Diamond finishes his study by looking at and grouping the twelve major environmental problems that modern society faces and also explains the timelines of how these problems will potentially play out in our future. He then identifies a dozen arguments that used to dismiss environmental problems and concludes with the simple statement “we need to live within our means” and although it may be difficult to solve our problems, it is neither improbable nor is it impossible.

1. Destruction of Habitat and Loss of Natural Resources (habitat, wild food sources, biological diversity, & soil)
2. Ceilings on Natural Resources (energy, fresh water, & photosynthetic capacity)
3. Harmful byproducts of Human development (toxic chemicals, invasive species, & atmospheric gasses)
4. Population (population increase & ecological footprint)

These problems do not develop in isolation from each other, they are linked in a feedback loop where one problem exacerbates another or makes its solution more difficult. Understanding all twelve problems is important to see how we impact the planet in a global manner. Seeing this “big picture” can at times be pessimistic, but it allows humans to understand and act proactively in order to grapple with the problems of the present.

What are the serious problems that we face?

1. Destruction of Habitat and Loss of Natural Resources
   - Habitats are being destroyed worldwide or are being converted to human – made habitats (i.e. cities). Examples include forests, wetlands, coral reefs, and the ocean floor
   - Forests provide timber & raw materials, but also give ecosystem “services” (protecting watersheds, inhibiting soil erosion, transferring moisture and oxygen to the atmosphere, & providing a home for terrestrial plant & animal species).
   - Wetlands maintain water quality and provide an ecosystem for many salt and freshwater commercially harvested fish
   - Coral reefs are home to a disproportional number of the ocean species. Once the protective coral is gone so is the home to the huge amount of ocean life.

2. Loss of Wild food sources
   - Fish provide a huge proportion of the human protein consumption, which reduces our dependence upon animal protein. 2 Billion People depend upon the oceans for protein.
   - If sustainable harvesting took place the fish stocks of the planet could be maintained in perpetuity but consider ISEP? The tragedy of the commons? The great majority of valuable fisheries have already collapsed or are in steep decline (think North Atlantic Cod)
   - Aquiculture could help but current practices drive down “wild” fish prices and cause more exploitation of stocks to compensate for the reduced amount of money made.
3. Loss of Biodiversity

- Small “seemingly insignificant” species are a part of a larger community and are essential to the overall health of the ecosystem they belong to. (An analogy is that tiny little rivets and wires are essential to operating and maintaining a jumbo jet airplane).
- Earthworms maintain soil and regenerate moisture, soil bacteria fix and regulate nitrogen in soil, insects pollinate flowers and crops, birds and mammals disperse wild fruits and consume detritus feeders and decomposers that clean our water, soil, and air. Any loss of these components in a balanced ecosystem has far ranging effects and further reduces the diversity necessary to stabilize and grow life.

4. Soil Erosion and Degradation

- Farmland soil, used for growing crops, has been eroded by wind and water at rates between 10 to 40 times greater than soil creation rates.
- Forest soils have been eroded by wind and water at rates between 500 to 10,000 times greater than soil creation rates.
- These two statistics prove a “net loss” of soil worldwide (remember it’s needed for plant growth)
- Soil has been damaged by modern agricultural practices (salinization, nutrient loss, acidification, and alkalinization).
- Estimates between 20 to 80% of farmland destruction have been estimated, but world population increases and the demand for more farmland puts more pressure on a dwindling commodity.

5. The increasing environmental cost of fossil fuel energy sources

- Oil, Coal, and Natural Gas form the main source of energy production for most industrialized societies in the world.
- Coal reserves are vast and readily accessible oil and natural gas reserves will last a few more decades.
- There are more oil and natural gas reserves, however they are deeper underground, dirtier, increasingly expensive to extract and process and will involve higher environmental costs (CO₂, HNO₃, H₂SO₄, CH₄)

6. Reduction in the Quality of and Access to Fresh Water

- Fresh water in unequally distributed on the planet
- Fresh water is used for domestic, industrial, and agricultural needs, along with transportation and recreational needs. Industry and agriculture add PCB’s and other toxins into the surface water we use.
- Aquifers, world wide, are being depleted at faster rates than natural replenishment.
- Today one billion people lack access to reliable safe drinking water, which causes diseases such as malaria, trachoma, elephantiasis, schistosomiasis, hookworm, typhoid, cholera, hepatitis, yellow fever, and diarrhea.
7. Amount of Sunlight Available

- Even though the amount of sunlight the Earth receives appears to be limitless, the capacity of plants to be able to use it is limited. Temperature and rainfall are to limiting factors, so there is a limited region where plants can be productive.
- Humans, according to a 1986 study, have appropriated half of the amount of incoming sunlight (golf courses, buildings, crops, tree plantations, and concrete) in most of the areas where plants are most productive. Most energy from sunlight will continue to be used for human purposes and little will be left over to support the growth of plant communities.

8. Harmful Toxic Chemicals emitted into the Ecosystem

- Insecticides, herbicides, pesticides, fungicides, mercury and other metals, fire retardants, refrigerator coolants, detergents, and plastic components are all released into the air, soil, and water by the chemical industry.
- These natural and anthropogenic (synthesized only by humans) chemicals are often by products of industrialization and we swallow them in our food, breathe them in our air, and absorb them through our skin.
- These chemicals cause birth defects, mental retardation, immune and reproductive system damage and death.
- These chemicals break down in the environment slowly (DDT and PCB) or not at all (Mercury). Chernobyl (nuclear waste), Prince William Sound (Exxon Valdez oil spill), Bhopal (Union Carbide chemical plant leak) are just three examples whose clean up costs were enormous.

9. The Introduction of an Invasive and Harmful Species into an Ecosystem

- Some introduced species are valuable to humans (crops, livestock, and landscaping) but others devastate populations of native species by preying on, parasitizing, infecting, or out competing them.
- The alien species have a compounded effect because the indigenous species had no previous evolutionary experience with them (think First Nations peoples in North America and smallpox)
- Think rabbits in Australia and how much that invasive species has been estimated to cost Australia ($133 million in control efforts and $600 million in agricultural losses annually). Think about the Mountain Pine Beetle in BC which has affected over 400 million cubic meters of timber with over 100 million dollars dedicated to the problem in 2005 alone.

10. Increasing levels of Atmospheric Gasses

- Activities of humans release gasses that either harm the ozone layer (CFC’s) or enhance the natural greenhouse effect on the planet (CO₂ & CH₄).
- Driving cars, heating homes, transporting goods, making products, and farming herds of cattle all add greenhouse gasses into the atmosphere that enhances the greenhouse effect that in turn causes global climate shifts.
- Melting of the Greenland ice cap and the Antarctic ice sheet will raise ocean levels worldwide and the people that live along coastal margins face a threatened future.
- The science can only predict so much and the secondary changes that will result from freshening of the cold arctic waters, due to global warming, could lead to a catastrophic series of events.
11. Continual Human Population Increase

- More people require more food, space, water, energy, and other resources.
- Many third world countries have population growth rates of 4% a year and there is a disproportionate number of children and young – reproductive aged people in today’s population.
- Because more people are of reproductive age, population will continue to increase on the planet for at least the next seventy years and those people will require the basic necessities of life.

12. The Ecological Impact of Humans

- Humans consume resources and generate waste. The per-capita impact (resources consumed and the wastes put out by each person) is highest in the First World (each citizen of the U.S., Western Europe, and Japan consumes 32 times more resources than inhabitants of the “Third World”).
- Low impact people are becoming high impact people for two reasons: the desire of Third World citizens to live the First World lifestyle and immigration (both legal and illegal) of individuals from the Third World to the First World.
- Raising Third World living standards to those of the First World is an impossible and unsustainable goal. Even if the population of the Third World did not exist, it would be impossible for the First World alone to maintain its present course, because it is not only depleting its own resources but those of the Third World as well.
- What will happen when the Third World finally realizes that the First World will not relinquish its current lifestyle and that lifestyle is an unreachable goal for them?

Diamond states:

> Our world society is presently on a non-sustainable course, and any of our 12 problems of non-sustainability summarized above would suffice to limit our lifestyle within the next several decades. They are like time bombs with fuses of less than fifty years. Any of the dozen problems if unsolved would do us great harm, and because they all interact with each other if we solved 11 of the 12 problems we would still be in trouble, we need to solve them all.

What objections have been used to contradict the seriousness of the environmental problems we face?

1. *The environment has to be balanced against the economy* in other words the environment is a luxury and solving environmental problems costs too much money so by not solving them we save money of which the opposite is true.

2. *Technology will solve all our problems* which implies a faith in untested technology that we hope will be successful and might have unintended side effects that cause more problems.

3. *If we exhaust one resource, we can always switch to some other resource meeting the same need* without realizing the long transition time it takes to switch to proposed new technology and resources (ex. Hydrogen fuel cells) which simply defers the solutions of a current problem to the distant future.

4. *There really isn’t a world food problem; there is already enough food; we only need to solve the transportation problem of distributing that food to places who need it (same could be said of energy)* but the problem here is the First World has no interest in eating less nor funding on a regular basis the feeding of billions of people chronically.
5. Just look around you: the grass is still green, there is plenty of food in the supermarkets, clean water still flows from the taps, and there are no signs of an imminent collapse but 80% of the world’s population live in poverty and this “head in the sand” perspective is based on seeing current prosperity without looking at the expense of environmental capital which will be bankrupted if we continue on an unsustainable path.

6. Look at how many times in the past the gloom—and—doom predictions of fearmongering environmentalists have proved wrong. Why should be believe them this time? But this complaint about false alarms is misleading because it looks selectively at environmentalist predictions that were wrong and does not account for environmentalist predictions that proved right or anti-environmentalist predictions that proved wrong.

7. The population crisis is already solving itself, because the rate of increase of the world’s population is decreasing, such that world population will level off at less than double its present level but the problem with this is that eight of the ten most populous countries have higher growth rates and more people with a higher growth rate means more poverty and stress on the environment which will exacerbate the problems we face.

8. Environmental concerns are a luxury affordable just by affluent First World yuppies, who have no business telling desperate Third World citizens what they should be doing which masks a selfish attitude that really states environmental concerns are flippant and I am doing fine in spite of all the problems because they fall upon the Third World and not on me.

9. If those environmental problems become desperate, it will be at some time far off in the future, after I die, and I can’t take them seriously but the problem with this Piaget like “pre-operational thought” attitude is that the environmental problems discussed in Diamond’s book will be confronting humanity in the near future, in other words OUR lifetime.

10. There are big differences between modern societies and those past societies of Easter Islanders, Maya, and Anasazi who collapsed, so that we can’t straightforwardly apply those lessons from the past This they were dumb but we are smart attitude is itself dumb because there are more of us today who have more potent technology that impacts the environment than they had in the past. The Easter Islanders only numbered in the tens of thousands and had but stone chisels to work with and they ruined their environment and collapsed their society.

11. What can I, as an individual, do, when the world is really being shaped by unstoppable powerful juggernauts of government and big business? This is a fatalistic attitude that completely dismisses the power of the individual in making decisions (“The fault, dear Brutus, is not in the stars but in ourselves that we are underlings”)

While we do face big risks, the most serious ones are not ones beyond our control; instead they are the ones that we are generating ourselves. Because we are the cause of our environmental problems, we are the ones in control of them, and we can choose or not choose to stop causing them and start solving them. Two types of choices have been crucial in success: long-term planning and the willingness to reconsider core values that we currently hold. The answer: a lower impact society which although fraught with challenges is not impossible as long as you are committed to a consistent policy of actions throughout your lifetime. How? Vote, Consider what you as a consumer buy or don’t buy, Protest and be a public consumer activist, Talk about the problem with your friends and family, Be an example and act locally to enhance your own environment, and Donate either your time or your money.