

Students' Final Essay

Environmental Studies 303: Human Ecology and Sustainability

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Dirt – The Foundation of Coupled Nature Systems

ENVS 303 Human Ecology and Sustainability
Final Group Paper

INTRODUCTION

* The effort for the group sections were equally distributed despite the disproportionate weight given to each section. We all feel that we equally shared the workload.

Effort Analysis*: [Student-A](#) 5%, [Student-B](#) 5%, [Student-C](#) 90%. We all met and brainstormed how we wanted to discuss our case studies. [Student-C](#) then took the ideas from the brainstorm and wrote them out. [Student-A](#) and [Student-B](#) did the final round of editing of the section.

Word Count: 1268

The human experience is tightly coupled with the Earth's capacity to provide the essential resources required for our survival (Liu et al., 2007). That experience, illustrated by our long history of civilizations come and gone has been defined by our relationship with nature. Our standard of living - the fulfillment of life sustaining necessities - is married to the capacity for civilization to sustainably utilize the natural environment. Nature has directed our experience and we have in turn altered nature in response. The outcomes resulting from nature human coupled systems and the resulting feedback loops ultimately determine societies long term success or failure.

Perhaps one of the most fundamental aspects of a civilization's relationship with nature is the one cultivated with the soil under its feet. At the most fundamental level, societies depend on the terrestrial life sustained by healthy soil for their most basic needs; food, shelter and, by extension, clothing (Montgomery, 2007, p. 16). The state of the soil determines what can be grown, for how long, preserving the basis for the wealth of future generations (Montgomery, 2007, p. 3). Soils complete the cycle of life by decomposing and recycling organic matter and regenerating the capacity to support plants that provide the base of a trophic pyramid on which we balance so precariously (Montgomery, 2007, p. 16). Therefore, the history of human life is inextricably related to the history of the soil (Montgomery, 2007, p. 15). Our collective well-being depends on human activities not exceeding the biospheres regenerative capacity to regenerate healthy soil. (Wackernagle, et al., 2002)

Legacies of ancient and contemporary soil degradation continue produce wasted land (Montgomery, 2007, p. 4) that have come to represent one of the Earth's most serious problems (Diamond, 2005, p.

489). The twin problems of soil degradation and accelerated erosion present a catastrophic loss of the precious foundation on top of which our civilizations rest (Montgomery, 2007, p. 2). A civilization can persist only as long as it retains enough productive soil to feed its people (Montgomery, 2007, p. 23). However, 24 billion tons of top soil is lost annually around the world - several tons for each person on the planet (Montgomery, 2007, p. 4). The Mississippi River alone deposits a dump truck load of soil every second into the Gulf of Mexico (Montgomery, 2007, p. 4). Overall, 20-80 % world's farmlands have been severely depleted (Diamond, 2005, p. 490). Erosion rates of farmland between are 10 to 40 times rate of soil formation and 500 to 1000 times faster than the erosion rate of forestland (Diamond, 2005, p. 489). If we are not careful, the Ecological impact of humanity may result in ecological suicide as our need for food reaches beyond the ability of our remaining soil to produce it.

Therefore we found soil to be a pertinent focal point for examining three coupled systems and the relationship that their respective human populations have with a resource on which they depend. We present three case studies – Haiti, Europe, and India – that investigate the condition of the soil and how the human relationship to that resource has influenced it. All three cases are posited on the supposition that soil has, in turn, has influenced the societies that depend on it. “Without fertile soil, what is life” (Shiva, 2009)?

Haiti presents the extreme example of topsoil loss and the corresponding social, political, economic, and environmental consequences that have paralleled the excessive degradation of a fundamental life sustaining resource. Occupying the western third of the island of Hispaniola, Haiti has a population nearing ten million people (July 2012 est.) mostly concentrated in the urban core of the capital city Port-au-Prince (CIA World Factbook, 2013). It is one of the poorest countries in the world with an average income of less than \$2 USD a day (Martin, 2008). The nation is listed as “High Risk” for many infectious diseases including HIV/Aids, typhoid, dengue fever, and malaria (CIA World Factbook, 2013). Its government is marked by perpetual unrest and violence highlighted by 32 coups in its 200 year history (Klemen, 2004). Environmentally, the country has cut down most of its forest, lost much of its soil to erosion and is continually challenged to secure potable drinking water. All of these factors, natural and human, have been, and continue to be inextricably coupled; reciprocally altering each other's history. In the case of Haiti, the resulting positive feedback loop has led to the cumulative decline in both natural and human systems to the extent that Haiti may provide a contemporary analogue for declining civilizations.

Europe has a long history of facing what may be the central problem facing growing populations –the ability to feed a society in the face of limited soil productivity. In turn, the region has experienced many of the social consequences of such an environmental constraint including “food shortages, starvation, wars among too many people fighting for too few resources, and overthrows of governing elites by disillusioned masses” (Diamond, 2005, p. 6). Like many societies around the world, Europe walked the predictable path of soil management. Growing population led to exploitation of the commons. Marginal lands were put under increasing pressure. Deforestation accommodated agricultural expansion. Agrochemicals are applied to supplement leached and distressed soil. And finally, as we now see in many European nations, agriculture has come full circle in the realization that the soil must be cultivated and not exploited. However, Europe differs in the unique way it ultimately solved its food shortage. Not, necessarily through sustainable agriculture but instead by importing its calories made available by its system of global colonialism (Dubois, 2012, p. 110). While many a nations' soil

relationships have been influenced by outside powers – Haiti for example – Europe was, many times, *the* outside power (Dubois, 2012, p. 7).

India highlights both the spatial and temporal heterogeneity of soil types and environmental relationships. The sheer size of the nation provides many combinations of social-ecological systems (Ostram, 2007). India, like any country, is highly dependent on the soil environment. It has the second largest population in the world at 1.2 billion (July 2012 est.) and makes up more than one seventh of the planet's overall population (CIA World Factbook, 2013). Therefore, India is a real example of the tendency of human populations to increase exponentially (Moran, 2006, p. 107). This human variable has put extreme pressure on the nation's soil. Like Europe, India is challenged to feed its rapidly growing population. Consequentially, erosion and nutrient leaching have become a very big problem for the farmers of India while destructive landslides due to decreasing soil stability have become a more common occurrence. India is facing the real possibility that it has more people than the land can support.

In each of these case studies the relationship that people have with the soil has influenced their societies while people have impacted nature. However, the outcomes of their respective interactions with this very important resource have varied. Our case studies are analogues that highlight the risk of not addressing critical by which other nature humans systems in the context of soil relationships might be compared. The future of soil in our case studies, as well as those globally, will be in "the society's response to its environmental problems (Diamond, 2005, p. 11). The question will be if societies will continue to "undermined themselves by damaging their environments" (Diamond, 2005, p. 6).

"The balance of nature is not a status quo; it is fluid, ever shifting, in a constant state of adjustment. Sometimes the balance is in his favor; sometimes--and all too often through his own activities--it is shifted to his disadvantage" (Carson, 146).

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CASE STUDY ONE – Haiti

Effort Analysis Student-C 90%, StudentA 5%, Student-B 5%. This was Student-C's case study so he researched and wrote the whole case study. StudentA reviewed for typos and gave feedback to improve the case study. Student-B formatted it so it fit into the larger report.

Word Count Case Study One: 1586

In his compelling 2005 book about the state of the world's soil, *Dirt - The Erosion of Civilizations*, David

Montgomery writes about the future of Haiti; "Prosperity disappeared along with Haiti's topsoil" (p. 228) Is Haiti a failed state? Has it collapsed? Haiti is by no measure prosperous. Haiti is the poorest country in the Western Hemisphere. Nearly 80% of the population is living under the poverty line and 54% in abject poverty with an unemployment rate of 40.6% (CIA World Factbook, 2013). Approximately 60 % of children younger than five are suffering from diseases of malnutrition (Hylkema, 2011). At the very least, these bleak statistics paint a grim portrait of a nation teetering on the precipice of foreseeable failure.

Haiti's crippling poverty is more than just economic. Its endemic environmental crises are perhaps the country's most immediate threat (Edwards et al., 2010). More than 98% of the nation's native tropical forests have been cleared for agriculture development and firewood collection. The resulting bare hills have shed their topsoil to the point that heavy rains, common in that part of the Caribbean, wash an estimated 6,000 hectares of soil away every year (Edwards et al., 2010). Haiti is left with only 28.11% of arable land (CIA World Factbook, 2013). The rest is unfit for cultivation due to steep slopes and severe susceptibility to erosion (Hylkema, 2011). Nearly a third of the country is practically sterile from extensive erosion and nutrient leaching (Montgomery, 2005, p.229; Hylkema, 2011). In short, Haiti has nearly as little environmental capital as it does economic.

So why would Haitians let their prosperity slip into the ocean? To understand what happened to Haiti's soil, we must couple the environmental history of the nation with its sociopolitical history. Liu et al. (2007) describes this relationship as a coupled nature human system. Coupled nature human systems are complex and dynamic interactions between people and their natural environment (Liu et al., 2007). Thus, it would be impossible to discuss the current situation of Haiti's soil without a parallel discussion of its human history. As Jean-Bertrand Aristide (Haiti's first democratically elected president) said in 1987; - "We have become subjects of our own history..." (Dubois, 2011, p. 360). The social history has shaped the natural environment of Haiti and vice versa.

When Christopher Columbus found the island in 1492, he claimed the island of Hispaniola for Spain and divided the land and its inhabitants among his men. Within 27 years, through a combination of murder and disease, the Spaniards had reduced the native Taino population from half a million to 11,000 (Diamond, 2005, p.333-334). In 1795, following a social and economic decline in Spain, the island was ceded to the French (Diamond, 2005, p. 334). In 1805, successive slave revolts on the western half Hispaniola achieved independence from the French and by 1850 the line between Haiti in the West and Dominican Republic (formerly a Spanish colony) in the East was firmly established (Diamond, 2005, p.335).

Under French occupation, Haiti's land was agriculturally exploited for the lucrative sugarcane, coffee, cotton, indigo, and tobacco (McClintock, 2010). To work the plantations, since all the natives had been eradicated, the French imported nearly three quarters of a million African slaves; at one point bringing the ratio of whites to slaves to ten to one (Diamond, 2005, p. 6) During the eighteenth century, Haiti (then, Saint-Domingue) was the most profitable colony in the world (Dubois, 2012, p. 19) and provided as much as 50% of France's gross national product earning it the title "The Pearl of the Antilles" (Hylkema, 2011).

The intensive monoculture of the French plantation system took a massive toll on the country's soil depleting it of nutrients and setting the stage for further degradation. After the slave revolt, the land use patterns underwent a drastic shift. Afraid of French return and determined to undermine any further reliance on slave dependent plantations, the nation underwent a massive reallocation of land into the hands of individual families (Diamond, 2005, p. 335). The destruction of plantation infrastructure was also that of intensive agricultural infrastructure and would have future environmental and economic consequences. Poor former slaves turned to substance farming, in part, as a cultural rejection of the brutal history of French plantations, in part because they had little need for coffee and tobacco. They found much more value in the substance crops of potatoes, livestock and fruit (Dubois, 2011, p. 33). As generations passed and family plots became increasingly smaller as they were divided among offspring, people cleared ever more marginalized land on steep slopes and the soil increasingly washed away. The generations of intensive exploitation of steep slopes with minimal crop inputs has given rise to the increasing erosion rates and poor crop yields experienced today (Hylkema, 2011). Currently, the area farmed in Haiti is six times greater than the estimated area suitable for crop production (Hylkema, 2011). Trees, the few that are left, continue to provide wood or charcoal- the main source of energy for more than 70% of the population (Hylkema, 2011).

The economic repercussions of freedom were equally stiff as the environmental impact. With the expulsion of the French, Haiti unintentionally exported the human capital of the White, of rich, educated land owners and, in turn, lost access to the global market economy and a degree of political stability (Diamond, 2005, p.335). France refused to recognize Haiti as a free state and politically isolated the nation with the support of Britain and the United States (Dubois, 2011, p. 7). Still embittered two decades after the revolt, France, imposed an indemnity, equivalent to \$3 billion USD, as compensation to the slave holders and their losses. To pay the indemnity, Haiti had to take out loans from French Banks that added interest to the crushing debt (Dubois, 2011, p. 7). Without the significant agricultural exports, Haiti relied heavily on timber exports to pay down the growing debt further contributing to soil loss, as well as, social instability as the farmer bared the burden of paying the debt- (McClintock, 2010). The ruling elite controlled the ports and exports and consolidated wealth among a privileged few. With little concern for the struggling poor or environmental stewardship, money was invested into bolstering the army that secured their power and not into supporting a healthy agricultural sector.

To compound internal maladaptive systems, much of Haiti's ecological history and its relationship with their soil has been, and continues to be, written by outsiders (Dubois, 2011, p. 7). Distant managers are insulated from critical environmental feedback and are divested from the experience of local people (Moran, p. 71). The result is a failure to perceive the environmental problems perpetuated by policies controlled by outside powers (Diamond, 2005, p. 336). From 1915-1934 U.S. Marines occupied Haiti under the pretense of reestablishing order after a bloody coup. The effect was the opening of the previously isolated nation to foreign investment and a deepening dependence on outside powers (Dubois, 2011, p. 9). Further political instability marked by a succession of dictatorial regimes has only aggravated declining environmental, social, and political capital.

With such systemic soil degradation, corresponding environmental decay, and internal social conflict, the question remains; is Haiti, therefore, an example of a modern day collapsed society? "The question that all visitors to Haiti ask themselves is whether there is any hope for the country, and the usual answer is "no" (Diamond, 2005, p. 330).

Jarod ~~D~~iamond (2005), author of *Collapse – How Societies Choose to Fail or Succeed* (2005), defines collapse; "[Collapse is] a drastic decrease in human population size, and/or political/ economic/ social complexity, over a considerable area, for an extended time" (p. 3). Unlike the "pPure" collapse of Easter Island, for example, Haiti is far from isolated from external support and has yet to witness significant population decline. However, Diamond offers an alternative to apocalyptic collapse. Instead, a nation may exhibit significantly lower living standards, chronically higher risks, and an undermining of what are considered key values (p. 7). "The phenomenon of collapse is thus an extreme form of several milder types of decline, and it becomes arbitrary to decide how drastic the decline of a society to be before it qualifies to be labeled as a collapse-" (p. 3).

~~While Sure,~~ Haiti meets many of the criteria that Diamond outlines, ~~but~~ Laurent Dubois (2011), author of *Haiti – The Aftershocks of History*, suggest an unconventional outlook. ~~He writes,~~ "Haiti's state has been quite successful at doing what it was set up to do: preserve power for a small group" (p.7).

Dubois remains optimistic. He reminds us of the remarkable origins of Haiti – as the first and only successful slave revolt. “They built it out of nothing – with furry, solidarity, and determination” (p. 370). In this spirit, Haiti continues to create its future.

However, the future of Haiti remains questionable. In January 2010, a massive magnitude 7.0 earthquake struck Haiti with an epicenter about 15 mi west of the capital, Port-au-Prince. Over 300,000 people were killed and some 1 million left homeless. The earthquake was assessed as the worst in this region over the last 200 years (CIA World Factbook, 2013). The disaster brought an already struggling nation to its knees and further undermined efforts to reform the country both politically and environmentally. The disaster further deepened already entrenched dependence on external forces. But the people have yet to give up. As graffiti on the walls of the city proclaimed a few years ago: “A different Port-au-Prince is possible” (Dubois, p. 370).

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CASE STUDY Two – Europe

Effort Analysis: [StudentA](#) 90%, [Student-c](#) 5%, [Student-B](#) 5%. This was [StudentA](#)'s case study so he researched and wrote the whole case study. [Student-c](#) reviewed for typos and gave feedback to improve the case study. [Student-B](#) formatted it so it fit into the larger report.

Word Count: 1,172

Soil management practices have varied spatially and temporally throughout Europe. These various management schemes have resulted in diverse patterns of soil quality spread throughout the region. During the Middle Ages populations were consistently low enough that agricultural pressures on soils were relatively low, helping to protect against degradation. General management practices also limited the exploitation of commons spaces further restricting negative impacts on soil quality and quantity.

Soil management throughout Europe was not only a representation of basic biological needs but also cultural norms. Similar to the opinions of white settlers in the American West (White, 1999) the European populations saw land not under cultivation to be unimproved and therefore worth less than cleared land (Freedman, 1999, p 28). "Plowing as a metaphor for virtuous productivity" appeared to be present in a variety of social hierarchical levels from the peasants, to the lords, and to the religious figures (Freedman, 1999, p. 35).

Between 1500 and 1550, in some areas of France, the population ~~was doubling~~^{doubled} every 30 years. This intense growth caused the “village lands, productive resources, and the labor market... [to reach] a point of saturation” (Ladurie, 1976, p. 53) formally not seen. As a result, of the population boom peasants attempted to recover marginal lands. Peasants attempted to cultivate “poor rocky soils that had never been worked before or that had been abandoned” during the 14th century due to the Plague (Ladurie, 1976, p. 56). This attempted cultivation only succeeded in increased degradation of already poor soils. Mixed cultivation was the chosen solution reducing the stress of wheat cultivation on sub-par lands. Through integrated management, soil was preserved. This still resulted in the loss of significant endemic flora and fauna in favor of those generalists that could thrive in human altered landscapes.

Comment [MSOffice1]: cite

By 1900 most of the original standing timber of central Europe had been harvested to fuel cooking fires, smelting operations, and building operations. This alone, as identified by Jared Diamond often has significant consequences on the viability of any culture. As manufacturing increased the demand for food and resources derived from soil became commercialized, each individual had an incentive to exploit the soil to their maximum ability (Hardin, 1968; Enters, 2007). Interestingly Europe may have been spared some of the worst consequences of extreme soil exploitation by importing large amounts of soil degrading crops from the Americas, where soil erosion went unchecked.

Comment [MSOffice2]: cite

In contemporary times land-use management has been directed towards conservation within the European Union. Public consciousness has been in favor of protecting soil resources in order to maintain productivity and social wellness. The EU also passed some of its first regulations to help maintain soil quality in the early 70's with the passage of the Environmental Action Programme. Germany in particular has made attempts to protect large tracts of agricultural land with some 42.3% of land under some amount of protection (Bertzky, 2012; World Bank, 2010). This may be a result of the success of the Green Party in German politics, one of the only countries where the Green Party has consistently been engaged in governing coalitions (Spretnak, 1986). Public awareness of the ecological consequences of mismanagement has helped the EU better safeguard its soil resources for future generations.

This may be a result of the success of the Green Party in German politics, one of the only countries where the Green Party has consistently been engaged in governing coalitions (Spretnak, 1986). Public awareness of the ecological consequences of mismanagement has helped the EU better safeguard its soil resources for future generations.

Europe has historically had close associations with a variety of domesticated animals used for agricultural purposes – the two best examples being the pig and the cow. The use of the pig as a living compost was previously widespread throughout Europe until a number of disease outbreaks were associated with the pig in the last 50 years. While these fears certainly are justified in many cases the result has been an increase in food waste being sent to landfills rather than being composted and reused within the food production cycle (Fairlie, 2010, p 47).

Pigs are highly efficient nutrient recyclers turning waste both into edible meat for human consumption and reforming those nutrients that they cannot use for mass accumulation into highly fertile manure. When properly used pigs can help to maintain the productivity of land and if needed help restore degraded land to functionality. Their ability to forage and eat most everything also makes them highly valuable when feed cannot be directly obtained or when the cost is too high. At 20-25% efficiency in converting feed to mass they are highly productive animals (Fairlie, 2010, p. 20). With the transition to concentrated feedlot models of production the value of the pig towards soil has

been decreased. Rather than feeding them food scraps, something that has been banned in various EU countries, alternative feed sources must be imported to the site. These feeds often come from monoculture systems that are participating in soil degrading practices. The increased risk of contamination from excrement in food sources, particularly leafy greens, has meant that manure is no longer being used in the most efficient ways further reducing the pigs benefit to soil quality.

The cow, as pointed out by Joel Salatin, an American farmer, is one of the most productive and efficient animals in improving soil fertility and quality (Salatin, 2012). Ruminant animals, like cows, create manure that is high in nutrient value and nitrogen. Polyculture systems that involve rotation of cattle and mixed management have been shown to have substantial benefits towards soil fertility. These management practices have largely been lost as commercial farm size has increased globally. An increasing number of farms are also be operated by corporations who use farmland in monoculture, reducing the number of grazing pastures where cattle can be utilized. Europe has been able to maintain its historic farming tradition better than some regions resulting in the more efficient use of cattle in soil management.

Comment [MSOffice3]: cite

Many EU member countries have been able to reduce their use of nitrogen through increased efficiencies and environmental policies that aim for more sustainable practices (Citation ##). This development has benefits not only for soils, which can experience serious negative consequences from excessive nitrogen application but also fisheries that experience eutrophication from runoff. Ultimately the limiting of fertilizer application benefits not only the soil but the people who rely on the soils, without which a livelihood cannot be derived from agriculture. The short term benefits of agricultural chemicals are clear (Kimbrell, 2002, p. 121), increasing productivity and yields, while the negative consequences can be masked by a slow degradation of soils (Diamond, 2005, p. 425).

Comment [MSOffice4]: ??

While Europe still has substantial problems in soil management they have ~~accomplished~~managed to maintain soil fertility and quality at levels much higher than other regions globally. Their tightly linked heritage to agriculture has provided them with context for sustainable management and practices. Considering the loss of almost all their standing timber and natural habitats in the quest for increased agricultural land base, Europe has fared incredibly well. They had a number of the factors that Diamond identifies as precursors to collapse (Diamond, 2005, p.6) but accomplished to maintain their

agricultural traditions. Soil has been a resource that has avoided excessive exploitation and will hopefully continue to be productive far into the future.

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CASE STUDY Three – India

Effort Analysis: [Student-B](#) 90%, [StudentA](#) 5%, [Student-c](#) 5%. This was [Student-B](#)'s case study so he researched and wrote the whole case study. [StudentA](#) reviewed for typos and gave feedback to improve the case study. [Student-c](#) formatted it so it fit into the larger report.

Word Count: 1297

With the population of India now at 1.2 billion people (CIA World Factbook, 2013) many key concerns need to be addressed to avoid a complete societal collapse. Primarily the ability to feed such a large population is incredibly important but also ensuring there is enough space for this expanding population to live. Both of these two factors rely on many things but probably the most significant is the soil on which all dwellings and buildings are built and on which all food is grown. The different small regions of India are loaded with interesting articles, stories and readings but looking at India as whole is very fascinating. In some areas there are yearly disastrous floods and torrential downpours that cause massive erosion and nutrient leaching of the soil. In other places there is little to no rain leaving otherwise fertile soils to go unused because of lack of irrigation. At the same time India has been able to grow record breaking crops in these unwelcoming soils. This case study will be looking at the soil state of different places in India to give an overall profile of the human-nature coupled soil systems there.

Comment [MSOffice5]: ??

India, like many other countries around the world has taken to deforestation and the conversion of pastoral lands to make way for more agriculture. While this kind of land cover change has detrimental effects on many human-nature coupled systems it is especially hard on the soils of India. An article written concerning these changes titled *Soil Fertility Index, Soil Evaluation Factor, and Microbial Indices under Different Land Uses in Acidic Soil of Humid Subtropical India* shows that land cover and land use changes tends to "reduce soil productivity because of increased erosion, cause decline in fertility, change in soil flora or fauna, and reduce soil organic matter, which plays a crucial role in sustaining soil quality, crop production, and environmental quality" (Sharma, 2011). Without the roots of native plants and trees the soil has nothing to cling to or develop around and is weakened.

Comment [MSOffice6]: cite

India has a span that includes several different climates that provides very different soil characteristics. Because most of the country has a sub-tropical climate the primary soil order found in India is Alfisol.

Alfisol soils form under cooler broadleaf forests and have high fertility but because they tend to be slightly acidic these types of soil often require the application of an alkaline substance to neutralize the pH for optimum yields (Schaetzl, 121). According to Dr S. S. Kulkarni who wrote an article for the *International Journal of Engineering Science & Technology* the regions of Punjab, Madhya Pradesh, Maharashtra, Andhra Pradesh and Karnataka located in east-central India have very tough soil cycles. Long dry periods dry out the soil leaving it susceptible to wind erosion leaving behind shallow soil while a heavy rainy season from August to October further erodes the soil diminishing the nutrients year after year (Kulkarni, 2011, p. 6306). Without the roots of the broadleaf forests to hold the soil in place and leaf litter to decompose to organic matter and further bind the soil it is able to simply slip away with the wind and rain.

India is quickly becoming a prime example of a self-regulating feedback loop. As their population expands they need more food; in order to produce more food they clear cut forests and convert other land for agricultural purposes, but without the forests to hold the otherwise fertile soil in place heavy erosion sets in making it more difficult to grow crops and sustain. India is highly invested in industrial agriculture as well which puts a tremendous strain on the soils that must be loaded with fertilizers to constantly produce high yielding crops. David Montgomery explains that the “changes in land use are widely recognized as capable of greatly accelerating soil erosion, and it has long been recognized that erosion in excess of soil production would eventually result in decreased agricultural potential” in his article titled *Soil Erosion And Agricultural Sustainability* (2013, p. 13268). As India puts more pressure on their soils the soil becomes more difficult to work with and more fragile.

Comment [MSOffice7]: So they clear more land. This is a self-enhancing loop, with the potential to grow wildly out of control

In the north of India near the Himalayas the soil poses a different kind of problem: hydrophobicity. The overall slope of the topography in the north coupled with vegetation that produces hydrophobic leaf litter causes rain to flow quickly from the higher elevations to lower ones causing many problems “including reduced seed germination and plant growth as well as irrigation efficiency, accelerated soil erosion and enhanced leaching of agrochemicals through preferential flow” (Mandal, 148). “water repellency has deteriorated so much that agricultural production is impossible without costly amelioration” (Mandal, 149). It’s interesting that the vegetation of higher slopes of India that aren’t suitable for industrial agriculture are left alone and then cause more problems for the clear cut areas of the lowlands.

In the north of India near the Himalayas the soil poses a different kind of problem: hydrophobicity. The overall slope of the topography in the north coupled with vegetation that produces hydrophobic leaf litter causes rain to flow quickly from the higher elevations to lower ones causing many problems “including reduced seed germination and plant growth as well as irrigation efficiency, accelerated soil erosion and enhanced leaching of agrochemicals through preferential flow” (Mandal, 148). “water repellency has deteriorated so much that agricultural production is impossible without costly amelioration” (Mandal, 149). It’s interesting that the vegetation of higher slopes of India that aren’t suitable for industrial agriculture are left alone and then cause more problems for the clear cut areas of the lowlands.

Recently, despite problems with soil quality and erosion across all of India a single farmer living in India’s poorest state of Bihar in the north-east of the country was able to produce a world record breaking harvest of rice. This is an incredible breakthrough for India with more than one seventh of the world’s population and for rice farmers who supply a crop that half of the world’s population depends on to sustain (Vidal, “India’s rice revolution”). Another news article titled “Farming communities in India improve soil fertility and earn higher income” on the United Nations Development Programme website tells of joint programs with small scale organic farmers in India teaming up with the United Nations and other groups to move away from industrial agriculture for a more sustainable alternative. This article states that these farmers are “building critical earthen embankments on the hills where they farm, slowing rates of erosion and keeping the soil fertile for much longer as a result” (“Farming communities in India improve soil fertility and earn higher income”).

Hydrophobic soils, land use change, and a rapidly expanding population have another disastrous effect on the environment: landslides. Many different factors play into the formation of areas that are now prone to landslide activity. As another example of a self-regulating feedback loop as humans change their environment to support their own needs the weakened environment collapses underneath them

As India develops and becomes wealthier they expand their infrastructure to more remote regions. The construction of new roadways and the magnification of different towns and villages in higher elevations have put humans in the path of landslides. As soil erosion becomes more prevalent so do landslides that take lives and destroy territories. Landslides are the result of a weak and poorly managed human-nature coupled system.

Comment [MSOffice8]: cite

India is a country that is highly dependent on the soil environment. It has the second largest population in the world and makes up more than one seventh of the planet's overall population. India was chosen as a case study because of its diverse soils and the human factors that have been shaping those soils over time. Soil is a resource that shapes every human society and as humans have more interaction with this resource it becomes even more important. Soil has shaped India's settlement patterns and social organization while the people of India have shaped the soil with their diet and technology. Despite obvious problems to soil quality and fertility with the added destruction caused by erosion India has been able to sustain. The question is whether they will be able to continue with their current practices and demand on the soil environment on which they depend on. The quality of the soils of India is a direct result of the demand that humans put on them because of their diet and social organization. As the population of India swells more pressure will be placed on probably the most important resource in the country.

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Mar. 2013.

Discussion

Effort Analysis*: [StudentA](#) 90%, [Student-B](#) 5%, [Student-c](#) 5%. We all met and brainstormed how we wanted to discuss our case studies. [StudentA](#) then took the ideas from the brainstorm and wrote them out. [Student-B](#) and [Student-c](#) did the final round of editing of the section.

Word Count: 2283

Soil, as an integrated part of human society, is inseparable from the influences of human action. Through degradation and restoration humanity can steer the productivity derived from land in any number of directions. Soil as a resource cannot be separated and treated independently from the consequences of human choices. In every sense that Lui et al intended humans and the natural soil are coupled. From this coupling both aspects become shaped and molded by the other. The sustainability of the resource becomes derived from the primary mode of use. In the case of Haiti the multiple instances of exploitation, from colonial times to the modern era, have caused a substantial shift in both subsistence patterns and economic viability. India likewise has seen many of the same patterns from the plantation models to the green revolution. Europe on the other hand has had the ability to fair the changing times with soil in much better shape. Having been able to export the production of many soil degrading crops to places like Haiti and India they were able to benefit from the cheap agricultural goods while avoiding the subsequent losses.

H/N Systems – Haiti has seen some of the worst environmental degradation imaginable. They, in an attempt to escape the poverty they had endured, inadvertently destroyed some of the only resources they had. The excessive exploitation of timber resources to meet payments on increasing debt resulted in massive soil erosion increasing the amount of marginalized beyond reasonable levels. In their defense Lui et al. points out that “the ecological and socioeconomic impacts of human-nature couplings may not be immediately observable” (Lui et al, 2007, p. 1515). Because the process of ecological degradation took some time the islands inhabitants appeared to have missed the mark. Not only did they fail to see the consequences as they happened they failed to predict them entirely. The ecological surprises that came with soil loss struck the islanders with little to no warning (Lui et al., 2007, p. 1514). If soil loss was not fully understood in Haiti it is certainly known now.

As logging demands increased to pay for the accumulated debt so did soil erosion. Many of the consequences could be seen “during the first 15 to 20 years” post logging (Lui et al., 2007, p.1515). Without soil the ability to locally produce food also decreased and because “there is no alternative to fertile soil to sustain life” Haiti was pushed deeper into debt and forced to import food stuffs from places like the United States (Shiva, 2008, p. 6). This balance of ecological and socioeconomic systems

created feedback loops that only increased both the drive to exploit and the consequences of exploitation.

Europe was spared some ecological failures that Haiti saw. Europe's forests were heavily exploited for hundreds of years pre-dating the push for colonialism. Areas like Greece and Italy were cleared of much of their standing timber a thousand years ago. Central Europe's timber was likewise exploited but not fully until the industrial revolution dramatically increased the need for timber as a fuel source. Populations in Europe also stayed low enough to protect against extreme soil exploitation. There was simply no need to cultivate much of the land. Europe also experienced massive differences in socioeconomic standings. Peasants lived under the rule of lords and monarchs who controlled much of the production. This social pattern actually helped to increase the homogeneity of impacts across large areas. This stands in contrast to Lui et al.'s concept of heterogeneity helping to prevent substantial degradation (Lui et al., 2007, p. 1516)

Comment [MSOffice9]: Well, and they had disease outbreaks to control population, albeit in a miserable way

Europe was less dependent on their immediate land base in order to meet their needs. By the colonial times Europe was able to import much of their commodity crops. Items like spices, cotton, and tobacco could be imported from the Americas or India. The soils of Europe were spared the reaching of thresholds like many other places were. Europe's long history of agricultural also helped them to better regulate their impacts on the soil environment resulting in an avoidance of collapse due to thresholds (Lui et al., 2007, p. 1514). These intensely coupled systems where the human management was invested in local success meant, and the ability to import degrading crops allowed Europe to benefit while other areas lost out.

It wasn't until the height of the industrial revolution that Europe saw the worst of their soil loss. As population pressures increased the need for food did as well. More efficient and intensive agricultural practices became the norm. This increased productivity fed into its own positive feedback loop increasing population pressures further (Lui et al., 2007, 1513). The consequences of that loss has been somewhat mitigated in Europe through increased protections as a result of changing public consequence. Ecosystems are increasing valued for their services and intrinsic value rather than just as a resource to be exploited (Daily, 2000, p. 395)

India, with the world's second largest population, knows the pressures of increasing population. In their agricultural sector they have been forced to constantly seek out more and more land to be put under cultivation. Without limitations on population growth India has been thrown into a powerful feedback loop where an increasing area needs to be put under cultivation, increasing erosion, lowering the value of land and pushing larger social groups into poverty. The poverty in turn pushes individuals back to subsistence patterns where they need to clear land to grow food and so on. These "land-cover changes influence biophysical processes" and, therefore need to maintain healthy people and soil and continue to feedback into the system at the expense of all involved (Lui et al. 2007, p. 1513).

India is also a prime example of threshold. With the increasing population and the explosion of petrochemical use many of India's regulating processes associated with soil have been lost. Monsoon floods have been exacerbated by the lack of soil and vegetative cover increasing erosion and so on. India has drastically surpassed its capacity to provide for itself importing massive amounts of food a resources to provide for its population. Shiva suggests that the solution to this is not to be found in the perpetuation of this system but rather "soil, not oil, offers a framework for converting the ecological catastrophe and human brutalization we face into an opportunity to reclaim our humanity" (Shiva, 2008, p. 8)

Commons – All three of these case studies have significant aspects of Hardin's *Tragedy of the Commons* woven in. Soil is a resource that is often overexploited without specific management systems to control its loss. Unlike some other charismatic resources soil has never had the conservation movements behind it. Observing its loss can also be difficult especially over longer time scales.

Haiti, post colonialism, experienced a redistribution of land among the inhabitants of the island affectively treating the entire island like a common resource. This instance of common resource distribution didn't appear to be lasting though. The nation as a whole failed to manage its soil resources in a sustainable manner. While the plantation model had been removed from use individuals were still exploiting their soil. Population increases also created incentives for individuals to exploit their local resources. Common forests where used to pay off the common debt of Haiti which further reduced soil stocks. Similar to the experiences of the white settlers on Whidbey Island the Haitian population broke down the soil to the point where it was no longer capable of supporting productive agriculture (White, 1999, p. 43). With no central management system and little to no localized management systems soil was and is exploited in Haiti with little concern for the maintenance of healthy soils.

The conditions for Hardin's collapse appear to be present within the Haitian model. A lack of communication across the country and personal benefit being derived from the exploitation predictable led to a collapse (Ostrom, 2007). In this case Hardin's theory was somewhat applicable although not a perfect model for the situation. The complex social interactions that have shaped Haiti prevent their from being a simple answer to what has gone wrong and the solution will most likely be just as complex (Ostrom, 2007)

England in particular has been used as perfect examples of Hardin's collapse when it appears that is not exactly the case. Europe is also a large area with a very diverse set of social and ecological systems. The case for Europe is that different areas have responded to commons exploitation is a variety of fashions most notably their exploitation of other's common resources. Ostrom defines this activity as "roving bandit" to imply that once the resource has been exploited they merely move on to greener pastures (Ostrom, 2007). This method of preventing a true tragedy of the commons was highly successful for Europe. Hardin's model doesn't factor in this ability for a given population to minimally exploit their own resources while extensively exploiting that of another's. Hardin attempts to suggest to we are only "fouling our own nest" when we pollute or exploit a resource but in reality

Europe was able to complete avoid this while still gaining all of the benefits of overexploitation (Hardin 1969, p 1245)

India, like Haiti, was unfortunate enough to be a colony of a European country. The British occupation led to a systematic exploitation of soil resources for the growth of commodity crops and the like. India is not a homogenous region either, with diverse populations and resources its management needs are highly complex. Management practices that work “in one region may not apply well elsewhere” making sustainable decisions about soil commons difficult (Daily, 2000, p. 395). With the need for increased production and efficiencies due to rising populations India has attempted to use “simple solutions to complex governance problems” that have caused substantial harm to soil commons (Ostrom, 2007). This can be seen in India’s green revolution where rather than develop sustainable management systems that opted for increased petrochemical use in order to meet demands. This has resulted in the increasing loss of arable soils and further detriment to India’s ability to meet its agricultural needs.

Outsiders – The influence of outsiders on soil conditions have been the most evident in Haiti and India. Europe on the other hand has historically been the outsider causing the detriment seen in the old colonies. This dynamic between the abused and abuser still causes conflict to this day. The ecological consequences of these interactions have had some of the more longstanding effects.

Haiti has suffered substantially from the influence of outsiders in their own collapse. First the colonization and abuse of their natural resources through the plantation system and in more modern times the influx of cheap agricultural goods from places like the United States have depressed the value of sustainable agriculture locally. In many cases it has been cheaper for Haiti to import food stuffs rather than grow them locally which has caused the devaluation of farmland in Haiti. A consequence of the colonial period ending in Haiti also resulted in a breakdown of a central management scheme, which the wealthy white colonials did offer, at other costs. Diamond points out that “dealing with adverse environmental conditions may be one of the things that complex societies do best” suggesting that already well developed French colonials had the resources and knowledge to efficiently manage Haiti’s resources but rather chose not to (Diamond, 2005, p 420) “In the absence of external powerful legal or military controls” Haiti shifted towards a system that was effective in the short term for sustainable management but ultimately couldn’t be sustained without an extensive management scheme (Moran, 2006, p 117). The negative impacts of colonialism in Haiti can’t be denied on sustainable soil management, sugar and tobacco are extreme soil degrading crops, but in the absence of even a localized management scheme the potential for sustainable use vanished.

India suffered much the same fate and Haiti. The exploitation of its resources by Britain caused both ecological and social harm that is still evident today. India in some ways has done better than Haiti at constructing sustainable social and ecological systems. While a huge percentage of India’s population lives in extreme poverty others have done rather well. As mentioned before India is an incredible heterogeneous nation with billionaires and paupers present. This diversity makes panaceas near impossible in sustainable soil management. Heterogeneity leads “to difference choices and behaviors” in regards to management (Lui et al. 2007). Some of this heterogeneity was caused by the

Outsiders – The influence of outsiders on soil conditions have been the most evident in Haiti and India. Europe on the other hand has historically been the outsider causing the detriment seen in the old colonies. This dynamic between the abused and abuser still causes conflict to this day. The ecological consequences of these interactions have had some of the more longstanding effects.

British occupation and some was simply a result of the caste system already present in India. The British made a point to remove royal families from power who were unwilling go along with the British model of exploitation and plantation. This helped change the dynamics in India to favor those who were willing to overexploit local resources for economic gain.

Europe's role in all of this helped to accelerate the decline in soil quality and quantity globally. It is impossible to say what Haiti and India would look like today if the European powers had not substantially altered the social and ecological environment. As outsiders they could act like roving bandits (Ostrom, 2007) and "exploit and use energy" (Moran 2006, p. 93) wherever they went. Individual European countries came under the control of various groups and governments throughout their history but for the most part the management philosophies regarding soil were consistent. In the end Europe was spared the worst of the soil degradation that happened and continues to happen. Europe with its vast wealth has been able to choose environmental protection over exploitation and save itself at the expense of the rest of the globe.

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Reflection

Effort Analysis*: [StudentA](#) 5%, [Student-B](#) 90%, [Student-c](#) 5%. We all met and brainstormed how we wanted to discuss our case studies. [Student-B](#) then took the ideas from the brainstorm and wrote them out. [StudentA](#) and [Student-c](#) did the final round of editing of the section.

Word Count: 1345

Comment [MSOffice10]: 720

Soil is a vital resource that humans depend on for every instance of their lives. We live in constant connection with the soil beneath our feet whether we think about it or not. It is very important for us to understand the many different ways that humans are integrated with soil and how soil is integrated with humans. As we demand more and more from our soils we are robbing it and ourselves of vital nutrients and minerals that everything that walks, crawls, or grows on the surface of the earth depends on. Most humans look at soil in an anthropocentric light. We use and reuse as if it was simply dirt, but soil is so much more; soil is alive.

When a soil had been degraded terribly and deprived of all its nutrients and organic matter it takes time to be restored. Because there are so many people that now live on the planet agriculture places a tremendous amount of stress on the soils these crops are grown on. David Montgomery points out that “agricultural erosion rates remain far beyond rates of soil production, global society will eventually be compelled to either adopt agricultural methods that sustain the soil or face increasing competition over a shrinking agricultural land base” in his article titled *Soil Erosion And Agricultural Sustainability* (13271). Feeding all the people of the planet is quite the task while saving enough land, soil and water for every other natural system that inhabits the planet.

The world’s population is growing though; It is projected that the population could reach as many as ten billion people by the year 2050 (Moran, 2006, p. 16). As of 2012 India had already surpassed the one billion mark, over one seventh of the world’s overall population, and is prime example of how humannature coupled systems will be for the rest of the world (India Country Profile, 2012). Liu et al. (2007) states that “as globalization intensifies, there are more interactions among even geographically different systems”; with a population of ten billion the world will be most likely be entirely integrated. We would depend on each other socially, economically, and we would put a tremendous strain on the environment, and an even greater strain on our soils.

Liu et al. explains surprises that occur in human-nature coupled systems; soil degradation leading to disastrous feedbacks should be no surprise. There is more than enough knowledge and evidence of the consequences of ruining soil in many more case studies other than Haiti and India. Montgomery explains that the “recognition of the detrimental influence of accelerated soil erosion on agricultural societies dates back to Plato and Aristotle” (13268). But after years and years of knowing the importance of soil and what happens when it is depleted situation and events such as the dust bowl are repeated. Lui says that “coupled human and natural systems are integrated systems in which people interact with natural components. Although many studies have examined human-nature interactions, the complexity of coupled systems has not been well understood” (1513). The interactions we have with soils however should be widely understood by now.

Hope can be seen in the small movements of people across the globe realizing the need for sustainable practices and the necessity to maintain healthy soil. These movements are the first step in moving away from destructive industrial agriculture and to a more ecologically friendly way of sustenance. As we look toward the future of our society and our sustainability it is important to understand that soil is the building block for so many natural processes and systems. Perhaps an anthropocentric view of soil is inevitable, but a realization needs to made that even if soil exists for the benefit of humans it should also be respected. If it is not cared for and destroyed then we will inevitably face inconceivable problems. We need to look at past examples and the states of India and Haiti to see what happens when soil is not respected; we need to read the countless studies and

books that educate on the importance of soil. Rachel Carson wrote that “we can read why the land is what it is, and why we should preserve its integrity. But the page lies unread” (65). Hopefully we the human race can find the time to read that page.

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