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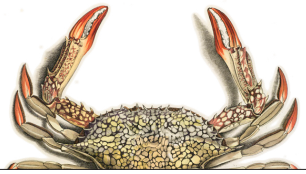

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LETTER FROM THE EDITORS

Dear Reader,

Welcome to Lessons in Conservation, the official journal of the Network of Conservation Educators and Practitioners (NCEP). NCEP is a collaborative project of the American Museum of Natural History's Center for Biodiversity and Conservation (CBC) and partners from around the world. This journal is designed to introduce NCEP's open-access teaching and learning resources (or "modules") to a broad audience. NCEP modules are written for undergraduate and professional level education. These modules—and many more on a variety of conservation related topics—are freely available for download on our website, ncep.amnh.org.

In this issue, we present selected NCEP syntheses, case studies, and exercises on the topic of environmental stakeholders. These resources can be useful for a diversity of teaching and learning contexts, from environmental sciences to civic studies, and provide specific group activities that require students to think critically and consider the diverse perspectives of people in regards to their environment. The featured synthesis examines stakeholders—specifically, who are they? How and why should they be engaged in an environmental or conservation project? And how can their involvement affect the outcomes of a project? Through an accompanying role-playing exercise, students apply the concepts learned to current conservation or environmental projects of their choosing. The subsequent modules cover a range of topics and settings, from rural India to New York City. In analyzing a multifaceted dam construction project in India, we explore issues of environmental justice that are essential to the fair and equitable management of natural resources. In a city setting, through a case study on street trees, we gain insights into the complexities of urban ecology, while an exercise on native bees allows students to analyze and debate the social, ecological, and economic factors involved in urban conservation. Across these very different backdrops, each module examines the diverse yet integral ways in which stakeholders and their roles shape the environment.

The modules in this issue are designed to promote the use of active learning techniques and develop critical thinking skills in a range of academic or training settings. NCEP materials are meant to be modifiable for each teacher's specific classroom or training needs; adaptable Microsoft Word versions of these modules are available for download at ncep.amnh.org along with accompanying teacher notes, exercise solutions, presentations, and links to other relevant open educational resources. We welcome any feedback on our materials and encourage those who are interested in becoming further involved to contact us for further information.

We are grateful to many people at the CBC and NCEP for their time and input to the development of this issue. Please see the back cover for a full acknowledgement of the organizations and individuals who have supported this project.

We hope you enjoy this issue of Lessons in Conservation and encourage you to visit our website to start using the full collection of NCEP resources in your classroom!

Questions and feedback are welcome at ncep@amnh.org.

Suzanne Macey
Co-Editor

Amanda Sigouin
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Note: to access teaching notes and exercise solution for these learning and teaching modules, visit our website: ncep.amnh.org and register as an educator on our online database.

Once registered, search for the module by title to find its associated teaching and learning resources.

Stakeholder Analysis in Environmental and Conservation Planning

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ABSTRACT

Stakeholders are defined as the people and organizations who are involved in or affected by an action or policy and can be directly or indirectly included in the decision making process. In environmental and conservation planning, stakeholders typically include government representatives, businesses, scientists, landowners, and local users of natural resources. These groups of stakeholders often have very different positions and values that may be difficult to reconcile with each other and the planned project. This synthesis provides a brief overview of why it is important to incorporate different stakeholders, including underrepresented groups and "hidden" stakeholders, in the planning process and discusses the potential benefits of inclusion. Before involving stakeholders, conducting a stakeholder analysis can help to identify relevant stakeholders and to assess their views and interests on a proposed project. The synthesis describes specific techniques for conducting a formal stakeholder analysis, such as the use of stakeholder tables and a stakeholder influence/interest grid. Finally, the synthesis also highlights some approaches and strategies that can help to facilitate a fair and productive participatory process.

1. INTRODUCTION

Figure 1 shows a collection of headlines in newspapers from just the United States. Do you see a common theme? From this small sample it is clear that environmental, natural resource, and conservation plans or decisions are complicated and involve many different people with differing opinions and values. Decisions about environmental and conservation projects like these are being made all over the world at multiple scales: from a small community deciding whether a parcel of land should be protected from development, to a multinational debate on whether there should be a total trade ban on ivory.

But what is the process by which different people, or stakeholders, are involved in making these decisions? Who exactly is a stakeholder, and how can stakeholders be identified and fairly involved in a project? In the following three sections, this module explores these key questions. First, it provides a brief overview of what a stakeholder is and why it is important to include them in the planning of environmental and conservation projects. Next, it describes several tools that can be used to systematically identify and better understand the set of stakeholders relevant to a particular project. Lastly, it describes some approaches for successfully engaging stakeholders in project planning. While not a comprehensive guide of all possible methods for identifying and engaging stakeholders, this module is intended to provide an introduction to the topic as well as some useful tools for performing a stakeholder analysis. For further information on the subject, we have included an appendix with suggested resources, including stakeholder engagement toolkits and guides.

2. IDENTIFYING AND INVOLVING STAKEHOLDERS

Environmental and conservation project planning and management often involve striking a balance between the protection and use of natural resources. Who decides what natural resources should be conserved or used? Landowners? Federal or local government? Scientists? The public? Such a diverse group of people is likely to bring together a variety of perspectives, motivations, past experiences, and interests to a given project (Madden & McQuinn 2014). When the scale of a natural resource project is large (e.g., construction of a mega dam or a pipeline) or spans country borders (e.g., creation of an international marine protected area), the list of private and/or public stakeholders can be expansive. In this section, we discuss different types of stakeholders and explore why it is important to involve them in the decision making process.

Grizzly bears in California: Reintroduction push ignites strong emotions
Mercury News, September 6, 2016

Public meetings held on the expansion of Papahanaumokuakea National Monument
KHON 2, August 1, 2016

North Dakota Oil Pipeline Battle: Who's Fighting and Why
The New York Times, August 26, 2016

Residents share concerns over Monterey Dam removal
GazetteXtra, November 11, 2016

Coyotes Create Dangers and Divisions in New York Suburbs
The New York Times, June 23, 2016

Environmental nuisance or grocery-store necessity? California voters to decide fate of plastic bags
The Sacramento Bee, October 8, 2016

Figure 1. Sample headlines about environmental and conservation issues in the U.S.

2.1. Who is a Stakeholder?

Broadly speaking, stakeholders are defined as the people and organizations who are involved in or affected by an action or policy and can be directly or indirectly included in the decision making process (Freeman 1984; Annan 2007; Sterling et al. 2017). A particular organization may further define situation-specific groups of stakeholders for its projects. For example, the U.S. National Park Service defines a stakeholder as a group or individual that should be present in order to reach the desired outcome or overall team purpose (U.S. National Park Service, www.nps.gov/ncrc), while the United Nations Environment Programme identifies and engages with nine specific major stakeholder groups for sustainable development projects under their oversight: farmers, women, scientific and technological community, children and youth, indigenous peoples and their communities, workers and trade unions, business and industry, non-governmental organizations, and local authorities (UNEP 2015).

2.2. Why Engage Multiple Stakeholders?

The idea of involving multiple stakeholders in a project may at first seem daunting and possibly counterproductive. This is because bringing together individuals with different perspectives, interests, and positions has the potential to slow the implementation of a project and create conflict. Resource managers often prefer to avoid lengthy negotiations and political stagnation and thus have traditionally turned to methods described as a "theory-driven approach" to research and evaluation (*sensu* Chen & Rossi 1980). Under this

Box 1: Hidden Stakeholders

"Hidden stakeholders" are those whose incomes and/or livelihoods depend on the use of a natural resource, but whose participation in public stakeholder decisions is not normally considered. For example, when discussing a topic such as the trade in a particular species, hidden stakeholders could include hunters, collectors, fishers, and squatters. Illegal poachers and dealers in black market wildlife trade represent a more extreme category of "hidden stakeholders," and their influence on the conservation of endangered species may span multiple international boundaries.

method, managers leading a project make decisions by consulting prior research on similar projects to identify likely outcomes. Use of a theory driven approach alone, however, fails to involve relevant stakeholders who can provide their different views and perspectives, resulting in a more successful and fair outcome. Thus an inclusive process that engages stakeholders is important for both pragmatic and democratic reasons (Sterling et al. 2017).

On the practical side, integrating stakeholder input into an initiative's planning process can be beneficial by providing early feedback and gathering consensus before a new rule, plan, or decision takes effect. This can lead to a more harmonious process and avoidance of unnecessary conflict. Often stakeholders oppose a project if they have been left out of the process, or were not informed about the numerous factors and compromises made before their participation (Mascia et al. 2003; Jones & Burgess 2005; Peterson et al. 2007). When stakeholders perceive (rightly or wrongly) that their views were not given fair consideration, hostilities can develop and possibly doom a project (Jentoft & McCay 1995; Madden & McQuinn 2014). As a result, fostering stakeholder ownership in the process can lead to increased support for, and improved implementation of, the project (Richards et al. 2004).

Stakeholder engagement throughout a project can also lead to higher quality decisions by incorporating more sources of information (Reed 2008). By considering a range of perspectives, engaging stakeholders can lead to a wider set of more creative options (Richards et al. 2004). Further, including the perspectives of local stakeholders can allow for solutions better suited for the social and cultural context of a region (Richards et al. 2004). Large organizations, such as the United Nations Environment Programme, recognize that "broad and balanced participation of [stakeholders]... plays a central role in providing expertise and scientific knowledge, informing governments of local needs and opinions, as well as identifying the 'on the ground' realities of policy decisions" (UNEP 2015).

Consideration of stakeholder values and opinions regarding an environmental or conservation project is also important from a democratic perspective. In a democratic, fair process, those most impacted by a project should have a say in its formation and implementation. In this context, stakeholder engagement can be seen as taking into account a diversity of values and facilitating empowerment, trust, and equity by including local communities in the decision making process (see Sterling et al. 2017 and references therein; Reed 2008). An inclusive stakeholder engagement process should comprise relevant actors and thus reduce the marginalization of underrepresented groups (Reed 2008). Another potential benefit of engagement from this perspective is social learning, where stakeholders can learn from each other and develop new relationships along the way (Reed 2008).

In any situation, it is important to consider which stakeholders to engage, as the most effective approach will balance the benefits of including a wide range of opinions and perspectives without being overly burdensome, to the point of hindering success of the engagement process (Sterling et al. 2017).

3. CONDUCTING A FORMAL STAKEHOLDER ANALYSIS

Given the importance of engaging stakeholders, governmental agencies or project managers may perform a stakeholder analysis prior to the planning and development of a conservation or environmental project. A stakeholder analysis is a group of techniques used as part of the planning process to identify and assess the relevant viewpoints of key people, groups, or institutions on a project or proposed activity. This type of upfront analysis can provide useful insights into stakeholder motivations and illuminate ways to facilitate a productive and successful engagement process for all involved parties. The most basic stakeholder analysis simply involves the identification of people, groups, and institutions that have some interest in a project or will be affected by it. As a pre-proposal technique, this analysis can be extended to anticipate the level of influence and support (either for or against) each group will have regarding a project or initiative. While any stakeholder or individual involved in a project could complete stakeholder analyses, stakeholder analyses completed by a team of project planners working together may achieve the best result.

3.1. Stakeholder Analysis Table

One stakeholder analysis technique used and modified by many, including UNICEF (available at http://bit.ly/2jd69XY), involves a table to aggregate information on the different stakeholders (Table 1).

When adding potential stakeholders and their interests to the table, it is important to consider the benefits the stakeholders may receive from the project, changes the project might require the stakeholders to make, and project activities that might cause damage or conflict for the stakeholders. Project planners should also include whether each individual, group, or institution would likely agree or disagree with the initiative, and describe their level of support or opposition for the project. A final step is to consider the actions or project revisions that could be taken to obtain stakeholder support and/or reduce opposition.

A stakeholder analysis encourages planners to include a diversity of viewpoints and incorporate the perspective of potentially underrepresented stakeholders. Further, by listing strategies to gain the support of stakeholders likely to oppose the action, this analysis provides the opportunity to consider changes to the proposed action.

3.2. Example: Analyzing a Stakeholder Table to Determine Strategies

For this example, a hypothetical watershed management proposal was modeled from several dam construction projects in locations as diverse as Harrisburg, Pennsylvania, and the Amazon (Tocantins River Basin) in Brazil. Typically, new dam construction (or renovation) provides downstream stakeholders safety benefits (e.g., reduction of flooding), and broader recreational or hydropower benefits to different stakeholder groups, depending on the specific project. In contrast, upstream stakeholders incur loss of land and natural river dynamics are altered, often to the detriment of wildlife and water quality. In some instances, there are further concerns regarding relocation of local peoples and political instability, which may add to the complexity of a project (see example in NCEP module, Environmental Climate Justice along the Brahmaputra River in Northeast India, accessible at ncep.amnh.org).

Table 2 shows a stakeholder analysis table for this hypothetical watershed management proposal. In this simplified example, the city government has proposed a new dam on the Pine River. This dam is proposed for hydropower, to prevent downstream flooding, and the city government proposes creation of a new city park with waterfowl habitat upstream. The city government's project planners have completed the below stakeholder analyses.

3.3. Stakeholder Grid

A stakeholder grid is a tool that can be used to visualize the relative influence (on one axis) and level of interest—either positive or negative—(on the other axis) of each of the stakeholder groups. This technique can be used either alone or in conjunction with the previously discussed table. A stakeholder grid can assist a project planner by visualizing which stakeholders share similar goals or have similar interests. A stakeholder grid is also useful for stakeholder groups to identify unexpected alliances, that is, groups that do not regularly share an interest, but which may join efforts to advocate for a singular position that both share.

An example of a stakeholder grid for the dam construction

Table 1. Pre-planning stakeholder analysis table template.

STAKEHOLDER	STAKEHOLDER INTEREST(S) IN THE PROJECT	LEVEL OF SUPPORT / OPPOSITION FOR PROJECT	NOTES AND STRATEGIES FOR OBTAINING SUPPORT OR REDUCING OBSTACLES

Table 2. A hypothetical pre-planning stakeholder table for a dam construction project.

STAKEHOLDER	STAKEHOLDER INTEREST(S) IN THE PROJECT	LEVEL OF SUPPORT / OPPOSITION FOR PROJECT	NOTES AND STRATEGIES FOR OBTAINING SUPPORT OR REDUCING OBSTACLES
Downstream Resident	Currently pays flood insurance costs	In favor	No new taxes would be used to subsidize construction
Upstream Landowner	Loss of land use of wet pasture	Strongly against	Financially compensate loss of use
City Government	Reduce flood potential, open up recreational use, possible hydropower generation could reduce air pollution and energy costs	In favor	Hydropower use could subsidize construction; needs strong support from other government agencies and offices
Bird Watching Group	Loss of riparian bird habitat	Strongly against	Mitigate loss by restoring adjacent habitat
Boating Group	Gain better boating access	Strongly in favor	Include development of boat ramp
Army Corps of Engineers	Stabilize flood cycles, but would also reduce wetlands	Somewhat neutral to mildly in favor	Mitigation of wetland loss; needs strong government support
State Department of Environment	Stabilize flood cycles, but also reduce water quality and native habitats	Somewhat neutral to mildly against	Mitigation of wetland loss; needs local government support
Regional River Commission	Improved water quality, for ecological, as well as human benefits	Moderately against	Fish ladders, water level management, downstream water user plan
City Parks and Recreation Department	Development of river park	In favor	Zoning and land use mitigation
Fishing Group	Public access to fishing, water quality for fish habitat	Mixed; members of group are split	Provide boat launch, mitigate upstream damage by habitat restoration, fish ladders
Energy Development Corporation	Develop hydropower plant	Strongly in favor	Will make proposal only after city support for dam announced

project is presented in Figure 2. Note that the placement of each of these hypothetical stakeholders depends on the specific project (e.g., city parks would become a low influence stakeholder if no recreational uses were planned).

Stakeholder grids can help identify potential group coalitions. Coalition building is an especially important tactic for stakeholders of low influence and high interest. Consider the bird watching group in the stakeholder grid above. The bird watching group and the upstream

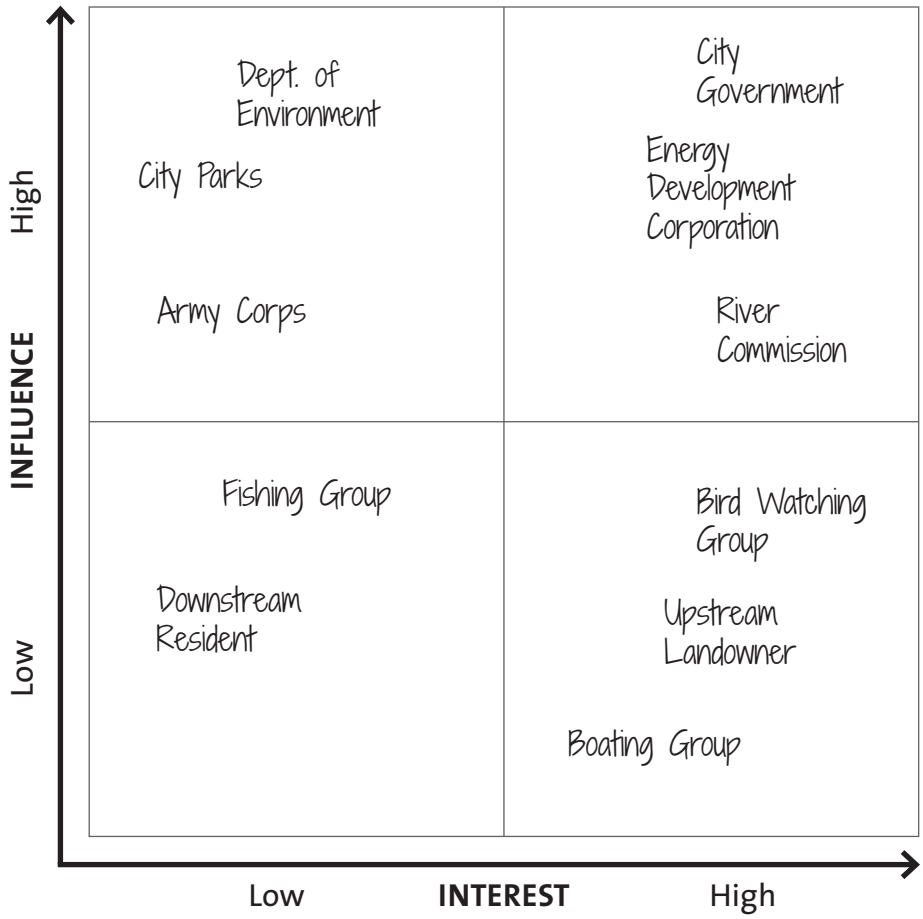

Figure 2. Stakeholder grid: an example using a hypothetical dam project.

landowner have similar (negative) views about a dam that would flood pastureland and destroy grassland bird habitat. Even if the upstream resident is not a bird enthusiast, he or she might be inclined to join forces with the bird watching group to gain a stronger voice in the debate.

Education and media coverage can also be used to possibly increase the interest level of other low influence groups. A coalition may eventually gain a higher level of influence than separate stakeholder groups, effectively moving to a new position in the grid. With greater numbers of informed stakeholders, coalitions can leverage that influence by appealing to stakeholders of even greater influence. In this example, coalitions of stakeholder groups with low influence but high interest could use their powerful collective voice to contact officials of groups with higher influence, such as the Department of Environment. Although perhaps not integral in the decision making process in this scenario, the Department of Environment may respond to a large public outcry and help to articulate these collective concerns to project organizers.

This flow of interest and influence can be visualized on the stakeholder grid as a backwards "Z" linking marginally interested stakeholders in the lower left quadrant, to the groups in the lower right through education and media, who use that empowerment to gain the assistance of stakeholders in the upper left, who ultimately advocate to the stakeholders holding the highest influence in the upper right quadrant (Figure 3). The dam proposer, the city government, could use this tool as well to identify and convene project supporters and opposition for early discussions.

3.4. "3 Rs" Approach: Rights, Risks, Responsibilities

Before assembling stakeholders, the project planners or meeting facilitators should consider acknowledging each stakeholder's individual rights, risks, and responsibilities. This "3 Rs" approach has been championed by the United Nations and is currently a part of their decision making process for the funding and planning of dam construction (Bird et al. 2005). Large water projects, especially those that span cultural or political borders provide good examples of how a 3 Rs stakeholder analysis early in the

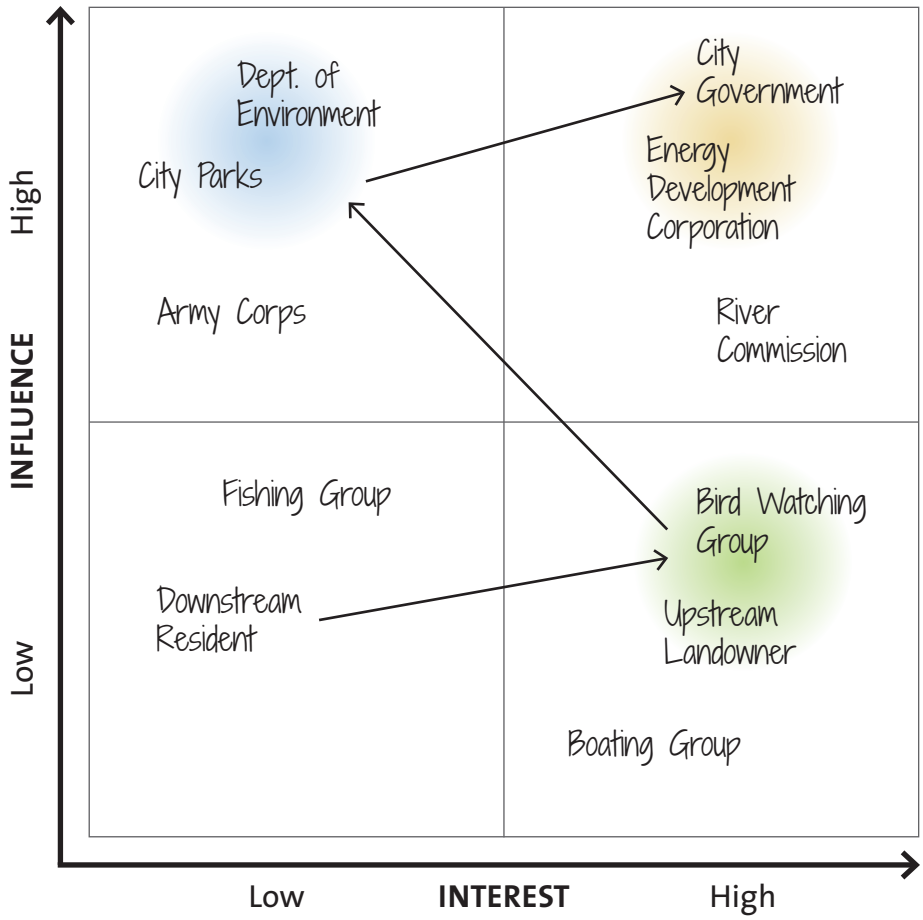

Figure 3. Stakeholder grid completed with backward "Z" included. Colors indicate possible coalitions or groups with common interests or concerns.

planning stages is vital to the well-being of upstream human communities and ecosystems, as well as to the success of the project (see World Commission on Dams 2000).

In this approach, project planners acknowledge and characterize stakeholder:

- **rights** (e.g., rights to extractable resources, rights of land tenure, human rights)
- **risks** associated with a project (e.g., loss of reputation, economic loss, loss of cultural integrity)
- **responsibilities** in planning and executing the project (may be included in a formal agreement or contract).

A 3 Rs approach may be used to inform the initial project planning, as an extension of a stakeholder analysis table. Can you envision what the rights, risks, and responsibilities could be for each of the stakeholders in Table 1?

Additionally, the 3 Rs approach may be used throughout a project as an independent and evolving document. As new stakeholders are brought into a project, or as the different agencies agree on specific responsibilities, the 3 Rs document can be modified. As the document develops, the responsibilities section can become the template for a legal contractual agreement or multi-party coalition (Bird et al. 2005).

4. FACILITATING INCLUSIVE STAKEHOLDER ENGAGEMENT

Following a pre-planning stakeholder analysis, a project proposal is typically announced and stakeholders are invited to participate in the process. Involving stakeholders early in the planning process is an important strategy to obtain support for an initiative and reduce obstacles to successful implementation (Jentoft & McCay 1995; Jones & Burgess 2005; Jupiter et al. 2014).

There are multiple ways in which stakeholders can be engaged. Some depictions of engagement have a normative framing, in which more participatory forms are viewed as better, such as Arnstein's (1969) Ladder

of Citizen Engagement. As shown in Figure 4, this framing lists non-participation as the lowest rung; non-participation can take many forms including situations where no provisions are made for participation at all or situations where stakeholders appear to have influence but actually have no say (i.e., manipulation). The ladder depicts increasing levels of stakeholder participation all the way to the top rung of "citizens decide" in which stakeholders hold the ultimate decision making power. Some have argued against such normative concepts, however, contending that optimal engagement methods should vary depending on the type and stage of a given project (Richards et al. 2004; Reid et al. 2009; Sterling et al. 2017). This more flexible approach eliminates a hierarchical framing and proposes that different stakeholder groups are likely to participate in different ways throughout the process. For example, in the Pine River dam case, it is possible that the area residents (upstream and downstream) are provided information, and asked for their input at different stages of the process, but not necessarily involved in making decisions at every step along the way.

Reviews of conservation actions involving stakeholders show that engagement of stakeholders per se does not necessarily always correlate with project success (Reed 2008; Mountjoy et al. 2013; Sterling et al. 2017). For this reason, it is important to evaluate key factors that lead to success across stakeholder engagement projects. A comprehensive review of the stakeholder engagement literature by Sterling et al. (2017) identified six key factors associated with successful conservation outcomes in stakeholder engagement projects (see Box 2).

4.1. Strategies for Engaging Stakeholders at Face-to-Face Meetings

Bringing stakeholders to the table is an important step of the engagement process. **Facilitated discussion** among stakeholders is one method that has been shown to help foster collaboration and the willingness to participate (Danielsen et al. 2005). This involves having a skilled, outside facilitator (a non-stakeholder) who can help encourage effective communication across the varying groups as well as set common goals and reduce conflict. Some governments have certified facilitators to moderate stakeholder discussions. For example, the State of Pennsylvania's Center for Collaboration and Environmental Dispute Resolution and the United Kingdom's Centre for Effective Dispute Resolution both maintain staff available to facilitate or mediate stakeholder meetings. In any case, the role of the facilitator is to maintain order and guide the discussion at arm's length, ensuring broad and meaningful participation by all while not advocating for a particular outcome. These mediators set the agenda and pace of discussion, and may solicit alternate views and counterpoints, especially in large group settings.

Scenario planning is a type of planning process that seeks to find innovative solutions to complex problems by allowing stakeholders to develop and share their mental models of the future (Bennett et al. 2015). Scenario planning can help stakeholders to consider desirable and undesirable future aspects and relevant tradeoffs as well as determine appropriate collective action (Bennett et al. 2015). **Capacity development** is another approach, which involves building the

Figure 4. Examples of levels in the ladder of citizen participation (adapted from Arnstein 1969).

Box 2. Key Factors Associated with Success in Externally-Driven Projects*:

1. **Identifying stakeholders**. It is important to foster inclusiveness without having so many stakeholders that it undermines the process.
2. **Timing and degree of stakeholder engagement**. Incorporating stakeholders early in the process can be beneficial. The manner in which stakeholders are engaged can also have an impact on overall project success; stakeholders should be appropriately involved while not overly burdened by engagement.
3. **Recognizing and respecting stakeholder values and institutions**. One important dimension of engagement is the recognition and integration of the values and institutions of stakeholders—keeping in mind that within a particular stakeholder group there can be a range of perspectives.
4. **Stakeholder motivation for engagement**. Understanding what drives stakeholders to participate can help to ensure adequate resources for their continued participation. Motivations could be economic or socially driven, which require different management approaches.
5. **Effective leadership**. Strong leadership and local champions are associated with project success, making it important to foster and support leadership among local stakeholders.
6. **Effective partnerships**. Strong positive relationships between stakeholders and project managers are important; trust can be built through open communication and transparency.

**Derived from Sterling et al. 2017.*
Note: Externally-driven stakeholder engagement projects are those that are led by an outside group or organization (e.g., a national or international NGO) that is organizing local stakeholders.

capacity of stakeholders to understand and solve the issue at hand and has been associated with more successful project outcomes (Brooks et al. 2013). It can include training workshops, courses, or professional development for key stakeholder groups to provide them with the necessary knowledge, skills, and tools for more productive engagement.

In the spirit of inclusion, a new approach for stakeholder input called a charrette has emerged out of a community of urban planners and architects. It was created to engage stakeholders who may not be able to meet at specific times due to their daily schedules, but yet want to participate in the design of a project. A **charrette** is an open, collaborative process that lasts at least three to four days, during which stakeholders offer input and feedback. A "design team" organizes the event, and works day and night to produce successive iterations of the design, as individual stakeholders cycle into and out of the process as their schedules allow. For more information, see Appendix 1.

Lastly, in the interest of civil and fair participation, stakeholders should agree to a common set of rules or principles of engagement at the onset and post them for reference during the actual discussion. An outside facilitator may provide an especially important service in maintaining adherence to these rules.

One example of such guidelines or principles are those proposed in the Brisbane Declaration (2005) by the Government of Queensland, Australia, in conjunction with a United Nations conference (Box 3). This model for inclusive stakeholder engagement recognizes four core principles of engagement in the creation of policy, particularly focused on addressing the inequity typically suffered by underrepresented indigenous and low-income groups (Brisbane Declaration 2005).

Can you envision a process whereby the multiple stakeholders in the Pine River Dam project would be able to engage in the decision making process, adhering to each of these four principles?

5. CONCLUSION

Conservation and environmental planning initiatives are best developed with key stakeholders identified and diverse viewpoints considered even before the stakeholders formally meet. Inclusion of stakeholders is important for both pragmatic and democratic reasons. A range of stakeholders should be encouraged to

Box 3: Core Principles of Stakeholder Engagement*

Core principles of integrity, inclusion, deliberation, and influence apply in many situations where conservation goals and human needs may conflict, and reflect the following:

- **Integrity**: when there is openness and honesty about the scope and purpose of engagement;
- **Inclusion**: when there is an opportunity for a diverse range of values and perspectives to be freely and fairly expressed and heard;
- **Deliberation**: when there is sufficient and credible information for dialogue, choice, and decisions; and when there is space to weigh options, develop common understandings, and to appreciate respective roles and responsibilities; and
- **Influence**: when there is the opportunity for stakeholders to have input in designing how they participate, when policies and services reflect the stakeholders' involvement, and when the stakeholders' impact is apparent.

**Derived from the Brisbane Declaration (2005), available at: http://www.ncdd.org/exchange/files/docs/brisbane_declaration.pdf*

participate, including underrepresented groups, not only because they are the people most likely to be impacted by an action, but also because consideration of diverse perspectives can lead to higher quality decisions that are better suited to the local context. A stakeholder analysis is a useful tool in developing strategies for a conservation plan, including identifying representative stakeholders, their likely positions and potential mitigation strategies. Ideally, a balanced—inclusive, but manageable—set of relevant parties should be brought to the table, and collectively agree to a common set of principles of engagement. While project success is not guaranteed by merely involving stakeholders, following key engagement principles can promote an inclusive engagement process and help achieve the best outcome.

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APPENDIX 1. ADDITIONAL TOOLS FOR STAKEHOLDER ANALYSES & STAKEHOLDER ENGAGEMENT

- **U.S. National Park Service, River Trails and Conservation Assistance**
  Their Community Tool Box website has concise downloadable guides to Facilitation, Stakeholder Analysis, Charrettes, Consensus Building and related tools. www.nps.gov/ncrc/programs/rtca/helpfultools/Toolbox/index_comtoolbox.htm

- **National Audubon Society**
  Audubon Tools of Engagement: A Toolkit for Engaging People in Conservation. The toolkit provides "20 steps to success" that take the reader through a detailed overview of how to plan for successful stakeholder engagement in a conservation project. http://web4.audubon.org/educate/toolkit/toolkit.php.

- **Convention on Biological Diversity**
  Communication, Education and Public Awareness (CEPA) Toolkit: How to engage stakeholders and mainstream biodiversity. Part 3 of this toolkit has information on how to engage stakeholders in conservation projects and also includes checklists and numerous examples of engagement. https://www.cbd.int/cepa/toolkit/2008/doc/CBD-Toolkit-Complete.pdf

- **Victoria Department of Environment, Land, Water and Planning (DELWP)**
  DELWP was created in 2013 from the Australian governmental department previously known as the Department of Sustainability and Environment. Their Effective Engagement Toolkit website provides an alphabetical list of over 40 tools to guide stakeholder participation in decision making including a dozen case studies involving stakeholders where these tools were deployed. http://www.dse.vic.gov.au/effective-engagement/toolkit

- **World Bank Group**
  The stakeholder resources website of this financial and global assistance group provides examples stakeholder grids and other analysis tools used in supporting economic and environmental initiatives in developing countries. http://www1.worldbank.org/publicsector/anticorrupt/PoliticalEconomy/stakeholderanalysis.htm

- **Nature Conservancy Water Funds Toolbox**
  While the website is targeted specifically to water projects, the examples involving multiple sectors from private, academic, public and international organizations demonstrate application of the tools of stakeholder analysis and downloadable templates. http://www.nature.org/ourinitiatives/habitats/riverslakes/wftoolkit-stakeholder-analysis.xml

- **The Sonoran Institute**
  Examples are provided from their own programs

where multiple partners or stakeholder groups were brought together to develop conservation plans. Their Resilient Communities Starter Kit is a downloadable "road map for communities" specific to climate change preparation, but should be adaptable to other community engagement activities. https://sonoraninstitute.org/resource/resilient-communities-starter-kit-08-29-2015/

- **National Charrette Institute (NCI)**
  The NCI provides training for teams to organize a Charrette event for stakeholders. Their website provides details on conducting a Charrette with examples focusing on regional planning that can be modified for specific conservation planning goals. http://www.charretteinstitute.org/

- **CARE Climate Change**
  This organization provides a short powerpoint on SlideShare as an introduction to Participatory Scenario Planning (PSP). It is followed by a case study of developing risk reduction in Kenyan communities under climate change scenarios. http://www.slideshare.net/CANSA2014/psp-southern-voices-workshop

- **U.S. Agency of International Development (USAID)**
  An Adaptive Management Tool for Conservation Practitioners provides a guide to develop, implement and test assumptions while using results to learn and adapt. It is available as a free download from the USAID Natural Resources Management and Development Portal. https://rmportal.net/library/content/tools/biodiversity-conservation-tools/putting-conservation-in-context-cd/adaptive-management-resources/5-5-a.pdf

- **United Nations Environment Programme (UNEP)**
  UNEP handbook provides guidance and recommendations for stakeholder engagement http://www.unep.org/civil-society/Handbook. The UNEP website is also a good source for specific programs, such as Agenda 21 for the Conservation of Biodiversity. http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=52&ArticleID=63&l=en

Practicing Stakeholder Analysis Using Current Environmental Issues

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LEARNING OBJECTIVES

After this exercise, students will be able to:

1. Identify a diversity of stakeholders relevant to a specific project and compare their varying viewpoints, degrees of influence, and interest for a particular project of conservation relevance;
2. Research an environmental project and select relevant evidence supporting an assigned stakeholder position; and
3. Explain the key factors of effective stakeholder engagement, why they are important, and analyze how these factors play out in the case of a specific conservation project.

1. EXERCISE OUTLINE

During this exercise, students will research a local or regional project with potential environmental or conservation impacts and then identify and research the stakeholders involved with the project. Equipped with the evidence collected from their research, students will fill out a stakeholder analysis table, complete a stakeholder grid, and select and act as a specific stakeholder in a public forum and a "face-to-face" stakeholder meeting. Students will work together towards a consensus regarding the proposed project and reflect on the participatory process in light of the key factors of engagement.

This exercise is designed to take two (90 minute) class sessions with approximately 20 students assigned to 3–4 working groups of 5–8 students. Please refer to the NCEP synthesis, Stakeholder Analysis in Environmental and Conservation Planning, for background information on the topics explored in this exercise. Additionally, suggested modifications of this exercise can be found in accompanying teaching notes online at ncep.amnh.org.

During the first class session, students will complete the following steps:

Step 1: Select a project and complete a project summary (~30 minutes)
Step 2: Identify a diverse pool of stakeholders and complete a stakeholder table (~30 minutes)
Step 3: Evaluate the relative positions of stakeholders by completing a stakeholder grid (~20 minutes)
Step 4: Select a stakeholder (~10 minutes)

After the first session, students will complete a homework assignment:

Step 5: Position statement (200–300 words)

During the second class session, students will complete the following steps:

Step 6: The public forum (~ 60 minutes)
Step 7: Stakeholders face-to-face meeting (~20 minutes)
Step 8: Post-process review (~10 minutes or as directed by the instructor)

As a concluding reflection, student will complete a final homework assignment:

Step 9: Assessing the process

2. STEPS FOR STUDENTS

2.1. Step 1: Selecting a Project (*30 minutes*)

You will be assigned to a working group that will be responsible for identifying and selecting a current local or regional environmental or conservation project from newspapers, magazines, trade journals or other materials. Your instructor may preselect materials for you

to decide from, or you may be assigned to complete your own search prior to class. Examples of environmental/conservation projects include proposed designations of roadless areas, construction of a dam, creation of a marine protected area, expansions of commercial developments or forestry plans, listing of species for protection, and changes in hunting/fishing/agricultural regulations. Ideally, the project should involve multiple stakeholders and the articles or online sources should provide sufficient background information about who will be potentially affected by the project and who is promoting the project. Choosing projects with a local focus is particularly encouraged as they may be relevant to your community and the information from public meetings may be current and useful for background. Appendix 1 provides some suggested resources for selecting an environmental or conservation project.

After confirming an appropriate project with your instructor, create a title for (e.g., Proposal for Dam on Pine River) and summarize the proposed project in a paragraph (4–5 sentences). In this summary, include details such as the timeline, who initiated the action, and what conservation or environmental goals will be supported or influenced by the proposed action, and who will have a role in final decision-making.

All members of your group should be listed on the document and provide input. One copy of the summary will be handed in to the instructor (and read out loud in class at a later date), but every group member should write down or get a copy of the finished summary for reference while writing your homework (described in Step 5). The summary copy handed into the instructor should also include citations for or copies of your information sources (e.g., newspaper articles, governmental documents).

2.2. Step 2: Identifying a Diverse Pool of Stakeholders (*30 minutes*)

Using the column headers shown in the example illustrated below (Table 1), construct a table of the stakeholders most relevant to your group's particular project. Considering the scope of the project selected, identify groups of people, agencies, or entities (e.g., downstream residents) that represent the different stakeholders. As you assemble the table, consider the following:

1. **Potential stakeholders** should be diverse and represent stakeholders from different sides of the issue as well as with different degrees of influence or interest. You should consider stakeholders that have great influence or power in the process, such as governmental agencies, as well as those who may have high interest in the project, but may lack significant power or regulatory authority such as individual landowners or conservation groups. Your list should include at least 8 different stakeholders, with 12 as an upper limit.
2. **Stakeholders interests** should indicate how they might be affected by the project or involved in the process of the project. For example, will the stakeholder group be economically hurt or helped by the action? Or, will the stakeholder group need to approve the project before it can proceed?
3. **A stakeholder's position** on the project (whether positive or negative) may be obvious from the source materials, but if not, speculate on their likely position with regards to the conservation action. Do you think they are likely to hold a strong opinion on the proposal (e.g., strongly in favor)? Or do you think they will have more limited interest in the project (e.g., neutral or mildly in favor)?
4. **Identify some strategies** or opportunities for the project proposal to be re-configured to take the stakeholders interests and risks into account, and hence gain or solidify their support. For example, cash payouts might compensate for lost economic benefits or narrowing the scope of the project might earn the cooperation of an otherwise antagonistic stakeholder.

If possible, create your stakeholder analysis table in an internet-based spreadsheet software program, such as Google Sheets, to allow easy group sharing and editing. Regardless of the format used, make sure every group member receives a copy prior to leaving class, as it will be helpful for the homework assignment. One copy per group needs to be handed in or shared with the instructor at the end of class.

Table 1: Template of a stakeholder analysis table with one example of a potential stakeholder listed for the proposal of a hypothetical dam on Pine River.

1. POTENTIAL STAKEHOLDER	2. STAKEHOLDER INTEREST(S) IN THE PROJECT	3. LIKELY POSITION	4. NOTES AND STRATEGIES FOR OBTAINING SUPPORT OR REDUCING OBSTACLES
DOWNSTREAM RESIDENT	CURRENTLY PAYS FLOOD INSURANCE COSTS	IN FAVOR	NO NEW TAXES WOULD BE USED TO SUBSIDIZE CONSTRUCTION

2.3. Step 3. Evaluating the Relative Positions of Stakeholders Using a Stakeholder Grid (*20 minutes*)

Working individually, create a stakeholder grid in Figure 1 by writing down each stakeholder from your table in the grid location that best describes that stakeholder's influence on the project, and interest relative to the other stakeholders represented. For example, a government budget office may have great influence on the final approval of the proposal, but have no particular opinion on the decision (i.e., high influence, low interest). The budget office's main concern is a balanced budget regardless of how the money is spent. Whereas a private citizen may be greatly affected by the project (positively or negatively), but lack the power to change the plan on his or her own (i.e., low influence, high interest). Your instructor may provide an example grid.

Where groups of stakeholders share the same position, and are clustered in the same block of the stakeholder grid, these are the stakeholders who would be expected to form coalitions. Draw circles around stakeholder clusters within the same grid block and with the same likely position that you would expect to work together towards a commonly shared goal.

Next, consider: which coalitions may be more aligned with each other, across the grid? Draw arrows from stakeholders or stakeholder clusters with low influence but high interest (lower right grid block) to those with high influence (upper two grid blocks) sharing similar positions on the project to identify potential influential allies for those groups of lower power. For example, low influence citizens often seek the assistance of a governmental or non-profit agency to use their power on behalf of a citizen's group.

Every student should complete this on his or her own grid and once completed, compare with group members and discuss differences.

2.4. Step 4: Selecting a Stakeholder (*10 minutes*)

In the next step, each group member should select one stakeholder listed on the stakeholder analysis table to represent. Keep in mind that members of your group must choose different stakeholders that collectively represent the major positions and key players in the conservation action (based on the four quadrats of the stakeholder grid). For example, your group needs to include those with high influence and those with low influence, those with high interest as well as low, and those with different positions (e.g., in favor of and against the project). You need not select stakeholders based on how close to your own position their views are likely to be; in fact, it may be more interesting to choose a stakeholder with positions different from your own.

Once you have discussed the selection of stakeholders with your group, write your name next to your chosen stakeholder on the stakeholder analysis table that will be handed in at the end of class. Once all members of the working group have made their choices, turn the stakeholder analysis table in to the instructor. You may turn in one copy of the stakeholder analysis table for your group, but make sure that each group member's name is listed next to their selected role and that each group member has a copy to assist in completing the homework. Your instructor may also have you turn in your individual version of the stakeholder grid.

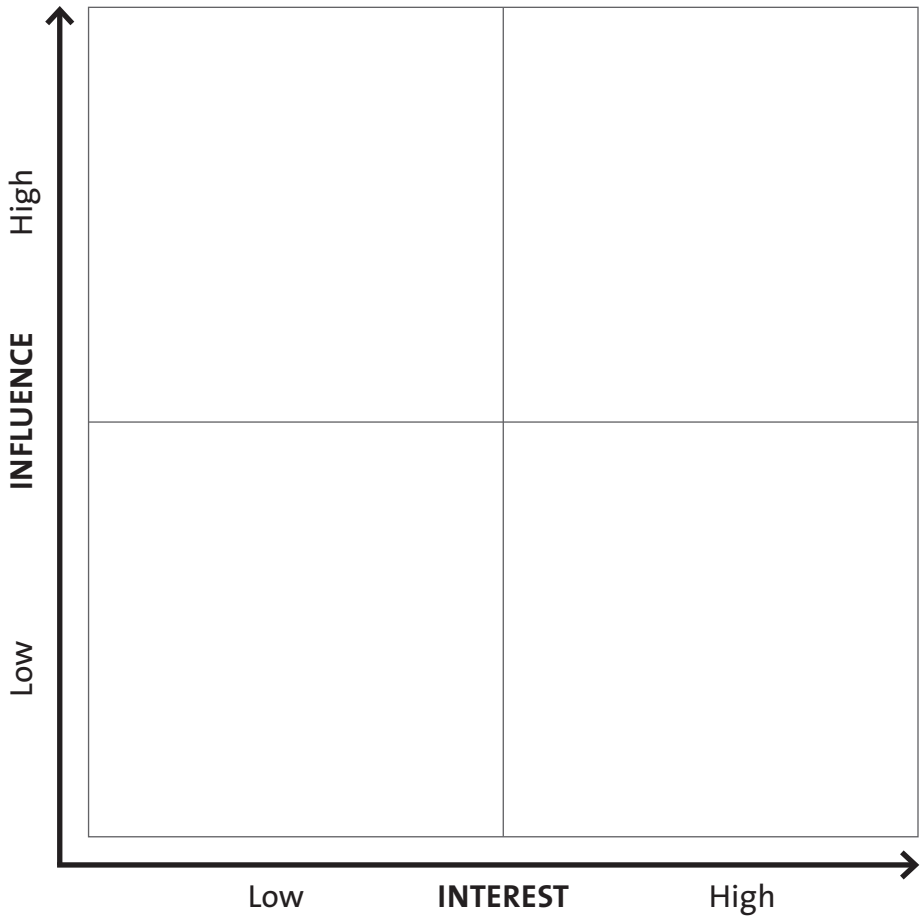

Figure 1. Template of a stakeholder (influence-interest) grid (to be completed by each student during Step 3).

2.5. Step 5: Position Statement (*homework due next class*)

As homework, each member of the working group should individually research the positions, views, and influence of the stakeholder they have selected. Taking the position of a person in your selected stakeholder group, compose a 200–300 word position statement. Identify which stakeholder you are representing early in the statement, and make your position clear. Be careful not to express your personal views on the project, but instead focus on what a representative of your selected stakeholder group would say. If your stakeholder holds a strong positive position then you should passionately advocate for the project. If you are representing a more neutral player, such as a government agency involved in the permit or budget review, focus on your responsibilities and obligations related to the project and provide a balanced view of the positive and negative aspects.

Your written position statement will be evaluated for use of proper grammar, organization, support of your position with evidence from cited sources, and clear recommendations for the future of the proposed project. Evidence in support of a position may include number of jobs lost or added, economic or environmental costs, examples of similar situations, or other plausible scenarios obtained from your selected articles or online research. Your recommendations may include modifications of a project to lessen harm or enhance the benefits to you (the stakeholder). Bring your position statement to the next class as you will be asked to read it aloud and hand it in to your instructor.

2.6. Step 6: Public Forum (*3 minutes per student: ~60 minutes*)

During the second class, stakeholders will be given an opportunity to provide input on their selected project via a public forum format. Governmental agencies or regional planners are frequently required by law to conduct scheduled public forums. Typically a neutral party facilitates the verbal input by individuals, and a

transcript is later made available to the public. Providing a written position statement helps the facilitators construct an accurate account of what was said.

Depending on the size of your class, the public forum may be performed in front of the entire class, with the instructor acting as the facilitator for all of the projects, or your class maybe split into multiple forums that occur simultaneously with different facilitators.

The facilitator will first read the project summary that a particular working group developed during the previous class (from Step 1), and call each stakeholder of that working group to come forward (from the completed stakeholder analysis table from Step 4). Stakeholders will take turns stating their name, which stakeholder group they represent, and reading their statement (from Step 5 homework). Each stakeholder will have 3 minutes to read his or her statement.

As a representative stakeholder, your oratory will be evaluated on the clarity of delivery, tone, and civility towards other stakeholder groups. As you read your statement, make sure to periodically look at the forum participants and include sufficient pauses to allow them to fully understand your position. A good presentation will balance supporting evidence with relevant examples, and convince other stakeholders that your perspective deserves consideration.

2.7. Step 7: Stakeholders Meet Face-To-Face (*20 minutes*)

After the public forum, stakeholders rejoin their working group and attempt to develop a consensus plan for the proposed project during a mock stakeholder meeting. Stay within your respective stakeholder role as you suggest and discuss modifications or alternatives for the project. At the same time you should recognize the necessity of compromise in achieving consensus. Your instructor may act as a moderator or assign one student from your working group to act as a moderator to ensure a balanced and realistic discussion.

While your group may come to a consensus, more often, some contentious issues will remain unresolved and prevent a full consensus. Note what issues prevent consensus. It is not realistic to expect to come to a full agreement with a single meeting of stakeholders. Your group may end up with several alternatives that are worthy of consideration, but either more information is needed or the group has one or two holdouts whose views cannot be reconciled. Although this activity will not have time to follow this process further, your group should appreciate how the process works (or fails). Overall, the goal of this activity is not to force a consensus, but to examine the process of stakeholder meetings in revealing and resolving conflict.

2.8. Step 8: Post-Process Review (*~10 minutes or as directed by your instructor*)

Following the discussion by the stakeholders, all students should step away from their role representing a particular stakeholder and now evaluate the overall process and outcome. Re-examine your group's original Stakeholder Analysis Table and your personal Stakeholder Grid. As a group, discuss:

1. In retrospect, were additional stakeholders identified during your research, the forum, and meeting process that should have been included?
2. Were the positions of influence, interest, and level of support for the stakeholders initially identified correctly? If not, how were they different?
3. Many approaches and standards have been developed to guide participatory processes. As an example, review the Brisbane Declaration (2005) Core Principles of Stakeholder Engagement in Box 1. Did your process meet these four standards? How? How did it not? For example, concerning inclusion, were all stakeholders represented fairly? Who was not given sufficient input into the discussion? Were those who were potentially hurt by the project given sufficient opportunity to have their concerns heard?
4. Which stakeholders benefited the most from the final agreement (if an agreement was met)?
5. What role, if any, did scientific evidence play in the process? What role(s) did spiritual or cultural values, or emotions play in the process?

2.9. Step 9: Assessing the Process (*homework due next class*)

You will turn in written answers to the following

Box 1: Core Principles of Stakeholder Engagement*

Core principles of integrity, inclusion, deliberation, and influence apply in many situations where conservation goals and human needs may conflict, and reflect the following:

- **Integrity**: when there is openness and honesty about the scope and purpose of engagement
- **Inclusion**: when there is an opportunity for a diverse range of values and perspectives to be freely and fairly expressed and heard
- **Deliberation**: when there is sufficient and credible information for dialogue, choice, and decisions; and when there is space to weigh options, develop common understandings, and to appreciate respective roles and responsibilities
- **Influence**: when there is the opportunity for stakeholders to have input in designing how they participate, when policies and services reflect the stakeholders' involvement, and when the stakeholders' impact is apparent.

**Derived from the Brisbane Declaration (2005), available at: http://www.ncdd.org/exchange/files/docs/brisbane_declaration.pdf*

questions, according to the guidelines provided by your instructor.

1. Reflect on your written position statement, your presentation of your position statement in the public forum, and the presentations of the other stakeholders. What are the most important aspects to include in a strong position statement? What are the most important attributes of a good presentation?
2. Did any coalitions emerge during your stakeholder meeting? If yes, what were they and why did these stakeholders work together? Were any stakeholders difficult for you (as a stakeholder) to work with? why?
3. During the deliberations among all members of your working group, what alternatives or modifications of the project plan are possible ways to move towards consensus? Describe one or two that were mentioned during the discussion, or develop one of your own.
4. For your group to have the best possible process and outcome, what additional information would have been helpful to know? For example, could research or some kind of professional expertise address important unanswered questions? Did you identify any missing stakeholders?
5. If you were to continue this stakeholder engagement process, what might you do next to best promote an outcome beneficial to your stakeholder group?
6. Imagine that rather than the small group of stakeholders used in this exercise, there were 100 citizens, business representatives, and government officials with some interest in this action. If you were asked to facilitate a stakeholder meeting of that size, how could you organize the process so that it would adhere to the Core Principles of Engagement (see Box 1)? In particular, what could you do to ensure integrity, inclusion, productive deliberation, and authentic influence for a very large group of very diverse stakeholders?
7. What do you see as the advantages and limitations of this stakeholder participation process, overall? Discuss at least two advantages and two limitations.

APPENDIX 1. USEFUL SOURCES TO FIND ENVIRONMENTAL OR CONSERVATION PROJECTS THAT INVOLVE MULTIPLE STAKEHOLDERS

Listed are several websites that can be consulted for examples of environmental or conservation projects. However, consider looking outside of major news outlets and international organizations because smaller and more local projects may not be covered by those sources.

- **Local newspapers.** We highly recommend trying to find an environmental or conservation project in your area. In local newspapers, most articles will be too brief to stand on their own, but a news story can then be linked to a municipal proposal,

or an agency that is conducting the activity.

- **NCEP modules**: ncep.amnh.org. Of the 150+ modules provided, several case studies involve issues or controversies with multiple stakeholders. Particularly relevant ones include:
  - Environmental and Climate Justice along the Brahmaputra River in Northeast India
  - Community Buzz: Conservation of Trees and Native Bees in Urban Areas
  - Marine Protected Areas and MPA Networks
  - How the West was Watered: A Case Study of the Colorado River

- **National and international news outlets**. In general, most major news outlets can be a source for breaking news that can lead the reader to other sources for more detailed accounts. Depending on the outlet, news stories vary from short summaries to lengthy investigations. Examples of these outlets are:
  - The Guardian: https://www.theguardian.com/us/environment. The Environment section provides news articles on many global issues related to conservation or environmental management.
  - New York Times: http://www.nytimes.com/section/science/earth. The Environment section frequently offers articles on wildlife, climate change, and environmental policies.

- **World Wildlife Fund/TRAFFIC**: www.traffic.org. TRAFFIC, the wildlife trade monitoring network, works to ensure that trade in wild plants and animals is not a threat to the conservation of nature. TRAFFIC documents wildlife trade information used by CITES and IUCN, much of which is available to the public.

- **World Commission on Dams**: http://www.internationalrivers.org/node/348. The mission of the WCD is to review the development effectiveness of dams and assess alternatives for water resources and energy development, and develop internationally accepted standards, guidelines, and criteria for decision-making in the planning, design, construction, monitoring, operation, and decommissioning of dams. The website provides examples of recent controversies.

- **United Nations Environment Programme** includes several reports that can be used. For an example, see this report on sustainable development of fragile mountain ecosystems: http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=52&ArticleID=61&l=en

Environmental and Climate Justice along the Brahmaputra River in Northeast India

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ABSTRACT

The glaciers of the Himalayas are the source of all of Asia's major rivers and are crucial to Asia's water supply, economies, and livelihoods. The Himalayan region is uniquely vulnerable to the impacts of anthropogenic climate change, while also becoming one of the most dammed regions in the world. This case study explores the unequal distribution of the impacts of climate change and dam building along the Brahmaputra River in Northeast India. It examines how the combined impacts of these two processes negatively affect local communities and explores environmental and climate justice issues. In discussing climate change impacts and hydropower development in Northeast India, this case study presents questions on the role of dams as a solution to climate change and as a form of sustainable development.

LEARNING OBJECTIVES

After completing this case study, students should be able to:

1. Describe current climate change threats in the Himalayan region and how they will impact the people of Northeast India;
2. Identify the factors contributing to hydropower development along the Brahmaputra River;
3. Explain and differentiate amongst the various environmental and climate justice issues relating to dam building along the Brahmaputra River;
4. Discuss the combined impacts of climate change and hydropower development on the riparian communities of Northeast India; and
5. Analyze and evaluate the role of hydropower development as an approach to address the climate change crisis and as a form of sustainable development, especially in areas where water resources are vulnerable to climate change impacts.

1. BACKGROUND

1.1. The Himalayas: "Asia's Water Towers"

The Himalayas are the highest mountain chain in the world. They are also a repository for the largest amount of ice outside of the poles, with Himalayan glaciers the source of all of Asia's major rivers (Figure 1). Rivers originating in the Himalayas are crucial to Asia's water supply, economies, and livelihoods[1]: Approximately 1.5 billion people rely on the runoff of these rivers in the Himalayan mountain region and further downstream in numerous countries including China, India, Pakistan, Nepal, Bangladesh, Vietnam, Burma, Thailand, and Lao PDR (Immerzeel et al. 2010; Xu et al. 2009). For this reason, the Himalayas are often referred to as "Asia's Water Towers."

1.2. The Brahmaputra River

The Brahmaputra River originates in the glaciers of Tibetan Plateau, in the Himalayas, and flows through Tibet, Northeast India, and Bangladesh, where it merges with the other rivers, before discharging into the Bay of Bengal (Figure 2). Its flow depends primarily on contributions from the South Asian summer monsoon[2] rains and the melting of Himalayan snow and ice, both of which occur between June and September (Goswami 1985). Throughout its course, the Brahmaputra supports a variety of different ecosystems from alpine meadows to tropical forests (Liu et al. 2012), as well as human communities.

The Brahmaputra is one of China and India's largest rivers both in terms of discharge and length (Shi et al. 2011), and is one of the most sediment[3]-charged rivers

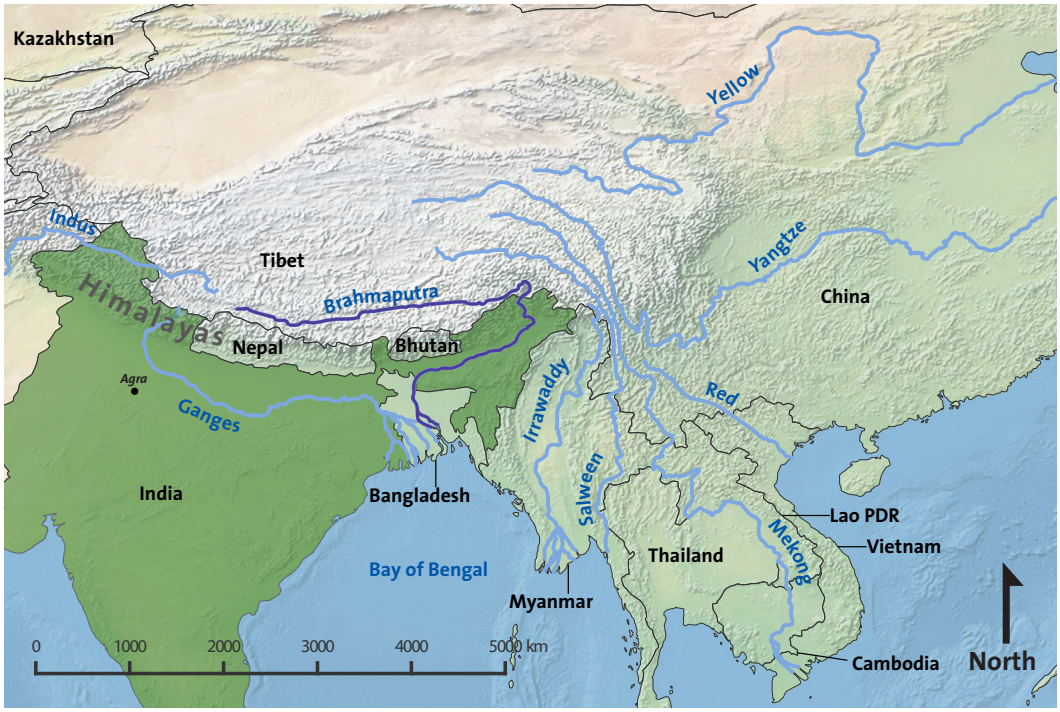


Figure 1. Asia's rivers with sources in the Himalayas.

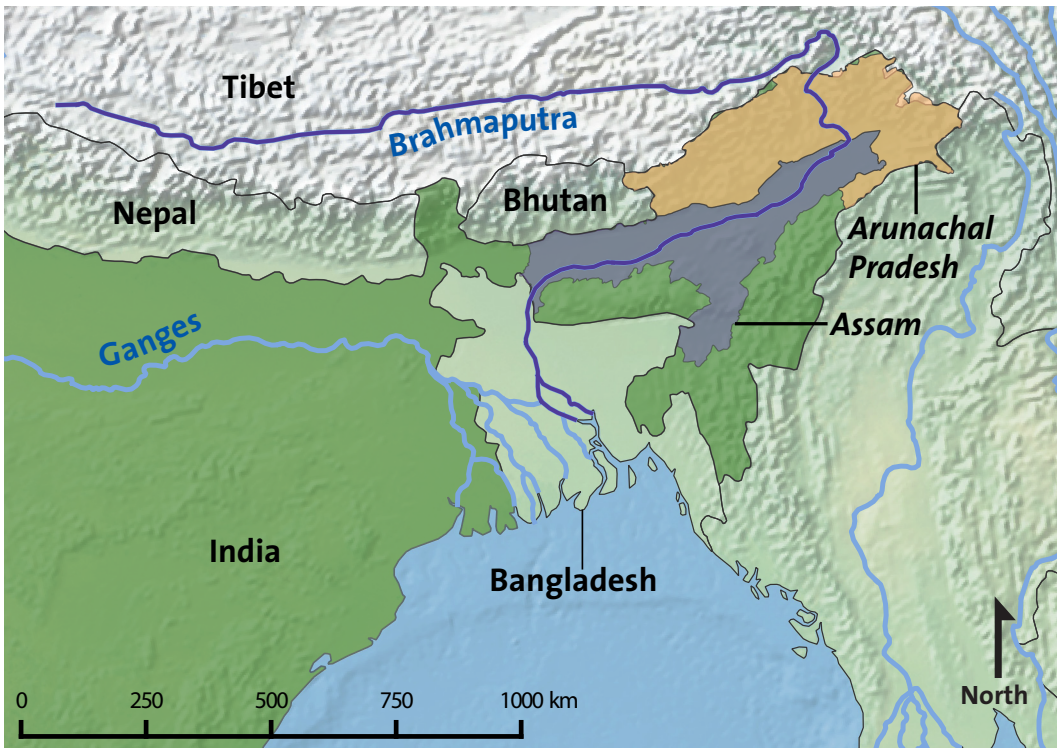


Figure 2. The Brahmaputra river basin with the Arunachal Pradesh and Assam states highlighted in orange and purple respectively, and labeled.

in the world (Goswami 1985). In India, the Brahmaputra River and its tributaries[4] are considered the "lifeline" of the Northeastern region and its people, a majority of whom depend on natural resources for their livelihoods (Vagholikar & Das 2010). Though the Brahmaputra river basin[5] drains all of the states of Northeastern India, except for Sikkim, a majority of its basin lies in the states of Arunachal Pradesh and Assam. In Arunachal Pradesh, the river and its tributaries traverse steep slopes as they go from the heights of Tibetan Plateau towards the Indian Ocean. In Assam, much of the power of the river gets dissipated and the river becomes highly braided[6] as it deposits vast amounts of silt and sand on the Assamese floodplains[7].

As a result of the unique topography of the Brahmaputra

Figure 3. Rice fields along the Dikrong riverbank, a tributary of the Brahmaputra, in Assam (photo credit: Costanza Rampini 2014).

river basin and the yearly onset of the South Asian summer monsoon—characterized by heavy rains—destructive floods are a recurrent and major challenge for the people of Arunachal Pradesh and Assam during the summer months. Summer floods cause tremendous damage to houses, fields, livestock, public utilities, infrastructure, and drinking water sources, and also lead to the spread of disease and the loss of human lives. At the same time, the Brahmaputra River provides countless ecosystem services[8] to the people of Arunachal Pradesh and Assam, including irrigation and fertilization of agricultural fields (Figure 3), groundwater recharge, transportation, food sources, and cultural services such as recreation and religious activities.

2. CLIMATE CHANGE IN THE HIMALAYAS

As the world's highest mountain chain, the Himalayas are uniquely vulnerable to the impacts of anthropogenic climate change[9], with important implications for the communities and ecosystems that depend on Himalayan rivers. This section details some of the impacts of climate change on water resources in the region, particularly in the Brahmaputra river basin, and discusses climate justice[10] implications for local communities.

2.1. The So-Called "The Roof of the World is Melting"

Increasing anthropogenic emissions of CO_2 and other greenhouse gases[11] are expected to cause a 2–2.5 °C temperature rise in the Himalayan region between 2021 and 2050 (Immerzeel et al. 2013; Eriksson et al. 2009). Already, increased surface temperatures due to climate change are causing Himalayan glaciers and snowpacks to shrink (Immerzeel et al. 2013). This suggests that glacier-fed Himalayan rivers, such as the Brahmaputra, could experience an increased variation in flows and even become entirely seasonal in the near future (Cruz et al. 2007). As Himalayan glaciers shrink, Himalayan rivers will first experience an increase in runoff as a result of the added meltwater, followed by a rapid and long-term decline in river runoffs as glaciers move past a critical threshold[12] (Baraer et al. 2012). Himalayan glaciers are expected to reach this threshold around 2050 (Immerzeel et al. 2013), at which point the Brahmaputra may experience a decrease in the average upstream water supply by nearly 20% (Immerzeel et al. 2010).

The impacts on water supply for those people who rely on the river are two-fold. On one hand, the short-term increase in glacial melt and Brahmaputra River runoff can exacerbate the challenge of summer floods for local communities living in the river basin. On the other hand, the long-term decrease in glacial melt will be especially felt during the winter dry season when glacial melt contribution to streamflow is most important (Baraer et al. 2012; Cruz et al. 2007). During the winter season, people living in the Brahmaputra river basin rely on the river for irrigating winter crops and for other important purposes such as laundry, bathing, drinking water for animals, and recreational and religious activities. A reduction in winter season flows of the Brahmaputra River will affect the capacity of local people to rely on these important services during the winter months.

2.2. Climate Change Impacts on the South Asian Summer Monsoon

The Brahmaputra River hydrology is also heavily influenced by monsoon rains during the summer season (Thayyen & Gergan 2010), which coincide with the melt season of Himalayan glaciers. Anthropogenic climate change is altering the South Asian summer monsoon, and climate models project an increase in the frequency of heavy precipitation events and a decrease in the frequency of light rain events during the summer monsoon season (Hijioka et al. 2014). More frequent heavy rain events will exacerbate the challenge of floods (Apurv et al. 2015).

But the range of effects of climate change on the South Asian summer monsoon are still poorly understood, and remain the largest source of uncertainty in determining the future runoff of Himalayan rivers such as the Brahmaputra (Immerzeel et al. 2013). For example, different climate models disagree as to whether changes in the water cycle will compensate for a long-term reduction in glacial melt by increasing annual precipitation, or exacerbate the problem by decreasing precipitation (Immerzeel et al. 2013).

2.3. Climate Justice

Overall, climate change is an impending threat to Asia's water towers, with cascading negative effects on biodiversity, local livelihoods, water and food security[13], and the region's economies (Cruz et al. 2007; Crow & Singh 2009; Pomeranz 2009; Xu et al. 2009). Particularly important to the people of Northeast India will be the impacts of climate change on the flood regime of the Brahmaputra River, on flow levels during the dry winter season, as well as the potential long-term reduction in river flows.

The industrialization and economic growth of Western countries, beginning in the 19th century, is largely responsible for the emission of greenhouse gases that are causing anthropogenic climate change (Liverman 2009). Northeast India is one of the poorest and least industrialized regions in India, with 70% of the population dependent on agricultural livelihoods (ICC 2013), and hence bears little responsibility for past greenhouse gas emissions (however, the country as a whole is industrializing rapidly, and emissions levels have been steadily rising). Yet as warmer temperatures cause changes to the Brahmaputra River flows and flood regime, the people of Arunachal Pradesh and Assam will bear a disproportionate burden of climate change impacts. Approximately 40% of Assam's land surface is vulnerable to flood (NRSC 2011). Annually, the area of land affected by floods in Assam ranges from one to nearly four million hectares, and vast areas of both Assam and Arunachal Pradesh are affected by flood-related erosion (World Bank 2007).

At the same time, Assamese and Arunachali farmers depend mostly on summer monsoon precipitation and sediment deposition from the river to provide irrigation and fertilization for their fields. Less than 17% of Assam's cropland is under irrigation schemes (Department of Irrigation 2013), and fertilizer use in both Assam and Arunachal Pradesh is low, with 63 kg and 3 kg of fertilizer used per hectare respectively, compared to the national average of 135 kg per hectare (ICC 2013). Changes in precipitation patterns and the long-term reduction in river flows pose a challenge to rain-fed floodplain agriculture in the region, making it increasingly difficult for subsistence farmers to sustain their livelihoods. Overall, climate change impacts on floods and water availability increase damages to traditional livelihoods, agricultural crops, and infrastructure, as well as an increase in human displacement and the number of climate refugees in the region (ICIMOD 2009).

The fate of the people of Assam and Arunachal Pradesh in the face of climate change impacts provides an important lesson for understanding the unequal distribution of benefits and losses as a result of climate change, an issue known as climate justice. While Assamese and Arunachali people have reaped few benefits from the industrialization of rich countries in the Global North[14] and even from the industrialization and economic growth of India, their largely sustainable agricultural livelihoods are directly threatened by the impact of anthropogenic climate change on key water resources.

3. DAMMING THE HIMALAYAS

The countries that make up the Himalayan region have plans to build over 400 hydroelectric projects along Himalayan Rivers, transforming the region into one of the most dammed regions in the world (Walker 2013).

3.1. Hydropower Development Along The Brahmaputra River In India

As of 2014, India is the world's second largest country in terms of population and the third largest contributor to global greenhouse gases (GHGs) emissions annually (World Bank 2016; Olivier et al. 2015). Therefore, the Indian government is confronted with the challenge of providing energy for a growing economy, while also facing international pressure to reduce its carbon footprint.

In the last decade, the Brahmaputra River has become the epicenter of India's renewable energy development efforts. The river has been identified as India's "future powerhouse" representing approximately 40% of India's total hydropower potential[15] when considering the hydroelectricity[16] generating potential of all Indian rivers (MDONER 2012). The amount of water and the force of the flows of the Brahmaputra river basin give it higher hydropower potential than all other river basins in India (CEA 2014), 87% of which remains unexploited (CEA 2014). This potential is concentrated in the northeastern state of Arunachal Pradesh, where the river and its north-bank tributaries flow across steep slopes as they go from the Himalayan Mountains to the flat floodplains of Assam.

As of 2012, the government of Arunachal Pradesh allotted contracts for 140 new dams along the Brahmaputra's north-bank tributaries—44 of which are mega-dams above 100 MW in capacity (MDONER 2012)—in an effort to meet India's growing energy demands, promote economic and sustainable development[17] (Verghese 2010), and curb GHG emissions from energy production (Government of Arunachal Pradesh 2008) (Figure 4).

4. DAMS AND ENVIRONMENTAL JUSTICE

Dam-building along the Brahmaputra, particularly in the context of climate change, exemplifies the unequal distribution of environmental costs and benefits across groups of people and across scales that is the focus of environmental justice[18] work. The government of

Figure 4: The Ranganadi Hydroelectric Project (405 MW) in Arunachal Pradesh (photo credit: Costanza Rampini, 2014).

Arunachal Pradesh profits from the allotted hydropower projects, India's urban centers largely benefit from the new energy supply, and the global community gains in terms of climate change mitigation. Meanwhile, the people of Northeast India, and especially Assam, are made to bear the social and environmental costs of hydropower development in the region. In addition, dam building amplifies the negative repercussions of climate change for downstream communities, thus creating "double losers."

4.1. Unequal Distribution of Costs and Benefits Between Arunachal Pradesh and Assam: Land Submergence vs. Flood Protection

The dams planned on the Brahmaputra River and its tributaries were initially conceived by India's central government for hydropower generation, irrigation, and seasonal flood control. However, in 2008, India's new Hydropower Policy prioritized attracting private investment in dam-building projects to speed up the development of hydropower resources in Northeast India (Water for Welfare Secretariat 2008). Private companies are now building approximately 90% of the new dams planned for the Brahmaputra river basin (Vagholikar & Das 2010). The entry of private investors in dam projects along the Brahmaputra led to a shift from multipurpose projects to run-of-the-river[19] projects, which have small reservoirs and little flood control capacity. Run-of-the-river projects maximize hydroelectricity production while minimizing the amount of land submerged by the dam reservoir and thus minimizing conflict with nearby upstream Arunachali communities, who would need to be compensated and relocated in order to accommodate for a large reservoir (Baruah 2012). However, these projects come to the detriment of the people living downstream of the dams, especially those living in the floodplains of Assam, who would instead benefit from upstream dams with large reservoirs that can help buffer floods.

4.2. Unequal Distribution of Costs and Benefits Between Arunachal Pradesh and Assam: Hydroelectricity and Changes to River Flows and Ecology

Because nearly all of the new dam projects for the Brahmaputra river basin are located in the state of Arunachal Pradesh, Arunachali people will be compensated for land submergence and the Arunachal Pradesh state government will receive both large down payments for the projects and a fixed amount of free hydroelectricity from each dam. Assam, on the other hand, must secure purchase agreements with the hydropower companies in order to receive hydroelectricity from the dams built just upstream of its territory. In addition, while the impacts of the dams on river flows and ecology will be felt by all communities downstream (regardless of state), riparian[20] communities in Assam could bear an even greater burden than those in Arunachal Pradesh (Baruah 2012). Assam's agriculture is centered around tea plantations, rice, silk farming, and

Figure 5. Children fishing in the Dikrong River in Assam (photo credit: Costanza Rampini, 2014).

fishing. Rice agriculture in Assam's floodplains depends on the transport and deposition of sediment by the Brahmaputra River and its tributaries for fertilization. As dams alter the flow of sediments in the Brahmaputra river basin, they will affect the fertility of Assam's floodplains (Vagholikar & Das 2010). In the winter, when people rely on the river for irrigating their winter crops and other important services, dams reduce river flows and cause unnatural daily fluctuations in flow levels as the water behind the dam is released only during certain hours to meet peak electricity demand (Vagholikar 2011). Additionally, as dams change river flows, they degrade wetlands downstream and block fish movement, which negatively impacts fish species in the Brahmaputra river basin and the food security of Assamese people, as fish play an important role in their diet (Figure 5).

4.3. Exporting Hydroelectricity from Northeast India to India's Mainland

The building of new dams in Arunachal Pradesh could bring development to Northeast India through jobs and infrastructure development, and is hence promoted as an engine of prosperity for this marginalized and largely rural region (Government of Arunachal Pradesh 2008). However, a majority of the hydroelectricity produced by dams built in Arunachal Pradesh will be transported to other parts of the country to satisfy the growing energy needs of India's urban centers (Baruah 2012), while the social and ecological costs of the dams are felt locally by the people of Arunachal Pradesh and especially Assam. Plans to build a large-scale power grid to transport the abundant hydropower resources of Northeast India to load centers located far away are already in the works. For example, a 6,000 MW transmission system from Assam to Agra, a city of 1.3 million inhabitants nearly 2,000 kilometers away in the northern state of Uttar Pradesh, was completed and commenced power flow in September 2015 (India Infoline News Service 2015; MDONER 2014), and more will be built as more hydropower projects are completed.

Additionally, India's National Hydro Policy and Tariff Policy allow for 40% of the electricity generated by a private hydropower project to be sold at market price rather than to pre-identified customers under long-term power purchase agreements (Vagholikar & Das 2010; Bhaskar 2013). This allows hydropower developers to sell energy to the highest bidder and is unlikely to benefit the relatively poor Northeastern states and their people, who will be unable to compete with richer states in an open market. Finally, while local Assamese and Arunachali people hope to benefit from employment creation, low levels of literacy in both states, and particularly in rural areas (Government of Assam 2003; Rajiv Gandhi University 2006), make it improbable that they will gain access to the high-level long-term jobs within the hydropower companies that are building dams along the Brahmaputra.

5. CONCLUSION: DAMS, CLIMATE CHANGE, AND THE PEOPLE OF NORTHEAST INDIA

Dams are promoted as a means to mitigate global climate change and promote the sustainable development of Northeast India. The labeling of dams as a form of sustainable development has already been critiqued for various reasons, including their significant ecological and social impacts, methane emissions from dam reservoirs, and the reduction in hydroelectricity generation as climate change reduces river flows (Giles 2006; Vicuna et al. 2008). Furthermore, in the case of hydropower development along the Brahmaputra, dams also increase the vulnerability[21] of riparian communities in Arunachal Pradesh and Assam to the impacts of climate change and diminish their capacity to adapt to those changes.

As mentioned before, an increase in the frequency of severe floods is predicted to occur as a result of climate change. On one hand, increasingly severe floods can compromise the safety of dam infrastructure and potentially cause dam failures, with serious downstream implications (Blackshear et al. 2011). On the other hand, by transforming river flows, ecosystems, local livelihoods, and local economies (WCD 2000), dams influence the capacity of local communities to cope with increasingly severe floods as a result of climate change. Along the Brahmaputra, dams are causing floods to become more abrupt, as floodwaters are released suddenly from behind the dam floodgates with little to no warning to downstream communities (Vagholikar & Das 2010). These flashfloods are making it harder for downstream communities to prepare for the arrival of floods and it is rendering traditional adaptation methods, such as

banana rafts, increasingly futile in the face of ever more destructive floods. Similar to climate change impacts, the building of over 140 dams in the Brahmaputra river basin will make it increasingly difficult for the people of Arunachal Pradesh and especially of Assam to live with recurrent summer floods, and may push a segment of the population to abandon their riparian livelihoods to seek wage labor in larger towns and cities, where they will become incorporated in a more carbon-intensive economy.

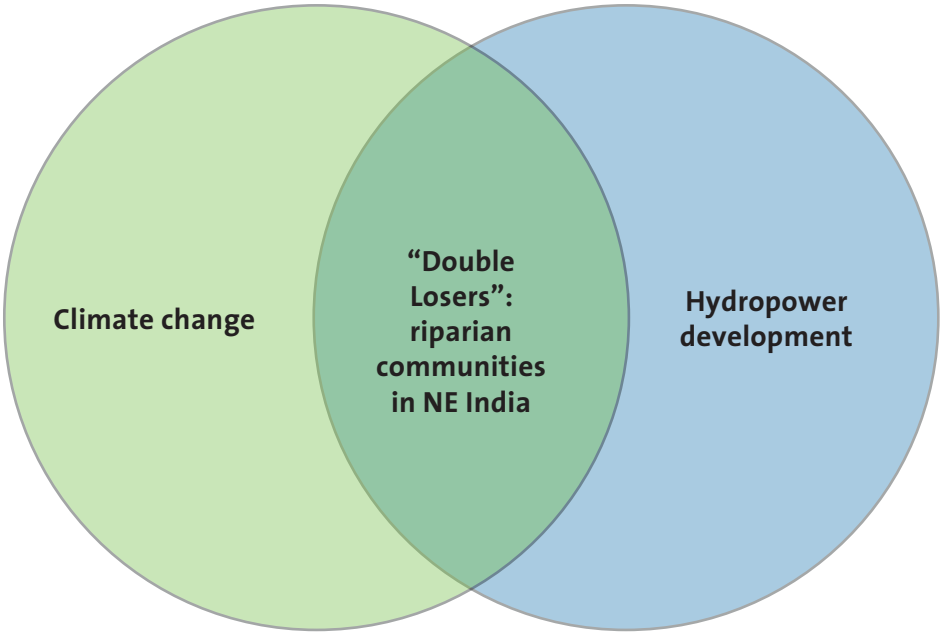
Dams along the Brahmaputra will benefit the global community by curbing the overall amount of GHGs emitted into the atmosphere, as well as India's national and state governments, its energy sector, and its large urban centers that will import the hydroelectricity generated in Arunachal Pradesh. Yet dams exacerbate the vulnerability of people of Northeast India to climate change impacts by further worsening floods, while undermining their adaptive capacity[22] to floods. This overlap of negative outcomes relating to climate change and dam building along the Brahmaputra is creating a "double loser" scenario for riparian communities in the river basin (Leichenko & O'Brien 2008): people living downstream of the dams in Arunachal Pradesh and especially in Assam bear both a disproportionate burden of climate change impacts in the form of more severe floods, and a disproportionate amount of the costs of dam building efforts (Figure 6). The question still remains as to whether the historically marginalized northeastern region of India will reap any benefit at all from the damming of its rivers via local job creation, electrification, and overall infrastructure development.

6. DISCUSSION QUESTIONS

Following guidelines from your instructor, discuss answers to the following questions:

1. Explain the various environmental justice issues related to the building of dams along the Brahmaputra and its tributaries in Arunachal Pradesh and Assam. Consider economic, ecological, and climate change related issues in your answer. What solutions could be employed to mitigate the local ecological and social impacts of dam building efforts and help redistribute some of the costs and benefits from hydropower development in the region?
2. The building of dams is heralded both as a solution to the global challenge of climate change and as a path for sustainable development. Using Northeast India as an example, explain in which ways hydropower development can be mitigate global climate change and how it can be considered a form of sustainable development. In which ways might hydropower impacts contradict notions of sustainable development?

Figure 6. Venn diagram of climate change impacts, impacts of hydropower development, and the "double losers," suffering from both.



3. Should harnessing the hydropower potential of the Brahmaputra River for mitigating climate change take precedence over the current uses of the river by local communities? Choose a position and support your argument with information from the module, or from cited, outside sources.
4. How are dams and climate change producing "double losers"? Who are these "double losers" and what are they "losing"? To answer this question, create a Venn diagram (see Figure 6). In one circle, list the impacts of climate change on river flows, floods, and ecosystems. In the other circle, list the impacts of hydropower development on river flows, floods, and ecosystems. In the overlapping middle, describe how this is creating "double loser" and what the combined impacts are for local communities living in the river basin.
5. Since the 1930s, dams have become synonymous with modernization and development. Jawaharlal Nehru, India's first Prime Minister after India's independence from the British Empire, famously proclaimed dams the "temples of modern India." Similarly, hydropower companies and the Indian government accuse anti-dam activists in Northeast India of being anti-development and slowing the country's economic growth. How might you argue against them on this point?

GLOSSARY

1. **Livelihood**: a set of activities that allows a person to secure the basic necessities of life including food, water, shelter, and clothing.
2. **South Asian summer monsoon**: a season of heavy rains caused by the movement of moist, cool air from the oceans towards the warmer landmass, due to the changing of seasonal wind patterns. The South Asian monsoon occurs between the months of June and September and causes devastating floods through much of South Asia, including India. The Himalayan Mountains play a key role in the South Asia summer monsoon by acting as a vertical barrier to the movement of moist air, causing the air to rise and cool, therefore leading to precipitation (see Figure 7).
3. **Sediment**: solid material, such as rocks, minerals, and organic material that has eroded and is transported and deposited to a new location by water, wind, or ice. Sediment often deposits nutrients onto the soil, increasing its fertility.
4. **Tributary**: or affluent, is a freshwater stream that flows into a larger stream or river.
5. **River basin**: the area of land drained by a river or stream and all its tributaries.
6. **River braiding**: when a river deposits large amounts of sediments causing it to divide into various channels that split off and rejoin each other, giving it a braided appearance.
7. **Floodplain**: an area of land nearby a river or stream that is prone to flooding. Floodplains are usually very fertile as a result of the deposit of nutrient-rich sediment from the river, and therefore are also generally heavily populated by human communities.
8. **Ecosystem services**: benefits people obtain from ecosystems often grouped into four categories: 1) provisioning services

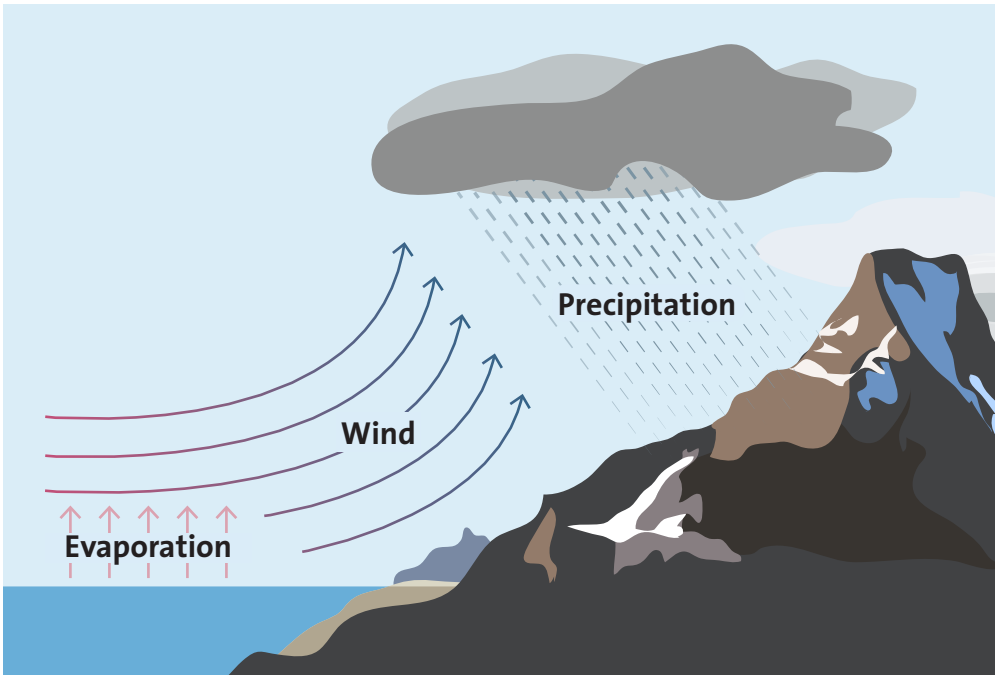


Figure 7. Diagram of the role of the Himalayas in the South Asian summer. The warm waters of the Indian Ocean evaporate and are transported towards the land by the wind. As the air faces the physical barrier of the Himalayas, it rises and cools down, and causes precipitation of fresh water in higher elevations (illustration: Nadav Gazit).

such as food and water, 2) regulating services such as flood control provided by wetlands and mangrove forests, 3) cultural services such as spiritual and recreational, 4) and supporting services, such as nutrient cycling.

9. **Anthropogenic climate change**: the addition of greenhouse gases (see 11) into the atmosphere as a result of human activities, such as the burning of fossil fuels and deforestation, leading to the intensification of the greenhouse effect (see 13), and thus the warming of Earth's climate. Anthropogenic climate change is largely attributed to the advent of the Industrial Revolution in the 19th century.
10. **Climate justice**: a body of work and a social movement that is primarily concerned with the equity dimensions of climate change. By recognizing the difference in resources use, development paths, and emissions contributions between rich and poor countries (as well as between groups of people), this concept acknowledges the differentiated responsibilities of nations and people for causing anthropogenic climate change, as well as the unequal distribution of benefits and costs as a result of climate change impacts. Climate justice is a component of environmental justice (see 16).
11. **Greenhouse gas (GHG)**: a gas in the atmosphere that absorbs infrared radiation from the Earth's surface, producing the so-called "greenhouse effect" which warms Earth's surface. The main GHGs include water vapor, carbon dioxide, methane, and chlorofluorocarbons (CFCs). The addition of greenhouse gases to the atmosphere as a result of human activities, such as the burning of fossil fuels and deforestation, intensifies the greenhouse effect, thus warming Earth's climate (see 9).
12. **Threshold**: critical values or limits, which, if crossed, can generate serious or socially unacceptable environmental change and/or irreversible consequences. In the case of a glacier-fed river such as the Brahmaputra, the glaciers that are the source of the river are considered to have crossed a critical threshold when the river begins experiencing a decrease in dry-season discharge.
13. **Food security**: people are food secure when they have physical, social, and economic access at all times to sufficient, safe, and nutritious food that meets their dietary needs and preferences for a healthy life.
14. **Global North**: a term used to describe countries that have a high ranking in the United Nations Development Programme's Human Development Index (which uses indicators such as income per capita and life expectancy), as opposed to countries (including India) that rank low, which are defined as the Global South.
15. **Hydropower potential**: the hydro-electrical power potential of a river or stream. It depends largely on the amount of water flowing in the river/stream and the gravitational force of the falling or flowing water. The hydropower potential of a river/stream is measured in Watts.
16. **Hydroelectricity**: the electrical power produced by harnessing the force of falling or flowing water.
17. **Sustainable development**: development that meets the needs of present generations in ways that do not exhaust natural resources, so as to safeguard the ability of future generations to also meet their own needs. Sustainable development entails balancing social, economic, and environmental objectives and needs in the process of decision-making to ensure long-term benefits. The concept has been the subject of various critiques for being too vague, for promoting corporate "greenwashing" and development activities, such as dam building, that in fact have significant social and environmental impacts.
18. **Environmental justice**: broadly defined, environmental justice is a body of work and a social movement that is concerned with and critical of the unequal distribution of environmental costs and benefits between groups of people, especially as a result of race, ethnicity, and income.
19. **Run-of-the-river dam**: a dam with little or no water storage behind the dam, and which relies primarily on the natural flow of the river for power generation.
20. **Riparian**: of, relating to, or situated near the banks of a river or stream.
21. **Vulnerability**: the degree to which a social or ecological system is exposed to and adversely affected by a hazardous event. Conventional risk assessments examine vulnerability as a result of exposure and damage, while other approaches have drawn attention to how characteristics such as ethnicity, religion, caste membership, gender, age, political power, and access to resources make some groups more vulnerable than others.
22. **Adaptive capacity to climate change**: the capacity of a social or environmental system to adapt to climate change and its effects. Diversity, flexibility, memory, and novelty are important components of adaptive capacity. In social systems, information and knowledge, good institutions, and overall development (e.g., poverty eradication, food security, access to resources, literacy, equity, livelihood diversification) are all considered key to improving adaptive capacity.

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Community Buzz: Conservation of Trees and Native Bees in Urban Areas

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ABSTRACT

The world is increasingly urbanized and yet, even in urban areas, humans remain dependent on the ecosystem services that nature provides. This case study and exercise explore selected aspects of the dynamic between humans and urban ecology in three parts. First, we briefly discuss urban ecosystems and the context of biodiversity conservation in urban areas. Then, through a case study of the Million Trees program in New York City, we provide evidence and start a discussion about the possible benefits—as well as potential negative social, ecological, and economic consequences—of urban trees. And finally, we introduce biodiversity conservation in urban green spaces through an exercise on native bees. After reading about the importance of, and threats to, native bees, students take on stakeholder roles to decide if their neighborhood should accept a grant to create and maintain bee habitat in an urban park. Students are tasked with conducting additional research and participating in a classroom town hall meeting to present and support their argument for or against the creation of native bee habitat.

LEARNING OBJECTIVES

After this case study and exercise, students will be able to:

1. Identify some of the social, economic, and ecological factors that may influence the success of an urban conservation initiative;
2. Summarize and synthesize the opportunities and challenges of biodiversity conservation in an urban setting; and
3. Discuss the trade-offs of urban conservation from diverse stakeholder perspectives.

1. INTRODUCTION TO URBAN CONSERVATION

> *The world is increasingly urban, interconnected, and changing. If current trends continue, by 2050 the global urban population is estimated to be 6.3 billion, nearly doubling the 3.5 billion urban dwellers worldwide in 2010. More than 60 percent of the area projected to be urban in 2030 has yet to be built.*
>
> *Secretariat of the Convention on Biological Diversity (2012)*

What does the growth of cities mean for the conservation of biodiversity? Is there a place for conservation within cities? And if so, what does urban conservation look like? These are important questions on both the local and global scale, with important implications regarding the impact of cities on the earth's ecosystems and the quality of life for humans.

1.1. Cities and Biodiversity

Through the destruction, degradation, and alteration of natural areas, the creation and growth of cities imposes major and often irreversible changes to the landscape and its biodiversity. Nevertheless, it may still be helpful to look at cities as their own type of ecosystem—an ecosystem dominated by humans. The built environment is the defining characteristic of cities, yet more than just remnants of its original biodiversity exist. In fact, many cities are located where they are because of the original biological diversity and productivity of the land. Cities were, and still are, established in areas with navigable waterways and abundant natural resources. An example of this can be seen in New York City's (NYC) Pearl Street. This street is so named because at one time it was the location of lower Manhattan's East River shoreline; once having abundant oyster reefs nearby, this was one of

the locations where the native Lenape people piled discarded oyster shells after harvesting (Feirstein 2001; Kurlansky 2007). Pearl Street is no longer a waterfront street (due to hundreds of years of landfilling that has extended Manhattan approximately 300 meters into the river; see Figure 1) and the present day rivers in NYC no longer have natural oyster reefs (however, see managed oyster reef restoration projects such as the Oyster Research Restoration Project). Today, visitors and residents may not make the connection between a street name and the original biodiversity of the region.

Cities are a patchwork of human, or anthropogenic, habitat (e.g., residential, commercial, industrial zones) and "greenspace" (e.g., recreational parkland, remnant woodlots, post-industrial areas). The biodiversity patterns that emerge "post-urbanization" are a result of the interactions between humans, their industry, trade, culture, and travel, in addition to the traditional environmental factors that often explain patterns of biodiversity in natural areas (e.g., local climate, soil, and vegetation). For example, as centers of trade and transport, cities are gateways for the establishment of exotic species, which is a serious conservation and economic challenge, as exotic species may outcompete native species and can be costly to eradicate or keep at bay (Kiviat & Johnson 2013). There are also certain cosmopolitan flora and fauna that thrive in urban areas and are found consistently in many cities around the world. This pattern suggests that urban development may have a homogenizing impact on biodiversity (Secretariat of the Convention on Biological Diversity 2012), but urban biodiversity is not entirely uniform between cities, throughout a city, or over time (Kowarik 2011). For example, older cities have more species than younger cities and wealthier neighborhoods have more floral diversity than poorer ones (Secretariat of the Convention on Biological Diversity 2012).

Figure 1. Egbert Viele's 1874 map of Manhattan, showing original landmass in green and subsequent landfill in orange. Image below is the left-most (southern-most) portion of the map shown in close up to visualize Pearl Street (Viele, Egbert L. [CC BY-NC-SA 2.0])

1.2. Cities and Ecosystem Services

Urban ecosystem services are vital for the resilience of a city and depend on urban biodiversity (McPhearson et al. 2014). Many city managers are now realizing that the stability of the "human-side" of cities (e.g., neighborhoods, the economic development of commercial districts) benefit from the conservation of urban biodiversity and the construction of green infrastructure[1] to maintain urban ecosystem services. For example, with global climate change leading to rising sea levels and more frequent, stronger storms, restoration ecologists are proposing and manufacturing living reefs off the coasts of urban areas. Oyster reefs, such as those being re-built in NYC waterways, protect shorelines by buffering storm surges while simultaneously promoting habitat for other species. They also provide the additional benefit of increasing water quality, which can have human health benefits (see Figure 2; Piazza et al. 2005; Beck et al. 2011; Grabowski et al. 2012).

Other examples of green infrastructure within cities are green roofs[2] and green streets[3] (Figure 2). In these cases,

green infrastructure not only reduces water pollution (Gregoire & Clausen 2011) and decreases temperatures in cities (Santamouris 2014), but it also creates and connects habitats for a diversity of invertebrates, like native bees[4] (Braaker et al. 2014), birds (Strohbach et al. 2013) and small mammals such as bats (Oprea et al. 2009). Additionally, green roofs have been shown to provide residents with increased apartment value (Ichihara & Cohen 2011) and improved mental well-being (Lee et al. 2015).

1.3. Impact of Cites: Outside the City Limits

Urban areas are growing rapidly, especially areas in close proximity to biodiversity hotspots and in species-rich coastal areas (Secretariat of the Convention on Biological Diversity 2012). This larger urban footprint will have far-reaching impacts, well beyond city limits. For example, even if a natural area is protected from development (e.g., in a nature preserve, national park, wildlife refuge), air and water pollution from a bordering city can enter the protected area. Also, bordering cities can alter that protected area's microclimate by increasing local temperatures and altering hydrology (Bolund & Hunhammar 1999), which in turn can change the local ecology of the ecosystem. The high resource demands of a large urban populace may also incentivize both legal and illegal natural resource extraction from nearby biodiversity hotspots, possibly increasing habitat degradation and increasing the risk of extirpation or extinction of threatened species (Lee et al. 2014). Furthermore, an increase in land prices—as it becomes more economically attractive to develop on cityscape borders—may make the future expansion of protected areas more difficult. For more information on this topic, please see the NCEP module, Sprawl and Biodiversity (ncep.amnh.org).

Figure 2. Oyster reef restoration project in Florida (left); similar projects are underway in urban areas, such as the Billion Oyster Project in New York City. Green roof in New York City (top right). Green street in Seattle, Washington (bottom right). Photo credits: left: Anne Birch. Top right: Jwilly77 (Own work) [CC BY-SA 3.0 [http://creativecommons.org/licenses/by-sa/3.0]. Bottom right: U.S. Environmental Protection Agency, public domain.

Ultimately, with an increasingly urban future ahead, established cities must place a priority on conservation and new cities should be developed with conservation objectives in mind in order to better protect biodiversity and maximize urban ecosystem services for human health and well-being. The following case study (Part A) will dive further into how initiatives to increase vegetation (specifically focusing on trees) in urban areas can affect the urban environment and city residents. In Part B, an exercise will focus on how the implementation of wildlife restoration projects in urban areas involves a diversity of stakeholders[5] and perspectives.

2. PART A: DOES AN URBAN FOREST MAKE FOR A BETTER NEW YORK CITY?

Between 2007 and 2015, one million trees were planted in NYC through the MillionTreesNYC campaign of PlaNYC, an initiative to build a greener, more sustainable city by 2030 (New York City Department of Parks 2015). Part of this plan also includes NYC setting aside 25% of its land for parks and open space (The City of New York 2014) but concrete and pavement, buildings, and roads, will still dominate the rest of the city. Most roads and building roofs are dark and dry, absorbing most of the sun's rays and warming the surrounding air through the process of conduction[6]. Collectively, the change in microclimate around built structures in a city creates an urban heat island where local temperatures can be 1–3°C higher than adjacent suburban and rural areas (Akbari 2005). However, vegetation in urban areas will cool the surrounding air (through direct shading and the process of evapotranspiration[7]) and can mitigate the urban heat island by changing the microclimate of entire neighborhoods (see Figure 3).

Street trees also can influence the microclimate by reducing wind speeds. For instance, a study comparing a residential area with no trees to a residential area with 77% tree density calculated that trees reduced approach wind speeds in the winter by 43% (Heisler 1990). By blocking cold winter winds, an urban forest can help homeowners and landlords reduce heating costs, though care must be paid to where these trees are planted. Planting trees that block the winter sun but none of the winter wind can actually increase heating costs in the winter (Nowak & Dwyer 2007).

Trees also have a variety of ecological, economic, and social benefits for cities beyond regulating the microclimate. During a rainstorm, a single large tree can temporarily capture up to 100 gallons (379 liters) of water via its leaves and trunk alone (Fazio 2010). This phenomenon is known as the "umbrella effect," and it greatly reduces storm water runoff (Figure 4). In NYC, this is an immense service since the city's combined sewer overflow (CSO) system does not distinguish between rainwater and sewage. In some neighborhoods of NYC, water treatment facilities become overloaded after as little as 1/10 of an inch (2.5 mm) rain per hour (Brown & Shapley 2014). After this point, a mixture of raw sewage and clean rain water bypasses treatment plants and is dumped directly into local waterways reducing water quality, damaging fisheries, and closing

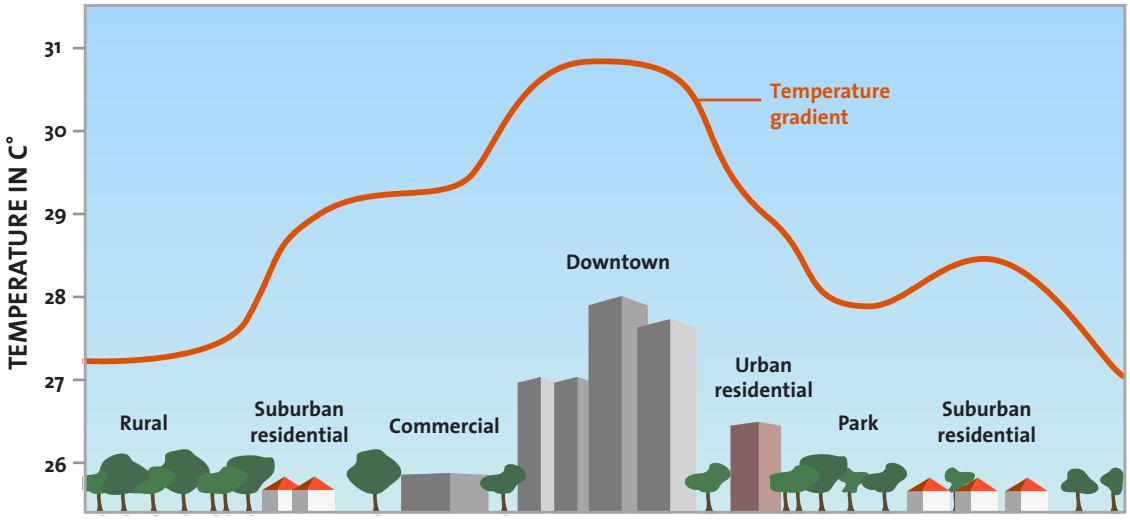

Figure 3. Average temperatures along a gradient of urbanization in landscapes with varying vegetation cover (illustration: U.S. Environmental Protection Agency, Washington, D.C. adapted by Nadav Gazit).

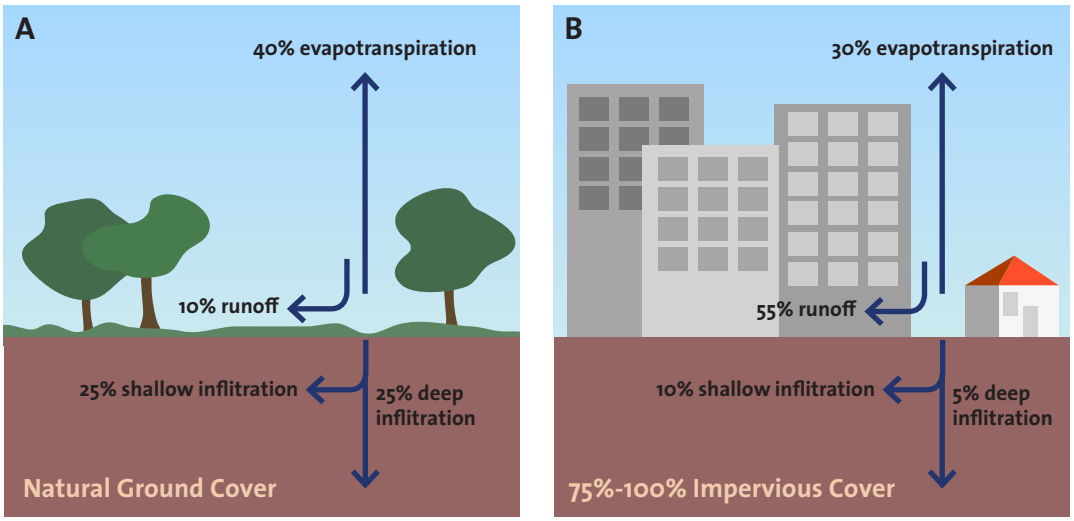

Figure 4. Waste and storm water flow in an area with (A) natural ground cover versus (B) an urban area (75–100% impervious cover) (illustration: U.S. Environmental Protection Agency, Washington, D.C. adapted by Nadav Gazit).

beaches. As of 2006, over 27 billion gallons of untreated sewage entered NYC waters from CSOs annually (Plumb 2007). These CSOs are the largest source of pathogens to the New York Harbor (New York City Mayor's Office of Long-Term Planning and Sustainability 2008). For example, one study linked these CSO events to widespread distribution of antibiotic-resistant bacteria in the Hudson River Estuary (Young et al. 2013). To address this pressing issue, the Mayor's office, through the PlaNYC initiative, implemented a combination of green infrastructure (including street trees) and grey infrastructure (e.g., improved sewer facilities) to capture upwards of 79% of CSO as of 2015 (New York City Mayor's Office 2016).

Trees may also contribute to cleaner, healthier air by intercepting particulate matter via their leaves and bark, and by absorbing gaseous compounds through their leaves' stomata[8] (Pugh et al. 2012). Urban trees have been shown to greatly reduce several compounds associated with lower air quality including ozone (O_3), nitrogen dioxide, and sulfur dioxide (SO_2) (Nowak & Dwyer 2007). The ability of trees to reduce particulate matter has also been hypothesized to help reduce the incidence of asthma in children: a 2008 study compared rates of asthma across different NYC neighborhoods that varied in street tree density and found lower incidences of childhood asthma in neighborhoods with more street trees (Lovasi et al. 2008). However, a follow-up study that used a finer-scale of sampling and looked at the relationships between asthma and overall tree canopy in NYC (from parks, gardens, and street trees) failed to see the same correlation (Lovasi et al. 2013); on the contrary, there was some evidence that increased canopy cover was positively associated with allergic sensitization to tree pollen. There are many factors that contribute to respiratory illnesses and how—and if—street trees have an impact is still uncertain.

In many urban neighborhoods where there are few parks and private gardens, street trees may be the dominant vegetation. Here, trees increase biodiversity both directly and indirectly by providing habitat to a variety of birds and insects (Alvey 2006). Where street tree corridors connect parks, trees may actually serve as ecological corridors[9], providing connectivity between green spaces (Fernandez-Juricic 2001).

Street trees can increase property values: one study in Portland, Oregon, recorded an increase of $8,870 to sales prices and a 1.7 days reduction of time on the market for homes adjacent to street trees (Donovan & Butry 2010). In addition to the economic value, street trees can provide social benefits. For example, urban trees and greenspaces are documented to reduce stress (Tyrväinen et al. 2005) and promote mental well being and social integration (Seamans 2013). Street trees are also believed to play an unexpected role in fostering community empowerment: studies suggest that areas of well-maintained vegetation encourage greater use of outdoor area, monitoring of outdoor areas, foster social interactions, and increased supervision of children (Coley et al. 1997). While in the past, urban vegetated areas have been associated with crime (the vegetation

was believed to conceal criminal activity; Nasar & Fisher 1993), new research has provided evidence that well maintained street vegetation might actually *reduce* crime by signaling to criminals that someone cares and is watching over the neighborhood (Donovan & Prestemon 2012). For example, in Baltimore County, Maryland, a higher percent of overall urban tree canopy cover correlated with lower crime rates (Troy et al. 2012). The relationship between vegetation, crime, and perceived crime risk is not simple and may hinge on vegetation type. The same Baltimore study also identified neighborhoods where the trend was reversed: more vegetation, more crime. Vegetation in these neighborhoods (a mixture of industrial and residential housing and abandoned lots) was characterized by weedy, overgrown, and unattended growth (Troy et al. 2012).

City planners, managers, and citizens need to carefully consider what type of vegetation to plant in an urban area. For example, many species of trees are selected for planting in street tree pits for their ability to survive the challenging sidewalk environment—not because they are native to that area. One example is the Norway maple (*Acer platanoides*), which was widely planted as an urban street tree in the northeastern United States several decades ago. Norway maples have since "escaped" their planned urban environment and can be found in many urban, suburban, and rural forests (Harrington et al. 2003). Owing to its ability to outcompete native red and sugar maples, the Norway maple is now considered to be an invasive species[10] and the subject of intense management (Nowak & Rowntree 1990). Exotic plants that are known to be invasive or potentially may be invasive can no longer be used as street trees in NYC (The City of New York 2014).

Although street trees may benefit a community as a whole, a single street tree most directly impacts the person or people who live adjacent to it. There are naturally many considerations that accompany the tree planting process: for example, care must be taken to make sure a tree has room to grow and is properly pruned. Trees that are too large can buckle sidewalks, potentially leading to injuries and repair costs. If a tree pit is too small, roots may seek out water well beyond its crown and in the process weaken the foundation of buildings or damage pipes and other underground services; tall growing trees may damage overhead services, such as telephone wires (Wang et al. 2014). A sick tree or one that is improperly pruned can lead to falling tree limbs and potentially harm to persons or property (Rae et al. 2011). Furthermore, the installation of tree pits and trees within a narrow sidewalk can reduce surface area for pedestrians to walk comfortably and safely away from the roadway, or complicate municipal services (e.g., garbage pick up). Many of the overall benefits of urban trees are only achieved when there is a sufficient density of tree canopy and the trees are actively maintained and replaced; the maintenance costs of these trees may outweigh the benefits (Wang et al. 2014).

So, if a tree is planted on a public sidewalk in front of your home, to whom does the street tree belong? Who is responsible for the cost of maintenance of the tree? Who actually benefits and who might be negatively impacted? In NYC, the Parks Department is responsible for all trees growing along streets and in parks (Nowak et al. 2007). While the City owns the space between the street and the building owner's property line, building owners are responsible by law for maintaining the sidewalks adjacent to their buildings, including repairing sidewalk defects caused by trees that may impact public safety (Rae et al. 2011). If building owners neglect their responsibilities, they may be fined by the Department of Transportation (New York City Department of Transportation 2008).

Rae et al. (2011) studied public perceptions and responses to the MillionTreesNYC project. Here the authors summarize some of the main issues with the program:

> *Objections to placement location was the biggest complaint about new street tree planting, followed by policy objections where people did not want a tree or had not been notified in advance before their sidewalk was cut or the tree was planted.... In other cases, residents take issue with the type of tree species chosen by the forester, often asking for a different variety to be selected.... These residents are accepting of the possibility of tree planting at this site, but would like more control over the planting since they expect the tree to become a part of their daily lives.... Even though the sidewalk is legally a public right of way with government*

jurisdiction, residents can have a psychological sense of ownership over this place that can have personal meaning (Rae et al. 2011).

In general, stakeholder engagement in conservation or environmental decisions plays an important role in the success—or failure—of a project (Sterling et al. 2017; see NCEP module, Stakeholder Analysis in Environmental and Conservation Planning, available at ncep.amnh.org). Rae et al. (2011) suggest that "...involvement in the planting process could help to transfer a citizen's sense of ownership over the sidewalk through giving them more investment in new street trees," while simultaneously acknowledging that the scale and complexity of the MillionTreesNYC project makes large-scale citizen involvement difficult. Despite these difficulties, the MillionTreesNYC program continues to actively promote community involvement and ensuring the future success of planted trees through their MillionTreesNYC Stewardship Corps and Stewardship Mini-Grants (http://www.milliontreesnyc.org/html/programs/stewardship_corps.shtm ; http://www.milliontreesnyc.org/html/care/grants.shtml).

2.1. Discussion Questions

Through the following discussion questions, students will synthesize and categorize the benefits and drawbacks of an urban tree planting initiative (such as the MillionTreesNYC project) through a general overview lens as well as through the perspectives of hypothetical individual urban residents (stakeholders).

1. What are some benefits and drawbacks of planting urban street trees?

   Fill in Table 1: Identify *eight or more ways* street trees can impact a city. Use the above case study (and Introduction section) as reference

Table 1. Template table for listing and categorizing benefits and drawbacks of planting urban street trees.

	TYPE OF IMPACT		
Impact	**Social**	**Ecological**	**Economic**
Reduce air pollutants	*Health benefits (+)*	*Wildlife/ plant health benefits (+)*	*Reduction in health costs (+)*

for filling in the table, but feel free to think critically about the complex social, ecological, and economic systems in urban areas you know and incorporate your own ideas into the table.

a. Identify whether the type of impact is social, ecological, and/or economic by writing the consequences under the appropriate column heading (note: impacts may fall under more than one category). For example, trees can reduce air pollution—this is a social benefit because it can improve human health; indirectly it may also be considered an economic benefit as the reduction of pollution could reduce public health costs.
b. Indicate if the impact is generally a positive or negative impact for the community, or if it a mixture of both, by placing a "+" or a "-" or a "+/-" within the type of impact column(s). For example, trees reducing air pollution would a positive (+) impact.
c. Once the table is filled in, reflect on the balance of positive and negative impacts as well as the balance of social, ecological, and economic impacts of street trees. Based on the balance of the table, do you think the MillionTreesNYC project was a worthwhile project? What do you think could influence the success of this urban conservation project?

2. Suppose that the city government of Beijing would like to start a MillionTreesBeijing project. Based on the case study and your analysis from Question 1, identify three possible urban stakeholders and speculate why these stakeholders might benefit from or possibly object to an urban tree project. What suggestions might you make to the city government on how to foster support for this project?

Figure 5. Examples of North American native bees. Megachile centuncularis *(top left).* Agapostemon virescens *(top right).* Lasioglossum zephyrum *(bottom left).* Bombus impatiens *(bottom right). Photo credits: top left: Flickr user JRexpo [CC BY-SA 2.0]. Top right: Flickr user Jeff Trei [CC BY-SA 2.0]. Bottom left: Flickr user Lostinfog [CC BY-SA 2.0]). Bottom right: Flickr user E ore Balocchi [CC BY-SA 2.0].*

3. PART B: URBAN BEE CONSERVATION

3.1. Introduction

When you think of bees, you probably immediately think of honey bees (*Apis mellifera*)—but honey bees are only one species of over 20,000! There are more than 4,000 species of native bees in the United States, with over 400 in New York and at least 50 in New York City (Matteson et al. 2008; Moissett & Buchmann 2011). In the U.S., native bees come in many forms and vary in color from all black to metallic blue to stripes of red, orange, yellow, or white. Some common names of U.S. native bees are bumblebees, carpenter bees, mason bees, plaster bees, leafcutter bees, and digger bees (Figure 5).

Honey bees have only been residents in the U.S. since the early 1600s and are native to Europe. Even though honey bees are only a small part of bee biodiversity, they are well known and extremely important to human well-being because they are responsible for pollinating more than 90 crops worldwide. This ecological service is estimated to be worth over $15 billion USD (Calderone 2012; Morse & Calderone 2000). Additionally, honey bees—social insects that live in high densities—produce honey that can be harvested and sold. U.S. honey sales in 2015 were valued at over $327 million USD (NASS 2016).

Native bees in the U.S. are not amenable to keeping in beehives, nor do they make honey; yet, they are still extremely ecologically and economically important. Native bees pollinate and are responsible for the reproduction of 70% of the world's flowering plants, including two-thirds of crop species, and these ecosystem services are estimated to be worth just over $3 billion USD (annual value 2001–2003; Losey & Vaughan 2006). Native bees pollinate the majority of plants in urban gardens (Matteson et al. 2008) and are 2–3 times more productive at pollinating New York State apple orchards than honey bees (Park et al. 2012).

Both honey bees and native bees are threatened due to human activities. Honey bees are primarily threatened by Colony Collapse Disorder (CCD), which is currently thought to be caused by a combination of disease, parasites, and pesticides (Lu et al. 2014). CCD has resulted in (a) widespread acknowledgement that honey bees are responsible for pollinating a large proportion of our food crops and (b) fear that CCD will result in a reduced food supply (Wines 2013). Although CCD does not impact native bees in the U.S., the onset of CCD has also resulted in the recognition of native bees as important pollinators and increasing the awareness of the need for native bee conservation alongside honey bee conservation (Mims 2009).

The largest threat to native bees is loss of habitat, particularly in urban areas. Native bees need floral resources as well as nesting and overwintering sites (e.g., wood piles, rock piles, logs) to survive in urban areas and these resources have been declining with loss of greenspaces and homogenization of urban biodiversity, especially of plants (Jha & Kremen 2013). To support declining populations of urban bees, residents can

Figure 6. Example bee house. A bee can be seen entering the house in its lower-left portion (photo credit: Tom Brandt [CC BY-SA 2.0]).

create native bee habitat in their yards or community parks and gardens by planting a diversity of flowering plants as well as providing logs or even bee "houses" (Figure 6) for breeding and overwintering habitats. There are manuals available to assist in the construction of effective native bee habitat (e.g., http://www.xerces.org/fact-sheets/). With increased habitat, native bees have a chance to survive and even thrive in urban areas, further increasing insect and plant diversity, and providing important pollination services.

3.2. Town Hall Exercise: Native Bee Conservation

Now it's your turn to make an important conservation decision. You will take part in a town hall discussion and vote on a proposed conservation project for your community. As a community member, you must bring your personal and professional goals to the table while also weighing the social, economic, and ecological factors involved.

3.2.1. The Situation

New York City has been awarded a national stewardship grant to fund a local habitat conservation project for native bees in parks across NYC. As a member of the community, you have your own opinion on this project and will help vote on whether or not the project gets approved for your local neighborhood park. A town hall meeting is being held and you must bring your thoughts to the table to share with others; then you will all come together to make final decision.

3.2.2. Preparation for the Town Hall Meeting (~*45 minutes, or as homework assignment*)

You will be assigned a stakeholder role and a short statement of thoughts and questions concerning the project in the voice of the stakeholder (Table 2). As assigned by your instructor (either during class or as a homework assignment), you will read your role description and research additional evidence to form your argument/voice for your stakeholder. When you perform your research, think about the types of evidence your stakeholder would use and how your stakeholder would find sources of evidence. For example, a bee scientist (entomologist) might use primary scientific literature, a concerned parent might use a news source, and a manager might use a report from a governmental agency, such as the U.S. Department of Agriculture. Note: you may be asked to turn in your research sources or a list of references.

After performing your research:

1. Individually, consider the position of your stakeholder role (Table 2): what factors are most influential in your argument around bee habitat creation? After performing additional research:
    a. Fill in your role at the top of Table 3.
    b. Rank each factor with a *unique* number (i.e., no repeated numbers) from 1–8, with 8 being the *most important* factor (to your role) when deciding whether to receive the grant and create native bee habitat. Put each number in the category (social, ecological, or economic) you think *best* represents each factor.
    c. Next, indicate if the factor is a Pro (favors bee habitat) by keeping it a *positive value* (e.g., factor ranked as 2 becomes +2), or a Con (against bee habitat) by making it a *negative value* (e.g., factor ranked as 5 becomes -5).
2. Considering the factors provided in Table 3, describe the three most important arguments in favor of your position on bee habitat creation and provide evidence from your research that supports their importance. Were there any factors that were not listed in Table 3 that you encountered during your research? If yes, list them and explain how they might or might not be important to your stakeholder.

3.2.3. Town Hall Meeting (~*55 minutes*)

During class, each group of students assigned to the same stakeholder role will first have 10–15 minutes to discuss amongst themselves their independent research on their role and come up with the main points they would like to share at the town hall meeting. Then, during the meeting (~45 minutes), the instructor will serve as the moderator/mayor, or the instructor will assign students in the local government representative stakeholder group to serve this role. The moderator

Table 2. Town Hall Stakeholder Roles.

STAKEHOLDER	STANDPOINT	SAMPLE THOUGHTS AND QUESTIONS
Bee scientist/ conservation biologist	Considers native species conservation a priority	*This project will provide important habitat and food sources for native bee species and many other insects. I believe that we need to focus on creating more green spaces for urban animals as increased species diversity is important both for conservation purposes, as well as for the lives of city residents. Native bee pollination services are economically important and can help bolster the productivity of the natural systems that we rely on for our health and well being.*
Beekeeper	Concerned about honey bee colony collapse	*I've been keeping bees in this neighborhood for almost 10 years now. I know the dangers of raising bees in urban areas without habitat for them to forage and stay healthy. I think this project will benefit native bees and the honey bees I am raising, and overall will keep our park spaces healthy and resilient for the future. I understand people have fears regarding bees, but if we provide educational resources and workshops for the community that teach about bee safety ... I think we can solve some of these health concerns and avoid major incidents.*
Parks manager	Concerned with the control and management of other of species, and the maintenance of the park	*As the park manager, I will have to balance my actions making our park safe for residents with keeping it a healthy space for nature. Normally I spray pesticides to control for harmful species like hornets and mosquitos, but if the new habitat is built ... I would have to cut back on spraying so as to not kill any of the native bees we are hoping to promote. Maintaining this new habitat and new flowers will also require more of my time. Does the city have the finances to pay for this or will they be able to hire any additional park staff?*
Concerned parent	Has a child with bee allergy	*I'm worried about the health impacts of creating this habitat for native insects. If the project will increase the number of native bees in to the park, won't this also promote the number of other bees and wasps? Isn't it our children and senior citizens who are most susceptible to stings? My 6-year-old daughter is extremely allergic to bee stings and she loves this park. Am I supposed to tell her she can't play here anymore? I want to know how you can protect all children if this grant goes through.*
Neighborhood resident	Worried about decreased safety and cleanliness of neighborhood	*We spent years cleaning up this neighborhood and we now have a safe park that kids can play in and families can enjoy. It would be nice to have more flowers, but I'm not sure why we would want to promote a potentially harmful species and plant bushes that crowd up the park and give us less space to enjoy. Don't these areas collect trash and provide space for drug use and other activities that are harmful to our neighborhood?*
Local government representative for that neighborhood	Wants to mediate and take into account all opinions (may be assigned to moderate discussion or make final decision based on stakeholder input)	*As an elected representative for this neighborhood, it's my duty to take into account the opinions and needs of all residents. I value both the social and environmental health of our neighborhood, and am ready to weigh all factors involved in this decision. My main concern is making sure everyone gets a chance to speak and that this town hall meeting runs smoothly and democratically.*

*Table 3. Importance of factors concerning native bee habitat creation for my stakeholder role:*_____

FACTOR	SOCIAL	ECOLOGICAL	ECONOMIC
Bees provide pollination			
Bees will require flowers for food			
Bees will require shrubs for overwintering			
Bees will require logs and rock piles to nest			
Bees will require reduced pesticide application			
Some bees can sting if threatened			
May help some native bees that are threatened with extinction			
Honey bees may also benefit from new food sources			

must introduce each group and keep time, making sure all groups have equal time to present and answer questions. Stakeholder groups will each present for five minutes on their concerns and reasons for why or why not they want to accept creating bee habitat in their town, based on their research. Time allowing, the moderator will allow the other stakeholders to ask each group questions for up to five minutes.

For other examples of running town hall meeting scenarios in the classroom, please see NCEP's module, Practicing Stakeholder Analysis Using Current Environmental Issues (ncep.amnh.org).

3.2.4. Post Town Hall Meeting Analysis (~*30 minutes*)

1. Once all stakeholder groups have presented, take 5 minutes to individually re-evaluate your earlier rankings from Table 3 and fill in Table 4: follow the same instructions for Table 3, but take into consideration the discussion during the town hall meeting.
    a. What did you change and why? Write down a brief summary.
2. From Table 4, add up your individual rankings for each category (social, ecological, economic), taking into account the negative sign (i.e., 5 + -3 = 2; -10 + 1 = -9) and record below (note: if column is blank, individual total equals zero for that category).
3. Then reconvene with your stakeholder group and average these individual totals within your stakeholder group (see Table 4).
4. Report the stakeholder group averages from each of the categories (social, ecological, and economic) to the instructor or town hall leaders who will then add up each groups' averages in each category. Record the results (see Table 4).
5. For approximately 10 minutes, discuss and decide amongst yourselves if the community should receive the grant money for the creation of native bee habitat in your local park. Discuss which category (social, ecological, or economic) is most important: a strong positive value means you should take the grant, a strong negative value means you should not take the grant; a weak positive or negative value (i.e., close to zero) means you should discuss it further. Your instructor or the local government representative stakeholder group might act as a moderator for this discussion.

3.2.5. Reflection Assignment (*Homework*)

Following the guidelines of your instructor, respond to the below questions in your own voice:

1. What was the outcome of the town hall meeting? Did the community accept the grant?
2. How were social, ecological, and/or economic issues considered? Did one outweigh the rest?
3. Do you feel each concerned group received equal consideration? Does it matter? Why?
4. Describe two pros and two cons to making decisions considering many stakeholder views.
5. Discuss if you think this example town hall meeting

Table 4. Re-evaluation of importance of factors concerning native bee habitat creation for my stakeholder role:_____

STEP	FACTOR	SOCIAL	ECOLOGICAL	ECONOMIC
1	Bees provide pollination			
	Bees will require flowers for food			
	Bees will require shrubs for overwintering			
	Bees will require logs and rock piles to nest			
	Bees will require reduced pesticide application			
	Some bees can sting if threatened			
	May help some native bees that are threatened with extinction			
	Honey bees may also benefit from new food sources			
2	**Individual Total**			
3	**Your Stakeholder Group Average**			
4	**Class Total**			

matches the process of deciding on a conservation issue for a community.

a. What about the process do you think would be different in the real world?
b. Was this set of six stakeholder groups a realistic representation of a community? Can you think of anyone who might be missing? List them.
c. If factors from your research—other than those in the ranking process—were included in the decision making process, do you think there might have been a different outcome? How so?

6. If you actually lived in this community, would you personally want to accept the grant? Why or why not? What additional information would assist you in making a more informed decision on whether or not to support bee habitat creation?

4. GLOSSARY

1. **Green infrastructure**: a range of design approaches that can increase wildlife habitat, provide flood protection, and improve air and water quality. In an urban setting, green infrastructure often is designed to improve stormwater management. Unlike most urban infrastructure, green infrastructure allows water to infiltrate into the soil, replenish groundwater, and reduce runoff, which in turn reduces the introduction of contaminants and pollution into waterways and processing facilities.
2. **Green roof**: building roofs that are covered in varying amounts of vegetation. Green roofs can be either "intensive"—thick, covered with a variety of vegetation, and requires more maintenance—or "extensive"—shallow infrastructure and soil, which require less maintenance. Green roofs can provide several benefits: reducing stormwater runoff, providing insulation for buildings (reducing energy costs), providing habitat for species, providing open spaces for people, and more.
3. **Green street**: landscaped right-of-ways that include green techniques, such as swales, that can help reduce stormwater runoff. By mimicking the natural water cycle, they allow water to seep into the soil, replenishing groundwater and filtering pollutants. They also provide other benefits, such as green spaces for people.
4. **Native bees**: bees that are indigenous or naturalized to an area.
5. **Stakeholder**: any individual, group, or organization that has a vested interest, or perceives itself to be affected by a project or endeavor and the potential changes it includes.
6. **Conduction**: the transfer of energy between stationary objects, through which heat or electricity is directly transmitted due to a difference in the objects' temperature or electrical potential.
7. **Evapotranspiration**: the sum of water transferred to the atmosphere through evaporation from soil and other surfaces and transpiration from plants.
8. **Stomata** (plural of stoma): openings in a plant's epidermis, usually found on plants' leaves and allow for gas exchange.
9. **Ecological corridor**: an area that connects existing, larger wildlife habitats, parks, ecosystems, etc. to maintain their connectivity and flow of species among them.
10. **Invasive species**: any kind of living organism that is non-native to the region in which it is introduced and via spread of individuals causes damage to the ecosystem, economy, or public health.

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