Bangladesh

The ND-GAIN Country Index

Increases in climate-related disasters and other climate change-related stresses will lead to increased costs for governments and businesses, complicate political decisions, and threaten the quality of life. Making adjustments to human systems intended to reduce vulnerability and to minimize negative impacts from climate change is referred to as *climate change adaptation*. The ND-GAIN country index aims to help drive an understanding of climate change adaptation, and help both public sector and corporations prioritize the adaptation efforts and investments to reduce vulnerabilitiesin the face of global shifts due to climate change. The ND-GAIN index summarizes a country's vulnerability[i] to climate change and other global challenges in combination with its readiness to absorb adaptation investments and initiatives. ND-GAIN is comprised of thirty-six indicators for calculating a *Vulnerability* measure and nine indicators for calculating a *Readiness* measure.[1]

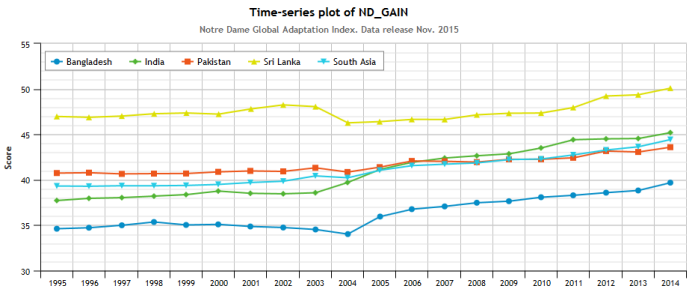

Figure 1.Bangladesh's ND-GAIN score over time. Pakistan, India, Sri Lanka, and South Asia's average are illustrated for reference.

As seen in Figure 1, Bangladesh's ND-GAIN score has increased from 34.62 to 39.69 over the last 19 years; however, a consistent improvement only happened since 2004. This improvement was due to a decreasing Vulnerability score and to a remarkable improvement in Readiness score. The ND-GAIN Matrix (Figure 2) illustrates Bangladesh's Readiness and Vulnerability relationship. During the 1995-2013 period, the nation's vulnerability improved by 0.0547 points[ii] (i.e. moved down in the graph). The mean progress of all nations for this period was 0.0232 points. Similarly, during the 1995-2013 period, the nation's readiness had an overall improvement of 0.0467 points (i.e. moved right in the graph). The mean progress of all nations in that period was 0.0897.

[1]Please refer to the Index Technical Document by visiting http://index.ndgain.org

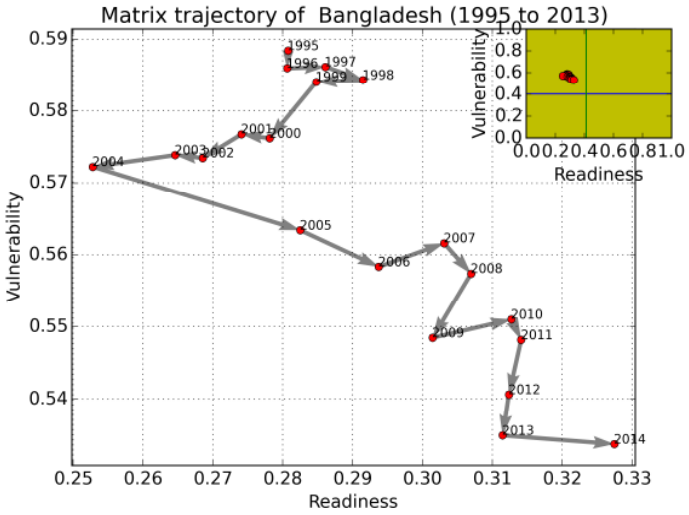

Figure 2. ND-GAIN Matrix trajectory of Bangladesh.During the 1995-2014 period, the nation's vulnerability has had an overall improvement of 0.0547 points. The mean progress of all nations for this period was 0.0232. 2008 was the year where Bangladesh had the most improvement in vulnerability (by 0.0089 points) from its previous level the year before. The average progress of all nations in that year was 0.004. The nation's Readiness has had an overall improvement of 0.0467 points. The mean progress of all nations in that period was 0.0897. 2004 was the year where Bangladesh had the most progress in Readiness, when the nation improved by 0.0297 points from its level the year before. The average progress of all nations that year was 0.0167.

In spite of this improvement, the nation still lags behind considerably compared to other nations and compared to South Asia's average, as can be seen in Figure 1.

As this report will show, the nation-state of Bangladesh has huge potential to keep improving, partially thanks to sectors that are related to the Readiness component. The report will also highlight some of the risks that the nation faces, the actions that the nation is taking, its progress, and how the world can learn from the nation's resilience.

CHALLENGES AND OPPORTUNITIES

The ND-GAIN Index underscores the widely held knowledge that Bangladesh is one of the most vulnerable countries in the world. However, as we just observed through the ND-GAIN matrix, the nation has improved its vulnerability and even made more improvement of its readiness measure.

The nation's standing, however, is a representation of the effect of a myriad of underlying factors and the interrelationships among them. Some of these factors are directly reflected in the sectors that compose ND-GAIN's Vulnerability measure. The following three key factors are

significant in their role of Bangladesh's overall vulnerability standing: geographic location, overpopulation, and dependence on natural resources. The nation's acknowledgement of them is leading Bangladesh into taking appropriate and effective actions towards the betterment of its vulnerability standing. We briefly describe these factors in the context of ND-GAIN's indicators and the specific urgent needs that the government has made explicit to the international community.

Geographic location

Figure 3 illustrates the vulnerability of the infrastructure sector. The indicators that represent the two most vulnerable areas of the Infrastructure sector are *population living under 5 meters above sea level* and *projections of sea level rise impacts*. These highlight the nation's vulnerability due to its geographic location in the Bay of Bengal, which is characterized by being dominated by river floodplains and low land elevation. Thus considerable portions of Bangladesh's current landmass could be permanently underwater, if proper actions are not taken.

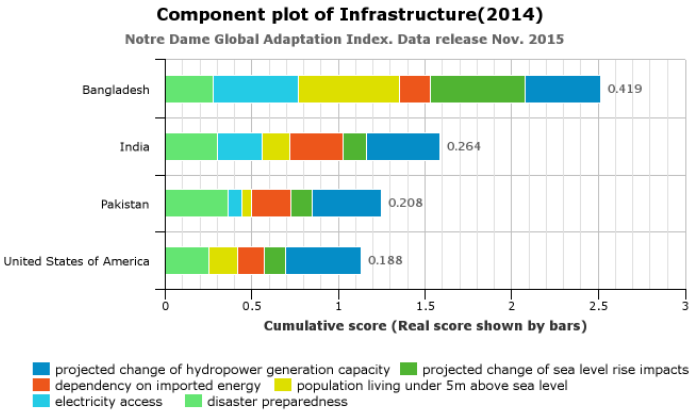

Figure 3.Bangladesh's Infrastructure score. Note the three indicators that make the nation the most vulnerable to climate change. Other nations are illustrated just for reference. Visit http://index.ndgain.org for exploring further those other nations.

The nation's vulnerability due to low land elevation, in addition to being dependent on sea-level rise, is also dependent on river flooding. Because the cause of river flooding is in function of water originating in other countries, Bangladesh has limited leverage in controlling river floods. The effects of river floods are mixed: their principal impact is the destruction of property; however it also causes land accretion, which is a positive phenomenon critical for Bangladesh's agriculture [8]. In this context, the Bangladeshi government and relevant stakeholders have prioritized the following technology options to address pressing issues that come as a result of the discussed vulnerabilities [6]:

a) Rehabilitation of existing embankments/dykes and dredging
b) Tidal barriers (sluice gates)
c) Tidal river management including computer simulation of tidal flow
d) Comprehensive disaster management incorporating early warning systems and involving community
e) Monitoring of sea level rise, tidal fluctuation, salinity intrusion, sedimentation and coastal erosion and
f) Urban Infrastructure development.

Dependence on natural resources

The nation has a vast range of resources. For instance, the nation enjoys a rich genetic estate, rich ecosystem diversity, and a favorable climate in one of the most fertile places on earth with soil conditions for the production of a variety of crops all the year round.

However, Bangladesh overwhelmingly depends on natural resources, which are sensitive to climate variability and climate change. The nation's dependence on agriculture makes the nation even more vulnerable to sea level rise, which also causes salinity infection of their coastal aquifers, one of the biggest concerns of the government and international institutions.

For instance, according the *Projected change of cereal yields* indicator, Bangladesh will be one of the nations that will be affected the most by climate change. Specific studies on change of agricultural yield differ considerably, but all agree on the reduction of crops due to climate change. In most countries, yields from rainfed agriculture could be reduced to 50% by 2020. For a country with increasing population and hunger, this will have an extremely adverse effect on food security.

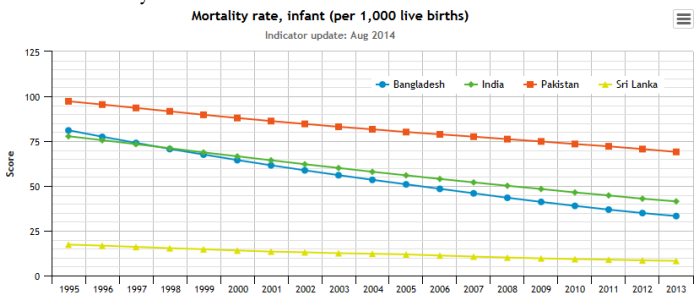

Figure 4. Bangladesh's infant mortality rate. Note the steady decrease.

The implications of this scenario are alarming, particularly because the potential impact to other sectors where Bangladesh has had a difficult progress, such as the mother/child malnutrition and child mortality rate. In spite of the nation's steady reduction of child mortality rate (See Figure 4), Bangladesh's rates of child malnutrition are among the highest in the world, where more than 54% of preschool-age children are stunted, 56% are underweight and more than 17% are wasted [9]. The numbers for women are also concerning: FAO indicates that more than 50 percent of women suffer from chronic energy deficiency. Reports state that here has been little improvement in women's nutritional status over the past 20 years [9]. The

reduction of crops in this context will certainly exacerbate such problems, if appropriate measures are not introduced.

The nation has, however, leveraged its labor-intensive agriculture to achieve steady increases in food grain and cereal production. For instance, the nation has improved its flood control and irrigation, has improved fertilizer use by creating more efficient processes, and has established and bettered the distribution of rural credit networks.

The government along other stakeholders have identified the following technology options related to their natural resources sector [6]:

a) Development of salinity-tolerant and drought-tolerant rice varieties
b) Training on improved farming practices for crops, irrigation and water management
c) Soil fertility management (conservation and restoration of soil quality) etc.
d) Establishment of climate-smart Agriculture Technology Dissemination Center
e) Establishment of special agricultural R&D centre
f) Land-use planning.

Overpopulation

The nation, with current population of 158 million, is one of the most densely populated nations in the world. As seen in Figure 5, density has constantly increased since 1995 and the trend implied from the figure indicates that this increase will continue in the future. Indeed, according to population growth and sea level rise projections, Bangladesh's population by the year 2050 will likely have reached 220 million [8].

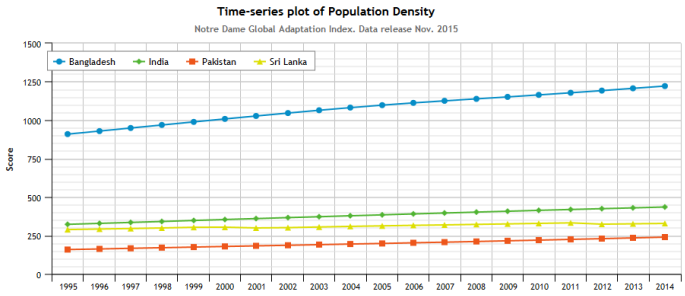

Figure 5. Bangladesh's population density. Note how it has constantly increased since 1995. The trend implied from the figure indicates that this increase will continue in the future.

A National Geographic Society article describes this overpopulation issue quite clearly: "*The countryside beyond is a vast watery floodplain with intermittent stretches of land that are lush, green, flat as a parking lot—and wall-to-wall with human beings. In places you might expect to find solitude, there is none. There are no lonesome highways in Bangladesh.*"[8].

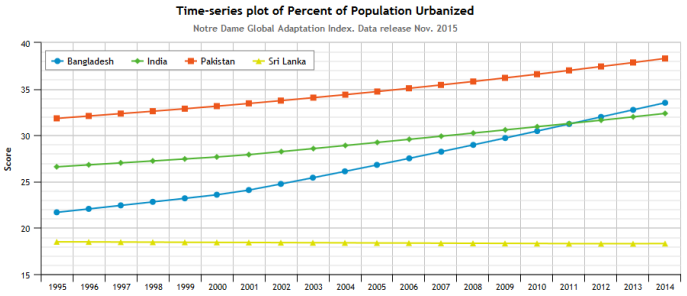

Figure 6. Bangladesh's percentage of population urbanized. Note now the rate of urbanization has consistently increased since 2002.

The implications of such density and the aforementioned projections are concerning: 10 to 30 million people along the southern coast would be affected. This scenario brings three different options for people affected by the consequences of climate change: i)they would have to crowd even closer together in rural areas, which are already densely populated and highly vulnerable to climate change; ii) displace to urban areas, which are already highly dense because the high rate of urbanization which has considerably increased since 2000 (See Figure 6); or iii) flee the country as climate refugees.

Learning from Bangladesh

Because of the nation's unique geographic, population and natural resource parameters, Bangladesh is an extreme example of the collusion of different factors and the long-term future challenges in the presence of the consequences of climate change. The flight of migrants because of climate change impacts is a representation of what could happen worldwide, particularly in nations similar to Bangladesh that have overpopulation and geographic location challenges. It is predicted that climate change refugees will grow to some 250 million worldwide by the middle of the century, many from poor, low-lying countries similar to Bangladesh [8]. Political instability, social problems, and other issues could be exacerbated by the influx of refugees, thus putting further stress in the economies of other nations, developing and developed. The consequences of climate change could reverberate to developed nations in various forms, if appropriate adaptation and mitigation actions not are taken.

The enabling value of Bangladesh' Readiness measure

The challenges that this relatively new nation state is experiencing and its adaptation capability is an example for world nations, developing and developed. According the UNEP, the nation's long exposure to hazards has turned Bangladesh into a world leader in adaptation strategies. Furthermore, the nation has taken a proactive investment on climate change, with an estimated three-quarters of adaptation funding coming from the government itself, versus the one quarter coming from international donors [5].

The ability to prioritize adaptation measures (including technologies) is one use for vulnerability assessments carried out by nations at different administrative and political levels.

ND-GAIN plays an important role in providing feedback at the national level. Furthermore, ND-GAIN also evaluates the nation's potential for absorbing investments through making efficient utilization of the nation's resources and capacity for building resilience; we carry out such assessment through the *Readiness* component, that is comprised of social, economic and governance subcomponents.

In 2014 Bangladesh ranked 148th place in Readiness on the ND-GAIN Country Index (i.e. there are 148 countries with better Readiness scores out of a total of 184 countries ranked.) This moderately worse score than the average country compares to Honduras, Ethiopia, Mozambique, Togo, and Cote d'Ivoire. As seen in Figure 7, the Economic sector contributed the most to this score. However, note that, in contrast to its Vulnerability measure discussed earlier, this time Bangladesh performs almost at the same level of India and Pakistan.

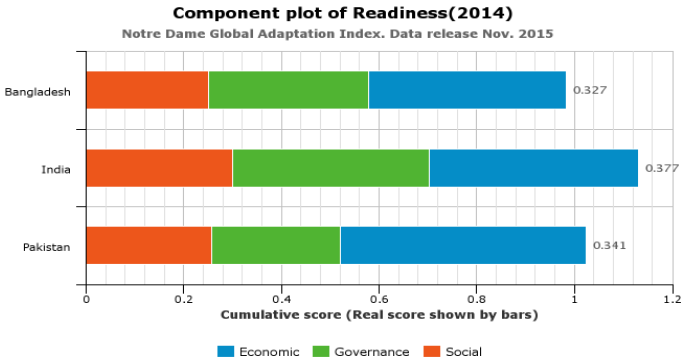

Figure 7. Bangladesh's Readiness score along the contribution of individual components. Neighboring nations is shown for illustrative purposes.

One of the sub-indicators of the economic component of readiness, *protecting investors*, ranks Bangladesh among the top 25 nations that have strong shareholder protections against misuse of corporate assets by directors for their personal gain. The indicator also measures shareholder rights, governance safeguards and corporate transparency requirements that reduce the risk of abuse. See Figure 8.

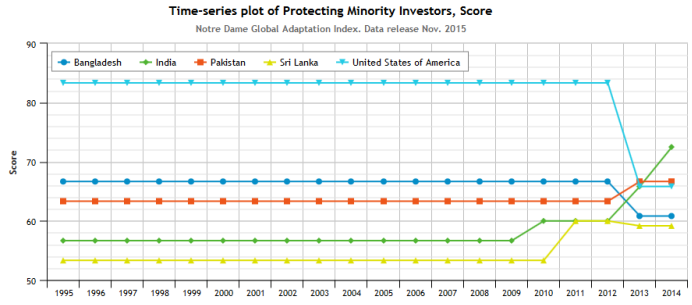

Figure 8.Protecting Investors indicator of a set of nations. Note how Bangladesh ranks considerably higher than its neighbors and quite close to United States in 2013.

This corroborates Pew Review reports that indicate that 80% of Bangladeshi's support the free market and agree that most people are better off in a free market system even if there is some inequality [3]. Indeed, the nation provides various opportunities to internal and external investors and other stakeholders that can help in resiliency and contribute to the nation's development. For instance, the nation has successfully attracted foreign investment in private power generation, gas exploration and production, cellular telephony, textiles, and pharmaceuticals.

The nation's textile industry is the second-largest in the world and the backbone of the nation's industrial sector. Garment exports accounted for more than 80% of total exports and surpassed $18 billion. Bangladesh has made huge strides in educating women and providing them with economic opportunities; female work-participation rates have doubled since 1995. Bangladesh is among the top five nations that produce fish and seafood [7].

Perhaps one of the best examples of resourcefulness and innovation is the creation and diffusion of successful institutions such as the Grameen Bank. The combination of innovation, social need and support and appropriate government policy have facilitated one of the most successful social-oriented economic development initiatives.

CONCLUSIONS

Bangladesh is a very resourceful nation and they are making a business out of it. The nation is leveraging its capacity to absorb investments to diversify its economy and better its capacity to adapt to climate change.

The nation has dramatically dropped infant mortality[iii] and has one of the highest rates of improvement among low-income countries [4]. However in spite of significant progress in bettering its Vulnerability and Readiness standing, the nation still has one of the highest rates of child and women malnutrition.

Bangladesh's adaptation and development are and will be impacted by the density of its population. Their rapid population growth and resulting high and growing food requirements pose a difficult challenge given the limited availability of cultivable land in the nation. Re-occurring disasters further complicate the stability of food production.

Overpopulation also threatens to complicate other issues, such as malnutrition, its high level of poverty, and the effectiveness of responses to shocks and stressors. Bangladesh has a wealth of extreme events such as cyclones whose intensities are rising due to the effects of climate change.

Given the acceleration of climate change and the high impact that it puts in nations such as Bangladesh, the lack of appropriate actions could lead the nation to become even more vulnerable, further endangering the considerable progress that the nation has made in critical areas.

While humanitarian-oriented measures should be taken by the international community towards the most needed, the Bangladeshi context also offers opportunities for more economically sustainable innovative and entrepreneur-oriented initiatives; this approach can be more appropriate for the most vulnerable of the nation, as it provides empowerment and reflects more the nation's attitude towards adaptation.

Initiatives should seek to have an appropriate impact to the various sectors of the population, particularly the poor, who live in the areas of the nation most affected by climate change. Finally, it must be highlighted again that no improvement measure will be complete without directly addressing Bangladesh's overpopulation issue. Innovation and efforts that go beyond the nation's borders might be needed in this challenging context.

Bangladesh rich natural resources is complemented with a more sustainable, vast and human resources who have proven through history their high level of resiliency. Bangladeshis have shown they can learn, adopt new skills and use such knowledge for overcoming the natural challenges they have faced, are facing, and will face in the Bay of Bengal. This resourcefulness is perhaps one of the best resources that the nation has to offer, particularly at times when the nation is enjoying political stability, partially favored by its few to none internal and external conflicts.

About ND-GAIN

ND-Global Adaptation Index is the world's first private nonprofit organization created to save lives and improve livelihoods in developing countries by promoting the understanding and importance of adapting to global changes brought about by climate, population shifts, urbanization and economic development. The ND-GAIN Country Index (http://index.nd-gain.org) is the leading index showing which countries are best prepared to deal with security risks, droughts, superstorms and other disasters and is the only free and open-source index to measure a country's vulnerability to climate change and other global forces, as well as its readiness to accept private and public sector investment in adaptation.

Decision-makers use ND-GAIN's country-level rankings to determine how vulnerable countries are to global changes and how ready they are to adapt, thus informing strategic operational and reputational decisions regarding supply chains, policy choices, capital projects and community engagements. The Index helps leaders avoid costs, manage liabilities and build resilience. ND-GAIN also informs market expansion by identifying which countries are ready for products and services that increase adaptation. Key elements of the metrics behind ND-GAIN include water, energy and transportation availability, along with economic, governance and human health factors. The Index was created in consultation with world-class scientists, civil society representatives and business leaders. The Global Adaptation Institute was founded in 2010, and moved to the University of Notre Dame from Washington, D.C. in April 2013, becoming the Notre Dame Global Adaptation Index within the Environmental Change Initiative.

The ND-GAIN Country Index measures vulnerability using a range of indicators that reflect medium and long-term climate change impacts in six life-supporting vulnerability sectors. The Index measures readiness through indicators that represent the nation's ability to mobilize and absorb adaptation investment. Each indicator comes from a reliable public data source such as the World Bank, Food and Agriculture Organization, and the United Nations. The selection of the indicators is based on literature survey and consultation with scholars, adaptation practitioners, and global development experts. The chosen indicators must be i) actionable through adaptation, ii) consistent with current knowledge and best practices, iii) potentially downscalable from national to regional or urban, iv) directly representative of the phenomena they measure, and v) must not include broad socio-economic measures such as GDP per capita or Human Development Index. Moreover, the indicators need to be quantified at the country-level with data that: i) provide global coverage, ii) provide time-series coverage, iii) are transparent and conceptually clear, iv) are freely accessible, and v) are provided by reliable sources that carry out quality checks on such data. More information is available at http://index.gain.org/about/methodology.

BIBLIOGRAPHY

Most illustrations shown in this report can be reproduced by going to http://index.nd-gain.org. Please refer to the Methodology document found at that address for further insights on the methodology and computation of the ND-GAIN index.

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Appendix 1. Bangladesh indicator basic statistics

Indicator	score	ranking	mean	st. dev.	st.devs.	median	perc. rank
Vulnerability	0.54	142	0.44	0.108	0.915	0.429	77.596
Food	0.56	102	0.537	0.186	0.148	0.543	53.125
Water	0.61	158	0.458	0.178	0.841	0.473	82.723
Health	0.58	156	0.358	0.217	1.024	0.304	81.25
Ecosystems	0.58	138	0.516	0.127	0.488	0.51	71.875
Habitat	0.44	115	0.416	0.138	0.198	0.407	59.896
Infrastructure	0.46	147	0.366	0.178	0.54	0.346	76.562
Readiness	0.35	141	0.481	0.165	-0.809	0.451	76.63
Economic	0.45	125	0.538	0.15	-0.619	0.535	68.306
Governance	0.3	165	0.485	0.181	-1.051	0.458	86.387
Social	0.3	126	0.429	0.225	-0.572	0.365	65.625
Nd-gain	40.39	139	52.121	13.002	-0.903	50.941	77.222
Sensitivity	0.39	152	0.304	0.098	0.911	0.304	79.167
Exposure	0.55	170	0.463	0.074	1.231	0.463	88.542
Capacity	0.67	147	0.518	0.199	0.773	0.503	76.562
Projected change of cereal yields	0.98	185	0.726	0.307	0.819	0.854	97.884
Projected population change	0.44	95	0.508	0.293	-0.224	0.443	49.738
Food import dependency	0.14	42	0.458	0.337	-0.935	0.39	24.852
Rural population	0.67	154	0.435	0.232	1.021	0.431	80.628
Agriculture capacity	0.15	31	0.598	0.343	-1.3	0.66	17.127
Child malnutrition	1	116	0.505	0.318	1.556	0.457	83.453
Projected change of annual runoff	0.59	79	0.643	0.264	-0.186	0.604	47.879
Projected change of annual groundwater recharge	0.7	54	0.746	0.136	-0.356	0.738	30.337
Fresh water withdrawal rate	0.03	63	0.195	0.29	-0.571	0.06	38.65
Water dependency ratio	1	169	0.295	0.365	1.933	0.076	90.86

Dam capacity	0.99	116	0.777	0.315	0.681	0.924	81.69
Access to reliable drinking water	0.33	135	0.262	0.316	0.226	0.121	72.193
Projected change of deaths from climate change induced diseases	1	185	0.348	0.197	3.304	0.395	96.354
Projected change in vector-borne diseases	0.11	77	0.263	0.298	-0.503	0.155	40.104
Dependency on external resource for health services	0.25	117	0.277	0.367	-0.074	0.061	65.363
Slum population	0.64	90	0.345	0.295	0.984	0.302	77.586
Medical staff	0.95	170	0.587	0.338	1.084	0.693	89.474
Access to improved sanitation facilities	0.53	134	0.338	0.355	0.534	0.194	72.043
Projected change of biome distribution	0.54	37	0.636	0.117	-0.811	0.625	22.024
Projected change of marine biodiversity	0.3	67	0.424	0.32	-0.375	0.372	34.896
Natural capital dependency	0.31	98	0.307	0.304	0.004	0.198	64.901
Ecological footprint	0.63	94	0.52	0.23	0.47	0.603	62.252
Protected biome	0.89	161	0.428	0.345	1.331	0.382	85.638
Engagement in international environmental conventions	0.8	115	0.706	0.232	0.41	0.763	59.896
Projected change of warm periods	0.06	2	0.52	0.314	-1.455	0.447	1.042
Projected change of flood hazard	0.75	183	0.424	0.227	1.444	0.454	95.312
Urban concentration	0.14	84	0.249	0.27	-0.422	0.166	43.75
Age dependency ratio	0.17	89	0.27	0.266	-0.388	0.171	49.171
Quality of trade and transport infrastructure	0.63	89	0.57	0.166	0.345	0.606	54.938
Paved roads	0.91	164	0.502	0.334	1.228	0.551	91.111
Projected change of hydropower generation capacity	0.43	45	0.452	0.11	-0.161	0.437	36
Projected change of sea level rise impacts	0.72	123	0.327	0.335	1.169	0.178	81.457
Dependency on imported energy	0.17	61	0.316	0.325	-0.459	0.225	45.522
Population living under 5m above sea level	0.58	152	0.307	0.329	0.828	0.183	80
Electricity access	0.6	141	0.321	0.391	0.722	0.09	73.822
Disaster preparedness	0.28	35	0.404	0.191	-0.672	0.382	25.735
Doing business	0.45	125	0.538	0.15	-0.619	0.535	68.306
Political stability and non-violence	0.23	173	0.487	0.194	-1.325	0.505	90.576
Control of corruption	0.33	146	0.485	0.199	-0.796	0.428	77.249
Regulatory quality	0.31	150	0.483	0.196	-0.898	0.465	79.365
Rule of law	0.32	151	0.482	0.196	-0.834	0.443	79.058
Social inequality	0.86	13	0.581	0.214	1.312	0.606	8.725
Ict infrastructure	0.15	160	0.432	0.263	-1.079	0.406	83.333
Education	0.19	118	0.473	0.351	-0.809	0.395	67.045
Innovation	0	114	0.239	0.337	-0.704	0.047	90.476

[ii] All measures of ND-GAIN are scaled from 0 to 1 for aggregation purposes. Thus a point refers to a fraction of 1.0
[iii] Between 1990 and 2008, from 100 deaths per 1,000 births to 43.