

# Sustainable Human Behaviours for Combating Sixth Mass Extinction

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## Abstract

Biodiversity loss through anthropogenic drivers is a matter of serious concern. Background extinction is a natural phenomenon. Anthropogenic biodiversity loss, also called sixth mass extinction has been addressed from various viewpoints. The issue of biodiversity loss has been discussed in local-, regional-, and national- and international –forums. The debate is continuing to identify the root cause of the anthropogenic mass extinction. The present communication discusses various anthropogenic drivers of biodiversity loss and explains the on-going sixth mass extinction using Garrett Hardin's "the tragedy of the commons". Such explanations provide options for policy makers and for the people to save the precious biodiversity of our planet. It has been demonstrated that our present consumption of the Net Primary Productivity must be reduced through reducing consumption of food and energy to save the other life forms or the biodiversity. Promotion of sustainable human behaviours to ameliorate the problem of anthropogenic extinction has been discussed in the light of recent findings from neurobiology and molecular biology to give options for solving the problem. Biodiversity conservation through providing benefit to the people may be the effective conservation strategies which would save the interest of human civilizations as well as other life forms on the earth.

**Keywords:** Biodiversity, Altruism, Eusociality, Selfishness, Sustainable behaviours, Policy.

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## INTRODUCTION

Diversity of ecosystems, species, and genes together constitute the biodiversity. Biodiversity is essential for our survival [1]. Anthropogenic biodiversity loss can be global, regional, national, or local and all are due to unwanted human population growth, poverty, harmful subsidies and incentives, land use policies, political will, political unrest and war, in fragmented decision making, unsustainable production and consumption pattern, inadequate valuation of biodiversity, globalization of trade, poor Governance, ineffective intersectoral coordination, loss of cultural identity and spiritual value, limited use of scientific and local knowledge and poor understanding about the role of biodiversity [2, 3]. Evolution or extinction is based on a thermodynamic process. Breakdown of S-P bond of DNA causes new arrangement of base pairs and forms new genome. This explains both evolution and extinction. Extinction of species is a matter of serious concern for the human society and other living organisms [4]. Although a number of anthropogenic drivers have been identified for biodiversity loss, the root cause of such drivers is not yet clearly known. The present communication attempts to establish the root cause of anthropogenic extinction as well as to address the debate with theoretical analysis of the anthropogenic sixth extinction which would have

significance to the policy makers as well as for the human civilizations.

## Extinction

When all individuals of a species are lost, the species is said to be extinct. Of 3 types of global extinctions, in background extinction some species disappeared without human intervention which is a normal process in the living world [5]. Mass extinctions, the exceptional loss of biodiversity, caused by natural disasters are substantial in size and global in extent. Such extinction affects a broad range of taxonomic groups over a very short period of geologic time [6, 7]. Third type, the anthropogenic extinction is caused by unwanted human activities. Extinct species out numbers living species by a factor of about 100:1 [8]. In spite of background extinction, diversification appears to have continued unabated in the world apparently reaching its highest ever level of species richness during the Pliocene and Pleistocene [4, 9]. A profound loss of biodiversity in a short period of the recorded history of the earth was due to five mass extinctions [10].

## Sixth Mass Extinction

That the earth has entered in the sixth mass extinction event in the Anthropocene is generally

agreed [11]. The Anthropocene epoch had started in latter half of the 18th century with clearly noticeable impact of anthropogenic activities [12] on biodiversity. The background extinction rate is believed to be less than one species per million per year or 0.000001 % annually [13]. If the number of eukaryotic species stands at 1 to 20 billion than the number of extinct species would be fewer than 20 per year. The present extinction rate is perhaps thousands of times higher than the background rate [14]. The human population now stands at 7.6 billion from 1.8 billion a century ago, averaging about 1% increase per annum [15, 16]. The human footprint between 1993 and 2009 on the landscape has grown at about 0.52% per year [17].

Intact forested landscape has reduced at a rate of 0.57% per year [18]. Human land use pattern has caused an estimated loss of 1014 kilograms of organic carbon from the topsoil [19]. The combined effects of pollution, compaction, erosion and salinization have degraded one quarter of terrestrial surface [20]. Anthropogenic climate change is manifested by acidification of Ocean by 26%, temperature rise by 0.85% and the rise of sea level by 0.2m over the past century [21]. A total of 605 declines in the population size of wildlife vertebrates have been recorded between 1970 and 2014 based on data from 4005 species [22]. Since 1500, a total of 338 extinctions have been recorded among the vertebrate taxa [23].

The Anthropocene biosphere is characterized by the widespread resetting of the composition of ecosystems accompanied with human consumption of some 25% to 40% of Net Primary Productivity, the human directed evolution in animals and plants and evolving technosphere [24, 25]. Some 25% of mammals, 13% of birds, 41% of amphibians, 33% of reef building corals, and 34% of conifers are identified as threatened with extinction [23]. The present ecosystem is a combination of modified novel ecosystem and human engineered ecosystem [26]. As per IUCN, 25% of 1306 marine invertebrate species and 42% of 3623 terrestrial invertebrate species are threatened with extinction [27]. Overexploitation, habitat loss, introduction of invasive species, pollution, climate disruption and toxification has caused serious declines in number and population size of vertebrate species [23]. Between 1970 and 2012, the wildlife has reduced by as much as 58% [28]. Agriculture is being practiced over a third of the terrestrial surface of the earth [29] at <http://www.fao.org/faostat/en/#data/EL>.

Anthropogenic activities are reported to produce more reactive nitrogen than all other planetary processes [30]. Mining, building and agriculture are reported to move more earth than all the planetary processes [31]. About two-thirds of global biodiversity loss was attributed to human encroachment, agriculture and forestry. Indirect land use footprints were high in low income but large countries with low population

densities like Australia, Brazil and Canada [32]. Biodiversity loss due to disturbances and habitat fragmentation by roads are contributed for about 9% of global biodiversity loss. Greenhouse Gas (GHG) emission has caused about 34% of total biodiversity loss. Human food consumption pattern has the highest contribution to the biodiversity footprint for most of the regions/countries. For 14 countries with a high demand for import of agricultural product, or forestry product, such as Luxemburg and Belgium, the environment pressure has caused more than 55% of their biodiversity loss [32]. Species with small ranges are particularly threatened [33]. Dispersive species as well as widespread species are less prone to extinction [34]. Plants with separate sexes are more prone to extinction than hermaphrodite sister clades [35].

Williams *et al.*, [36] mentioned that a global signal of terrestrial and marine neobiota, the dominance of human over Net Primary Productivity, the human directed evolution of organisms and evolving technosphere as the reasons behind sixth mass extinction. Invasive alien species constitute the second most serious threat next to habitat destruction [37]. Such species comprises the introduced plants, animals and organisms; the establishment and spread of which threatens ecosystems, habitats and other species [38].

### The Tragedy of the Commons

Thucydides [39] describes how self interest work against group benefit and ultimately degrades individual's success. The phrase 'the tragedy of the commons' was coined by Hardin [40] for this purpose. Garrett Hardin's tragedy of the commons, a situation in which individual competition reduces the resources for which individuals compete, resulting in lower overall fitness for all members of a group or population. It shows how individuals driven by self interest can destroy (tragedy) the common resources on which they all depend [41]. The tragedy of the commons in evolutionary biology includes what social scientists call a public good game, or an N-person prisoner's dilemma [42]. Solving the dilemma often requires negotiations and sanction which can change the payoffs and the group beneficial behaviour and also becomes optimal for the individual.

The tragedy of the commons describes a situation in which selfish action of individuals result in the complete collapse of the resources over which they are competing [40]. Religions possible role in facilitating eusocial human societies has been discussed from an ethological perspective [43]. The evolutionary principle of the survival of the fittest seems to predispose individuals to selfishness. In altruism one individual, or a group increase the fitness of the other group. In selfishness, system will only perform action that increases individual fitness. Thus, one's own fitness is indirectly reduced by altruistic behaviour [44]. In certain conditions, genes make their carrier altruistic

[45, 46]. Some variation in willingness to help others is heritable.

The genetic polymorphisms between altruism and selfishness relies on single locus two alleles models that lead to recurrence equations for the frequencies of genotypes in successive generations [47]. Knafo *et al.*, [48] used two scales in describing our money allocation behaviour. The first scale was the universalism including tolerance, protection, appreciation and understanding and nature of the well being of all people. The second scale, the Benevolence refers to the preservation and enhancement of the well being of the people with whom one is in personal frequent contact. It is also concluded that arginine vasopressin 1a gene contribute to individual difference in money allocations and the long alleles of the promoter RS3 repeat region are linked with higher scores on the above two scales of human altruism. It suggests that people with the long Rs3 repeats allocate more money than individuals having short repeats. Thus polymorphism of the arginine vasopressin 1a receptor is identified as a factor that would reduce altruistic behaviour. Individuals who have founded more companies are significantly more likely to be homozygous for the long-repeat allele of AVPR1a [49]. The study of Avinun *et al.*, [50] with preschoolers is consistent with the above study. It is interesting to note that with 0.06% biomass human worldwide are now consuming 30% to 40% net primary productivity [51]. Such consumption pattern in context of conservation behaviour should be addressed urgently.

### Sustainable Human Behaviours

Attempts have taken to explain “why we behave the way, we do”. Human behaviours often attract media attention. However, many aspects of human behaviour are controversial [52, 53]. The environmental changes we face today are the result of human consumption pattern, human population growth and technological advances [54]. Technological advance make consumption easier which results in resource depletion and emission of greenhouse gases [55]. Interventions in change of our behaviour need to be moved beyond creating green consumers rather foster and support green initiatives [54]. Sustainability can be achieved by reducing consumption, leading a simple life that will improve societal and individual well being [56].

Green citizenship refers to environmental behaviours through which individuals can engage in everyday life patterns through the act of sharing resources like act of sharing skills, services or items with others. This practice has been common throughout the recorded human history with the exception of modern industrial age [54]. Two factors are noteworthy to discuss in this context from the view point of behavioural biology. The first factor is the understanding of the people's non-conscious nature of

much of human behaviour. The second factor is the value attached to the outcomes of intervention. Sustainable policies find more support when outcomes are presented in terms of the health benefits of mitigation rather than the health risk of climate change [57, 58]. Huge and immediate changes are required for promoting sustainable behaviours that would arise from research on public acceptability of effective interventions including economic ones to meet the unprecedented global challenge [58] including sixth mass extinctions.

## CONCLUSION AND RECOMMENDATIONS

Goody and Krall [59] identified the ultra sociality of human as the root cause of ecological collapse and alter collapse. According to them, “The question implicitly raised by ultra sociality is whether we leave our fate as a species to the whims of blind evolutionary processes that have brought us to our current state of ecological collapse alter our future”. Ellis [60] concluded that socio-cultural niche construction by modern human has reshaped the biosphere and would continue to reshape both the biosphere and human societies. Laland and O'Brien [61] also discussed the niche construction process with implication for human science.

Motives are independent drivers of goal directed human behaviour [62]. Human motives have been inferred from individuals' behaviour by assuming that various motives lead to various behaviours [63]. A low or even negative connectivity in the network consisting of left anterior insula, left ventricular striatus and anterior cingulate cortex of the brain was reported to be responsible for selfishness while the positive connectivity in the said networks was reported to be responsible for prosocial behaviour [63]. Effective strategies for timely amelioration of sixth mass extinction problem require contribution from many disciplines. Transformations being called for include actions in seven dimensions (law, technology, democracy, science, money, culture, and behaviour [64]. Promoting a circular economy [65] and bringing the most sustainable product in the first place [66] must be given due importance. The principles of sustainable development include fairness, equity and justice.

Nagoya Protocol describes the process for achieving a fair and equitable benefits sharing mechanism from the utilization of genetic resources (i.e. genetic diversity, one component of biodiversity) and on applications and commercialization. Protocol dictates benefit sharing including monetary and non monetary benefits [67]. Lastly it is safe to conclude that providing incentives or other benefit to the people would have potential to solve the biodiversity crisis as found in case of Joint Forest Management [68].

Numerous attempts have been taken to conserve the biodiversity in all places through regional – national- and global -efforts. Various environmental problems are interconnected. This is difficult to solve the problem of sixth extinction in isolation and at the same time only by scientists, Government departments and Policy makers. The main cause of anthropogenic extinction appears to be the consumption behaviour of our species. Behavioural biology is linked with many disciplines. Creating green consumers or promoting citizenship or eco-friendly practices or sustainable living can only be possible if we can change our behaviours. Seven dimensions --law, technology, democracy, science, money, culture, definitely behaviour have tremendous importance in ameliorating the problem of anthropogenic extinction. Out of the said seven dimensions five are operating. Thus, it appears that promotion of sustainable human behaviours by providing incentives to the people would help in involving the people for protecting biodiversity and would have significant bearing to the humanity.

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