The Cultural and Technological Mechanisms of Overpopulation and the Resultant Effects on the Environment.

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In the study and practice of environmental protection it becomes evident that a thorough and unbiased view of the past can help one understand the present and, more importantly, what lies ahead for the future. Contrary to popular belief, environmental protection is more than just protecting wildlife habitat and cleaning up toxic wastes. Its most fundamental goal, stated or not, is to protect the sustainability and biological viability of the human species. The other peripheral objectives and actions of an institution, government or other entity charged with environmental protection becomes a tool to achieve that final goal. Ironically it is this same species that has become the cause of most environmental problems. Humans are, despite most contemporary views, an integral and vital part of the natural world, not over and beyond nature.[1] The problem lies, in part, on the extraordinary ability of human culture to provide a framework and mechanism by which humans have bypassed most of the biological factors that are at work in natural selection. This capability allows human populations to thrive which, in turn, magnifies the detrimental effects that technology has on the environment.

At least 4 million years ago, *Australopithecus afarensis* walked down a new path of mammalian evolution that has led to one of the most remarkable creatures to inhabit the earth. This Australopithecine evolved into the modern form of *Homo sapiens sapiens* which has been shaped by natural selection and other biological factors into a bipedal organism with excellent manual dexterity and an ability to reason mentally using abstract concepts and symbols. The species has also developed systems by which to pass on behavioral traits by means of a culture irrespective of genetics. These shared behaviors along with shared beliefs, values, customs and material objects are used by members of a society to cope with the outside world and with fellow members of that society.[2]

It has been over these last 130-200 thousand years that *Homo sapiens* have been on this earth in a contemporary form. About 16 thousand years BC a fully modern hominid named *Homo sapiens sapiens* first appeared. Since then, humans have not changed in any significant way biologically.[3] The fossil and archaeological record has shown that through their culture these fully modern humans have led a rich existence, utilizing a full inventory of values and beliefs in much the same way that people do today.

For this article the term complexity refers to the numbers of people and their interconnections within a cultural system instead of their technological sophistication.[4] It is important to understand that although a human culture may lack a more developed technology, it is as elaborate and structured a system as the most complex society. An example of this can be the !Kung hunters and gatherers who use an ingenious method of hunting. They will coat their arrows with a poison made from a beetle's blood which, upon penetration of the skin, will attack the central nervous system of the prey. This does not render the meat useless, however, since the poison is harmless when ingested by humans. The technology used by the !Kung shows the same level of refinement that can be seen in any western biochemistry laboratory. In a less developed country the

technology is considered and mistakenly classified as inferior. As a consequence this view leads to unfounded ethnocentric behaviors such as colonization and enslavement.

It is this framework of culture and technology that has clashed with the environment since *Homo erectus*. It was *Homo erectus* who first used fire in Africa, Europe and Asia. The effects of this valuable tool on the environment were impossible to see then because the environment was able to tolerate this limited contamination. About 20-30,000 years BC humans, using their tools and well developed brains, almost certainly caused a mass extinction of many large mammals including the woolly mammoths, saber-toothed tigers and the giant ground sloth throughout the western hemisphere.[5] One thing that these facts show is that human involvement in and responsibility for environmental problems has always existed to some degree. At the core of the environmental issue is the less obvious but very significant fact that the larger the human population grew the greater its impact on the environment.

Humans used their skill and mastery of tools to develop the highly effective and long lived practice of hunting and gathering purposes. This adaptive strategy is an efficient one which uses very little biological power to achieve a high caloric return (although there was a reliance on large areas of land).[6]This strategy promoted low growth rates among populations because of the need for mobility and a high risk period during the first five years of a person's life. The availability of food resources was generally not a problem since it was easy to pick up and go to where the food was, providing the space was still uninhabited.

According to the population pressure hypothesis, this appeared to be a sustainable subsistence. However, the positive growth rate, no matter how low, eventually caused the groups to exceed the carrying capacity of the land with nowhere left untouched. Around 10-6,000 years BC, bands of hunting and gathering societies became more sedentary and the first evidence of domestication of animals and plants are traced back to what is now the modern day Middle East.[7] For the first time humans began to produce food instead of gather it. The populations of the areas practicing this new subsistence strategy possibly bottlenecked just around the transformation (first evidence of nutritional anemia and TB found here[8]) and then certainly followed with a sharp rise in numbers[9]. The new lifestyle and horticultural food production system provided an abundant food supply which resulted in a greater carrying capacity of the land. Less post-natal care due to the new lifestyle increased the population growth rates as well[10]. There were approximately 5-20 million people world wide and these more sedentary people began living in larger groups.[11] The egalitarian style of socio-political control could not handle the more dense populations and greater complexity of social relationships. A shift was made towards a chiefdom society[12] that allowed for better organization among the sub-groups. This agricultural revolution and shift in socio-political methods occurred independently throughout the globe in reaction to higher populations.

Along with this new subsistence strategy and sociopolitical strategy came an entirely new grouping of tool technology. Projectile points were replaced by hoes and spears were replaced by Shadoufs[13]. This new technology became an integral part of the culture to which it belonged and shows the interrelationship between technology, culture and the environment. It is important to treat these relationships as connections and not a form of determinism. During these environmental and technological changes, the culture of these

groups began changing to accommodate a whole new set of beliefs, practices and taboos. Soon pottery making evolved to meet the storage requirements of the surplus food being cultivated. Long distance trade often exchanged this surplus for other goods or food types. Irrigation intensified the agriculture and then full-time specialists improved the technology which in turn created more surplus which a new invention, the wheel, helped distribute even farther in every direction. All of this surplus food was eventually eaten by more individuals and population continued to increase. Humans had reached a point of no return; agriculture and the intensive manipulation of the natural environment was here to stay.

Yet, all the while this was occurring, there were species of plants and animals being "artificially" selected out in favor of domesticated versions. The soil was being depleted of the nutrients and humus that were important to its stability. As population densities became even greater, more complex systems of governments became necessary[14]. One of these more complex governments, Mesopotamia, fell because the soil had reached a level of depletion which could not sustain the people reliant on it.[15] The archaeological record shows that the annual crop yield was approximately that of today's mid-western United States[16]. These changes that occurred were a byproduct of the technology, culture and the environment working with and against each other with the resultant effect on the environment being far reaching and irreversible.

This brief summary of history leads to the more familiar topic of industrialized societies and the environmental impacts that can be seen occurring since the beginning of the industrial revolution. An important example of this is the fuels that power these industrial societies. Originally, wood had been used exclusively until coal was found to have more efficient combustible properties. Then that black stuff leeching out of the ground and ruining crops on North American farms was identified as a combustible material called oil. This made a few Native American tribes who were displaced into reservations located on these lands, due to their "useless nature", very wealthy. When the potential of these fossil fuels began to be realized it allowed for less human energy to be spent on food production with an increase in the available energy for mechanical food production. The available energy, along with the emerging technology developed to harness it, meant that even less human power was required to cover the basic food resource demands. This development of technology also allowed for greater specialization of labor and resources to be used on more industrialization. This increase in industrialization helped meet the ever growing demand for food resources.

What needs to be introduced next into the equation is a theory concerning the two converse reactions by which human groups respond to a depletion of resources. In an agrarian society, children are often viewed as economic bonuses who serve as extra laborers. [17] In industrial societies this view comes around full circle and children are seen as a burden since their presence brings another mouth to feed. This can be seen in present day America with its strong industrial and agricultural bases. Industrialization, and later women's equal rights, also cause a longer period before marriage which effectively limits the available reproductive time. Modernization of agriculture and Agribusiness throughout the western world placed limits on the potentials of young rural couples even further. The children of rural families in these industrialized societies began their migration to the cities thus further increasing the urban densities but decreasing the

overall growth of the entire country. This is because these fledgling urbanites would have probably produced a greater per capita number of children if they had remained behind in their native rural towns[18]. Overall, there is a drop in population growth to a lower, but still positive, growth rate. In the less developed societies, which tend to be agrarian and without significant industrial complexes, there remains a steady positive growth rate at a higher level. This is due to the value of children as inexpensive labor. In more drastic cases this utilitarian view sometimes manifests itself through the cultural significance of male children over female children. Recently in India, a nation that is finding itself with the second highest population problem, female infanticide as well as sex selective abortions have become commonplace practices. Yet, population wise, Asia comes out on top by far with an official census for China showing 1.134 billion people in 1990[19] and an estimate for the entire continent of 3.113 billion people in 1990.[20]

Demographic Index	10,000BC	AD 1	1750	1950	1990
Population (millions)	6	252	771	2530	5292
Doubling Time (years)	8369	1854	1083	116	38
Annual Growth (%)	0.008	0.037	0.064	0.596	1.845

Table 1. World population growth.
Source: Massimo Livi-Bacci, P.31

To bring this into better perspective, the human population has grown exponentially since the beginning of the industrial revolution. Estimates show that around 1350 AD there were approximately 85 million people and after a drop of 20 million people during the first major outbreak of the Plague the population increased again from 65 million in 1500 AD to 110 million in 1600 AD.[21] By 1930 there were approximately 2 billion people inhabiting the Earth; in 1968, 3.5 billion, now there are 5.3 billion. World wide the last few decades have shown a slowing of the birth rates from 2.1% (1960's) to 1.8% (1990) bringing the doubling rates from 32 years down to 39 years.[22] However this is to small a period to ascertain any change in trends. This is due to the variable nature of global population growth at specific times within a consistent long term upward trend.[23]

In the United States, the population doubles only every 55 years compared to the 32-39 years of the world's growth. Some groups have grown significantly faster than the United States. One of those groups is the African nation of Kenya, which has an average annual growth rate of over 4% and a doubling rate of 17 years.[24]These figures show that there are eighteen people born every 6 seconds; that's nearly 11,000 more food consumers every hour. However, there is less available topsoil, estimated to be in the hundreds of billions of tons, and trillions of gallons less groundwater with which to grow crops.[25]

In today's world this population problem affects society in many ways. In industrialized societies there is an ever increasing reliance on fossil fuels, oil in particular, which is a highly unstable resource base. Oil is extracted from the ground using drilling rigs which need energy to operate. Then the oil eventually loses pressure and needs to be pumped out using electrical energy harnessed from other fossil fuels. The crude is then shipped expending fuel energy where it is heated using energy and distilled into its byproducts, then shipped again to warehouses where it will be shipped again to

distribution centers. Some of the byproducts are shipped from the distribution centers to homes for heating, a little to power stations, and some becomes the gasoline that helps ship these products all over. Some of the byproducts go into fertilizer which is shipped to farms to grow crops that are in turn cultivated and harvested using fuel energy. Then the harvest is shipped to preparation plants or directly to the distribution centers where they end up in grocery stores. Then individuals use their fuel driven cars to gather these products from the grocery store. To pay for these products people must drive these cars, sometimes in heavy traffic, to work, use energy there, and then drive back home. The net result is barely enough energy to flick a Bic, but the system works, despite the diminished returns, since the entire process supports each component part's immediate requirements.

The problem lies in how much of those resources are ultimately available, the use of those resources over time, and the heavy reliance of the entire system on one individual type of resource. Due to conservation efforts, the total requirement of fossil fuels has been decreased but the total reliance on them has not. This is because effective alternative fuels have not yet been fully developed. There are many different figures reported concerning the availability of oil resources, based on current consumption. These range from 20-60 years depending on the source. However, that figure is useless if one considers that current consumption will not remain where it is, despite conservation, if the population continues to increase and more countries opt for the technological fix and become more industrialized. This 'if' is becoming reality and can be seen all over the world. For example, in India they have recently retired the balance of their steam locomotives for diesels and many South American countries are clearing huge tracts of land for beef and manufacturing industries.

The question remains, that if the available resources are depleted will nature cull the population through disease and starvation or will humans be able to adapt, once again deferring the inevitable future problems? This ultimate question is what really scares the majority of people. Bring up this issue in Vatican City and you will hear, amidst the uproar, Catholic Bishops say that "the world's resources can theoretically feed 40 billion people."[26] The pressures from all sides, against candid discussion, are insurmountable. The Christians and other religious communities feel that this will be an open invitation to contraceptives and abortions. The economists surmise that their ever expanding consumer base will shrink and wreak havoc on the world's economy.

In fact, the issue of population control is the most important and difficult to deal with. The debate begins, for the most part, with Johann Peter Süssmilch in 1741 the first to study demographic issues. He stated his pro-growth view within four main rules saying that the state should 1) remove obstacles delaying or preventing marriages, 2) eliminate all impediments to marital fertility, 3) help preserve the lives of its citizens and 4) must keep its subjects at home while attracting foreigners.[27] His ideas and supporting conclusions reflected humane anti-war principles and institutional support for the under-privileged. His work was soon challenged by the most well known work to date on demography by Thomas Robert Malthus, *An Essay on the Principle of Population*. Malthus went against the popular beliefs of the day and showed that population growth could and would ultimately surpass the available resources. The Malthusian model can be summarized in four points as well:

- The primary resource is food and its scarcity causes mortality to increase, slowing (or reversing) population growth and reestablishing equilibrium.
- The law of diminishing returns is unavoidable. Cultivation of new land and intensification of labor in response to demographic growth adds progressively smaller increments to production for each additional unit of land or labor.
- Production or productivity increases resulting from invention or innovation provide only temporary relief, since any gains achieved are inevitably canceled by demographic growth.
- Awareness of the vicious cycle of population growth and positive checks may lead a population instead to check its prolificity (and so demographic increase) by means of nuptial restraint.[28]

However, he used this argument to condemn the English Poor Laws by stating the provision of welfare to the poor only decreased the effectiveness of positive and preventative checks on population control by allowing people to live beyond their means. An example of his preventative check was the foresight given to the cost of having a family while his positive checks were the actual distresses by poor families from a lack of food resources.[29] Historically, the Malthusian theory, more specifically the positive checks, has been proven to be correct.[30] One important thing to remember is that humans have always provided support for the less fortunate. An excellent example of this human trait is the 45,000 year old *Homo sapiens neanderthalensis* fossil found in Shanidar Cave in northern Iraq. It was a forty year old male who lived in the cave and was crushed by an avalanche triggered by an earthquake. The skeletal remains indicated that he was arthritic and was born with a deformed right shoulder blade, collarbone and arm. The arm was then amputated above the elbow as evidenced by a healed wound. The extraordinary wear on his teeth shows that he used his mouth as a tool to compensate for his handicaps. The left side of his skull shows damage which occurred early on in his life. The trauma resulted in the loss of use in his left eye. Apparently he was unable to hunt and was most likely cared for by his family.[31]

Today the debate rages on regarding what, if any, population controls are necessary to sustain a viable global human population. The arguments for the issue of overpopulation or against range from economic to humanitarian and from environmentalism to nationalism. The issue of population control also raises questions of abortion, viral pandemics and Fascist selection. Concerned with this issue, the United Nations International Conference on Population and Development in Cairo recommended the inventory of a full range of family health and planning methods be made available in all countries. They should be offered according to the equal rights of access for all members in a society and with the freedom to make personal choices. They opposed the usage of abortion as a primary method for population control yet left it as an individual's option. A large emphasis was placed on women's issues, education and the universal availability of medical services and family planning options.

Economists in the past have viewed a growing population as a necessary precursor to a better economy [32] but neglected to take into account the resources required to support this population. Those that have attempted to address the resource issue have cited the ability of humans, over the millennia, to adapt using technology in overcoming population pressures. However there was the attitude that resources were inexhaustible. This has

shown itself to be false when it comes to many resources like fossil fuels and, most of all, land. Granted, more oil can be obtained from the abandoned oil wells, but the process is literally attempting to extract oil from a stone and yields only one barrel of oil for every one ton of shale processed.[33] In 1988 the US consumption of oil was 17 million barrels a day[34] which cannot be supported by this method. Along with more offshore prospecting, this method is also much more expensive and will soon be inefficient compared to other alternative fuels. Besides this, running out of oil also means running out of plastics and fertilizer, for which there are not many viable alternatives.

This is where many business leaders chime in, stating that "open and competitive markets . . . foster innovation and efficiency" which will help cause environmental change.[35] The problem with this is that industries are governed by a profit margin which, in the context of business, is fine, except that change only occurs when it becomes economically beneficial, which may be to late. The market changes only when pressure is placed upon it by consumers or other factors. It should not be construed that industry and technology will not hold an important role in environmental protection. On the contrary, technology will assist in providing the means by which people will live a more environmentally conscious existence. For example, industry will develop alternative fuels and environmentally sound products to replace the technology of today. However it should be noted that technology may not be capable of saving the species in the end. Yes, it has been the ability of humans to develop adaptive technology to continue on, yet no one can say for sure whether this will be true for the future. In fact, much, if not all, of the technology used to increase food production is harmful to humans.[36]

Some economic leaders are, for their part, attempting to educate the economic community to the problem and long term benefits of resource management. The members of the Business Council for Sustainable Development (BCSD) are making the point that markets must reflect the total cost of their product, both economic and environmental. This also applies to people since their labor and consumption are the most valuable resources. It remains illogical to damage the human population with toxic chemicals, whether they be airborne or waterborne, since the medical effects resulting will only diminish the capabilities of everyone affected. For instance, a worker with environmentally caused cancer not only misses work and becomes less efficient but also spends more on medical care and less on consumer products. The business also spends more on medical insurance premiums. These costs and lost productivity, along with fines, becomes larger expenses than the proper disposal and conservation of chemicals.[37]

Along with technology, government in all societies has an important role in environmental protection. This role is now and will continue to include passing laws and funding alternative research and education that will provide outside pressure to business and individuals alike. This role in American and other western governments is most effective if one looks at the technology that has come out of the defense industry and the successful environmental clean up efforts which have provided better air and water quality. Examples of this are radar, the Internet and, ironically, many medical technologies originate from military technology. Granted, this success has come at great costs if one looks at the money spent, money which no industry could ever provide.

However the government's most important role is its function as a tool of the culture. The laws and actions of any government or socio-political system reflect the culture as a

whole. History and prehistory have shown that the socio-political system has become larger in response to the larger population and more complex social structure that accompanies it. It is necessary to have a government which intervenes in environmental issues. Without legislation or other governmental action industries and individuals will continue their destructive practices as they have always done. It is important to note that government educates in part through information but mostly through legislation. There is a push and pull dynamic between the society and its government. As things become more culturally accepted they become more accepted by the government and vise-versa. This response allows the socio-political system to continue its role of providing the individuals within a culture the context of beliefs and values within which they act. The government provides only the beliefs and values proscribed to it by the culture.

Throughout the process there has been the trial and error approach to protecting the environment. This is common in all human enterprises and must be expected. The links between over-population, technology and the cultural system to the process of environmental protection are complex and come to the core of this issue. Over-population is often regarded as a problem for the future, yet it has been shown to have been a problem for much of the past. Limiting population growth soon is imperative to the ultimate survival of the human species. Technology will play a role in lessening the damage done to the Earth but will in no way save the species. It will take a greater knowledge of the past and present to make an effective change for the future. It will also take the cooperation of governments, industries and individuals to work within their culture to solve the problems faced by an entire species. It needs to be mentioned that the solution for one cultural group might not be suitable for another and all peoples possess the capabilities to cope with this problem through many different, effective and intelligent solutions. One can not place the blame of overpopulation on less developed countries or on the poor. It is those poor and less developed nations which have helped provide the resources and means by which the industrialized nations subsisted after outgrowing their own boundaries.

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