

**1. Title:** Moving to higher ground: Ecosystems, Economics and Equity in the floodplain

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### **3. Abstract**

Healthy river systems serve a wide variety of functions, from recreation to habitat provision and crop production. Because there may be tradeoffs between some functions, effective floodplain management requires integrating cultural, economic and ecosystem components. The Mississippi River basin and the management of its floodplains illustrate many of these challenges. Flooding of the Mississippi has become increasingly frequent in the last half century. Decades of alterations to the river structure to facilitate commercial navigation and agricultural production have resulted in a floodplain largely severed from the main stem of the river and subsequently, the decreased provision of multiple ecosystem services. Applying a jigsaw case study approach, activities incorporate role-play techniques to explore various human and ecological interests in this complex socio-environmental system (SES). The substance of the case study activity is based on a real community.

The case setting takes place in Olive Branch, Illinois, a community of less than one thousand residents, devastated by the flood event of 2011. Students are asked to complete background reading on the ecological function of floodplains and historical management practices before their first exposure to the case. Students are assigned one of four stakeholder roles: hunter, local resident, farmer, or conservationist. After meeting within homogenous stakeholder groups to develop their positions, they meet in jigsaw groups with multiple interests represented. As a “community group” of diverse, vested citizens, students compose a letter to a State Senator from Chicago that acknowledges trade-offs among three alternatives in Olive Branch: relocate the town and restore floodplain habitats in its place (the costliest option), relocate the town and promote agriculture expansion (less costly than habitat restoration), or, do nothing and continue business as usual. The assignment requires students to synthesize information and argue analytically by simulating the real-world obstacles of stakeholder conflict and compromise in socio-environmental decision-making.

### **4. What course(s) is this case appropriate for?**

This case study was designed by a multidisciplinary team representing four fields of study (including the social and natural sciences). Therefore the goal was to create a transdisciplinary activity that could be used across a variety of courses and a diversity of students. That being said,

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this case study is most appropriate for courses that examine the role of the natural and constructed environment in producing socio-environmental problems and potential solutions. Course examples include “Issues in Environmental Science”, “Environment and Society,” “Hazards and Society,” “Social Problems,” and “Social Perspectives in Environmental Issues”.

## **5. What level is this case appropriate for?**

This case study targets students enrolled in higher education in a myriad of institutions. The students will be expected to creatively and collaboratively examine a single case, write a formal letter to a political leader and orally participate in a debrief. Therefore the instructor will need to reflect on the student strengths and weaknesses in their classroom, including oral and written communication, critical thinking, and reading comprehension skills. With the above information in mind, the case study team designed the activity to be flexible for classrooms throughout introductory and senior-level courses.

## **6. SES Learning Goals- which SES goals are addressed in this case?**

Learning Goals for Socio-Environmental Synthesis:

### ***1. Ability to describe a socio-environmental system, including the environmental and social components and their interactions.***

Students are given background information on floodplain management and the ecosystem services provided by river systems and their floodplains. Students are exposed to the multitude of ecosystem services provided by floodplains and the interdependencies of human communities and these important ecosystems. After they complete background reading and the in-class components to the exercise, their assignment asks them to describe the socio-environmental system present in the floodplain by explaining the sociological, economic and environmental aspects of the issue.

### ***2. Ability to co-develop research questions and conceptual models in inter- or trans-disciplinary teams.***

Ability to identify disciplines and approaches relevant to the problem.

An optional part of the exercise can include asking students to identify relevant stakeholders to the Socio-Environmental (SE) system besides those included in the role-playing part of the case. Once they are together in jigsaw groups, various management approaches and perspectives should become apparent. The written assignment requires acknowledgement and discussion of trade-offs among vested interests relevant to the problem.

Ability to identify potential users of and applications for research findings.

As information users in their assigned stakeholder roles, students are asked to identify research and information needs to monitor results of SE decision-making.

### ***3. Ability to find, analyze, and synthesize existing data.***

Ability to integrate different types of data (interdisciplinary integration).

As part of the SES assignment, students are asked to write a letter to a non-local politician as an interdisciplinary community group in which they note the kinds of data and information that they and the state legislature need to make a better informed decision and monitor the success of

management plans regarding moving the town of Olive Branch, Illinois to higher ground. The types of data the students, as their stakeholder roles, will request will likely include: ecological data on river functioning and floodplain reconnection; economic data on job creation, property values, and taxes; and hydrological flood frequency analysis. Through their group collaboration on the written assignment, students will be required to describe and substantiate why their stakeholder groups and community constituents would need the information and how they would integrate it to come to more informed management decisions.

***4. Ability to consider the importance of scale and context in addressing socio-environmental problems.***

Understand that ecological and social processes often vary across differing contexts, including space, time, and conditions (e.g. economic or political).

The case study we present is an actual example of a town located in the Mississippi River floodplain that has been inundated repeatedly by floodwaters. In 2011, a severe flood event devastated the town and the case study assignment requires collaboration among students playing various stakeholder roles to advocate rebuilding the town, moving the town and promoting agriculture, or moving the town and restoring the floodplain. Impacts of management choices in the case study's SE system vary across scales of governance and result in varying impacts on these and other stakeholders. One of the purposes of the assignment is for students to understand how the interests of stakeholders such as farmers, hunters, local property owners, and conservationists coincide and conflict. Successful synthesis of perspectives in consensus-building groups requires understanding of variation across these contexts in ecological and social processes.

## **7. Learning Objectives**

We want students to:

1. be able to describe in writing how this system has environmental, sociological and economic components and their interdependence;
  - a. Objective 1 is a required activity in the written assignment. Students are asked to describe the SE issue to a state senator unfamiliar with the system, the geography, and the local population.
2. understand that the choices that the community makes involve trade-offs, and how the situation that the community is in may itself be a manifestation of social inequality;
  - a. Stakeholder information sheets outline various interests in the relocation of Olive Branch, Illinois. Students are assigned stakeholder roles and required to integrate often competing motivations for action that acknowledge winners and losers in different alternative scenarios.
3. understand what ecosystem services are provided by floodplains and how different management choices affect the provision of ecosystem services;
  - a. Class discussion and background information provided to students describe the associated ecosystem services provided by a healthy river system with connected floodplains. In consensus-building discussion groups, students in assigned

stakeholder roles are required to justify supporting or opposing floodplain restoration and the how the management of the floodplain promotes or hinders the provision of ecosystem services.

4. recognize that different stakeholders may value those services differently, and how different worldviews shape those values;
  - a. Students, in their assigned roles representing the interests of various stakeholders in the SE system, advocate for different management choices in consensus-building groups. Stakeholder interests may include crop production, cultural attachment to the town, and ecological enhancement for recreation or to improve biodiversity - each having different associated services. These often competing perspectives of the community roles the students take on in the jigsaw exercise illustrate how stakeholders value ecosystem services differently.
5. to understand that there are different kinds of methods to research an issue and gather information and different competencies in different disciplines, and the all have a role to play in solving the problem;
  - a. The substance of the floodplain case study is the consensus-building activity, which requires students to integrate the various perspectives of different stakeholders and disciplines represented in the SE system. From the standpoint of individuals in these roles, students have to determine research and information needs and work to synthesize multiple, competing interests to form group recommendations on natural resource management, local land use choices, and advocate how to best use state-level funding.
6. be capable of integrating quantitative and qualitative data;
  - a. The types and sources of data to monitor the success of consensus-building groups' recommendations vary due to the diverse interests and disciplines of stakeholders. An understanding of the synthesis of some of these quantitative and qualitative data sources is necessary to complete the groups' collaborative statement on data needs.

## **8. Introduction/Background**

Our case study focuses on the real case of the unincorporated town of Olive Branch, a little community on the East side of the Mississippi River in Southern Illinois. Parts of the town were flooded in 1993 and again in 2011, and the community is considering moving upland, out of the floodplain, and has received funding to do so. But these funds can only be used if at least two-thirds of the local residents agree to the move. If the community agrees to move, the area could then be restored to floodplain habitats (wetlands and forests), although a quality restoration project would require additional funds from taxpayer revenue. The town is also considering extensive habitat restoration to Horseshoe Lake, historically a destination for waterfowl hunters, which was surrounded by cabins, bars and restaurants that once supported a strong local economy. Horseshoe Lake used to be the "Goose Hunting Capital of the World." However, habitat loss due to floodplain development and management, and climate change has decreased the waterfowl population. An alternative to floodplain restoration would be to allow agricultural expansion throughout the lowland area where the town used to be.

The case study aims to teach students how human actions – urban development and agricultural production - affect natural systems (especially flood frequency and habitat provision), and how

this in turn has multiple feedback effects. Specifically, urban development and agricultural activities (and climate change) on a portion of the floodplain may have impacts on flood frequency and severity in other portions of the floodplain, and affect habitat availability and quality. In our case, floodplain development has impacted flood severity, biodiversity (including waterfowl populations), hunting, and other types of recreation. Because of the increased flooding and reduced habitat, the community of Olive Branch is considering relocating out of the floodplain and at the same time engaging in restoration activities that would improve waterfowl habitat and thus improve the local economy. Such a decision, however, would involve trade-offs for farmers, and is opposed by some residents who do not want to leave their homes and relocate.

This case study was developed with three specific courses in mind: an introductory environmental science course (ranging from 18 to 50 students), an upper division sociology of disasters course (capped at 50), and a sophomore/junior interdisciplinary core course on social perspectives in environmental issues (average size 50). Based our experience, we suggest a class size of 40 students as the maximum for a smooth running of the case. Each instructor can supplement additional background information with initial readings to be assigned for the first class of the module, but this is not necessary. Because this case study illustrates the coupling of human and environmental systems and their interconnectedness, it can be used at the outset of an upper level class with students who already understand how humans manipulate and manage environmental systems. Or, it could be used later in the semester in an introductory class to illustrate specific concepts introduced earlier in the class. For example, in an “Intro to Environmental Studies” class the case can be used to discuss habitat restoration and challenges in implementing conservation, while in a “Sociology of Disasters” class the different stakeholders can be used to exemplify different levels of vulnerability.

## **9. Classroom Management**

This case is designed to be completed within three 50 minute class periods, but could be modified to fit two 75 minute periods or compressed to a single class period if the letter is written outside of class (although we would strongly encourage debriefing the case for at least 10-20 minutes in the following class). The week before the case, students should read through the introduction, description of the issue, and overview of the assignment (the stakeholder position statements will be handed out in class at the beginning of the case). All of these items are contained in the “student handout” file. Instructors may also assign further background reading (see annotated References) or even require the students to do some independent background research, but this is not necessary. Part I, Part II and III combined, and Part IV should each take approximately 50 minutes.

### Part I

At the beginning of class, the instructor may wish to briefly (5-10 minutes) “set the stage” for the students; that is, describe the scenario, lay out the issue to be discussed, and explain the students’ task for the day (stakeholder group discussion and consensus-building team work). The students should already be familiar with the case if they completed the assigned reading(s), but the instructor should make sure the readings were clear and ask if the students have questions.

To divide the students into groups, pre-written index cards may be helpful. One side of the card has the stakeholder role the student is playing and the other the “consensus building team” to which the student is assigned. If the class has a number of students that is not a multiple of four, the instructor can write extra cards so that some of the communities/consensus building teams have five members. The instructor then distributes the stakeholder position statements – each student gets assigned one character to represent. After allowing a few minutes for the students to read their statements, have the students meet in their stakeholder groups and discuss the three questions in Part I of the student handout. For very large classes, the stakeholder groups may need to be divided into smaller subgroups to encourage student participation in group discussions.

At the end of the class session (if structuring the case across three 50 minute sessions), remind students to bring laptops to the next class for writing the letter (unless of course the instructor prefers that the student groups draft the letter by hand or enforces a no-laptop policy).

## Part II

The instructor should assign one student from each stakeholder group to a “consensus building team” that will discuss the issue, come to an agreement, and write the letter. These consensus-building teams should be limited to only 4 students if possible, even in a large class.

## Part III

The instructor may wish to circulate the classroom in Part III to ensure that group dynamics are balanced. In a group of four students sometimes one strong leader may take over the task and often the other students will simply yield to the strong leader. Some groups may need to be reminded that all stakeholders must be carefully considered. Additionally, students may be anxious about collaboratively writing a letter when their roles are conflicting. If this occurs, the instructor could remind the students that:

1. Disagreements are frequent in the “real world” and students must begin to develop the skills necessary for collaboration and democratic decision-making;
2. Make sure everyone has time to speak and make contributions to the letters;
3. The group needs to come to some level of agreement in the letter.

## Part IV

Reading the letters out loud to the whole class if time permits.

## Part V

This jigsaw case study requires a debriefing period. Facilitated by the instructor, a debrief offers an opportunity for students to collectively analyze and reflect upon the activity. Possible guiding questions after the case study may include: summarize the SES themes present in the activity, identify the course concepts explored within the floodplain management case study, and discuss how assigned roles differ from personal worldviews. As one example of the importance of

debriefing, many students will find it useful to share beliefs, challenge assumptions and draw conclusions separate from their stakeholders. Lastly, debriefing permits the instructor to receive student feedback to the benefit of future case study application. During our pilot running of the case, we received several comments from students suggesting that more interests be represented (e.g., what about people from Olive Branch who DID want to move?), and giving the local residents more input because they have more at stake (so their vote counts would double, for example). While these are valid points, we kept this more simplified format of the case (in terms of choosing from only three options and have only four stakeholder groups) because it generates a good amount of discussion and remains manageable.

***PLEASE NOTE – Though this case study is inspired by the real situation of Olive Branch, the alternative plans here were created specifically as a classroom exercise and are not identical or in some cases even similar to the real Olive Branch plans.***

## **10. Blocks of Analysis**

### **1. The ecological functions of floodplains and their importance**

Floodplains perform numerous ecological functions that contribute to valuable ecosystem services. Aside from attenuating floods, floodplain wetlands and forests filter excess nutrients and other contaminants, which enhances water quality. For example, an analysis of North American streams demonstrated that floodplain forest buffers reduce inputs of contaminants to headwater streams, as well as facilitate in-stream processing of pollutants, which reduces their downstream export to rivers and estuaries (Sweeney et al. 2004). Floodplains are also important for sediment transport and may recharge groundwater in some regions. Additionally, floodplains provide a variety of habitats that maintain high biodiversity, which in turn is important for ecosystem functioning (Elosegi and Sabater 2013). All of these ecosystem services are compromised by dams, levees, stream channelization, urbanization, agriculture, and other types of development within the floodplain zone. For example, urban development may increase the risk that peak discharge will be exceeded in any year by up to 300% in a 10-year floodplain and up to 600% in a 2-year floodplain (Konrad 2013).

### **2. History of US floodplain policy basics**

In the United States, historically, the Mississippi River and its tributaries have been heavily managed to allow navigation. This was one of the historical functions of the Army Corps of Engineers since the 1900s, and it is the reason that the upper portion of the Mississippi is divided by 27 locks and dams. The lower portion of the river does not need to be locked due to the flow of water from the Missouri and the Ohio Rivers, which more than double the size of the river. However, because flow increases significantly and there is more development on the floodplain past St. Louis, the river also floods more dramatically. The great flood of 1927, which affected the lower portion of the river, was the driver behind the 1936 Flood Act. The act mandated a more integrated levee system

to be administered by Federal authorities, instead of the private levees (paid for by individuals living in the levee districts). Therefore, in the US, the management of the Mississippi floodplain has focused on flood management with structural measures, such as levees, and on maintaining navigability. As a result, the river's floodplain has been severely reduced from pre-Colombian times, and habitat has correspondingly been reduced. Moreover, the channelizing of the river and the reduction of the floodplain has allowed human activities to expand on the floodplain, both in the form of settlements and agricultural activities (Sparks 1995; Galloway, 2004). This in turn caused pressures to increase protection for burgeoning communities. More frequent extreme events, in part attributable to climate change, compound the problem.

### 3. Environmental justice and economic considerations

The management of floodplain protection has important environmental justice and socioeconomic components. Many of the communities at risk of flooding are poor or minority, have less resources to face a flood and less political clout to ensure proper maintenance or improvement of the levees. Levee maintenance is very expensive, and in the lower Mississippi it is largely paid for by the Federal government. Moreover, less than 50% of people living on floodplains have flood insurance (Rand Institute for Civil Justice, 2006), which often means that the public sector has to step in when a disaster occurs or the victims are left destitute and communities are unable to rebuild.

### 4. Alternative floodplain management strategies

In the last 30 years, there has been increasing interest in using a wider range of approaches to floodplain management, in order to allow floodplains to simultaneously achieve several functions: habitat, agricultural production, flood storage and conveyance. European countries – particularly the Netherlands – have been at the forefront of these efforts, however some notable examples exist in the US, such as the Yolo bypass in California (Opperman et al., 2009). These plans create “Room for the River” (RfR - the name of the Dutch project), and retain water in the landscape. The key to these approaches is strategic river reconnection. This allows for habitat improvement to co-exist with agricultural (and/or fisheries) production, and improves flood mitigation and flood-risk reduction. The rationale is manifold – as climate change is increasing the costs of maintaining levees and dams increases, ecological functions are lost, and the wrong incentives prompt more people to move into flood-prone areas. RfR plans consider all these issues and the specific hydrology of a river and its floodplain to determine the best locations to allow reconnection, incorporating ecological and socio-economic considerations, and including a wide range of stakeholders in the planning process.

### 5. Disasters and Social Vulnerability.

For too long the conceptualization of hazards overlooked social inequality, assuming tragedies were equal opportunity events. After all, how could a geophysical or technological event be discriminatory? But we know our social characteristics shape our history, experiences and life chances, and more recently disaster scholars acknowledge

that disaster risks exist within historical and contemporary systems of stratification. So while no population can fully escape the fear and burden associated with disasters, our assigned and chosen social groups also result in disparate abilities to prepare, respond and recover.

Therefore, being "at risk" or even being impacted by a disaster is not simply bad luck or a factor of genetics. Instead the risk is socially produced from historical, political, geographic and economic influences. For example, if a group has historically lacked access to political power and disproportionately lives in poor housing, these factors may leave them at a higher risk. Or, if emergency planners only print disaster preparedness "check sheets" in English, then they limit the capacity for self-help within the full community and therefore participate in the creation of vulnerability. For example, during Hurricane Katrina, the city evacuation plan for New Orleans assumed residents and households could personally transport themselves out of the area in response to danger. Because political leaders failed to consider that 1 in 3 within their community did not own a car, this in part contributed to the disproportionate rates of death and injury among the poor, black and elderly populations (Bolin 2006; Bullard et al. 2009). These examples demonstrate that disasters are not inherently accompanied by vulnerability. Instead, the social system fails to account for unique needs and limitations and thus the marginalized (whether due to geography, racial or ethnic identity, gender, income, immigration status, etc.) suffer greater losses (Fothergill and Peek 2004; Phillips et al. 2010).

## 11a. References

- Bolin, Bob. 2006. Race, Class, Ethnicity and Disaster Vulnerability. Pp. 113-129 in *Handbook of Disaster Research*, edited by Rodríguez, H., E. Quarantelli and R. Dynes. New York: Springer.
- Bullard, Robert D., Johnson, G.S., and Torres, A.O. 2009. Transportation Matters: Stranded on the Side of the Road Before and After Disasters Strike. Pp. 63-85 in *Race, Place and Environmental Justice after Hurricane Katrina: Struggles to Reclaim, Rebuild, and Revitalize New Orleans and the Gulf Coast*, edited by Robert D. Bullard and Beverly Wright. Westview Press.
- Elosegi, A., and Sabater, S. 2013. Effects of hydromorphological impacts on river ecosystem functioning: a review and suggestions for assessing ecological impacts. *Hydrobiologia*. 712:129–143.
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- Rand Institute for Civil Justice, The National Flood Insurance Program's Market Penetration Rate: Estimates and Policy Implications. URL: [http://www.rand.org/pubs/technical\\_reports/2006/RAND\\_TR300.pdf](http://www.rand.org/pubs/technical_reports/2006/RAND_TR300.pdf).
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- Sweeney, B. W., Bott, T. L., Jackson, J. K., Kaplan, L. A., Newbold, J. D., Standley, L. J., Hession, W. C., and Horwitz, R. J. 2004. Riparian deforestation, stream narrowing, and loss of stream ecosystem services. *Proceedings of the National Academy of Sciences* 101(39): 14132-14137.

### **11b. Recommended further reading**

#### Possible advance readings for the students

- Galloway, G. 2004. Integrated Flood Management Case Study - USA: Flood Management - Mississippi River. World Meteorological Organization and Global Water Partnership Associated Programme on Flood Management 12 (2004). 12 pages. URL: [http://www.apfm.info/publications/casestudies/cs\\_usa\\_mississippi\\_full.pdf](http://www.apfm.info/publications/casestudies/cs_usa_mississippi_full.pdf)  
This gives a concise history on how floodplains have been managed in the Mississippi, and the general pros and cons of buyouts and conversion to wetlands versus structural measures such as levee construction as a flood management strategy.
- Cutter, S.L., Boruff, B.J. and Shirley, W.L. 2003. Social Vulnerability to Environmental Hazards. *Social Science Quarterly* 84(2):242-261. URL: <http://www.colorado.edu/hazards/resources/socy4037/Cutter%20%20%20Social%20vulnerability%20to%20environmental%20hazards.pdf>  
Cutter and her colleagues (2003) use county-level socioeconomic and demographic data from the 1990 census to create a Social Vulnerability Index (SoVI) for the U.S. The SoVI includes a diversity of vulnerability indicators related to employment, infrastructure, gender, age, education, etc. Their research indicates that most counties within the U.S. face moderate social vulnerability, with higher social vulnerability found in areas such as the Mississippi Delta region.
- Konrad, C. P. 2013. Effects of urban development on floods. U.S. Geological Survey Fact Sheet 076-03. URL: <http://pubs.usgs.gov/fs/fs07603/>.  
Konrad describes the ways in which urbanization typically increases the size and frequency of floods, exposing communities to hazards. The website concludes with suggested infrastructure changes to reduce these hazards, while integrating multiple images and graphs to benefit student comprehension.

#### Suggestions for student homework or review

"Still Waiting, Life After Katrina" DVD URL: <http://www.stillwaiting.colostate.edu/index.html>

"Women in New Orleans: Post Katrina" 4 min Youtube video URL:

<http://www.youtube.com/watch?v=bdPVSRSYgeU>

Freudenburg, William R., Robert Gramling, Shirley Laska and Kai Erikson. 2008. Organizing Hazards, Engineering Disasters? Improving the Recognition of Political-Economic Factors in the Creation of Disasters. *Social Forces* 87(2): 1015-1038.

Possible resources for faculty review

"Social Vulnerability Approaches to Disaster." URL: <http://training.fema.gov/EMIWeb/edu/sovul.asp> The Federal Emergency Management Agency (FEMA) offers multiple resources on the topic of vulnerability, including Powerpoints, handouts and readings on vulnerability subtopics of gender, health, immigration and sustainability.

"Katrina Research Hub." URL: <http://katrinaresearchhub.ssrc.org> The Social Science Research Council (SSRC) Katrina Research Hub publicly shares a collection of essays on Hurricane Katrina, including examination of racial, gender and age vulnerability /

"Greater Olive Branch Area: Strategic Vision and Design Proposals (2012). URL:: [http://etcu.files.wordpress.com/2013/01/ob-charette-documentation\\_sml.pdf](http://etcu.files.wordpress.com/2013/01/ob-charette-documentation_sml.pdf)  
The book produced from the planning charette at Olive Branch, with photos and other visual materials

"Flooding in Alexander County." URL: <https://sites.google.com/site/alexcomitigation2011/flooding-in-alexander-county>  
The Alexander County Community Recovery & Rebuilding site, where Olive Branch is located, with up to date information on the buyout and other community events:

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Camillo, Charles A., "Divine Providence: The 2011 Flood in the Mississippi River and Tributaries Project" (2012). US Army Corps of Engineers, Omaha District. Paper 142. <http://digitalcommons.unl.edu/usarmyceomaha/142>

A book on the 2011 floods written by the historian for the Mississippi River Commission and the Mississippi River and Tributaries project

## 12. Answer Key

Although there is no clear-cut right or wrong answer in this case study, students should be able to identify the key trade-offs. These are:

1. Even if there are subsidized programs to help with relocation, this is not a costless process. The relocation of the poor and disadvantaged in particular may have high hidden costs and certain populations may be more vulnerable to disasters. Further, if there are subsidies in place, taxpayers must pay for those. If not properly designed, government funded subsidies for both relocation and rebuilding can also create an incentive for people not to move away from floodplains, or build appropriately in high-risk areas and can therefore cause vicious circles and create unintended consequences. For example, subsidies to rebuild on a floodplain that do not specify the use of stilts or piles might

result in people re-building inadequate structures which are destroyed during the next flood and necessitate further subsidies.

2. Some land uses are incompatible with the production of particular ecosystem services. Agricultural monocultures typically provide poor habitat for wildlife and reduce biodiversity. However, agriculture is necessary to produce food. Students should understand that nature has value for humans, and be able to identify hunters as a group of stakeholders that attributes value to nature.
3. More advanced students in the area of environmental studies may be able to identify potential differences of opinion between conservationists and hunters – different habitat restoration priorities may result in different specific restoration plans. Similarly, more advanced students in the social sciences may be able to identify differences within the community itself depending on the specifics of a relocation plan, and who benefits and loses from it.

As of 2013, the real Olive Branch has been approved for a buyout by the Federal government. The Federal Emergency Management Agency was slated to provide \$9 million and the state of Illinois an additional \$3 million. However, no specific plans for the buyout have been finalized. Specifically, it is still unclear where to rebuild outside the floodplain, what to do with the properties left vacant and who can rebuild on site using flood-damage resistant construction methods.

### **13. Assessment**

To calm student anxiety, instructors may offer full credit for student participation in the case study or tie multiple grades to the exercise (for example through the completion of a homework quiz, journal reflection and/or group letter). Regardless of the number or type of graded components associated with the case study, transparency with the expectations and objectives of the case study will empower student success.

Here we provide an example rubric to grade the group letter, but we encourage each instructor to customize the rubric to their own needs, the course objectives, and the strengths of their students. The rubric below uses a point system (rated 1 through 5). We divide graded components into the following two parts, "content" and "other."

**SAMPLE RUBRIC FOR LETTER WRITING ASSIGNMENT**

<b>Criteria</b>	<b>1</b>	<b>2</b>	<b>3 (meets expectations)</b>	<b>4 (better than average)</b>	<b>5 (exceeds expectations)</b>
<i>Content:</i> The perspective in the letter reflects the knowledge presented in terms of accuracy and thoroughness					
<i>Content:</i> Synthesis of socio-environmental data					
<i>Content:</i> Communicates trade-offs and inequality; acknowledges differences in stakeholder values					
<i>Content:</i> Demonstrates knowledge of ecosystem services					
<i>Other:</i> Grammar and spelling (quality of writing)					
<i>Other:</i> Demonstrates critical analysis and thinking					
<i>Other:</i> Letter persuasiveness					
<i>Other:</i> Appropriate letter format					

Points earned: \_\_\_\_/\_\_\_\_Points possible

Additional Teacher Comments:

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The instructor can also choose to incorporate self- or peer- evaluation. Here we provide examples of broad questions for student reflection.

**Moving to Higher Ground. Self and Peer-Evaluation**

Your Name: \_\_\_\_\_ Your role: \_\_\_\_\_

(1) Regarding your oral participation and letter writing: What were your strengths within the case study activity? Describe examples (this can include, but is not limited to preparedness for case study, creativity, quality of ideas, and/or letter editing).

(2) Regarding your participation and final product: What were your weaknesses within the case study activity? Give support for your claims.

- (3) Which of your peers provided the most helpful participation? Describe.
- (4) Any last reflections on the case study exercise? (Here you are welcome and encouraged to provide constructive criticism on the classroom exercise)

### **Example Assessment Questions.**

The questions below are designed as pre-case study brainstorming questions.

- Create a list of disasters (natural, human-made and/or technological) that have occurred in the U.S. in the last 10 years. What has been uncovered about social vulnerability from these events?
- What role can and should technology play in reducing a community's disaster risk?
- Does the U.S. government have a responsibility to protect U.S. residents from disasters? Is this protection a human right?

The questions below are designed for a myriad of uses including a final reflection or an exam.

#### *Natural Science Questions:*

- Describe several floodplain ecosystem services.
- What are the benefits and losses for the floodplain ecosystem (including the flora and fauna) for option 1, 2 and 3?

#### *Social Science Questions:*

- Do human communities have a responsibility to support ecosystem services to the benefit of non-human species? Discuss the ethical considerations of humans destroying an ecosystem's ability to provide a diversity of services to the region.
- How can the stakeholders' conflicting interests for the land be reconciled?
- In discussing the conflicting interests of the stakeholders, did the voices get treated equally? How would you personally rank the contribution and insight each stakeholder has to offer in this case study?
- Pretend the ultimate decision was to move the town and restore the floodplain. How would you divide the large financial cost (over time? across the state? through the use of private or public funds?)
- What do you think was the actual recommended solution for the town of Olive Branch? Why?
- Identify secondary stakeholders not included in the case study activity. Evaluate the three alternatives from their perspective.

- Identify Olive Branch community members who are vulnerable. What resources may these individuals or families be lacking and what could they contribute to community resilience?
- How do governments at different levels impact floodplain management? How do the relevant stakeholders vary among national, state, and local actors?

### *Sustainability Questions*

- Do you think that it is sustainable in the long term for humans to live on floodplains, given that we have growing populations and people who have historically lived on floodplains for a long time, while on the other hand climate change may contribute to more flooding and natural reconnected floodplains provide many ecosystem services?
- How would you balance immediate needs, benefits, and costs of floodplain management stakeholders today with the needs, benefits, and costs of future generations?
- Can you think of other places/land uses on the planet that are important for social, ecological and economic reasons? Are there any lessons from this case study that could be used in these places?