-0.16707	0.07758	0.04369	-0.0123	-0.01426	0.14847	-0.11275	-0.07407	0.13756	-0.20092	
Neonatal tetanus protection	0.20223	0.20059	-0.19108	-0.12639	-0.0524	-0.24232	-0.1167	0.17051	0.3179	-0.14064	0.18719	0.00715	
Children under 5 with diarrhoea in the last 2 weeks	0.02978	0.44397	0.068	0.08015	-0.07585	-0.06232	-0.14117	0.19638	0.0131	0.02395	-0.01799	-0.00396	
Antenatal care- at least once by skilled health profession	0.27845	0.04768	-0.04356	-0.13506	-0.18774	-0.08157	-0.23423	0.01709	-0.04162	-0.00473	0.42402	-0.2047	
Antenatal care coverage- at least 4 times by any provide	0.37116	0.1463	0.0011	-0.09917	-0.27913	-0.26392	-0.33417	-0.17605	0.06868	-0.12931	0.40152	0.06495	
Antenatal case- BP measured urine and blood samples ta	0.25282	0.11164	-0.07102	-0.05888	-0.10276	0.03297	-0.09385	-0.02428	-0.13887	0.03355	0.29711	-0.28591	
Skilled attendant at delivery	0.35155	0.01521	-0.13191	0.0146	-0.22098	-0.1443	-0.26724	-0.00575	-0.04949	-0.2209	0.45108	0.10227	
Institutional delivery	0.40386	0.15802	-0.12105	0.09206	-0.32626	-0.18714	-0.32338	-0.06198	-0.06734	-0.11602	0.51621	-0.0849	
Caesarean section delivery	0.33783	0.298	0.08722	0.07705	-0.32799	-0.189	-0.35181	0.02	-0.14832	-0.12419	0.51885	-0.14221	
Postnatal health check - newborn within 2 days	0.37453	0.28813	-0.2189	0.05707	-0.1843	-0.07335	-0.20091	-0.00564	-0.009	-0.11551	0.35823	-0.14674	
Postnatal health check - mother within 2 days	0.36059	0.28795	-0.19678	0.11986	-0.1218	-0.00945	-0.17796	-0.00456	-0.04865	-0.01937	0.40686	-0.19173	
Knowledge of HIV women age 15-24	0.19133	0.13928	-0.00893	-0.12173	-0.22075	-0.30041	-0.16779	0.08723	-0.18878	-0.19913	0.16267	-0.08575	
HIV_AIDs -woman 15-49 years - who have heard of AIDs	0.24963	0.04708	-0.01409	-0.01342	-0.1676	-0.13611	-0.0577	0.12702	-0.21772	-0.13969	0.28394	-0.1818	
HIV_AIDs -woman 15-49 years - who have knowledge ab	0.2994	0.04787	-0.02954	0.00091	-0.21939	-0.22989	-0.19302	0.24365	0.18431	-0.09285	0.26111	-0.01374	

3. Example: Optimizing Investments







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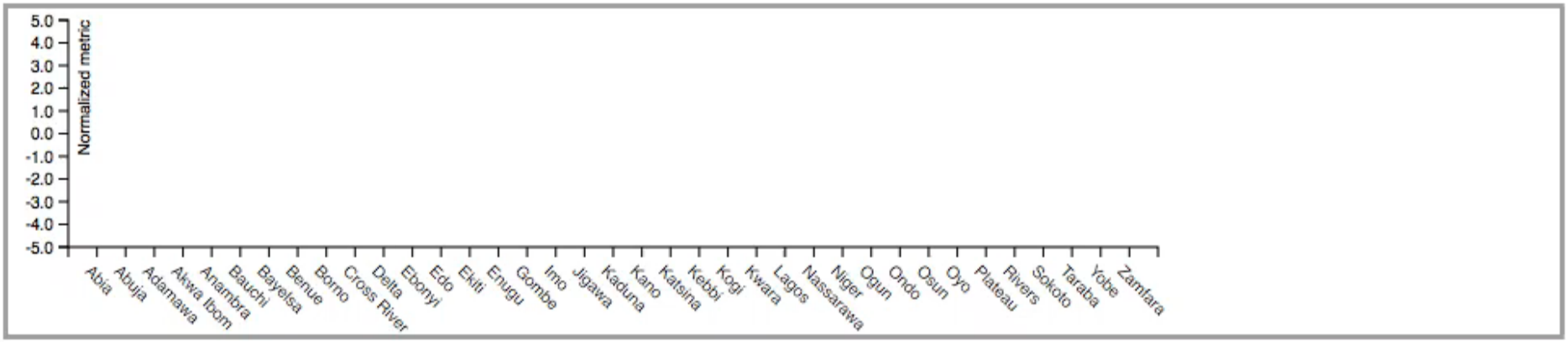
Normalized metric
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
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Abuja
Adamawa
Akwa Ibom
Anambra
Bauchi
Bayelsa
Benue
Borno
Cross River
Delta
Ebonyi
Edo
Ekiti
Enugu
Gombe
Imo
Jigawa
Kaduna
Kano
Katsina
Kebbi
Kogi
Kwara
Lagos
Nassarawa
Niger
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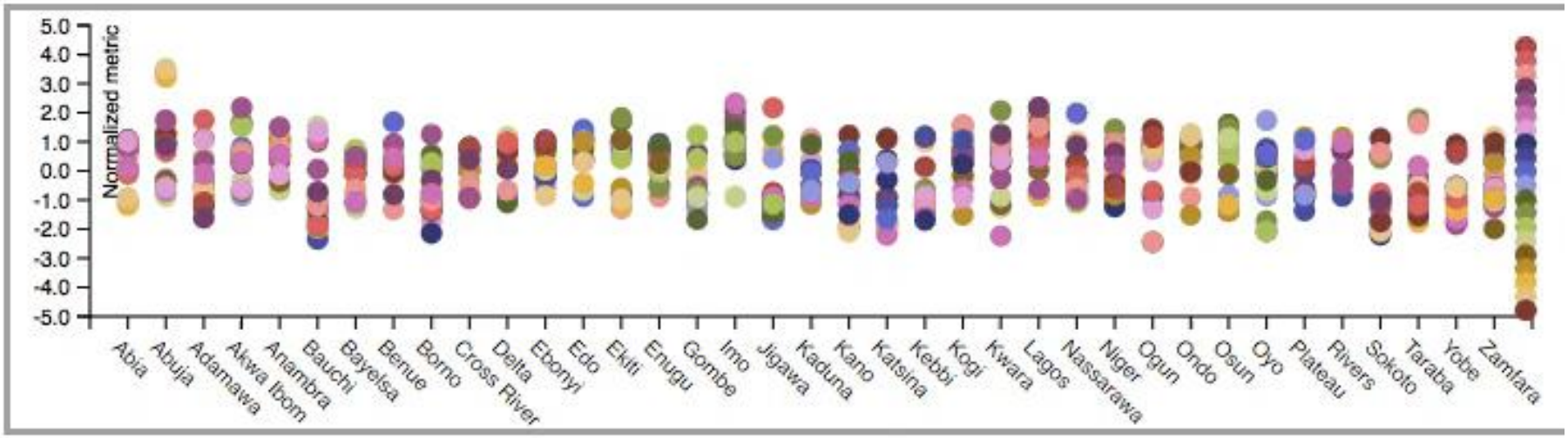
Osun
Oyo
Plateau
Rivers
Sokoto
Taraba
Yobe
Zamfara


Normalized metric
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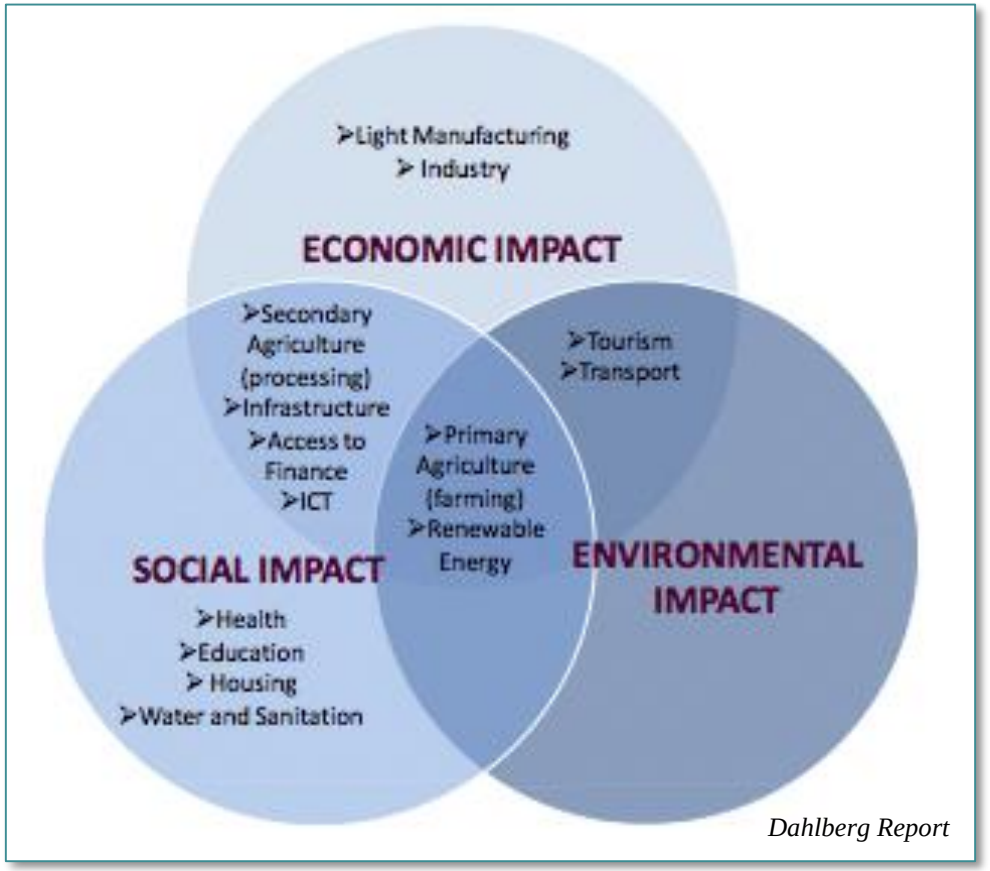
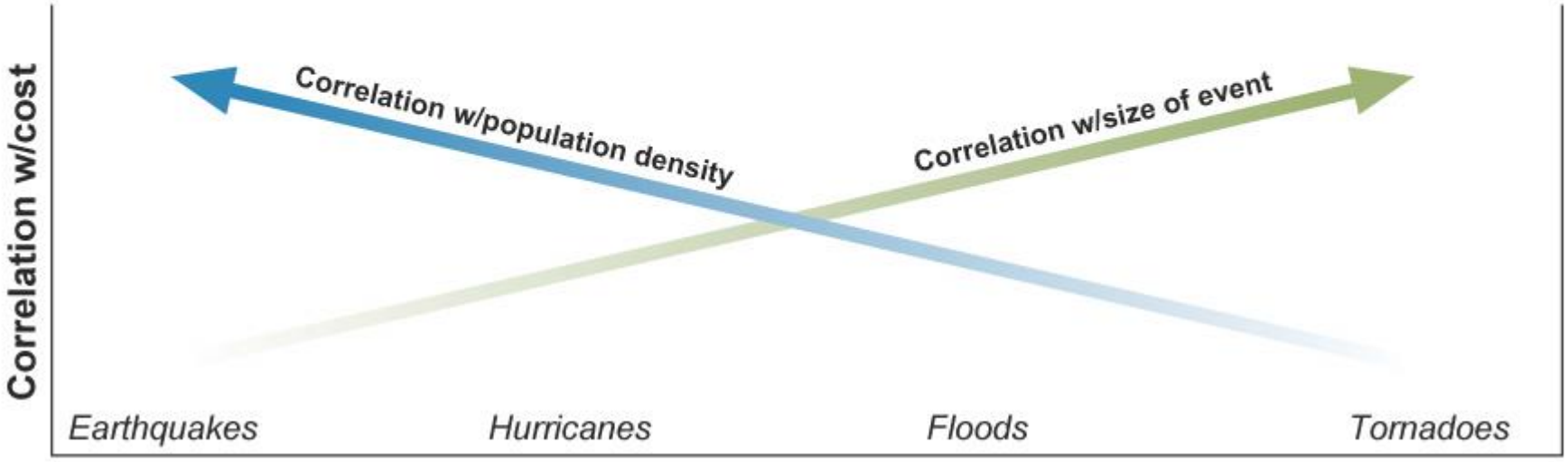
Anambra
Bauchi
Bayelsa
Benue
Borno
Cross River
Delta
Ebonyi
Edo
Ekiti
Enugu
Gombe
Imo
Jigawa
Kaduna
Kano
Katsina
Kebbi
Kogi
Kwara
Lagos
Nassarawa
Niger
Ogun
Ondo
Osun
Oyo
Plateau
Rivers
Sokoto
Taraba
Yobe
Zamfara

Holy Grail:

Sustainable use of natural resources to promote economic development and political stability.



Summary of Correlations



	Frequency/Year	Correlation with Cost	
		Size of Event	***Population Density***
Earthquakes	<1	Low	Very High
Hurricanes	1-2	Low	Moderate
Floods	25	Moderate	Low
Tornadoes	500-600	Very High	Low

Risk = [probability of an event] x [exposed elements]

Recurrence Interval	Probability of event / year	Population exposed to risk	People at risk / year
20 year flood	(0.05)	10,000	500
50 year flood	(0.02)	50,000	1,000
100 year flood	(0.01)	100,000	1,000

By creating protective measures against frequent events,
you may encourage more people to move into high-risk areas
and increase overall risk!

- The costliest events are not necessarily the largest or those that occur in the areas of highest population density.

- The costliest events are those that are unusual, either in terms of size (for frequent events) or location (for infrequent events).

Policy Development Process

EVENT

AWARENESS

PUBLIC SUPPORT

LEGISLATION