BUILDING FLOOD RESILIENCE THROUGH INTERLINKING OF LAKES

- THE CASE OF AHMEDABAD

CASE STUDY: INTERLINKING OF LAKES | FOLDER - C

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CONTENTS

TEACHING NOTES

The purpose of this folder is to communicate to the user/ instructor the possibilities of utilizing the case study. We as authors have some suggestions that might be helpful while introducing the case to the audience. These however, should be treated as guiding principles and the users might develop their own way of teaching. We have divided the teaching notes into five sections that cover avenues for utilization, pedagogical possibilities, probing questions, and the way forward in the research. We have also provided the definitions of terminologies and a brief of certain key concepts in the Annexure that may be useful to the instructor.

POSSIBILITIES OF USE

This section is a note providing guidance on using the case as a module in various courses or as an independent teaching module. The case could be useful as a resource for a course or training program covering:

1. **Environmental Resources in Urban Planning/ Socio-Ecological Systems**
   This case would help students appreciate the ecosystem services provided by urban lakes.
   The instructor can take up this case and then take the students through an exercise of mapping ecosystem services of the urban lake/ green spaces in the selected area. Students can also undertake an exercise of local area planning with a focus on an urban lake and apply the learnings from this case.

2. **Cities and Climate Change**
   This case can be used to introduce the concepts of climate change, vulnerability, and adaptation to students in the context of urban areas.

3. **Integrated Infrastructure Planning/ Green Infrastructure**
   This case can be introduced in a course that focusses on integrated infrastructure planning. In this case, floods are tackled through integration of lakes in stormwater management. Through this case the students would be able to better understand the complexity of planning problems and the need for an integrated approach.

4. **Social-Ecological Systems**
   The case elucidates that climate adaptation strategy is multifaceted. While the primary objective of this case was to understand the mitigation of flood through interconnected lakes, it had led to other benefits ranging from an increase in green space, access to open space, and increase in groundwater levels among other things.

PEDAGOGICAL POSSIBILITIES

For teaching courses or as an independent module these pointers are prescribed ways in which the case study can be delivered.

1. **Classroom Discussion**
   The students could be given the case study folder A and B chapter by chapter. After each chapter, an open discussion based on the probing questions in the next section can be taken up.

2. **Classroom Debate**
   The students could be given the case study folder A and B and divide the students into groups to argue whether the Interlinking of the Lakes Project was a successful model or not given the adaptation strategy and the benefits accrued along with the risks involved.

   The "for group" should be encouraged to discuss the benefits of the project with respect to the flood mitigation, ground water increase, access to green/open spaces, conservation of lakes etc.

   The "against group" should be encouraged to discuss the potential risks of such interlinking of projects on ecology and so on. The lack of integrated planning leading to coordination issues between the institutions that led to incomplete implementation, the decrease in the lake footprint and need for a development plan approaches for lake conservation than pilot demonstration projects could also be moot points.

   The questions in the next section can be used as probing questions for the debate.

3. **Research and Analysis**
   The case can be used in two ways depending on the objective of the module:

   Research Design
   Students could be given the case study folder A and B without sharing the chapter on impact assessment and told to develop the indicators for impact assessment of the project. The exercise would require students to identify the sectors that could be impacted from the project; the indicators that best capture the impact, and develop a strategy to collect and analyze the data. The impact assessment chapter should then be shared to compare and discuss the approaches. The

students could then be encouraged to carry out an impact assessment study for a lake development or any green infrastructure in a city.

Analysis of Institutional Framework
Students should be given folder A and B and then a detailed discussion on institutional framework of the case should be carried out. As an exercise students could also be encouraged to develop an institutional matrix for a lake or green infrastructure project that has been either proposed or implemented in their city. They could identify the institutional responsibilities and the overlaps in implementation, operation and maintenance.

4. **Environmental Cost Benefit Analysis/ Ecosystem Services**
   The students could be introduced to environmental cost benefit analysis or valuation of ecosystem services and the tools to capture this. They should be given the folder A and B. They could then be tasked to map and/or carry out valuation for any case study on lake or a green infrastructure in a city.

5. **Site Exposure**
   After they have read the case, the students could be asked to undertake site visits to different lakes selected based on the extent of project interventions. They could study and collect data regarding the condition of the lakes and their surrounding areas on a comparative basis. Experiential learning would contribute to understanding the ecosystem services and the impact of the project interventions.

These are some of the prescribed methods of delivering the case with a given set of outcomes. However, the faculty or tutor may not be limited to these and could interpret the case study in numerous innovative ways.

PROBING QUESTIONS

This section provides probing/ guiding questions to encourage discussion on case chapters.

Chapter 1

1. What are the different risks that get exacerbated by climate change for Indian cities? How does urbanization affect these risks?
2. What goals of the SDGs can be influenced through blue-green infrastructure?
3. What are the ecosystem services provided by blue - green infrastructure?

Chapter 2

4. What are the planning gaps in the current case? Which components of green and blue infrastructure should be planned at watershed level, development plan level and town planning scheme level or neighborhood level?
5. What should be the strategy to identify, plan, design and manage ecosystems across city or district or state boundaries?
6. What are the mechanisms for assessing the project viability (traditional and ecosystem service valuation)?
7. In a city/ region which are the stakeholders involved with the blue-green infrastructure?

Chapter 3

8. What are the possible strategies for impact assessment of Blue-Green Infrastructure Projects?
9. What is the influence of sustainable infrastructure projects on the urban equity and amongst marginalized communities in the cities? Does blue-green infrastructure promote environmental gentrification and inequity in urban areas?
10. How can risks be identified for these projects, especially the ecological risks? Can these be mitigated?

Chapter 4

11. How does the urban development respond to green and blue spaces in a city? How can a development plan respond to blue and green infrastructure during the plan creation?

WAY FORWARD - AREAS OF FURTHER RESEARCH EMERGING FROM THE CASE

This case study could be fruitfully used to explore future research. The first area of research could be how cities can plan climate change strategies around the blue and green spaces. Such a research would require the cities to assess the climate change impacts (due to increase in intensity of hazards like flooding, heat waves etc.) and vulnerability of urban areas (areas susceptible to flooding, population at risk etc.). The research in this area would open avenues for discussion on the adaptation strategies for cities that may include planning of green infrastructure.

The second area could be on developing an integrated approach for mainstreaming blue and green infrastructure projects. This integration can be at many levels of urban planning and design. The research here would define the legal processes, the institutional mechanism, the levels of intervention, the financing mechanisms etc.

The third area of research could be on exploring the valuation of ecosystem services of infrastructure projects. The research in this area would lead to mechanisms for analysis of ecological benefits in the Indian context for natural systems like lakes, urban forests, etc.

CASE ARCHIVE

This section comprises the data sets that were used for analysis in this case study. The intent is to provide the tutor with raw data for reference and value addition. The case archive includes interviews, maps, matrices, infographics, a list of the raw data referred, and relevant water management legislation of the country and Gujarat state.

Chapter-wise index to the contents of the case archives:

Chapter 1: Ahmedabad City & Triggers for Interlinking of Lakes Project

- Consultation with Mr. H Thakkar, Ex-Town Planner, AUDA (27.02.2020 & 13.07.2020) and Mr. Surendra Patel, Ex-Chairman, AUDA (18.12.2020).
- Historical map of Ahmedabad city and map of urban expansion of Ahmedabad
- Historical photos of Kankaria Tank and Sarkehj Roza Complex.
- Newspaper clips showing impacts due to floods in Ahmedabad.
- Infographics presenting appropriation of lake land for other land use purposes.
- Public Interest Litigations (PIL) against the local authorities holding them accountable for water pollution and depletion of lakes.

Chapter 2: Lake Redevelopment & Interlinking of Lakes Project

- Consultations with AUDA and AMC officials, real estate developers and water sector experts.
- Map presenting Lake Interlink Network
- Thesis and research material in interlinking of lakes by AUDA
- Photos covering current conditions of the interlinked lakes

Chapter 3: Impact of Lake Redevelopment & Interlinking of Lakes Project

- Map showing water stagnation points in Ahmedabad
- Consultations with AUDA and AMC officials, real estate developers and water sector experts.
- Indian Meteorological data presenting year wise (year 2009 to 2019) heaviest rainfall within 24 hours in Ahmedabad post LRIL
- Newspaper clips showing impacts due to floods in Ahmedabad

- Central Ground Water Board data showing Groundwater Monitoring Locations in Ahmedabad and Change in ground water near Vastrapur, Ghuma, and Sola Lakes
- Indian Meteorological Data explaining annual rainfall recorded in Ahmedabad
- Satellite images explaining change in land cover on lake plots covering both pre and post LRIL
- Analysis of the water quality of interlinked lakes based on the water samples collected on 30/11/2020 by grab sampling.
- Data supporting NDVI analysis within 300 meter buffer around the interlinked lakes. /Data covering change in vegetation within 300 meter around the interlinked lakes.

Chapter 4: Mainstreaming Lake Redevelopment & Interlinking projects as a Sustainable Urban Infrastructure Practice

- List of the legislative and institutional data for Gujarat state supporting preparation and implementation of LRIL-like projects
- Referred data covering the National level Legal Provision and Schemes for Protection and Conservation of Water Bodies.

Complementary Reference Reading Material

- For Folder A
- For Folder B

ANNEXURES

TERMINOLOGIES

This glossary builds from IPCC reports (WG I,II & 3 IPCC, 2014) , the Millennium Ecosystem Assessment (MEA, 2005) and UNISDR reports:

Adaptation:

A process of adjustment is required to adapt to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.

Adaptive capacity:

This is the ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.

Ecosystem:

An ecosystem is a functional unit consisting of living organisms, their non-living environment and the interactions within and between them. The components included in a given ecosystem and its spatial boundaries depend on the purpose for which the ecosystem is defined: in some cases, they are relatively sharp, while in others they are diffuse or not evident. Ecosystem boundaries can change over time. Ecosystems are nested within other ecosystems and their scale can range from very small to the entire biosphere. In the current era, most ecosystems either contain people as key organisms, or are influenced by the effects of human activities in their environment.

Ecosystem service:

Ecological processes or functions that impact monetary or nonmonetary value to individuals or society. These are frequently classified as (1) supporting services such as productivity or biodiversity maintenance, (2) provisioning services such as food, fiber or fish, (3) regulating services such as climate regulation or carbon sequestration and (4) cultural services such as tourism or spiritual and aesthetic appreciation.

Extreme weather event:

An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme, weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy rainfall over a season).

Hazard:

The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources. The term hazard usually refers to climate-related physical events or trends or their physical impacts.

Mitigation (of climate change):

Human intervention to reduce the sources or enhance the sinks of greenhouse gases (GHGs).

Resilience:

The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation.

Risk:

The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability or likelihood of occurrence of hazardous events or trends burgeoned by the impacts if these events or trends occur. The term risk is often used to refer to the potential when the outcome is uncertain, for adverse consequences on lives, livelihoods, health, ecosystems and species, economic, social and cultural assets, services (including environmental services) and infrastructure.

Vulnerability:

Vulnerability is the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

SOCIAL - ECOLOGICAL SYSTEMS FRAMEWORK

Social-Ecological Systems Framework or SES framework acknowledges that the natural resources consumed by man are part of a complicated network of social and ecological functions. It is a conceptual framework for the understanding of the intertwined ecological and social systems. There are four subsystems identified by the framework that occur and interact in such systems (McGinnis & Ostrom, 2014). It includes:

1. **Resource System:** The larger entity that is the subject of the study. Take, for example, water resources in a city can be a resource system.
2. **Resource Units:** They form the sub-units that interact on the upper layer for the functioning of the larger resource system. Streams, drains and other water entities can form such units.
3. **Governance System:** The authority that controls and manages these complicated systems like Local Bodies, Area Development Authorities etc.
4. Users: They are the beneficiaries or the users from the particular resource, and may be directly or indirectly linked to the entire system.

All of the above subsystems form an integral part of the larger SES

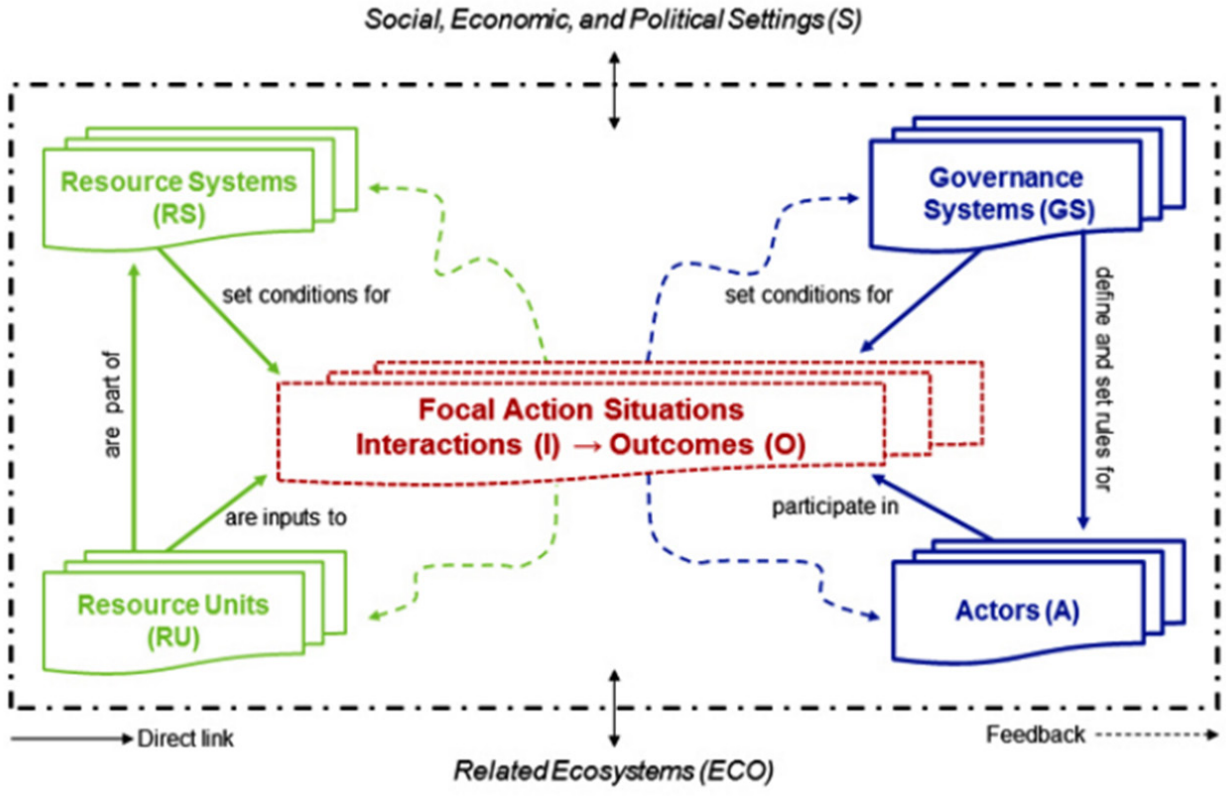

Figure 1: The interdependency of entities within a Socio Ecological System
Source: (McGinnis & Ostrom, 2014)

and perform with each other to keep the system functional and productive. For a better understanding of the complicated system, there is always a requirement for much more information about the variables and their interdependency. The dependency should be carefully studied as the variables often act in a non-linear pattern in a complex web of inter-related activities. The variables within these four categories have further sub-systems at different levels as one gets deeper into the subject.

The information about specific variables and their parts-relativity is required to develop an understanding of the total complex entity. While studying the variables it is important to define the temporal and spatial scales of the analysis. Therefore, one must absorb and untangle the complications in an SES. The interdependency at various levels influences one another and the social, political and economic environment as well.

The framework helps recognize variables on different levels meant for studying single or several similar Socio-Ecological Systems. It also delivers a common ground for the study of similar SES across biological or social precincts. The framework is critical for understanding the impact of policy intervention in enhancing a certain aspect in one type and scale of resource in comparison with another.

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Notes

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