Earth Science Extras (ESE2):
Telling Stories of Humans and the Earth
Earth Science and Sustainability

Agriculture and Erosion—Discussion Prompts

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The following prompts are intended to guide you in examining a complex question involving agriculture and erosion, in particular how how human activity can influence erosion. This question is only a small part of the broader consideration of how landscape and soils effect people and how people effect landscape and soils. In addition to reading these prompts, you should do some online investigation to get a broader understanding of questions, risks, and remediation possibilities.

By altering complex interactions, small-scale human actions can often produce unexpected changes in large-scale earth systems. An action can result in indirect consequences that either enhance or diminish the effects of the original action—that is, there are often cascading consequences and feedback loops in nature that result from complex interactions within earth systems. We consider some simplified feedback loops within climatic systems in another lesson: Earth Science Essentials (ESE1) lesson on greenhouse warming (http://EarthSci4Teachers/ESE/Telling-Stories_of_Other_Worlds/How_to_Build_Climate_Zones/Greenhouse_Warming-Text/index.html . You might review (or preview) that lesson in preparation for our discussion on agriculture and erosion. In addition, feel free to do some exploratory reading online about effects of human agricultural activity on soil fertility, erosion, and sustainability.

Brainstorming step:

In preparation for the discussion, think about what factors might affect soil erosion. How might soil erosion be mitigated? For example, think about what soil mitigation methods you have seen. Have you seen tree belts cutting across farm fields (many were planted after the 1930s but many have been cut down in more recent years)? Have you seen terraces built? Contour farming? Tilling perpendicular to prominent wind directions? What other methods can you envision? Are there any methods that might be made possible with new technologies or methodologies?

Investigative step:
Brain storming ideas is fine, but speculative idea-generation is not the end of a scientific investigation. A more important step (from a science investigation point of view) is to think about how you would design a study to investigate whether or not a particular method would mitigate erosion. How would you set up the study? What variables might be important and how would you control/measure them? How would you establish that one action *causes* a particular result?

Don't get too broad. A study to find out how "humans affect erosion" is too vast to be implemented even by an individual scientist or team of scientists, let alone a student or classroom of students. Instead, think of a more specific study—for example, how does application of manure to a farm field in November affect over-winter wind erosion? Then design a study—what you would do/measure/observe that would definitively answer the question.

Considering Consequences and Feedback Loops:
Again, you can't consider the consequences for everything or all possible feedback loops, but pick one process or mitigation effort and think about what unexpected consequences might occur.

For example, decreasing the areal extent of a wetland area to favor farm fields might decrease evaporation, which in turn might decrease atmospheric moisture and therefore decrease rainfall, which would affect farm yields and potentially increase wetland loss and affect erosion. Of course, each step of this would need to be tested—does the wetland put more moisture into the air than a farm field? Does the change in atmospheric moisture result in decreased rainfall? How might you test these questions?

Here's another example. Suppose that you dam a river. How will that affect erosion?

Well, slowing the water down will cause the sediment load carried by the river to be deposited (eventually silting up the reservoir formed behind the dam). The presence of the reservoir might affect local evaporation, which can have an indirect effect on precipitation—perhaps keeping area soil moister and decreasing wind erosion, or perhaps increasing water runoff and increasing water erosion.

What happens downstream from the dam? Sediment downriver will still be transported, but there won't be any new sediment from upstream to replace it. This could result in net erosion on point bars of the rivers, or decreased deposition in agriculturally-important floodplains. If the river flows into a sea, and has historically provided sand for area beaches, then there might be a net erosion on the beaches as sediment is

transported away by longshore currents but the amount of incoming sediment is greatly reduced due to the presence of the dam.

The presence of a new reservoir might change the local water table, potentially replenishing ground water, or changing or even reversing the direction of ground water flow. This could have unintended consequences (think of some).

These are offered just as examples. The goal is for you to think about how particular actions might have unintended consequences due to complex interactions or feedback loops (particularly as related to agricultural erosion). Please bring some of your example thoughts to our discussion.