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Desperate 'Dystopia' instead of Brilliant 'Utopia' in Environment and Ecology: Abyss as a Result of 'Progress of Scientific Technology and Development of Society'

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Desperate 'Dystopia' instead of Brilliant 'Utopia' in Environment and Ecology: Abyss as a Result of 'Progress of Scientific Technology and Development of Society'

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Abstract

The progress of scientific technology and development of society have not only brought us large profits and conveniences but also have caused serious damages, degradations and destructions of natural environment and ecology. These environmental/ecological crimes and harms have put lives of human beings, other species and the Earth in danger, done extensive damages to their health, and encroached on the 'right to live a healthy life in safe and secure environment and to keep our mother Earth itself clean' for our generation as well as future generations. First, in the capitalist mode of production, in accordance with the progress of scientific technology, as the intensive production and mass consumption have been exponentially increased with using a large amount of hazardous materials and extracting natural resources, environmental/ecological damages, degradations and destructions have remarkably accelerated. Applying a perspective of green criminology, the way to investigate into causes and to take countermeasures against them should be fundamentally changed. Second, using the concepts and methods of 'complex dynamic green criminology', the complex and uncertain relationship between human activities and environmental and ecological degradations and destructions should be deliberated. Then basic ideas and action plans should be suggested in order to construct the system of production and consumption, in which the environmental protection and sustainable development can be possible and human beings can enjoy the right to live in a safe and secure environment, other species can escape from damages and extinction, and the earth, other planets and the outer space can be kept clean.

I. Introduction

The progress of scientific technology and social development have not only brought us large profits and conveniences but also have caused serious damages, degradations and destructions of natural environment and ecology. These environmental/ecological crimes and harms have put lives of human beings, other species and the Earth in danger, done extensive damage to their health, and encroached on the 'right to live a healthy life in safe and secure environment and to keep our mother Earth itself clean' for our generation as well as future generations.

Since the industrial revolution until now, various kinds of pollution and contamination, illegal dumping and disposal of noxious industrial wastes, illegal locking, illegal trade of endangered species etc. have been made formerly at the local level, and nowadays they have been expanded to the global level. Meanwhile, as environmental/ecological degradations and destructions have invaded most of all regions around the Earth from the equator to the polar, from lands to seas, from sky to underground, and even around and beyond the Earth (i.e. space debris and outer space extraction), a lot of people have suffered from their ill effects and harms to their lives and health have occurred. Although many kinds of international treaties and regulations against environmental degradation and destruction have been made and adopted, and each country have taken measures, they have been not enough and not succeeded in stopping environmental degradations and destructions and preventing their harms and damages.

In this report, taking several cases at various levels (i.e. air, sea, land, underground and outer space) as materials and analyzing the structural mechanisms of in a sense 'paradoxical occurrence' of these crimes and harms are cleared. Then the fundamental ideas and principles for concrete and feasible action plan will be suggested in order to stop environmental/ecological degradations and destructions, prevent their damages and harms, and establish and maintain the 'right to live a healthy life in safe and secure environment and keep the Earth itself and around, other planets and outer space clean'.

II. Components

1. Prologue and Epilogue

The progress of scientific technology and development of society have not only brought us large profits and conveniences but also have caused serious damages, degradations and destructions of natural environment and ecology. These environmental/ecological crimes and harms have put lives of human beings, other species and the Earth in danger, done extensive damages to their health, and encroached on the 'right to live a healthy life in safe and secure environment and to keep our mother Earth itself clean' for our generation as well as future generations. First, in the capitalist mode of production, in accordance with the progress of scientific technology, as the intensive production and mass consumption have been exponentially increased with using a large amount of hazardous materials and extracting natural resources, environmental/ecological damages, degradations and destructions have remarkably accelerated. Applying a perspective of green criminology, the way to investigate into causes and to take countermeasures against them should be fundamentally changed. Second, using the concepts and methods of 'complex dynamic green criminology', the complex and uncertain relationship between human activities and environmental and ecological degradations and destructions should be deliberated. Then basic ideas and action plans should be suggested in order to

construct the system of production and consumption, in which the environmental protection and sustainable development can be possible and human beings can enjoy the right to live in a safe and secure environment, other species can escape from damages and extinction, and the earth, other planets and the outer space can be kept clean.

2. Honey Bee Loss, Fruitless Fall, and Catastrophe of Flora and Fauna: Will the Butterfly Effect of Green Crime happen?

In 1962 Rachel Carson predicted a 'silent spring' and warned of a 'fruitless fall'. In recent years, beekeepers watch a great many bees mysteriously die, and they continue to disappear. The remaining pollinators, essential to the cultivation for large part of crops, are now trucked across the country and flown around the world, pushing them closer to collapse. Has a 'pollinator crisis' really been occurring during recent decades, or are these concerns just another sign of global biodiversity decline? Several researches have highlighted different factors leading to the pollinators' decline that have been observed around the world.

One can say that there is no single cause of Colony Collapse Disorder (CCD), and recent population declines are likely caused by a combination of factors acting in concert to weaken bee colonies to the point of collapse, and emerging science points specifically to impaired immunity. Lead suspects in this causal complex include: nutritional stress, pathogens and pesticides. Regulations and phase-outs of acutely toxic pesticides have reduced the number of acute poisonings in most of Europe and North America, but bee exposure to multiple pesticides continues. Sub-lethal effects, less studied and understood than acute effects, have become a key concern as systemic neonicotinoid pesticides —present in small amounts throughout plant tissues from seed to harvest— have become an important and rapidly growing segment of the global insecticide market since their introduction in the 1990s. Other pesticides of concern include those used by beekeepers to control pathogens, and certain fungicides thought to be safe for bees which have recently been found to act synergistically with some neonicotinoids.

Human activities and their environmental impacts may be detrimental to some species, with sometimes subtle and counter-intuitive causal linkages. Pollination is not just a free service but one that requires investment and stewardship to protect and sustain it. This research suggests that there should be a renewed focus on the study, conservation and even management of native pollinating species. It also shows how different factors and their complex causal linkage lead to the growing catastrophe.

3. Contamination of Marine Environment by Floating, Drifting and Precipitating Microplastics in the Ocean: Potential Menace to Marine Species, Ecosystems and Human Health

Large amounts of plastic debris enter the ocean every year, where it slowly fragments and accumulates in convergence zones. Scientists are concerned about the possible impacts of small plastic fragments (microplastics) in the environment. The role of plastics as a vector for transporting chemicals and species in the ocean is as yet poorly understood, but it is a potential threat to marine species, ecosystems and human health.

The contamination scale of marine environment by plastic debris is vast. It is floating in all the world's oceans, everywhere from polar region to the equator. Solid materials, typically waste, that has found its way to the marine environment is called marine debris. It is known to be the cause of injuries and deaths of

numerous marine animals and birds, either because they become entangled in it or they mistake it for prey and eat it. Many different species have suffered from entanglement or ingestion of marine debris including seabirds, turtles, seals, sea lions, whales and fish.

Improved waste control is the key to preventing plastic and other types of litter from entering the ocean. Present situation of plastic debris in the world's oceans is cleared and what should be done is considered.

4. Deadly Legacy of Geological Disposal of High-level Radioactive Nuclear Waste: 100,000 years deep underground repository for future generations

Nuclear power plants provide about 11 % electricity around the world. The spent nuclear fuel is highly radioactive and there are no facilities which can permanently and safely store it. In November 2015, Finland's government firstly approved a construction of such a store, a deep underground repository, after more than 30 years of efforts.

The main problem is where to put a repository. Most countries do not use deep underground stores, but store their spent nuclear fuel above ground in temporary storage facilities. The United States selected a site at Yucca Mountain in Nevada in 1987, but its government wanted to scrap the idea in 2010. In Japan, United Kingdom and Canada, governments have declared plans to build deep geological repositories, but have yet to begin the thorny process of picking sites. In Germany, salt formations at Gorleben were studied for decades, but the government called off the work in 2000.

On the other hand, Swedish government is currently considering a license to build a facility in Forsmark. In France a nuclear-waste agency ANDRA hopes to apply for a license to build a facility in Bure in 2017.

At present, although researches on the ways how to get rid of nuclear waste continue, most countries agree that permanent burial underground is the best solution. From a perspective of green criminology the following question is considered: Is a deep underground legacy of nuclear waste 'treasure box' or 'Pandura's box' for the present and future generations?

5. Lithium Extraction at the Salar de Uyuni in Bolivia: 'Dirty Business for Clean Energy' emancipates Bolivia from 'Curse'?

Lithium is a key global resource for the global energy transition, efficient batteries that are used in smart phone and electric car. But the booming demand threatens to contaminate one of the world's great wonders, the Salar de Uyuni in Bolivia, which holds 70% of the world's lithium reserves. The present government of Bolivia wants to extract lithium under complete state control and to initiate an industrialization of the raw material and create a processing industry within Bolivia. But the plans demonstrate a lack of the consciousness about the social and environmental costs. As the water scarcity around the Salar de Uyuni is largely ignored by the lithium strategy, the high water consumption of the lithium plant would deprive indigenous communities of their traditional income strategies, mainly quinoa and pastoral farming. In addition, they warn the risk of widespread pollution which would put the Salar's flora and fauna at risk. With little concern for the environment ill-effects of using toxic materials, destroying the people's environment, the lithium strategy contradicts the principle of 'vivir bien' (live well) and the 'rights of mother earth'.

In this presentation, based on our research in Bolivia, emerging environmental and ecological problems of lithium extraction in Bolivia are cleared and what we should do is suggested.

6. 'Multiple Battlefields' of Lithium Extraction-Production at and around the Salar de Uyuni: Economy vs Environment/Ecology, Colonization vs Decolonization, and Global-North vs Global-South

The current state of the lithium extraction in Bolivia and the problematique of 'environmental human rights' and 'political ecology' in Latin America are critically analysed. The Bolivian constitution of 2009 has been classified as one of the most progressive in the world regarding indigenous rights. The indigenous principles of Suma Qamaña/ Vivir Bien/ Good Living on the harmonious relationship between humans and nature are established in the constitution. Nonetheless, these rights clash with the constitutionally recognized rights of the nation state to extract and commercialize natural resources mainly hydrocarbons and mining under the banner of redistributive justice, welfare reforms and the common good: the dilemma of extractive development. The class-ethnicity tensions have altered throughout history, according to changing socio-economic, cultural and political settings. During Evo Morales' presidency, class based human rights in practice tend to be superior to the ethnically defined rights, as a reflection of the dilemma of extractive development. In Latin America, human rights have emerged as a weapon in the political battleground over the environment as natural resource extraction has become an increasingly contested and politicized form of development. However, the application of human rights discourses has yielded limited concrete results largely because the state as a guardian of human rights remains fragile in Latin America and is willing to override their commitment to human and environmental rights in the pursuit of development. In order to break this impasse, we need a new epistemology and emancipation, knowing and enacting 'political ecology'.

7. 'Drought and Flood (Climate Change) –Social-Ecological System Destabilization – Conflict – Nexus' in East Africa: Climate Change-induced Environmental Degradation, Food Insecurity, Migration and Violence around Mt. Kilimanjaro

Climate change leads to environmental degradation which has an impact on natural resources. Competing livelihood systems are subject to stiff competition, leading to social tensions and violence. In other incidences, environmentally induced migration has contributed to competition over shrinking resources in host communities, and is a recipe for violence. Droughts or floods are examples of extreme weather events, which are categorized under climate variability and characterized by their severe effects on people's livelihoods, especially on agricultural production and associated food security. The current drought situation in the Horn of Africa is worryingly familiar, and the situation is deteriorating faster than expected. Severely erratic and below average rainfall has resulted in widespread food insecurity and malnutrition, deteriorating livestock conditions, and the mass movement of populations within and across borders. In this research, focusing on the region around and near Mt. Kilimanjaro (Tanzania) in Kenya, the following questions are cleared; first, how climate change over a period of time disrupts the normal functioning of the ecosystem that interacts with humans, and affects how they access certain vital resources for their survival; second, how climate change hazards create imbalances in the socio-ecological system that have the potential to exacerbate or even trigger violence in some contexts.

8. Astro-Green Criminology: A New Perspective against Space Capitalism
— Outer Space Mining may make the Same Mistakes in Space as we have on Earth —

History of outer space mining began with heightened interests in outer space and launch of satellites in the late 20th century. Being concerned with depletion of natural resources on Earth, many people began to pay more attention to available resources in outer space. Many scientists believe that outer space mining will become a reality within few decades. Our research insist that, when the moon, Mars and other celestial bodies are explored and eventually mined for resources, environmental damages caused by mining ought to be taken into consideration. If we fail to treat the relevant space and planetary environments with respect that they deserve, we compromise their intrinsic and extrinsic value. We should not continue to use the world around us as little more than a resource to be exploited. Instead we should recognize how our human existence is interconnected with the universe's environment. There can be significant unintended consequences of invasive exploration, and when it comes to the extraction of water and volatiles for fuels on a planet such as Mars and drilling of asteroids with potential terrestrial impacts, there is simply no telling what might happen, and this supports the provisional case for planetary and space protection.

III. Causal Complexity of the System: Contingency and 'Butterfly Effects'

1. Causal Complexity, Multiple Effects, and Thresholds

One must acknowledge complexity when dealing with multiple effects and thresholds. The causal links between stressors and harm are more complex than was previously thought and this has practical consequences for minimizing harm. Much of the harm is caused by several co-causal factors acting either independently or together (EEA: 674; NHBHSCSC; Conte et al.).

In some cases, it is the timing of exposure to a stressor that causes the harm, not necessarily the amount; the harm may also be caused or exacerbated by other stressors acting in a particular timed sequence. In other cases, low exposure can be more harmful than high exposure; and in others, the harmful effects of mixtures can be greater than from each separate stressor. There are also varying susceptibilities to the same stressors in different people, species and ecosystems, depending on pre-existing stress levels, genetics and epigenetics. This variation can lead to differences in thresholds or tipping point exposures, above which harm becomes apparent in some exposed groups or ecosystems but not others. Indeed there are some harmful effects that occur only at the level of the system, which cannot be predicted from analyzing a single part of the system (EEA: 674).

The increased knowledge of complex biological and ecological systems has also revealed practical implications. First, it is very difficult to establish very strong evidence that a single substance or stressor 'causes' harm to justify timely actions to avoid harm; in many cases only reasonable evidence of co-causality will be available. Second, a lack of consistency between research results is not a strong reason for dismissing possible causal links; inconsistency is to be expected from complexity. Third, while reducing harmful exposure to one co-causal factor may not necessarily lead to a large reduction in the overall harm caused by many other factors, in some cases the removal of just one link in the chain of multi-causality could reduce much harm (EEA: 674).

In short, one can insist that a more holistic and multi-disciplinary systems science is needed to analyse and manage the causal complexity of the systems. For example, there would be substantial benefits from

exploring, much earlier and more systematically, the multiple effects on people and ecosystems of chemical and other stressors, their cumulative effects, chemical metabolites, and their mixture effects (EEA: 674; Khoury et al.).

2. Rethink and enrich Environment and Health Research

EEA mentions that greater awareness of the complexity, interconnectedness, multi-causality and uncertainties inherent in global environmental issues underlines the need for greater humility about what science can and cannot tell us. Framing issues as purely scientific and technical inappropriately places scientific perspectives about equally valid social and ethical contributions that should be part of decision-making. A shift is needed to more explicitly integrative environmental science approaches in support of public policy, in which systemic considerations and early warnings feature strongly. This shift has started to take place in discourses but often not in practices. Therefore, we need environmental science to become more attuned to the inherent complexities of socio-ecological systems by, for example, balancing a traditional disciplinary focus with more holistic cross-disciplinary scientific research, thereby complementing precision with relevance and comprehensiveness. Such science would often embrace longer timescales, more end-points, and multi-causality (EEA: 676).

In addition, we must improve the quality and value of risk assessments. EEA mentions that it is often inappropriate to use a narrow conception of 'risk' to manage the complex issues with their inevitable features of ignorance, indeterminacy and contingency. The increasing awareness of the complexity of biological, ecological and technological systems, calls into question the relevance and prevalence of some of the simplistic methods, models and assumptions used in risk assessments. For example, assuming uni-causality is too simplistic when multi-causality is the reality, as in many ecosystems. Testing for single substances is inadequate when mixtures are present as in all cases of chemical exposures (EEA: 676-677; Blacquière et al.).

In short, EEA concludes that the value of being transparent about what is known and not known and about uncertainties and disagreements is equally pertinent. Scientific conclusions should not be portrayed as if there is consensus when there is not. Science by its nature progresses by building on critical appraisal. Several cases show that disagreement can be helpful to decision-makers with a broader picture of the alternative directions and options available before making a decision (EEA: 677-678).

IV. Conclusions

At the break of dawn and in the prime of time of the scientific technology and social development, the air was saturated with dazzling dreams and hopes, and a bright future lay before us. However, after some decades or centuries, our environment and ecology are brimming over with pollutions and contaminations, with degradations and destructions, and with sufferings and harms. There are only misery and sorrow. A 'brilliant hope for utopia' has changed to a 'black despair of dystopia'.

First, in the capitalist mode of production, in accordance with the progress of scientific technology, as the intensive production and mass consumption have been exponentially increased with using a large amount of hazardous materials and extracting natural resources, environmental/ecological damages, degradations and destructions have remarkably accelerated. Focusing on these phenomena, from a perspective of political

economy and ecology of green criminology, the way to investigate into causes and to take countermeasures against them should be fundamentally changed.

For the 'treadmill of production and consumption', chemically contaminated or hazardous materials, which add a load to environmental and ecological system, are excessively pumped, and materials and energies are extracted from natural resources. As a result, our environmental/ecological system continue being degraded and destructed. Concerning the state-of-the-art nuclear power plants, embodiments of the most sophisticated skills of scientific technology, many suspicions have arisen against the long-range security of the way of disposing their used nuclear wastes into deep underground. The way of solving this problem comes up against a blank wall. Moreover, in the name of the progress of scientific technology and social development, as industrialization have been urged like snowball, degradations and destructions of environmental and ecological system have fallen into the worst situation which cannot be recovered. At present, facing above-mentioned fatal crises, we must fundamentally reconsider the way of using scientific technology, what social development should be, and what production and consumption should be, and establish and keep the lifestyle based on the environmental/ecological protection and sustainable development.

Second, using the concepts and methods of complex dynamic green criminology, the complex and uncertain relationship between human activities and environmental and ecological degradations and destructions should be deliberated. Then basic ideas and action plans should be suggested in order to construct the social system of production and consumption, in which the environmental protection and sustainable development can be progressed and human beings can enjoy the right to live in a safe and secure environment, other species can escape from damages and extinction, and the earth, other planets and outer space can be kept clean.

We have to take not only the complex causal relationship between hazardous factors and their results but also the environmental and ecological system as complex system into consideration in order to piece out the present state of affairs concerning global environmental and ecological crimes and harms, prospect the future of these phenomena, and take measures against them. Minutely, a) not a simple hazardous factor linearly causes hazardous result, but multiple hazardous factors nonlinearly act and yield the hazardous results in complex relations; b) we cannot necessarily interrupt the occurrence of hazardous results which was caused by many co-factors by means of excluding one hazardous factor, but it may possible to decrease hazardous results by means of excluding one of many causal chains; c) keeping nonlinearity, complexity, and contingency of causal relation and system in mind, the research and policy planning concerning occurrence mechanism and countermeasure of environmental and ecological crimes and harms must be done.

Finally, the nature not only in our planet but also all over the universe/multiverse should be preserved as it is at all cost for people, lives and environment itself not only inner space but also outer space in the future

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Chapter 2

Honey Bee Loss, Fruitless Fall, and Catastrophe of Flora and Fauna: Will the Butterfly Effect of Green Crime happen?

Abstract

In 1962 Rachel Carson predicted a 'silent spring' and warned us of a 'fruitless fall'. In recent years, beekeepers watch a great many bees mysteriously die, and they continue to disappear. The remaining pollinators, essential to the cultivation for large part of crops, are now trucked across the country and flown around the world, pushing them closer to collapse. Has a 'pollinator crisis' really been occurring during recent decades, or are these concerns just another sign of global biodiversity decline? Several researches have highlighted different factors leading to the pollinators' decline that has been observed around the world.

One can say that there is no single cause of Colony Collapse Disorder (CCD), and recent population declines are likely caused by a combination of factors acting in concert to weaken bee colonies to the point of collapse, and emerging science points specifically to impaired immunity. Lead suspects in this causal complex include: nutritional stress, pathogens and pesticides. Regulations and phase-outs of acutely toxic pesticides have reduced the number of acute poisonings in most of Europe and North America, but bee exposure to multiple pesticides continues. Sub-lethal effects, less studied and understood than acute effects, have become a key concern as systemic neonicotinoid pesticides —present in small amounts throughout plant tissues from seed to harvest—have become an important and rapidly growing segment of the global insecticide market since their introduction in the 1990s. Other pesticides of concern include those used by beekeepers to control pathogens, and certain fungicides thought to be safe for bees which have recently been found to act synergistically with some neonicotinoids.

Human activities and their environmental impacts may be detrimental to some species, with sometimes subtle and counter-intuitive causal linkages. Pollination is not just a free service but one that requires investment and stewardship to protect and sustain it. This research suggests that there should be a renewed focus on the study, conservation and even management of native pollinating species. It also shows how different factors and their complex causal linkage lead to the growing catastrophe.

I. Introduction

United Nations Environmental Programme (UNEP), based on current evidence, demonstrates that a sixth major extinction of biological diversity event is underway. Mainly due to habitat loss, pest invasion, pollution, over-harvesting and disease, between one and ten percent of biodiversity in the earth is being lost per decade. It is obvious that certain natural ecosystem services are vital for human societies. Many fruit, nut, vegetable, legume, and seed crops depend on pollination. Pollination services are provided both by wild, free-living organisms (mainly bees, but also many butterflies, moths, flies and so on), and by commercially managed bee species. Bees are the predominant and most economically important group of pollinators in most regions (UNEP: 1; De La Rúa et al. 2009; Klein et al. 2007).

In 1962 Carson predicted a 'silent spring', and she also warned us of a 'fruitless fall', a time with no pollination and no fruit (Carson 1962). Only after 46 years, in 2008, Jacobsen wrote the book titled 'Fruitless Fall: The collapse of the honey bee and the coming agricultural crisis.' He insist that the fruitless fall nearly become a reality when, in 2007, beekeepers watched thirty billion bees mysteriously die. Although bees are essential to the cultivation of a third of American crops, while a lot of them continue to disappear, the remaining pollinators are now trucked across the country and flown around the world, pushing them ever closer to collapse. He highlights the growing agricultural catastrophe, emphasizes the miracle of flowering plants and their pollination partners, and warns us not to take the abundance of our Earth for granted (Jacobsen 2008: 100-153; Neumann et al. 2010; Gallai et al. 2009; Porrini et al. 2003).

The starting question presented in this article is the following: has a 'pollinator crisis' really been occurring during recent decades, or are these concerns just another sign of global biodiversity decline? Several researches have highlighted different factors leading to the pollinators' decline that have been observed around the world (UNEP: 1; PSSA 2013; Potts et al. 2010a; Potts et al. 2010b; Aizen et al. 2009).

This article considers the latest scientific findings and analyses possible answers to this question. As the bee group is the most important pollinator worldwide, this article also focuses on the instability of wild and managed bee populations, the driving forces, potential mitigating measures and recommendations.

II. Pesticide and Honey Bees: State of the Science

1. Public and Scientific Controversy

Pesticide Action Network North America (PANNA) explains the state of science which analyses the relation between pesticide and honey bees.

It mentions that honey bees and other pollinators are dying off at unprecedented rates around the world. First in France, then in the U.S. and elsewhere, colonies have been mysteriously collapsing with adult bees abandoning their hives. Two years after this phenomenon hit the U.S., in 2006, it was named 'Colony Collapse Disorder,' or CCD. U.S. beekeepers have reported annual hive losses of 29%-36% each year since that time. Commercial beekeepers tell that their industry, which is the care and cultivation of an indicator species, is on the verge of collapse. Honey bees pollinate 71 of the 100 most common crops that account for 90% of the world' food supply, making managed honey bees the most economically important pollinator (PANNA 2012: 1; Johnson 2007; Ellis et al. 2010; Pettis et al. 2010; Cane et al. 2001).

It is said that, while few contest that the recent, dramatic decline of honey bee populations present serious challenges to an already-stressed food system, the public debate over what lies behind CCD is at this point so polarized and confusing that concerned citizens find it difficult to know how or where to intervene. Indeed, the debate over the causes of CCD has become a case study in public, scientific controversy. This issue has become characterized by policymaker inaction in the face of irreducibly complex science. In this controversy, two increasingly intractable sides have emerged: beekeepers and environmental health advocates vs. pesticide companies and the scientists supported by them. The weight of evidence demonstrates that pesticides are indeed key in explaining honey bee decline, both directly and in tandem with the other two leading factors, pathogens and poor nutrition (PANNA 2012: 1; Mullin et al. 2010).

2. Colony Collapse Disorder: Understanding pesticides as a causal factor in context

It may be said that there is no single cause of CCD, and recent population declines are likely caused by a combination of factors acting in concert to weaken bee colonies to the point of collapse; and emerging science points specifically to impaired immunity. Lead suspects in this causal complex include: nutritional stress, pathogens and pesticides (PANNA 2012: 2; Maini et al. 2010; Dinat et al. 2012; Genersch et al. 2010; Meeus et al. 2011; Le Conte et al. 2010; Goulson 2003).

First, we can find a pesticide prevalence in many places on our earth. Multiple surveys in U.S. and Europe have shown that a mixture of pesticide formulations and types are present in bees, wax, stored food and pollen and nectar on which bees forage. Field studies have found neonicotinoid pesticides in particular in soil, dust, planter exhaust, water (guttation) droplets exuded by treated plants and on nearby, untreated plants and fields (PANNA 2012: 2).

Second, the neonicotinoid has acute, sub-lethal and chronic effects. Neonicotinoids are a relatively new, and very widely used class of insecticides that work on the central nervous system of sucking insects such as fleas and aphids. They were introduced in the 1990s and have since become the fastest-growing class of insecticides in the history of synthetic pesticides. Most U.S. regulatory decision-making addressing risks posed to honey bees by neonicotinoids has hinged, by default, on the establishment of acute toxicity exposure scenarios without requiring tests for sub-lethal effects. Despite repeated calls for a reevaluation of pesticide testing protocols, regulatory processes in the U.S. and Europe have not been adapted to consider sub-lethal, chronic or synergistic effects of pesticides on pollinators. Many independent studies in the U.S. and Europe have shown that small amounts of neonicotinoids — both alone and in combination with other pesticides — can cause impaired communication, disorientation, decreased longevity, suppressed immunity and disruption of brood cycles in honey bees (PANNA 2012: 6-8; Decourtye et al. 2010a).

Third, multiple factors have synergistic + combined effects. Synergism is a phenomenon in which two or more factors produce a combined effect that is greater than the sum of their separate effects. As investigations into the causes of CCD have continued to point toward multiple factors working in concert to increase bees' susceptibility to disease, synergism and combined effects have emerged as a critical area of research. In 2004, a lab study showed that the acute toxicity of two neonicotinoid pesticides on honey bees dramatically increases when combined with either of two common fungicides. Four years

after this finding was published, researchers established that these types of combinations are prevalent in bee hives (PANNA 2012:11).

Fourth, honey bees are like living in the 'chemical cocktail' (fungicides, pyrethroid insecticide, miticides). Neonicotinoids are but one class of pesticides, honey bees are exposed to dozens of different pesticides on a daily basis. Included among these are a mix, or 'chemical cocktail,' of insecticides, herbicides and fungicides as well as the miticides used by beekeepers to control pathogens in the hive (PANNA 2012:11; Lawrence et al. 2013).

Fifth, there are pathogen interactions: nosema + pesticides. Nosema, a family of fungal gut parasites, and the Varroa destructor mite are two relatively recent honey bee pathogens. Both pathogens have been shown to interact with pesticides to weaken colony health more than either does alone. The overall pattern for bees exposed both to systemic pesticides (neonicotinoids and fipronil) and Nosema infection is that bees get sick more easily and die sooner as a result of both stressors in combination than either in isolation (PANNA 2012: 13; Forsgren 2010; Klee et al. 2007; Genersch 2010; Bromenshenk et al. 2010; Runckel et al. 2011; Pettis et al. 2012).

Sixth, there is a problem of microbiota out of balance: gut culture, immunity + nutrition. Unintentional disruption of natural, symbiotic bee microbial cultures is one way in which hive health may be critically undermined by pesticides as well as other stressors in the contemporary, commercial beekeeping environment. Honey bee microbiota (including fungi, bacteria, viruses, etc.) exists at two levels: within the individual bee 'gut' culture and throughout the hive considered as an extended organism. While very little is understood about the honey bee's complex and diverse microbial community, scientists do know enough to describe a co-evolved, minimally functioning, or 'core', honey bee microbial community as well as hypothesize about key functions susceptible to disruption — specifically nutrition and immunity. The road to sustainable honey bee pollination may eventually require detoxification of agricultural systems and in the short term, integrated management of honey bee microbial systems (PANNA 2012: 15; Evans et al. 2011; Forsgren 2010; Cox-Foster et al. 2007).

3. Research Challenges

In the context of multiple, interacting factors, methodological challenges are expected. Some are endemic to the task of epidemiological research and therefore unavoidable. Others are the result of equipment limitations, poor research design or regulatory framework failures (PANNA 2012: 17).

On the one hand, concerning equipment limitations (equipment+ detection sensitivity), until 2003, analytical techniques were not sensitive enough to detect systemic pesticide residues in plant tissue below a level of 20-50 ppb --- much higher than the levels now known to be typical. Pollen had also never been analysed. Detection of pesticides at very low levels is key for our understanding of the actual pesticide load in bee hives, bees and foraging habitat, including soil (PANNA 2012: 17).

On the other hand, designing researches that accurately assess pollinators' exposure to pesticides under field (i.e. outdoor) conditions is especially difficult because of the wide variety of factors in the natural environment. Multiple exposure pathways, synergistic and combined effects from multiple chemicals (i.e. the 'chemical cocktail' effect), timing, relative levels of existing pathogens, variability of weather and genetic predispositions all run the risk of confounding any experiment designed to measure pesticide exposure and toxicity in the honey bee environment (PANNA 2012: 18; Krupke et al. 2012).

First research design is 'laboratory vs. field research'. Researches seeking to determine the effects of pesticides on honey bees typically begin in the lab with a single pesticide and a sample of adult honey bees. Once several studies achieve similar results, the relationship between the tested substance and the organism is informed with an initial understanding of potential effect. Conditions in the lab are highly controlled to eliminate the possibility that observed effects might actually be caused by some other factor than the tested substance (PANNA 2012: 18).

Second research design is regarding to 'multiple exposure pathways: touch contact and oral ingestion'. There are multiple exposure pathways, mainly two kinds of toxicity: one is contact by touch toxicity (dust, soil and planter exhaust/talc), and the other is oral (ingestion) toxicity (pollen, nectar + guttation droplets). Scientists began to exploring the possibility that bees were being poisoned by the dust emitted from pneumatic drilling neonicotinoid-coated seeds around 2003. More recent studies have confirmed that this rout of exposure is indeed lethal, and exacerbated by humidity. The leading hypothesis is that bees flying through contaminated dust are 'powdered' with acutely toxic levels of neonicotinoids as their abdomens collect airborne fragments of treated seed coating (PANNA 2012: 19).

Established oral toxicity levels neonicotinoids for bees are significantly higher than are contact toxicity level. Potential oral exposure routes that have been recently studied include pollen, nectar and guttation droplets. Guttation droplets are a kind of dew exuded by plants during the night and in the early morning; they have been shown to contain lethal levels of neonicotinoid pesticides. Field studies have shown that bees collect and bring back to the hive pollen and nectar contaminated with neonicotinoid pesticides both from directly treated crops, and from nearby untreated plants known to serve as nutrition sources for bees (PANNA 2012: 21).

Third research design is regarding 'time + timing'. Understanding the effects of pesticides and other stressors on hive health is complicated by issues of time: duration, sequencing and developmental stages of a bee can all play a role. Studying the effects of pesticide exposure over too short a time scale is perhaps the most critical blind-spot of most research to date. Recent research into synergistic effects of pesticides and Nosema has surfaced a potential sequencing issue whereby bees exposed first to infection, then to pesticides show signs of poisoning at sub-lethal levels, when pesticide exposure alone at the same levels do not appear to have a toxic effect (PANNA 2012: 22).

4. Structural Bias of Research

Structural bias is also an important problem for research on relations between pesticide and honey bees. Bias appears to be playing a role in our collective understanding of pesticide effects on honey bees. The prominent role of pesticide manufacturers in conducting and funding studies has generated controversy and concern among independent researchers, beekeepers and citizen groups. Conflicts of interest in honey bee research impact research findings, yield citation bias where contradictory studies are excluded from introductory literature reviews, and exert undue influence on pesticide policymaking decisions (PANNA 2012: 23). Researches on honey bee losses must be carried out carefully like 'decoding the complicated puzzle'.

Science funded by agrochemical companies (including Bayer CropScience, the maker of several neonicotinoids including imidacloprid) have; 1) focused CCD research more on parasites and pathogens than on pesticides; 2) published the most favorable among all results on studies of pesticide effects on honey bees (no significant effects or effects at dose levels that do not correlate to environmental levels); and thus 3) potentially

influenced policy decisions made to protect bees from pesticides toward less rigorous risk assessments and less cautious regulations (PANNA 2012: 23).

As for the impact of neonicotinoid insecticides on honey bees etc., among studies showing that imidacloprid has negligible sub-lethal or chronic toxicity to honey bees, or that the effects seen are not relevant to amounts found in the bee environment, most were funded or carried out by the manufacturer. Conversely, a longer list of industry-independent research tends toward opposite results: imidacloprid being sub-lethal and chronically toxic at lower amounts, which are indeed relevant to environmental levels (PANNA 2012: 23).

Results were influenced by factors related to the agendas of those who funded and conducted the studies as well as the regulatory reviewers. The regulatory process is found to be deficient in its assessment for a variety of reasons: lack of standard methodology for investigating sub-lethal effects, failure to investigate long-term, seasonal, conditional, or synergistic effects in the face of compelling evidence for doing so, negligence in requiring studies on larvae, lack of validation criteria for reviewing study methodologies and failure to investigate all possible routes of bee exposure (PANNA 2012: 23).

III. Seed-dressing Systemic Insecticides and Honeybees

1. Effects of Seed-Dressing Systemic Insecticide

European Environment Agency (EEA) mentions that the widespread use of systemic insecticides raises serious concerns about their threat to wild pollinators. Declines in wild pollinators are reported worldwide, which is particularly worrying since they are essential for 35% of global crop output. This has led to growing concern about agriculture's dependence on pollinators and fears of a global pollination crisis (EEA 2013a: 370).

According to EEA research, in 1994 French beekeepers began to report alarming signs. During summer, many honeybees did not return to the hives. Honeybees gathered close together in small groups on the ground or hovered, disoriented, in front of the hive and displayed abnormal foraging behavior. These signs were accompanied by winter losses (EEA 2013b: 26). Many factors influence the state of honeybees and pollinators more generally. Land use practices and agrochemicals are regarded as particularly important. It is said that the risk to honeybees is resulting from the Bayer's seed-dressing systemic insecticide Gaucho, whose active substance is imidacloprid. There were the vehement controversy over the use of Gaucho and the justification that ultimately lead banning its use on sunflower and maize seed-dressing in France (EEA 2013a: 370).

In the face of this situation, scientific findings were used by stakeholders and decision-makers to influence policy during the controversy. Public scientists were in a difficult position in this case. The results of their work were central to a social debate with high economic and political stakes. In certain cases their work was not judged according to its scientific merit but based on whether or not it supported the position of some stakeholders. This situation tested the ability and courage of researchers to withstand pressure and continue working on imidacloprid. Other European countries also suspended neonicotinoid seed-dressing insecticides. Evidence of the toxicity of neonicotinoids present in the dust emitted during sowing of coated seeds supported such decisions. Most important, French case highlighted the major weaknesses of regulatory risk assessment and marketing authorization of pesticides, and particularly neonicotinoids (EEA 2013b: 26; EFSA 2013).

2. Lessons on the Governance of Controversies

From the case study of Gaucho, EEA draws eight lesson about governance of controversies related to chemical risks.

First, governance must focus on identifying potential properties of new chemicals and anticipating surprises that may arise from them. When dealing with new technologies, verify whether the methods already in use for risk assessment are relevant, given the specific new properties and characteristics of new risks. Second, with the adequacy of the present standardized tests regarding the assessment of pesticide risks to honeybees, new tests must be developed to assess sub-lethal effects of pesticides, their chronic effects and their effects on the colony. Third, policymakers need to ensure adequate personnel in number and competence and financial resources to design efficient regulatory procedures for risk governance and thus reinforce their ability to manage risks effectively. Fourth, the independence and competence of the experts on the issue at hand must be assured, as well as complete transparency of the research process. Fifth, the social quality of the scientific information which one communicates in the debate determines the public trustworthiness. The case study showed major deficiencies in the communication of scientific information by Bayer and by certain administrative services of the French State. Sixth, structures responsible for assessing the scientific adequacy of applications for marketing authorization should develop clear and standardized scientific quality criteria to enable existing studies to be evaluated and compared. Seventh, with multi-causality, the potential causal factors have to be prioritized and addressed separately before assessing potential correlation or synergies among them. Eighth, the regulatory background is needed to protect early-warning scientists (EEA 2013a: 389-392).

In short, if there is a lack of one of these eight factors, such a controversy is not justified and cannot lead to correct results.

IV. Ecology of Pesticides and Pest Management

1. Modern Industrialized Agriculture and Pesticide Use

Angelo insists that, although concerns over the ecological impacts of pesticides gave rise to the environmental movement of the late 1960s and 1970s, pesticide use and its effects have been largely ignored by the law and by legal scholars. Dealing with a wide range of questions relating to pests and pesticides, she focuses on agricultural pesticide use as the largest contaminator, and also examines the legacy of past pesticide use and analyses how recent developments in ecological science can inform the law and increase our understanding of ecology.

According to her analysis, modern industrialized agriculture, which has its concomitant reliance on chemical pesticide inputs, contributes to substantial harms to both the environment and human health. Through both ecological concepts and related management approaches harm to the environment is best understood. A variety of past legal and policy efforts to address the risks associated pesticide use have fallen short both at the national and international level, at least in part due to their failure to incorporate ecological concepts and tools (Angelo 2013: 1).

She continue to explain that only recently new ecological understandings have highlighted the fact that current environmental laws a wholly inadequate to address ecological impacts of pesticide use. Recent studies

demonstrate that the actions taken in the 1970s and early 1980s to ban or restrict certain ecologically harmful pesticides, such as DDT and its relatives, only partially protect wildlife, including threatened and endangered species, or ecological systems from the harm of pesticide use. Moreover, in 2006, a study demonstrates that the impacts from pesticides extend to international economy. A recent study conclude that non-pest insects, which are frequently non-target victims of pesticide use, provide ecological services such as pest control, pollination, and grazing land clean up, amounting to more than $57 billion per year in the US alone. In 2006 the National Research Council Report concludes that populations of pollinators and other insects providing ecological services are in serious decline, due at least in part to pesticide use (Angelo 2013: 2-3).

2. Complex Nature of Pest Ecology, Natural Pest Controls, and Adverse Effects of Chemical Pesticides

She analyses and finds the irony of pest controls that the interactions of humans with their natural environment have created a seemingly perpetual cycle of the evolution of pests leading to the evolution of pesticides, resulting in ecological harms leading to the need for evolution of environmental laws. Accompanying with the alteration of ecology by humans, they have facilitated the emergence of new pests and the expansion of existing pest problems. These newly created pest problems create a need for new pest controls, which ultimately result in the need for new environmental regulations to address the risks posed by controls. The irony is that the pest controls that have been developed to pest problems result in new or worsened pest problems, creating a need for new or more aggressive pest controls, which frequently carry with them new, or more insidious, environmental harms (Angelo 2013: 3).

Moreover, she continues that it is important to acknowledge that in addition to the ecological risks associated with pesticide use, pesticides pose significant risks to human health. The World Health Organization estimates that approximately three million humans are poisoned by chemical pesticides each year. Of these poisonings, approximately 220,000 result in death and 735,000 result in chronic illness. When considering the limited pest control abilities of chemical pesticides in light of the undeniable substantial human health and environmental consequences of chemical pesticide use, it is not clear why society would choose to continue to rely so heavily on chemical pesticides. The reasons why farmers continue to use chemical pesticides despite the problems associated with them are complicated: they include the fear of losing one's livelihood, risk aversion, encouragement from the chemical industry, government research and extension service, and flawed agricultural subsidy system that encourages high-intensity, high-yield practices (Angelo 2013 4).

Finally, she concludes that new ecological understanding of the complex nature of pest ecology, natural pest controls, and adverse effects of chemical pesticides suggest that there may be better ways to manage pests and protect human health and the environment at the same time. Concerns about the long term sustainability of industrial agriculture and the environmental harms associated with it are leading to a reevaluation of our agricultural system, including the way we control pests. The new focus on eco-agriculture can provide a roadmap for shifting away from a predominantly industrialized agriculture system toward a more sustainable system. The related concept of ecologically based pest management can provide the tools needed to reduce our dependence on chemical pesticides, thereby reducing the harms associated with them. However, despite the scientific basis for such a shift, our current environmental laws and agricultural policies are geared toward maintaining the status quo. Changes

our laws and policies will be necessary to move away from a chemical input-dependent agricultural system to an ecologically based one (Angelo 2013:4).

V. Causal Complexity of the System

1. Causal Complexity, Multiple Effects, and Thresholds

One must acknowledge complexity when dealing with multiple effects and thresholds. The causal links between stressors and harm are more complex than was previously thought and this has practical consequences for minimizing harm. Much of the harm is caused by several co-causal factors acting either independently or together. For example, bee colony collapse can be linked to viruses, climate changes and neonicotinoid pesticides (EEA 2013a: 674; NHBHSCSC 2012; Conte et al. 2008; Williams et al. 2010; Brown et al. 2009; Tscharntke et al. 2005; Bacandritsos et al. 2010).

In some cases, it is the timing of exposure to a stressor that causes the harm, not necessarily the amount; the harm may also be caused or exacerbated by other stressors acting in a particular timed sequence. In other cases, low exposure can be more harmful than high exposure; and in others, the harmful effects of mixtures can be greater than from each separate stressor. There are also varying susceptibilities to the same stressors in different people, species and ecosystems, depending on pre-existing stress levels, genetics and epigenetics. This variation can lead to differences in thresholds or tipping point exposures, above which harm becomes apparent in some exposed groups or ecosystems but not others. Indeed there are some harmful effects that occur only at the level of the system, such as bee colony, which cannot be predicted from analyzing a single part of the system, such as an individual bee (EEA 2013a: 674).

The increased knowledge of complex biological and ecological systems has also revealed that certain harmful substances can move around the world via a range of biogeochemical and physical processes and then accumulate in organisms and ecosystems many thousands of kilometers away. The practical implications of these observations are threefold. First, it is very difficult to establish very strong evidence that a single substance or stressor 'causes' harm to justify timely actions to avoid harm; in many cases only reasonable evidence of co-causality will be available. Second, a lack of consistency between research results is not a strong reason for dismissing possible causal links; inconsistency is to be expected from complexity. Third, while reducing harmful exposure to one co-causal factor may not necessarily lead to a large reduction in the overall harm caused by many other factors, in some cases the removal of just one link in the chain of multi-causality could reduce much harm (EEA 2013a: 674; Thomson 2004; Vandame et al. 2010).

From above mentioned consideration, one can insist that a more holistic and multi-disciplinary systems science is needed to analyse and manage the causal complexity of the systems in which we live and to address long-term implications. For example, there would be substantial benefits from exploring, much earlier and more systematically, the multiple effects on people and ecosystems of chemical and other stressors, their cumulative effects, chemical metabolites, and their mixture effects. Exposures to low doses or contaminants and their effects, particularly in susceptible sub groups in populations, should also be more fully investigated, accompanied by more biological monitoring that would improve the detection of the precursors of disease (EEA 2013a: 674; Khoury et al. 2011; Johnson et al. 2010; Moritz et al. 2010; Williams et al. 2009).

2. Rethink and enrich Environment and Health Research

EEA mentions that greater awareness of the complexity, interconnectedness, multi-causality and uncertainties inherent in global environmental issues underlines the need for greater humility about what science can and cannot tell us. Framing issues as purely scientific and technical inappropriately places scientific perspectives about equally valid social and ethical contributions that should be part of decision-making. A shift is needed to more explicitly integrative environmental science approaches in support of public policy, in which systemic considerations and early warnings feature strongly. This shift has started to take place in discourses but often not in practices (EEA 2013a: 676).

Therefore, we need environmental science to become more attuned to the inherent complexities of socio-ecological systems by, for example, balancing a traditional disciplinary focus with more holistic cross-disciplinary scientific research, thereby complementing precision with relevance and comprehensiveness. Such science would often embrace longer timescales, more end-points, and multi-causality (EEA 2013a: 676).

In addition, we must improve the quality and value of risk assessments. EEA mentions that it is often inappropriate to use a narrow conception of 'risk' to manage the complex issues with their inevitable features of ignorance, indeterminacy and contingency. The increasing awareness of the complexity of biological, ecological and technological systems, calls into question the relevance and prevalence of some of the simplistic methods, models and assumptions used in risk assessments. For example, assuming uni-causality is too simplistic when multi-causality is the reality, as in many ecosystems; testing for single substances is inadequate when mixtures are present as in all cases of chemical exposures (EEA 2013a: 676-677; Blacquière et al. 2012).

EEA instruct us how the risk assessment should be as follows. Risk assessments could be, in practice, improved by including a wider range of stakeholders when framing the scientific risk agenda, through ensuring all available evidence is readily accessible, by broadening the scope and membership of risk evaluation committees, by increasing transparency and consistency of committee approaches and methods, and by ensuring their independence of vested interests. The case studies on bees, lead and nuclear accident risks have shown that the scope and membership of some risk assessment committees have been too narrow, and they have sometimes been dominated by one discipline or paradigm with shared assumptions which are not therefore questioned. Risk assessments can be made more reliable if they embrace all relevant scientific knowledge and approaches (EEA 2013a: 677).

In short, EEA concludes that the value of being transparent about what is known and not known and about uncertainties and disagreements is equally pertinent. Scientific conclusions should not be portrayed as if there is consensus when there is not. Science by its nature progresses by building on critical appraisal. Several cases show that disagreement can be helpful to decision-makers with a broader picture of the alternative directions and options available before making a decision (EEA 2013a: 677-678).

VI. Concluding Remarks

Based on these deliberations, one can remark that currently available global data and knowledge on the decline of pollinators are not sufficiently conclusive to demonstrate that there is a worldwide pollinator and related crop production crisis (Cameron et al. 2011; Ghazoul 2005). However, one may say that human activities and their environmental impacts may be detrimental to some species but

beneficial to others, with sometimes subtle and counter-intuitive causal linkages (Winfree et al. 2009). Pollination is not just a free service but one that requires investment and stewardship to protect and sustain it. There should be a renewed focus on the study, conservation and even management of native pollinating species in order to complement the managed colony tradition (UNEP 2010:12; Decourtye et al. 2010b; Kremen et al. 2002; Chauzat et al. 2009).

This article focuses on the social consequences of diversity of eco-toxicological effects. A diverse eco-toxicological portfolio allows each stakeholder to identify their own 'scientific arguments' and use them for defending opposite positions in the debate. Declining honeybee colonies have been reported in several countries and have sometimes been related to seed-dressing insecticides. The European Parliament, which has officially acknowledged the issue since December 2001, states that extremely serious damage has been caused to bee populations in several member states by systemic insecticides with extremely long residual activity periods used in arable seed coatings, which have led to the mass poisoning of colonies (EEA 2013a: 392).

The role of honeybee as a bio-indicator for the state of the environment was highlighted during the debate in France. A study found that honeybees tend to respond faster than other insects to environmental pollution. The size of the major detoxifying gene families is smaller in the honeybee, which makes it unusually sensitive to certain pesticides. It must be underlined that honeybee losses can be interpreted as an 'alarm bell' of harm to other entomo-fauna and indirectly to plants, birds and other species. In this context, social concerns are essential to establishing a relevant research agenda. As pollinators, honeybees have an ecologic impact on the survival of plants in the wild. But they have important impacts on people, most notably the economic value of free pollination of many fruits and vegetables (EEA 2013a:393).

As a final result, one can conclude that human activities and their environmental impacts may be detrimental to some species, with sometimes subtle and counter-intuitive causal linkages. Pollination is not just a free service but one that requires investment and stewardship to protect and sustain it. Different factors and their complex causal linkage may lead to the growing catastrophe. There should be a renewed focus on the research, conservation and even management of pollinating species.

[Notes]

1) This chapter is based on the paper titled " 'Butterfly Effects' triggered by Green Crimes? Honey Be Loss, Fruitless Fall, and Catastrophe of Living Things," and presented at the 14the Annual Conference of the European Society of Criminology, Prague, Czech Republic, 10-13 September, 2014.
2) This chapter is also a part of results of 'Research on Environmental- and Eco-crimes by Progress of Scientific Technologies and Development of Societies and Measures against Them 2015-2019' supported by the Grant-in-Aid of Scientific Research by Japanese Ministry of Education, Culture, Sports, Science and Technology.

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Chapter 3

Contamination of Marine Environment by Floating, Drifting and Precipitating Microplastics in the Ocean: Potential Menace to Marine Species, Ecosystems and Human Health

Abstract

Large amounts of plastic debris enter the ocean every year, where it slowly fragments and accumulates in convergence zones. Scientists are concerned about the possible impacts of small plastic fragments (micro-plastics) in the environment. The role of plastics as a vector for transporting chemicals and species in the ocean is as yet poorly understood, but it is a potential threat to marine species, ecosystems and human health. The contamination scale of marine environment by plastic debris is vast. It is floating in all the world's oceans, everywhere from polar region to the equator. Solid materials, typically waste, that has found its way to the marine environment is called marine debris. It is known to be the cause of injuries and deaths of numerous marine animals and birds, either because they become entangled in it or they mistake it for prey and eat it. Many different species have suffered from entanglement or ingestion of marine debris including seabirds, turtles, seals, sea lions, whales and fish. Improved waste control is the key to preventing plastic and other types of litter from entering the ocean. Present situation of plastic debris in the world's oceans is cleared and what should be done is considered.

I. Introduction

Plastic debris has now become the most serious problem affecting the marine environment, according to Thevenon et al., not only for coastal areas of developing countries that lack appropriate waste management infrastructures, but also for the world's oceans as a whole because slowly degrading large plastic items generate microplastic particles (smaller than 1 to 5 mm) which spread over long distances by wind-driven ocean surface layer circulation. Growing scientific and public awareness is fueling global concern regarding the impact of plastic ingested by marine species and the accumulation of plastics in coastal and remote areas of oceans in trash gyres (Thervenon: 9).

They continue that it is well recognized that drifting plastic debris has several adverse effects on marine species and ecosystems. However, there is still a lack of precise knowledge about the quantity, sources, transport, accumulation and fate of plastics in the oceans. The most visible and disturbing impact of marine plastic pollution is the ingestion, suffocation and entanglement of hundreds of marine species. Floating plastics, presently the most abundant items of marine litter, also contribute considerably to the transport of non-indigenous (alien) marine species thereby threatening marine biodiversity and the food web. These floating particles accumulate toxic pollutants on their surface during their long-residence time in polluted seawater and can therefore represent a concentrated source of environmental pollution, or serve as a vector for toxic pollutants that accumulate in the food webs (bio-accumulation of contaminants) (Thevenon et al.: 9; Arthur et al.; Barnes et al.; Darraik; Hammer et al.; Lytle).

They conclude that the globally emerging environmental, economic and health risks related to plastic pollution require immediate international attention. It is time to take regional- and global-level actions against the entry of plastics into the ocean. There is also an urgent need to monitor the type and quantity of marine plastics as well as to better assesses the impacts of plastic pollution on marine environments, species and ecosystems (Thevenon et al.: 9; United Nations Environment Programme (UNEP); Moore et al.; Decker).

In this chapter, present situation of plastic debris, especially microplastics, in the world's oceans is cleared and what should be done is considered [1) 2)].

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II. Plastic Debris in the Ocean

1. Assessing the Extent of the Problem

Kershaw et al. assess the extent of plastic debris problem in the oceans as follows. The ocean has become a global repository for much of the waste we generate. Marine debris includes timber, glass, metal and plastic from many different sources. Recently, accumulation and possible impacts of microplastic particles in the ocean have been recognized as an emerging environmental issue. Some scientists are increasingly concerned about the potential impact of releases of persistent bio-accumulating and toxic compounds (PBTs) from plastic debris. At the same time, fishing and tourism industries in many parts of the world are affected economically by plastic entering nets, fouling propellers and other equipment, and washing up on beaches. Despite international efforts to stem the flow of plastic debris, it continues to accumulate and impact the marine environment. To reduce the quantity of plastic entering the ocean, existing management instruments need to be made more effective and all aspects of

waste treatment and disposal need to be improved (Kershaw et al.: 21; Cole et al.: 2596; Cózar et al.: 10239; Andrady: 1602-1603; Thompson et al.; Teuten et al.).

Although monitoring, surveillance and research focusing on plastic and other types of marine litter have increased in recent years, they complain about present situations and makes their suggestion, a comprehensive set of environmental indicators for use in assessment has been lacking, as have related social and economic indicators. These types of indicators could include trends in coastal population increase and urbanization, plastics production, fractions of waste recycled, tourism revenue, waste disposal methods, shipping tonnage and fishing activities. Indicators also provide a means to measure the effectiveness of mitigation measures, such as improved waste management and the introduction of economic measures (Kershaw et al.: 23; Ivar do Sul et al.: 361; Ryan et al.).

2. Physical and Chemical Impacts

Then they mention physical and chemical impacts of plastic debris that environmental damage due to plastic and other marine debris can be defined as mortality or sub-lethal effects on biodiversity through physical damage by ingestion; entanglement in in 'ghost nets' (fishing nets lost or left in the ocean) and other debris; chemical contamination by ingestion; and alteration of community structure, including the importation of alien species. Exposure of plastic debris to the variety of physical, chemical and biological processes in oceans results in fragmentation and size reduction. In general, potential chemical effects are likely to increase with a reduction in the size of plastic particles while physical effects, such as the entanglement of seals and other animals in drift plastic, increase with the size and complexity of the debris (Kershaw: 25).

Microplastics are ubiquitous in the ocean, contain a wide range of chemical contaminants, and can be ingested by marine organisms. However, the lack of certainty about the possible role of microplastics, as an additional vector for contaminants taken up by organisms, calls for caution and further research (Kershaw et al.: 75, 28; GESAMP: 30, 48; Thevenon et al. : 27, 29, 31-32; Brander et al.; Gregory).

III. Presence of Microplastics in Water and Fishes of Easter Island

1. Plastic Pollution in the South Pacific Subtropical Gyre

Martinez et al. insist that we should be on the watch for floating and drifting plastic debris in the South Pacific Ocean as well as in the North Pacific Ocean. In the South Pacific, after a longer time period of drift, floating marine debris accumulates in the eastern-center region of subtropical gyre from where they do not escape. We should wonder what happens to those accumulated detritus. As the horizontal convergence upper layer induces a vertical divergence in the lower layer, are some of the dislocated plastic fragments trapped? Do they sink? Do they accumulate in the sediments at the bottom of the oceans? (Martinez et al.: 1353-1354)

It is difficult to estimate the damages in the eastern-center region of the subtropical gyre since there is only one island, Easter Island, and no surveys carried out in the region (in 2009). People should worry about the same happening in the South Pacific Ocean, and care should be brought regarding the increasing plastic products and other detritus that are released by our polluting way of life (Martinez et al.: 1353-1354; Eriksen et al.: 71-72).

2. Undesirable Items from Far Away and Thread for Marine Lives and Human Health

Ory et al. made a valuable research on microplastics around the Easter Island, and analyse the problems caused by them. Winds and currents of the Pacific Ocean had brought to the shore of the islands living organisms for millions of years, allowing life to flourish on one of the most remote island of the world. Nowadays, however, winds and currents also bring undesirable items from far away: microplastics (Ory et al.: 5).

They explains that microplastics also originate from the degradation of larger plastic object which, once released in the ocean by human activities (urban waste, industry, fishing), gradually degrade in smaller fragments under the combined effects of the sun, temperature and microbial activity. Floating plastics may drift for years and over thousands of kilometers within oceanic gyres, which are zones where currents converge and at the center of which plastic particles accumulate in high abundance. Five main subtropical gyres exist in the world: Rapa Nui is located in the center of the South Pacific gyre (Ory et al.: 5).

In addition to the esthetical problem of the presence of microplastics in one of the clearest waters of the world, hey continue, these tiny particles are a threat for marine wild life because they may be ingested by various marine organisms, such as fishes. Once ingested, microplastics may cause inflammation and physical lesions to the digestive system and reduce the amount of food taken by the animals. Microplastics also contain hazardous chemical elements or may accumulate at their surface contaminants present in the seawater. These contaminants may be transferred to the tissues of the fishes and, in turn, to humans who eat the fishes. The effects of microplastics on human health are still unclear, but they may represent a threat for communities where fish is an important source of food, such as in Rapa Nui (Ory et al.: 6).

3. Researches and Solutions to the Problem caused by Microplastics

They explain their researches and solutions as follows. Members of the Nucleus Millennium Ecology and Sustainable Management of Oceanic Islands (ESMOI) of the Universidad Catolica del Norte in Coquimbo went to Rapa Nui for 6 weeks between March and April 2015. The goal of this study was to quantify the amount of microplastics in superficial water, subtidal sand and fish stomachs at different sites around the coasts of the islands (Ory et al.: 7).

They continue that the first results of this study confirmed a high abundance of microplastics in surface waters around the coasts of the islands. Most of the microplastics found were brittle and tarnished, indicating that they had spent a long time floating at the surface of the ocean. Few plastics were found in the sand surrounding coral and rocky reefs, which signifies that microplastic input from Rapa Nui is limited. These observations support the fact that the microplastics found around the coasts of Rapa Nui originate far away from countries surrounding the South Pacific Ocean and large fishing vessels operating in the open ocean. Almost all the stomachs of planktivorous fishes (i.e. feeding on tiny organisms living in the water column), such as the ature (amberstrip scad, Decapteruas muroadsi), contained at least one microplastic fragment, with a maximum of six particles found in a single individual. Interestingly, a high proportion of these microplastics were of similar size and colour (transparent and blue) as planktonic crustaceans, very abundant in our water samples and often also found in the fish stomachs. Planktivorous fishes may thus mistakenly ingest microplastics instead of their natural prey, which makes them very micronatural prey (Ory et al.: 7-8; Joret et al.; Boersema).

IV. Dynamic and Complex Effects of Microplastics on Ecosystem, Food Chain, and Humans

1. Dynamic and Complex Effects on Ecosystem, Food Chain and Humans

Depending on the amount and size of the particles, GESAMP continues, different functional groups may be directly affected by microplastics, compromising ecological process and ecosystem function. As exposed above, absorption of microplastics in the organism surface, e.g. algae and zooplankton, was demonstrated to reduce the photosynthetic and feeding rate, respectively. However, what this effect at the base of the food chain could mean for the productivity and resilience of ecosystems in the long term is unknown. Considering that amount of plastics entering the ocean is increasing, plastic degradation produces smaller particle sizes, smaller particles are supposed to be more toxic, and the effect of microplastics at the higher levels of organization is supposed to increase, it is possible to suppose an increasing impact of microplastics on marine systems. However, due to their complexity, with species-specific and generalized response from the biota to the presence of microplastics, with external and internal exposures and with physical and chemical effects, which are not well understood, the direction of this effect is hard to be predicted (GESAMP 2015: 52; Oehlmann et al. 2009; Prüss-Ustün et al. 2016; Science for Environmental Policy 2011; Secretariat of the Convention on Biodiversity 2012).

On the other hand, GESAMP explains dynamic and complex effects on food chain and humans. The potential accumulation of microplastics in the food chain, especially in fish and shellfish (species of molluscs, crustaceans and echinoderms) could have consequences for the health of human consumers (GESAMP: 52; Seltenrich).

2. Biomagnification of Chemical Contaminants in the Food Chain

From the viewpoint of biomagnification, Rochman analyses chemical contaminants in the food chain. The long-range transport, persistence and global dynamics of plastic debris are key aspects to understanding the ultimate fate of this material and any potential impacts of plastic debris on marine ecosystems. The addition of plastic to the marine environment adds a novel medium for chemical contaminants to interact with, and it is important to understand how plastic debris should be considered in future environmental fate. Plastic debris is a novel environmental matrix and it plays a potential role in helping to mediate the fate and distribution of chemical contaminants globally. Specifically, plastic debris is a sink and a source for chemical contaminants in the marine environments and it may facilitate the global transport of chemicals in the marine environment and the transport of chemicals into marine foodwebs (Rochman: 124-125, 130; Thevanon et al.: 33).

V. Uncertainty and Complexity in Kinetics and Thermodynamics of Interaction between Marine Debris, Toxic Chemicals and the Food Web

1. Plastic Debris, Toxic Chemicals and the Food Web

Engler explains the uncertainty and complexity in Kinetics and Thermodynamics of Interaction between Marine Debris, Toxic Chemicals and the Food Web. Some plastic debris acts as

a source of toxic chemicals: substances that were added to the plastic during manufacturing leach from plastic debris. Plastic debris also acts as a sink for toxic chemicals. Plastic sorbs persistent, bioaccumulative, and toxic substances (PBTs), such as polychlorinated biphenyls (PCBs) and dioxins, from the water or sediments. These PBTs may desorb when the plastic is ingested by any of a variety of marine species. This broad look at the current research suggests that while there is significant uncertainty and complexity in the kinetics and thermodynamics of the interaction, plastic debris appears to act as a vector transferring PBTs from the water to the food web, increasing risk throughout the marine food web, including humans (Engler: 12302).

He continues that no one is sure how long traditional plastics persist in the environment, but rates may be as slow as just a few percent of carbon loss over a decade. Plastic objects typically fragment into progressively smaller and more numerous particles without substantial chemical degradation. Furthermore, although much of the marine debris research focuses on floating plastic debris, it is important to recognize that not all plastic floats. Depending on the density of the material and the presence of entrapped air, marine debris may float or sink. After some amount of time in the ocean, floating plastic debris may become sufficiently fouled with biological grows that it sinks. As a result, plastic debris will be found throughout the water column, but largely concentrated near the surface and on the ocean floor (Engler: 12302, 12304, 12308-9).

2. Potential Solutions, No Single Solution and Many Opportunities

Engler offers potential solutions that among the challenges in addressing marine debris is that the greatest impacts are largely invisible from the origin of the debris (fugitive loss, litter or other improper disposal). Another significant challenge is that marine debris arises from sources around the world. Unilateral action by one country will be helpful, but cannot solve the problems presented by marine debris. Debris dropped anywhere on earth may end up being transported via surface water to the ocean where it may be carried vast distances before it settles to the bottom. Furthermore, plastic debris is simply too widely dispersed to effectively clean it up. Even in the 'Great Pacific Garbage Patch' there are only a few kilograms of plastic per square kilometer of ocean. This is roughly equivalent of a few teaspoons of plastic pieces spread over a football field and trying to clean it all up with tweezers. Reversing the impacts of plastic debris will take sustained efforts and novel technologies (Engler: 12309).

In addition, he insists that there is no single solution and there are many opportunities. There is no single solution to the risk posed by plastic marine debris and toxic chemicals in the ocean. While there are limited, if any, viable options to clean up plastics or toxics already present in the oceans, there are many opportunities to prevent more plastics and toxics from being released. Plastic reduction strategies will have to include low-tech solutions to reduce littering, such as behavior change, and high-tech solutions, such as new, biodegradable resins, as well as public policy options. Public policies may include limiting trash in water discharges by, for example, physical trapping debris before discharging effluent to surface water, financial incentives to increase reuse or recycling, such as plastic bag fees, or even incentives for ambitious system-wide redesign of plastic manufacturing-use-disposal cycles to 'close the loop' for resins (Engler: 12310; McKinsey & Company et al.).

VI. Conclusions

In the end, we can conclude as follows. Large amounts of plastic debris enter the ocean every year, where it slowly fragments and accumulates in convergence zones. Scientists are concerned about the possible impact of small plastic fragments (microplastics) in the environment. The role of plastics as a vector for transporting chemicals and species in the ocean is as yet poorly understood, but it is a potential threat to marine species, ecosystems and human health (Kershaw et al.: 21).

Marine plastic debris has major direct and indirect harmful effects on the marine biota and wildlife. Problems associated with absorption and entanglement of plastic debris include ingestion of specific plastic items by animals that mistake plastic waste for prey, and to a lesser extent consumption of pelagic fish and other prey that have plastic particles in their guts. Accumulation of plastic debris in the marine environment can result in habitat degradation whereas floating plastics create new habitats and enable transport of invasive (alien) species over long distances. Finally, plastics contain toxic substances that were added to the polymers during the production process. Marine plastics accumulate toxic pollutants present at the sea surface and serve as a potential transport vector for chemical contaminants of concern. Although pollution by plastics is increasingly recognized worldwide as a major threat to marine biota, the effects of oceanic plastic debris on marine organisms and food webs, community structure, and ecosystems are still poorly understood (Thevenon et al.: 27; Prüss-Ustün et al.).

According to them, future ecotoxicological studies are needed to assess the harmful effects of plastic marine ingestion, especially regarding the transfer of adsorbed pollutants and additives towards high trophic levels in the food web. There are increasing number of scientific studies focusing on the bioaccumulation of the chemical associated to plastic debris and about their potential to affect organisms ranging from zooplankton to top predator fish species. Consequently, inadvertent plastic material ingestion represents a threat for marine organisms living in polluted waters, with possible public health concerns for the consumption of fish and seafood living in polluted waters enriched in microplastics. These recent findings strengthen the need for a better assessment of the extent of marine plastic pollution (characteristics, sources, accumulation zones, transport pathways and sedimentation), as well as the necessity to regulate the manufacturing of polymer substances and plastic additives at an international level (Thevenon et al.: 33).

At last, it is certain that contamination of marine environment is a serious, potential menace not only to our generation but also to next and future generations.

[Notes]

1) This chapter is based on the two papers. One is titled “Contamination of Marine Environment by Floating Plastic Debris: Potential Threat to Marine Species, Ecosystems, and Human Health,” and presented at the 15th Annual Conference of the European Society of Criminology, Porto, Portugal, 2-5 September, 2015. The other is titled “Plastic Debris in the Ocean: A Potential Threat to Marine Species, Ecosystems, and Human Health,” and presented at the 71st Annual Meeting of the American Society of Criminology, Washington D.C., U.S.A., 18-21 November, 2015.
2) This chapter is also a part of results of ‘Research on Environmental- and Eco-crimes by Progress of Scientific Technologies and Development of Societies and Measures against Them 2015-2019’

(Subject Number: 15K03181) supported by the Grant-in-Aid of Scientific Research by Japanese Ministry of Education, Culture, Sports, Science and Technology.

3) In order to make research on the situation of contamination by plastic debris near and around the gyre in the South Pacific, the author visited the Easter Island (Isla Rapa Nui) and the Tahiti Island in August 2015.

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Chapter 4

Deadly Legacy of Geological Disposal of High-level Radioactive Nuclear Waste: 100,000 Years Deep Underground Repository for/to Future Generations

Abstract

Nuclear power plants provide about 11 % electricity around the world. The spent nuclear fuel is highly radioactive and there are no facilities which can permanently and safely store it. In November 2015, Finland's government firstly approved a construction of such a store, a deep underground repository, after more than 30 years of efforts. The main problem is where to put a repository. Most countries do not use deep underground stores, but store their spent nuclear fuel above ground in temporary storage facilities. The United States selected a site at Yucca Mountain in Nevada in 1987, but its government wanted to scrap the idea in 2010. In Japan, United Kingdom and Canada, governments have declared plans to build deep geological repositories, but have yet to begin the thorny process of picking sites. In Germany, salt formations at Gorleben were studied for decades, but the government called off the work in 2000. On the other hand, Swedish government is currently considering a license to build a facility in Forsmark. In France a nuclear-waste agency ANDRA hopes to apply for a license to build a facility in Bure in 2017. At present, although researches on the ways how to get rid of nuclear waste continue, most countries agree that permanent burial underground is the best solution. From a perspective of green criminology the following question is considered: Is a deep underground legacy of nuclear waste 'treasure box' or 'Pandura's box' for the present and future generations?

I. Introduction

High-level radioactive nuclear wastes are highly dangerous and there are no facilities in the world which can permanently and safely store it. In November 2015, after more than 30 years of efforts, Finnish government firstly approved a construction of such a store, a 'deep underground repository'. Similarly, Swedish government is currently considering a license to build a facility in Forsmark. In France a nuclear-waste agency ANDRA hopes to apply for a license to build a facility in Bure in 2017 (Gibney).

Where to put a repository is the main problem. Most countries do not use deep underground stores, but store their spent nuclear fuel above ground in temporary storage facilities. In Germany, salt formations at Gorleben had been studied for decades, but the government called off the work in 2000. The United States selected a site at Yucca Mountain in Nevada in 1987, but its government wanted to scrap the idea in 2010. In Japan, United Kingdom and Canada, governments have declared plans to build deep geological repositories, but have yet to begin the thorny process of picking sites (Gibney).

At present, although researches on the ways how to get rid of nuclear waste continue, most countries agree that the permanent underground burial is the best solution (Irvine: 58-61). In this research, from a perspective of green criminology, following questions are considered: 100,000 years deep underground nuclear waste repository, can we keep it safely without troubles and accidents for such a long time? How is the problematique of high-level nuclear waste geological disposal?

II. Positive Evaluation: Safety and Necessity of Deep Geological Repository/ Disposal

1. Radioactive Waste Management and its Safety

World Nuclear Association (WNA) explains a radioactive waste management and emphasizes its safety as follows.

WNA explains that some radioactive wastes are produced in the nuclear fuel cycle, and the relatively modest cost of managing and disposing of this is part of the electricity cost. At each stage of the fuel cycle proven technologies are used to dispose radioactive wastes safely. While for low- and intermediate-level wastes these are mostly being implemented, for high-level wastes some countries await the accumulation of enough of it to warrant building geological repositories, others have encountered political delays. Unlike other industrial wastes, the level of hazard of all nuclear waste, its radioactivity diminishes with time. Each radionuclide contained in the waste has a half-life, the time taken for half of its atoms to decay and thus for it to lose half of its radioactivity. Radionuclides with long half-lives tend to be alpha and beta emitters, making their handling easier, while those with short half-lives tend to emit the more penetrating gamma rays. Eventually all radioactive wastes decay into non-radioactive elements. The more radioactive an isotope is, the faster it decays (World Nuclear Association).

Then WNA emphasizes its safety that the main objective in managing and disposing of radioactive waste is to protect people and the environment. This means isolating or diluting the waste so that the rate or concentration of any radionuclides returned to the biosphere is

harmless. In order to achieve this, all wastes are practically contained and managed, some clearly need deep and permanent burial. None is allowed to cause harmful pollution from nuclear power generation. All toxic wastes need to be dealt with safely, not just radioactive wastes. In countries with nuclear power, radioactive wastes comprise less than 1% of total industrial toxic wastes (World Nuclear Association; Nuclear Energy Agency/ Radioactive Waste Management Committee).

2. Geological Disposal of Radioactive Waste and its Necessity

European Commission (EC) explains a geological disposal of radioactive waste as the best way and insists its necessity as follows.

EC explains that since the development of nuclear power in the 1950s, it has been proposed for many years that the most appropriate and natural way of dealing permanently with our radioactive wastes is to return them to the ground. Careful burial in well-engineered repositories at various depths below the land surface at specially selected sites is the favored solution in every country that has decided how to handle the problem (European Commission: 4).

Then EC insists its necessity that the burial at several hundreds of meters depth in stable rock environments, 'geological disposal', is the option for disposal of the most hazardous radioactive wastes because it will provide permanent safety, not just for ourselves but for future times very much longer than the whole of past human history. Although we currently store all our wastes safely and make every effort to minimize the amount of radioactive waste that we produce, it is inevitable that there will always remain some wastes that have to be disposed of deep underground. The European Union has been researching geological disposal for almost 30 years and is on the verge of constructing its first deep repositories (European Commission: 4).

III. Critical Evaluation: Dangerous and Deadly Legacy of Radioactive Waste

1. Hazardous for Hundreds and Thousands of Years and No Other Solution than Burying the Problem

If we consider that high-level radioactive nuclear wastes could continue to be hazardous for hundreds of thousands of years, and that at present there is no other solution to radioactive wastes than burying the problem, one may say that keeping and depending on nuclear power means a dangerous waste of time.

Greenpeace explains that high-level wastes, which include materials containing highly-radioactive elements, can be radioactive for hundreds of thousands of years and emits large amounts of hazardous radiation. Even a couple of minutes of exposure to high-level waste can easily result in fatal doses of radiation. Therefore it needs to be reliably stored for hundreds of thousands of years. Humankind has been on Earth for the last 200,000 years, yet it takes 240,000 years for plutonium to be considered safe. The safe and secure storage of the dangerous waste needs to be guaranteed throughout this period, which potentially spans many Ice Ages. It's no wonder that a solution for dealing with nuclear waste has still not been found (Greenpeace 2009: 4).

Then Greenpeace continues that the nuclear industry wants to bury the problem of radioactive waste by storing it in deep geological repositories. But it appears to be impossible to find suitable locations where safety can be guaranteed for the necessary timescales. Given the

immense difficulties and risks associated with the storage of dangerous nuclear waste, it's not surprising that the nuclear industry tries to dump it out of sight. Despite the billions already invested in research and development for dealing with radioactive waste, new experiments are still being presented as 'solutions'. Methods that will not be ready for a long time, may never be commercially viable or do little to solve the long term waste problem (Greenpeace 2009: 5).

2. Rock Solid? Scientific Review of Geological Disposal

According to a scientific review of geological disposal of high-level radioactive, containment barriers would lead to significant releases of radioactivity, and predicting such a complex, coupled processes over the long timescale is difficult. Unless such difficulties can be resolved, a significant release of radioactivity from a deep repository could occur. The status of research and scientific evidence regarding the long-term underground disposal of highly radioactive wastes is overviewed as follows.

Wallace explains that a number of phenomena are identified that could compromise the containment barriers, potentially leading to significant releases of radioactivity: Copper or steel canisters and overpacks containing spent nuclear fuel or high-level radioactive wastes could corrode more quickly than expected; The effects of intense heat generated by radioactive decay, and of chemical and physical disturbance due to corrosion, gas generation and biomineralization, could impair the ability of backfill material to trap some radionuclides; Build-up of gas pressure in the repository, as a result of the corrosion of metals and/or the degradation of organic material, could damage the barriers and force fast routes for radionuclide escape through crystalline rock fractures or clay rock pores; Poorly understood chemical effects, such as the formation of colloids, could speed up the transport of some of the more radiotoxic elements such as plutonium; Unidentified fractures and faults, or poor understanding of how water and gas will flow through fractures and faults, could lead to the release of radionuclides in groundwater much faster than expected; Excavation of the repository will damage adjacent zones of rock and could thereby create fast routes for radionuclide escape; Future generations, seeking underground resources or storage facilities, might accidentally dig a shaft into the rock around the repository or a well into contaminated groundwater above it; Future glaciations could cause faulting of the rock, rupture of containers and penetration of surface waters or permafrost to the repository depth, leading to failure of the barriers and faster dissolution of the waste; Earthquakes could damage containers, backfill and the rock (Wallace: 7).

Then Wallace continues that although computer models of such phenomena have undoubtedly become more sophisticated, fundamental difficulties remain in predicting the relevant complex, coupled processes (including the effects of heat, mechanical deformation, microbes and coupled gas and water flow through fractured crystalline rocks or clay) over the long timescales necessary. In particular, more advanced understanding and modelling of chemical reactions is essential in order to evaluate the geochemical suitability of repository designs and sites. The suitability of copper, steel and bentonite as materials for canisters, overpacks and backfill also needs to be reassessed in the light of developing understanding of corrosion mechanisms and the effects of heat and radiation. Unless and until such difficulties can be resolved, a number of scenarios exist in which a significant release of radioactivity from a deep repository could occur, with serious implications for the health and safety of future generations (Wallace: 7-8).

3. Deadly Legacy of Radioactive Waste

(1) Failed solutions

We have seen many cases of failed solutions around the world.

According to Beránek et al., billions of euros have been spent over the past half-century on finding a solution to the nuclear waste problem. But the attempts have all been unsuccessful (Beránek et al.: 3).

a) Russia, USA, France, UK, Netherlands, Japan and others: Waste dumping at sea

Low level radioactive wastes had been dumped at sea for years, based on the irresponsible idea 'out of sight and out of mind'. Disintegrating barrels had brought the wastes back into the environment and dangerous substances had been accumulated in bodies of animals. In 1993, an international treaty, which bans all dumping of radioactive waste at sea, was signed (Beránek et al.: 3).

b) Germany: Waste dump in water floods salt layers

In Asse, Germany, an experimental radioactive waste dump had been set up in the 1960s in salt formations deep underground. A few years later it was discovered that it had started leaking water in 1988 and is currently flooding with 12,000 litres of water each day. As a result, all 126,000 barrels of waste already placed in the dump now need to be cleared out. Asse was envisaged as a pilot project for a final storage solution in the salt layers under Gorleben, but there is now serious doubt in Germany about the viability of salt layers as storage for nuclear waste (Beránek et al.: 3; Federal Ministry of Economics and Technology).

c) France: Unknown waste inventory

One of the largest nuclear dumps in the world, the Centre de Stockage de La Manche (CSM) in northern France had been opened in 1969 to store low-level wastes, and it was closed in 1994. It currently stores 520,000m^3 of radioactive materials from waste reprocessing and French nuclear reactors. A 1996 commission set up by the French government concluded that the site also contained long-living waste and high-level waste, and that the true inventory was effectively unknown. In 2006 it was found that contaminated water from the site had already been leaking into an underground aquifer, threatening the surrounding agricultural land (Beránek et al.: 3; Agence Nationale pour la Gestion des Déchets Radioactifs (ANDRA) 2014).

d) USA: Seismic fault line compromises bedrock storage

In 1987, Yucca Mountain in Nevada, about 80 miles north of Las Vegas, was designated as the site for long-term disposal of radioactive wastes in the United States. However, the US Geological Survey has found a seismic fault line under the site and there are serious doubts about the long-term movements of underground water that can transport deadly contamination into the environment. As a result of these problems and billions of dollars in cost overruns, the US government stopped funding the project in early 2010. But some years later its political climate has changed again. The White House's fiscal 2018 budget plan for the Department of Energy includes 120 million dollars to restart licensing for the proposed Yucca Mountain nuclear waste dump (Beránek et al.: 3; Macfarlane et al.; Washington Reuters).

(2) New researches and challenges

Regardless of these failed solutions, and in order to overcome them, they begin new researches and challenges. Beránek et al. explain the present situation in Sweden, Finland, France and Belgium. In Europe, according to the DOPAS Project, the state-of-the-art researches and full-scale experiments are currently in progress.

a) Forsmark, Sweden – Olkiluoto, Finland: Copper corrosion

In Sweden, Svensk Kärnbränslehantering AB (SKB) (Swedish Nuclear Fuel and Waste Management Company) is tasked with managing Swedish nuclear and radioactive waste in a safe way. In the spring 2011, it applied for a license to build the Spent Fuel Repository in Forsmark in Östhammar and an encapsulation plant next to Clab in Oskarshamn. The regulatory authorities are currently considering the applications, and this will take several years. According to SKB's current timetables, its construction can start on the repository in the beginning of 2020 and it can be put into operation ten years thereafter. The reason why SKB selected Forsmark is that it is a site that offers good prospects for the long-term safety of the nuclear fuel repository. The rock is stable and homogenous, with few fractures and low water flows at depth (Svensk Kärnbränslehantering AB (SKB) 2015; Svensk Kärnbränslehantering AB (SKB) 2016). Sweden plans to pack waste in cast iron inserts in copper canisters and place them in holes bored in tunnel floors, 400-500 meters deep underground, surrounded by bentonite clay. Water is expected to make the bentonite clay expand so that it fills the cavities in the surrounding granite rock which would reduce groundwater movement (Beránek et al.: 4).

In Finland, Teollisuuden Voima Oyj (TVO) and Fortum Power and Heat Oy (Fortum) (producers of nuclear power-generated electricity) , being fully responsible for their own nuclear waste management, have established Posiva Oy to manage the disposal of spent nuclear fuel produced in their power plants and associated research and development work. The construction of ONKALO, an underground research facility located in Olkiluoto, began in 2004. The facilities currently completed include personel and ventilation shafts, access tunnel, and technical rooms. ONKALO enables disposal research in actual conditions. The disposal activities are scheduled to begin in about 2020 (TVO, Fortum and Posiva). Finland adopted same way of disposal as Sweden (Beránek et al.: 4).

According to Beránek et al., the copper canisters were expected to survive corrosion for at least 100,000 years, but a recent research shows that they can fail in just 1,000 years or less. The build-up of hydrogen was produced as a result of corrosion. High temperatures from the canisters could also affect the clay buffer, while groundwater flows could bring the contaminants from any compromised containers into the biosphere. Furthermore, Nordic countries will face at least one Ice Age in the coming 100,000 years, entailing extremely violent earthquakes, penetration of permafrost to the disposal depth and below, potential intrusion of water and unpredictable changes in groundwater flows (Beránek et al.: 4).

b) Bure, France – Dessel, Belgium: uncertainties of clay as a natural barrier

In France, L'ANDRA (Agence nationale pour la gestion des déchets) was established by la loi du 30 décembre 1991 (the December 1991 Waste Act) as a public body in charge of the long-term management of all radioactive waste. It benefits from 20 years' experience in the preparation of projects for the implementation of a repository, and demonstrates the feasibility of deep geological disposal for HL (high-level) and IL-LL (intermediate-level long-lived) waste and the safety of its solution. It also develops various construction and handling methods and processes, for which demonstrators and pilot models were built and tested. The performance of the disposal facility and the safety it provides are constantly reassessed via a series of methods developed and designed to integrate both the existing knowledge and system analysis. The Agency has developed a methodology for the phenomenological analysis of repository situation in order to describe and analyse any phenomenon likely to occur throughout the evolution of the repository, including over the long term (ANDRA; Agence Nationale pour la Gestion des Déchets Radioactifs (ANDRA) 2016).

According to Beránek et al., France and Belgium are exploring clay as a natural barrier, while Sweden and Finland rely on man-made barriers to prevent leakage. The waste is to be contained in simple stainless steel canisters, which can corrode much faster than the Swedish copper ones. Hence, the French/Belgium concept relies on the natural clay formation to contain radioactivity. The crucial question is whether it can be guaranteed for hundreds of thousands of years that no cracks or channels will form in the clay layers, which would cause water to leak in and out again, poisoning nearby aquifers (Beránek et al.: 4).

c) DOPAS Project: Full Scale Demonstration of Plugs and Seals

The Full-Scale Demonstration of Plugs and Seals (DOPAS) Project was a European Commission (EC) programme of work jointly funded by the Euratom Seventh Framework Programme and European nuclear waste management organizations (WMOs). The DOPAS Project was undertaken in the period September 2012 – August 2016. Fourteen European WMOs, and research and consultancy institutions, from eight European countries participated in the DOPAS Project. The Project was coordinated by Posiva (Finland). A set of full-scale experiments, materials research projects, and performance assessment studies of plugs and seals for geological repositories were undertaken in the course of the Project. The DOPAS Project aimed to improve the industrial feasibility of full-scale plugs and seals, the measurement of their characteristics, the control of their behavior in repository conditions, and their performance with respect to safety objectives. It also contributes to the implementation of geological disposal across Europe (The Full-Scale Demonstration of Plugs and Seals (DOPAS) Project: 3-4).

IV. Uncertainty and Complexity of Underground

1. Substantial Uncertainties of Geologic Repository

There are substantial uncertainties in geological repository, and no guarantee that radioactive nuclides will not be released into the environment in the future. Critical problems of 'uncertainty' and 'prediction' are raised and discussed at this moment.

Macfarlane et al. explain that there are substantial uncertainties in the geologic repository far into the future, and there is no way to guarantee that a repository will not release radionuclides into the environment at some point in the future. As for a suitable and safe geological repository for high-level nuclear waste, there are uncertainties, some of which can be reduced by additional work and research, and some are inherent to the extrapolation of the results of models over time and space. Can geologic and hydrologic processes be adequately understood in order to make predictions about radionuclide transport over geologic periods of time, especially once thermally hot radioactive waste has perturbed the natural system? (Macfarlane et al.: 3, 393-394).

They continue that a variety of factors make it difficult to predict repository behavior over geologic time. The environmental and chemical conditions of the repository evolve over time. This uncertainty arises from the difficulty of predicting interactions over tens to hundreds of thousands of years brought about by introducing a thermally and radioactively hot waste package into a complex geologic environment. Furthermore, knowledge about features, events, and processes is continually in flux. Over the long term, such factors may cause substantial divergence from the original prediction, and may cause unexpected results (Macfarlane et al.: 394-395).

2. Models in Predictions and No Solution in Sight

Macfarlane et al. insist that models of natural systems over geologic periods of time ignore the realities of the complexity of open systems over large timescales. Complex Earth systems problems, such as understanding the behavior of a repository, require the cooperation and coordination of many different values and diverse perspectives. Models of Earth systems cannot be validated because they attempt to simulate open systems, which exchange matter and energy with their surroundings. In open systems, there is no way to know all the input parameters or processes, or to assess the boundary conditions that might affect the system. For geologic timescale, it is unfeasible to anticipate all input parameters for all processes that will occur over the time period modeled (Macfarlane et al.: 397-398).

They continue that investigations into past reactions among minerals and fluids in rocks show that 'equilibrium' may be rarely reached, and therefore it is almost impossible to decipher the detailed history of a rock, let alone predict reactions into the geologic future. Geology has not advanced far enough yet to expect that it can do this. The problem is that the agency does not know all the features, events, and processes that will affect a repository over geologic timescales (Macfarlane et al.: 397, 399-400). According to Alley et al., any chosen course will be an imperfect solution. The problem is just too big, too complex, and too long. As investigations proceed, surprising should be expected and this expectation acknowledged from the outset (Alley et al.: 325).

3. Global Challenges

There are a number of difficulties to be solved in deep disposal of highly radioactive waste. Among four phases (construction, operation, transient and long term), especially latter two are too difficult to solve.

Pesh at al. explain that the transient phase is the time span with the most complex processes and interactions during repository lifetime. The waste still produces heat and the heavily distorted hydraulic and mechanical states are trying to get back to equilibrium conditions. Oxygen trapped in the system causes chemical reactions and enhances microbial activity in the repository. Analysis of all these processes demonstrates their complexity and show the problems that are faced in investigating this phase in the laboratory. Major problems are associated with time --- the thermal pulse will last for several hundreds to thousands of years and re-saturation processes are delayed because of the low hydraulic conductivity of argillaceous rock. Total equilibrium will not be reached before several tens to hundred thousands of years. The long-term behavior of a repository is the most important feature for evaluating the safety conditions and performance of a repository but no experiments in underground laboratories can be conducted to simulate this phase adequately. The evident critical issues in long-term performance prediction, beyond the problems that attend development of prediction models, are: (a) the lack of actual data from laboratory experiments and field studies, and (b) incomplete understanding of the kinetics of reactions both short-term and long-term abiotic and biotic reactions (Pusch et al.: 297-298).

As a result, based on the research by the Greens/EFA, we can conclude as follows.

Although there are at hand basic approaches to restrict the possible impacts of the hazard potential of the waste, but that there is no option available to completely eliminate the potential hazard. There are also problems to pass the responsibility for the radioactive waste onto succeeding generations and the high degree of uncertainty when forecasting social developments (social system, safety culture, economic attitude) for more than a few decades. The

alleged safety is solely based on retrospectively collected empirical data and on restricted current knowledge of the respective point of time. An exact proof of long-time safety cannot be scientifically provided today and also not within the foreseeable future according to present knowledge (The Greens/EFA: 29-30).

In addition, according to Rana, a clear demonstration about safety aspects of nuclear waste management would help in gaining public and political confidence in any possible scheme of permanent nuclear waste disposal. A common public desire is retrievability of finally disposed waste in case repository fails to isolate wastes from the live environment. But desire of retrievability is in direct contradiction with the principle of final disposal and adds serious complexities to the problem (Rana).

V. Conclusions

Although there is an international consensus among nuclear experts that nuclear waste can be safely disposed of in a geologic repository, but after many decades of effort, we have only one geologic repository licensed to receive high-level waste. The technical issues and the accompanying uncertainties related to predicting the long-term behavior of a geologic repository are and will continue to be a challenge (Macfarlane et al.: 4).

On the system and modelling level, as central as natural systems are to the concept of geologic disposal, one must account for the inevitable and inherent 'uncertainties' in modeling the behavior of geologic systems, particularly over long time spans (many hundreds of thousands of years) and great distances (tens of kilometers). We must face the problem of high-level nuclear waste disposal and its long-term solutions. While geologic repositories may offer the best solution, we must endeavor to understand the 'complexity' and 'uncertainty' of the multidisciplinary science that is required to support this strategy (Macfarlane et al.: 5).

On the policy level, a public policy is complex subject. It requires the consideration of a number of technical as well as social parameters. Policy for the high level nuclear wastes disposal is a multifaceted issue and it requires to resolve a number of inter-related problems. In situations like disposal of HLW, comprehensive evaluation of policy success is extremely important as implications of a failure can be serious for the present and future life at earth. There are stringent complications in assessment of the involved risks due to unpredictability of future geophysical events over a long time scale of more than 100,000 years (Rana).

In short, there are a number of difficulties to be solved in deep underground repository/disposal of highly radioactive waste. Among four phases (construction, operation, transient and long term), especially latter two are too difficult to solve. The state-of-the-art researches and full-scale experiments are currently in progress. But there are substantial uncertainties in geological repository/disposal, and no guarantee that radioactive nuclides will not be released into the environment in the future. Critical problems of 'complexity' and 'uncertainty' are raised, and will continue to be discussed. The problem is just too complex and too uncertain.

[Notes]

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2) This chapter is based on the three papers. The first was titled 'Radioactive Waste Disposal into Deep Underground: Green Criminological Consideration of 'Intergenerational Environmental Crime" and presented at the 70th Annual Meeting of the American Society of Criminology, San Francisco, CA, U.S.A., November 19-22, 2014. The second was titled 'Legacy of Deep Underground Nuclear Waste: 'Treasure Box' or 'Pandora's Box' for the Present and Future Generations?' and presented at the 16th Annual Conference of the European Society of Criminology, Münster, Germany, September 21-24, 2016. The third was titled '100,000 Years Nuclear Waste Deep Underground Repository: Can we keep it safely without troubles and accidents for such a long time?' and presented at the 72nd Annual Meeting of the American Society of Criminology, New Orleans, LA, U.S.A., November 16-19, 2016.

3) In order to do this research the author joined the DOPAS 2016 Seminar and visited three sites concerning geological disposal of high-level and low-level radioactive nuclear waste. The DOPAS 2016 Seminar took place in Turk, Finland 25th-26th May 2016, with a site visit to Olkiluoto on 27th May 2016. Over 110 participants representing WMO's, TSO's regulators, university persons etc. from around 50 organizations and 16countries worldwide attended the Seminar. As on-the-spot investigations, the author visited Äspö Hard Rock Laboratory of SKB, Oskarshmn, Sweden on 26th August 2016, Le Centre de Meuse/Haute-Marne (CMHM) de L'ANDRA on 30th August 2016, and Le Centre de Stockage de la Manche (CSM) de L'ANDRA on 1st September 2016. The author is most grateful to his colleagues, Ms. Johanna Hansen (Posiva), Mr. Pär Grahm (SKB), and M. Richard Poisson (L'ANDRA), for their help.

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Chapter 5

Lithium Extraction at the Salar de Uyuni in Bolivia: 'Dirty Business for Clean Energy' emancipates Bolivia from 'Curse' ?

Abstract

Lithium is a key global resource of efficient batteries used in electronic devices (ex. smart phone, electric car, etc.). But its booming demand threatens to contaminate one of the world's great wonders, the Salar de Uyuni in Bolivia, which holds 70% of the world's lithium reserves. The present government of Bolivia wants to extract lithium and to create the processing industry within Bolivia. However the plans lack a consciousness about social and environmental costs. The water scarcity around the Salar de Uyuni being ignored, the high water consumption of lithium plant would deprive indigenous communities of their traditional income measures: quinoa and pastoral farming. In addition, with little concern for the environmental effects of using toxic materials, widespread pollutions would put the flora and fauna at risk. Destroying the people's environment, the lithium strategy contradicts the principle of '*vivir bien*' (live well) and the 'rights of mother earth'. In this chapter, the environmental problematique of lithium extraction in Bolivia is cleared and the way of solving problems is suggested.

I. Introduction

Lost in the great Bolivian lithium race is, Hollender and Shultz warn, a set of very deep and real environmental concerns. In the name of providing cleaner cars to the wealthy countries of the north, Bolivia's beautiful and rare Salar could end up an environmental wasteland. The adequacy of environmental strategy for lithium development in Southwest Potosí is doubted by several well-regarded Bolivian environmental organizations (Hollender et al.: 5).

They mention that the lithium development could cause a major water crisis. The region already suffers from a serious water shortage, impacting quinoa farmers, llama herders, the tourism industry, and drinking water sources. Although Bolivian officials contend that the lithium project's water requirements will be minimal, their estimates are based on very limited and incomplete information (Hollender et al. 2010: 5-6).

Contamination of the air, water and soil is also a major concern. A large quantity of toxic chemicals, they add, will be needed to process the predicted 30,000 to 40,000 tons of lithium per year. The escape of such chemicals via leaching, spills, or air emissions is a danger that threatens the communities and the ecosystem. Bolivian officials have dismissed those risks, and the government system to protect the environment is inadequate. Public institutions, such as the Ministry of Environment and Water, which are responsible for ensuring compliance with environmental requirements, clearly lack the capacity or authority to intervene in effective way (Hollender et al.: 6).

In short, the possible environmental impacts of lithium development are too wretched. However, thus far, the government is not paying sufficient attention to these risks. We should take these risks seriously, especially for future generations.

II. Far-reaching Ill Effects of Lithium Mining: Crisis of Intact Water System

1. Quinoa Cultivation and Pasture Farming

The cultivation and exportation of quinoa is a far more sustainable income strategy than the export of lithium. Nowadays quinoa has about the same world market price as lithium (6€/kg), but it is renewable resource which can be grown for a time that lasts much longer than the typical resource exportation cycles. According to official estimations by the lithium-extraction in the Salar de Uyuni only 700-1500 jobs will be created. But more than 13,000 families are currently producing quinoa (Hollender et al.: 46; Poma et al.: 13). Furthermore in contrast to the industrial lithium carbonate production, it allows the local indigenous peasants to maintain their culture and traditional form of life (Anlauf: 25).

In addition, Ströbele-Gregor mentions an importance of intact water system on which the other income strategies of the communities around the Salar de Uyuni depend. The second income source is a pasture farming. Together with the quinoa production it is mainly used for subsistence-purposes and the continuation of rural family economies. While only 10% of the area in the south-eastern Potosí is used for agricultural purposes, 60% are used for pasture farming. The raise of camelids is only possible because of local wetlands and highland moors, which are a very fragile ecosystem reacting very sensible to changes in the water system (Ströbele-Gregor: 55-56, 61-62; Hollender et al.: 40; Anlauf: 25).

2. Crises of Intact Water System, Untouched Nature and Right to Water

Ströbele-Gregor and Anlauf explain the crisis of intact water system. Traditionally, communities are also engaged in the extraction of salt, which they sell to foreign markets or they trade it directly for corn or other products from the near valleys. In recent times this traditionally diverse income strategy is also supplemented by temporal migration or touristic activities.

But the latest income strategy, tourism, also highly depends on in intact water system. Tourists are mainly attracted by the spectacular colorful lagoons, which might dry out under the immense water needs of the industrial lithium carbonate production. These lagoons also host three species of flamingos that would not only die out as a tourist attraction, but also as a species itself in the region. The image of an 'untouched nature' that attracts most tourist will be hard to keep up with drillings and plants spread all over the salar (Ströbele-Gregor: 62, 81; Anlauf: 25-26).

Furthermore, many warn the use of toxic chemicals, such as hydrogen chloride (HCl) and potassium chloride (KCl), which are needed in vast amounts to produce the desired 40,000 tons of lithium carbonate per year: 265.300 tons of HCl and 250.100 tons of KCl. These toxic substances pollute the subterranean waters, which highly threatens agricultural and pastoral activities in the region. The pilot plant itself wasn't even tested on its environmental compatibility (Ströbele-Gregor: 80; Hollender et al.: 41-42; Anlauf: 26).

Finally, Ströbele-Gregor and Anlauf insist the crisis of 'right to water'. The migration of laborers towards the industrial lithium area makes higher the pressure on the resource water. As outlined above, the government's plans will lead to a disappearance or degradation of water sources used for human consumption. Already today, only 20-60% in rural areas and 50-70% in urban areas have access to fresh water. For COMIBOL (Corporacíon Minera de Bolivia), a lithium company, the fresh water supply of the workers on the plants will have priority over the water access of the communities around the Salar. Thus their constitutional 'right to water' is very likely to be violated for the benefit of an export oriented industry (Ströbele-Gregor: 57, 61, 81-82; Anlauuf: 26)

In short, while all the economic activities of the local population highly depend on water, their continuous existence is threatened by the water consuming lithium production.

III. 'Gold of the 21st Century helps lift Bolivia out of Poverty?

1. History of Colonialization and Raw Material Exploitation

Doyre explains the history of colonialization that, although Bolivia contains the world's largest lithium reserves, it is one of the poorest nations in South America. Due to a lack of infrastructure, this nation is unable to take advantage of own wealth of natural resources located in the remote area of Salar de Uyuni. Even with transnational corporations from France, South Korea, and Japan to invest in Bolivia's lithium, the administration of President Evo Morales has nationalized much of its natural resource industry, thus preventing many foreign companies from investing in Bolivia. Although Morales has been heavily criticized for closing the doors to Bolivia, the justifications for nationalization are based on a long history of exploitation (Doyre: 10).

Following this, Dyre explains the exploitation of raw materials in Bolivia which dates to its colonization by the Spanish during the sixteenth century. During the colonial period, the Spanish stripped Bolivia of its richness in natural metals such as gold, silver, tin, cadmium, tungsten, iron, lead and antimony. Hardly any of the profits from the extraction of these resources went to the Bolivian people but instead lined the pockets of imperialist Spain for 250 years. The social effects of this exploitation were extreme, including a forced labor system comprising of the indigenous population. The harsh conditions of mines, specifically in Cerro Rico and Potosí, led to the deaths of millions of indigenous people who died extracting ore for their colonial masters (Doyre: 10-11).

Although the Bolivian people eventually gained independence from the Spanish, Doyre continues to explain a serious situation after independence, they fell to further exploitation by transnational corporations who hoped to take advantage of the newly independent Bolivians and become wealthy from the country's natural resources. Since such corporations were

engaged in extractive industries, they brought little development or improvement to the Bolivian people, specifically the native populations. Transnational corporations thrive in poor countries like Bolivia because they have the power to provide industry, foreign exchange and jobs (Doyre: 11).

2. Lithium Industry is Next Potosí? Dirty Business for Clean Energy

Dyre explains an agony of dependence on foreign investment that a Bolivian-owned and -controlled lithium industry could lead to the economic advancement the country always had the power to create. The current administration of President Evo Morales is determined to avoid the history of raw material exploitation concerning to Bolivia's lithium resources. In 2008, Morales broke ground on a lithium processing plant with the hope of making batteries in the next year. The Morales administration tapped the mining company COMIBOL to run the $5.7 million state-owned plant, which represents a clear intention by the Bolivian government to nationalize the entire mining industry. Despite Morales's intentions to make the Bolivian people the primary beneficiaries of their country's resource wealth, the total lack of developed infrastructure requires foreign investors to aid in the development of a successful lithium industry (Doyre: 13).

While the Bolivian lithium industry represents hope for this perpetually exploited nation, Dyre warns expected environmental damages, it is likely that lithium production will greatly interfere with the fragile ecosystem of the Salar. Bolivia will use brine beds and evaporation ponds, and then re-inject the remaining salt to extract the lithium. This method increases the salinity of rivers, which the local people in this region use to irrigate their farms. Further environmental concern exists over the processing of lithium, which is most commonly done by mixing magnesium with lithium and could lead to further contamination. Finally, environmentalists have raised concerns about the unintentional combination of lithium with water, which results in highly corrosive lithium hydroxide. This combination could likely result during the rainy season, when the Salar often floods. The fragile character of the Salar de Uyuni further exacerbates the environmental concerns of lithium extraction. To extract enough lithium to meet even ten percent of global automotive demand would cause irreversible and widespread damage to a natural wonder that have taken millennia to form (Doyle: 13-14).

In short, the state-of-the-art lithium mining and its product industrialization have caused an archaic and unchanged 'theft of nature and poisoning of the land' (Goyes et al.) in Bolivia. State-corporate initiatives and socio-economic structures profit from or cause the conditions leading to environmental damage and over-exploitation.

IV. Political Economy and Ecology of Emancipation from 'Curse'

1. Colonial Extractivism and Breaking Potosí Principle

Anlauf explains a 'colonial extractivism' that since colonial times Bolivia's economy has historically evolved as a dependent, peripheral economy in the world system, supplying the economic centers with raw materials. While this transfer of resources is facilitated by local elites, who are closely allied to the core and also benefit from this system, they have little interest in the industrialization and diversification of the economy that could reduce internal asymmetries and the structural dependence on the core. Within these unequal structures the labor force is highly exploited and neglected any rights, justified by racism. Furthermore, the extractive economy appropriates itself of the nature in very destructive forms. In the search of quick surpluses ecosystems are damaged for hundreds of years and the local population deprived of its livelihood means. These patterns have been described as the 'Potosí Principle', which largely continued after colonial times (Anlauf: 26-27).

Although having formally gained independence, he continues, the Bolivian state continued to be a colonial one neglecting the indigenous majority participation in the political system. On the contrary they were the ones who kept on suffering the most under the extractive economy. Bolivia went through different export cycles of silver, tin and gas that were always accompanied by economic, political and social crises. Although in the mid-20th century some attempts of initiating an internal growth were made via the nationalization of hydrocarbons and tin, the policy-makers did not gain much more than temporal control over these resources (Anlauf: 27).

Finally he adds that after an intense protest-cycle in 2005/2006 a new political force took over the power from a regime that had largely discredited itself by its exclusiveness and an immense deepening of the extractive logic in the neoliberal model. With a very vivid long memory of the resource-deprivation and an ethicized political consciousness, the MAS (MAS-IPSP: Movimento Al Socialimo – Instrumento Politico por la Soberanía de los Pueblos) promised a sovereignty over natural resources and an adequate participation of the indigenous majority in the political system. The new constitution of 2009, explicitly recognizing indigenous rights and establishing the principle of *vivir bien*, as well as the law of 'rights of mother earth', can be seen as first materialization of these ideas (Anlauf: 27).

2. Decolonization through Lithium Industrialization without Environmental and Social Consciousness

In contrast to earlier periods of extractivism in Bolivia, Anlauf explains, the MAS government wants to the lithium to be extracted under complete state control. It wants to initiate an industrialization of the raw material within Bolivia and create a processing industry that adds value to the resource, mainly in the form of lithium-ion batteries for electric cars. It is very careful in implementing these plans, at least with regard to the search for international financing and technology, which is lacking in Bolivia, as a part of the periphery in the world system. These intentions clearly show the consciousness about historically being a dependent, resources-exporting and thus underdeveloped country and represent the aim of breaking with these dependence structures and the Potosí Principle (Anlauf: 27-28).

However, he mentions a lack of environmental and social consciousness that, although the new constitution explicitly recognizes the right to water and for indigenous people the right to manage their water systems according to their own customs, the water scarcity around the Salar de Uyuni is largely ignored by the lithium-strategy. The high water consumption of lithium plant would deprive the indigenous communities of their traditional income measures, mainly quinoa and pastoral farming. The destruction of natural water cycles and the degradation of soils via using toxic chemicals within lithium production, will make it impossible for indigenous people around the Salar to keep on living in their territories. Their constitutional rights to a clean natural environment and the autonomous gestion of indigenous territories are neglected (Anlauf: 28).

In addition, he warns that thus they will have to migrate to production centres or into the cities enlarging the masses of unqualified labour and those employed in the informal sector. Therefore by destroying the people's environment, the lithium strategy clearly contradicts the principle of *vivir bien* and the 'rights of mother earth', which are often referred to as central parts of the decolonization (Anlauf: 28).

3. Environmental law and regulation in Bolivia

In principle, Hollender et al. insist, Bolivian law requires that all industrial project proposals complete a public consultation, environmental impact assessment (EIA) and technical proposal that highlight potential environmental impacts and how they will be mitigated. These studies must be submitted and approved before breaking ground. The technical proposal, approved by the government for the pilot plant, does not seriously address pre-existing

environmental problems of the region in its baseline study. However, according to Bolivian environmentalists, environmental assessments are notoriously unreliable in their scientific foundations and rigorousness. Companies and the government view them as a bothersome formality and wriggle around them to get the green light for a project. Public institutions, such as Bolivia's Ministry of the Environment and Water, which are responsible for ensuring compliance with environmental requirements, clearly lack the capacity or authority to intervene in an effective way (Hollender et al. 2010: 42).

They conclude that "Bolivia's environmental law lacks just about everything to monitor and enforce environmental protection for this type of industrial project." All this raises serious concerns about the environmental consequences of large-scale lithium development in the Salar de Uyuni. Bolivia will likely face significant tradeoffs between drawing its lithium riches out from under Southwest Potosí and causing serious environmental desecration of that region in the process (Hollender et al.: 43; Perreault)

In short, we need, first, more secure livelihoods and resource rights, second, broader forms of participation and the democratization of decision-making processes regarding natural resources, third, alternative model of economic development.

V. Transnational Mining, Global South/ Global North and Everlasting Environmental Exploitation

1. New Perspective of 'Southern Criminology'

Carrington et al. explain the recent development of green criminology. The nation state focus of criminology has led to the relative neglect, until recently, the implications of borderless and transnational crimes such as environmental crimes. However, there is a growing tradition of green criminology attempting to correct this neglect. Notwithstanding its growing interest in crimes against environment, criminology devotes little attention to global environmental and corporate harms whose incidences and impacts are greatest in the global South, such as those associated with resource extraction, climate change and economic exploitation. Where globalization has been a foci of criminological theorizing, it has too readily assumed the simple extension of northern trends across the globe, failing to do justice to global diversity in sources and trajectories of economic, social and penal policy (Carrington et al.; 4)

They insist the importance of Global South/ North perspective that the selective popular, official and criminological gaze which settles on the crimes of the socially excluded, overlooks/normalizes, violence and harm elsewhere. Corruption, violence, expropriation of landowners, environmental degradation and diversion of scarce public resources are commonplace and mutually reinforcing in their harmful effects. Instead of their rich resource base delivering benefits to ordinary citizens, poverty, poor health, degraded living conditions and conflict are perpetuated and exacerbated. If stable, prosperous, democratic states cannot avoid corruption, cronyism, economic distortions and other symptoms of the resource curse, we can only ponder the vulnerability of poor and fragile states confronting the power of global corporations (Carrington et al.: 9-10).

2. Environmental Exploitation of Transnational Mining in Latin America

Allimande explains the specific activity of mining and its associated impacts as being fundamental to the constitution of Latin American coloniality. Indeed, the exploitation of minerals in the region is vital to the very genesis of modernity. The historical evolution of modern mining is intrinsically linked to the emergence, constitution and the political vicissitudes of colonialism/coloniality, the dark counterpart and recurrently denied of the modern order. As such, we focus on mining in the region to understand larger political ecologies of socio-natural transformation. In recent years, neo-liberalization was part of a wider economic globalization that prompted renewed demand for Latin America's minerals. Thus aggregate global demand for

consumer goods requiring mineral inputs was on the rise in certain sectors, notably computers and mobile phones, only enhanced this process with their insatiable demand for diverse minerals such as lithium (Alimonda: 149, 155).

We can find the historical-structural link between the rise of large-scale mining in Latin America and the colonial condition of the region in relation to the world system. Such coloniality refers to the 'exploitation and degradation of both nature and people'. Mining revenue was withdrawn from the region to serve national purpose that rarely translated into local advancement. Thus regions such as Uyuni show markedly lower social development than the metropolitan areas of these countries (Alimonda: 159-160).

Finally he concludes that Latin America's miming enclaves are based on sharp asymmetries of political and economic power in which local residents are habitual victims. Here, 'modernity' and 'coloniality' collide as state-of-the-art mining refashions nature, dispossessed people and inscribes new territorialities in a neoliberal idioms. No wonder that mining is a regional 'flashpoint', as local groups and their national and international supporters fight megaprojects that violate human rights and democratic principles. This dynamic of control and resistance has deep roots in Lain American history (Alimonda: 160; Böhme).

In short, the mining industry and the indulgent response to harmful exploitation lead to the contamination of water, air, animal and plant life and even serious health problems for workers and local communities. This is a current example of human rights violations in the context of transnational business activities in Latin America.

VI. Conclusion

The Salar de Uyuni and surrounding region is rich in animal, bird, and vegetative life. Nearly all of the local plants are still used by communities for medicinal purposes. The Salar is home to three of the six flamingo species in the world and serves as their breeding ground during flood season. Due to the importance of the Salar watershed for human and animal life, it is protected by the RAMSAR Convention, an international treaty for the conservation of wetlands. The delta of the Rio Grande, the drainage from which is crucial for the Salar's regeneration, has already been classified as one of 34 global biodiversity Hot Spots by Conservation International. This delta forms a year-round lagoon, used by birds as well as wild and domestic animals (Hollender et al.: 41).

All of this could be thrown into environmental disarray by a large scale, water-using, industrial project in the region. Industrialization plans of lithium for the region will stress an already over-tapped supply of water. It is certain that increased water scarcity in the region will have an impact on the people who live there and on their ability to continue working, farming and living in the region (Hollender et al.: 41, 51)

In conclusion, although the ecosystem as a whole has already been contaminated and will be more and more degraded and destroyed, the government pays far too little heed to the warnings raised about serious environmental damage at the Salar de Uyuni and its surroundings. If we continue to be in chase of lithium wealth, Bolivia will end up destroying its entire ecosystem. Struggles for justice in Bolivia are far from over, and its efforts to construct more equitable political, economic and social systems must involve more inclusive forms of social organization, not just in the formal politics but within civil society.

[Notes]

1) This chapter is based on the paper titled "Lithum Extraction of the Salar de Uyuni in Bolivia: Flora and Fauna at Risk with Widespread Pollution" and presented at the 17th Annual Conference of the European Society of Criminology, 13-16 September 2017, Cardiff, United Kingdom.

2) This chapter is a part of research results of "Research on Environmental- and Eco-crimes by Progress of Scientific Technologies and Development of Societies and measures against Them 2015-2019" (Subject Number: 15K03181) supported by the Grand-in-Aid of Scientific Research by Japanese Ministry of Education, Culture, Sports, Science and Technology.
3) In order to make a research on current situation of lithium extraction and environmental degradation at and around the Salar de Uyuni in Bolivia, the author visited the relevant places: the salt plane lake (Uyuni), lagoons (Colorada, Honda, and Charkota), lithium factories (Rio Grande and Lippi), quinoa farms and factory, salt factory (Colchani), etc. in August 2017.
4) The author is most grateful to his colleagues, Professor María Laura Böhme (University of Buenos Aires) and members of her research group, for their help..

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Chapter 6

'Multiple Battlefields' of Lithium Extraction-Production at and around the Salar de Uyuni: Economy vs Environment/Ecology, Colonization vs Decolonization, and Global North vs Global South

Abstract

The current state of the lithium extraction in Bolivia and the problematique of 'environmental human rights' and 'political ecology' in Latin America are critically analysed. The Bolivian constitution of 2009 has been classified as one of the most progressive in the world regarding indigenous rights. The indigenous principles of Suma Qamaña/ Vivir Bien/Good Living on the harmonious relationship between humans and nature are established in the constitution. Nonetheless, these rights clash with the constitutionally recognized rights of the nation state to extract and commercialize natural resources mainly hydrocarbons and mining under the banner of redistributive justice, welfare reforms and the common good: the dilemma of extractive development. The class-ethnicity tensions have altered throughout history, according to changing socio-economic, cultural and political settings. During Evo Morales' presidency, class based human rights in practice tend to be superior to the ethnically defined rights, as a reflection of the dilemma of extractive development. In Latin America, human rights have emerged as a weapon in the political battleground over the environment as natural resource extraction has become an increasingly contested and politicized form of development. However, the application of human rights discourses has yielded limited concrete results largely because the state as a guardian of human rights remains fragile in Latin America and is willing to override their commitment to human and environmental rights in the pursuit of development. In order to break this impasse, we need a new epistemology and emancipation, knowing and enacting 'political ecology'.

I. Introduction

In Bolivia lithium has taken a more central economic position since 2008 and will continue being central in the anticipated future, Revette explains the current situation of lithium extraction, although hydrocarbons currently serve as the primary source of revenue. Bolivia is a critical node in the 'triangle of lithium' and much of the hype surrounding its lithium industry is associated with the global excitement around this unique alkali metal's role in changing energy technologies. Increased use of battery powered electronics, tools, and vehicles has resulted in a tremendous recent growth in global demand for lithium, and our appetite for all things tech-related only seems to grow. Hybrid and electronic cars along with endless versions of new smartphones and similar devises all demonstrate our expanding dependence on lithium (Revette: 35).

She continues that there are questions regarding the ability of current production to keep up with growing demand. Some foresee a quadrupling of lithium consumption over the next two decades, and others even argue that lithium shortage will be likely soon. These tangible shifts in the global market place have opened up space for lithium to play a critical role, and Bolivia, home to the world's largest known reserve of lithium, has identified this an opportunity to step in as a key player in lithium production. The challenge, however, comes in determining exactly how Bolivia will insert itself into this shifting global energy matrix (Revette: 36-37; Perotti and Coviello).

In this context, then she analyses, Evo Morales, current President of Bolivia, rejected several offers of foreign investment in the lithium industry because he required majority Bolivian ownership in the process, and tremendous emphasis has been placed on the 100% state ownership and management of the initial phases of the industrialization. The lithium industry was placed under the control of a division of the state-run mining corporation Corporación Minera de Bolivia (COMIBOL), Gerencia Nacional de Recursos Evaporiticos (GNRE), and Morales has repeatedly emphasized how the lithium industry is critical to the growth, development, and sovereignty of Bolivia. What makes lithium particularly distinctive in such a mineral rich country is that it represents the unprecedented opportunity for the state to fully control the extraction and industrialization process from its beginning. In conjunction with the larger context of socio-political changes in the country and region, the 2008 inauguration of the state-run lithium industry brought with it great hope and expectations regarding Bolivia's ability to rewrite its long and troubled history with natural resource extraction curse (Revette: 37; Mares; Aguilar-Fernandez).

In this article, the current state of the lithium extraction in Bolivia is critically analysed. Then, the problematique of 'environmental human rights' and 'political ecology' in Latin America is deliberated. At last, future prospects of lithium and natural resources mining and its problems in Bolivia and Latin America are suggested.

II. Extractive Capitalism or Imperialism of the Twenty-First Century

1. Development, Difficulties and Negative Effects of 'Progressive Extractivism'

In recent years, we can see the development of new form of extractivism in Latin America: 'progressive extractivism'. According to Veltmeyer, this is a heterodox form of extractivism based on resource nationalism and 'inclusionary state activism' in the form of the regulation of operations of extractive capital in the public

interest, environmental protection, 'equitable growth' and 'sustainable resource development'. Progressive extractivism, which is exemplified by Bolivia and other post-neoliberal states, is characterized by a development strategy of resource extraction and primary commodity exports, which has been used to deepen the contributions of extractive sector and extend extractivism to other resources such as rare earth or industrial minerals, and lithium in Bolivia. In this scheme, the state plays a much more active role than in the classical model of extractivism and this state activism has a more 'inclusionary' character (Veltmeyer: 81-82).

A more indirect but no less active role for the state has to do with development financing and infrastructure support, and the provision of subsidies and production incentives. In this scenario, he explains, the transnational mining companies would by no means be done away with. As in the case of Bolivia, they reappear in a new form of association with the state. Even in its new 'progressive' form, a strategy based on natural resource extraction is unsustainable, unable to escape the development trap of reliance and dependency on foreign direct investment and the machinations of global capital and the imperial state (Veltmeyer: 82-83).

As for the extraction and production of lithium, then he mentions, the government anticipates state participation only in the first or easiest phase of the industrialization process, via the formation of a state enterprise (COMIBOL) for the production of carbonate and lithium chloride. For the more complex heavy industrialization process required for the production of metallic lithium, and for the financing of this production, the government has been actively seeking and continues to seek alliance with foreign companies. The policies of governments in Bolivia in the mining sector have created a scenario in which the extraction and exportation of minerals and metals are dominated by the transnationals (Veltmeyer: 91).

2. Labor, Conflict and Class Struggle in the New Bolivia

Most of conflicts in the extractive sector, and the resource wars over water and gas etc. which surround these conflicts, Veltmeyer analyses, derive from the negative environmental impacts of extractive operations on the economy and on the livelihoods of indigenous communities located near those operations. In this context, class or social struggles have tended to take the form of a defense of the territorial rights of the indigenous population to the land, water and resources from the predation of extractive capital. Composed mostly of peasant farmers and rural landless or near-landless workers, the indigenous population can be viewed as a new proletariat, one more victim of a protracted capitalist development process of 'accumulation by dispossession' (Veltmeyer: 108-109).

The communities of indigenous peasants that make up rural society, he continues, form the social base of the environmental and social movements of resistance provoked by and brought into existence over the past decade in response to the destructive operations of extractive capital. In this situation, the indigenous peasant farmers have been largely proletarianized, forced to abandon agriculture and their rural communities and to work off-farm, many in the mining sector, or to migrate to the cities where they have joined the ranks of the ubiquitous street workers in the informal sector, which now accounts for up to 60 percent of the economically active population in Bolivia (Veltmeyer: 109).

Bolivia's extreme dependence on the extraction of hydrocarbons and minerals, he mentions, makes the economy vulnerable to the vagaries of commodity prices and leads to conflicts with indigenous and environmental groups over the adverse impacts of extractive projects. The mining sector continues to be disrupted by inter-sectorial conflicts between peasants and indigenous working class fighting over the scraps which the transnational mining industry leaves behind. An abundance of natural resources, together with other

endogenous processes of a pathological character, distorts the allocation of economic resources in the region, resulting in a negative redistribution of national income, the concentration of wealth in a few hands, and widespread poverty and recurrent economic crises, while consolidating a 'rentier' mentality, further weakening an already weak institutional framework, encouraging corruption and damaging the environment (Veltmeyer: 113; Veltmeyer et al.: 247; McNeishi; Plekkenpol).

3. Costs of Extractive Capitalism or imperialism

The impacts of extractivism can be put into several categories, both socioeconomic and environmental. Veltmeyer et al. insist that the latter relate to the degradation of environments, in which indigenous and farming communities of small-scale producers have to live and work, operate their enterprises and sustain their livelihoods. A large number of detailed scientific studies have corroborated the endless charges, claims and concerns of the populations and communities negatively affected by the operations of extractive capital, particularly open-pit mining (Veltmeyer et al.: 237).

The negative social impacts of extractivism, Veltmeyer et al. continue, concern jobs and livelihoods, and the health of community members and mineworkers, as well as new forms of social inequality. They also have to do with 'accumulation by dispossession', i.e. enclosure of the commons of land, and water, separating the direct producers from their means of production for the purpose of extracting, exploiting and profiting from the human and natural resources. In conditions of the new extractivism, the 'enclosure' and 'depossession' dynamics of the capital accumulation process take and are taking the form of privatizing access to and commodifying both the commons of land and water and extracted subsoil resources, degrading the environment (e.g. polluting air and water), and undermining the livelihoods of the direct producers in their communities (Veltmeyer et al.: 237; Gudynas; López and Quiroga).

In short, the extraction and production of lithium have drawn a lot of money, but the result has been very poor and sad: there is no development; the mass poverty and negative environmental impacts are alarming; what they have is environmental contamination and pollution, massive deforestation, and damage to health and disease.

III. Ethnic Rights and Dilemma of Extractive Development in Plurinational Bolivia

1. Suma Qamaña, Ethnic Rights and Extractive Dilemma in the Constitution 2009

Academics, social movement activists and politicians in Bolivia, Ecuador and elsewhere frequently use the Suma Qamaña (vivir bien, live well) concept, both as critique of development understood as progress/economic growth and as a principle of harmonious and ecologically sustainable life. According to Lalander, for a better comprehension of the legal setting and the complexities amidst the dilemma of extractive development, the ethnic-indigenous as well as broader social rights, and also the 'extractive developmentalist' rights of the state, it is of great importance to examine some crucial parts of the 2009 Constitution. Broadly speaking, there are references to the central objectives of poverty reduction, welfare provision, economic development and environmental protection throughout the Constitution (e.g. article 312). Moreover, articles 306 and 313 emphasize that the overarching ambition of Bolivian economic policies is to overcome poverty and social/economic exclusion (Lalander: 470-471).

However, he mentions, the same Constitution equally expresses the rights of the state to explore the natural resources of the soil, as pronounced in articles 319 and (below) 355, which also indicates the destination of the incomes derived from these activities:

1) The industrialization and sale of natural resources shall be a priority of the State.
2) The profits obtained from the exploitation and sale of the natural resources shall be distributed and reinvested to promote economic diversification in the different territorial levels of the State. The law shall approve the percentage of profits to be distributed.
3) The processes of industrialization shall be carried out with preference given to the place of origin of the production, and conditions shall be created which favor competitiveness in the internal and international market (Lalander: 471).

Clearly, then he analyses, prevailing economic and political interests conflict with indigenous-territorial and environmental rights. Reinforced rights and the maintenance of resource extraction reliance, this enigma is clearly expressed in the Constitution. National authorities justify the persistent extraction with the necessity to achieve distributive justice, that is, a diminution of poverty and the provision of welfare for all, especially the marginalized sectors. This approach, with the partial sacrifice of the specific rights of the environment/nature and indigenous peoples to achieve social welfare, is sometimes labelled progressive neo-extractivism (Lalander: 472).

2. Indigenity and the Dilemma of Extractive Development

The capitalist logics of accumulation are, Lalander explains, still central traits of the Bolivian political economy, which has been criticized by many activists and scholars who were hoping to witness the progress of an anti-capitalist/post-capitalist project in the country. However, since the beginning, the Morales administration has explicitly communicated that the state should attain control of extractive industries so as to finance welfare reforms and to achieve economic development. Moreover, the Morales government realized radical legal reforms regarding both human rights and environmental principles within the hydrocarbon sector. These improvements, including the acknowledgment of rights in the 2009 Constitution, were the outcomes of decades of popular struggle, principally by lowland indigenous peoples (Lalander: 475).

The indigenous and class-defined discourse of Evo Morales and his government is, he continues, pronounced and directed at different levels: the domestic and global spheres respectively. Evo Morales has indeed been portrayed as a climate hero around the world, leaning on discourses based on indigenous values and the worldview of Suma Qamaña (vivir bien) as options for responding to both global capitalism and the climate crisis. But, this discourse is applied mostly at a global level, whereas the domestic speeches of Morales deal more with development economics and fair distribution of resources, that is, policies and rights defined by class and social justice. The aim was consequently neither to abandon the matrix of capitalist development, nor to entirely end the pollution of nature through extractivism or to always respect the indigenous territories, but to establish the dilemma and propose the Suma Qamaña as an alternative to the world. The relative superiority of welfare policies vis-à-vis environmental conservation and indirectly indigenous territorial rights is similarly expressed in the quotation. Rounding off, he mentions, the extractive dilemma has been characterized by recent years of contentious politics and resource governance in Bolivia (Lalander: 476-477; Feil und Rüttinger; Schilling-Vacaflor; Mähler and Pierskalla).

3. Political Economy of Extractive Development Dilemma

The Bolivian Constitution of 2009 is, according to Ladander, undoubtedly among the most radical in the world regarding the incorporation of international human rights criteria and the recognition of specific indigenous rights. As expressed above in the fragment of the preamble to the Constitution, Bolivia is no longer a republic but a plurinational state, which is a direct acknowledgment of the indigenous custom to organize according to distinct ethno-cultural identification within the same nation state. Additionally, the indigenous ethical-philosophical conceptualization of Suma Qamaña (vivir bien, live well) on the harmonious relationships among human beings and with nature/the environment has been established as the backbone of the Constitution and national development policies. A principal endeavor of the government since 2006 is the ambition to decolonize society, the state and the economy, which is also reflected in the Constitution. Historically, the Bolivian political economy had excluded the indigenous population. Mining and extractive capitalism and imperialism based on exploitation of the indigenous peoples as labor force have characterized the Bolivian political economy since colonial times. The 2009 Constitution strengthened the position and role of the state in the economy, as a response to the discontent with neoliberal global capitalism (Lalander: 464-465).

The Morales government, which has been in the forefront of what has been labeled twenty-first century socialism, he mentions, has repeatedly emphasized that the state should achieve control of extractive industries in order to fund welfare policies and to achieve economic development. Regarding the state control of vital industries, mainly hydrocarbons, agro-business and mining, the Constitution declares the industrialization and commercialization of natural resources to be a key priority of the state, though taking into consideration the rights of indigenous peoples and provided that revenues should be directed at the common good (articles 319 and 355). The dilemma of state authorities is consequently, to be able to deliver welfare for all, which requires economic resources. With the public control of strategic industries, the redistribution of wealth through extraction can be achieved as provision of class-defined rights. The rights of indigenous peoples and of the environment are affected in situations where natural resources are extracted in indigenous territories (Lalander: 465; Kröger and Lalander; Canessa).

In short, the incorporation of the indigenous philosophy of Suma Qamaña in the Constitution and national development policies has reinforced the ethno-ecologist profile of the Morales government, particularly at a global level. Likewise, the government strategically uses the indigeneity and ethno-ecologist discourses. In Bolivian, ethnic rights frequently tend to be downgraded in relation to the broader class-defined rights as an outcome of the extractive dilemma.

IV. State-led Extractivism and Frustration of Indigenous Development

1. Contradictions of Plurinational Extractivism

The paternalist-clientelist state-society relations in Bolivia, reproducing themselves from resource revenues, according to Paweska, are not contradictory but fully complementary with and functional to the global capitalist system, thus facilitating the subjugation of Bolivia to the interests of global resource markets. Because of the Bolivian state's stronger involvement in socio-political mechanisms produced/conditioned by the resource extraction-dependency, as well as the need to respond to these mechanisms of state-society relations.

Bolivia is more prone to capitulate before market pressure for natural resource exploitation. It also contributes to understanding why the Bolivian state, controlled by a supposedly pro-indigenous government, is more sensitive to the interests and expectations of indigenous peoples protesting against state-led extractivism (Poweska: 446).

The configuration of power and dominating social interests and expectations cannot be underestimated. He analyses that the evolution of the state project towards centralism and the substantial reduction of 'plurinational' elements of the state's ideology is following traditional and well-established patterns of the Bolivian political culture and character of state-society relations. Corporatism, clientelism, statism and rentierism are interrelated and constitute together the backbone of the Bolivian 'national ideology' and political system, historically rooted but re-articulated with the world commodities boom. This model incites conflicts between different social groups competing to gain influence in state power and capture rents. State-owned resources are used to secure the political loyalty of different social groups and the prolongation of power (Poweska: 457-458).

However, he insists, there is a fundamental contradiction between this model of state control of resources and indigenous peoples' self-determination in development. In its perverse logic of power, the state's paternalism discourages society's own initiatives. Instead of increasing incentives for people's own choices and direct opportunities of development, the state limits people's autonomy in disguise as the protector and saviour of society (Poweska: 458; Ströbele-Gregor; von Braun).

2. Compensatory or Predatory? Problem of the State and Asymmetries of Power

Is the Bolivian state compensatory or predatory? We can say it is both at once. Poweska explains that, in order to be compensatory towards dominating parts of society, it is simultaneously predatory towards indigenous peoples occupying resource rich areas. But how can we explain this ambiguous nature of the Bolivian state's performance, based upon the contradiction of pro-indigenous discourse and pro-extractivist economic policy? (Poweska: 457).

In the interplay of structural and conjunctural factors, he continues, we can find the 'double face' of MAS (Movimento al Socialismo) which is incarnated in the current state project. The ruling party almost since its beginning combined two ideological and pragmatic wings or discursive axis. The one 'wing' deals with extractive economic issues , interested in the return of the economically active central state, the revocation of privatization, nationalization of hydrocarbons and redistribution of rents, industrialization and general modernization, and the generation of employment. The other 'wing' deals with ethnic issues: claims for the end of the persistent exclusion and marginalization of native sectors of society which sought greater access to and presence in the political system, greater sensibility of the state to the interests of indigenous peoples and conferring collective rights (e.g. territorial autonomy, communitarian justice and democracy, recognition of cultural rights, and so on) (Poweska: 457).

There was no one agenda, he mentions, but several different agendas which formed an unfocussed scope of interests and expectations for the state's renovation, agendas of different sectors of society that felt similarly harmed by imperialism and neoliberalism. While these different dimensions combined well before the winning of political power, the apparent union of the indigenous-populist lock started to dissolve thereafter (Poweska: 457).

3. Indigenous Rights, Extractivism and 'Pragmatic Retreat'

Bolivia is a state with a long colonial legacy, and with a tradition of discrimination and exclusion of indigenous peoples. Historically, Poweska explains, it was a country where privileged sectors used state power as a mechanism to secure exploitation of subaltern groups. The term 'accumulation by dispossession' is used to address the indigenous peoples' resource dispossession by central state power as transferring property from indigenous groups to state ownership for the benefit of domestic elites and other social groups which are favorably oriented towards central power. All of these refer to the problem of unequal socio-political relations that render the power structure of the state (Poweska: 455).

Bolivia also demonstrates some attributes of a classic rentier state. He continues that, as the country is historically a natural resource extraction-dependent state, such a state cannot function without revenues coming from resource export sectors, and it has a strong tendency to centralism and vertical relations with society. These patterns are conditioned by the need for control of vital resources and strategic sectors of the economy. Inevitably such a state would maintain a strong central character. This goes hand in hand with the predatory character of such a state (Poweska: 455).

Despite Morales' reputation as a defender of Mother Earth, he insists, the Bolivian state brings into question the authenticity of its pro-indigenous agenda. The extractivist priority policy quickly contradicted the official policy of vivir bien. The project of decolonialization became problematic for the policy of nationalization of resources. There is a fundamental conflict between the state and many indigenous groups over this question. The expansion of hydrocarbons exploitation and mining as well as the development of infrastructure and energy projects progress at the expense of the most fundamental indigenous rights. The Bolivian state's 'pragmatic retreat' undermines indigenous rights to territorial and resource control. It seems that the promise of the plurinational state has been converted into empty rhetoric (Poweska: 444).

In short, the fundamental paradox of the rhetoric of human rights have been used and abused by the 'Janus-faced state': one face compensatory and the other predatory. Even if indigenous rights are being strengthened through international activism at the global level, their implementation strictly depends on local circumstances. Even the ratification of well-constructed international law and incorporation of fundamental indigenous rights into the Constitution cannot ensure their effective realization in practice. The indigenous rights and indigenous agenda are being deformed and manipulated by the state. Together with infrastructural and energetic projects, the expansion of hydrocarbons and the mining industry are at the expense of the most fundamental indigenous rights.

V. Environmental Human Rights and Political Ecology in Latin America

1. New Human Rights Perspective Critiques Current Development

Natural resource exploitation, as the increasing number of large-scale and mega-development projects in the region, according to Raftopoulos, has made Latin America one of the most dangerous places for human rights activists and environmentalists in the world. Human rights have emerged as a weapon in the political battleground over the environment as natural resource extraction has become an increasingly contested and politicized form of development. Latin American governments have relentlessly pursued extraction, regardless of the socio-environmental costs and the abrogation of the most fundamental human rights which this

development model entails. Along with the increasing recognition of the linkage between human rights and extractivism, questions are raised within human rights law over approaches to environmental protection and recognition of intercultural perspectives (Raftopoulos: 387-388).

The explosion of social-environmental conflicts that has accompanied the expansion of extractive activities, she explains, has posed a challenge to the political and economic ideology of the current development model. This challenge comes from the new relational ontologies of local and indigenous communities and cultures which have opened up debates about the relationship between the human and non-human world, the rights of nature and human rights and duties. It has become increasingly apparent that the Commodity Consensus model and the largescale export of primary products in Latin America have advanced in recent years in a context of increasing violence and have impacted enormously on the promotion and protection of human rights. As a consequence of this new cycle of protests in the region, the environment has emerged as a new political battleground for human rights, and along with it, the urgent need to carry out more research on the relationship between human rights, extractivism and the environment (Raftopoulos: 388, 401; Hogenboom; Gianolla; Columbia Center on Sustainable Investment, Sustainable Development Solution Network, UNDP and World Economic Forum; Goyes et. al).

2. Epistemology: Knowing 'Political Ecology'

In Latin America, Leff explains the epistemology of knowing political ecology, the ecological destruction generated by the exploitative appropriation of nature during the colonial regime and then on to the present world economic order was accompanied by the exclusion and eradication of traditional practices even as Western knowledge, economic rationality and religious beliefs were imposed on the conquered territories. Unequal international economic exchange is connected to the creation of 'enclave' economies as well as the historical and political alliances and dynamics in Latin American countries which facilitated such activity. The political ecology conceive of dependency and underdevelopment as a structural state of world affaires where poor nations provide the natural resources and cheap labor in an unequal interchange for capital and technology from 'developed' nations. The cause of Latin American misery is firmly connected to capitalist relations of production which underpin the wealth and power of Euro-America and not to rapid population growth in the Third World. With the contemporary emergence of severe and intensifying environmental crises, the dialectical relation of capital and ecology is incorporated into the contradictions of the economic world order (Leff: 47).

Decolonizing knowledge, epistemological vigilance and critical thinking about the power strategies which are being deployed in the contemporary geopolitics of sustainable development, he insists, are central to the fight-back against the rampant forces of global capital which combine traditional and new forms of exploitation and oppression in Latin America as well as in the rest of the global South. Decolonizing knowledge is therefore an epistemological condition for deconstructing the exploitative trends of the global economy and reviving the ecological potentials and cultural meanings of local people (Leff: 49; López and Vértiz; Albrecht).

3. Emancipation: Enacting 'Political Ecology'

Leff suggests the emancipation of enacting political ecology that sustainable production is based on the negentropic conditions of production which is based on the ecological potentials of the earth and the cultural creativity of the peoples. Political ecology faces the challenge of harnessing and reversing this process of

entropic degradation by prompting negentropic thermodynamic processes in the construction of a social order founded in the immanence of life, the ecological productivity of the biosphere, and culturally innovative practices which preserve and enhance the sources of life on the planet (Leff:51-52).

Enacting political ecology has also revolves around a clear sense of how past and present hegemonic power structures impinge on people's everyday lives. He insists that, to plot a strategy of emancipation involves an often highly location specific sense of multifaceted ecological distribution conflicts geared by multiple power structures. In effect, socio-environmental conflicts encapsulate the battle between sameness and otherness, likeliness and difference, and ontological uniformity and diversity. While assessment of these conflicts is by no means confined to Latin America, this region affords an especially rich setting within which to explore and test this concept (Leff:52).

In Latin America, he concludes, the idea which socio-ecological justice and emancipation is based on the 'cultural re-appropriation of nature' is central to political ecology analysis. If the ethical politics of otherness points towards the pacific coexistence of different ways of being-in-the-world, the variety of ways in which human cultures construct nature open political ecology to conflicts of 'equity in difference' arising from different cultural visions and valuations of nature, as well as the confrontation of cultural/economic rights to appropriate nature and territorialize cultural diversity (Leff: 53).

In short, we need the transition towards de-colonial approaches to human rights built upon alternative cosmologies and intercultural perspectives, whereby nature has inalienable rights. There are a number of emerging themes which warrant further attention: how transnational human and environmental rights advocacy networks are shaping the meaning and possibility of human rights discourses, de-colonial approaches to human rights and methodologies in Latin America, the adoption of human rights discourses in different social and cultural contexts and legal systems and also gendered impacts of extractivism and the role of women in social-environmental conflicts could provide valuable new insights into the merits of extractivism as a development strategy. It is hoped that more multidisciplinary research into the topic, broadening the analytical base of debates on extractivism, helps foster a new relationship between humans and nature.

VI. Conclusions

The Bolivian Constitution of 2009 has been classified as one of the most progressive in the world regarding indigenous rights. The indigenous principles of Suma Qamaña (vivir bien, live well) on the harmonious relationship between humans and nature are established in the Constitution. Nonetheless, these rights clash with the constitutionally recognized rights of the nation state to extract and commercialize natural resources and mining under the banner of redistributive justice, welfare reforms and the common good: the dilemma of extractive development. The ethnic identity is multifaceted in Bolivia, and large segments of the indigenous population prefer to identify in class terms. According to changing socio-economic, cultural and political settings, the class-ethnicity tensions have altered throughout history. A central argument is that class based human rights in practice tend to be superior to the ethnically defined rights, as a reflection of the dilemma of extractive development, during Evo Morales' presidency.

In Latin America, human rights have emerged as a weapon in the political battleground over the environment in accordance with natural resource extraction which has become an increasingly contested and

politicized form of development. Furthermore, the explosion of socio-environmental conflicts which have accompanied the expansion and politicization of natural resources have highlighted the different conceptualizations of nature, development and human rights. While new human rights perspectives are emerging in the region, mainstream human rights discourses are providing social movements and activists with the legal power to challenge extractivism, and critique the current development agenda. However, while the application of human rights discourses can put pressure on governments, it has yielded limited concrete results largely because the state as a guardian of human rights remains fragile in Latin America and is willing to override their commitment to human and environmental rights in the pursuit of development.

In order to break this impasse, we need a new epistemology and emancipation, knowing and enacting 'political ecology'.

[Notes]

1) This chapter is based on the paper titled "Lithium of the Salar de Uyuni in Bolivia, 'Gold of the 21st century' helps lift a Nation out of poverty or throw it into the abyss of despair?: The next battlefield between economy and environment/ecology" and presented at the 73rd Annual Meeting of the American Society of Criminology, 15-18 November 2017, Philadelphia, U.S.A..
2) This chapter is a part of research results of "Research on Environmental- and Eco-crimes by Progress of Scientific Technologies and Development of Societies and Measures against Them 2015-2019" (Subject Number: 15K03181) supported by the Grand-in-Aid of Scientific Research by Japanese Ministry of Education, Culture, Sports, Science and Technology.
3) In order to make a research on current situation of lithium extraction and environmental degradation at and around the Salar de Uyuni in Bolivia, the author visited the relevant places: the salt plane lake (Uyuni), lagoons (Colorada, Honda, and Charkota), lithium factories (Rio Grande and Lippi), quinoa farms and factory, salt factory (Colchani), etc. in August 2017.
4) The author is most grateful to his colleagues, Professor María Laura Böhme (University of Buenos Aires) and members of her research group, for their help.

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Chapter 7

'Drought and Flood (Climate Change) – Social-Ecological System Destabilization – Conflict Nexus' in East Africa: Climate Change-induced Environmental Degradation, Food Insecurity, Migration and Violence around Mt. Kilimanjaro

Abstract

Climate change leads to environmental degradation which has an impact on natural resources. Competing livelihood systems are subject to stiff competition, leading to social tensions and violence. In other incidences, environmentally induced migration has contributed to competition over shrinking resources in host communities, and is a recipe for violence. Droughts or floods are examples of extreme weather events, which are categorized under climate variability and characterized by their severe effects on people's livelihoods, especially on agricultural production and associated food security. The current drought situation in the Horn of Africa is worryingly familiar, and the situation is deteriorating faster than expected. Severely erratic and below average rainfall has resulted in widespread food insecurity and malnutrition, deteriorating livestock conditions, and the mass movement of populations within and across borders. In this research, focusing on the region around and near Mt. Kilimanjaro, Tanzania, the following questions are cleared; first, how climate change over a period of time disrupts the normal functioning of the ecosystem that interacts with humans, and affects how they access certain vital resources for their survival; second, how climate change hazards create imbalances in the socio-ecological system that have the potential to exacerbate or even trigger violence in some contexts.

I. Introduction

Climate change leads to environmental degradation which has an impact on natural resources. Competing livelihood systems are subject to stiff competition, leading to social tensions and violence. In other incidences, environmentally induced migration has contributed to competition over shrinking resources in host communities, and is a recipe for violence. Droughts or floods are examples of extreme weather events, which are categorized under climate variability and characterized by their severe effects on people's livelihoods, especially on agricultural production and associated food security. The current drought situation in the Horn of Africa is worryingly familiar, and the situation is deteriorating faster than expected. Severely erratic and below average rainfall has resulted in widespread food insecurity and malnutrition, deteriorating livestock conditions, and the mass movement of populations within and across borders.

In this article, focusing on the region around and near Mt. Kilimanjaro, Kenya, the following questions are cleared; first, how climate change over a period of time disrupts the normal functioning of the ecosystem that interacts with humans, and affects how they access certain vital resources for their survival; second, how climate change hazards create imbalances in the socio-ecological system that have the potential to exacerbate or even trigger violence in some contexts.

II. Climate Change, Environmental Threats, Migration, and Human Rights

1. Climate Change, Environmental Degradation and Migration: Complex?

Greenpeace explains that the risk to humans of being displaced through sudden natural disasters is 60 percent higher today than it was forty years ago. Today an average of 25.4 million people is displaced every year as a consequence of natural disasters. Climate change contributes to the increase in extreme weather events and weather-related natural disasters, and to the increasing number of people who lose their life support base and are forced to flee their homes and migrate to other places. Climate change and environmental degradation are already much stronger drivers of migration flows than many of us may be aware of. We need to understand the complex relationships between climate change, environmental degradation and migration, and to provide insight into current research as well as political initiatives (Greenpeace: 6).

The climatic and environmental factors driving migration are often ignored because it is difficult to isolate them from other motives, Greenpeace continues. Climate and migration researchers therefore attempt to investigate climatic and environmental factors in differentiated ways and to explore and reveal the many ways in which they are connected to other factors. Climate change and environmental degradation are multipliers of additional problems and crises that lead to displacement and migration. The more differentiated our understanding of complex contexts is, the better governments and society can prepare for these challenges and support the people affected (Greenpeace: 6).

Greenpeace concludes that the correlations between climate change and environmental destruction are already complex. The International Organization for Migration (IOM), outlining the links between climate change, environmental changes and migration, has derived the concept of environmental migration now used more and more frequently: climate change leads to environmental degradation, to which other factors, such as the excessive use of natural resources, also contribute. Environmental degradation destroys people's livelihoods and increasingly exposes them to the risk of natural disasters. Therefore, the link between climate

change and migration is environmental degradation. As climate change progresses, environmental destruction increases, as does the pressure to migrate. The working definition of 'environmental migrants' used by the IOM describes them as "persons or groups of persons who, predominantly for reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and who move either within their country or abroad." In order to explore the climate change factor, it is useful to use the term 'environmental migration' (Greenpeace: 6).

2. Dynamics of Migration, Climate Justice, and Human Rights

At present, Greenpeace insists, an important issue in legal research on climate change is to explore how the gap in protection can be closed for people who migrate due to environmental changes or natural disasters. Research on climate change and migration has expanded enormously and become differentiated in the past ten years. Understanding of the reasons, dynamics, and extent of migration has improved, and yet many questions remain unanswered. Many research projects and political initiatives are based on a common understanding and goal—that migration is an important step in adapting to climate change. The common objective is to provide better support to particularly vulnerable population groups and to migrants fleeing the effects of climate change and environmental degradation. The aim is to boost the resilience of people in vulnerable areas to prevent unwanted migration and to enable desired migration. One focus of current research is to find out which opportunities migration offers to both the communities and states losing their populations and the communities and states taking in migrants. Researchers are making efforts to overcome the widespread image of migrants as threatening or passive victims. "Societies affected by climate change are societal actors who actively shape and change their life circumstances to find common solutions. A constructive approach strengthens the positive interrelationships between migration, human development, and adaptation to climate change" (Greenpeace: 7).

In conclusion, Greenpeace mentions, a special right to protection for environmental migrants is substantiated in the context of justice and human rights. Floods, storms, drought and famine can deprive people of their basic rights: the rights to life, personal freedom and security, food, housing, water, health, and education. This makes environmental migration part of the human rights debate. Those countries and social groups which have contributed the least to global warming will continue to be especially vulnerable to the effects of climate change. Providing highly affected populations and migrants with substantial support can be understood as a first step toward more 'climate justice' (Greenpeace: 7).

3. Climate Change, Environmental Threats, and Human Rights

Human Rights Watch explains that, over the past century, the average annual temperature on earth has increased, the oceans have warmed, snow and ice caps have diminished, and sea levels have risen. Although evidence of climate change, and its causes, has been debated for more than two decades, there is now scientific consensus that climate change is occurring and is due to human activity. Climate change is being felt in countries throughout the world, from low-lying countries such as Bangladesh and the Maldives, to temperate countries in the northern hemisphere, to countries in Africa's arid and semi-arid Sahel. Climate scientists have attributed both the increasing frequency of specific extreme weather events (such as drought, flooding, and heat shocks) and the slow but steady change in long-term features of the environment (such as receding glaciers and melting permafrost) to rising temperatures caused predominantly by anthropogenic (i.e. human)

sources. They predict that these, and other, observed climate changes will become more severe in coming years (Human Rights Watch: 1).

These changes in the climate are imposing an increasing burden on governments, Human Rights Watch continues, especially in countries with limited resources, in their efforts to protect vulnerable populations and realize human rights. Changing precipitation patterns such as drought, and shorter but more intense rainfall, can have negative direct and indirect impacts on health and contribute to desertification and flooding, food insecurity, migration and increased conflict. Indigenous populations, poor and socially marginalized individuals, women, and people with disabilities, are often most affected. The United Nations Office of the High Commissioner for Human Rights (OHCHR) has identified climate change as posing particular risks to the rights to life, food, water, and health. In the past decade, the UN Human Rights Council and other human rights bodies have as well, adopting several resolutions highlighting the consequences of climate change on the full realization of human rights. UN human rights experts have also repeatedly stressed that the response to climate change must respect, protect, promote and fulfil human rights (Human Rights Watch: 1-2).

In conclusion, Human Rights Watch insists, one reason for the attention to the relationship between climate change and human rights is the recognition that climate change is having an uneven impact across the world. Countries with tropical or subtropical climates (such as those in Africa) are projected to experience the effects of climate change most intensely, and low-income countries are least able to prevent and prepare for the impact of climate change (Human Rights Watch: 2).

4. Climate Justice and Knowledge: Contingent?

Climate change has divided societies but also generated avenues to unify them, Mihr mentions, for example, a human rights-based approach to climate migration can support the most affected communities. 'Climate justice' is about how resources, wealth and access to a good quality of life are guaranteed under dramatically changing conditions that do not stop at borders of any kind. It endorses the human rights of people to development, freedom and a healthy and sustainable environment, and reflects the full spectrum of international human rights law (Mihr: 47)

Climate change is perceived as an environmental as well as a socio-ecological and economic threat that causes human rights violations, he insists, particularly against the poor and the marginalized. It is reinforcing the intensity and frequency of extreme weather events, including floods, storms, heatwaves, droughts and tornadoes. These, in turn, have profound consequences on human development and human rights. Women's and indigenous people's rights, along with the more general rights to life, food, health, water, adequate housing, culture and self-determination, are all affected by climate change. UNDP has warned that allowing such a tragedy to develop would cause a systematic violation of human rights of the world's poor and future generations and represents a step back from universal values. Therefore (Mihr: 47).

Baldwin insists that the knowledge of climate change, migration and human rights is not universal but situated. While climate change is a matter of pressing concern, to manage its migration effects through human rights law is a very particular and thus political undertaking. Acknowledging the contingent nature of this knowledge is important because it allows us to widen the terms of responsible action. It allows us to pose questions about whether this form of knowledge is indeed best suited for managing the migration effects of climate change or whether other forms of knowledge, such as indigenous knowledge, might equally be up to the task. Indeed, if climate change demands that we ask fundamental questions about what it means to live

in the world today or about what kind of life is possible as we stand on the threshold of profound global environmental change, then perhaps answers to these questions can be found in the experiences of human life and living that are not synonymous with what we understand to be modernity today (Baldwin: 224).

III. Climate Change, Migration and Conflict

1. Africa: Climate Change, Escalating Conflict/Violence and Migration

(1) Climate change, escalating violence and continental migration

Greenpeace mentions that the extent of the drought in the Horn of Africa, which currently threatens the lives of some 20 million people in Yemen, Somalia, Kenya, South Sudan und Ethiopia, is reminiscent of the famine in the Sahel region in the 1970s and 1980s. More recently, the Horn of Africa experienced a prolonged drought in 2010 and 2011. The climate in this region is influenced by fluctuating sea surface temperatures in the Indian Ocean. Similarly to El Niño and La Niña in the Pacific, sea surface temperatures off the coast of East Africa and Indonesia also oscillate between a warm and a cold side. When sea surface temperatures off the coast of East Africa are cold, less water evaporates and the northeast trade winds, which bring rain to the interior of the region, are weakened or completely absent. Droughts on the African continent in recent decades have not only become more frequent, but also lasted longer. When the intervals between recurring droughts become shorter, the ability of the population to recover from the most recent drought and prepare for new droughts diminishes. If extreme climatic events are accompanied by violent conflict, as in Yemen, Somalia, and South Sudan, then people try to reach refugee camps to obtain some degree of protection for themselves and their families and to ensure survival through food aid (Greenpeace: 26-27).

(2) Climate change, migration and conflict

Since the 1960's, according to ICCA, Africa has experienced a general warming trend with certain regions experiencing more warming than others. Kenya has experienced general rise in temperatures. Moreover, high evapo-transpiration rate reduces surface water especially in the northern Kenya where pastoral system is dominant. Despite the fact that pastoralists have been migrating in the past in search of water and pastures, conditions have become much tougher as the region is prone to frequent episodes of droughts forcing them to venture beyond their original migration zones. During migration, they encounter hostile communities who resist invasion in order to protect resources within their borders. This has led to incessant conflicts and migrations in the arid and semi-arid lands (ASALs) (ICCA: 2).

Repeated reporting of these conflicts in these communities indicates either the absence of suitable conflict resolution mechanisms and approaches, or their ineffective implementation, ICCA continues. Many communities resort to violence as a way of "managing" their conflicts without sustainably resolving them. Use of violence increases tension between the involved communities, causing fear among community members and inevitably forcing people (in particular women, children and other vulnerable groups) to leave their homeland (ICCA: 2).

Considering that the environment is already stressed, ICCA explains, it is most likely that the number of conflicts and casualties will increase, causing more people to take refuge. However, there is still a lot of hesitation by the international community to acknowledge the existence of climate refugees and their eligibility

to seek asylum. Kenya like many other Africa countries is yet to ratify the Kampala convention on Internally Displaced Persons. This framework may address displacement caused by natural disasters that influence human life, peace, stability, security and development. Thus, the implementation of such frameworks is essential to improving the Government's response to the protection needs of IDPs (ICCA: 2).

In short, UNFCCC recognizes climate change as one of the greatest human rights challenge of our time (Human Rights Watch, 2015). Similarly, Stockholm and the Rio Declaration have acknowledged the link between environmental quality and the human rights (ICCA: 2).

2. Kenya: Climate Change-Induced Conflicts and Migration

(1) General remarks

According to the analysis of ICCA, only 20 percent of the land in Kenya is arable whilst the rest of the country in the northern, north eastern and much of the southern areas are arid and semi-arid lands (ASALs) which constantly experience incessant conflicts especially over pasture and water resources. These areas experience unpredictable, non-equilibrium weather conditions. Against this background, nomadic pastoralism is the dominant livelihood system. Migration as an adaptation and coping mechanism leads to competition over the dwindling natural resource base. The scarcity results in violent inter-community conflicts leading to migration. Lately, there has been an increase in migration trends both in space and time among pastoralists causing severe competition resulting into conflicts which hinder accessibility to critical resources. Inter-communal conflicts have been exacerbated by dwindling land and water resources as well as socio-political, economic and cultural factors alongside institutional oversights such as drawing communal boundaries without consideration to pastoralist's mobility needs (ICCA: ix).

There is an emerging correlation between climate variability and violent conflict in Northern Kenya, where most conflicts were resource based, ICCA continues. Thus, up scaling the findings from the two case studies to regional, national or elsewhere will be insightful for forward perspective in the future. It was evident land use had changed significantly as reflected in the species composition in both counties' shrinking forests. In addition, precipitation was associated with increased variability as witnessed in the increased frequency of droughts over the last 10 year with shorter cycles of about 3-5 years. Moreover, we can note a correlation between droughts and conflicts; these conflicts have led to displacement of communities, loss of livelihood and migration. Moreover, migration is influenced by the search for opportunities and in other instances; there has been forced migration due to incessant cycles of conflicts (ICCA: ix-x).

(2) Climate change and natural resource conflicts

Following the analysis of ICCA, underdeveloped societies are at high risk of environmental problems which have accumulated changes such as rising sea levels, land degradation, and declining freshwater resources resulting to relatively more permanent and dispersed effects. Such societies are relatively more likely than developed societies to exit the affected area, because they are highly vulnerable, as is the case in Least Developed Countries (LDCs) whose borders were carved by colonial powers leading to a push effect of societies to more resourceful areas which over time result to conflicts over dwindling resources (ICCA: 13).

The competition for natural resources is the root cause of conflicts, ICCA explains. The current conflicts and displacements have been reinforced by a number of factors and key among them are the changing climate regimes. For instance, in Wajir and Garissa Counties, climate change has dramatically increased the region's vulnerability to droughts and floods. This has imperiled the rather fragile livestock based livelihoods

and ruled out possibilities of sedentary agriculture. Conflicts over resources (pasture and water) are on the rise as influx of refugees from Somalia intensifies population pressures in the County (ICCA: 13).

- Mandera County which is located on the North Eastern tip of Kenya and borders Somali on the Eastern side and Ethiopia on the Northern is arid with few water resources. It has only one permanent river (River Dawa) flowing from southern Ethiopian highlands down through Mandera into southern Somalia and the rest of the County is served by water pans, natural springs and boreholes, which are owned by resident communities. During dry periods when scarcity worsens, community elders usually come up with complex schedules for sharing the water resources. Failure by a group to adhere to these schedules usually results into conflict (ICCA: 13).
- Marsabit County borders Wajir, Isiolo, Samburu and Turkana Counties all of which are arid and semi-arid. Marsabit County is dry with the exceptions of small patches of mountainous arable areas in central and northwestern parts. As such, natural resource-based conflicts over pasture and water are prevalent. Land in Marsabit is categorized as Trust land which is held by the local authorities in trust for the people. As such, there is no individual land tenure. This predisposes the area to conflicts between nomadic communities as property rights are loosely defined. The County has no major water source and therefore the residents rely on water springs, underground water and seasonal rivers. These are communal resources which could easily trigger conflict in times of scarcity. Droughts also increase vulnerability and exacerbate conflict (ICCA: 14).
- The Turkana in the North western tip of Kenya is bordered by equally hot and dry Counties. The County is prone to famine and cattle rustling due to constant migration by pastoralists from its different parts and from neighboring Counties in search of pastures for their livestock and occasionally has experienced cross border conflicts from indigenous groups from Uganda, South Sudan and Ethiopia. Climate variability has caused degradation of the environments leaving it worse off than before. Further, Lake Turkana is drying up and receding due to climate change not to mention creation of dams upstream by the Ethiopian government on River Omo (ICCA: 14).
- Baringo County shares borders with quite a number of neighbours namely, West Pokot, Elgeyo Marakwet, Nakuru, Laikipia and Uasin Gishu Counties. Some of its neighbours have serious security concerns, in particular the border between Baringo and West Pokot; and Laikipia counties are porous and in the hands of cattle rustlers who are in possession of small arms. Communities from the three Counties habitually raid each other to steal livestock. The primary economic activity within the County is livestock keeping. Inevitably this leads to conflicts as communities have to fight for pasture in the dry seasons. These seasons also coincide with rites of passage which create demand for activities such as cattle rustling. The conflicts that arise in these situations are for pasture and water (ICCA: 14).

On displacement and migrations, a report by UNOCHA (2014) shows that in Turkana 1730 people were displaced, in Mandera-125,107 people were displaced; in Wajir, 84,980 people were displaced between January and November 2014, ICCA mentions. Displacement figures have sharply increased due to increase in number and frequency of droughts leading to resource based clashes. Mandera County has particularly suffered from struggle from political representation and its proximity to both the Somali and Ethiopian borders. Although the causes of conflicts differ according to the report, a good number of the reported cases include struggles for control and use of dwindling resources-in particular water and land for pastures. Figures for 2013/14 show that almost 500 people in Mandera were killed and more than 55,000 people were displaced as

a result of inter-communal violent conflicts. That means the number of people displaced by conflicts in the first half of 2014 was almost four times the number of people displaced in the entire previous year (2013) (ICCA: 14-15).

(3) Areas most affected by inter-communal conflict

Areas most affected by inter-communal conflicts in Kenya include semi-arid districts of Turkana, Isiolo, Samburu, Wajir, Moyale and Mandera in the north of the country, ICCA continues. Apart from the traditional causes of conflicts in these areas which have mainly been cattle rustling and clan or tribal conflicts over political representation, recent conflicts are either caused or exacerbated by the effects of climate changes which include scarcity of water and pastures for pastoral communities who make the majority of the resident communities in these areas. A report by IDCM revealed 95 percent of the 220,000 displaced people in 2014 were from Kenya's north-east where pastoralism is the primary means of livelihood. Conflicts and displacement are as a result of pressure on scarce resources as the region hosts the largest pastoralist groups. Furthermore, the deteriorating security situation was resulting from threats from terrorist groups and proliferation of small arms and lastly, historical grievances and the effects of new power structure relating to marginalization and failed struggle for secession after Kenya gained independence (ICCA: 15).

The Kenyan climatic land condition leaves the majority of ASALs' residents susceptible to weather disasters as the climate changes over time, ICCA mentions. In the last decade, frequency and severity of natural disasters in Kenya have affected larger numbers of people (NCPD, Kenya Population Situation Analysis, 2013). For example, before 1990s, drought events occurred at five to ten-years intervals and on average affected less than 50,000 people per year (UNISDR, 2012). This statistics dramatically changed over the 2000-2009 decade when drought events occurred every one to three years and affected an annual average of 1.5 to 4.5 million people (UNISDR, 2012) (Boko, Niang, & Nyong, 2007). The 2008/2009 drought alone affected 10 million people, and decimated over 20 percent of livestock population in the arid and semi-arid lands (ICCA: 15).

Furthermore, ICCA continues, the international disaster database (CRED, 2002) 1993-2010, a total of 73 natural disaster events including droughts, epidemics, flood, landslides and a tsunami, occurred in Kenya. These events affected accumulative total of 48.46 million people. Droughts had the highest impact (39.2 million people) epidemics (6.9 million people and floods (2.4 million people) (ICCA: 15-16).

(4) Conclusion

In conclusion, ICCA mentions, natural resource based conflicts among different ethnic groups due to competition over access to scarce resources has always existed. However, they have become more frequent and deadly despite peace initiatives and measures in place to enhance communities' resilience to cope with severe droughts. Most conflict incidences were reported during dry spell, an indication that climate change has exacerbated their occurrence. Pastoralists are migrating beyond their original migration routes due to reducing pasture within their grazing belt. Therefore, interactions between different ethnic groups spark conflict. There is a positive correlation between increase in drought episodes and conflicts. Moreover, decreasing natural resource base in Turkana as indicated in the land use land cover (LULC) has exacerbated unprecedented forced migrations to territories crossing over to the neighboring international community's especially to Uganda, South Sudan, and Ethiopia (ICCA: 70).

Natural resources (grazing land and water) account for a sizeable share in fueling conflict, ICCA insists. Therefore, clear policy guide lines on issues to do with management and utilization of water resources are required. The study also noted that conflicts are likely to arise at water points especially in pasture areas. However, other factors such as political interests and traditional customs could not be ruled out. In both case study areas, conflicts have increased economic hardship as the only livelihood option, pastoralism, has been ravaged. Despite government taking proactive steps to protect pastoralists by deploying more security personnel, its effectiveness is not clear. The study noted that inadequate security enforcement in both Turkana and Samburu Counties is because security personnel are either unable or unwilling to confront cattle rustlers who are well armed. Insecurity leads to formation of local vigilante groups popularly known as home guards who acquire small and light weapons for self-defense. The weapons used by these vigilante groups are also used during cattle rustling leading to more conflicts (ICCA: 70).

IV. Global Environmental Change, 'Environmental Refugee' and International Human Rights Law

1. Environmental Refugee in International Human Rights Law

(1) Impact of climate change on people's lives

Whereas it has been demonstrated that phenomena linked to climate change are among the main causes of population movement, according to Piasentin, it is also true that these people do not belong to any well-defined category of subjects of international law that can guarantee their protection. In 2013, people obliged to flee their habitat by disasters were almost three times as many as those forced to flee their homes by conflicts. In 2015 98.6 million people were affected by disasters and, according to UNISDR, "Climate was a factor in 92% of those events." The natural disasters producing the greatest impact were droughts: in comparison to the ten-year annual average, drought rates have more than doubled in number, affecting 50.5 million people, particularly in Africa. Floods were the phenomenon that had the second greatest impact in 2015 (Piasentin: 33).

Scientists agree that climate change, he continues, in combination with other factors, will cause an increase of people displacement in the future. Moreover, according to the IPCC report, "Displacement risk increases when populations that lack the resources for planned migration experience higher exposure to extreme weather events, in both rural and urban areas, particularly in developing countries with low income." It has been reported that 97% of disaster-related displacement, between 2008 and 2013, occurred within developing countries. In addition, climate change is also expected to have an indirect impact on increased risk of violent conflicts, such as civil war and inter-group violence (Piasentin: 34).

(2) Protection of people on the move in international law

While it is clear that climate change produces a serious impact on migration and displacement, he analyses, it is also true that it is quite difficult to identify a direct link between the two phenomena. The reason is that different communities perceive the impacts of climate change differently, depending on their political, economic and social conditions. Their ability to cope with the same type of sudden or slow-onset disaster and their resilience are therefore different. This obviously affects people's mobility decisions. It is more common that displaced people affected by a sudden or slow-onset disaster stay within the borders of their home country.

In this case, the state has the obligation, under national and international law, to respect their rights and to protect them. On the other hand, when they move to a foreign country, there is no specific legal instrument that regulates how these migrants have to be treated for what concerns their permission to stay and their protection (Piacentin: 34-35).

He continues that refugees are a very precise legally-defined category of people including anyone who, "Owing to well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion, is outside the country of his nationality and is unable or, owing to such fear, is unwilling to avail himself of the protection of that country." When a sudden or slow-onset disaster happens, only if the state discriminates against some specific group of people in giving assistance, can those people who do not receive protection be considered as persecuted and therefore entitled to international protection. In the same way, if the disaster is caused by some action or inaction imputable to a discriminatory attitude by the state towards a particular group of people, these people could fall into the refugee category (Piacentin: 35).

However, he adds, migrants who cross borders for reasons connected to climate change and cannot demonstrate persecution by the criteria defined in the Convention cannot be considered refugees. Even if some decide to live and work in a foreign country do so as a consequence of the impact of climate change on their country of origin, it does not mean that they are entitled to international protection. In addition, the Convention does not guarantee the right to be admitted to or stay in a foreign country (Piacentin: 35-36).

(3) Way forward

In conclusion, he mentions, international human rights law does not address the issues of people's admission to and stay in a foreign country following a sudden or slow-onset disaster connected to climate change. However, the international community is in the process of identifying a practical solution to this legal protection gap. It seems that for the time being an international convention is not feasible: it would need complex negotiations and would take time. The Nansen Initiative, for instance, is a state-led consultative process led by Norway and Switzerland aimed at building international consensus on a protection agenda to address the needs of people displaced abroad following the impact of climate change. The Agenda for the Protection of Cross-Border Displaced Persons in the Context of Disasters and Climate Change (Protection Agenda) was endorsed by 109 governmental delegations during a global intergovernmental consultation in October 2015 (Piacentin: 36-37).

In September 2015, he adds, at an historic UN summit, the 2030 Agenda for Sustainable Development was adopted, including 17 Sustainable Development Goals (SDGs) that universally apply to all. These goals aim to end all forms of poverty, fight inequalities, tackle climate change and improve environmental protection. With the 2030 Agenda for Sustainable Development, it was finally recognized that climate change is already affecting public health, food and water security, migration, peace and security, and there are some specific goals that address these impacts. Moreover, with the historic climate agreement reached in December 2015 in Paris, the international community in its entirety has further demonstrated its concern about the issue of climate change and its willingness to enact an effective response to the threats it poses to the world's population. Hopefully, this is particularly a positive moment to address the issue of the international protection of people displaced by the impact of climate change, in a framework of multi-level cooperation and solidarity (Piacentin: 37-38).

2. Future Challenges and Opportunities

The report of Government Office for Science considers migration in the context of environmental change over the next 50 years. The scope of this report is international: it examines global migration trends, but also internal migration trends particularly within low-income countries, which are often more important in this context. The report has the following key conclusions:

- Environmental change will affect migration now and in the future, specifically through its influence on a range of economic, social and political drivers which themselves affect migration. However, the range and complexity of the interactions between these drivers means that it will rarely be possible to distinguish individuals for whom environmental factors are the sole driver ('environmental migrants').
- Powerful economic, political and social drivers mean that migration is likely to continue regardless of environmental change.
- The impact of environmental change on migration will increase in the future.
- The complex interactions of drivers can lead to different outcomes, which include migration and displacement.
- Environmental change is equally likely to make migration less possible as more probable.
- Consequently, in the decades ahead, millions of people will be unable to move away from locations in which they are extremely vulnerable to environmental change.
- Preventing or constraining migration is not a 'no risk' option (The Government Office for Science: 9).

According to the report of GOS, the challenges of migration in the context of environmental change require a new strategic approach to policy. Policy makers will need to take action to reduce the impact of environmental change on communities yet must simultaneously plan for migration. Critical improvements to the lives of millions are more likely to be achieved where migration is seen as offering opportunities as well as challenges.

- Measures prevent harmful environmental changes, reduce their impact, and build resilience in communities.
- Migration can represent a 'transformational' adaptation to environmental change, and in many cases will be an extremely effective way to build long-term resilience.
- Cities in low-income countries are a particular concern, and are faced with a 'double jeopardy' future (The Government Office for Science: 10).

In summary, the report mentions, the key message of this report is that migration in the face of global environmental change may not be just part of the 'problem' but can also be part of the solution. In particular, planned and facilitated approaches to human migration can ease people out of situations of vulnerability. In light of this, international policy makers should consider the detailed evidence from this report in a range of areas, with the following of particular priority:

1) Many of the funding mechanisms for adaptation to environmental change are currently under discussion.
2) Whilst the twin challenges of population growth and environmental change will pose an increasing threat to urban areas in the future, cities in many countries are already failing their citizens (The Government Office for Science: 10).

The cost of inaction is likely to be higher than the costs of measures discussed in this report, the report of GOS concludes, especially if they reduce the likelihood of problematic displacement. Giving urgent policy

attention to migration in the context of environmental change now will prevent a much worse and more costly situation in the future (The Government Office for Science: 10).

V. Critical Exploration of the Non-linear Relationship among Climate Change, Migration and Conflict, and Catastrophe, and Insecurity

1. Dire Forecast: Theoretical Model of the Impact of Climate Change on Crime

Agnue explains that climate change will increase crime and other harmful acts through its effect on social conflict. Climate change will contribute to conflict through several mechanisms, with perhaps the most important being increased competition between groups over scarce resources. Such conflict will increase crime and harmful acts in a variety of ways (Agnew: 34-35).

Criminologist typically explain crime in terms of individual traits and features of the social environment, he continues. They have devoted little attention to the direct and indirect effects of the natural environment on crime, with the limited exception of temperature. Therefore research should focus on the criminogenic consequences of such things as habitat change (especially land degradation); extreme weather events, including both sudden-onset (e.g. hurricanes) and slow-onset events (droughts); and food and freshwater shortages. Such factors may directly affect crime (e.g. food shortages as a type of strain, which directly prompts crime); and they may indirectly affect crime (e.g. food shortages are a source of malnutrition, which impairs cognitive development). However, criminologist should keep in mind a key point, 'the future will not be the same as the past' (Agnew: 37).

As climate change proceeds, he adds, its effects will become more widespread, frequent, and severe. People will also become more likely to experience multiple effects (e.g. coastal flooding, extreme weather events, and food and freshwater shortages). Further, the context in which these effects occur will change. As individuals, groups, and states struggle to cope with the effects of climate change, their ability to legally adapt to further effects will decline. Also the way in which the effects of climate change are interpreted will change. Most notably, individuals and groups will become increasingly likely to view these effects as unjust. These changes increase the likelihood that climate change will lead to crime (Agnew: 38).

However, he concludes, researchers can roughly approximate certain of these changes. They can test for 'threshold effects' or the idea that 'certain of the independent variables do not affect crime until they have passed a certain level. And they can determine whether a range of factors condition the response to climate change, including factors that influence or directly index coping ability and perceptions of injustice. Such research is critical, although tentative given the evolving state of climate change (Agnew: 38).

2. Climate Change, Migration and Conflict Nexus

Burrows and Kinney analyses that the potential link between climate change, migration, and conflict has been discussed in the academic for several decades. However, despite this growing concern and focus on climate change and conflict, uncertainty remains regarding the pathways linking climate change to migration to conflict. This uncertainty is partly brought about by the inherent complexity of climate change projections. It is furthered by the challenges of accurately projecting population growth and movements, identifying the outbreak of conflict, and determining the significance of climate and migration as drivers of conflict relative to other stabilizing or destabilizing forces. Despite these challenges and inherent uncertainty, the potential

consequences are so severe that it is essential that further research be conducted to better understand the possible linkages between climate change, migration, and conflict (Burrows and Kinney: 1).

The potential for global environmental change to result in conflict has been discussed since the 1980s, they explain. A number of different pathways between climate change and conflict have been proposed and discussed. These include declines in agricultural productivity leading to food shortages, water scarcity, and competition for mineral resources. Among the most frequently cited link between climate change and conflict is the potential for increased migration. The climate-migration-conflict pathway has received increased focus from policy makers and the media. A popular view has emerged in these circles that climate change will lead to a dramatic increase in movement of people away from impacted areas and will result in increased conflict with populations in areas receiving migrants. Despite and in response to the fact that this issue is viewed as relatively linear and even deterministic in the media, scholars have been increasingly cautious when discussing the climate-migration-conflict pathway. In fact, there remains no real consensus about whether or not this pathway exists, whether it can be considered causal, and how future research could fill critical knowledge gaps (Burrows and Kinney: 2).

At present there appears to be no clear consensus as to how substantial an impact climate change will have on worldwide conflict or the role which migration may play as a part of that pathway, they continue. Despite this uncertainty, it is clear that climate change is one of the most significant threats that mankind will need to address in the coming decades, and the potential impacts of climate variability and change on migration and conflict will remain an important area of research and policy planning. The major contention in this research surrounds the importance of climate and migration as drivers of conflict compared to other potential factors which may either enhance or suppress risk of conflict. Given the complexity of this issue, future research should seek to understand how climate interacts with other key governance, economic, cultural and social factors. In order to address the interactions of these multiple drivers more thoroughly, future research will be especially valuable to the extent that it can be focused on specific places and contexts (Burrows and Kinney: 10).

In short, they conclude, there has been increasing recognition of the complexity of the systems linking climate, migration and conflict, and the extent to which this system depends on social, demographic, economic, and political drivers which interact with climate variability and change. All of these are very location-dependent. Thus, future research can help to inform our understanding of the contexts in which climate might increase risk of conflict by focusing on the local interplay of these multiple drivers.

3. Conflict, Catastrophe, and Securitization of Resources

White explains that, in response to real and perceived threats and risk linked to climate change, issues of security are generating angst among people. The securitization of natural resources is emerging as an important climate-related issue, especially in regard to food, water, land and air quality (White 2018: 59).

Natural resources need to be protected and secured for the public benefit of those living within nation-states, he continues. The rich and powerful will continue to use their resources to secure productive lands, restrict access to food and water, exploit the financial hardships of others, and impose their own coercive rule (private security). The moral and material universe within which these trends occur is one that is generally supportive of this sort of natural resource exploitation. The ravaging of nature generally takes place with the consent of its beneficiaries, among whom are the general populaces of advanced industrialized countries. It is

the relative privilege of those in the Global North that outweighs concern for the plight of their neighbors in the Global South (White 2018: 74).

The social construction of 'security' in an environmental context frequently privileges the rights and interests of the powerful over the public interest, he mentions. Environmental security is basically a form of securitization which protects financial interests rather than ensuring fair and equal access for all. In pursuit of the ownership and control over natural resources, and to exploit these for particular purposes, governments and companies have singularly and in conjunction with each other worked to break laws, bend rules and undermine participatory decision-making processes (White 2018: 74).

Catastrophe and the responses to it are defined by those most affected, he insists. Worldwide, disasters related to climate change have tended to have most impact upon the poor and vulnerable. Those with the capacity to build stronger, higher and better are those most likely to survive. They are also those who have the resources to rebuild and to thrive afterwards. For the rest, the options are less clear, the option reduced. While those who have, want to retain, those who do not have, do what they can to survive. In this gulf between have and have-not lie many struggles and fundamental conflicts. The result is insecurity for all (White 2018: 77).

Ultimately we need to go beyond parochial viewpoints and those perspectives that frame harm in terms of national or regional interests, he adds. Our loyalty has to be to the planet as a whole, rather than being bound by a narrow prescriptive patriotism based on nation. The nation-state remains an essential platform for concerted action to deal with the causes of environmental harm, as well as mitigating the worst symptoms of such harm. But the global nature of the problem – climate change – means that inevitably our collective survival will require planetary cooperation and worldwide action. For eco-global criminology, this is best undertaken under the guidance of an eco-justice framework, rather than protection of existing privilege or might makes right strategies. For the latter only lead to further violation of rights, and the downward spiral to our mutual destruction (White 2009: 35).

4. Environmental Insecurity: Approaching a Tipping Point?

South mentions that problems of climate change and environmental damage may be approaching a tipping point (Hoggins et al.). Climate change has produced differentiated social vulnerabilities to natural resource scarcity, and environmental changes and harms pose a challenge to the security and sustainability of nations and their populations. They say that the concept of 'security' must be broaden to embrace broader political, economic, social and environmental concerns and recognition not just of the need for protection of the state but also of individuals and their communities. The concept of 'human security' was given emphasis by the 1994 Human Development Report of the United Nations Development Programme (UNDP 1994) with the subsequent Commission on Human Security (2004), emphasizing that human security is about protecting people's fundamental rights, such as freedom, peace and safety, access to resources and the basic necessities of life, and that this also encompassed an environment which does threaten health and well-being (South 2012: 100, 104, 106-107).

What is vital in contemporary calculations of sustainability and security is the factor of change, he insists. Security is not about protecting a stable status quo from external threat but about developing an economic system which reduces dependence on a single resource, dynamic system which can accommodate change. This does not fit easily into traditional understanding of defense or national security, which is the whole point

of trying to rethink security. One way to do this rethinking has been to explore the idea of environmental security in the context of the pre-eminent change of our times. Climate change is producing a new set of global dividing lines, now between those at most risk and those at least risk. This 'climate divide' is recognized in many ways but arguably not on a widespread basis or with full appreciation of what it really means. In essence, the climate divide represents a further extension of the inequitable state of the affairs of humanity, one in which the conditions producing climate change are contributed to most overwhelming by rich consumer societies but which will impose the greatest costs and resultant miseries on the already poor and newly developing nations (South 2012: 108-109).

In conclusion, he mentions, it might be argued that the concept of environmental security is simply stretching the 'security' umbrella too far because it encompasses and blurs with many other and well-understood aspects of security --- political, economic and social. Inevitably, it is also entwined with social injustice, poverty, differential vulnerability, weak political structures, population growth, unsustainable economies, industrialization and resource demand. It would be good if we could begin to characterize the twenty-first century as one in which we strive to preserve both human rights and human security but also recognize that such goals cannot be fully realized unless we demonstrate similar regard for environmental rights and environmental security --- both now and into the future which subsequent generations will inherit (South 2012: 109-111; South 2009).

VI. Conclusions

Today, climate change and environmental degradation are already important triggers of displacement and migration. The consequences of climate change, such as prolonged heat waves, more frequent droughts, sea level rise, floods and an increase in extreme storms are destroying the livelihoods of a growing number of people. Extreme weather events already displace twice as many people as war or violence do. Moreover, millions of people are leaving their homes because gradual environmental degradation – to which climate change is often a contributor – is destroying their livelihoods. Even measures such as the use of land for the cultivation of biofuels, exporting food, and flood protection barriers, which are designed to protect our climate and facilitate adaptation, can result in further displacement. Scientists fear that if the release of greenhouse gases into the atmosphere is not stopped, by the end of this century every tenth person will be living in an area affected in multiple ways by the consequences of climate change.

Displacement and migration should be understood as a signal to finally take seriously the fight against climate change, to promptly implement the goals of the Paris Climate Agreement, and expedite the phaseout of fossil fuels. There are no reliable figures on how many people are suffering from long-term displacement and have been living, often for years, in the slums of growing cities, makeshift camps and emergency shelters. The major share of environmental migration takes place in the Global South and within national boundaries. However, it is difficult to predict how migration flows would change if global warming progresses.

In addition to a further increase in migration, the forced immobility of trapped populations is likely to increase considerably. These include populations whose livelihoods have been destroyed, or who are exposed to tremendous risks, but who lack the resources to migrate, or have no access to escape routes and places of refuge. The current humanitarian crisis in the Horn of Africa and Yemen is a frightening example of

helplessly trapped populations. The precarious living conditions of people who are particular affected by the consequences of climate change and environmental degradation show that great efforts must be made to better protect them.

Kenya is already vulnerable to existing climate variability because of its high-dependency on natural resources and low-adaptive capacity to cope with climate-related impacts. To ascertain this, it is important to note a few examples of such impacts as:

(a) The cost of climate change is estimated to be 2.6% of Kenya GDP each year by 2030.

(b) The costs of the 1998/2000 drought were estimated at US$2.8 billion. In some regions, up to one third of all livestock perished due to the most recent drought.

(c) Four (4) million people in Kenya are at risk of hunger because of the prolonged drought.

Against this background, building resilience to the impacts of climate change such as frequent or prolonged droughts and flash flooding in the arid and semi-arid areas of Kenya should have been given priority (ICCA: 7).

The real problem of international migration and refugee policy is not the lack of international statements of intent, but rather the behavior of key players. As long as the challenge posed by the major transition to a post-fossil economy and society has not been recognized and accepted by everyone, and as long as the corresponding changes in behavior of all those involved – individuals, groups and states – are not addressed more seriously, the planet will continue to experience natural disasters which do not (yet) affect some of us, but bring great suffering to the poorest of the poor who are the least to blame for their occurrence. We can simply no longer afford to continue to underestimate and ignore these catastrophic events.

[Notes]

1) This chapter is based on the paper titled "Drought or Flood (Climate Change) – Social-ecological System Destabilization –Conflict Nexus in East Africa: Rainfall-induced Environmental Degradation, Food Insecurity, Migration and Violence around and near Mt. Kilimanjaro" and presented at the 18th Annual Conference of the European Society of Criminology, 29 August - 1 September 2018, Sarajevo, Bosnia and Herzegovina.

2) This chapter is a part of research results of 'Research on Environmental- and Eco-crimes by Progress of Scientific Technologies and Development of Societies and Measures against Them 2015-2019) (Subject Number: 15K03181) supported by the Grant-in-Aid of Scientific Research by Japanese Ministry of Education, Culture, Sports, Science and Technology.

3) In order to make a research on 'current situation of climate change-induced environmental degradation, food insecurity, migration and violence around and near Mt. Kilimanjaro', the author visited the relevant places: Masai Mara National Reserve, Amboseli National Park, etc. in August 2018.

4) The author is most grateful to his colleagues, Professor Shem O. Wandiga (University of Nairobi) and members of his research group, for their help.

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Chapter 8

Astro-Green Criminology: A New Perspective against Space Capitalism
——Outer Space Mining may make the Same Mistakes in Space as we have on Earth——

Abstract

History of outer space mining began with heightened interests in outer space and launch of satellites in the late 20th century. Being concerned with depletion of natural resources on Earth, many people began to pay more attention to available resources in outer space. Many scientists believe that outer space mining will become a reality within a few decades. Our research insists that, when the moon, Mars and other celestial bodies are explored and eventually mined for resources, environmental damages caused by mining ought to be taken into consideration. If we fail to treat the relevant space and planetary environments with respect that they deserve, we compromise their intrinsic and extrinsic value. We should not continue to use the world around us as little more than a resource to be exploited. Instead we should recognize how our human existence is interconnected with the universe's environment. There can be significant unintended consequences of invasive exploration, and when it comes to the extraction of water and volatiles for fuels on a planet such as Mars and drilling of asteroids with potential terrestrial impacts, there is simply no telling what might happen, and this supports the provisional case for planetary and space protection.

I. Introduction

As outer space expeditions have been actualized in modern history, humankind started to view outer space as another hope and chance for human conquest and achievements. Bearing in mind that outer space presented new challenges and opportunities to humans, it was important for them to decide how to utilize this seemingly infinite opportunities. In other words, humankind could potentially gear towards the abuse and reckless conquest of this new frontier if they chose to do so since no one was and is familiar with this new territory. Nevertheless, humankind recognized the need for a legal framework to utilize outer space effectively and cautiously as it feared possibilities of world wars, space wars, and chronic conflicts among nations.

Since outer space mining became an emerging plan for many countries, it is critical to determine what the main concerns are and to legislate necessary laws for peaceful outer space. Outer space mining became a more controversial topic because of its vulnerability to breach of many treaties of the United Nations as it promotes ownership and sales of outer space materials which is a main subject of violation for many UN treaties.

In this chapter, we discuss some problems in outer space mining: space capitalism and sustainable development, national and international regulations, space environment and its protection, and philosophical foundation of outer space protection

II. New Gold Rush 'Space Mining': Space Capitalism

1. Space Capitalism: New Space Economy

Committee on the Peaceful Uses of Outer Space (hereafter COPUOS) explains the dawn of asteroid mining that history of outer space mining so-called asteroid mining began with heightened interests in outer space and launch of satellites in the late 20th century. As many became concerned with depletion of natural resources on Earth, they began to pay more attention to available resources in outer space. For example, a metallic asteroid can potentially provide with billions of iron and millions of cobalt, nickel and platinum. In fact scientists have been in search of new renewable energy resources and have determined that helium-3 is viable natural resources. It is important to note that this particular resource is only available on the Moon as the Earth only contains extremely minimal amount of it (COPUOS 2017a; McKay et al.: 220-229)

Then COPUOS examines the legality of space mining. Many scientists believe that space mining will become a reality within a few decades. Outer space has become a more promising idea for numerous countries as they anticipate more resources to be found. Not only nations but private mining companies are also closely paying attention to outer space mining at this time. United States and Luxembourg governments attempt to fund outer space mining projects soon, and they put their efforts into approving legislations which would legalize outer space mining through allowing companies to own, sell, and transport outer space materials. However, it is inevitable for them to face the breaches of the UN treaties such as the Outer Space Treaty and the Moon Agreement since these treaties ban the ownership of resources and planets outer space for the sake of peacekeeping in outer space (COPUOS 2017a).

According to Pelton, space mining enterprises are moving from dreams to experimental tests and technology development to the formation of actual businesses which are now seeking to implement these new resource-capturing capabilities in space. There are real companies with real employees, raising real capital to

support actual ventures which want to bring new assets to resource-starved world. These vital New Space commercial activities will be keys to replacing fossil fuel energy and assisting with natural resource shortages which will become increasingly common by the end of twenty-first century. Without the ability to access space resources our planet and the global economy could wither away under the weight of too many people and too little resources (Pelton 91). One of the prominent firms Deep Space Industries is aiming to send small satellites to research the prospect of minerals and ice for future mining. Another firm Planetary Resources aims to develop telescopes to analyse asteroids for mining (COPUOS 2017a).

The new space economy is the pathway to the future as we enter a new era for humankind. But, Pelton warns, if this transition is not done correctly, the longer-term sustainability of the planet and of human civilization will remain at risk. These new space enterprises must do more than simply replenish diminishing natural resources and fossil fuels. They must be broadly conceived as part of an overall strategy to transform human society (Pelton: 91).

2. Technological Progress and Space Mining Development

Next let's start with a following question: where do we stand in terms of truly developing a space mining industry? Currently there are four companies which are pursuing space mining and they are all US-based. These startup companies are Planetary Resources, Inc., Deep Space Industries, Shackleton Energy and Moon Express (Pelton: 99).

Pelton explains a diversity of space mining that today's space mining companies represent a diversity of viewpoints on several key points. Some envision mining on the Moon, and others are more focused on the mining of asteroids. The potential targets for these space mining operations also vary widely. Some focus on volatiles, and especially water, which could be broken down to hydrogen and oxygen to create space-based 'filling stations' for rocket launchers. Others talk about obtaining rare substance such as helium-3 isotopes, and yet others talk about finding asteroids which are nearly pure platinum. Most agree on the need for careful prospecting to find reasonable asteroid targets before actually thinking of space mining operations (Pelton: 101; Hellgren).

However, Pelton refers to technological progress and developments of space mining. there is clearly skepticism as to how soon space mining could really happen. Skeptics challenge the very idea. What possible resource could be cost effectively reclaimed from space which would have sufficient value to pay for the huge investment costs? What space resources make sense, given the competitive advantage of mining carried out in land mines and even the oceans? (Pelton: 99) In the past half century there has been enormous progress in space transport, space habitats, and artificially intelligent robots which are capable of achieving progressively more demanding tasks. The technology to create reliable and increasingly low-cost space transportation systems, small, low cost robotic prospecting spacecraft with sophisticated sensors and robotic devices to carry out remote mining, and dozens of other technical capabilities to allow space mining, are either currently being developed or are on the way (Pelton: 106; Chen et al.; Hein et al.).

In short, history reveals that outer space mining is a promising future industry and technology. But at the same time, it can be the root cause of further global conflicts and controversies.

III. Space Mining and Its Regulation

1. Legal Framework for Sustainable Space Mining Activities

As the development of the space mining industry progresses, Leterre explains, the need for a legal framework regulating space resource utilization increases. The ambiguity left by the Outer Space Treaty regarding the permissibility of such activities has already led two countries, the United States and Luxembourg, to adopt their own national legal framework in order to offer investors the legal certainty which they require to further develop their activity, and which current international law might not fully secure. The choice of the United States and Luxembourg to favor a national framework, rather than wait for the establishment of an international regime, was criticized by the international community, most notably during the session of the Legal Subcommittee of the UN Committee on the Peaceful Uses of Outer Space (COPUOS 2017a; Leterre: 3-4; Johnson: 90-91)

Reflecting on the future legal framework of outer space is not an exercise, valuable as it is, in theory. It corresponds to crucial interests of mankind, Leterre warns, as resources found in outer space can be regarded as a substitute for resources extracted from Earth at a time when such resources are becoming scarcer. That private entities can be the ones carrying out the mission to use outer space is probably less important than protecting mankind from the negative outcomes this exploitation can lead to. This is why it is important not to repeat what has been done on Earth: exploit first, be concerned about consequences only second. It is the role of legal reflection to provide the elements of consideration which will help find a solution to such dilemmas (Leterre: 78; Doshi).

2. Principle of 'Common Heritage of Mankind'

De Cnudde introduces the principle of 'Common Heritage of Mankind' as an international regime. It is important to stress out why an international regime is necessary for the exploitation of space. There are a lot of risks regarding space exploitation which is not a contained activity, much can go wrong during the mining of resources on the Moon. Also, in the future, space exploitation will be the result of the corporation between states and private companies. This asks to be regulated in order to achieve the most optimal effects in a commercial sphere. On another level, the aspect of environment is important because a big risk of endangering the unique environment of space comes with exploitation. The current space debris is partly already a consequence of the commercial use of telecommunications in space. The need for an international regulation is also needed here to guarantee the preservation of the unique ecology of space. Next to this, not all states have the capacity to start commercial operations in space. As states with the capacity and resources are rather rare, in order to avoid the creation of more inequality between states, an international treaty seems appropriate to provide some security. The role of the controversial 'Common Heritage of Mankind' principle plays a very substantial role in this context. A last argument for facilitating an international regime for space exploitation is to create a well-arranged market where commercial activities are organized as fair as possible for each party involved (de Cnudde: 2-3; Takemura).

From the developed states' point of view, de Cnudde adds, one could argue that the current status of exploitation suffices and that the further regulation should be handled on a national level. However, this would lead to some issues. The environmental protection would not be strong enough and consequences for violating the ecology would be nearly absent. Eventually, as the interests for mankind would only be a shallow promise,

only the developed states would truly enjoy the benefits of outer space. In order to create a fair and safe environment, thus, there is a need for an international regulation (de Cnudde: 93).

3. International and National Regulation

Jakhu et al. mention that the difficulty of consistency between national and international regulations. Difficult and demanding space mining activities may be undertaken under the current status of the international and national regulatory environment. Current international space law, represented mainly by the 1967 Outer Space Treaty and the 1979 Moon Agreement, will take us only so far. There is the need for a clear global space governance system to provide the basis for orderly exploitation of space natural resources. National regulatory initiatives such as the U. S. Space Act of 2015 are necessary for national legal and administrative purposes, but could also potentially render the concerned states in violation of their international obligations. Thus, careful implementation of such national laws is important in order to maintain full compliance with relevant international treaties (Jakhu et al.: 147; Hobe et al.)

Jakhu et al. explain that there are no specific resolutions or measures that exclusively discuss the subject of mining in outer space as it is yet to be fully explored. However, in the past few years, the United Nations passed numerous resolutions regarding outer space activities. As of now, the UN has had reports on a variety of issues such as space debris mitigation, near-earth object (NEO) management, global satellite systems, nuclear power use in outer space, review of the outer space treaties, and capacity-building in space law. (Committee on the Peaceful Uses of Outer Space (OPUOS) 2017a; Committee on the Peaceful Uses of Outer Space (OPUOS) 2017b).

In short, noticing a rapid growth in space expeditions and industries, with new developments in space activities, such as mining outer space, it is necessary to discuss stronger enforcement of space laws and the idea of rule of law, and to regulate outer space better in the near future (Committee on the Peaceful Uses of Outer Space (OPUOS) 2017a).

IV. Space Environment and Its Protection

1. Protection of Space Environment

COPUOS mentions the importance of environmental considerations concerning space mining. Since large scale mining was first undertaken on Earth, it has become evident that there are significant environmental externalities generated by the process. The rise of the environmental movement in the past few decades has seen a heightened level of scrutiny towards these practices. Mining companies have been forced by both regulation and public opinion to alter their production methods. A significant part of this adjustment has been in the making of the mining process more energetically efficient. As NEAs (near Earth asteroids) and other celestial bodies are explored and eventually mined for resources, a similar debate will likely emerge for endeavors undertaken in this new frontier. It remains to be determined if environmental damage caused by mining ought to be taken into consideration in space. The nature of the body on which the mining is being done will likely affect this debate, as those bodies intended for long term inhabitation will be subject to harsher scrutiny. If environmental considerations should come into play, its extent is a potential area of contention, as is which environmental law ought to regulate mining practices (Committee on the Peaceful Uses of Outer Space (OPUOS) 2017a).

Then Almár explains 'astroenvironmentalism' that the problem of cautiously preserving solar system environment is called astroenvironmentalism, which could provide a conscience to the plans of planetary exploration and exploitation. There is a fundamental conflict between the interest of future exploiters of planetary resources on the one side and astronomers as planetary environmentalists on the other. Namely, in case planetary explorers do not fully address the environmental consequences of their activity and do not protect the pristine surface and subsurface of celestial bodies, all essential in situ evidence on the origin and evolution of planets, asteroids and satellites will be denied future generations of astronomers. A balance must be found between the impact of any mission and the scientific results or other benefits which may be obtained thereby. Furthermore, certain activities may be sufficiently detrimental to the environment to require restrictions and prohibitions thereof, regardless of any benefits which otherwise may be realized (Almár: 1577-1578; Hlimi: 445-449; MacWhorter).

2. Classification of Activity and Possible Action

Space activities are classified into following four categories by Almár as follows.

-*Research* -In situ research is always producing a certain amount of pollution. Only product and not pollution should be delivered to the celestial bodies and the Earth's environment in general. There is a lot of space debris already on the surface of the Moon, Venus and Mars.

-*Industrial activity,* - Mining in particular may destroy smaller celestial bodies. It can be clearly demonstrated how the surface of an entire celestial body can be modified and destroyed by a medium range surface mining activity. The small Martian moon Phobos is considered an ideal base for such an activity. Phobos, with its special system of surface grooves, however, is probably unique in the solar system. If mankind decides to mine the Moon or colonize Mars, the environmental impact will increase by at least an order of magnitude. As terrestrial experience has shown, when exploration becomes exploitation the environment tends to suffer.

- *Colonization and terraforming* - The result will be a large-scale transformation of the environment – it means reforming the environment of a planet to accommodate human life. Several difficult questions are posed: Does Mars as a planet have any intrinsic value in and of itself? Is there less intrinsic worth in a planet which is devoid of life than in one with an active biosphere? Should we access and use the resources which are available there or should we leave them as they are? Environmental issues can reasonably leave the problem of terraformation for future generations to worry about, if and when it assumes a degree of reality (Almár: 1578).

-*Free-for-all*- The result of every kind of activity in these foreign environments will depend heavily on the strategy and legal regime of the endeavor. The worst possible scenario is free-for-all, i.e. whoever gets there first should have the right to do whatever they want. This could lead to destruction of entire celestial bodies preventing the possibility of its further investigation in the future. Enormous damage and danger could be caused by a free-for-all in space (Almár: 1579).

Then Almár insists that the time has come, however, for environmental concerns to be applied to developments in space. The 1979 Moon Treaty has a central premise the notion that no single nation or private entity has the right to appropriate commonly-owned resources. The 'Common Heritage of Mankind' principle is the basis of this notion. Two recent examples illustrate, however, that these principles are not really respected: the private Artemis Society plans to organize lunar excursions to interested people. Business interest to the Moon will arise without authorization and without being conscious of rights and obligations. SpaceDev

plans for launch private space probes to investigate and eventually mine the resources of asteroids. Again there is no authorization and the private ownership of asteroid would be a dangerous example in the future (Almár: 1579; Krolikowski et al.).

3. Framework or Mechanism of Preservation

Consideration is given to the designation of areas of special scientific interest, or 'international scientific preserves' by several other authors as well. Constructing an adequate environmental legal regime for outer space prohibiting private ownership of wilderness areas is a fundamental wilderness principle. The realization of such a system needs, however, an effective legal framework, otherwise in the 21st century large-scale industrial activity on different celestial bodies could reach detrimental effects before anybody could react. Clearly an international environmental-protection treaty is needed for the 'outer-space wilderness.' The standards implementing those principles have to be tailored to meet the needs of the specific environments which they are designed to protect. Some degree of flexibility is needed in order to make regular space exploration and even exploitation possible (Almár: 1580).

In short, the time has come, however, for environmental concerns to be applied to developments in space. In constructing an adequate environmental legal regime for outer space prohibiting private ownership of wilderness areas is a fundamental wilderness principle.

V. Philosophical Foundation of Outer Space Environmental Protection

1. History of Environmentalism: Anthropocentric-, Ecocentric-, and Astrocentriic Environmentalism

First, Hueber et al. explains 'anthropocentric' environmentalism. Human beings would self-identify as enemies of 'the environment.' After all, everyone wants clean air to breathe and clean water to drink, and does not want anyone to invade his/her person or property with harmful substances. People who go this far with their environmentalism probably comprise the majority of humanity. They can be said to be adherents of 'anthropocentric' environmentalism. Anthropocentric environmentalists can be found across the political spectrum. For example, voices ranging from the right to the extreme Marxist left have called for unprecedented global government intervention to combat perceived environmental threats to human well-being. Others, however, have advocated *laissez-faire* capitalism as the appropriate means to protect the environment to maximize human well-being on Earth. For the anthropocentric environmentalist, non-human creatures and objects are valuable to the extent that humans value them (Huebert et al.: 283).

Second, Huebert et al. explains 'ecocentric' environmentalism. In the second half of the twentieth century, another type of environmentalism came to the fore: 'ecocentric' environmentalism. Ecocentric environmentalism holds that the environment itself is intrinsically valuable, and that human beings themselves have value only to the extent that they play a role in, and support, this environmental whole. According to radical ecocentrism, only 'ecological wholes' (such as species, ecosystems, the land or the biotic community) have a value in themselves and the value of the ecological parts is determined by how far they contribute to the survival and well-being of the ecological whole. The ecocentric view is not limited to concern for animals or even plants, but extends to the entire Earth, dirt and rocks included. Everything on Earth, except for humans,

is seen as possessing 'intrinsic value' that is destroyed or threatened by any human tampering at all (Huebert et al.: 284).

Third, we can see two kinds of 'astrocentric' environmentalism. One aspect is that in the next few decades we see a significant movement into outer space and other celestial bodies: 'astroenvironmentalism.' With an environmental approach, protection of the outer space environment and its subsystems is the priority, not ensuring that outer space can be used for human space activities. Outer space, a source of wonder and inspiration for centuries, deserves to be preserved 'in its original pristine state, for its own sake' and for future generations to enjoy (Huebert et al.: 286). The other is that astroenvironmentalism is a concept which applies the values of environmentalism and preservationism to developments in space exploration, commercialization, and militarization. Recent developments in space exploration suggest this perspective is not widely acknowledged enough by those who envision taking steps to enter space. Since mankind made such a mess of this planet and is now paying the environmental price for the damage, this topic is of extreme importance because we must avoid making the same mistakes in space as we have on earth. At issue are the environmental consequences of the steps we are about to take in entering space. Astroenvironmentalism is another re-formulation of the associated environmental concerns involving a space wilderness to protect, rather than a 'frontier' to exploit (Miller 2001; Miller 2005).

2. From 'Frontier Exploitation' to 'Wilderness Protection'

Billings gives an important query: Do humans have rights to exploit extraterrestrial resources and alter extraterrestrial environments? (Billings)

First appears the perspective of 'frontier exploitation'. Billings explains that in the 21st century, politicians and other advocates have been promoting 'the Moon-Mars thing' as exploration for the sake of exploring and also as a means of opening up the solar system to private property claims, resource exploitation, and commercial development. One space advocate compares the solar system to a giant grocery store which has everything. In this vision, those with the means to get to the store first get the all the goods; those who get there late may get nothing, it is like a system in the spirit of imperialism. The rhetoric of this space advocacy reflects an assumption that the values of materialism, consumerism, and hyper-consumption are values worth extending into the solar system. The conception of outer space advanced by these advocates embodies the idea of a solar system and beyond of wide-open spaces and limitless resources – a space frontier. This frontier rhetoric, with its images of pioneering, homesteading, claim-staking, and conquest, has been persistent in American history, and the frontier metaphor has been, and still is, a dominant metaphor in rhetoric about space exploration (Billings; Weeks: 171-179; Caradini).

Currently, on the other hand, we can see the movement to 'wilderness protection', scientific, legal and ethical considerations of protection and preservation in space intersect in planetary protection policy. According to Billings, NASA and the international Committee on Space Research (COSPAR) have long-standing national and international planetary protection policies in place directing solar system exploration missions to take steps to prevent the transport of terrestrial biological contamination to extraterrestrial environments and the transport of extraterrestrial biological contamination to Earth through solar system sample returns. The rationale for these policies is to maintain pristine conditions in extraterrestrial environments for the purpose of scientific exploration. The wilderness metaphor has been suggested as an alternative to the idea of space as a frontier in the concept of 'astroenvironmentalism', the idea of applying the values of environmental

protection and preservation to space exploration. Treating the solar system like a wilderness to protect rather than a frontier to exploit could keep environmental hazards, human-made debris, nuclear weapons, and nuclear power out of space, and prohibit private and sovereign property claims. It is the most important, as Miller points out, 'to avoid making the same mistakes in space as we have on Earth' (Billings; National Academies of Sciences, Engineering, and Medicine; Huebert et al.: 287-288).

3. Space Sustainability as Systemic 'Space Justice'

According to the systemic view, Aganaba explains, sustainability is the self-evident term for the dynamic equilibrium between man and nature and for the co-evolution of both within the Gaia mega-system. On a practical level this can be understood as a requirement of harmonization of all public policies and social practices and their convergence towards ensuring the co-evolution of manmade systems and ecosystems. It is this harmonization and convergence that makes it a modern conception of justice, justice towards nature and future generations (Aganaba: 35).

Under the principle of systemicity, Aganaba continues, sustainability exists when three kinds of capital, namely natural capital, social capital, and cultural capital, are not diminished by the decisions and acts of states and citizens, but increase with the passage of time. The aim is that the increase in the capital is by virtue of public policy adopted through a regulation of the process of co-evolution to prevent further degradation of the ecosystems and society. This provision of degradation of the space environment is a shared goal which should seek to unite and restore cohesion. The reconceptualization of space sustainability from this perspective therefore includes a greater value being given to natural capital which includes outer space as well as the cultural capital of actors utilizing the domain alongside increasing social capital such as safety, stability and security (Aganaba: 36-37; Islam).

In short, astroenvironmentalism is a concept which applies the values of environmentalism and preservationism to developments in space exploration, commercialization, and militarization. The declaration of celestial bodies as pristine wildernesses which need to be protected rather than frontiers to conquer is listed among space environmentalism's goals. Outer space, a source of wonder and inspiration for centuries, deserves to be preserved in its original pristine state, for its own sake and for future generations to enjoy.

VI. Conclusions

'Space capitalists' advocate effectiveness of space exploration and exploitation pursued by private entrepreneurs. They think that market-driven, private initiatives should take the lead through enhanced competition and significant resources of outer space. There are vast gold mines in the sky which are sufficient to replenish many of our rarest natural resources; water which can be broken down to hydrogen and oxygen to fuel spaceship; rare metals such as platinum and other valuable ores which are being depleted on Earth; and we need to look at space as a new frontier which opens almost unlimited opportunity.

Contemporary visions of the human future in space range from careful exploration and enjoyment of a pristine wilderness to extension of familiar terrestrial patterns of conquest, colonization and exploitation. Facing an opportunity to envision a new 21st century era of spacefaring, the aerospace community has chosen to go back to the future, leaning on outdated rhetoric of frontier conquest and manifest destiny to justify mining

the Moon and others and creating human colonies in space. But the frontier/conquest/exploitation rationale for space exploration may not be widely relevant outside the space community today. The question of 'why we should be going into space' deserves deep thought.

At this moment, against the recent tendency of space exploration, space capitalism, we need create a new discipline named 'astro-green criminology'. Humans have created environmental and ecological ruin on the planet, and now space debris is starting to pollute space around Earth. From this new perspective, if we need the space exploration and space exploitation, they must be done in an environmentally and ecologically safe and sound manner which does not pollute outer space around the Earth, create adverse effects such as climate change, or endanger life. We have no right to pollute and contaminate other planets (the Moon, the Mars, asteroids and so on) through human space activities such as mining and colonization.

[Notes]

1) This chapter is based on the paper titled "Outer Space Mining: A New Frontier for Universal Green Criminology. Interconnect between human existence and space-/ astro-environment", and presented at the 74th Annual Meeting of the American Society of Criminology, 14-17 November 2018, Atlanta, U.S.A..
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