IWDRI 2018

International Workshop on Disaster Resilient Infrastructure 2018

Workshop Summary

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Government of India

UNISDR

The United Nations Office for Disaster Risk Reduction

in collaboration with UNISDR

"Over the next couple of decades, most of the new infrastructure in the world will come up in our region. All our public expenditure must take into account risk considerations. India will work with other partner countries and stakeholders to build a coalition or centre for promoting disaster resilient infrastructure in the region. This will help generate new knowledge for hazard risk assessment, disaster resilient technologies and mechanisms for integrating risk reduction in infrastructure financing."

Shri Narendra Modi
Hon'ble Prime Minister of India at AMCDRR 2016

fig 1: Asian Ministerial Conference on Disaster Risk Reduction, New Delhi, 2016 (Source: http://www.unisdr.org/2016/amcdrr)

International Workshop on
Disaster Resilient Infrastructure 2018

Workshop summary

Introduction

The Sendai Framework for Disaster Risk Reduction (SFDRR) highlighted the role of improved disaster resilience, including that of infrastructure, as a cornerstone for sustainable development. While inaugurating the Asian Ministerial Conference on Disaster Risk Reduction (AMCDRR, New Delhi, Nov 2016), the Prime Minister of India announced that India would work with partner countries and key stakeholders in launching a **"Coalition for Disaster Resilient Infrastructure (CDRI)".**

With an aim to garner inputs from the wider base of global stakeholders, the Government of India (GoI) in collaboration with the United Nations Office for Disaster Risk Reduction (UNISDR) hosted the International Workshop on Disaster Resilient Infrastructure in New Delhi, India from 15-16 January 2018. The two-day event was widely appreciated as a pioneering effort towards attainment of the Sendai targets, Sustainable Development Goals (SDG) and Climate Adaptation goals. It was attended by senior technical experts from 25 countries, multilateral development banks, the United Nations (UN), the private sector and academia with the following objectives:

- Taking stock of good practices as a body of evidence in building the case for investments towards making infrastructure disaster resilient.
- Identifying critical gaps in current practices that would need to be addressed in the coming years.
- Identifying potential areas of collaboration along the following four themes:

    1. Development of risk assessment methodologies, risk metrics and indicators of sustainability for different infrastructure classes;
    2. Issues of standards, design and regulation for infrastructure development, operations and maintenance;
    3. Financing for disaster resilient infrastructure (DRI) including risk transfer mechanisms; and
    4. Reconstruction and recovery of key infrastructure sectors after disasters.

The workshop was opened with speeches from the Hon'ble Union Home Minister of India, Mr. Rajnath Singh; Additional Principal Secretary to the Prime Minister of India, Dr. P. K. Mishra; Member, National Disaster Management Authority of India (NDMA), Mr. R. K. Jain; the Special Representative of the UN Secretary General for Disaster Risk Reduction, Mr. Robert Glasser; and Country Director for the World Bank Group in India, Mr Junaid Kamal Ahmad.

- Presentations from all sessions may be accessed at: www.ndma.gov.in/iwdri/presentations.html.
- Videos from all sessions may be accessed at: https://ndma.gov.in/iwdri/livewebcast.html

Summary of Technical Sessions

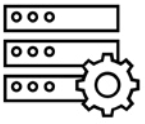
TS1: "CASE STUDIES ON INFRASTRUCTURE"

- Leadership of the national government
- System of systems
- Structured economic evaluation
- Integrating resilience in infrastructure planning
- Investing in human resources

TS 2A: "RISK ASSESSMENT"

- Understanding the fundamentals of resilience
- Create better risk metrics
- Data standardization
- Use local knowlegde
- Create access to open source data and tools

TS 2B: "STANDARDS"



- Manual of Practice for end users (MoP)
- Adopting a lifecycle approach for adaptive standards
- Standards for soft infrastructure
- Interdisciplinary standard setting

TS 3A: "FINANCING"

- The role of finance in incentivising resilience
- Understanding contingent liabilities
- Acceptable level of risk
- Looking beyond insurance
- Mainstreaming the role of the private sector

TS 3B: "RECOVERY AND RECONSTRUCTION"

- Small and medium scale disasters
- Build Back Better
- Standardised reporting methods
- Owner-driven reconstruction
- Psychology of decision making
- Role of sub-national governments

Icons from Creative Stall and Max Hancock, The Noun Project

Technical Session 1

CASE STUDIES ON INFRASTRUCTURE

Leadership of the national government | **System of systems** | **Structured economic evaluation** | **Integrating resilience into infrastructure planning** | **Investing in human resources**

1. **Leadership of the national government:**
   - The national government must take the lead in developing and encouraging the use of national multi-hazard risk profiles, climate adaptation strategies and provision of a coherent basis for decision-making to inform investment in disaster resilient infrastructure.

2. **System of systems:**
   - The "*system of systems*" approach for infrastructure risk assessment combines multiple data streams for end-to-end risk assessment from the infrastructure systems to the economy. This is essential to tackle each risk layer and design appropriate adaptation plans.

   - An optimal investment strategy for resilience focuses on a balance between structural and non-structural measures. This may include concepts such as basin-wide solutions for adaptation to water risks like the sponge-city concept, nature based solutions, multi-layer flood security and Climate Risk Informed Decision Analysis and Support (CRIDA).

   - Ports and dependent supply chains are complex systems that are vulnerable to a variety of threats and require a system-wide understanding of impacts and strategies for developing resilience.

3. **Structured economic evaluation:**
   - High-risk countries such as Japan and Netherlands have DRI ingrained in their national development strategies. Both countries initially invested about 4% to 8% of their Gross Domestic Product (GDP) in disaster prevention, and continue to invest about 0.15% of their GDP in operations and maintenance (O&M) of infrastructure systems.

   - Tools such as ex-ante economic evaluation and dynamic Cost-Benefit Analysis (CBA) are essential to allocate investments in preventive strategies for disaster risk reduction,

fig 2 Source: Creative Commons

and operation and maintenance costs. E.g. Disaster Control Infrastructure (DCI) has a high up-front construction cost, but yields returns in the long run.

- The key challenges for building resilient infrastructure are: (1) Dealing with *low-probability high-consequence events;* and (2) The bargain between business risk appetite versus incentives to avoid market failure.

- To understand ownership of risk, cost-benefit analyses (CBAs) need to delineate the bearer(s) of the costs and recipient(s) of benefits.

4. **Integrating resilience into infrastructure planning:**
   - Integrating climate and disaster risk in every stage of infrastructure development calls for innovation in planning, design and material science.

   - A two-pronged approach is needed to address business-as-usual estimates of downstream risk exposure: (1) A way to monitor exposure levels to assets to update their risk profiles to inform decisions related to retrofitting or increasing specifications of the infrastructure; and (2) The integration of risk data into land-use planning and population distribution at local and regional levels.

5. **Investing in human resources:**
   - There is a gap in the professional cadre of engineers, architects and planners trained in measurement and use of risk data to build DRI and carry out O&M of infrastructure.

fig 3: Opening Ceremony, IWDRI 2018 (Source: NDMA)

Technical Session 2A

RISK ASSESSMENT

Understanding the fundamentals of resilience | **Create better risk metrics** | **Data standardiza-tion** | **Use local knowlegde** | **Create access to open source data and tools**

fig 4 Source: Creative Commons

1. **Understanding the fundamentals of resilience:**
   - Development of a framework for investing in DRI must be preceded by a clarification of the fundamentals of resilience. This includes ways of measuring resilience, performance metrics for different infrastructure classes and recovery profiles of infrastructure towards a range of disasters for a given context.

   - Resilience indicators must be able to measure performance, link it to achievement of SDGs, incorporate effects of climate change, Industry 4.0 and the cyber economy.

2. **Create better risk metrics:**
   - Infrastructure standards are not absolute, and must be seen as a function of resource availability, risk appetite and capacity to reduce risks. Therefore, using a notional definition of resilience can help in the development of metrics for measurement.

   - A comprehensive risk management strategy must move from creation of risk metrics to development of a national multi-hazard risk profile to a high-resolution infrastructure sector risk systems model. As systems level coordination may be time-consuming; a sector-wise approach may be recommended to begin comprehensive assessments. E.g. UK has: (1) A national risk assessment produced every two years; and (2) Sector security resilience plans.

   - ***Sharing of methodologies and information at a global-level will be valuable to create a workforce that is able to understand and use risk information to build resilience.***

3. **Data standardization:**
   - While hazard and vulnerability data is being recorded in various forms, there is a lack of standardization in data formats and collection methods. Combined with the lack of accurate time series data at local-level and lack of capacity to carry out complex risk analysis; end users are being deprived of information required to make risk-informed

decisions about development. This gap is further exacerbated by the effects of climate change that dynamically alter the patterns of hazards.

4. **Use local knowledge:**
   - While the quality of risk assessments may be sufficient for investment decisions, they may not be nuanced enough for policy and political decisions. Risk assessments must be aligned with the needs of the end-user and the local planning process. E.g. Mozambique, Kenya, Afghanistan and Kyrgyz Republic.

   - Chile has developed a "*Supplementary Methodology to Reduce Disaster Risk in Public Investment*" by integrating disaster risk assessment in the public infrastructure investment process. The supporting online spreadsheet tool enables site-level risk calculations that can inform decisions about mitigation measures.

5. **Create access to open source data and tools:**
   - The next generation of decision makers (engineers, town planners and infrastructure financiers) must be provided access to open source risk models to aid risk-informed infrastructure development. There is a need for a technical workforce that can understand and use risk information in development work.

Technical Session 2B

STANDARDS

Manual of Practice for end users (MoP)

Adopting a lifecycle approach for adaptive standards

Standards for soft infrastructure

Interdisciplinary standard setting

1. **Manual of Practice for end users:**
   - A bouquet of state-of-the-art standards must be made available for end users of information on resilient infrastructure. A Manual of Practice (MoP) for Climate Resilient Infrastructure that is being developed by the American Society of Civil Engineers (ASCE) is a good example.

   - A more comprehensive MoP maybe co-created by experienced practitioners, government representatives and researchers to collate systematic knowledge in the field that provides necessary guidance to practitioners. The Coalition provides an important platform to capture lessons learned and manage their dissemination towards creating a required pool of knowledge.

2. **Adopting a lifecycle approach for adaptive standards:**
   - Past statistical trends are no longer a good guide for future standards. Hence, "*stationary, non-time variant*" prescriptive standards must give way to "*evolving adaptive*" standards to continually tackle changes from climate risks and other externalities that impact the life span of infrastructure.

   - The adaptive design framework may lead to "*real options*" that are pre-decided responses to changes in the infrastructure project environment. E.g. The Los Angeles to San Diego (LOSSAN) rail corridor uses the "Observational Method" for constant monitoring to update risk models and take decisions about upgrading or discontinuing the use of the infrastructure.

3. **Standards for soft infrastructure:**
   - The "*systems approach*" must attribute due importance to soft infrastructure. This underpins the vital knowledge base, supporting institutions and capacity development needs for technical specialists.

fig 5 Source: S Krishnan

4. **Interdisciplinary standard setting:**

- Appropriate standards may provide the first line of defence against shocks and stresses. However, standards permeate through disjointed phases of procurement, design review and failure analysis. The "*design phase*" of any project is critical to enable comprehensive inclusion of good standards for resilience.

- A multidisciplinary design phase that includes land-use planning, climate science, disaster management in coherence with the engineering sector can make for better informed decisions underpinning investment in resilient infrastructure.

fig 6: IWDRI 2018 (Source: NDMA)

Technical Session 3A

FINANCING

The role of finance in incentivising resilience | **Understanding contingent liabilities** | **Acceptable level of risk** | **Looking beyond insurance** | **Mainstreaming the role of the private sector**

1. **The role of finance in incentivizing resilience:**
   - Infrastructure is largely publicly owned. Therefore, determining the extent of resilience a country can afford is a public finance issue with the goal being to maximize benefits (i.e. loss of assets, or economic losses) while minimizing costs.

   - Financial instruments play a key role in incentivising uptake of good practices towards building DRI. However, effective financial planning requires a sound underpinning of data on hazards, risks and climate dynamics. E.g. Taking resilience into account while developing infrastructure may raise upfront construction costs by 5 to 15%. This can be justified only by a comprehensive cost benefit analysis over the lifecycle of a project.

2. **Understanding contingent liabilities:**
   - Governments are advised to set up institutional and operational frameworks to understand "*contingent liabilities*" to identify how and to what extent a budget is impacted after a disaster.

3. **Acceptable level of risk:**
   - Mitigation funding and residual risk financing is beneficial for recognition of risk at various levels. Governments need to better understand the acceptable or optimal level of risk, and how much could be retained, before transferring their risk to markets through insurance.

   - Mexico's Fund for Natural Disasters (FONDEN) provides a series of different financial instruments to address risks at all levels. Colombia also uses public private partnerships (PPP) for disaster resilience, and strong disincentives are built into the policy for non-compliance.

fig 7 Source: Creative Commons

4. **Looking beyond insurance:**
    - While insurance is able to create incentives for governments and private institutions by making premium risk reflective, it is unable to address the root cause of risk. Hence, using insurance in the absence of other systemic measures cannot be the answer to creating incentives for building resilient infrastructure.

    - Risk financing strategies for sovereign nations will depend on their varying capacities, risk appetite, resources and willingness to manage risk. Ownership of risk is a critical issue in this regard. *No matter who owns the infrastructure, the government of any country still has to plan for the risk.*

    - A layered approach to risk management can be facilitated through a range of financial instruments that are now available to address financing development (or redevelopment) of resilient infrastructure. Disaster risk screening of infrastructure is one such method.

5. **Mainstreaming the role of the private sector:**
    - Since the last decade, the Indian private sector is investing almost half as much as the Government in infrastructure. Banks are a key source of finance for infrastructure projects and have a role in improving compliance to standards for risk assessment and building. Institutional risks are critical, which is why a study of contingent liabilities becomes important.

Technical Session 3B

RECOVERY AND RECONSTRUCTION

1. **Small and medium scale disasters:**
   - At present, most countries focus on systematic post-disaster recovery of infrastructure sectors only after major disasters. More predictable mechanisms are needed to account for damages, degradation and productivity losses due to small and medium-scale events.

2. **Build Back Better:**
   - Under the concept of "*Build Back Better*", Japan highlighted the importance of having a combination of structural and non-structural (social and economic) measures for faster recovery. Japan has established a system of pre-disaster contracts that are made with private sector infrastructure developers such that they are prepared to facilitate efficient post-disaster reconstruction activities.

   - As infrastructures are interconnected, their reconstruction must be discussed at a regional/territorial level to account for downstream risk creation and capacities must be built at the local level to manage reconstruction activities.

   - The expenditure money for reconstruction after the 2011 Tohoku earthquake was derived from taxation, issuance of bonds, and even taking 10% off all government employees' salaries for a period of three years.

3. **Standardized reporting methods:**
   - UNDP reflected on its experience in infrastructure recovery and reconstruction to emphasize the role of a standardized format for estimation of post-disaster damages, losses, and replacement costs. E.g. Post Disaster Need Assessment (PDNA) tool, Global Recovery Cost Estimation guideline.

   - PDNA plays a critical role in guiding future projects, especially in order to follow the "*Build Back Better*" principle based on existing building codes.

fig 8 Source: Creative Commons

- There is a need to move away from pure "*restoration of services*" to *"resilience focused reconstruction"*. Hence, alternative models of financing recovery such as private sector participation, selling of reconstruction bonds, and the setting up of intergovernmental risk pools must be explored.

- Nepal's experience in reconstruction and recovery after the 2015 Gorkha Earthquake started with the setting up of the National Reconstruction Authority (NRA).

- Environmental impact assessments encourage reduction in creation of new risks, adopting different approaches to rural and urban reconstruction projects and the incorporation of business continuity related indicators in the resilience building process.

4. **Owner-driven reconstruction:**
   - Post-disaster reconstruction is an opportunity for incorporating resilience.

   - An owner-driven reconstruction programme will provide greater impetus for mainstreaming risk awareness and resilient practices.

   - An inclusive approach for recovery and reconstruction is crucial for ensuring that the needs of the most vulnerable sections of the population, such as the poor, marginalized and persons with disabilities, are effectively incorporated.

5. **Psychology of decision making:**
   - Uncertainty, complexity and volatility are factors that challenge decision making in post-disaster contexts. Additional complexities are added due to time pressure, changing preferences/norms and the cascading effects of infrastructure damage.

   - Mapping and quantifying vulnerabilities of various sectors, industries and their failures aid in prioritization of decisions.

   - The ***Humanitarian Decision Maker's Anatomy*** helps understand the psychology of decision-makers in post-disaster contexts that must be able to account for various interdependencies and fragmented/volatile coordination.

6. **Role of sub-national governments:**
   - Faster rebuilding processes require developing and maintaining capacities of sub-national governments

CONCLUDING PANEL DISCUSSION

7 Policy-Level Contributions

Harmonization of policy provisions	Layered approach to risk: "System of systems"	Forward looking risk models	Contingent liabilities	Qualitative platform for collaboration	Quality and standardized data	Global Infrastructure inventory

1. Harmonization of policy provisions at all levels – national, local and institutional – was underlined for coherence towards developing resilient infrastructure.

2. The complexity of global infrastructure systems demands the "system of systems" approach for assessing risks layers at the regional/territorial level to prepare for higher performance.

3. The value of utilizing probabilistic and forward-looking models for driving global risk assessments was emphasized to identify "*global hotspots*" and determine risk ownership within interconnected networks.

4. Risk is a shared entity. The notion of "contingent liability" was deemed critical and requires addressing at the policy-level to account for possible hidden risks. There must be a focus on processes rather than on products alone.

5. For infrastructure-related reporting, a qualitative platform was thought to be a beneficial starting point to identify relationships between various interconnected parameters that influence resilience.

6. The availability of quality data can support critical investment decisions for resilient infrastructure, considering scenarios and modeling, loss exceedance curves, risk layers, risk appetite and acceptable levels of risk.

7. To achieve quality data, it was proposed to create a global infrastructure inventory with resilient infrastructure reports considering the entire spectrum of risk and risk management applications. A related practical framework was suggested for countries to self-assess their policy and institutional arrangements for greater resilience. The self-assessment process can be complementary to the Sendai Framework monitoring requirements with peer reviews that can create a sense of common objective and knowledge sharing.

7 Knowledge Products

Integrate indigenous and local wisdom	Develop a Manual of Practice (MoP)	Data standardiza-tion for loss estimates	Creation of a "Resilience Academy"	Kickstart comprehensive study on one sector	Formulate long term plans	Sustained financial commitments

1. Encouraging an innovation and research culture around resilient infrastructure development, including indigenous and local wisdom, would be very beneficial to find solutions.

2. A regional Manual of Practice (MoP) was proposed as a useful step to contextualize hazards and scope of asset categories. This can catalogue adaptive design and planning strategies for critical infrastructure using innovative approaches, deep uncertainties (such as climate change) and emergent risks. In addition, the manual can propose resilience metrics for key infrastructure classes, explore conditions for granting resilience certifications through public tenders (analogous to LEED and ASCE etc.), and outline climate risk-resilient infrastructure asset classes for specific sectors.

3. Standardization of data collection for damages and cost estimations in relation to infrastructure was suggested.

4. Theory can influence practice, and vice versa, in the creation and promulgation of resilient infrastructure. In this respect, a "resilience academy" was suggested to train the future generation of planners and designers.

5. A regional study on risk in any one sector (e.g. water) was suggested to be kick started, with an emphasis on adaptive metrics and adaptive standards.

6. Long-term plans will be critical to realize significant changes in "business as usual" modes of operation because typically risk information penetration may be quite low and detailed data on damage and loss may be lacking in certain national contexts.

7. Sustained commitment at the national and institutional levels for resilient infrastructure is critical, actualized through financial commitments.

Capacity Development

1. Capacity development across multiple sectors, institutions, manpower and scales was the underlying message of the concluding session. Key capacities which require development to better define, quantify and design for greater resilience are: a) the ability of a system to absorb disruptive events; b) adaptive capacity; and c) restorative capacity for recovery following a disruptive event. Capacity for decision making at all levels is key.

2. Local technical capacity development for those directly involved in infrastructure development and O&M was affirmed; in particular, for workers, artisans, technicians, engineers and architects. Training of trainers, especially in operations, maintenance, monitoring and evaluation, was emphasized going forward. It was suggested that greater funding be directed towards development of supporting manuals.

3. Informing resilience design using lifecycle considerations was recommended, complemented by methods and processes for standard-setting and risk assessment for different infrastructure classes.

CLOSING CEREMONY

A summary of the proceedings was provided by NDMA, India, drawing upon the concluding panel discussion deliberations. Closing remarks were then delivered by Additional Principal Secretary to the Prime Minister of India, Dr. P. K. Mishra; Minister of State for Home Affairs, Shri Kiren Rijiju; Vice-Chairman, National Institution for Transforming India (NITI Aayog), Dr. Rajiv Kumar; and Special Representative of the UN Secretary General for Disaster Risk Reduction, Mr. Robert Glasser. With the vote of thanks, the workshop was formally brought to a close.

The strong rationale for advancing this effort on sharing knowledge and experiences in disaster and climate resilient infrastructure was echoed as a closing note to this workshop, with sufficient momentum generated for creation of a Coalition on Disaster Resilient Infrastructure.

List of participants

in alphabetical order

1. Asian Development Bank
2. Crisis Management Branch, Emergency Management Australia, Department of Home Affairs, Australia
3. Queensland Reconstruction Authority, Australia
4. Ministry of Disaster Management and Relief, Bangladesh
5. Ministry of Works and Human Settlement, Bhutan
6. National Emergency Office and Ministry for Social Development, Chile
7. Federal Office of Civil Protection and Disaster Assistance, Germany
8. Bureau of Indian Standards, India
9. Central Water Commission, India
10. General Insurance Corporation of India
11. GeoHazards Society, India
12. IDFC Infrastructure Finance Ltd, India
13. IIT Jodhpur, India
14. IIT Mumbai, India
15. Indian Institute for Human Settlements
16. Jawaharlal Nehru University, India
17. Ministry of External Affairs, India
18. Ministry of Home Affairs, India
19. National Disaster Management Authority, India
20. National Disaster Response Force, India
21. National Institute of Disaster Management, India
22. National Institute of Public Finance and Policy, India
23. National Institution for Transforming India (NITI Aayog), India
24. Power Grid Corporation of India
25. State governments, India
26. International Commission on Irrigation and Drainage
27. Department of Civil and Environmental Engineering, Politecnico di Milano, Italy
28. Cabinet Office, Japan
29. Japan International Cooperation Agency
30. Keio University, Japan
31. Water and Disaster Management Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Government of Japan
32. Ministry of Interior and Safety, Republic of Korea
33. Construction Research Institute of Malaysia (CREAM), Malaysia
34. Sustainable Construction Excellence Centre, Construction Research Institute of Malaysia
35. National Defence Force, Maldives
36. Ministry of Social Security, National Solidarity and Environment and Sustainable Development, Mauritius
37. National Emergency Management Agency, Mongolia
38. Munich Re
39. Ministry of Social Welfare, Relief and Resettlement, Myanmar
40. Ministry of Urban Development, Nepal
41. 4TU Resilience Engineering Centre EU, Delft University of Technology, The Netherlands
42. Deltares, The Netherlands
43. New Development Bank
44. Minister of State for Power, Works & Housing, Nigeria
45. Norwegian Geo-technical Institute, Norway
46. Risk Nexus Initiative
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57. UNICEF
58. UNISDR
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