

A THEOLOGICAL FRAMEWORK FOR THE SUSTAINABLE
DEVELOPMENT OF ENERGY AND MINERAL RESOURCES
IN KOREA

By

Kahp-Chin Chung

Submitted in accordance with the requirements for degree
of Philosophiae Doctor to the Faculty of Theology,
University of Pretoria.

Supervisor: Prof. Dr. D. E. de Villiers
Co-supervisor: Dr. A. S. van Niekerk

April 2010
Pretoria, South Africa

University of Pretoria

Summary

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The objective of this thesis is to provide Korean churches with a theological framework to solve the current environmental impact of energy and mineral development in Korea. But this is merely a microcosm of what is happening in securing energy and mineral resources throughout the world, because we cannot imagine one day of our lives without energy and mineral resources in current civilized societies, just as we cannot exist without pure blood.

In effect, the key question is whether there are Christian insights and theological perspectives which can help prevent complex and dynamic environmental impacts from mining activities and nuclear plants in the environmental crisis. In this thesis a variety of development and consumption trends of energy and mineral resources in the world as well as Korea has firstly been analyzed to comprehensively grasp their environmental impacts as well as their economic contributions in current civilized societies in chapters 2, 3 and 4.

Secondly, this thesis looks at the controversial concept of sustainable development set up by the Brundtland Commission. The thesis goes on to discuss two controversial views of a traditional finite world paradigm and market resource allocation paradigm to examine the ideology and practice of economic growth. The thesis moves on to discuss fundamental roots of environmental degradation and the biblical proposition for sustainable development in order to redefine its concept. This thesis finally suggests

"biblical sustainable development in accordance with the will of God" as a practical matrix to set up a theological framework for sustainable development of energy and mineral resources in the environmental crisis. Additionally, biblical sustainable development in the mining context is also discussed as a basic tool to develop a new scheme for ecological integrity in mining activities in chapter 6.

Thirdly, through looking at theological perspectives and Christian insights, the thesis arranges a theological framework for biblical sustainable development of energy and mineral resources as the rudiments of an environmental ethic grounded in the Bible and as a criterion to capture theological and ethical reflections on the environmental impacts from nuclear plants and mining activities in Korea. Additionally, practical guidelines for biblical sustainable development is suggested to lead this world into the biblical sustainable society based on the theological perspectives for energy and mineral resources in chapter 7.

Fourthly, in order to clearly identify the challenging tasks of Korean churches, this thesis evaluates the environmental initiatives of Korean churches based on the factual analysis of the environmental impacts from mining activities and nuclear plants and environmental activities of Korean churches and NGOs in chapters 4 and 5, and then suggests practical guidelines for individuals and churches based on the theological framework for biblical sustainable development in accordance with the will of God in chapter 8.

Finally, through evaluating the Korean energy regime and mining policy, directions for the Korean government is also suggested in order to bring their environmental initiatives more in accordance with the will of God in chapter 8.

The Church is arguably the most powerful institution in the world and can literally move mountains because it has its power from our Lord God. This power has to be utilized not only in Korea but in the whole world in order that humanity can save this planet before it is too late.

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Chapter 1: Introduction.

1.1. Preliminary Remarks.

Since they first started to use stone tools, humans have been dependent on mineral resources contained in or on the earth. This dependence has increased as we have evolved to our present industrialized status, to the point today where our livelihood is utterly dependent on mining. However, mining cannot be sustainable because the deposit is finite and is eventually exhausted.

Future global perspective will depend on energy and mineral resources that are safe, reliable, and environmentally sound. However, most countries continue to use fuels that are non-renewal and technologies that pose significant hazards to the environment and human health.

Therefore, there is a pressing need in the new century to adopt sustainable energy and mineral options, especially in the face of mounting evidence of global warming linked to fossil fuel use, environmental impacts from mining activities and the persisting threat of nuclear accidents, unresolved problems of radioactive waste disposal, and the spector of nuclear weapons proliferation associated with continued use of nuclear power.

1.1.1. Worldwide/Global Environmental Impact of Mining Activities.

From the industrial revolution onwards the main origins of international conflict and environmental impact have been the fast growth of population and rapid increasing demand of energy and mineral resources in accordance with the expeditious development of science and technology.

Centuries of uncontrolled exploitation of nature and international wars to preoccupy the resources have played havoc on our planet Earth. The phenomenal advance of science and technology has placed enormous pressure on the earth's resources to meet the frightening increasing requirements of human beings. Many environmentalists are predicting the demise of all humanity unless the earth's ecological trauma is quickly alleviated.

Particularly, the mining industry from exploration and extracting to refining and transporting has left very serious impacts on all the creatures

and environment by polluting fresh air and water, spewing almost half of all toxic emissions from all the industries in some countries, threatening nearly 40 percent of the world's undeveloped tracts of forest, and consuming about 10 percent of world energy.

Such mining activities have resulted in the depletion of mineral resources, desertification and deforestation, climatic changes, droughts and floods and other natural problems threatening all human beings and their environment on this earth. These environmental problems are being compounded to even more alarming proportions by the more rapidly increasing requirements for energy and mineral resources year by year.

1.1.2. Global Environmental Impact of Nuclear Plants.

Nuclear plants, nuclear waste, and nuclear weapons raise substantial public concern in the current world. In particular, many risky decisions regarding nuclear plants may impose serious risks on future generations that require a different kind of consideration of the danger to people living today.

The energy issue dominated the early days of nuclear power. Arguments were made that the world has only a finite amount of petroleum and natural gas so that uranium must be used for energy generation. Even though fission's future was very doubtful, because of concerns about apprehensive nuclear technology, high cost, reactor accident risks, radioactive waste management, and potential links to the spread of nuclear weapons.

There is a technical stigma attached to nuclear plants so that trying to site a new nuclear plant leads to substantial public opposition. The uncontrolled and mistaken use of such nuclear technology in mining and industry can cause heavy pollution on vast areas of land and rivers as shown at the Chernobyl nuclear accident in Russia.

In particular, nuclear waste sites have seriously generated substantial public opposition all over the world. Radioactive waste is generally categorized as low-level waste (LLW), trans-uranic waste (TRU), and high level waste (HLW). HLW has led to requirements for a 10,000 year isolation which is based on inter-generational equity arguments.

We have a responsibility to handle the nuclear plants wisely, not only for the present but also for the future. This is not a technical mandate but an ethical one of long-standing. Traditional risk analysis based on natural

science and engineering has difficulty incorporating such nuclear plants, which are moral values and not easily quantifiable.

So, the critics of nuclear plants argue that nuclear waste may become a problem in many hundreds, perhaps thousands of years. The International Atomic Energy Agency (IAEA) has stressed that its responsibility today is to manage the nuclear waste to protect human health and environment in the present and in the future without imposing undue burdens on future generations.

Nuclear plants generate large amounts of electricity. This is a serious social problem because it requires the overconsumption of large amounts of electricity in order to recover the large sunk costs for the construction of nuclear plants and provide the incalculable large amounts for the management of nuclear waste and finally the dismantling of nuclear plants. This has been a cardinal source to promote an anthropocentric extravagant life rather than a theocentric temperate life to meet final profit targets for nuclear plants.

1.1.3. Climate Change from GHGs Emissions.

The climate change is just one indicator of the threats we face as a rigorous alarm from the Creator, God of grace. It is obviously our urgent duty to heal the climate change caused by human beings.

Ironically, climate change accompanied with disasters is more unfavourable to the socio-economically weak, who are usually less responsible for the advent of climate change and have less ability to cope with the impact of climate change. In particular, most of Africa would be hit the hardest if climate change continues in its current course.

It is necessary for us to make it clear that while the earth is dying with the environmental degradation, we are indulging ourselves in overdevelopment and overconsumption so much beyond the carrying capacity of the earth.

We should recognize that if we do not act urgently to recover it, the true cost of our failure will be borne by succeeding generations. This is the moral challenge of our generation. We should therefore set a road-map to a more secure climate future. We cannot rob our children of their future.

1.1.4. Advanced Countries and Developing Countries.

As a result of the unethical international policies for energy and mineral development of advanced countries in the northern hemisphere, to develop overseas petroleum, uranium and other mineral resources through using the loose environmental legal system of developing countries, those living in the third world are not only fighting for their own survival, but battling with the growing disparity between the North and their own poorer South. The wealthier Northern countries face new pressures as they depend on the resources of the poorer South, while the South wants to have a say in the management of its own resources. As the divide increases, the crisis intensifies.

Additionally, non-Christians have criticised the biblical doctrine of creation, particularly its teaching on dominion, for being the root cause of environmental disasters brought about by Western Christian countries. The arrogant attitude towards nature that this has bred, is, in the opinion of critics, responsible for the indiscriminate way in which our earth's resources have been exploited purely for their consumption. Eco-feminists extend the focus to male-dominion pointing out that both oppression of nature and oppression of women could be traced back to this same root.

1.1.5. Christian Insights and Perspectives.

With such grave concerns about the environmental impact of energy and mineral development, we are challenged by the urgent task of coming to grips with root issues. Dealing with superficial symptoms will not be sufficient. Getting to root issues will turn out to be an absorbing theological discussion. Restoring, even reinterpreting biblical doctrines will help the Church to face the challenge as God's people. Theology is not merely for our academic indulgence but a motivation for actions.

1.2. Environmental Impact of Energy and Mineral Development in Korea.

Korea has needed a great deal of energy and mineral resources to meet the increasing demand for her rapid economic development. In order to meet the need for mineral resources, she has developed domestic mining activities, with the exception of coal, gold and limestone and has made an effort to develop overseas ones.

After going through the serious energy shortage as a result of the oil shock in 1973 and 1979 by OPEC, she has developed nuclear power plants. However most western countries have suspended and/or decreased the development of plants after the serious impact of the nuclear accidents at Three-Mile-Away Island in America and Chernobyl in Russia.

In her energy and mineral development drive to meet the rapidly increasing requirements of energy and mineral resources, Korea confronts some serious environmental and ethical problems at the moment.

1.2.1. Pollution from Closed Mines.

Once a mine reaches the end of its operational lifetime and dumping activities cease, ground-water is contaminated by acid water drainage and eventually flows into rivers and dams. Adjacent soils are polluted with heavy metals such as cadmium and lead, which come out of abandoned mine sites.

According to a report from a Korean newspaper on September 5, 2006, there are 936 closed mines in Korea. Some adjacent soil from these abandoned mine sites are seriously contaminated so that vegetables, rice and corn produced in those areas in 2005 contained lead and cadmium at a much higher level than the international standard approved by the International Food Regulatory Commission.

1.2.2. Pollution from Limestone and Coal Mines.

Korea has abundant reserves of limestone, dolomite, calcareous marl and hard coal (anthracite) which are the main materials for various cements, iron-manufactured solvents and briquette. However, limestone and coal mines bring about serious air pollution with dust coming from mining activities. Most of the roofs at Taebaek city, the main mining area for limestone and coal are covered with grey dust blown from the mines. The residents don't like to hang out their washing.

1.2.3. Management of Nuclear Waste and Accidents.

After the establishment of a nuclear plant in 1975 by the Korean military government, at the time without opening discussions with the citizens, Korea

is now operating 20 plant without detail managing counter-plans for nuclear wastes and accidents. She is also planning to set up more than 9 plants by 2015 and 16 plants by 2030 without the consensus of her citizens for further plant development and despite public concerns about apprehensive nuclear technology, high cost, reactor accident risks and management of radioactive waste which can make serious environmental impacts on humans and non-humans. This is a very serious ethical problem as the environmental impact will definitely place serious burdens on the future generations and neighboring states.

1.2.4. Overseas Energy and Mineral Development Policy.

Most advanced countries try to save their domestic mineral reserves and develop overseas resources despite the poor legal systems for environmental protection in developing countries at the present. However, Korea overdeveloped domestic mineral resources in her rapid economic development course, which drained almost all her valuable resources entrusted by our Lord to manage them from generation to generation. Now, she has been pushing to develop overseas resources to meet increasing requirements without taking any serious consideration of the Will of God.

1.2.5. GHGs Emission Control for Climate Change.

The climate change is a warning from the Creator concerning the unsustainability of modern industrial societies based on fossil fuels and unsound economic wealth orientation. It is not only an environmental issue but also a survival matter for all the creatures created by God. It is not only a scientific issue but also a ethical matter considering the will of our Creator.

However, Korea has drawn global attention because of her unique situation and rapid growth of greenhouse gas (GHG) emissions. Korea is the ninth largest emitter of GHGs and its emissions have nearly doubled in the past 15 years. This is the fastest emissions growth among OECD members from 1990 to 2005 (Min 2009:3).

With regard to the amount of CO₂ emission growth, Korea ranked fourth during 1990 to 2002. During the 20th century, the world temperature increased by 0.6 Celsius, while in Korea it increased 1.5 Celsius. Korea is

very vulnerable to climate change because it is a peninsula with long coastal lines (Son 2009:4).

Nowadays, Korea is required to make notable counter-measures for global warming. It should call for creative measures, mapping out a national comprehensive plan aimed to slow down climate change, reduce energy consumption and invent technologies that can cut down greenhouse gas emissions.

1.3. Environmental Negligence of Korean Churches.

It is not surprising that the rapid growth of Korean churches has been reported in various Christian magazines in accordance with that of her economy. However, Koreans are facing the impact of the above-mentioned due to environmental neglect in the execution of reckless economic development programmes as well as energy and mineral development.

Most Korean churches are unconcerned about the deteriorating physical environment as a result of energy and mineral development. Their attitude appears to be that environmental issues are only for the government and specialized non-government agencies, not for the church. They have executed their pastoral duties within the existing political and economic structures. They have been interested in their quantitative expansions to the extent that of the 50 largest churches in the world 27 of them are Korean.

They have become encapsulated communities isolated from their societies as a result of the dichotomous philosophical influence of Western Christendom, that the church is good and the world is evil. These church-centered Christians have failed to fulfil their social responsibility in so much that they are almost unconcerned about the environmental actions against reckless development for national economic plans, as well as the nuclear plant operations and mining activities without the detailed environmental counter-plans to give comprehensive control of any development projects.

They should have used the catch-phrase: "Let us live straightly" instead of the slogan of "Let us live well" which is to encourage citizens to work harder. While the government is proud of "the economic miracle in Han river," they should teach their members a pure life attitude living in the presence of God (*coram deo*). They should spell out in very clear terms the Will of God to create all humans and non-humans. They should not just sit

back and watch the deteriorating situation of the very weak and vulnerable environment.

1.4. Research Problem.

Does theology have anything to offer to the sustainable development of energy and mineral resources in Korea? Are there theological criteria to evaluate the sustainable development of energy and mineral resources in Korea as well as the lack of involvement of Korean churches in promoting sustainable development? Can guidelines for sustainable development in acceptance with God's will be formulated to practice in Korean churches and societies?

1.5. Theological Foundation for Sustainable Development of Energy and Mineral Resources.

God's talk cannot be separated from our concerns for human fulfillment and the flourishing of human community. Theology is a critical reflection on the liberating faith and transforming praxis of the Christian community in relation to the revelation of our Lord, Jesus Christ. Christian life is the sacred duty entrusted by the Creator, our Lord, Jesus Christ.

So, Churches and Christians should actively participate in policy-making and policy-performance through the influence they can bring to bear on policy issues which comes from their Christian insights and perspectives which are in tune with Biblical witness. What are these Christian insights and perspectives which can contribute to the sustainable development of energy and mineral resources? They can essentially stand for the following Christian teachings which are rooted in Biblical witness and Christian experience.

1.5.1. The Holistic Mission of Jesus Christ.

The holistic mission of Jesus Christ should be a challenge for Christian theology and ethics and be appropriated as a moral value in theological discussions of sustainable development of nuclear plants and mineral resources.

1.5.2. The Holy Spirit of Creation and Salvation.

If Christian salvation is the resurrection of Christian bodies and the new creation of all non-humans, the salvation Spirit of Jesus Christ is the creation Spirit of our Lord God (Colossians 1:14-17). So, all humans and non-humans in the earth are the existences of loving solidarity in the hope of salvation (Romans 8:21-23) waiting for the new heaven and new earth (Revelation 21:1).

1.5.3. Sustainable Development by the will of the Creator.

Our Lord God is the owner of all the earth. The sons and daughters of God are the shepherds who keep sustainable development of all the non-humans on the earth. They are not only objects for reckless development for only the current generation, but are subjects cared and used by the will of God for all generations till the coming again of our Lord Jesus Christ into the earth to integrate environmental, social and economic concerns now and in the future without any environmental impact for all humans and non-humans.

It goes without saying that sustainable development of energy and mineral resources on the earth in accordance with the will of God. We cannot image one day of our lives without energy and mineral resources in current civilized societies, just as we cannot exist without pure blood.

1.5.4. The Fulfillment of Eco-Justice Stewardship.

The life of Jesus Christ is a clear demonstration of the reign of our Creator of justice. The heart of a harmonious relationship between humans and non-humans on the earth, whether individually, communities or internationally, is the essence to start the journey for justice and equity of development and sustainability. Social ministry is an adequate method for contemporary churches to fulfill their eco-justice stewardship through analysis, education, action, and feedback about development, consumption and management of nuclear plants and mineral resources.

1.5.5. Christian Right and Duty in Jesus Christ.

All Christian churches and Christians should not only insist on their rights in Jesus Christ in accordance with their selfish minds, but they should truly perform their duties to love others and recover the environment of nature. In particular, they must do their best to restore a balance between civilization's ravenous appetite for energy and mineral resources and the fragile equilibrium of environment by means of a theocentric temperate life in contrast to an anthropocentric extravagant life.

1.6. Background of Thesis.

1.6.1. Main Point of Departure.

My thesis argues that Christian theology does indeed have something to offer to help solve the current environmental impact of energy and mineral development. Its contributions are in the form of Christian insights and perspectives which can prevent an impact on the environment by practicing Biblical sustainable development of energy and mineral resources in accordance with the will of the Creator, Lord Jesus Christ.

This involves a clear presentation of theological and ethical criteria as a practical matrix, which are founded on Biblical witness and Christian experience. There is an urgent and timeous need to present a theological framework which would capture theological and ethical reflections on the environmental impact from nuclear plants and mining activities in Korea.

1.6.2. Research Objectives.

1) To describe overall the world environmental crisis as a result of the overconsumption and overdevelopment trends of energy and mineral resources in particular produced by means of nuclear plant operations and mining activities. This study will call attention to how much this seriously impacts on all non-humans to meet the rapidly increasing requirements of energy and mineral resources of current civilized societies.

2) To analyse in detail the Korean consumption trends of energy and mineral resources and development policies of mineral resources and nuclear plants compared with those world trends above-mentioned, and break down the current and potential environmental impact of mining activities and nuclear plant operations in Korea. That will make all Koreans

awake environmentally and ethically how seriously her policies and activities has impacted and will impact on the future generations as well as the current generation.

3) To analyse typical features (pathologies) of Korean Churches concerning their social responsibility in order to raise awareness of the lack of concern about the environmental impact from the development drive of nuclear plants and mining activities in Korea.

4) To formulate Christian insights and perspectives which are in tune with Biblical witness by means of restoring and even reinterpreting biblical doctrines such as the holistic mission of Jesus Christ, the Holy Spirit of creation and salvation and so forth.

5) Even though the Kingdom of God has not yet fully come on earth, it is a present reality in this world. The salvation of our Lord Jesus Christ is not only a matter of the future but also the present. It is also not only a matter for humans, but also for non-humans. The salvation Spirit of Jesus Christ is the Creation Spirit of the Creator God for all humans and non-humans. So, this study will formulate a view of the holistic mission of our Lord Jesus Christ relating the eschatological present to the eschatological future. This study will be a theological criteria to evaluate the dichotomous characteristics of Korean churches, that they are isolated from their societies and have failed to fulfil their social responsibility.

6) To develop a practical benchmark for the sustainable development of nuclear plants and mineral resources in accordance with the will of God. This study will examine eco-justice stewardship, social ministry, and Christian duty to argue ethical criteria which have relevance for the sustainable development of nuclear plants and mineral resources.

7) To evaluate the environmental activities of Korean churches and the energy and mining policies of the Korean government from the standpoint of a theological framework above-mentioned.

8) To develop practical guidelines for Biblical sustainable development of nuclear plants and mineral resources in Korea based on the will of God and Christian insights and perspectives discussed in this study.

1.6.3. Research Motivation.

In order to meet the great need for energy and mineral resources to sustain the rapid economic development of Korea, I worked for more than

30 years doing feasibility studies, establishing investment criteria, and making trade contracts for petroleum and mineral resources.

However, I failed to notice the will of God with regard to the earth created by Him, even though I knew very well that most developing projects of energy and mineral resources would result in serious environmental damage by ravenous economic minds.

Fortunately, in the course of studying Magister Philosophiae in Applied Theology (MPhil) from 2002 and the Magister Artium in Missiology (MA) from 2004, the following theological notions transformed my conviction;

1) Nothing that God did in salvation history and the church did in faithful obedience to God's will can be divorced from God's overall hope for his creation.

2) There is no way in which the church can pursue its mission and ignore the challenge that environment destruction poses.

3) It is of crucial importance for all Christians to become involved in positive projects geared towards the natural environment in accordance with the will of God.

4) The developing projects of nuclear plants and mineral resources have to move away from the dominant anthropocentric perspective to one that embraces the whole earth community as belonging to God and as having intrinsic value.

1.6.4. Research Method.

The methodology of this study will consist mainly of literature study and qualitative empirical analysis. According to the process of social ministry such as analysis-reflection-practice-feedback based on the Biblical perspectives and Christian insights, this thesis will firstly concentrate on a comprehensive survey of the environmental movement of Korean churches and the environmental impact of nuclear plants and mining activities in Korea compared with world development trends.

Secondly, the literature study of both primary and secondary sources will focus on Christian ethics, creation spirituality, and philosophy of law and economics to develop a theological framework for biblical sustainable development in accordance with the will of God as a criteria to capture theological and ethical reflections on the environmental impacts from mining activities and nuclear plants in Korea.

I will interpret numerous statistics on, for example, the environmental impact of nuclear plants and mining activities, consumption, demand, production and reserves of mineral resources in Korea in the light of the world situation supplied by the Korean Institute of Geology and Mineral Resources (KIGAM), Korea Energy Economics Institute, Korea Resources Corporation (KRC), Korea Society for Geosystem Engineering, United Nations Sustainable Development Committee, IAEA, World Resources Institute (WRI) and so on.

Qualitative empirical analysis will mainly be done through the interviews of Korean church members, NGO's, government institutions and prominent Koreans. This is in order to gather data and information on the environmental impact of nuclear plants and mining projects in Korea.

1.7. Outline of Thesis.

1.7.1. Chapter 1: Introduction.

The first chapter will give the introductory information such as the environmental problem, purpose, motivation, relevance, methodology and resources used to write this thesis.

1.7.2. Chapter II: World Development Trends Regarding Energy and Mineral Resources.

I will describe the characteristics of a nuclear plant and mining industry and the world trends of development, consumption, reserves of energy and mineral resources, and identify the mining policy of the advanced countries and developing countries to check out the situation of mining activities.

1.7.3. Chapter III: Environmental Impact from Mining Activities and Nuclear Plants.

I will identify the serious environmental impact brought about by means of nuclear plant operations and mining activities, and indicate the challenge to meet the rapidly increasing demand of energy and mineral resources of current civilized societies.

1.7.4. Chapter 1V: Environmental Impact of Mining Activities and Nuclear Plants in Korea.

In order to help Korean readers (churches, NGO's and government) to recognize the grave concerns concerning the environmental impact brought about by means of nuclear plant operations and mining activities in Korea, this chapter analyzes the development policies regarding nuclear plants and mineral resources and management plans regarding nuclear waste and closed mines. It gives detailed information on environmental and social issues such as poor resources, overconsumption and overseas mineral development policy rather than domestic policy and statistical pictures of Korea.

1.7.5. Chapter V: Inadequate Environmental Involvement of Korean Churches.

In order to help Korean churches to recognize their attitude of unconcern regarding the environment movement in spite of the serious impact on the environment from reckless development as well as nuclear plants and mining activities, this chapter will outline the environmental activities of Korean churches and associations, surveying the situation and history of the Christian environmental movement and describing their contributions to spreading environmental awareness and participating in the environmental impact assessments and environment management plans of nuclear plants and mining projects in accordance with the holistic mission of our Lord Jesus Christ. Additionally, it will describe the historical development of Christian churches and their leadership pathologies in order to understand the Korean Christian context.

1.7.6. Chapter VI: A New Concept of Sustainable Development of Energy and Mineral Resources in accordance with the will of God.

Even if sustainable development is a useful approach to solve the contradiction between industrialization and the preservation of the environment, it is still faced with some dilemmas particularly in relation to consumerism as sustainable industrialization advances. This is the irresolvable tension between people's drive to consume more and more goods and services in order to improve the quality of life, and the

environmental degradation threatened by such consumption (Park 2004:247-249).

Through analysing the controversial views of traditional finite world paradigm and market resource allocation paradigm, fundamental roots of environmental degradation and biblical proposition for sustainable development, I will introduce a new concept of sustainable development in accordance with the will of God to show a fundamental approach going beyond discussing only the socio-economic forces encouraging population growth, technological development and production activity on account of anthropocentric greedy values. Additionally some concepts of biblical sustainable development in mining context will be introduced for mining activities in accordance with the will of God.

1.7.7. Chapter VII: Theological Framework for Biblical Sustainable Development of Nuclear Plants and Mineral Resources.

I will give an account of my views on Christian insights and perspectives for nuclear plants and mineral resources based on biblical sustainable development in accordance with the will of God. This account is not intended to be exhaustive – as that would fall outside the scope of my study – but is merely stated by me as a researcher and hint at what criteria can be employed to evaluate the environmental impact of energy and mineral resources. The purpose is to awake the Korean churches from the lack of a theology that emphasizes the holistic mission of our Lord Jesus Christ through creation spirituality and a Christian ethic for non-humans as well as humans and sustainable development in accordance with the will of God through eco-justice stewardship, social ministry and Christian duty.

1.7.8. Chapter VIII: Evaluations of Korean Churches regarding Biblical Sustainable Development of Energy and Mineral Resources.

An attempt will be made at evaluating the biblical sustainable development of nuclear plants and mineral resources in Korea in order to identify challenging tasks which Korean churches are now facing, as well as approaches that will help them to come to grips with the absorbing theological discussion. The evaluation will be made using the theological framework for biblical sustainable development in accordance with the will

of God discussed in former chapters.

And then I will suggest practical directions for Korean churches to practice in their daily lives. Additionally, a direction for the Korean Government will also be suggested through evaluating its energy regime and mining policy in order to offer targets for Korean churches to push the government for an integrity of environment.

1.7.9. Chapter IX: Summary, Critical Findings and Recommendation.

The final chapter will offer a summary, critical findings (conclusion) of the research, and practical proposals (recommendation) for future research.

Chapter II: World Development Trends Regarding Energy and Mineral Resources¹⁾

Since human beings first started to use stone tools, they have been dependent on minerals contained in or on the earth. This dependence has increased as we have evolved to our present industrialized status, to the point today where our livelihood is utterly dependent on mining.

Our dependence on modern mineral-derived artifacts and on energy is not going to decrease. Indeed, population growth and increasing living standards will rapidly increase our dependence on energy and mineral resources.

Over the last century, the exploitation of energy and mineral resources has grown enormously, in parallel to the growth of economic activities. Currently, western economies use about 20–40 metric tons of raw materials per person per year (Adriaanse et al. 1997:35–37).

While high material consumption rates certainly have contributed to the high living standards in large parts of the world, their enormous throughput has also raised questions with regard to the sustainability of the current use of energy and mineral resources.

Some people have pointed out the risks of depleting limited reserves of high-grade resources. In addition, the exploitation of energy and mineral resources requires a sizeable amount of global capital and energy inputs,

1) All the materials that make up the lithosphere (the rigid outer of the earth's crust and mantle) and the biosphere (the part of the earth's surface and its immediate atmosphere that is inhabited by living organisms) comprises of the sum total of the living and non-living endowment of the earth. The endowment which has a value as something useful becomes resources. The resources are classified into natural and social resources. The natural resources are one set of goods within the category of land, most of which become the capital goods used in production, while the social resources are the tools and systems to develop, use and manage other resources such as people, knowledge, skills, capacities, technologies, organizational and institutional structures, political and economic schemes and so forth.

and causes different sorts of environmental problems in mining, transport, and upgrading.

2.1. Characteristics of Energy and Mineral Resources²⁾

2.1.1. Development.

Geological resources are converted into reserves by exploration activities. Ore extracted from the reserves is used to produce refined metals or metal compounds (primary production), which are subsequently used to produce final consumption goods. These products remain in use for some time during or after which the metals they contain (1) slowly dissipate or (2) are dumped in ways and places where they could constitute a secondary resource as long as they are not dissipated into the environment. Alternatively, materials can be recycled directly after their lifetime within the secondary production. Consumption of mineral resources is made as primary production and secondary production.

2.1.2. Demand.

Over the last 100 years, the global consumption of metals has sharply increased, with an average annual growth rate of more than 3% (Strengers, B. J. et al. 1999:239–255). Obviously, the building of cities, heavy industry and all kinds of machines and appliances have made a significant contribution to the growing use of mineral resources.

In the most industrialized countries, demand for most mineral resources in the last two decades has been showing slow growth or has even levelled

2) According to the predominant end-use, natural resources are generally divided into renewable resources and non-renewable (mineral) resources. The former are flow or continuous resources that are produced, as part of the functioning of natural or managed systems, at about the same rate that they are used up. They can provide a sustained yield. The latter are the resources that has a finite endowment. It either cannot be reproduced once it is used or lost, or cannot be reproduced within a time span relevant to present or future generations.

off. In contrast, demand for mineral resources has been growing sharply in many developing countries. Recently, Asia experienced an average annual growth in iron demand of about 8% per year.

Population growth, economic growth and spread of material-intensive lifestyles can potentially increase the demand of mineral resources by order of magnitude. So, major policy initiatives are needed to reverse current trends in resource use and material-intensive lifestyles.

2.1.3. Production.

Historically, the processing of mineral resources has been subject to steady progress in energy efficiency. The recycled metals may require substantially lower energy inputs than the use of virgin metals. Primary production encompasses all processes from mining and milling to smelting and refining.

Secondary production is often mentioned as an important factor to a more efficient use of resources. In principle, consumer recycling rates have increased over time, because recycling limits waste flows to the environment and reduces energy requirements. The main factors influencing the recycling rates are: (1) scrap availability compared to consumption, (2) relative processing costs of scrap and virgin metals, and (3) possibility of cost-effective scrap collection.

2.1.4. Reserves³⁾

The impacts of ore grade decline or depletion has been the subject of long debate. But we can define the issue of potential depletion of resources completely in terms of quality, i.e. ore grade. Assuming that resources of the highest quality are exploited first, further exploitation might lead to quality decline. Next, the effects of quality decline are calculated in terms of the energy requirement and production costs per unit of primary mineral

3) The proven reserves mean the amount of energy and mineral resources which are reasonably certain to be commercially recoverable using current technology. So, the proven reserves are much lower than resources ultimately recoverable in place.

resources.

The production costs of mineral resources are a sum of energy costs, capital costs and exploration costs. So, the depletion of resources is defectively involved in the energy intensity as a function of ore grade decline and technological development.

We are well aware that new discoveries of mineral deposit and technology in the mining industry have increased mineral reserves in the past and are likely to do so in the future. But we should regard mineral resources as limited, based on social impacts and environmental damage associated with resources production.

2.1.5. Environmental Impact.

Several case studies indicate that mining is both a direct and an underlying cause of forest loss and degradation, and that mineral wealth can actually depress social conditions in developing countries. As society resorts to lower grades and to more remote deposits, natural areas will be more heavily disturbed by large open-pit mines and mining accidents as witnessed recently in China.

And more energy will be needed and increasing amounts of environmental wastes generated. Due to sheer growth in the demand for energy and minerals⁴⁾, waste production will increase to levels several

4) Energy and mineral resources can be categorized by some criteria of physical and chemical characteristics, end-uses, scarcity etc. Based on the physical and chemical characteristics of mining and mineral-using industries, the Metals and Minerals Annual Review classified them into six groups: (1) precious metals and minerals (gold, silver, diamonds etc.); (2) major metals (copper, aluminium, zinc, tin, lead etc.); (3) steel industry metals (iron ore, steel, chromite, cobalt, manganese, nickel etc.); (4) speciality metals (magnesium, titanium, cadmium, mercury etc.); (5) industrial minerals (asbestos, graphite, alt, kaolin, phosphate rock, industrial diamonds etc.); and (6) energy minerals (coal, oil, natural gas, uranium etc). The resources are also typed into (1) energy minerals; (2) ferrous metallic minerals; (3) non-ferrous metallic minerals; (4) precious minerals; and (5) industrial minerals by the principal end-uses approach of minerals.

times higher than current ones in the near future.

Air pollution, acid rain and global warming are all attributed to the use of fossil fuels, with coal seen as the worst culprit. However, the combination of economic growth, population increases and urbanization is driving up the global energy demand to new levels.

Over 1.3 billion people worldwide live in areas of heavy air pollution and millions more have their health or quality of life undermined by the emissions from motorvehicles, factory chimneys and power stations. Chinese cities have concentrations of airborne particulates 14 times worse than in the USA. The burning of coal and oil may also release trace cadmium and mercury. Energy which poisons the air we breathe is a poor mark of progress.

The current material-intensive lifestyles will generate large and increasing energy use, which in turn aggravates the impending threat of climate change; rising prices of energy and minerals keeps less industrialized regions in a poverty trap; enormous fluxes of mining wastes and land degradation put an ever-increasing stress on ecosystems; and results in the loss of bio-diversity.

So, our current material-intensive lifestyles, economic and demographic growth should be taken into account giving an adequate picture of development in energy and minerals demand and environmental recovery.

2.1.6. Unsustainability.

Fossil fuels cannot last forever and burning them gives off a range of pollutants and greenhouse gases. Known reserves of crude oil will be exhausted in about 40 years at current production rates. Though new oil fields are being discovered and higher prices will spur new exploration efforts and recovery techniques, this comfortable situation cannot last forever. At some time in the 21st century it seems likely that oil will cease to be used as a standard fuel for transport and power generation.

The USA, once the world's main supplier of crude oil, now has to rely on imports for half its requirements, because many of its own wells have run dry. The assumption that tar sands, shale oils and synthetic fuels made from coal will eventually take over from oil seems less and less realistic in light of high production cost and the heavy environmental impact. Synfuels, for example, give off even more carbon dioxide than coal, require large

amounts of water for processing and lose 30–40% of the energy in the original coal. Much of the same problems are presented by oil shale and tar sands.

In spite of such a serious current energy situation, few in the West would care to live without electric power or motor cars. The world's economy is closely geared to a continuation of the fossil fuel regime, yet an extension of the present energy habits of industrialized countries on the rest of the world would be unwise, straining, perhaps to breaking point, both resource availability and environmental quality (World Bank 2007:22–27).

Paradoxically, the current global financial turmoil is expected to slow major economies down, particularly the USA, Europe and Japan, whose economies are reported to have shrunk for one or two years. The financial crisis is anticipated to spread throughout the world at various levels of intensity, exerting pressure on economic growth and downward revision of forecasts for energy and mineral resources.

2.1.7. Terrestrial Industry.

Mining companies are entrusted with the task of satisfying the requirements of energy and minerals, as are farmers entrusted with satisfying our food needs. However, unlike farming where there is a choice of where and what to grow, mining can take place only where minerals occur. Consequently, mitigation of environmental impacts by moving a mine to a more environmentally suitable site cannot be considered, as would be the case for most other development projects.

Additionally, mining is very often a temporary land-use. This is unlike almost all other developments which permanently alienate land from its original use. Being a true extractive industry, mining cannot be sustainable at one place because the deposit is finite and is eventually exhausted.

2.2. Demand–Supply Trends of Energy and Mineral Resources.

2.2.1. Energy Minerals.

Cheap fossil fuels transformed the world during the 19th century and became the foundation of modern civilization. The three fossil fuels such as

oil, gas and coal provide nearly 90% of the energy which drives industrial society (UGI 2004:2-16).

The energy infrastructure based on fossil fuels has developed over the last 200 years and now extends through worldwide systems of mining and exploration, transportation by land, sea and air, electricity generation, chemicals and many other products. Even agriculture depends heavily on the fuels and fertilizers produced by this system.

Over the last century, we have come to take energy for granted, not thinking about the effort needed to bring electricity to our houses or petrol to our cars. Occasional strikes and power cuts remind us of how much we depended on a continuous flow of energy and what a thin line divides civilized life from barbarism.

However, the demise of the fossil fuel economy has been predicted for some years by those who deplore its polluting and global warming downside and by pundits who claim that reserves are running out. Yet fossil fuels such as oil, natural gas and coal continue to account for 89% of the world commercial energy supply (the energy that has to be purchased rather than simply gathered like wood and other biomass used for fuel in Third World countries).

In fact, dependence on fossil fuels is growing because there is still no other practicable way to meet the world's energy demands, as more and more countries transform themselves from rural-agrarian to urban-industrial societies.

Though coal is often categorized as dirty and its use as a household fuel in western countries has greatly declined, it still generates over 37% of global electricity. Coal is the main energy source in China and India, which together account for a third of the global population (DME 2007:51-69).

At present the per capita use of commercial energy in China and India is well under 1,000 kg of oil equivalent a year compared with over 5,000 kg in most OECD countries and about 8,000 kg in the USA. The growth in demand which accompanies economic development has serious implications for both the energy supply and carbon emissions.

2.2.1.1. Oil.

Oil is the ultimate risk and reward business. Most oil wells yield insufficient oil to be commercially viable. Even with detailed geological

surveys and a century of experience, the industry's average hit ratio is only about one commercial well to ten exploratory drillings (Ikaneng 2008: 48–51).

The first oil well of modern times was drilled by Edwin L. Drake in 1859 in northwestern Pennsylvania, USA. The huge Prudhoe Bay field in the Arctic was found only on the last of a series of test drillings. Offshore drilling began in the Gulf of Mexico and has spread to many parts of the world. The technology developed there and in the North Sea has made production possible in water almost 2,000 meters deep.

The International Energy Agency (IEA) stated that world oil demand is expected to rise by an average of 2.2% between 2008 and 2012, while production will lag behind, which will lead to a supply deficit. The demand is expected to reach 95.8 million b/d from 86.1 million b/d in 2007. Large scale exploration will continue in deep water blocks for both oil and gas immediately after rights are finalized.

2.2.1.1.1. Reserves.

The estimated world proven oil reserves decreased from 1,239.5 billion barrels in 2006 to 1,237.9 billion barrel in 2007. The Organization of Petroleum Exporting Countries (OPEC) accounted for 75.5% of the world oil reserves. The Middle East is estimated to have 61.0% of the world proven reserves and produces almost 1/3 of the world's crude oil.

The Middle East has many advantages regarding oil sources such as cheap- high-quality crude which is relatively easy to extract from a central global location with easy access to the sea. There may be plenty of oil beneath the bandit-ridden Caucasus, the frozen wastes of Siberia, the jungles of Latin America, Africa and Asia, and from sea beds in various parts of the world. But it is more expensive to produce and harder to transport oil in these areas. The environmental impact of oil production is also more serious there.

2.2.1.1.2. Production.

The world oil production fell by 0.2% from 81.7 million barrels per day (b/d) in 2006 to 81.5 million d/d in 2007. The major oil producers in the OPEC group were Saudi Arabia and Iran, with a contribution of 10.4 million

b/d and 4.4 million b/d respectively.

The production outside OPEC countries remained weak, falling by 0.7% to 33.5 million b/d in 2007. Output rose by 0.5 million b/d in the Commonwealth Independent States (CIS), with Azerbaijan and Russia each growing by more than 0.2 million b/d. The Organization for Economic Cooperation and Development (OECD) output dropped by 1.4% to 19.2 million b/d.

Over 41,000 oil fields have been discovered, but most of them are small wells. The world's biggest 370 fields contain three-quarters of all discovered oil. The biggest 3% of oil fields account for 94% of all oil ever discovered. Although new fields are found regularly, new super-giants are extremely rare.

Today the seven major oil companies are Shell, Exxon, BP, Mobil Chevron, Amoco and Texaco. Other international oil companies include ENI (Italy), Elf Aquitaine and Total (France), Atlantic Richfield, Phillips Petroleum and Enron (US), and Statoil (Norway). Major Middle East enterprises include Aromco (Saudi Arabia) and NIOCO (Iran).

2.2.1.1.3. Consumption.

Oil was initially sold as a fuel for lamps. Oil's strategic importance was boosted when the British navy, advised by Winston Churchill, decided in 1911 to switch from running its ships on coal to running them on oil. Now all the world's aircraft, ships and vehicles run on petroleum fuels. In some countries many power stations use oil. Many products in daily use such as textiles, plastics, fertilizers, pharmaceuticals are made from petroleum-based feedstocks.

The global oil consumption increased by 1.1% to 85.2 million b/d in 2007. The consumption in the oil-exporting regions of the Middle East, South and Central America and Africa accounted for two thirds of the world's growth. However, oil consumption in the OECD decreased by 0.9%.

The International Energy Agency projects that if left unchecked, global energy consumption will rise more than 50% by 2030, with fossil fuels remaining the dominant energy source. In turn, vulnerability to price shocks and supply disruptions would rise, and carbon dioxide (CO₂) emissions could increase by more than 50% (Worldwatch Institute 2007:33).

Table 2.1: Consuming Trends of World Fossil Fuels. unit: million TOE.

Year	1950	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005	2006	2007
Oil	470	951	1,530	2,254	2,678	2,972	2,801	3,155	3,264	3,559	3,871	3,911	3,953
Natural Gas	171	416	632	924	1,075	1,304	1,493	1,788	1,936	2,199	2,497	2,558	2,638
Coal	1,074	1,544	1,486	1,553	1,613	1,814	2,107	2,229	2,268	2,340	2,892	3,042	3,176

Source: UN, BP, IAEA Press Reports.

2.2.1.1.4. Prices.

Higher demand resulting from higher economic growth rates exerted upward pressure on prices. Consequently, the price of Brent crude oil averaged \$72.39 per barrel in 2007, which is almost 11% above the 2006 average. This price growth continued into 2008, testing the \$150/bl hurdle, before plunging back to below \$50/bl in the fourth quarter of 2008. This development is expected to cushion inflationary pressure inherent in higher prices of oil.

2.2.1.2. Natural Gas.

Though the Chinese drilled deep holes to tap natural gas over 2,000 years ago and flames from natural gas were known in ancient Persia where it was associated with Zoroastrian fire worship, this energy was unknown in Europe until the 17th century and was not widely used until the middle of 20th century. But natural gas now has a high net energy yield. As more gas fields are discovered, its use is expanding rapidly. It burns hotter and produces comparatively less pollution and carbon dioxide than oil and coal (Ikaneng 2008: 48-51).

2.2.1.2.1. Reserves.

The world's proven gas reserves increased by 0.6% to 1177.36 trillion m³ in 2007 due to new discoveries. The Middle East, Europe and Eurasia accounted for 74.8% of the total reserves

2.2.1.2.2. Production.

The oil shortages and steep price rises as well as the concerns over environmental impact of using coal and oil forced producers to take a closer look at the potential of natural gas. The world gas production rose by 2.40% in 2007 to 2,940 billion m³. Russia was the largest producer, accounting for 20.6% of the total world production, followed by USA at 18.4%, China at 18.4% and Qatar at 17.9%. The production in the European Union declined by 6.4% with the United Kingdom's output falling by 9.5%.

Table 2.2: World Reserves and Production of Oil and Natural Gas, 2007

Country	Proved Reserves		Production	
	Oil(billion bl)	Gas(trillion m ³)	Oil(1,000 b/d)	Gas(billion m ³)
Algeria	12.3	4.52	2,000	83.0
Indonesia	4.4	3.00	969	66.7
Iran	138.4	27.80	4,401	111.9
Iraq	115.0	3.17	2,145	0.0
Kuwait	101.5	1.78	2,626	12.6
Libya	41.5	1.50	1,848	15.2
Nigeria	36.2	5.30	2,356	35.0
Qatar	27.4	25.60	1,197	59.8
Saudi Arabia	164.2	7.17	10,413	75.9
UAE	97.8	6.09	2,915	49.2
Venezuela	87.0	5.15	2,613	28.5
(OPEC/ Subtotal)	934.7(75.5%)	91.08(51.2%)	35,204(43.0%)	537.8(18.3%)
Argentina	2.6	0.44	698	44.8
Australia	4.2	2.51	561	40.0
Brazil	12.6	0.36	1,833	11.3
Brunei	1.2	0.34	194	12.3
Canada	27.7	1.63	3,309	183.7
China	15.5	1.88	3,743	69.3
Ecuador	4.3	0.0	520	0.0
Europe & Eurasia	143.7	59.41	17,835	1,075.7
India	5.5	1.06	801	30.2
Malaysia	5.4	2.48	755	66.7
Mexico	12.2	0.37	3,477	46.2
Oman	5.6	0.69	718	24.1
USA	29.4	5.98	6,879	545.9
Others	30.5	9.13	5,006	-
(Others/ Subtotal)	303.2(24.5%)	77.15(48.8%)	46,329(57.0%)	2,388.5(81.7%)
Total	1,237.9	177.36	81,533	2,940.0

Source: BP Statistical Review of World Energy, June 2008.

2.2.1.2.3. Consumption.

Global gas consumption rose by 3.1% to 2,922 billion m³ in 2007. The USA accounted for 22.6% of the world's gas growth, driven by cold winters

and strong demands in power generation. China's consumption grew by 19.9% and accounted for the second largest increment to the global consumption, while the European Union consumption declined by 1.6%.

2.2.1.3. Coal.

Coal's high calorific value makes it a valuable fuel. But mining, transporting, processing and burning coal is a messy business which contributes significantly to environmental pollution and in particular global warming. Although new technology can make coal a relatively clean fuel, the cost is high and there is no way to make coal transformation pollution-free.

Coal has been mined by the Chinese for over 2000 years. It began to be widely used in Europe in the 18th century. As the industrial revolution proceeded, coal became the main energy source for those parts of the world which were engaged upon rapid industrialization. Coal mining became a major industry in Europe and North America, employing millions of people, including many children. These days, coal is used in the West mainly for power generation, but there are many countries, including China and India, where coal is still the main energy source for both domestic and industrial consumers. (Ikaneng 2008:42-47).

2.2.1.3.1. Production.

World coal production grew by 5.3% to 6,488 Mt in 2007, following a four-year period of strong growth averaging 6.5% per annum. China remained the largest producer, accounting for 39% of the total production, followed by the USA (16.2%), India (7.5%), Australia (6.1%) and Russia (4.8%).

World hard coal production grew by 6.5% to 5,543 Mt in 2007, driven by growth in production in the non-OPEC countries with 8.8% growth in 2007. The major producing countries were China, Russia, India, Indonesia, Kazakhstan, Vietnam and Colombia. China was the largest producer of hard coal, contributing 2,549.2 Mt of the world production, followed by the USA (980 Mt), India (451 Mt), Australia (323 Mt) and South Africa (247 Mt).

Brown coal production went up by 0.8% to 945.2 Mt in 2007. Production increase came from Germany (180 Mt), Australia (72.3 Mt), Turkey (70.0 Mt) and Bulgaria (28.3 Mt) and offset by being decreased in Russia, USA,

Poland, Serbia and Montenegro.

Table 2.3: World Coal Reserves, Production and Exports, 2007.

Country	Reserves (Mt)	Production (Mt)	Exports (Mt)
China	62,200 (14.4%)	2,549.1 (39.3%)	53.7 (5.9%)
USA	112,261 (26.1%)	1,052.0 (16.2%)	53.4 (5.9%)
India	52,240 (12.1%)	484.4 (7.5%)	1.2 (0.1%)
Australia	37,100 (8.6%)	395.3 (6.1%)	243.6 (26.9%)
Russia	49,088 (11.4%)	313.7 (4.8%)	100.7 (11.1%)
South Africa	27,981 (6.5%)	247.7 (3.8%)	67.7 (7.5%)
Indonesia	1,721 (0.4%)	259.2 (4.0%)	202.2 (22.3%)
Poland	6,012 (1.4%)	147.8 (2.3%)	11.8 (1.3%)
Kazakhstan	28,170 (6.5%)	86.4 (1.3%)	23.0 (2.5%)
Colombia	6,578 (1.5%)	71.7 (1.1%)	67.2 (7.4%)
Canada	3,471 (0.8%)	69.4 (1.1%)	30.8 (3.4%)
Ukraine	15,351 (3.6%)	59.0 (0.9%)	3.4 (0.4%)
Others	28,723 (6.7%)	752.3 (11.6%)	47.7 (5.3%)
Total	430,896 (100%)	6,844.0 (100%)	906.4 (100%)

Sources: BP Statistical Review of World Energy, June 2008.

OECD/ IEA, Coal Information 2007.

2.2.1.3.2. Consumption.

World coal consumption increased by 0.8% to 271.7 Mt in 2007, following a four-year trend of annual increases averaging 6.6%. Hard coal consumption was up by 6.9%, steam coal by 7.3% and coking coal by 4.9%.

China maintained its position as the largest coal consuming country, an increase of 10.3% to 1,930.7 Mt in 2007. India, Russia and Indonesia increased by 10.7%, 2.7% and 10.4% respectively, while Ukraine and Kazakhstan declined by 1.1% and 1.6% respectively.

2.2.1.3.3. Trade.

Estimated world coal trade amounted to 917.3 Mt in 2007, an increase of 6% compared with 2006. Australia remained the world's leading coal exporter with its hard coal export reaching 243.6 Mt in 2007, an increase of 5.3% more than 2006. Indonesia showed continuing growth with an increase of 17.8% reaching 202.7 Mt, followed by Russia (9.6%) and

Colombia (8.4%).

2.2.1.4. Uranium.

2.2.1.4.1. Production.

According to the World Nuclear Association (WNA), world uranium mine production increased by 4.7% to 41,279 tU (48,680 U O) in 2007 as shown in the table 4. The three major producing countries such as Canada (22%), Australia (21%) and Kazakhstan (16%) accounted for 59% of world production (Chili, Thomas 2008:58-62).

Table 2.4: World Resources and Production of Uranium, 2007

Country	Uranium Resources (RAR/ kt U)	Production	
		2006 (tU)	2007 (tU)
Canada	433	9,862	9,476
Australia	754	7,593	8,611
Kazakhstan	474	5,279	6,637
Niger	225	3,434	3,153
Russia	133	3,262	3,413
Namibia	240	3,067	2,879
Uzbekistan	106	2,260	2,320
USA	106	1,672	1,654
Ukraine	90	800	846
China	60	750	712
South Africa	300	643	619
Others	81	803	959
Total	3,002	39,429	41,279

Sources: OECD's IEA and IAEA, Uranium 2007: Resources, Production and Demand/ WEA, Market Report Data, 2007.

Note: RAR; Reasonably Assured Resources plus inferred Resources.

In 2007, 62% of uranium was recovered from both underground and open pit mines, 29% from in-situ leach and 9% as by-product. The world-leading producers in 2006 were Canada's McArthur River with 7,200 tU (18.3%), Australia's Ranger with 4,026 tU (10.2%), Namibia's Rossing with 3,067 tU (7.9%), Russia's Krazanokamensk with 2,900 tU (7.4%), and Australian Olympic Dam with 2,868 tU (7.3%).

2.2.1.4.2. Nuclear Reactors.

According to the World Nuclear Association (WNA), about 16% of world electricity was generated from 439 nuclear reactors, operating in 30 countries with the total output capacity of about 371,989 MWe in 2007. Currently, 36 nuclear reactors are under construction and a further 93 new reactors are at planning stages. World nuclear electricity generation had dropped down by 2% to 2,608 billion kWh in 2007. The decline resulted from the closure of 7 units in Japan's largest nuclear plant (Kashiwazaki-KKariwa) and 6 German reactors that have undergone major repairs and maintenance.

Table 2.5: World Nuclear Plants and Uranium Requirements 2006–2007.

Country	Nuclear Electricity Generation	Reactors Operable 2006	Uranium Required 2006	Reactors Operable 2007	Uranium Required 2007
	Billion kWh	Number	tU	Number	tU
USA	787.2(19%)	103	19,715	104	20,052
France	428.7(78%)	59	10,146	59	10,368
Japan	219.5(30%)	55	8,169	55	8,872
Germany	158.7(32%)	17	3,458	17	3,486
South Korea	141.2(39%)	20	3,037	20	3,037
Russia	144.3(16%)	31	3,439	31	3,777
UK	62.2(18%)	23	2,158	19	2,021
China	51.8(2%)	10	1,294	11	1,454
Spain	57.4(20%)	8	1,505	8	1,473
Canada	92.4(16%)	18	1,635	18	1,836
Sweden	65.1(48%)	10	1,435	10	1,468
Ukraine	84.8(48%)	15	1,988	15	2,003
Belgium	44.3(54%)	7	1,075	7	1,079
Others	248.4	66	6,424	55	5,603
Total	2,658(16%)	442	65,478	439	66,529

Sources: World Nuclear Association, World Nuclear Reactors and Uranium Requirements, 2006–2007./ IAEA, Nuclear Electricity Production and Percentage of Electricity, 2006.

2.2.1.4.3. Demand.

The uranium demand was dominated by the USA, with 104 reactors equivalent to 23.3% of the world total reactors, followed by France with 59 reactors. 19% of USA's national electricity demand was supplied by nuclear

energy, while France derived 77% and Japan 27.5% of their electricity from nuclear plants. Belgium, South Korea, Sweden and Ukraine all derived more than 30% of their electricity supply from their nuclear reactors.

Table 2.6: World Electrical Generating Capacity of Nuclear Power Plants.

unit: gigawatts.

year	1960	1965	1970	1975	1980	1985	1990	1995	2000	2004	2005	2006
Capacity	1	5	16	71	135	250	328	340	349	366	369	370

Source: Worldwatch Institute Database, IAEA and Press Reports.

2.2.2. Ferrous Metallic Minerals.

Demand for ferrous minerals depends on steel production where over 80% is consumed. Annual world crude steel production rose to 1,344.3 Mt in 2007 representing 7.5% improvement on 1,251 Mt produced in 2006. China continued its double digit growth in steel output, recording a rise of 16% on its 2006 production, to 487.3 Mt in 2007 (Bonga et al. 2008:96-99).

The accelerated growth of world steel production in recent years has raised concerns as to whether such increases are sustainable. The production growth has stemmed mainly from the Asian region, driven largely by China and India. The commodities most affected will be ores and alloys of iron and manganese for steel production and chromite ore and ferro-chrome for stainless steel.

2.2.2.1. Iron Ore.

2.2.2.1.1. Production.

World iron ore production increased by 9% from 1,482.6 Mt in 2006 to 1,632.5 Mt in 2007. Output increased in the four major producing countries such as Brazil, China, Australia and India, which collectively accounted for 72% of total world production as shown in the table 7. Developing countries increased their contribution to total global iron ore production from 60% in 2006 to 62% in 2007 while the Commonwealth of Independent States (CIS) contributed 12%, down from 13% in 2006 (Bonga 2008:104-108).

2.2.2.1.2. Trade.

Total world exports increased for the sixth successive year in 2007 to 822.4 Mt, up 8.1% compared with 2006. Developing countries increased their share of the export market to 53%, while developed countries accounted for 39% and CIS contributed 7.6%. Brazil was the leading exporter at 269.4 Mt, while Australia and India exported 266.8 Mt and 93.7 Mt respectively.

Asia has consistently dominated the iron import market since 1997. China, which accounted for 45% of total imports increased its imports by 17% to 383 Mt in 2007, while Japan's imports increased modestly by 3.3% to 138.9 Mt. The four largest importers such as China, Japan, Germany and South Korea accounted for 74% of total world imports, while the EU accounted for 21%.

Table 2.7: World Reserves, Production and Exports of Iron Ore, 2007.

Country	Reserves (Mt)	Production (Mt)	Exports (Mt)
Australia	25,000 (15.6%)	299.1 (18.3%)	266.8 (32.4%)
Brazil	11,000 (6.9%)	336.5 (20.6%)	269.4 (32.8%)
Canada	2,500 (1.6%)	33.2 (2.0%)	28.3 (3.4%)
China	15,000 (9.4%)	332.3 (20.3%)	0
CIS	63,000 (39.4%)	201.4 (12.3%)	62.6 (7.6%)
India	4,000 (2.5%)	206.9 (12.7%)	93.7 (11.4%)
South Africa	1,500 (0.9%)	41.3 (2.5%)	30.3 (3.7%)
Sweden	5,000 (3.1%)	24.7 (1.5%)	19.4 (2.4%)
USA	14,000 (8.8%)	52.0 (3.2%)	9.3 (1.1%)
Venezuela	1,500 (0.9%)	22.5 (1.4%)	5.9 (0.7%)
Others	18,000 (11.0%)	82.8 (5.1%)	32.0 (4.4%)
Total	160,500 (100%)	1,632.5 (100%)	822.4 (100%)

Sources: UNCTAD, Trust Fund on Iron Ore: Production and Exports, 2007.

USGS, Reserve Base for Iron Ore, 2007.

2.2.2.1.3. Outlook.

Analysts have forecast a growth rate of between 7 and 10% for steel consumption and hence, iron ore production is expected to grow by another 10 to 12% in 2007. China is expected to account for more than 50% of that increase as its economic expansion continues unabated.

2.2.2.2 Chromium.

2.2.2.2.1. Production.

World chrome ore production amounted to 23 Mt in 2007, of which 93% was metallurgical grade and 3% foundry grade while refractory and chemical grades amounted to 2.4% and 1.6% respectively. South Africa dominated production at 9.7 Mt, followed by Kazakhstan at 3.7 Mt and India at 3.3 Mt.

World ferro-chrome production amounted to 7.7 Mt with an increase of 17.5% higher than 2006 on the back of higher demand. South Africa was the biggest ferro-chrome producer producing 3.6 Mt, 17.5% more than 2006. Consequently, Africa is by far the greatest producer with a share of 46.4% of global ferro-chrome production, followed by Kazakhstan and China at 14% and 13.8% respectively (Mosiane 2008:100-103).

2.2.2.2.2. Reserves.

World chrome ore reserves amounted to 7.6 Gt. More than 80% chrome ore resources are located with the Bushveld Complex and the Great Dyke of Zimbabwe in Southern Africa. South Africa hosts 72% of the world reserves, followed by Zimbabwe with 12.2% and Kazakhstan with 4.2%.

2.2.2.2.3. Demand.

Demand for chromium depends on stainless steel production, which consumes over 90% of chromium. World stainless steel production fell by 2.6% to 28.5 Mt in 2007 compared with 2006. The stainless steel production declined in all regions except in Asia where the production was dominated by 60% to 17 Mt in 2007. China was the largest producer by 42% to 7.6 Mt, followed by Japan at 4 Mt and USA at 2.2 Mt. However, demand for chromium increased by 17% as stainless steel producers shifted to the production of cheaper stainless steel using more chrome and less nickel of which prices rose so much in 2006.

2.2.2.3. Manganese.

2.2.2.3.1. Production.

World manganese ore production increased by 12.6% to 38.2 Mt with a manganese (Mn) content of 12.7 Mt in 2007. However, since the higher manganese ore production resulted mainly from increased exploitation of lower grade sources, demand of 13.6 Mt for manganese content exceeded supply of 12.7 Mt.

World manganese ferro-alloy production increased 11.9% to 13.2 Mt compared with 2006. World production capacity for manganese ore increased to 43.9 Mt while capacity utilization increased to 89% in 2007 mainly as a result of higher demand from alloy plants driven by increased steel production (Bonga 2008:109-115).

2.2.2.3.2. Demand.

Demand for manganese depends on steel production which accounts for over 90% of consumption. Annual world crude steel production rose to 1,344.3 Mt in 2007, representing a 7.5% improvement on the 1,251 Mt produced in 2006. China continued to lead world production with an increase of 16% to 487.3 Mt in 2007 compared with 2006. Regional contribution to the world steel production was still dominated by Asia with 59%, followed by the EU with 16%, Americas with 14%.

In line with the increasing world steel production, demand for manganese ore grew by 14.9% to 13.6 Mt (Mn content) in 2007 and this trend persisted into the first quarter of 2008 when demand was 11% higher compared with the same period in 2007. Chinese crude steel production remained the dominant driver for world demand for manganese ore and alloys as steel output total was 124 Mt in the first quarter of 2008, up 7.5% from the year before.

2.2.3. Non-Ferrous Metallic Minerals.

The supply deficit experienced by most non-ferrous commodity markets exerted upward pressure on prices, with the price of cobalt up by 78% to \$29.33/lb compared with 2006 while the delicately poised supply-demand balance pushed up aluminium prices marginally by 2.7% to \$2,640/t.

Furthermore, the supply deficit in lead markets pushed prices up by 100% while the nickel prices were up 53.5% driven by market tightness.

The present higher demand for titanium drove prices up, with Europe's TiO₂ pigment price rising by 2.27% to \$2,200/t while Asia Pacific's price rose by 9.38% to \$2,132/t (Themba 2008:56–57).

However, the slowdown in world economic growth brought about by the United States sub-prime credit crisis, which has since escalated into an international financial crisis and threatens to drag the economy into recession, has resulted in a downward movement to prices in 2008, forcing a downward revision of market forecasts.

2.2.3.1. Aluminium.

2.2.3.1.1. Production.

World refined aluminium output rose by 12% to 38 Mt in 2007 compared with 2006. China was the largest producer with 31.6% of the world total production, followed by Russia (11.1%) and Canada (8.2%), which collectively accounted about for 50% of world production. Russia exported 22.3% of the world total exports, with second and third places occupied by Canada (14.2%) and Australia (9.4%). Production increased in all regions except Africa, where production declined by 5.3% as a result of power supply disruptions (Chili 2008:58–62).

2.2.3.1.2 Consumption.

World refined aluminium consumption increased by 9.4% to 37.2 Mt in 2007 compared with 2006. Consumption was dominated by Asia (19Mt), followed by Europe (9.1 Mt) and America (7.7 Mt). Consumption grew in all the regions except the Americas where it declined by 8.6% owing to the economic slowdown. The largest increase in consumption was experienced in Asia (18%) and Oceania (8.7%).

The demand for refined aluminum is driven by transport (26%), construction (22%) and packaging (22%) as well as the machinery (8%) and electrical industrial sectors (8%). A driver of demand in the transport sector is the shift to light-weighting, which is a response to regulating the environmental impact of fuel economy. Light-weighting involves aluminium replacing steel in the structural components of vehicles.

Table 2.8: World Aluminium Smelter Capacity, Production and Exports 2007

Country	Smelter Capacity(kt)	Production (kt)	Exports (kt)
China	14,000	12,000 (31.6%)	546 (3.1%)
Russia	4,400	4,200 (11.1%)	3,948 (22.3%)
Canada	3,100	3,100 (8.2%)	2,501 (14.2%)
USA	3,700	2,600 (6.8%)	399 (2.3%)
Australia	1,950	1,930 (5.1%)	1,659 (9.4%)
Brazil	1,700	1,498 (3.9%)	823 (4.7%)
Norway	1,190	1,330 (3.5%)	1,610 (9.1%)
India	1,500	1,100 (2.9%)	108 (0.6%)
South Africa	914	914 (2.4%)	625 (3.5%)
Bahrain	830	830 (2.2%)	na
Others	6,220	8,512 (22.4%)	5,452 (30.9%)
Total	42,700	38,000 (100%)	17,671 (100%)

Sources: World Bureau of Metal Statistics (WBMS), 2008, p. 15.

USGS, Mineral Commodity Summaries 2008, p. 23.

2.2.3.2. Copper.

2.2.3.2.1 Production.

World copper mine production amounted to 15.5 Mt in 2007, a 2.8% increase compared with 2006. Production increased in all four major producing countries such as Chile, the USA, Peru and Australia, which collectively accounted for 57% of the total world output. Chile remains the largest producer at 5.6 Mt, followed by the USA (1.2 Mt), Peru (1.2 Mt), Australia (0.87 Mt) and China (0.83 Mt).

World refined copper output rose by 3.7% to 18.0 Mt in 2007. Production increased in all the regions except Europe where it declined by 1.5% to 0.34 Mt. World trade in refined copper declined by 1.6% to 7.35 Mt compared with 2006 (Chili 2008:71-75).

2.2.3.2.2. Consumption.

World refined copper consumption grew by 5.7% to 18.0 Mt in 2007. Regional consumption was dominated by Asia which accounted for 53%, followed by Europe and America at 26% and 18% respectively. China was the leading copper consumer at 4.8% ahead of the USA (2.2 Mt) and

Germany (1.4 Mt).

Refined copper demand was driven by the building sector which accounted for 44% of total consumption, succeeded by the electrical sector at 18% and engineering at 17%. Additionally, light engineering and transport sectors accounted for 9% and 8% respectively. In 2007, the supply and demand balance remained tight as a result of continued supply constraints compounded by industrial disputes and lower copper grades.

Table 2.9: World Reserves, Production and Exports of Copper, 2007

Country	Reserves (Mt)	Production (kt)	Exports (kt)
Chile	360 (38.3%)	5,557 (35.8%)	5,673 (42.1%)
USA	70 (7.4%)	1,222 (7.9%)	613 (4.5%)
Peru	60 (6.4%)	1,190 (7.7%)	1,259 (9.3%)
Australia	43 (4.6%)	870 (5.6%)	676 (5.0%)
China	63 (6.7%)	831 (5.3%)	126 (0.9%)
Indonesia	38 (4.0%)	773 (5.0%)	600 (4.5%)
Russia	30 (3.2%)	770 (5.0%)	277 (2.1%)
Canada	20 (2.1%)	589 (3.8%)	608 (4.5%)
Zambia	35 (3.7%)	544 (3.5%)	491 (3.6%)
Poland	48 (5.1%)	452 (2.9%)	239 (1.8%)
Kazakhstan	20 (2.1%)	424 (2.7%)	356 (2.6%)
South Africa	13 (1.4%)	158 (0.7%)	36 (0.5%)
Others	140 (15.0%)	2,033 (14.2%)	3,029 (18.5%)
Total	940 (100%)	15,541 (100%)	13,476 (100%)

Sources: World Bureau of Metal Statistics (WBMS), 2008, p. 24.

USGS, Mineral Commodity Summaries 2008, p. 55.

2.2.3.3. Lead.

2.2.3.3.1. Production.

World lead mine production grew by 1.5% to 3,591 kt in 2007. China accounted for 37.9% of the bulk of production, followed by Australia at 16.5% and the USA at 12.4%. Asia dominated production accounting for 45%, followed by America and Oceania at 28% and 16% respectively.

World refined lead production increased by 2.7% to 8,189 kt in 2007 compared with 7,969 kt in 2006. China and the USA dominated production, accounting for 33.7% and 16.6% respectively. The contribution to refined lead output by region was dominated by Asia at 48.3%, followed by America

at 25.8% and Europe at 21.3% (Pitso 2008:76–80).

2.2.3.3.2. Consumption.

World lead consumption rose by 1.8% in 2007 to 8,220 kt compared with 2006. The major lead consumers were China (2,543 kt) and USA (1,580 kt) China's lead consumption increased by 13% while the USA declined by 1.9%. The rise in global lead consumption was attributed to the growth in the automobile industry, and the increase in China's lead usage was attributed to the introduction of battery powered bicycles. The lead consumption by region was dominated by Asia which accounted for 49%, followed by America at 25%.

2.2.3.4. Nickel.

2.2.3.4.1. Reserves.

Nickel is mined from sulfide and laterite ores, which contribute equally to the current primary nickel production. The major nickel sulfide deposits are situated in Australia, Canada, Russia, and South Africa and are mined in underground operations. In contrast, laterite deposits are mined from open-pit mines, which are located in Western Australia, New Caledonia, Indonesia, the Philippines, Colombia, Cuba, Venezuela and Brazil. In 2007, world nickel reserves were estimated at 137 Mt with Australia (27 Mt), Cuba (23 Mt) and Canada (15 Mt) collectively accounting for 45% (Ikaneng 2008:81–84).

2.2.3.4.2. Production.

World mine production increased by 8.8% from 1.45 Mt in 2006 to 1.6 Mt in 2007 with increases in output mainly from Asia. Russia was the largest consumer contributing 18% to the total world production, followed by Canada, Indonesia and Australia accounting for 15.8%, 11.6% and 11.1% respectively.

World refined nickel output grew by 6.4% to 1.4 Mt in 2007 compared with 2006. The largest producer was Russia, accounting for 19.3%, followed by China (14.2%), Canada (11.3%) and Japan (11.2%). Asia is the fastest

growing region with an increase of 25% to 383 kt with China producing 205 kt, mainly due to the significant contribution by Chinese nickel pig-iron production estimated at 85 kt.

2.2.3.4.3. Consumption.

Over 60% of all nickel produced is consumed in stainless steel production. World stainless steel production declined by 2.6% to 28.5 Mt in 2007 as a result of weaker demand. Consequently, global nickel consumption was 7% lower at 1.3 Mt than in 2006 as some stainless steel producers switched to cheaper alternatives.

2.2.3.5. Zinc.

2.2.3.5.1. Production.

The world mine output of zinc increased by 6.1% to 11,105 kt in 2007. China dominated production at 3,110 kt, followed by Peru (1,444 kt), Australia (1,398 kt), the USA (787 kt) and Canada (619 kt). World refined zinc production increased by 5.8% to 11,302 kt in 2007. Production was dominated by China (3,714 kt), followed by Canada (802 kt), South Korea (697 kt), Japan (598 kt) and Australia (502 kt) (Pitso 2008:88-92).

2.2.3.5.2. Consumption.

Global consumption of zinc metal in 2007 increased by 2.7% to 11 Mt. The major consumers were China (3,588 kt), followed by USA (1,037 kt), Japan (588 kt), Germany (534 kt) and South Korea (517 kt). Although the world economy is entering a major downturn, The International Lead and Zinc Study Group (ILZSG) forecasted that global zinc demand will still increase primarily due to continued growth in Asia.

2.2.4. Precious Minerals.

An all time quarterly record of \$32 billion demand for gold was recorded for the third quarter of 2008 as investors sought refuge from the global financial meltdown. Investment demand for gold due to its safe haven status

is expected to continue as a result of the uncertainty surrounding the global economy (Conradie 2008:19–20).

Although the USA currently accounts for about 50% of the global jewellery sales, increased demand from India, China and the Middle East is expected to offset decreased demands from the USA in the foreseeable future. The total world supply of diamonds was expected to decline in 2008 and beyond, partly due to a lack of major new mines, Furthermore, many of the mines currently in operation are beyond their production peaks and therefore expect lower production in the years ahead.

2.2.4.1. Diamond.

2.2.4.1.1. Production.

According to the Kimberley Process Rough Diamond Statistics, world diamond mine production declined by 4.4% to 168 million carats (Mct) in 2007. The value of mine production decreased by 0.6% to \$12.1 billion in 2007 compared with 2006. The decrease in global production volume was attributed to a decrease in production from Australia, Botswana and China. The De Beers Group, with mines in Botswana, South Africa, Namibia and Tanzania, contributed 51 Mct (29%) to world production by mass and an estimated \$3.35 billion (41%) by value (Ndou 2008:21–26).

Table 2.10: World Rough Diamond Production, 2007 Unit: 1,000 carats

country	Russia	Botswana	DRC	Australia	Canada	RSA	Angola	Others	Total
production	38,291	33,638	28,452	18,539	17,008	15,211	9,702	7,318	168,199

Source: Kimberly Process Rough Diamond Statistics 2007.

Note: DRC: Democratic Republic of Congo/ RSA: South Africa

2.2.4.1.2. Demand.

The USA is the largest consumer of polished diamonds, accounting for roughly 50% of the world retail diamonds sales, while India and China are the two fastest growing diamond markets. India processes about 80% by volume of the world's rough diamonds and its diamond consumption has increased by 27% annually for the past five years. The USA imported 28% of the total gems and jewellery exports from India in 2007. The recent

slowdown in the US economy has had a negative effect on India's diamond industry.

2.2.4.2. Gold.

2.2.4.2.1. Production.

The total world gold supply decreased by 1.6% to 3,895t in 2007, mainly due to a sharp drop in the supply of scrap, despite a rise in official sector sales. Mine production declined by 0.2% to 2,459t, while net official sector sales increased by 30% to 481t, and scrap supply dropped by 15% to 956t (Conradie 2008:27–32).

2.2.4.2.2. Demand.

The Total world demand fell by 1.6% to 3,895t in 2007, mainly as a result of the 63.1% drop in implied net investment to 141t, despite a 5.1% rise in jewellery fabrication to 2,401t. Total fabrication demand increased by 4.8% to 3,072t, while producer de-hedging rose by 8.8%, from 410t in 2006 to 446t in 2007. There was also a 0.5% increase in bar hoarding to 236t in 2007.

Table 2.11: World Gold Reserves and Production, 2007. Unit: t

Country	Reserves	Production
China	4,100 (4.6%)	280.5 (11.4%)
South Africa	36,000 (40.1%)	252.6 (10.3%)
Australia	6,000 (6.7%)	246.3 (10.0%)
USA	3,700 (4.1%)	239.5 (9.7%)
Peru	4,199 (4.6%)	169.6 (6.9%)
Russia	3,500 (3.9%)	169.2 (6.9%)
Indonesia	2,800 (3.1%)	146.7 (6.0%)
Canada	3,500 (3.9%)	101.2 (4.1%)
Others	26,000 (29.0%)	853.0 (34.7%)
Total	89,700 (100%)	2,458.6 (100%)

Sources: USGS, Mineral Commodity Summaries 2008 pp.72–73.

2.2.4.3. Platinum Group Metals (PGMs).

The platinum group metals (PGMs) constitute a family of six chemically similar elements such as platinum, palladium, rhodium, ruthenium, iridium and osmium (Conradie 2008:33–38).

2.2.4.3.1. Production.

Global supplies of platinum, palladium and rhodium rose by 1.8% to 497.5t in 2007, due to an increased supply from Russia, despite lower sales from South Africa and North America. Total supplies of platinum fell by 4.4% to 208.1 in 2007, while palladium and rhodium supplies increased by 7% to 264.5t and 4.7% to 25t respectively.

2.2.4.3.2. Demand.

World demand of platinum, palladium and rhodium increased by 5.8% to 457.9t, caused primarily by an 8.6% increase in demand for platinum in 2007. Platinum demand improved by 8.6% to reach 218.7t, driven by strong sales to the auto catalyst industry and for investment purposes.

2.2.4.4. Silver.

2.2.4.4.1. Production.

The total silver supply, which includes mine production, government sales, and scrap recovery, declined by 2% to 29,115t in 2007. Scrap volumes, which contributed about 19% to silver, declined by 3% to 5,648t (Ndou 2008:39–41).

2.2.4.4.2. Demand.

Silver demand was dominated by industrial and domestic applications, collectively accounting for 51% of total consumption, followed by the jewellery and photography sectors which accounted for 27% and 17% respectively in 2007. Global silver demand for total fabrication increased 1% to 26,239t, while demand from the industrial sector increased 7% to 14,160t. Demand from the electrical and electronic sector increased by 6% to 6,220t.

2.2.5. Industrial Minerals.

Industrial minerals are defined as minerals which are mined and processed for the value of their non-metallic properties. They can be generally defined as being non-metallic and non-fuel minerals. They are found in a wide range of industrial and consumer products and play key roles in many complex and sophisticated manufacturing and processing applications for agricultural, building and construction sector throughout the world (Naidoo et al. 2008:123-131).

2.2.5.1. Dimension Stone.

2.2.5.1.1. Production.

The total world stone output was estimated to have been more than 210 Mt in 2007. China was the largest producer contributing 23% to world production, followed by India at 18% and Italy at 11% (Twala 2008:137-139).

2.2.5.1.2. Demand.

Dimension stone is used mainly in the construction sector. Major end markets are floors and paving (35%), special works and memorial art (18%). Global consumption amounted to 1,130 million square meters (thickness 2 cm) in 2007. The USA remains the largest dimension stone market in the world, exhibiting steady growth over the last decade.

2.2.5.1.3. Trade.

The total world exports were estimated to be 32.5 Mt in 2007. China continued to dominate international markets accounting for 55% of total world exports, followed by India (14%), Brazil (9%) and Italy (7%). Italy continued to be the dominant supplier of technology for cutting and polishing machinery.

2.2.5.2. Fluorspar.

2.2.5.2.1. Production.

The total world production decreased marginally 0.7% to 5.31 Mt in 2007 compared with 2006. Production increases in China, Mongolia, South Africa and Russia were offset by decreases in Mexico, Spain, Morocco and Kenya. About 80% of global fluorspar production comes from China (51.8%), Mexico (16.9%), Mongolia (7.5%) and South Africa (5.6%) (Modiselle 2008:140–143).

2.2.5.2.2. Demand.

China accounted for 32% of the world fluorspar demand, followed by Western Europe at 19%, USA and Canada at 14%, Russia at 9%, Mexico at 8% and Japan at 6%. Approximately 47% of the fluorspar production was consumed in the production of hydrofluoric acid, the starting point of the manufacture of fluorocarbons, used mainly in refrigeration and air conditioning. The next significant markets were for steel production at 42% and aluminium production at 7%.

2.2.5.2.3. Trade.

World trade of fluorspar is estimated to be 2 Mt. The major exporters are China (35%), South Africa (15%), Mongolia (25%), and Mexico (20%), accounting for over 90% of the world exports. The major importers are USA (32%), Japan (23%) and Germany (15%), which collectively account for 70% of the total world imports. The supply and demand during 2007 continued to be extremely tight, because China's continued reduction of exports created shortages in Europe and North America.

2.2.5.3. Sulphur.

2.2.5.3.1. Production.

According to the International Fertilizer Industry Association (IFA), world production of elemental sulphur increased by 1.6% to 48.6 Mt in 2007 compared with 2006. The largest sulphur producers are concentrated in North America and Eastern Europe. The world sulphur production leaders were Canada and USA which produced 14% and 13% of the total world

production respectively, closely followed by China (13%), Japan (5%) and Saudi Arabia (5%). China is the world's leading producer of pyrite (FeS₂), which is also used to produce sulphuric acid, followed by Russia, Spain, South Africa and Finland (Nevondo 2008:156–159).

2.2.5.3.2. Demand.

The world sulphur consumption was estimated to be 49.6 Mt in 2007, an increase of 2% compared with 2006. The biggest consumers were China and India. About 90% of sulphur production is consumed in the form of sulphuric acid. Agricultural chemicals, primarily fertilizers, account for 60% of sulphur demand, while petroleum refining and metal mining account for 25% and 3% respectively. Other uses, representing 12% of the demand, are used in other forms of manufacturing. The global supply and demand balance of elemental sulphur was tight in 2007, due to growth in demand which had exceeded supply. This has exacerbated market pressures and resulted in higher import levels, especially in China.

2.2.5.3.3. Trade.

Major exporters of sulphur are Canada, Russia, Germany and Saudi Arabia, while major importers are China, Morocco and the USA. Industrial sulphur use has greatly increased in China, further supporting high demand. The current shortage in China has been exacerbated by a series of closures of sulphuric acid production facilities over the past decade owing to poor market conditions and serious environmental impacts.

2.2.5.4. Limestone.

Over 80% of total world limestone production is used in the manufacturing of cement. The construction sector, comprising of residential, non-residential and civil construction, has been one of the economic growth drivers in the cement demand over the past decade, which was in turn driven by the robust performance of the economy all over the world. In particular, the continuing development of social overhead infrastructures and the improvement of residential houses and non-residential buildings has maintained the upward momentum in the increased limestone production.

The major cement suppliers were China, USA, South Korea, Japan, Brazil, Germany and Russia (Naidoo et al. 2008:144-147).

2.3. World Trends in Mining Policy.

Today, mankind faces three major tasks for its survival: curbing population growth, protecting the environment and carefully managing scarce non-renewable resources. Solving such problems is directly related to developed and underdeveloped economies.

On the basis of these tasks, we should foresee the rise of a new ecological social market economy which will provide a framework for achieving sustainable development in accordance with the will of God.

However, those living in the Third World are not only fighting for their own survival, but also battling with the growing disparity between the North and their own poorer South. The wealthier Northern countries face new pressures as they depend on the energy and mineral resources of the poorer South, while the South wants to have a say in the management of its own resources. While the divide increases, the crisis intensifies.

2.3.1. Growing Inequality.

The inequality in wealth is staggering: 'The average income in the richest 20 countries is 37 times the average in the poorest countries, a gap that has doubled in the past 40 years (World Bank 2001:3). There is a simultaneous and linked environmental crisis. Few studies doubt that the giant transnational corporational companies (TNCs) of advanced countries have played their part in creating both strands of the globalization of poverty and the environmental crisis, in particular because of their neo-liberalist embrace of free market economic theories.

Through their production, trade and investment activities, they are integrating countries into a global market. Through their control over energy and mineral resources, access to markets, and development of new technologies, TNCs have the potential to generate enormous benefits for poverty reduction and environmental protection. However, that potential has been totally lost by their corporate practices, which maximize short term profits, undermine the capacity of poor countries and result in the serious

degradation of the environment.

The TNCs and their 250,000 foreign affiliates account for most of the world's industrial capacity, technological knowledge and international financial transactions. They mine, refine and distribute most of the world's oil, gas, diesel and jet fuel. They have developed most of the world's energy and mineral resources from the ground.

They manufacture and sell most of the world's automobiles, airplanes, communication satellites, computers, home electronics, chemicals, medicines and biotechnology products. They harvest much of the world's wood and make most of its paper. They grow many of the world's agricultural crops, while processing and distributing much of its food. All told, the transnationals hold 90% of all technology and product patents worldwide and are involved in 70% of world trade (UNCTAD 1995;xix-xx).

Indeed, TNCs have no soul to dam and no body to kick which leaves them as faceless and convenient repositories for the guilt of the societies which invented them, profit from them and tolerate their operations.

"The world today behaves like a madhouse. The worst of it is the values we had more or less defined, taught, learned, are thought of as archaic as well as ridiculous..... It seems that it's more important to reach Mars than prevent 13 million Africans dying of hunger..... Priorities need to be redefined" (Saramago 2002:3).

2.3.2. Advanced Countries.

There is no doubt that there has been a significant export of dirty industries and significant pollution from the activities of mining and manufacturing operations masterminded by TNCs of advanced countries across the world.

One of the keys to understanding the global problem of waste and pollution is that much of its incidence in the developing world is due to developed nations' illegal shipment of their own waste to developing countries.

The trucks entering Eastern Europe from Germany export hundreds of tons of waste that Westerners find too expensive or inconvenient to dispose of themselves. The pressure is mostly financial. Under the USA and European environmental laws today, the cost of disposing of hazardous

industrial and mining waste can be as high as several thousand dollars per ton. Shipping such materials abroad is often much cheaper (Dine 2005:12).

Japan has reduced its aluminium smelting capacity from 1.2 million tons to 149,000 tons and now imports 90% of its aluminium. What this involves in human terms is suggested by a case study of the Philippine Associated Smelting and Refining Corporation (PASAR). PASAR operates a Japanese-financed and constructed copper smelting plant in the Philippine province of Leyte to produce high grade copper cathodes for shipment to Japan.

The plant occupies 400 acres of land expropriated by the Philippine Government from local residents at give-away prices. Gas and waste water emissions from the plant contain high concentrations of boron, arsenic, heavy metals, and sulfur compounds that have contaminated local water supplies, reduced fishing and ice yields, damaged the forests, and increased the occurrence of upper respiratory diseases among local residents. Local people whose homes, livelihoods and health have been sacrificed to PASAR are now largely dependent on the occasional part-time or contractual employment that they are offered to do the plant's most dangerous and dirtiest jobs (Dine 2005:12).

Karliner chronicles the migration of the chlorine industry from developed countries to Brazil, Mexico, Saudi Arabia, Egypt, Thailand, India, Taiwan and China, and similar strategies being followed by the nuclear power industry, the automobile industry and tobacco marketing. (Karliner 2005:81-82; Dine 2005:12).

The citizens of the wealthy industrialized countries are responsible for the majority of the earth's environmental degradation to date. There is no doubt that citizens of the wealthier nations wreak more devastation on the earth on a per capital basis. Paul and Anne Ehrlich offer the following comparisons in the Population Explosion (Paul et al. 1990:134):

A baby born in the United States represents twice the destructive impact on earth's ecosystems and the services they provide as one born in Sweden, 3 times one born in Italy, 13 times one born in Brazil, 35 times one in India, 140 times one in Bangladesh or Kenya, and 280 times one in Chad, Rwanda, Haiti or Nepal.

2.3.3. Developing Countries.

Despite of the absence of detailed environmental data on the development of energy and mineral resources, most developing countries try to promote their domestic resources to get their foreign exchange earnings in accordance with their loose environmental legal system. And most of their energy and mineral production are supplied to meet the demand of advanced countries .

So, it has been argued that one of the key threats to environmental management in developing countries is the lack of institutional capacity to undertake the complex environmental task. In this regard, it has been noted that many third world governments do not have the organizational machinery to enforce environmental regulations, or in some cases the political will to oppose powerful vested interests.

It is time that third world government should pay close attention to the environmental impact from mining activities and adopt new legislation for a stronger control of environmental problems. The major environmental problems associated with the mining industry are (1) Rehabilitation of old mine sites; (2) Acid mine drainage; (3) Tailings disposal; (4) Disposal of hazardous waste; (5) Pollution of water, air, and surrounding land areas and so forth.

Chapter III: Environmental Impacts from Mining Activities and Nuclear Plants.

Can you remember a day when you opened your morning newspaper without finding a disturbing story about some environmental crisis that is either here already or lurks around the corner? On one day the story may be about global warming; on the next it may be about overpopulation or air pollution or resource depletion or species extinction or sea-level rise or nuclear wastes or toxic substances in our food and water.

The uncontrolled exploitation of natural resources for the last two centuries have played havoc on our earth. The phenomenal advance of science and technology, and the frightening increase in population, have placed enormous pressure on the earth's resources. Depletion, desertification and deforestation, climatic changes, droughts and floods and other natural problems threaten life on earth. And with pollution on a hazardous scale these problems are being compounded to even more alarming proportions.

Human civilization has been developed with mineral and energy resources. Mineral and energy resources such as metal, petroleum and coal are the most important materials for the industrial development of a country. It is true that the stable and continuous supply of resources is the major factor for economic growth of a country. However, environmental damages such as acid mine drainage (AMD), mine tailing sweeping, ground subsidence, and forest ruin are inevitable in the development of a mine.

These mining hazards are considered as causes of natural damages such as ground collapse, contaminated water outflow, heavy metal contamination of soil, dust scattering, noise and vibration. These damages are caused by the process of mine development such as exploration, excavation, grinding, transportation and concentration. The mining hazards are characterized as contamination, continuation, accumulation and diffusion, so they may happen long after the mine development has finished, and result in environmental problems, safety concerns and a civil appeal. The crisis from mining activities has resulted in dire consequences for everyone.

With such grave concerns, we are challenged by the urgent task of coming to grips with root issues. Dealing with superficial symptoms will not be sufficient. Neither can we look only at local situations, as environmental

concerns are interlinked and have assumed global dimensions, penetrating total human life. And therefore, whether philosophically, theologically, economically, socially, politically or in any other way possible, we will need to collectively handle these mounting problems with determination and dedication.

Getting to root issues will turn out to be an absorbing theological discussion. Restoring, even reinterpreting biblical doctrines will help the Church to face the challenge as God's people need to be doing.

3.1. Environmental Impact from Mining Activities.

It is now well understood that mining activities such as exploration, development, production, processing, refining and transportation have surely generated environmental pollutions by altering land-forms and ecosystems, disrupting the hydrological cycle and discharging waste into air and water.

Mining has left a lasting mark on people and landscapes around the world. Each year mining activities take more materials out of the earth than the world's rivers move. A single mine in Papua New Guinea, the Ok Tedi, generates an astounding 200,000 tons of waste a day on average which is more than the waste of all the cities in Japan, Australia, and Canada combined.

Mines have uprooted tens of thousands of people from their homelands and have exposed many more to toxic chemicals and pollution. And mining is the world's most deadly occupation. 40 mine workers are killed on the job each day on average, and many more are injured (Sampat 2003:111-129).

If an accountant were to weigh the costs and benefits of extracting minerals from the earth and then processing and refining them, the balance sheet would reveal that the mining industry consumes close to 10% of the world energy, spews almost half of all toxic emissions from all the industries in some countries, and threatens nearly 40% of the world's undeveloped tracts of forest.

The environmental impact from mining ore is affected by its percentage of metal content, or grade. The more accessible and higher grade ores are usually exploited first. As they are depleted, it takes more money, energy, water, and other materials to exploit lower grade ores. This in turn increases land disruption, mining waste, and pollution.

Although underground mining generally has less dramatic environmental impact than small-scale and open-pit mining, it carries the potential for a collapse of the underground shaft. In addition, the movement of large amounts of waste rock and vegetation can lead to the same pollution problems as an industrial mine, such as acid mine drainage which is discussed further in this section.

Table 3.1: Environmental Impact from Mining Activities.

Activity	Environmental Impacts
Water Discharge	<ul style="list-style-type: none"> • Acid mine drainage. • Heavy metals overloading.
Dewatering	<ul style="list-style-type: none"> • Ecological impacts. • Sediment runoff. • Effluent contamination. • Impacts upon water resources.
Smelting	<ul style="list-style-type: none"> • Air pollution. • Acidic deposition. • Heavy metals contamination.
Transportation	<ul style="list-style-type: none"> • Noise pollution. • Dust and sediment. • Gaseous emissions. • Oil and fuel spills. • Soil contamination.
Mineral Extraction	<ul style="list-style-type: none"> • Erosion. • Landform changes. • Alteration of water tables. • Dust. • Vegetation and habitat destruction. • Aesthetics.

Source: Krivtsov, A. I., *Geoenvironmental Problems of Mineral Resources Development in Geology and Ecosystems*, Springer Inc., Ridgeway, UK, 2006, P. 74.

However, there have been relatively few studies which attempt to identify and quantify the environmental impact from mining activities. So, it is difficult to determine the scale and cost of environmental problems associated with the mining industry at the present.

Currently, most of the harmful environmental costs of mining and processing energy and minerals are not included in the price of the resulting consumer products. Instead, these costs are passed on to society

and future generations, which gives mining companies and manufacturers little incentive to reduce waste and pollution. We should call for phasing these external costs into the prices of goods made from energy and mineral resources through full-cost pricing. This makes it an effective preventer to curb mining-related pollution and fulfill an intra-industrial equity and inter-generation equity.

3.1.1. Pollution from Extracting Mineral Resources.

3.1.1.1. Air Pollution.

The environmental impact of mines extends beyond the threats to habitat. The mining industry is one of the planet's leading polluters. Smelting metals contributes some 19 million tons of acid-rain-causing sulfur dioxide to the atmosphere annually, that is about 13% of global emissions. In the USA, processing minerals contributes almost half of all reported toxic emissions from industry, sending 1.5 million tons of pollutants into the air and water each year.

3.1.1.2. Water Pollution.

The amount of waste generated by mines is staggering every year. Canadian mines generate more than a billion tons which are 60 times larger than the amount of trash Canadian cities discard. To transport this waste, some mines now use a kind of giant dump truck that can move 360 tons of material of which each behemoth tire weighs 4.5 tons and stands almost 5 meters high.

In 2000, mines around the world extracted some 900 million tons of metal, and left behind some 6 billion tons of waste ore. This figure does not include the overburden earth moved to access the ores. Much of this waste came from the production of just iron ore, copper, and gold.

For every usable ton of copper, 110 tons of waste rock and ore are discarded, and another 200 tons of overburden earth is moved. For gold, the ratio is more staggering: about 300,000 tons of waste is generated for every ton of market gold, which translates into roughly 3 tons of waste per gold wedding ring. Much of this waste is contaminated with cyanide and other chemicals used to separate the metal from ore.

The amount of waste generated by mines has increased as ore grades have declined for a number of metals. As the more easily accessible and rich veins of metal have been dug out, miners have turned to less abundant sources through using more energy and chemicals to extract the same amount of metal while generating more waste. In 1906, copper ores in the USA yielded on average 2.5 grams of metal for every 100 grams of ore. In 2000, U.S. miners extracted copper from ore with an average grade of 0.44 grams of metal per 100 grams of ore, meaning that five times more waste is now generated per gram of marketable metal.

3.1.1.3. Landscape Transformation.

In the last century, lower energy costs and the development of new mining technologies have made it possible to transform landscapes completely. Earth-moving equipment is used to literally move mountains in order to get to a mineral deposit. These technological advancements have led to two trends: the extraction of minerals from lower-grade ores and the development of open-pit mines instead of underground ones.

Today, about two thirds of metals are extracted from open-pit mines. These open-pit mines use more diesel fuel and generate a lot more waste than the subterranean kind. On average, open-pit mines produce 8-10 times more waste than underground mines do.

3.1.1.4. Deforestation.

By one estimate, mining projects threaten nearly 40% of the world's large, untouched forests. These include a titanium mine being developed in a Madagascar forest that is inhabited by rare lemurs, birds, and indigenous plant species; gold exploration in Peru's Andean cloud forests; and columbite-tantalite mining in the Okapi Reserve in the Democratic Republic of Congo (DRC), home to the endangered lowland gorilla. Also in the works is a nickel and cobalt mine on Gag Island, off the coast of Papua New Guinea. The reefs off the island are inhabited by an astounding variety of coral, fish, and mollusks.

3.1.1.5. Biological Threat.

The Lorentz National Park in the Indonesian province of West Papua, which is the western half of the island of New Guinea, is one of the world's most biologically diverse and least explored places. It is the largest protected area of 2.5 million hectares in Southeast Asia. In the span of about 125 kilometers, the park covers a dramatic range of ecosystems. It is a naturalist's dream come true.

But the area has more than just biological wealth. Lorentz lies next to what is considered the world's richest rode of copper and gold ore, valued at about \$50 billion. The U.S. mining company, Freeport McMoRan first dug open the deposit in 1973, and has expanded its foothold ever since. The company now dumps 70 million tons of waste each year into the nearby Ajkwa River, and by the time it closes in 30 years, it will have excavated a 230 km² hole in the forest that is visible from outer space. The region's population has increased from 6,000 to 70,000 in the last 30 years and the area now boasts an 18 hole golf course for mining executives.

Much new mining development is taking place in or near ecologically fragile regions around the world, which are including world heritage sites such as the Bystrinski National Reserve in Russia and the Sierra Imataca Reserve in Venezuela.

3.1.1.6. Remains of Toxic Chemicals.

Chemical innovations have also contributed to the dual trends in low grading and surface mines. In the late 1800s, chemists in the USA patented cyanide heap-leaching as a method of separating gold from ore. Today, gold mines everywhere from South Africa to South Korea use this technique. Cyanide is mixed with water and is then poured or sprayed over heaps of crushed ore in order to dissolve bits of gold. Once the usable gold is removed, the stacks of crushed ore known as tailings are treated to reduce cyanide concentrations, although the chemical is never entirely diluted.

When gold prices shot up in the early 1980s, this method gained new popularity as miners rushed to extract gold from deposits containing even tiny amounts of the metal. Between 1983 and 1999, USA's consumption of crystalline sodium cyanide reached more than tripled to reach 130 million kilograms, about 90 % of which was used in gold mining. A teaspoon containing a 2 percent cyanide solution can kill an adult.

Where do these chemical-laced wastes end up? They are piled into

heaps, walled into constructed holding areas called dams, and in some parts of the world simply dumped into rivers, streams, or oceans. Tailing dams are typically built by stacking piles of waste above ground or in freshwater ponds. Today three mines in the world – all of them on the Pacific island of New Guinea – officially uses rivers to dump tailings. Mine waste elsewhere have spilled out of waste sites and poisoned drinking water supplies and aquatic habitat. In the US West, mining has contaminated an estimated 26,000 kilometers of streams and rivers.

3.1.1.7. Emission of Carbon Dioxide (CO₂).

A sizable share of the energy used in extracting and refining minerals comes from fossil fuels such as oil and coal, whose burning emits carbon dioxide which is implicated in global climate change. In the United States, about 50% of the electricity used to smelt aluminium comes from coal-burning power plants, for instance. But mining's role in global climate change does not end with its fossil fuel use. Producing cement from limestone releases an additional 5% of annual carbon emission to the atmosphere each year. The aluminum smelting process releases about 2 tons of carbon in order to produce a ton of primary aluminium.

3.1.1.8 Emission of Perfluoro-carbons (PFCs).

The aluminium smelting process releases about 3 tons of perfluoro-carbons for each ton of primary aluminium produced, which are very rare gases not emitted through any other industrial activity. PFCs are extremely potent greenhouse gases: a ton of PFCs is equivalent to the greenhouse potential of 6,500–9,200 tons of carbon.

In 1997, PFC emissions from aluminium smelters in Australia, Canada, France, Germany, England, and USA were equivalent to about 19 million tons of carbon, although at least this is 50% less than their emissions in 1990, thanks to improvements in smelter efficiency.

3.1.1.9. Energy Consumption.

Extracting, processing, and refining minerals is extremely energy-intensive. Between 7 to 10% of all oil, gas, coal, and hydro-power energy

produced globally each year is used to extract and process minerals. Mining and processing of just the three minerals of aluminium, copper and steel consumes an astounding 7.2% of world energy. This is more than the entire Latin American region uses each year. This makes it a major contributor of greenhouse gases such as carbon dioxide (CO₂).

3.1.1.10. Environmental Incidents.

There is no reliable way to dispose of billions of tons of materials discreetly. Catastrophic spills of mine wastes in recent years have resulted in enormous fish kills, soil and water pollution, and damage to human health.

In 2000, for instance, a tailing dam spilt open at the Baia Mare mine in Rumania. This accident sent some 100,000 tons of wastewater and 20,000 tons of sludge contaminated with cyanide, copper, and heavy metals into the Tisza River, and eventually into the Danube – destroying 1,240 tons of fish and polluting the drinking water supplies of 2.5 million people.

That same year major accidents took place at mines in Gallivare in Sweden, Guangxi in China, Cajamarca in Peru, Tolukuma in Papua New Guinea, Sichuan in China, and Borsa in Rumania. The accident at a copper mine in Guangxi killed 29 people and destroyed more than 100 homes.

Of the hundreds of mining-related environmental incidents since 1975, about 75% have involved tailing dam ruptures. According to the United Nations Environment Programme (UNEP), there are 3,500 tailing storage facilities in active use around the world and several thousand others that are now closed, all of which pose potential risks.

3.1.1.11. Life Alteration of Local People.

Mines have not only transformed landscapes, but have also dramatically altered the lives of the local people who live near mineral deposits. Hundreds of thousands of people have been uprooted in order to make way for mine projects. Many others have had to forsake traditional occupations and endure the effects of living beside a mine that poisons their water supplies or near a smelter that pollutes the air they breathe.

At the same time, mines have brought jobs, roads, and electricity to poor regions. Men and women with little other choice for work and communities living in extreme poverty have had to make the Faustian tradeoff—typically

not out of their own choice: incur increased risks of lung disease and other health problems in exchange for jobs and income.

Each year 14,000 mine workers are killed at accidents on the job, and many more are exposed to chemicals or particulates that increase their risks of respiratory disorders and certain kinds of cancers. There have been significant improvements in mine safety in the last few decades, but mining is still the world's most hazardous occupation. According to the International Labour Organization (ILO), the sector employs less than 1% of all workers but is responsible for 5% of all worker deaths on the job.

Prostitution and drug use are serious problems at mining camps where migrant workers live, which has led to a high incidence of sexually transmitted diseases, including HIV/AIDS. In South Africa, about 30% of workers at gold mines are HIV positive.

3.1.2. Pollution from Extracting Fossil Fuels.

3.1.2.1. Pollution from Coal.

3.1.2.1.1. Damage from Mining Accidents.

Though safety standards have greatly improved, coal mining has been one of the most dangerous and environmentally damaging of all the major industries. Many thousands of miners have been killed or injured in mining accidents in countries such as Turkey, China and India, and large numbers have had their health impaired by breathing coal dust and working in dark, wet and cramped conditions.

3.1.2.1.2. Emission of Carbon and Sulphur Dioxides and Nitrous Oxides.

Coal's main disadvantage is the pollution it causes in its mining, transportation and use. Sulphur and ash content are especially high in soft coals, but all coals give off the fossil fuel problem emissions such as sulphur dioxide (the cause of acid rain), nitrous oxides (greenhouse gases which contribute to ozone smog), particulates (a cause of respiratory diseases) and carbon dioxide (the cause of global warming).

3.1.2.1.3. Acid Mine Drainage.

Acid mine drainage refers to water with high concentrations of sulfuric acid draining out of surface or subsurface coal mines. The sulfur-laden water originates from rainwater percolating through numerous fractures in crushed sulfur-rich coal in the mines. Prior to the 1950s, coal mining was conducted with little regard for its environmental impact. Today, the greatest problem with acid mine drainage generally stems from abandoned deep mines. Effluent from abandoned mine sites continues to be the leading water quality problem. However, China, India and other developing countries have still based their energy future on coal, while seeking to make use of affordable new technologies for reducing the environmental impact.

3.1.2.1.4. Damage from Metal Exposures.

The increased use of coal in the future will also increase metal exposures because coal ash contains many toxic metals and can be breathed deeply into the lungs. For countries such as China and India, which continue to rely on high-ash coal as a primary energy source, the health implications are ominous. Coal can be washed to reduce its ash content but this itself consumes energy and creates a waste water problem (Silver and Rothman 1995:7).

Coal contains a small amount of radioactive uranium, barium and thorium, around or slightly more than the average concentration of those elements in the Earth's crust. They become more concentrated in the fly ash because they do not burn well (Ojovan and Lee 2005:315).

However, the radioactivity of fly ash is still very low. It is about the same as black shale and is less than phosphate rocks, but is more of a concern because a small amount of the fly ash ends up in the atmosphere where it can be inhaled (USGS 1997:57-69).

3.1.2.2. Pollution from Oil.

Oil is a natural product which quickly breaks down in sea water. Chemical dispersants may do more harm than the oil itself, though heavy spillages close to shorelines can be disastrous for local sea birds and other forms of marine life. Of even greater concern is the build-up of atmospheric carbon dioxide caused by burning oil and other fossil fuels, and the pollution

caused by sulphur dioxide, nitrous oxides and volatile organic compounds (VOCs).

Residues from the oil and gas industry often contain radium and its daughters. The sulphate scale from an oil well can be very radium rich, while the water, oil and gas from a well often contains radon. The radon decays to form solid radioisotopes which form coatings on the inside of pipe-work. In an oil processing plant the area of the plant where propane is processed is often one of the more contaminated areas of the plant as radon has a similar boiling point as propane.

3.1.2.3. Pollution from Natural Gas.

Though natural gas produces less pollution and carbon dioxide than oil and coal, it also gives off the fossil fuel problem emissions such as sulphur dioxide, nitrous oxides and carbon dioxide. Methane is 21 times more powerful than carbon dioxide as a greenhouse gas, so pipeline leaks have to be carefully monitored.

3.1.2.4. Oil Leakage.

Oil spills, from crude to used forms, not only in infamous cases like the Exxon Valdez in Prince William Sound, Alaska in 1989 and acts of war in the Persian Gulf in 2001, but also in the little collision between an oil tanker and a barge in the West Sea in South Korea in 2007, can be disastrous for marine life and ecological system.

For example, a total of 38,000 tonnes of crude oil spewed out into the pristine subarctic waters of the estuary with devastating results by the accident of the supertanker Exxon Valdez running around on reefs in Prince William Sound, Alaska in March 1989. The oil slick lost from the Exxon Valdez had spread 750 km down the Alaskan coastline from Prince William Sound into the Gulf of Alaska through Montague Strait. which was the worst incident in the United States waters.

3.1.2.5. Acid Rain.

Acid rain originates from sulfur dioxides and nitrous oxides emitted by motor vehicles, smelters, and especially electrical utility plants using high

sulfur coal. Acid rain kills aquatic life in lakes, streams, and bays. It also destroys forests and other vegetation and thereby deprives wild animals of their habitats. It damages crops and corrodes buildings and historical monuments.

3.1.2.6. Discharge of Radioactive Wastes.

Radioactive wastes are waste types containing radioactive-chemical elements that do not have a practical purpose. They are sometimes the products of nuclear processes such as nuclear fission. However, other industries not directly connected to the nuclear industry can produce large quantities of radioactive waste. For instance, over the past 20 years it is estimated that just the oil-producing endeavors of the US have accumulated 8 million tons of radioactive waste (Silver and Rothman 1995:7-8).

3.1.3. Damage from Extracting Heavy Metals.

Since the Industrial Revolution, the production of heavy metals such as lead, copper, and zinc has increased exponentially. Between 1850 and 1990, production of these three metals increased nearly 10 times, with emissions rising in tandem (Nriagu 1996:223).

Heavy metals have been used in a variety of ways for at least 2 millennia. For example, lead has been used in plumbing, and lead arsenate has been used to control insects in apple orchards. The Romans added lead to wine to improve its taste, and mercury was used as a salve to alleviate teething pain in infants. Lead is still widely used as an additive in gasoline (Eaton and Robertson 1994:116-117).

3.1.3.1. Toxicity of Heavy Metals.

The toxicity of heavy metals has been documented throughout history: Greek and Roman physicians diagnosed symptoms of acute lead poisoning long before toxicology became a science. Today, much more is known about the health effects of heavy metals. Exposure to heavy metals has been linked with developmental retardation, various cancers, kidney damage, and even death in some instances because of exposure to very high concentrations.

Exposure to high levels of mercury, gold and lead has also been associated with the development of autoimmunity, in which the immune system starts to attack its own cells, mistaking them for foreign invaders (Glover-Kerkvliet 1995:236-237).

Autoimmunity can lead to the development of diseases of the joints and kidneys, such as rheumatoid arthritis, or diseases of the circulatory or central nervous systems (Glover-Kerkvliet 1995:237). Despite abundant evidence of these deleterious health effects, exposure to heavy metals continues and may increase in the absence of concerted policy actions.

3.1.3.2. Toxic Emissions from Heavy Metals

Once emitted, metals can reside in the environment for hundreds of years or more. Evidence of human exploitation of heavy metals has been found in the ice cores in Greenland and sea water in the Antarctic. The lead content of ice layers deposited annually in Greenland show a steady rise that parallels the mining renaissance in Europe, reaching values 100 times the natural background level in the mid-1990s (Nriagu 1996:223).

Mining of heavy metals is itself a major route of exposure. Despite some noted improvements in worker safety and cleaner production, mining remains one of the most hazardous and environmentally damaging industries. In Bolivia, toxic sludge from a zinc mine in the Andes had killed aquatic life along a 300-kilometer stretch of river system in 1996.

It also threatened the livelihood and health of 50,000 of the region's subsistence farmers (Edwards 1996:4). Uncontrolled smelters have produced some of the world's only environmental "dead zones," where little or no vegetation survives. For instance, toxic emissions from the Sudbury, Ontario, nickel smelter have devastated 10,400 hectares of forest downwind of the smelter (Young 1992:21).

3.1.4. Environmental Impact from Small-scale Mining.

3.1.4.1. Damages from Mercury Use

Mercury is still extensively used in gold mining in many parts of Latin America. The use of mercury in small-scale mining techniques has health and environmental consequences. Mercury is discharged into the environment when miners fail to recover mercury tailings, either by dumping

waste directly into rivers or by releasing mercury vapors into the atmosphere when the mercury-gold compound is burned.

Small-scale miners use inorganic mercury, which is often converted through natural processes into toxic organic and inorganic compounds. Of greatest concern is the highly toxic organic compound, methyl mercury, which forms in rivers and lakes when micro-organisms metabolize metallic mercury. This toxic form of mercury then accumulates in fish and when ingested causes mercury poisoning in humans.

Metallic or inorganic mercury can also be hazardous if it is transformed into gas from its liquid state; in a recent case, teenagers in the United States who handled liquid mercury were hospitalized for mercury poisoning after samples of the silvery substance formed a hazardous vapor. Although symptoms differ for poisoning by inorganic and organic mercury, both kinds may result in nervous system disorders, birth defects, or death. Estimates for the amount of mercury released into the environment as a result of small-scale mining vary from 1-4 kilograms per kilogram of gold extracted (Hutcheson 1998:12).

In the Amazon Basin alone, between 90-120 tons of mercury is discharged annually into local rivers (Malm et al. 1990:11-15). In Venezuela, the amount of mercury lost in the environment is estimated to exceed 10 tons per year (Nriagu et al. 1992:389). While the impact of mercury pollution may be severe at a site of mining activity, it is by no means restricted to that area and can affect communities many kilometers away (Stallard 1995:73).

In Venezuela, substantial metallic mercury deposits have been found to exist in the bottom of a river where mining is occurring, and as of 1989, fish were beginning to show evidence of mercury contamination (Malm et al. 1990:11-15). Nonetheless, without baseline data on the water quality and composition of the river bottom materials before mining began, it is difficult to determine with any certainty how much mercury has been deposited in local riverbeds as a result of small-scale mining operations (Litos 1989:7).

3.1.4.2. Soil and Water Damage

Most small-scale mining, mostly operated in under-developed countries, increase sedimentation in rivers through the use of hydraulic pumps and suction dredges. By blasting hillsides with water under high pressure,

hydraulic pumps leave scars on the landscape, which may take years to develop even the lightest covering of vegetation.

Since most small-scale miners do not preserve the topsoil removed before excavation begins, this topsoil is often washed away into surface water, carrying with it ecologically valuable seed banks that are necessary for the regeneration of vegetation. Additionally, few small-scale miners engage in reclamation or post-mining recovery practices.

3.1.5. Damage from Closed Mines.

3.1.5.1. Acid Mine Drainage.

Mining's effects frequently persist long after an operation is closed. Acid drainage is an especially long-lived problem. This happens when a mining operation excavates rock that contains sulfide minerals. When these materials are exposed to oxygen and water, they react to form sulfuric acid. This acid will continue to form, and to drain out of the rock, as long as the rock is exposed to air and water and the sulfides have not been depleted – a process that can take hundreds or thousands of years.

Once a mine reaches the end of its operational lifetime, ground-water is contaminated by acid water drainage and eventually flowed into rivers and dams, and adjacent soils are polluted with heavy metals such as cadmium, lead and so forth which come out of abandoned mine sites.

The Iron Mountain mine in northern California, for instance, has been closed since 1963 but continues to drain sulfuric acid, along with heavy metals such as cadmium and zinc, into the Sacramento River. The river's bright orange water is completely devoid of life. Experts report that the mine may continue to leach acid for another 3,000 years.

3.1.5.2. Pollution of Groundwater.

Ground-water pollution from mining is exacerbated by abandoned and derelict mines, which threaten to decant acid mine drainage into the country's water courses. Under normal circumstances, operational mines pump water out of the underground workings to facilitate underground operations and to prevent the water from becoming polluted by the operations as well as to secure access to mineral reserves (Tyrer

2006:8-9).

However, once a mine reaches the end of its operational lifetime and pumping activities cease, clean ground-water can reach mined-out areas where it becomes exposed to iron sulphides, which causes the water to become contaminated with heavy metals and salts. The contaminated water, which is known as acid mine drainage, rises to the surface through shaft entrances, decanting into adjacent mines and eventually reaches rivers and dams.

Beside acid mine drainage, mining operations can affect water quality through heavy metal contamination and leaching of slime dams, processing chemical pollution, erosion and sedimentation and tailings pollution.

3.2. Climate Change from Greenhouse Gases (GHGs) Emissions.

Rapid environmental change is all around us. The most obvious example is climate change alarmed by the Creator today. If we do not act to recover it, the true cost of our failure will be borne by succeeding generations, starting with ours. That would be an unconscionable legacy; one which we must all join hands to avert. So, the climate change is not only a political and geological problem, but also an ethical and peace problem for all creatures (Choi 2008:1).

Mr. Utah Phillips, an American singer, said that "the earth is not dying. It is being killed, and the people killing it have names and addresses." It is necessary for us to make it clear that while the earth is being killed, we are indulging ourselves in human civilization so much.

A population of 6.5 billion used the equivalent of 9.3 billion tons of oil, which released 7.6 billion tons of carbon emissions in 2005. Much of this oil, coal and natural gas supported consumer lifestyle—literally fueling nearly 900 million vehicles on the roads and 3.7 trillion kilometers that passengers flew in planes in 2006, as well as keeping houses warm, lights on, and factories running. Our activities raised the atmospheric levels of carbon dioxide by 2.2 parts per million (ppm) in 2006, bringing the total to 382 ppm, which is 100 ppm higher than pre-industrial level, that resulted in 2006 being the fifth hottest year since 1880.

Weather-related disasters are already having dramatic impacts on all the animals and natures as well as human beings. The climate change is just one indicator of the threats we face as a rigorous alarm from the Creator,

God of grace. At least 60% of ecosystem services are being degraded or used unsustainably, according to the Millenium Ecosystem Assessment (Worldwatch Institute 2007:9-10).

The people causing this destruction have name and addresses. They include you and me and all the other consumers in the world. They include politicians who make empty promises or no promises at all. They include corporate executives who continue to ignore the realities of doing business on a finite and fragile planet and instead put profit over long-term concerns by encouraging consumers to crave various kinds of goods that are bad for them and the planet.

3.2.1. Causes of Climate Change.

Since the beginning of the industrial revolution around 1750, human beings have emitted significant amounts of greenhouse gases (GHG) into the troposphere by three activities. One has been the sharp rise in the use of fossil fuels, releasing large amounts of carbon dioxide (CO₂) and CH₄. Another is deforestation and clearing and burning of grasslands to raise crops, releasing CO₂ and N₂O. The third is cultivation of rice in paddies and use of inorganic fertilizers, releasing N₂O in the troposphere (Miller 2004:280-304).

There is no doubt that CO₂ among such greenhouse gases is leading to significant changes in the climate. In 2007, the Intergovernmental Panel on Climate Change (IPCC) released its strongest statement yet linking rising CO₂ emissions and increasing global temperatures. Some 2,500 experts concluded with at least 90% certainty that the observed warming over the last 50 years has been caused by human activities and that discernible human influences are now apparent in changed precipitation and storm intensity and in other instances of extreme weather worldwide (Jung, 2007:8).

The two largest contributors to CO₂ emissions are the world's thousands of coal-burning power and industrial plants and millions of gasoline-burning vehicles. Nor is there doubt that these changes will impose huge costs. The question is no longer whether we can afford to do something, but rather how to control emissions in an equitable and effective way.

The United States is the largest polluter in the world. But she refused to sign the Kyoto Protocol. China is in a race to be the world's worst polluter

with the United States. And there are no requirements put on developing countries to control the GHGs emissions in the Protocol, even though they will contribute half or more of emissions. Additionally, nothing was done about deforestation in the Protocol, which is contributing to global warming as well. Indonesia might be the third polluter owing to its rapid deforestation.

3.2.2. Emissions of Carbon Dioxide (CO₂).

Carbon emissions continue rise unrelentingly. In 2006, atmosphere carbon dioxide (CO₂) concentrations reached 381.84 parts per million by volume (7.60 billion tons). Average CO₂ concentrations have risen 20.8% since measurements began in 1959 and are now more than 100 parts per million higher than in pre-industrial times.

Fossil fuel burning represents about 80% of this increase. In 2006, the carbon emissions of 7.60 billion tons means to emit more than one ton for every person on earth. Annual emissions from fossil fuels have risen 17% just since 2000 as shown in the table 2.

The average global temperature increased from 13.85 degree Celsius in 1950 to 14.54 in 2006. The climate is warming most rapidly at the poles. Over the past century, Arctic temperature rose at almost twice the global average rate. One model projects that Arctic summers could be ice-free by 2040. In late 2006, the U.S. Interior Department proposed adding polar bears to the list of threatened species as accelerating ice loss threatens their habitat.

Table 3.2: Global Average Temperature and Carbon Emission from Fossil Fuel Burning and Atmospheric Concentration of Carbon Dioxide.

Year	1950	1960	1970	1980	1985	1990	1995	2000	2005	2006
Atmospheric Concentrations of CO ₂	-	316.91	325.68	338.68	345.90	354.19	360.88	369.48	379.66	381.84
Carbon Emissions	1.61	2.53	4.00	5.21	5.30	5.99	6.21	6.45	7.56	7.60
Temperature.	13.85	13.99	14.03	14.18	14.06	14.38	14.38	14.33	14.63	14.54

Sources: GISS, BP, IEA, CDIAC, DOE, and Scripps Inst. of Oceanography. Worldwatch Institute, Vital Signs 2007–2008, New York, 2007, p.43.

The United States remains the world's top emitter, accounting for over 21% of carbon emission from fossil fuel burning in 2005. But the largest

increases occurred in Asia. China's emission rose 9.1% in 2005. Experts predict that China will emit more carbon from fossil fuel consumption than the United States does before 2010.

Table 3.3: CO₂ Emission Situation of Major Countries in 2004.

Country	Annual Emission (million tons)	Per Capita Emission (ton)	Increasing Rate from 1990 to 2000 (%)
USA	7,074	19.73	15.2
China	4,938	3.65	32.3
Russia	1,952	10.63	-36.4
India	1,884	1.02	41.5
Japan	1,355	9.52	9.6
Germany	1,015	10.29	-16.7
Brazil	851	1.76	24.8
Canada	758	17.24	20.9
England	659	8.98	-10.1
Italy	583	7.95	7.1
South Korea	521	9.61	79.1

Source: Korean National Statistical Office, International Statistics Yearbook 2007/BP/IEA/Hankyuhrae Shinmoon, June 1, 2007.

3.2.3. Impact of Climate Change.

Floods, droughts, melting ice caps, disappearing coastlines, deadly heat waves and bizarre weather are all the signs of climatic upheaval from global warming caused by the continued build-up of carbon dioxide and greenhouse gases. The heatwaves, floods, and droughts could cause hunger for millions of people and water shortages for billions, with the world's poor hit the hardest.

Weather-related disasters are often perceived as natural events, but many actions have a hand in their creation. For example, climate change is warming sea temperatures, which can lead to stronger hurricanes. Sea levels rising threatens low-lying areas, especially during storms. Damage to mangrove forests and coral reefs weakens natural storm defenses. And with more people forced to live in undesirable, riskier areas, the potential for disaster is ever higher.

However, most developing countries may not feel responsible for the vast majority of the carbon dioxide hanging around in the atmosphere. Because most of it has been emitted by Western advanced countries during their own development over the past 200 years.

Ironically, experts predict climate change will disproportionately affect poorer countries and communities, and insist on the need for solidarity in the fight against global warming. Climate change accompanied by the aforementioned disasters is more unfavourable to the socio-economically weak, who are usually less responsible for the advent of climate change and have less ability to cope with the impact of climate change. Namely, the least responsible are the most vulnerable to climate change.

It has turned out that Africa is the continent most suffering from the impact of climate change. Most of Africa will be hit the hardest if climate change continues in its current course. So, it is necessary to set up an international supporting system for the poor and Africa.

3.2.4. The Kyoto Protocol.

Under the Kyoto Protocol established in 1997 by the U.N. Convention on Climate Change adopted in 1992, developed country members are legally required to cut their greenhouse gas emissions. They agreed to cut greenhouse gas emissions collectively by an average of 5% of 1990 levels over the first commitment period from 2008 to 2012. Each member country has its own specified target listed in an annex.

Developing countries are not required to commit to their emission reductions because of their lower development level and little contribution to the historical buildup of carbon dioxide in the atmosphere. They might commit to collect data on greenhouse gases at the national level and formulate national measures for developed countries to provide them with finances and technologies concerned with global warming.

However, some countries are no longer satisfied with developing countries' exemption from binding emission cuts and suggesting for the second period to place new conditions targeting big countries like China and India and more industrialized countries such as South Korea and Brazil. They are also calling for comprehensive negotiations for a new post-2012 treaty to pull developing countries into making their commitments with different levels for different developing countries. Another problem is the refusal of the United States to join the Kyoto Protocol and follow its emission targets. She has complained about letting big countries off the hook, and used it as a reason for pulling out of the Protocol.

So, the year of 2012 is very important because the first commitment

period ends and the second period starts in 2013 to carry out the new agreed binding targets for further reducing their emissions. Global warming is too important to be held hostage in another attempt at squeezing the poor. It is obviously our urgent duty to heal the climate change caused by human beings and alarmed the Creator God. So, we should talk an effective, comprehensive and equitable post-2012 international climate change arrangement based on the will of God as the post-Kyoto Protocol to control GHG emissions perfectly.

U.N. Secretary-General Ban Ki-moon urged at the United Nations Climate Change Conference held at Bali, Indonesia December 3-14, 2007 that the world must reach an agreement by 2009 for a new treaty to meet "the moral challenge of our generation." Succeeding generations depend on us, we need to set a road-map to a more secure climate future. We can not rob our children of their future (Cho 2007:3).

3.3. Environmental Impact from Nuclear Power Plants.

3.3.1. Concern from Nuclear Power Plants.

Concern for the effects on the future of nuclear power plants has focused on high cost, reactor accident risks, radioactive waste management, and potential links in the spread of nuclear weapons.

3.3.1.1. Handling of Radioactive Waste.

When trying to establish a long term nuclear energy production plan, the issue of disposal methods for nuclear waste has been one of the most pressing current problems, which stems from uncertainties, complications and setbacks in handling the issue properly.

3.3.1.2. Risking Future Generations.

Although managing issues for radioactive waste have been raised concerning possible consequences for future generations in the past three decades, many risk decisions may impose risks on future generations that require a different kind of consideration from risks to people living today. The long-term existence of radioactive waste results in referring to the

issue of inter-generational equity.

3.3.1.3. Proliferation Concerns for Nuclear Weapons.

Even though being dismantled by the major nations, nuclear weapons are growing in number due to the production of these mass destruction weapons through using the materials generated from nuclear plants. This is another unfortunate legacy for future generations.

When dealing with uranium and plutonium, the possibility that they may be used to build nuclear weapons is often a concern. Active nuclear reactors and nuclear weapon stockpiles are very carefully safeguarded and controlled.

However, high-level waste from nuclear reactors may contain plutonium. Ordinarily, this plutonium is reactor-grade plutonium, containing a mixture of plutonium-239 (highly suitable for building nuclear weapons), plutonium-240 (an undesirable contaminant and highly radioactive), plutonium-241, and plutonium-238; these isotopes are difficult to separate.

Moreover, high-level waste is full of highly radioactive fission products. However, most fission products are relatively short-lived. This is a concern since if the waste is stored, perhaps in deep geological storage, over many years the fission products decay, decreasing the radioactivity of the waste and making the plutonium easier to access. Moreover, the undesirable contaminant Pu-240 decays faster than the Pu-239, and thus the quality of the bomb material increases with time (although its quantity decreases).

Thus, some have argued, as time passes, these deep storage areas have the potential to become "plutonium mines", from which material for nuclear weapons can be acquired with relatively little difficulty. Critics of the latter idea point out that the half-life of Pu-240 is 6,560 years and of Pu-239 24,110 years, and thus the relative enrichment of one isotope to the other with time occurs with a half-life of 9,000 years.

The weapon grade plutonium mines would be a problem for the very far future (9,000 years from now), so that there remains a great deal of time for technology to advance and solve this problem, before it becomes acute. Pu-239 decays to U-235 which is suitable for weapons and which has a very long half life (roughly 109 years). Thus plutonium may decay and leave uranium-235. However, modern reactors are only moderately enriched with U-235 relative to U-238, so the U-238 continues to serve as

denaturation agent for any U-235 produced by plutonium decay.

One solution to this problem is to recycle the plutonium and use it as a fuel e.g. in fast reactors. But in the minds of some, the very existence of the nuclear fuel reprocessing plant needed to separate the plutonium from the other elements represents proliferation concern. In pyrometallurgical fast reactors, the waste generated is an actinide compound that cannot be used for nuclear weapons.

3.3.1.4. Promoting Energy Consumption.

In order to construct and demolish nuclear power plants and manage nuclear waste safely, we must do an enormous amount of investment into nuclear fields. Nuclear power plants also produce large amounts of electricity. Whereas other types of electrical generation can be limited in scale, no engineer has come up with an effective design for a truly small nuclear plant so far.

This is a problem because it requires the consumption of large amounts of electricity to make up for the high construction, demolition and management costs. For highly developed countries, the results in high consumption need not be an economic problem, but it eventually results in a serious environmental and social impact. Additionally, the energy demand is not that high in much of the developing world yet, and the infrastructure for transmitting electricity throughout sparsely populated areas does not exist.

3.3.1.5. Technical Stigma.

Other problems associated with nuclear reactors deal with safety, the fear of radiation, and the presence of an unwanted facility. There is a stigma attached to nuclear power. Technical stigma is a fact of nuclear power. So, trying to site a future nuclear plant, hazardous waste site, low-level waste site, or any industrial facility does produce substantial public opposition.

In the United States, nuclear power plants and nuclear waste sites have generated substantial public opposition. Controversy over nuclear energy, both bombs and reactors, has been exceptionally durable and violent, exciting more emotion and public protest than any other technology.

3.3.1.6. Apprehensive Substitute Energy.

A fundamental foundation of ecology is that we live on a finite and self-contained planet. Although the limits of non-renewal resources can be sometimes significantly extended by means of human science and technology, there are no inexhaustible energy and mineral resources. So, ecological prudence for resource exhaustion is adaptation to the forces and restraints of nature that cannot be changed, no matter how sophisticated our science and technology develops in the future.

Therefore, the resource issue dominated the early days of nuclear power. Arguments were made that the world has only a finite amount of oil and gas, so that uranium must be used for energy generation. Then it was argued that uranium was in short supply, so it would be necessary to recycle used fuel and to build breeder reactors that could transmute the large quantities of non-fissile uranium 238 into fissionable material.

However, there are still some serious problems which we should solve with regard to the use of nuclear energy as the substitute energy for fossil fuels as mentioned above. We should keep in mind that nuclear energy has a much higher environmental impact than fossil fuel energy.

3.3.2. Management of Nuclear Waste.

When trying to establish a long term nuclear energy production plan, the issue of disposal methods for nuclear waste has been one of the most pressing current problems (www.uic.com.au/nip78.htm).

3.3.2.1. Sources of Radioactive Waste.

Radioactive waste comes from a number of sources. The majority originate from the nuclear fuel cycle and nuclear weapon reprocessing. However, other sources include medical and industrial waste as well as naturally occurring radioactive materials (NORM) that can be concentrated as a result of the processing or consumption of coal, oil, gas and some minerals.

Although not significantly radioactive, uranium mill tailings are waste. They are byproduct material from the rough processing of uranium-bearing

ore. Uranium mill tailings also contain chemically-hazardous heavy metals such as lead and arsenic.

3.3.2.2. Categorization of Radioactive Waste.

In the United State, radioactive waste is categorized as low level waste (LLW), transuranic waste (TRU), and high level waste (HLW). HLW includes the spent fuel from commercial and other reactors and government waste from the production of nuclear weapons. Currently, HLW is generally being stored at the reactor sites in the country and at several government facilities.

The majority of radioactive waste is low-level waste, meaning it has low levels of radioactivity per mass or volume. This type of waste often consists of used protective clothing, which is only slightly contaminated but still dangerous in case of radioactive contamination of a human body through ingestion, inhalation, absorption or injection.

3.3.2.3. Significance of Radioactive Waste.

Radioactive waste typically comprises a number of radioisotopes: unstable configurations of elements that decay, emitting ionizing radiation which can be harmful to human health and to the environment. Those isotopes emit different types and levels of radiation, which last for different periods of time.

The radioactivity of all nuclear waste diminishes with time. All radioisotopes contained in the waste have a half-life time it takes for any radio-nuclide to lose half of its radioactivity, and eventually all radioactive waste decays into non-radioactive elements.

Certain radioactive elements (such as plutonium-239) in spent fuel will remain hazardous to humans and other living beings for hundreds of thousands of years. Other radioisotopes will remain hazardous for millions of years. Thus, this waste must be shielded for centuries and isolated from the living environment for hundreds of millennia (www.marathonresources.com.au/nuclearwaste.asp).

Some elements, such as Iodine-131, have a short half-life around 8 days and thus they will cease to be a problem much more quickly than other, longer-lived, decay products but their activity is much greater initially.

The faster a radioisotope decays, the more radioactive it will be. The energy and the type of the ionizing radiation emitted by a pure radioactive substance are important factors in deciding how dangerous it will be. The chemical properties of the radioactive element will determine how mobile the substance is and how likely it is to spread into the environment and contaminate human bodies. This is further complicated by the fact that many radioisotopes do not decay immediately to a stable state but rather to a radioactive decay product leading to a decay chain.

3.3.2.4. Difficulty of Repository Location.

Establishing a site has not been easy. For example, the Waste Isolation Pilot Plant (WIPP) site for transuranic waste (TRU) had been under study for 25 years before opening in 1999. In May of that year, the U.S. Environmental Protection Agency (EPA) stated that there is a reasonable expectation that WIPP can be counted on to contain the TRU waste for the next 10,000 years. That points out one of the great difficulties of finding a repository location. The time period required for safety calculations exceeds recorded human history (Ojovan and Lee 2005:315).

3.3.2.5. Disposal Target of Radioactive Waste.

The main objective in managing and disposal 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 radio-nuclides returned to the biosphere is harmless.

To achieve this, the preferred technology to date has been deep and secure burial for the more dangerous waste. Transmutation, long-term retrievable storage, and removal to space have also been suggested. So in principle the waste needs to be isolated for a particular period of time until its components have decayed such that they no longer pose a threat. In practice this can mean periods of hundreds of thousands of years, depending on the nature of the waste involved to avoid causing harm to remote future generations.

3.3.2.6. Disposal of Low Level Waste (LLW).

Low level waste (LLW) is generated from hospitals and industry, as well as the nuclear fuel cycle. It comprises of paper, rags, tools, clothing, filters, etc., which contains small amounts of mostly short-lived radioactivity. Commonly, LLW is designated as such as a precautionary measure if it originated from any region of an active area, which frequently includes offices with only a remote possibility of being contaminated with radioactive materials.

Such LLW typically exhibits no higher radioactivity than one would expect from the same material disposed of in a non-active area, such as a normal office block. Some high activity LLW requires shielding during handling and transport but most LLW is suitable for shallow land burial. To reduce its volume, it is often compacted or incinerated before disposal.

Low level waste is divided into four classes, class A, B, C and GTCC, which means greater than class C. Intermediate level waste (ILW) contains higher amounts of radioactivity and in some cases requires shielding. ILW includes resins, chemical sludge and metal reactor fuel cladding, as well as contaminated materials from reactor decommissioning. It may be solidified in concrete or bitumen for disposal.

3.3.2.7. Disposal of High Level Waste (HLW).

High level waste (HLW) is produced by nuclear reactors. It contains fission products and transuranic elements generated in the reactor core. It is highly radioactive and often thermally hot. HLW accounts for over 95% of the total radioactivity produced in the process of nuclear electricity generation. The amount of HLW worldwide is currently increasing by about 12,000 metric tons every year, which is the equivalent of about 100 double-decker buses or a two-story structure built on top of a basketball court (Babu and Karthik 2005:93-102).

3.3.3. Issue of Inter-Generational Equity.

The predominant inter-generational issue associated with nuclear waste is that of radioactive waste, primarily the HLW from spent fuel. International bodies have taken the position that in disposal methods, future generations should not be asked to bear a burden any greater than that borne by present generations.

The International Atomic Energy Agency (IAEA) has stressed that it is responsible today to deal with the future: "The objective of radioactive waste management is to deal with radioactive waste in a manner that protects human health and the environment now and in the future without imposing undue burdens on future generations" (par. 314). The IAEA has also stated that "radioactive waste shall be managed in a way that predicted impacts on the health of future generations do not exceed relevant levels that are acceptable today" (par. 314).

What are "undue burdens," and who decides what is acceptable? Kristen Shrader-Frechette has written:

All alleged risk reductions are actually risk tradeoffs, and one cannot diminish one risk without increasing another.....Indeed, throughout life, we exchange risks rather than remove them, and we increase our risks to gain something more valuable.

If a geologic repository is built, the waste would be stored in containers that should not fail for at least 1,000 years, and probably longer. Thus, for the present generation, there would be no risk because the waste cannot get to the surface and cause radiation exposure. But at some unknown future time, a container will fail, and eventually a radionuclide will enter the biosphere. Since some radionuclides will be around for several hundred thousand years, there will be a burden on any people living then that would be greater than the burden on the present generation.

The current focus is to try to design waste packaging and a repository that will be able to last at least 10,000 years. Can we imagine to hold up over such a long time frame? But a National Academy of Sciences study indicated that there is no technical basis to stop at 10,000 years, because the estimated dose that could be received external to the site would continue to rise until perhaps a million years.

A major difficulty in concluding that a HLW repository should be constructed now relates to the uncertainty in estimates of long-term releases. Those opposed to a repository do not believe that a convincing case has been made that the current repositories will be safe for such long periods of time. The opponents ask, "For how long should we be concerned that the nuclear waste is safely stored?" and "How do we protect the future environment and people?" This is called the issue of inter-generational

equity.

It is clear that we should not punish our children and grandchildren today, in order to fend off wholly imaginary demons in the unforeseeable future. On the other hand we cannot leave problems for future generations that cannot be resolved today. But it is also of serious concern that doing nothing today may lead to far greater hazards in the future. Nonetheless, we have a responsibility to handle them wisely, not only for the present but also for the future. This is not a technical mandate but an ethical and theological one of long-standing significance (Ahearne 2000:763-770).

Chapter IV: Environmental Impact from Mining Activities and Nuclear Plants in Korea.

South Korea¹⁾ has accomplished a very compressed form of economic growth over the last 50 years. But the rapid economic growth has been accompanied by rapid ecological dilapidation and environmental pollution. The environment was sacrificed by pursuing more economic growth through industrialization. However, the Korean people's recognition of the value of the environment was revitalized with the experience of several environmental disasters including the phenol accident in the Nakdong river in 1991, the acid drainages from closed mines in 2006, and the oil spill in the West Sea in 2007 etc.

Economic growth has made people pay more attention to aspects of quality of life which is mostly dependent upon the quality of the surrounding environment. Since democratization from the long lasting military government in 1987, environmental movements have also grown as rapidly as environmental destruction and have actively engaged in environmental recovery and protection.

However, most of Korean churches used to distance themselves from environmental movements except voluntarily participating in the oil-removing activities in the west seacoast polluted by the oil spill disaster in December 2007. They have not particularly concerned themselves with an ecological mission for mining activities and nuclear power plants in South Korea. They are of the opinion that environmental issues are only for the government and specialized non-government agencies, not for the churches.

1) Korea is located between 124 11'E and 135 53'E and between 33 06N and 43 01N. Its area is 221.467 km², of which length and width are about 1,000 km and 216 km respectively at its shortest point. It is surrounded by the East Sea, West Sea and South Sea. Korea is divided by the Republic of Korea (South Korea) and the Democratic People's Republic of Korea (North Korea). The governing area of South Korea is 99,117 km² (about 45% of total area). Due to the rising of the eastern part of Korea, about 67% of Korean territory is geomorphologically characterized by abundant hills and mountains. The population of South Korea is 48.45 million people in 2007.

4.1. Korean Political and Economic Context.

4.1.1. Economic Growth Trends.

The Koreans are one ethnic family speaking one language and they have a strong cultural identity. A number of wars led to reconstruction efforts which were highly successful in promoting national prosperity and stability. Thus, modern day Korea is a nation that has rebuilt itself from the devastation of wars and has achieved an economic miracle in just 50 years.

Some of the factors that are generally cited to explain the "economic miracle" include the strong government support, the export-oriented economic strategy, the emphasis on high technology in industrial policy and the abundance of highly skilled and educated labourers.

An outward-oriented economic development strategy contributed greatly to the radical economic transformation of South Korea. As a result of such a strategy, Korean exports have rapidly increased from US\$ 55 million in 1962 to US\$ 371,489 million in 2007 as shown in table 1. Korea's major industries include electronics, automobiles, semi-conductors, steel products, shipbuilding, textiles and so on.

Since the financial crisis in 1997, Korea has achieved the most rapid economic growth among countries belonging to the Organization for Economic Cooperation and Development (OECD) with an annual growth of 6%. As a result of the rapid economic growth, Korea's gross domestic product (GDP) increased from US\$ 2.3 billion in 1962 to US\$ 7,821 billion in 2007, with its per capita GDP soaring from US\$ 87 in 1962 to US\$ 20,045 in 2007. The number of cars has also sharply increased from 10.4 million vehicles in 1997 to 16.4 million in 2007. With a history as one of the fastest growing economies in the world, Korea is now working to become the financial and business hub of Northeast Asia in the 21st century (KEEI 2008:253-265).

Nevertheless, it has accomplished little progress on the environmental fields of air, water and waste management as pointed out in the OECD environmental report in 2007. The major environmental problems South Korea is now facing is the increasing emission of CO₂, nuclear waste treatment and pollutions from the closed mines spread all over the country.

Therefore, it has become urgent to consider seriously the environmental impact of the continuing supply of energy and mineral resources to meet

such a rapid economic growth.

Table 4.1: Export and Import Trends of Korea. Unit: US\$ Million.

Year	1962	1970	1980	1995	2000	2005	2006	2007
Exports	55	835	17,505	65,016	172,268	284,419	325,465	371,489
Imports	422	1,984	22,292	69,844	160,481	261,238	309,383	356,846

Source: Korea Energy Economics Institute (KEEI), Yearbook of Energy Statistics, 2008, p. 256.

4.1.2. Demand for Energy and Mineral Resources.

Korea has needed a great deal of energy and mineral resources to meet the increasing demand for her rapid economic growth. In order to meet the requirements for mineral resources, she promoted domestic mining activities, but was faced with serious difficulties as a result of the deepening and narrowing of mines, except in the case of some minerals such as anthracite coal, limestone, pyrophyllite, kaolin, sulphur etc. Consequently, she has made an effort to develop overseas energy and mineral resources.

After going through the serious energy shortage from the oil shock in 1973 and 1979 by OPEC, she has developed nuclear power plants from the 1970s. However, most western countries have suspended and/or decreased the development of plants as a result of the serious impact of accidents at three-mile-away Island in America and Chernobyl in Russia, treatment of nuclear waste and technical stigma as mentioned in 3.2.1.

In her energy and minerals development drive to meet the rapid increasing requirements, she confronts some serious environmental and ethical problems at the moment in the light of the demand for sustainable development.

4.1.3. Hot Political Issue.

Korea is the only country in the world that is divided into two states as the result of the superpower hegemony of the U.S.A. and the Soviet Union during the Cold War. In the late 1980s and early 1990s, epochal changes in Eastern Europe and the Soviet Union brought an end to the Cold War, while South Korea moved swiftly to exploit the situation by actively promoting a "Northern Diplomacy." South Korea's energetic pursuit of the Northern

Diplomacy contributed to the enhancing of its ties with North Korea and former socialist countries, which had languished due to ideological and structural differences.

As a result of these efforts in bringing about a peaceful coexistence between South and North Korea, the Agreement on Reunification, Nonaggression and Exchanges and Cooperation (the Basic South–North Agreement) and the Joint Declaration of the Denuclearization of the Korean Peninsula were concluded in 1991. The people of South Korea have surely recognized that these historic documents represent a step towards their common political target of the peaceful reunification of a divided nation.

In spite of the Joint Declaration of the Denuclearization of the Korean Peninsula in 1991, North Korea finally announced at the end of 2004 that it had already developed some nuclear weapons in the vindication of protecting its territorial right. Nevertheless, South Korea is pursuing its diplomacy through dialogue in dealing with the nuclear issue posed by North Korea in coordination with U.S.A., Japan, China, Russia, the European Union, and other countries (KOIS 2008:49–60).

4.2. Mining Situation of South Korea.

Korea is a small state and has poor natural resources. But Korea has rapidly consumed its energy and mineral resources to meet the rapidly increasing demand for mineral resources as a result of her rapid economic growth and welfare promotion.

4.2.1. Historical Summary of Mining Industry.

With Korean mining activities starting from the neolithic and bronze era, the Silla (B.C. 57 – A.D. 935) and Baekje dynasty (B.C. 18 – A.D. 660) transferred their high steel-manufacturing techniques to Japan. But the Choseon dynasty with a self-sufficient economy based on agriculture down-played mining and manufacturing activities due to practicing the principle of confucianism.

The Mines Act was promulgated in 1906 by the Japanese colonial government for the first time in Korea. The Japanese government continually used the Mines Decree to exploit mineral resources in full swing

in Korea to supply strategic war materials such as tungsten, iron and coal etc., and the Gold Mining Decree to monopolize the gold mines by the Japanese and to build war funds. During the colonial period of Japan, Korea was the second largest gold-producing country in the world. The reckless mining activities under Japanese colonial rule caused serious environmental damages in Korea (KORES 2003:5-9).

After independence from Japan in 1945, the Korean government encouraged the mining industry to build the foundation funds for a Korea totally destroyed by World War II. The mining law was firstly enacted in December 1951 during the Korean War between South and North Korea (1951-1953). The mining industry had played a pivotal role in the Korean economy so that mineral products accounted for 78% of the total export earnings in 1953.

Korea established the Korea Resources Corporation to promote the mining industry to meet the increasing need for mineral resources as a result of her rapid economic growth, and set up the Korea Petroleum Development Corporation to prevent the serious energy shortage after the oil crises by OPEC.

In spite of trying to promote the domestic mining industry, most of the metallic mining and smelting works were ceased in the 1980s as a result of scanty reserves and the deepening of mines. Most of the metal mines were also shut down due to poor development conditions, except a number of iron and titanium mines currently in normal operation.

Anthracite coal as fuel material has lost its international competitiveness since the late 1980s as a result of environmental problems. The anthracite coal industry in South Korea has been rationalized due to its poor development conditions and environment impact.

Thus, Korea has resorted to import about 99% of her energy and metal consumption. However, the non-metal mines are still viable. Their non-metal products account for 72.78% of her requirements in 2007 (KIGAM 2008:5-7; KEEI 2008:12-13).

4.2.2. Register Trends of Mining Areas.

There are 330 kinds of minerals identified in Korea so far. 66 kinds

among them were registered as legal minerals (36 for metallic and 20 for non-metallic minerals). The 20 kinds were under operation in 2007, of which 6 were metallic and 14 non-metallic (KORES 2007:13-17).

However, the registered numbers of mining areas have sharply decreased from 12,036 in 1990 to 5,284 in 2006 due to the closure of mines with low profits as a result of their scanty reserves, the deepening of mines, and increasing environmental impacts as shown in the table 2. The numbers of operating mines have decreased to 506 in 2007 from 830 in 1985, diminishing the mining workers from 13,719 in 1985 to 3,739 in 2007 as shown in table 2.

So, the Korean government has been pursuing a development of overseas mineral resources instead of her domestic ones to meet the rapid increasing demand of mineral resources and avoiding environmental problems.

Table 4.2: Register Trends of Mining Areas in South Korea.

Minerals		1990	1995	2000	2004	2005	2006
Metallic	gold/ silver/ copper/ lead/ zinc	2,581	1,473	691	567	592	561
	iron/ manganese	194	129	55	56	60	57
	others	168	120	94	87	70	73
	Sub Total	2,943	1,722	840	710	722	691
Non- Metallic	limestone	1,879	1,979	1,464	1,451	1,369	1,445
	kaolin/ pyrophyllite	2,398	2,450	1,302	1,416	1,384	1,384
	feldspar/ silica stone	1,883	1,973	922	787	854	878
	pagodite	194	155	110	151	129	127
	talc	166	120	166	72	63	65
	mica	182	202	184	185	187	177
	others	1093	713	485	456	453	418
Sube Total	7,795	7,592	4,565	4,518	4,444	4,494	
Energy	coal	1,298	476	178	127	99	99
	Total	12,036	9,790	5,583	5,355	5,265	5,284

Source: Ministry of Knowledge Economy (MIKE), 2008.

4.2.3. Operation Situation of Mines.

Korea has developed 2,006 mines since 1930 and 1,276 mines among them had been abandoned as shown in the table 3. 730 mines were still operating in 2007, of which 669 mines are non-metallic mines. 395 mines out of these non-metallic mines are limestone and kaolinite ones.

533 mines out of the 730 are ones currently under operation (coal 9,

metal 24, and non-metal 500), and 197 mines are planning to start operation on small scale mines operating irregularly according to mineral economic situations. 415 mines out of the 2006 ones are located in Kwangwon, 349 in Kyeongbuk, 308 in Chungnam, 284 in Chungbuk, and 191 in Keongnam province respectively (MIRECO 2007:4-5).

However, the abandoned mines have impacted lots of residents in the mining regions as a result of various environmental impacts such as acid mine drainage, soil contamination, health damage and sudden ground collapse etc. Additionally, the 1,276 abandoned mines are just the confirmed ones which the Korean government has gotten hold of based on the register records in accordance with the Mining Act. But there remains a lot of unconfirmed closed mines imprudently developed during the colonial period of Japan and left without aftermath management.

Table 4.3: The Present Mining Situation in South Korea.

Category	Coal Mines	Metallic Mines	Non-metallic Mines	Total
Operating Mines	9	52	669	730
Abandoned Mines	340	936	0	1,276
Total	349	988	669	2,006

Source: MIRECO, 2007 International Symposium Report on Mine Reclamation, 2007.

4.3. Energy Minerals.

4.3.1. Demand and Supply

4.3.1.1. Energy Consumption

The primary energy consumption of South Korea rapidly grew from 34,214 thousand TOE in 1977 to 236,454 thousand TOE in 2007, with the annual rate of more than 10% on average during the last three decades, due to expanding the industrial sectors, improving the living standards and sharply increasing numbers of vehicles (KEEI 2008:12-13).

The per capita energy consumption also increased from 0.94 TOE in 1977 to 4.86 TOE in 2007. The energy consuming growth will surely be continued due to social and economic development, even though the

population is expected to grow at a rate of less than 1% per annum and to be frozen after 2020.

Table 4.4: Primary Energy Consumption Trends of South Korea.

Unit: 1,000 TOE/ TOE.

Year	1977	1987	1992	1997	2002	2006	2007
Consumption	34,214	67,878	116,010	180,638	208,636	233,372	236,454
Per Capita Energy	0.94	1.63	2.65	3.93	4.38	4.83	4.86

Source: Korea Energy Economics Institute (KEEI), Yearbook of Energy Statistics, 2008.

4.3.1.1.1. Consumption Policy Shift.

As a result of industrialization concentrating on the energy intensive industries such as petrochemicals, cement and steel industries in the first stage of her economic policy, the increasing rate of energy consumption had outpaced the economic growth rate. The energy/GDP ratio had risen from 0.314 in 1989 to 0.385 in 1999.

So, Korea had to change the industrial policy to promote less energy intensive industries such as semi-conductors, machinery, electronics and equipment industries owing to the volatile oil price, insecurity of oil supply, concern about the 10th largest emission of CO₂ in 2004. Due to the structural shift of the manufacturing industry together with energy conservation efforts, the energy/GDP ratio has steadily decreased at the peak of 0.385 in 1999 to 0.335 in 2007 (MIKE 2008: 8-9; Yun 2007:3-4).

4.3.1.1.2. Sectoral Energy Consumption.

The sectoral energy consumption in Korea is characterized by a rapid increase in the industry and transportation sectors, and relatively slow growth in the residual, commercial and public sectors. The energy consumption in the industrial sector has increased up to 104,327 thousand TOE in 2007, increasing 6.1% compared with 97,235 thousand TOE.

The most rapidly increasing sector during the last three decades was the transportation sector. A sharp increase took place from 571 thousand vehicles in 1981 to 16,428 thousand in 2007. The consumption came to 36,938 thousand TOE in 2007, increasing 1.1% from 36,527,000 TOE in

2006.

The energy consumption in the residual and commercial sectors grew moderately compared with other sectors, this resulted in shrinking sectoral shares of the final energy consumption. The characteristic consuming trends was fuel substitution from low-quality energy to high-quality. The consumption in 2007 reached 36,212 thousand TOE, increasing 0.6 percent compared with 35,986 thousand TOE in 2006 (KEEI 2008:28-29).

The sectoral shares of energy consumption consisted in 2007 as follows: industrial sector 57.5% of the total energy consumption, transportation 20.4%, residual and commercial sectors 19.8%, and public and others 2.7%.

4.3.1.1.2. Energy Consumption Structure.

The increasing requirements of higher quality energy has made petroleum, gas and electricity almost replace firewood and anthracite coal for heating and cooking. In particular, the demand for anthracite coal has sharply decreased in reverse proportion to the increasing income level. The structure of energy consumption in 2007 was composed of petroleum 44.6%, coal 25.2%, LNG 14.7%, nuclear power 13.0%, hydro-power 0.5% and renewable and others 2.0% (KEEI 2008:26-27).

4.3.1.2. Energy Supply.

Korea has a poor endowment for energy resources so that her indigenous energy resources are limited to anthracite coal, firewood and hydro-power. The total primary energy supply reached 236,454 thousand TOE in 2007 as shown in the table 5. But the domestic production was only 38,338 thousand TOE, accounting for 14.5% for the total energy supply, while the imports recorded 246,773 thousand TOE, accounting for 85.5% for the total supply.

In order to diversify energy sources and to substitute the increasing oil consumption, Korea set up a nuclear power plant for the first time in 1978 at Gori, Keongnam province, and liquefied natural gas (LNG) was introduced in 1986. LNG imports had sharply increased from 2,184 thousand TOE in 1987 to 33,239 thousand TOE in 2007, accounting for 14.7% of the total supply (KEEI 2008:18-19).

The nuclear power generation enlarged from 18 thousand TOE in 1997

to 30,731 thousand TOE in 2007, producing 80.2% of the total domestic production. The domestic energy production structure in 2007 was composed of nuclear 80.2% of the total production, anthracite 3.5% hydro 2.8% and renewals and others 13.5% in 2007.

Table 4.5: Primary Energy Supply Trends of South Korea.

Unit: 1,000 TOE.

Year		1977	1987	1992	1997	2002	2006	2007
Production	Anthracite	9,073	11,166	5,387	2,030	1,493	1,271	1,342
	Hydro	348	1,336	1,216	1,351	1,327	1,305	1,084
	Nuclear	18	9,827	14,133	19,272	29,776	37,187	30,731
	Other	3,117	1,319	723	1,344	2,925	4,358	4,828
	Sub-total	12,556	23,649	21,459	23,997	35,521	44,582	38,338
Import	Petroleum	21,745	36,508	90,732	151,040	147,133	156,060	159,298
	Coal	1,417	13,865	19,816	32,850	44,990	49,854	54,237
	LNG	n/a	2,184	4,453	15,118	22,711	32,788	33,239
	Sub-total	23,162	52,557	115,001	199,007	214,833	238,702	246,773
Total	34,214	67,878	116,010	180,638	208,636	233,372	236,454	

Source: KEEI, Yearbook of Energy Statistics, 2008.

4.3.1.3. Energy Imports.

Energy imports had dramatically increased from 23,162 thousand TOE in 1977 to 246,773 thousand TOE in 2007. The import value had remarkably enlarged from 7,765 million US\$ in 1981 to 94,978 million US\$ in 2007, accounting for 26.6% of the total imports of 356,846 million US\$. So, energy imports has become a huge burden for Korea's international balance of payments. The overseas dependence rate of energy had also increased from 65.8% in 1977 to 96.6% in 2007 (KEEI 2008:20-21).

4.3.2. Major Energy Minerals.

4.3.2.1. Petroleum.

4.3.2.1.1. Demand.

Korea's petroleum consumption showed a dramatic growth during the last three decades, thanks to brisk economic activities more than 10% annually. The petroleum consumption reached 794,946 thousand barrels (2,178

thousand barrels per day (b/d) in 2007, accounting for 44.6% of the total energy consumption, increasing 10.4% compared with 765,520 thousand barrels (2,097 thousand b/d) in 2006, and placing South Korea in the rank of the 6th largest oil consumer in the world (KEEI 2008:72-73).

4.3.2.1.2. Imports.

Korea imports her whole requirement of crude oil from abroad to meet her domestic demands. She imported the crude oil of 872,541 thousand barrels (2,390.1 thousand b/d) in 2007, emerging as the 4th largest crude oil importer in the world, and decreasing 1.7% compared with 888,794 thousand barrels in 2006 (KEEI 2008:78-79).

The import value of crude oil reached 60,324 million dollars, accounting for 64.4% of the total energy imports in 2007. Even though the crude import sources were remarkably diversified to 26 countries, the dependency on the Middle East region was still high at over 70% of the total imports.

4.3.2.1.3. Refining Facilities.

The first oil refinery plant with a capacity of 35 thousand b/d was built in 1963. The crude distillation capacity had remarkably grown up to 2,812 thousand b/d in 2007 in a comparatively short span of time, ranking the 6th in the world (KEEI 2008:90-91).

4.3.2.1.4. Oil Stockpile.

According to the recommendation of International Energy Agency (IEA) in the light of meeting her huge demand, she has maintained an oil stockpile of a 90-day consumption, preparing for a national state of energy emergency, and comparing with advanced countries such as Japan with a stockpile of 75 days and USA with 35 days (Kim 2007:1-2).

4.3.2.2. Coal.

The coal demand was up to 94,128 thousand tons increasing 10.7% toward 87,827 thousand tons in 2006, which will be increased in the future owing to the increasing requirement of bituminous coal for industrial

sectors. The coal imports reached 88,898 thousand tons in 2007, increasing 11.0% compared with 80,067 thousand tons in 2006. The import value amounted to 6,445 million US\$, accounting for 6.8% of the total energy imports in 2007 (KEEI 2008:108-109).

4.3.2.2.1. Anthracite Coal.

Anthracite coal is a major indigenous energy source mainly consumed in the residential and commercial sectors, which contributed so much to overcome the two oil crises that occurred in 1973 and 1978. The anthracite reserve reached 331.1 million tons in 2006, but the bituminous reserve was not yet identified in South Korea (KORES 2007:26-29).

The production had peaked at 24,295 thousand tons in 1988, and then decreased to 2,886 thousand tons in 2007 due to increasing production costs with the deepening and narrowing of the coal mines. The imports increased to 5,444 thousand tons in 2007 (448 million US\$) from 5,113 tons in 2006 (407 US\$).

The consumption also dropped to 4,254 thousand tons from 26,843 thousand tons in 1987 due to the favoring of higher quality energy as a result of the increase in income level and concern about the environmental impact. So, the Korean government restructured the anthracite mining industry, while she promoted the consumption of anthracite coal through establishing two anthracite power plants. However, the demand will not be increased in the future.

4.3.2.2.2. Bituminous Coal.

South Korea has totally imported bituminous coal for power generation, cement plant, and steel industry. She imported 83,454 thousand tons (5,997 million US\$) in 2007 from Australia, Canada, Indonesia, Russia and South Africa, an increase of 11.3% compared with 74,954 thousand tons (4,911 million US\$) in 2006.

4.3.2.3. Natural Gas (LNG).

In order to reduce the oil dependence rate of her economy, Korea has tried to promote a diversity of energy sources. She signed a long-term

contract with Indonesia to import 2 million tons of liquefied natural gas (LNG) annually for 20 years in 1983. Since then, the LNG consumption has exploded to 34,663 thousand TOE in 2007, with a share of 14.7% of the total energy consumption (KEEI 2008:94-103).

The consumption will continually be increased for town gas and power generation in the future, with the completing of the supply infrastructure such as receiving terminals and nationwide pipeline networks, and the encouragement of its consumption to mitigate the environmental concern from CO₂ emission.

4.3.2.4. Uranium.

Even though the grade is low (the average grade of U₃O₈ 0.039%), Korea identified a uranium reserve of 115.6 thousand tons in Chungcheong province. It is not economical yet to do commercial production with the current mining technology. So, Korea has been importing all the uranium required to operate 20 nuclear power plants at the moment (KORES 2003:49-50).

4.3.3. Electricity.

The supply and demand for electricity has ever-increased along with the rapid economic growth and improvement of living standards. The electricity consumption rapidly grew to 368,605 GWh in 2007 from 35,424 GWh in 1981. The major consuming entity was the industrial sector, using 50.5% (186,252 GWh) of the total consumption in 2007.

The capacity of electric power generation showed a remarkable growth from 9,835 milliwatts (MW) in 1981 to 67,196 MW in 2007, while electric generation increased from 40,207 GWh in 1981 to 403,208 GWh in 2007. The generation structure of electricity utilities is composed of hydro (5,056 GWh), steamed thermal (177,511 GWh), internal combustion (77,706 GWh), and nuclear power (142,934 GWh) in 2007 (KEEI 2008:128-133).

4.4. Metallic and Non-metallic Minerals.

4.4.1. Demand.

The total demand for metallic and non-metallic minerals were 14,678.9 billion Won (₩) in 2007, an increase of 10.3% compared with 13,303.1 billion Won in 2006 as shown in table 6. The metallic mineral requirements has rapidly increased due to the expansion of copper, lead and zinc refinery plants, steel manufacturing, vehicle and the electronic industry. The non-metallic mineral demand has steadily increased due to the expansion of steel, cement, and paper and steel manufacturing (KIGAM 2008:6-7).

Table 4.6: Demand Trends of Mineral Resources in South Korea.

unit: billion Won(₩)

Year	1995	1998	2000	2002	2004	2005	2006	2007
Total Demand	5,187	13,832	7,130	8,191	11,621	9,678	13,303	14,679
Domestic Consumption	3,062	4,037	4,372	6,230	7,553	8,755	11,542	12,473
Exports	1,942	9,617	1,877	1,382	3,862	655	1,309	1,340
Stocks	182	179	882	579	205	267	452	867

Source: Korea Institute of Geology and Mineral Resources (KIGAM), The Demand and Supply Situations of Mineral Resources in Korea, 2008.

4.4.2. Production.

The domestic production was 2,759 billion Won in 2007, an increase of 13.4% from 2,434 billion Won in 2006 as shown in table 7. The domestic production of metallic minerals such as gold, silver, zinc, iron and titanium has decreased due to scanty reserves, deepening of mines and closure of existing mines, while imports has sharply increased to meet the rapidly increasing requirements (KIGAM 2008: 11-12).

The domestic production of non-metallic minerals has increased with abundant reserves of limestone, kaolin, pyrophyllite, feldspar and silica, while the imports of premium refined product has also increased along with high quality needs.

The minerals with a self-supply rate of more than 50% of the domestic demands are 11 kinds such as limestone, pyrophyllite, silica stone, kaolin, feldspar and titanium, while the rest of the minerals are imported from foreign countries such as Australia, Chile, Peru, South Africa, Brazil and Indonesia etc. The domestic production of metallic and non-metallic minerals accounted for 0.31% of GDP and 0.4% of total export earnings respectively in 2007.

Table 4.7: Supply Trends of Mineral Resources in South Korea.

unit: billion Won(W)

year	1995	1998	2000	2002	2004	2005	2006	2007
Total Supply	5,185	10,650	7,131	8,191	11,239	9,431	12,956	15,049
Domestic Production	1,059	1,204	1,203	1,557	1,937	2,069	2,434	2,759
Imports	3,970	9,224	5,756	5,633	9,097	7,094	10,070	11,423
Transfer	156	222	172	1,001	205	268	452	867

Source: KIGAM, 2008./ Note: transfer is amounts transferred from previous year.

4.4.3. Reserves.

Korea has relatively rich reserves of non-metallic resources such as limestone, pyrophyllite, feldspar, kaolin and silica as shown in the table 8, while the reserves of metallic resources are very poor and most of the mines are in poor condition (KORES 2007:13-19).

The average self-supply rate of all the minerals was 10.39% in 2007, of which metallic was 1.06% and the non-metallic 72,78%. Completely self-supply minerals are silica, pyrophyllite, feldspar, alunite, serpentine, green gemstone, partly self-supply ones are gold, silver, zinc, iron, limestone, talc etc. Completely imported minerals are copper, phosphate, magnesite, sulphur and so on.

Table 4.8: Major Metallic Reserves in South Korea. unit: 1,000 tons.

Metallic	Gold	Silver	Copper	Lead/ Zinc	Iron	Tungsten	Rare Earth
Reserve	4.7	6,452	1,642	14,589	23,725	12,958	20,181
Non-Metallic	Talc	Kaolin	Fedspar	Limestone	Graphite	Pyrophyllite	Silica Stone
Reserve	6,102	75,904	67,110	7,533,765	6,102	54,489	939,177

Source: KORES, 2007.

4.4.4. Imports and Exports.

The imports of metallic and non-metallic minerals amounted to 12,292.8 million US\$ in 2007, accounting for 3.4% of the total imports and increasing with 16.6% compared with 10,539.2 US\$ in 2006 due to an increase in the

mineral prices, while the exports amounted to 1441.6 million US\$, accounting for 0.4% of the total exports and increasing with 5.2% compared with 1,370.1 million US\$ in 2006 as shown in the table 9.

The minerals of which more than 1 million US\$ in value that were imported in 2007 are gold, silver, platinum, molybdenum, lead, and sulphur, titanium, kaolin, diamond and pyrophyllite etc., while the minerals of which more than 1 million US\$ were exported are gold, silver, platinum, molybdenum, lead, sulphur, magnesite, kaolin, diamond and pyrophyllite etc. The major countries to which these minerals were exported are England, Holland, Germany, Japan and the USA.

Table 4.9: Import and Export Trends of Mineral Resources in Korea.

Unit: million US\$

Year	1985	1990	1995	2000	2005	2006	2007
Exports	41.0 (0.14)	239.0 (0.37)	2,516.7 (2.01)	1,660.3 (0.96)	641.1 (0.23)	1,370.1 (0.42)	1441.6 (0.40)
Imports	783.2 (2.52)	1,752.9 (2.51)	4,958.0 (3.67)	7,247.3 (4.52)	9,282.8 (4.70)	10,539.2 (5.10)	12,292.8 (5.2)

Source: KIGAM, 2008./ Note: The numbers in the parenthesis is the export and import ratio to their total amounts.

4.4.5. Major Metallic Minerals.

4.4.5.1. Ferrous Metallic Minerals.

A great tungsten mine at Sangdong, Kangwon province, which old Koreans were proud of as a major exporting locomotive in the 1960s and 1970s, was closed in 1987 due to loss of commercial profit as a result of the deeping of the mine and a drop in the international price as a result of a great supply of Chinese low-priced tungsten from the beginning of 1980s. Presently, several mines of iron and titanium are maintaining the domestic production of ferrous metallic minerals in South Korea.

4.4.5.1.1. Iron.

4.4.5.1.1.1. Production.

South Korea produced 290.8 thousand tons in 2007, an increase of 27.9%

compared with 227.4 thousand tons in 2006, which were supplied by cement plants such as Asia Co. and Dongyang Co. and iron foundries such as Pohang Steel Corporation (POSCO) and Kwangyang Steel Corporation.

However, the domestic production was only 0.6% of the total requirement of 47,777.0 thousand tons in 2007. So, Korea imported 46,176.3 thousand tons from Australia, Brazil, South Africa and India, an increase of 10.5% compared with 43,895.4 million tons in 2006. The iron ore reserve amounted to 23,725 thousand tons with the average grade of Fe 38.3% in 2006, mainly located in Keongki, Kwanwon and Chungbuk provinces (KIGAM 2008:21).

4.4.5.1.1.2. Steelmaking Capacity.

The steel industry has played a leading role in the rapid economic growth in Korea. The steel-making capacity has dramatically increased up to 48,883 thousand tons in 2007 from 150 thousand tons in 1962. It has grown by 12% annually and expanded 326 times more since 1962. The expansion trend of the steelmaking capacity will be continued to meet the increasing domestic requirements. The steel production has almost completely been to meet the domestic demand and only 9.9 thousand tons were exported to China and Japan.

4.4.5.1.2. Titanium.

The demand of titanium reached 225.5 thousand tons in 2007, decreasing 19.5% compared with 280.2 thousand tons in 2006 due to a slump in the vehicle and aircraft industry. However, the domestic production increased with 7.8% from 179.9 thousand tons in 2006 to 193.9 thousand tons in 2007. Imports decreased from 188.3 thousands tons in 2006 to 116.4 thousand tons in 2007, while exports increased to 98.8 thousands tons in 2007 from 78.9 thousand tons in 2006. The titanium ore reserve amounted to 857.6 thousand tons with the average grade of TiO₂ 19.2% in 2006, located in the iron mines of Keongki and Kwangwon provinces (KORES 2007:164-165).

4.4.5.2. Major Non-ferrous Metallic Minerals.

4.4.5.2.1. Smelting and Refinery Capacity.

Kumho mine used to be the only zinc one in Korea and produced 10,000 to 20,000 tons of zinc concentrate ores every year, but it was closed in 2001. So, there is not a base metal mine in South Korea at the moment, but there are two big smelters operating with the concentrate ores imported from Indonesia, Chile, Peru, Papua New Guinea, Australia and Guinea etc.

One is the copper smelter with a smelting capacity of 420,000 tons and refinery capacity of 510,000 tons per year. The smelting and refinery plants are located at Onsan and Janghang and operated by LC-Nikko Co. The other is the zinc smelter with capacity of 400,000 tons for zinc and 200,000 tons for lead per year, managed by Korea Zinc Co. Adding to the smelters, Young-Poong Co. has also operated the zinc smelter at Sukpo with the capacity of 110,000 tons per year (KORES 2003:52-56).

4.4.5.2.2. Demand.

Korea was the fifth largest lead consumer following China, USA, Japan and Germany and the fourth largest zinc consumer following USA, China and Germany in 2007. She consumed lead of 179.5 thousand tons and zinc of 1,388.1 thousand tons. The increasing requirements were almost met with imported lead of 256.4 thousand tons and zinc of 1,333.5 thousand tons in 2007. The domestic production of lead and zinc were no more than 24 tons and 4,067 tons respectively in 2007. So, the imports of lead and zinc will be continually increased in the future to meet the increasing demand. The lead and zinc ore reserves with average grade of Pb 2.2% and Zn 3.2% amounted to 14,588.9 tons in 2006 (KIGAM 2008:15-16).

4.4.6. Non-metallic Minerals.

4.4.6.1. Limestone.

4.4.6.1.1. Reserve.

Limestone is one of the abundant minerals in Korea with a reserve of 7,533,765 thousand tons in 2006. It has played a leading role in promoting the building industry and social infrastructure in South Korea, because it is

a major material for making cement and iron-manufacturing solvents (KORES 2007:266-269).

4.4.6.1.2.

South Korea produced 86,121.3 thousand tons in 2007, an increase of 8.5 % compared with 79,404.1 thousand tons in 2006, and consumed 87,198.4 thousand tons with an increase of 7.5% in comparison to 81,132.8 thousand tons in 2006. She exported 62.7 thousand tons in 2007 with an increase of 55.6% in comparison to 40.3 thousand tons and imported 1,337.0 thousand tons in 2007, a decrease of 9.8% compared with 1,482.1 thousand tons in 2006 (KIGAM 2008:5-6).

Table 4.10: Major Mineral Situation in South Korea, 2007.

Minerals	Demand	Production	Import	Export
Gold (kg)	44,527	47,078 (3,098)	60,610	36,574
Silver (kg)	1,093,803	1,393,935 (57,369)	1,207,046	1,504,940
Copper (t)	1,428,547	6	1,402,886	n/a
Lead (t)	179,454	24	256,367	134,041
Zinc (t)	1,388,113	4,067	1,333,481	16,923
Iron (t)	47,777,024	290,802	46,176,285	9,930
Chrome (t)	2,536	n/a	2,596	n/a
Titanium (t)	255,463	193,953	116,374	98,756
Aluminium (t)	276,580	n/a	276,622	42
Platinum (kg)	26,093	n/a	28,253	297,856
Limestone (t)	87,198,375	86,121,391	1,336,971	62,696
Talc (t)	122,536	9,557	119,124	10,176
Pyrophyllite (t)	653,290	798,654	4,889	101,193
Feldspar (t)	463,630	398,513	6,929	23,912
Kaolin (t)	2,963,571	2,630,358	391,776	57,887
Silica Stone(t)	3,550,748	3,510,699	48,849	3,850
Sulphur (t)	510,28	670,000	118,525	277,905
Mica (t)	127,716	42,385	78,119	244
Zeolite (t)	161,397	157,408	1,541	109

Source: KIGAM./ Note: The numbers in the parenthesis of gold and silver column is the amount produced at the domestic mines.

4.4.6.2. Kaolin.

Kaolin is used in various fields such as ceramics, chemical industry and radioactive waste water treatment etc. The demand of kaolin was up to 2,963.6 thousand tons in 2007, an increase of 10.2% compared with 2,690.5

thousand tons in 2006 due to a boom of ceramics, fire-resisting industry and treatment of nuclear waste water (KIGAM 2008:7-8).

The domestic production also increased with 9.6% from 2,399.5 thousand tons in 2006 to 2,630.4 thousand tons in 2007 to meet the increasing requirements. Imports increased from 363.7 thousands tons in 2006 to 391.8 thousand tons in 2007, while exports decreased to 57.9 thousands tons in 2007 from 71.8 thousand tons in 2006. The kaolin ore reserve is relatively abundant with 75,904.5 thousand tons in South Korea in 2006.

4.5. Nuclear Power Plants.

South Korea has continually built nuclear power plants to meet her increasing energy demand since she started the operation of the first nuclear plant in 1978. She is planning to set up 10 more plants by 2030 in a small country of 99,117 km .

However, except for a few Asian countries such as Japan, China and India, most of the western countries have suspended and/or decreased the number of nuclear plants to prevent serious environmental impacts until new technology is developed for nuclear waste treatment and operation safety as mentioned in 3.3.2.

4.5.1. Facilities.

Due to her efforts for diversity of energy sources to alleviate the insecurity of oil supply, South Korea started the operation of the first nuclear power reactor with Kori Unit #1 in 1978. She is now operating 20 reactors and 5 reactors are under construction as shown in the table 11, producing 80.1% of the total domestic energy production in 2007.

Additionally, she announced the first national energy basic plan (2008-2030) in August 2008 to build 10 more plants until 2030. And then, nuclear electric power generation will be expanded from 36% of the total generation in 2008 to 59% in 2030 (Kim 2008:3-4).

4.5.2. Uranium Demand.

South Korea consumes uranium at 4,000 tons annually to operate 20 nuclear plants at present. But she doesn't produce it at all and has a lack

of conversion and enrichment facilities. So, she has imported all the nuclear fuels in their semi-processed form of UO₂ on long-term contracts with USA, England, Canada, Australia, France and South Africa. Additionally, she signed an agreement with Uzbekistan for the long-term supply of uranium on September 25, 2006 (KHNP 2007:27-31).

Table 4.11: Nuclear Power Plant Situation in South Korea.

Situation	Name	Unit No.	Capacity(MW)	Operation Date	Reactor Type
Operation	Kori	#1	587	Apr. 29, 1978	PWR
		#2	650	Jul. 25, 1983	PWR
		#3	950	Sep. 30, 1985	PWR
		#4	959	Apr. 29, 1986	PWR
	Wolsong	#1	679	Apr. 22, 1983	PHWR
		#2	700	Jul. 01, 1997	PHWR
		#3	700	Jul. 01, 1998	PHWR
		#4	700	Oct. 01, 1999	PHWR
	Yonggwang	#1	950	Aug. 25, 1986	PWR
		#2	950	Jun. 10, 1987	PWR
		#3	1,000	Mar. 31, 1995	PWR
		#4	1,000	Jan. 01, 1996	PWR
		#5	1,000	May 21, 2002	PWR
		#6	1,000	Dec. 24, 2002	PWR
	Ulchin	#1	950	Sep. 10, 1998	PWR
		#2	950	Sep. 30, 1989	PWR
		#3	1,000	Aug. 11, 1998	PWR
		#4	1,000	Dec. 31, 1999	PWR
#5		1,000	Jul. 29, 2004	PWR	
#6		1,000	Apr. 22, 2005	PWR	
Construction	Shin-Wolsong	#1	1,000	2011	PWR
		#2	1,000	2012	PWR
	Shin-Kori	#1	1,000	2010	PWR
		#2	1,000	2011	PWR
		#3	1,400	2013	PWR
		#4	1,400	2014	PWR

Source: KHNP, 2007/ Note: PWR and PHWR are Pressurized Water Reactor and Pressurized Heavy Water Reactor respectively.

4.5.3. Nuclear Waste Treatment.

Nuclear waste from nuclear plants have been stored in temporary storage facilities located at each of its nuclear plant sites in Korea. But such a interim waste treatment has put pressure on her to seek permanent disposal sites and construct permanent disposal facilities. Because she had faced strong opposition in the course of deciding which sites. Much more serious

opposition is expected in the process of seeking the disposal sites for high level waste (HLW). Furthermore, that is an urgent matter, because Kori Unit #1 with an age of more than 30 years should be closed down in the near future.

The Korean government designated the Gyeonju region to be the final candidate to build disposal facilities for low to medium level radioactive waste as the result of voting local residents in December 2005 after a long struggle with serious opposition to the site decision. The facilities constructed at Bonggilri in Gyeongju city will accommodate a total of 800,000 drums (KHNP 2007:28-29).

The first facility consists of cylinder-shaped vertical caves with a depth of 80 meters to dispose of 100,000 drums of waste, to be completed at the end of 2009. A temporary storage facility as well as inspection and processing facility will be set up at the ground level. The disposal facility for the remaining 700,000 drums will be designed from reflecting the experiences of the first construction stage and changes in composition and processing technologies of nuclear waste.

4.6. Overseas Energy and Mineral Development Policy.

The uncertainty in the international resource market has increased in recent years owing to a rapid rise in energy and mineral demand in developing countries, in particular China and India. In addition, some oil and mineral-producing countries are showing signs of resource nationalism by taking advantage of their energy and mineral resources to serve their political and diplomatic purposes or by adopting policies that support and foster their national resource companies.

Consequently, energy and mineral-importing countries have been eager to improve their energy and mineral security. The United States and Western Europe have gained firm footholds in resource-owning countries through their long history of resource development. Though China, Japan and India initiated overseas resource development much later than the United States and major European countries, they have increased their investment aggressively and supported their companies by offering overseas developmental assistance (ODA) or by exploiting their diplomatic influence.

Most of the companies of advanced countries have avoided to develop domestic energy and minerals due to strict environmental regulations and

pursued to develop overseas resources by taking advantage of the poor environmental legal systems in developing countries, without taking into account their responsibility to be stewards of the earth.

4.6.1. Developing Trends.

In Korea, the overseas resource development refers to corporate activities in which Korean companies are partly or wholly involved in the processes of resource development such as exploration, development, production, and distribution in foreign countries. Since Korea imports nearly all of its energy and minerals, overseas resource development is regarded as one of the effective measures for promoting resource supply security.

Korea's first venture into overseas resource development was in 1977 when she invested in the San Antonio Uranium Mine in Paraguay. She invested in an oil field in the Madura region of Indonesia in 1981, and then expanded continually to invest and participate in overseas resource development projects.

However, due to the financial crisis of 1997 that impaired her two-decade-long efforts, her investment in overseas resource development projects did not pick up until 2005. And her overseas resource development policy underwent a sort of paradigm shift in terms of investment scale, regional diversification, and project numbers.

4.6.2. Performing Result.

Korean companies invested 8.9 billion dollars in oil and gas development and 2.5 billion dollars in developing other mineral resources to carry out 286 ongoing resource development projects in 53 countries as of the end of 2007 (Lee 2009:37-43).

4.6.3. New Development Policy.

The Korean government set energy and mineral security as one of the high priorities of the national policy in 2008, and planned to achieve a goal

for the independent resource development rate²⁾ of 32% in 2012 from 18.24% in 2007 and then 40% by 2030 for strategic resources such as oil, natural gas, uranium, copper, iron, lead and zinc.

In order to improve her energy and mineral security by means of overseas resource development, she made a decision to set up the resource development fund of about 1 billion US\$ to support the overseas projects in May 2009. And she has promoted overseas resource development as an item on the national agenda and conducted resource cooperation diplomacy with various countries.

4.7. Environmental Impact from Mining Activities in Korea.

Human civilization has been developed with mineral and energy resources. Mineral and energy resources such as metal, petroleum and coal are the most important materials for the industrial development of a country. It is true that the stable and continuous supply of resources is the major factor for the economic growth of a country. However, environmental damages such as acid mine drainage (AMD), mine tailing sweeping, ground subsidence, and forest ruin are inevitable in developing a mine.

These mining hazards are considered as causes of natural damages such as ground collapse, contaminated water outflow, heavy metal contamination for soil, dust scattering, noise and vibration. But these damages are caused by the process of mine development such as exploration, excavation, grinding, transportation and concentration. The mining hazards are characterized as contamination, continuation, accumulation and diffusion. They may happen long after the mine development has finished, and result in environmental problems, safety concerns and civil appeals.

Until the early 2000s, only simple construction methods such as stone embankments and retaining walls were used as measures to prevent mine

2) The "independent resource development rate" is a concept used in Korea and Japan to indicate the proportion of resources which a country developed and produced for itself in comparison to the total imports. Independently developed resources from a project are calculated by multiplying the output from the project by the share of the country in the project.

hazards in South Korea. At the moment South Korea is confronted by some serious problems. More comprehensive technologies related to geology, mining chemical, civil, mechanical and environment engineering are necessary to reclaim mine sites.

Therefore, the Korean government launched the Mine Reclamation Corporation (MIRECO) in 2005 in accordance with the Mining Damage Prevention and Mine Reclamation Act of 2005, and set up a mine reclamation plan in June 2006 to carry out long-term and systematic projects. However, most of the Korean churches have not been concerned about an ecological mission regarding mining activities in Korea, even though it involves environmental problems that can't be solved by government and specialized agencies alone.

4.7.1. The Current Situation of Mine Hazards.

Once a mine reaches the end of its operational lifetime and dumping activities cease, ground-water is contaminated by acid water drainage that eventually flows into rivers and dams. Adjacent soils are polluted with heavy metals such as cadmium and lead, which come out of abandoned mine sites.

According to MIRECO, 936 sites of 388 mines out of 515 abandoned non-coal mines and 399 sites of 220 mines out of 340 abandoned coal mines are producing various types of mine hazards and contaminations as shown in table 12. However, the exact number of the abandoned mines in Korea has not established yet. Many of the closed mines recklessly developed under Japanese colonial rule are still spread out all over the country, and has impacted serious environmental damages.

Table 4.12: The Current Mine Hazard Sites from Abandoned Mines.

category	AMD	waste rock	tailings	mine subsidence	waste facilities	abandoned mine head	outflow water	total
abandoned mines (936)	19	90	30	9	20	348	-	516
abandoned coal mines (340)	36	138	-	114	104	-	7	399
total	55	228	30	123	124	348	7	915

Source: MIRECO, 2007 International Symposium Reports on Mine Reclamation held in Korea on September 13-14, 2007.

According to the report on the environmental impacts from mining activities, 44% (418 sites) of 936 abandoned mine sites have seriously contaminated the adjacent soil so that vegetables, rice and corns produced in the areas in 2005 contained lead and cadmium at a much higher level than the international standard approved by International Food Regulatory Commission (Yang 2006:7; Kim_(a) 2006:6).

4.7.2. Acid Mine Drainage.

Once a mine reaches the end of its operational lifetime, ground-water is contaminated by acid water drainage that eventually flows into rivers and dams, and the adjacent soil is polluted with heavy metals which come out of abandoned mine sites. Fish and aquatic plants cannot live in the water, because mine water is acidic and includes a number of heavy metals such as iron, lead, zinc, cadmium, manganese.

It is also difficult to use this water as an agricultural water source. Mine water often contaminates farm lands because of the high content of heavy metals. From a survey of the Ministry of Knowledge and Economy, 60,000 tons of mine water is coming out at 137 abandoned coal mines a day and 3,800 tons from 124 metal mines a day in South Korea (MIRECO 2007:7-8).

4.7.3. Mine Tailings.

Most of the metallic mining and smelting works were ceased in the 1980s and huge amounts of mine tailings were left behind without proper environmental treatment. The unprotected mine tailing piles have been dispersed down slopes by wind and water.

Sweeping of mine tailings in abandoned metallic mines could cause ecosystem contamination and high concentrations of heavy metals in soil that exceeds the current regulation for arable land. The case of Keumjung mine is a serious example. The tailing deposit of the Keumjung mine was swept by typhoon Lusa in 2002. As a result of tailing discharges, water and soil were contaminated by heavy metals (MIRECO 2007:5-6).

Most cases of abandoned mine areas in South Korea are in remote mountains. It is difficult to transport tailings out of the mine areas and procure treatment sites.

4.7.4. Soil Contamination.

Soil contamination in mine areas can be caused by heavy metals in AMD outflow and mine tailings. Heavy metals are accumulated in agricultural soil and crops. Eventually, they may cause a potential health risk to the residents in the vicinity of the mines.

In 2004, there was a report about a possibility of cadmium toxicities for residents near abandoned metal mines in Kosung county in Kyungnam province. As a result of this report, consumption of the crop produced from this province was severely affected. Also in 2006, the Korean government announced that heavy metals exceeded the standard regulation in these crops from metallic mined areas (MIRECO 2007:9).

Korean newspapers disclosed in September 2006 that some of the adjacent soil of the 936 abandoned mine sites are seriously contaminated so that vegetables, rices and corn produced in those areas in 2005 contained lead and cadmium above the international standard level approved by the International Food Regulatory Commission. It has become a big social issue in the country.

The Korean government surveyed heavy metals in those arable lands near the 236 abandoned metal mines until 2008, and will survey other 310 abandoned metal mine areas during 2009. It is also ready to start soil remediation projects to treat the affected arable lands.

4.7.5. Mine Subsidence.

There was a sudden collapse of a graveyard located in Incheon Bupyeong in May 1993. The accident was occurred by the neglect of management of the Bupyeong abandoned metallic mine. As a result, the 154 graves were ruined. This is a typical example of mine subsidence of abandoned metal mines (MIRECO 2007:9-10).

Mine subsidence means that the ground collapses and cracks when the upper part of an underground goaf breaks down with the lapse of time. That is developed into the upper part of the goaf and linked to the ground surface. Therefore, ground safety near an underground goaf is emerging as an important issue. Several projects for the prevention and restoration of ground subsidence were performed in the coal mined areas in South Korea. Most of the projects were performed in the vicinity of national highways

and the Yeungdong railroad.

4.7.6. Pollution from Limestone and Coal Mines.

South Korea has abundant reserves of limestone, feldspar, pyrophyllite, talc and anthracite coal, which are the main materials for various cements, iron-manufactured solvents and briquette. However, limestone and coal mines bring about serious air and water pollution with dust coming out of mining activities.

Most of the roofs at Donghae and Samchuk, the main mining areas for limestone and coal are covered in grey with dust from the mines. The residents complain that they cannot hang up their clothes outside after washing them. They also complain about health problems such as asthma and chest troubles as a result of the environmental impact from limestone mining and cement plants.

In 2007, Korean journalists exposed in 2007 that several heavy metals are contained in cements such as cadmium, lead and arsenic, causing cancer. The reason for this was that many companies made various cements from industrial waste such as waste tyres and iron-smelting dregs etc. It causes serious social concerns about health problems and the environmental impact from cement and cement plants. Some medical doctors warned that if a family moves into a new apartment built with this cement, skin diseases could break out as a result of this toxic cement (Yoon 2007:6-7; Jang 2007:5).

4.7.7. Pollution from Asbestos Mines.

Asbestos is a useful material for cement, tile, plastic, chemical tools etc. produced mainly in Canada, South Africa and Russia. It, however, causes various diseases of respiratory organs such as lung cancer and asthma.

In 2008, it was collectively discovered that the residents living in the vicinity of asbestos mines at Hongsung, Boryung, Suhsan and Yesan in the Chungnam province were suffering from chest diseases (Han 2009:12). They have asked the government to do a comprehensive health check for all the residents and prepare a detailed course of treatment in response to an enactment of a special act concerning health damage as a result of the mines.

4.7.8. Pollution from Oil Refining Plants.

The oil refining industry is facing a lot of environmental problems such as air pollution, water and soil contamination. Other problems are oil spillages seriously polluting the sea coasts in the course of transportation and the shortage of refinery construction sites in the small land of South Korea.

4.7.9. Pollution from Oil Leakage.

The worst-ever oil spill took place in the West Sea, located 90 km southwest of Seoul on December 7, 2007, when a Hongkong-registered giant tanker (Hebei Spirit) collided with a barge owned by Samsung Heavy Industries Company. The oil leak caused about 11,000 tons (81,000 barrels) of crude oil to gush into the waters and it has seriously damaged the region's marine farms and beaches. The vessel was carrying crude oil to the refinery factory of Hyundai Oilbank Company located at Daesan, which is the fourth biggest refinery in South Korea (Jan 2008: 1).

The accident resulted in spilling more than twice the size of the spill of 5,035 tons of crude oil that occurred in 1995, when a tanker struck a reef off the south coast (Yeosu) of Korea, located 455 km south of Seoul. According to data on the International Tanker Owners Pollution Federation, this oil leakage is a third of the 37,000 tons spilled into the Prince William Sound, Alaska by the Exxon Valdez in 1989 (Bang 2008:9).

According to the Ministry of Marine Affairs and Fisheries, the accident hit 350 oyster and abalone marine farms covering 3,571 hectares and 6 beaches covering 221 hectares in Taean County and about 50 kilometers of the western coastlines of Korea. The giant spill also dealt a blow to the tourism business in the region which is popular for its beautiful beaches and sunsets.

The government declared a state of disaster for Taean County and its five surrounding counties and cities on December 8, 2007. It had also made all-out efforts to stop the oil from spreading to a couple of western bays which are rich in marine resources and farms. A lot of workers including soldiers tried their best to remove as much of the oil as possible, along with some vessels and helicopters.

More than 50,000 citizens voluntarily participated in removing the oil everyday for about 3 months since the accident occurred. It was confirmed by the government that most of them were christians systematically sent by all the Korean churches at their own cost.

4.7.10. Pollution from Copper and Zinc Smelting and Refinery Plants.

Korean citizens living in the vicinity of the copper, zinc and lead smelting and refinery plants have for many years been complaining about health impediments and economic troubles from the serious air and water pollution. As a result, the Korean government does not allow the expansion of zinc and copper refining facilities. Instead, it has met the increasing demand by importing the ingots and semi-ingots (KORES 2003:53-54).

4.7.11. Some Case Studies of Mining Pollution.

4.7.11.1. Soil and Ground-water Contamination from the Residual Mine Tailings at Shihung Mine Area.

The Shihung mine was restored in the early 1990s after abandonment of 20 years since 1973. Although the disposed mine tailings were removed and the site was replaced by an incineration plant, still some residual mine tailings were prone to impose an adverse impact on the soil and ground-water and needed investigation for potential contamination.

Mine tailing samples were collected from the old tailing disposal area and the rice paddy. The pore-water from the mine tailing was extracted and analysed to investigate chemical changes along the reaction path. Batch leaching tests were also carried out in the laboratory to find any supporting evidence found in the field analysis.

Evidence of elemental leaching was confirmed both by the investigation of the mine tailing and the pore-water chemistry. The element concentrations of Cu, Cd, Pb, and Zn in the pore-water exceeded the standard for drinking water in Korea and the U.S.A. In batch leaching tests, it was confirmed that heavy metals were continuously released.

Combining the information with pore-water variation with depths and the geochemical modeling results, most of the elements are controlled by dissolution and/or precipitation processes, with some solubility controlling

solid phases (Cu, Pb, Fe, and Zn).

The batch leaching test conducted at a fixed pH4 showed much higher releases at heavy metals up to 400 times (Zn) compared with the legitimate standard level. This area is becoming more vulnerable to soil and ground-water pollution by the shift into an acidic condition through precipitation of pH4 (Jung and Lee 2001:461-470).

4.7.11.2. Environmental Assessment on the Acid Mine Drainage at Youngwol, Jungseon and Pyungchang Areas.

During December 2000 to July 2002, water samples were collected seasonally from acid mine drainage and nearby streams at 13 coal mines to carry out an environmental assessment of the water system in the Youngwol, Jungseon and Pyungchang Areas in Korea. The physical and chemical properties, including pH, Eh, total dissolved solids (TDS), salinity, bicarbonates and dissolved oxygen (DO), were measured in the field. Eighteen cations including Al, Ca, Fe, Mg, Mn and Zn, and 6 anions nitrates were also analyzed respectively.

The acid water from the Jungam coal mine has characteristic of AMD with a very low pH (3-4 mg/l) and high TDS (1,000-5,000 mg/l). But high concentrations of heavy metals, such as Al (380 mg/kg), Fe (80), Mn (44) and Zn (8), were found in the water samples from the Jungam coal mine area. The water samples from the Seojin, Sebang and Sungjin coal mines also contained Al (more than 50 mg/l), Fe (100) and Mn (10). In addition to anions, over 1,000 mg/l of sulfate was found in several water samples.

Seasonally, the concentrations of metals and sulfates varied. During the wet season samples were relatively higher in metals and sulfates than dry season samples. It is necessary to establish the proper remediation and environmental monitoring of the AMD continuously (Jung 2003:111-121).

4.8. Climate Change from Emission of CO₂ in Korea.

The climate change is a warning from the Creator concerning the unsustainability of modern industrial society based on fossil fuels and unsound economic wealth orientation. It is not only an environmental issue but also a survival matter for all the creatures created by God. It is not only a scientific issue but also an ethical matter considering the will of the

Creator. Nobody can avoid responding to this urgent issue.

It asks us to control the current unrestrained and imprudent economic growth. Every nation should voluntarily give up trying to have a bigger share of GHGs emissions to avoid an immediate economic burden. Even though Korea has achieved some progress in environmental performance, more complicated challenges lie ahead to supply energy and mineral resources to meet its rapid economic growth and modern lifestyle.

4.8.1. Environmental Progress.

Several environmental pressures have been decoupled from growth in gross domestic product (GDP). Sulphur oxide (SO_x) emissions are remarkably decoupled from economic growth. The emission growth of carbon monoxide, nitrous oxides (NO_x), small particles (MP₁₀), lead, and hydrocarbons (VOCs) are all slightly decoupled. Actually, Korean emissions of SO_x and NO_x per unit of GDP are below the OECD average.

Concerning the management of general waste, she has accomplished massive progress. Although the generation of municipal waste has increased about 6% since the middle of the 1990s, the growth rate is lower than GDP through volume-based waste fees and the 3R strategy of reduce, recycle and reuse. The Korean government has constructed sanitary landfills and achieved energy recovery by landfill gas capture and combustion. The environmental expenditure has increased and exceeded 2% of GDP in 2007.

4.8.2. Environmental Challenges.

Despite the progress in environmental management, more serious challenges lie ahead. The problems require more than technological treatment. What is needed is social restructuring and changes in lifestyle based on self-reflection on the modern industrialization process and the relationship between society and nature.

Korea still has problems in managing PM₁₀, Ozone, NO_x, and carbon dioxide (CO₂) emissions. The air quality in Seoul turned out to be the worst among the capitals of member countries of the OECD in 2007. Concentration levels of PM₁₀ and nitrogen dioxide, and an increasing frequency of high ozone concentrations are problematic in the Seoul megalopolis. The concentration levels of PM₁₀ in the Seoul megalopolis satisfies the Korean

environmental standard (70 micrograms per cubic meter), but are much higher than the standard of WHO (40 micrograms per cubic meter). Increasing numbers of cars and high population density have led to a deterioration of air quality despite improving fuel quality and engine technology.

Chemical management is also troublesome. Even though the risk posed by chemicals was forewarned by Rachel Carson in her "Silent Spring" (1962), more than 100,000 kinds of chemicals are globally circulated and more than 2,000 kinds of chemicals are annually developed and commercialized. Chemicals are used everywhere from home detergents to mining fields. In pursuit of a convenient life and profitable industrial production, their safety has not been assured through risk assessment.

Since the consumption of chemicals is rapidly increasing year by year in Korea, the safe management of chemicals has become urgent. Thorough risk assessment and cautious management are necessary, because a lot of chemicals can make a fatal impact on human health and the ecosystem. Korea is facing a very critical moment requiring deeper recognition of the interlocking relationship between human beings and the ecosystem, because the chemical management is just beginning in Korea.

4.8.3. Emission Control of CO₂.

The most serious environmental problem Korea is facing now is increasing CO₂ emissions. CO₂, mainly produced from fossil fuel combustion, is the most effective greenhouse gas (GHG), which causes climate change resulting from global warming.

CO₂ takes the largest share of the total emission of GHGs by volume, accounting for 88.4% in Korea which is much higher than the global level of 77% and 83.2% in industrialized countries. This environmental evidence demonstrates that the rapid economic growth has been accompanied with more energy consumption and more CO₂ emissions. This means again that CO₂ emissions are highly correlated with energy consumption which enables rapid economic growth and more convenient lifestyles.

Korea has drawn global attention because of her unique situation and rapid growth of GHGs emissions. Although Korea is a member of the OECD, she is classified with the non-industrialized countries which have no obligation to reduce GHGs emissions during the first commitment period of

the Kyoto Protocol.

Korea reached the 10th place in the world in 2004 in terms of energy-related CO₂ emissions. Her CO₂ emissions have doubled (rising 104.6%) from 1990 to 2004. This is the highest among the members of the OECD. With regard to the absolute amount of CO₂ emission growth, she ranks fourth during 1990 to 2002.

Korea's energy consumption has sharply increased since the middle of the 1970s accompanied with the rapid economic growth driven by heavy and chemical industries. The increasing rate in energy consumption has almost outpaced the growth rate of GDP for the last 40 years. Concerning per capita energy consumption, Korea of 4.43 tons of oil equivalent (TOE) exceeded Japan of 4.18 TOE, Germany of 4.22, and most EU countries of 3.91 in 2004 (Yun 2007:4-5).

During the 20th century, the world temperature increased by 0.6 Celsius, while in Korea it increased 1.5 Celsius owing to the effect of urban heat islands through urbanization. Korea is very vulnerable to climate change because she is a peninsula with long coastal lines. So, Korea should actively set up a reduction target for CO₂ emission and set an example by fulfilling it before the first year of a post-Kyoto treaty.

Table 4.13: Emission Trends of GHGs in South Korea.

Index	Unit	1990	1995	2000	2004	Annual Growth Rate: '90-'04
GHG	million ton	310.6	452.8	528.6	590.6	4.0%
CO ₂	million ton	239.0	366.9	432.2	482.5	5.1%
GDP	billion Won	320,696	467,099	578,665	693,424	5.7%
GHG/GDP	ton/million Won	0.97	0.97	0.91	0.85	-0.9%
CO ₂ /GDP	ton/million won	0.75	0.79	0.75	0.70	-0.5%

Source: Yun, Sun-Jin, "Climate Change Test for Korean Adaptability,"
The Korea Herald, December 7, 2007, p. 4.

4.9. Environmental Impact from Nuclear Power Plants in Korea.

Some scientists assert that human history is a chronicle of taking advantage of nature's power to improve the quality of life by the development of science and technology. The power of fire was used to illuminate the darkness, and wind power drove ships to discover new worlds. In more detail, what would we do without electricity today? What if

power went out at a hospital? What if office elevators stopped working?

Such opinions and questions make us all appreciate the development of science and technology and a stable electricity supply. However, they are only meaningful because of the existence of human beings and nature. All these assumptions can be overwhelmed by the question, "What if there were no users?" How if there is no nature?

Furthermore, energy is neither created nor destroyed, which is the same total amount as created by the Creator God. This is known as the principle of energy conservation. Ultimately, electrical power generation is simply the transformation of natural energy into electrical energy useful to people. Thus, being environmental-friendly not only for the current generation but also for future generations, this is not a choice but a necessity for all power generation projects.

Therefore, we should minimize the negative impacts from the operation of existing nuclear plants on human beings and environments through assessing the environmental impact and changes in the ecosystem around the plants transparently, objectively and regularly. We should also improve sewage and wastewater treatment and waste-reduction facilities to protect marine resources, reduce discharge of nuclear pollutants and prevent leakage of any radioactive materials into the environment.

4.9.1. Nuclear Plant Technology.

In the not-too-distant past, Koreans did not even have adequate electricity for lighting. Virtually no one then imagined that power generation would become one of the nation's leading industries. It is certain that Korea cannot tap into non-existent petroleum reserves, but technology serves as a power for self-reliance. It also is agreed that Korean nuclear power technology has already caught the world's attention. Few people doubt today that Korean power generation technology is world class. However, Korea should not stop research and development (R&D), keeping in mind the dangerous stigma of nuclear plants.

We should note that Korea is not a safe land from earthquakes which occurs more than 100 times with a low magnitude annually. Japan had been proud of its safe operations of their nuclear plants from her frequent and powerful earthquakes. But we should pay special attention to the fire and releasing accident of radioactive materials at Gasiwajaki-Gariwa nuclear

plant by the magnitude 6.8 earthquake which occurred in Nigata Province July 16, 2007 (Park_(a) 2007:7).

4.9.2. Nuclear Waste Treatment.

South Korea finally decided on a site to build disposal facilities for low to medium level radioactive waste in 2005 after a long struggle with serious opposition against the site decision. However, she still has a serious dilemma to deal with the high level waste (HLW) from Kori Unit #1 which will close down in the near future, maintaining more than 10,000 years and having no precedent treatment in the world as mentioned in 3.3.2.

The original life span of the reactor of Kori Unit #1 was 30 years which finished in April 2008. However, after serious disputes concerning the prolongation in light of the safety of the plant in 2008, she finally decided to expand 10 to 20 years (Cho 2008:1-2). No matter how long it will prolong from now on, the 10 to 20 years is too short to prepare its treatment for 10,000 years.

4.9.2. Plant-building Plan.

After starting the establishment of a nuclear plant in 1978 without opening discussions with the citizens by the Korean military government at that time, she is now operating 20 plants with 6 plants under construction. Furthermore, she declared the first national energy basic plan to build 10 plants more by 2030 in a small land of 99,117 km with public concern about nuclear technology and also without citizen consensus for further plant development.

This is a very serious ethical problem as well as the environmental impact which will definitely give serious burdens to the next generations and even neighboring states in the light of long, huge and the dangerous stigma of nuclear plants. This is obviously to be met with strong opposition from civic groups that have been against the use of nuclear power, only leading to increasing energy consumption and producing massive nuclear waste (Cho 2008:3).

Chapter V: Inadequate Environmental Involvement of Korean Churches.

It is not surprising that the rapid growth of Korean churches has been reported in various Christian magazines and journals along with that of the Korean economy. It has attracted attention among Christians worldwide, particularly those who are involved in church growth studies (Ro and Nelson 1995:5).

However, it is clear that the tide began to turn at the end of the 1990s. Even though there are no exact statistics at the moment, it is common information among Koreans that the total membership of the Protestant churches has decreased more than 10% from that time on. They are also confronted with the new problem of environmental impact as a result of the energy and mineral development to meet the demands of the Korean rush for economic growth as mentioned in 4.3 to 4.5.

They have no honorable position for environmental degradation in Korea, because they have concentrated on church growth but not so much on social movements, keeping pace with the rapid economic growth. They have generally executed their pastoral duties with indifference regarding taking a position on political and economic programs and structures. They have become encapsulated communities separated from their societies as a result of the dichotomous theological influence from Western Christendom that the church is good and the world is evil.

Most of them are unconcerned about the serious environmental deterioration as a result of energy and mineral development projects. Their church-centered ministries do not exhibit the necessary social responsibility to actively participate in environmental movements. They are rather of the opinion that the environmental issues are only the responsibility of government and specialized non-government organizations, not for Christian churches.

In this chapter, I will briefly analyse the Korean religious context, the direct contributing factors to the rapid growth of Korean churches, the leadership pathologies in Korean churches and the environmental activities of the secular organizations (NGOs) to understand the Korean Christian context concerning environmental movements, and then look over the environmental-involving situation of Korean churches to recognize their unconcerned attitudes to the environment in light of the serious environmental impact from mining activities and nuclear plant operations as

mentioned in 4.7 to 4.9.

5.1. Korean Religious Context.

With a history stretching over 5000 years, Korea boasts a rich and distinct culture that is steeped in confucianism and Buddhism. Consequently, unlike some cultures where a single religion is dominant in western countries, the Korean culture includes a wide variety of religious elements that have shaped the people's ways of thinking and behaviour. Historically, Koreans lived under the influences of shamanism, Buddhism, Taoism and Confucianism. In modern times, Christianity has made strong inroads into the country, bringing forth yet another important factor that has changed the spiritual landscape of the people (KOCIS 2004:424-441).

Table 5.1: Market Share of Korean Religions in 2001. Unit: %

Religion	Buddhist	Protestant	Catholic	Indigenous Religion	Confucian	Muslim	Others	Non-Religious
Market Share(%)	23.89	23.55	8.12	8.00	0.47	0.07	0.88	35.02

Source: P. Johnstone and J. Mandryk, Operation World: 21st Century Edition, 2001 P. 218.

5.1.1. Shamanism.

The different religions of Korea reflect dissimilar religious thought. Shamanism is a primitive religion that does not have a systematic structure but permeates into the daily lives of Korean people through folklore and customs. Shamanism gradually gave way to Confucianism or Buddhism as a tool for governing the people, but its influence lingered on and has remained an underlying religion of the Korean people as well as a vital aspect of their culture.

The shaman, Mudang in Korean, is an intermediary who can link the living with the spiritual world where the dead reside. The shaman is considered capable of averting bad luck, curing sickness, assuring a propitious passage from this world to the next and solving conflicts and tensions that might exist between the living and the dead.

5.1.2. Buddhism.

Buddhism is a highly disciplined philosophical religion which emphasizes personal salvation through rebirth in an endless cycle of reincarnation. Since Buddhism was introduced into Korea from China in 372, many temples and monasteries were constructed and the number of believers grew steadily under royal patronage.

The past few decades have seen Buddhism undergo a sort of renaissance, involving efforts to adapt to the changes of modern society. While the majority of monks remain in mountainous areas, absorbed in self-discipline and meditation, some come down to the cities and universities to propagandize and research their religion. Meditation-oriented Korean Buddhism has been growing noticeably with many foreigners following in the footsteps of revered Korean monks through training at several temples.

5.1.3. Confucianism.

Confucianism is a system of ethical precepts such as benevolent love, righteousness, decorum and wise leadership to inspire and preserve the good management of family and society, which was founded by Confucius in the 6th century B.C.

The Chosun Dynasty accepted Confucianism as the official ideology and developed a Confucian system of education, ceremony and civil administration. When Korea was invaded by many other countries including Japan in the late 19th century, the Confucianists raised "righteous armies" to fight against the aggressors. They are also making efforts to reform Confucianism to adapt it to the changing conditions of the times. Today, Confucian ancestral worship is still prevalent and filial piety is highly revered as a virtue of Korean society.

5.1.4. The Catholic Church.

The tide of Christian mission activity reached Korea in the 17th century, when copies of the Catholic missionary Matteo Ricci's works in Chinese were brought from Beijing by the annual tributary mission to the Chinese Emperor. Along with religious doctrine, these books included some aspects of Western learning such as the solar calendar and other matters that

attracted the attention of Chosun scholars of the Practical Learning School.

By the 18th century, there were several converts among these scholars and their families. No priests entered Korea until 1794 when a Chinese priest, Chu Mun-Mo, visited Korea. The number of converts continued to increase, although the propagation of foreign religion on Korean soil was still technically against the law and there were sporadic persecutions.

By the year 1865, a dozen priests presided over a community of some 23,000 believers. With the coming power of Daewongun, a xenophobic prince regent in 1863, persecution began in earnest and continued until 1873. 79 Koreans were martyred during the persecutions of the Chosun Dynasty and were beatified at Saint Peter's Basilica in Rome in 1925, and an additional 24 were honoured in the same way in 1968.

During and after the Korean War from 1950 to 1953, the number of Catholic organizations and missionaries increased. The Korean Catholic Church grew quickly and its hierarchy was established in 1962. The Roman Catholic Church in Korea celebrated its bicentennial with a visit to Seoul by Pope John Paul II and the canonization of 93 Korean and 10 French missionary martyrs in 1984. It was the first time that a canonization ceremony was held outside the Vatican. This gave Korea the fourth largest number of Catholic saints in the world, although quantitative growth has been slow for the Catholic church in Korea.

5.1.5. The Protestant Churches.

We cannot help accepting that God has been deeply interested in the missionary history of Koreans and the growth of their churches since the Sorae Church and Saemoonan Church were planted by Sang-Ryun Suh and H. G. Underwood in 1885 and 1887 respectively. In the 1970s and 1980s, the Korean church had grown at a remarkable pace from 30,000 churches in 1984 to over 50,000 with about 14,839,000 members and more than 60,000 pastors in 2000. There are 11 mega-congregations, the largest Pentecostal, Presbyterian and Methodist congregations in the world and the second largest Baptist (Hong 2001:19-29).

Korean missionaries have rapidly increased from 93 persons serving in other lands in 1979 to 10,422 persons sent by over 160 Korean and International Missionary Agencies in 2002. That is the second highest number of overseas missionaries after U.S.A in the world. There are more

than 20 protestant missionary colleges and postgraduate seminaries, including several of the world's largest theological colleges. Over the last century, Korea has recorded the most miraculous growth of Christians and churches ever experienced in any part of the world.

The Seoul Young Men's Christian Association (YMCA) was founded in 1903 along with other such Christian organizations. The organizations carried out social and political programmes actively encouraging the establishment of similar groupings of young Koreans. These groups pursued not only political and educational causes but also awakened social consciousness against superstitious practices and bad habits, while promoting the equality of men and women, eliminating the concubine system, and observing the ceremonial simplification (Park 2000:5-38).

The growing vitality of Korean churches saw the inauguration of large-scale conferences for Bible study in 1905. Four years later "A Million Souls for Christ" campaign was kicked off to encourage massive conversions to the Christian faith. The Global Consultation on World Evangelism (GCOWE) was held in Seoul in 1995 and 2000.

However, as already mentioned, the tide began to turn at the end of the 1900s. In particular, the leadership crisis is regarded as one of the biggest challenges for the churches in Korea.

5.1.6. Western Missionary Activities in Korea.

While Catholic missionaries performed only evangelical work, Protestant missionaries simultaneously carried out evangelical and social programmes such as medical, educational and social welfare projects. As a result of such versatility, the Korean Government favoured Protestant missionaries over Catholic ones.

Protestant missionaries were permitted by the Government to set up the Kwanhae hospital in April 1885 and to establish Baejae college in 1886 and Iwha women's college in 1888. By 1910, they had set up 37 colleges and high schools and several orphanages, which inspired a number of Koreans to become Christians.

It was by working together, by ecumenical cooperation, that Western missionaries succeeded in their task in Korea. They carried out their missionary projects together, which included publishing "the Korean Mission Field" in 1905, "The Christian Newspapers" in 1906 and "the Korean

Table 5.2: The Members and Affiliates of Korean Churches in 2001.

Churches	Congregations	Members	Affiliates
Presbyterian(Hapdong)	6,494	918,306	2,295,766
Presbyterian(Tonghap)	6,270	1,103,983	2,307,966
Korean Methodist	4,752	656,486	1,365,490
Korea Assembly of God	1,178	513,953	1,130,696
Presbyterian(Hapdong Bosu)	3,172	630,000	1,097,000
Korean Baptist Convert	2,245	270,000	650,000
Presby.(Hapdong Jeongtong)	1,695	183,482	610,818
Jesus Korean Holiness	953	193,373	505,946
Korea Evangelical	2,041	400,000	501,793
Presbyterian(Koshin)	1,416	176,832	442,080
Unification(Moonies)	407	132,132	440,000
Presbyterian(Yejang)	425	185,000	345,325
Presbyterian(Kijang)	1,448	141,750	321,773
Jesus Assembly of God	270	120,836	302,090
Seventh-day Adventist	628	147,080	190,000
Presbyterian(Yejang Hapbo)	293	109,700	187,500
Presbyterian(Hohun)	976	145,000	182,000
Jehovah's Witnesses	1,502	87,179	130,000
Latter-day Saints(Morm)	150	47,170	75,000
Episcopal	88	15,000	75,000
Jesus Korean Methodist	330	26,224	75,000
Gospel Baptist Convert	155	37,500	75,000
Full Gosp. Intl. Gen. Mtg.	95	30,000	75,000
Church of the Nazarene	210	40,000	55,000
Church of God(Clev)	117	20,601	36,000
Korea Evangelical	35	4,505	10,000
Catholic	980	2,125,665	3,804,940
Other denominations	17,496	2,896,000	5,429,000
Doubly affiliated		-4,000,000	-8,291,000

Source: P. Johnstone and J. Mandryk, Operation World: 21st Century Edition, 2001 P. 218.

Hymnal" in 1908. Together they established Soongsil University in 1906 and Yeunshe University in 1916.

The characteristics of the Western missionary activity in Korea can be summarized as follow:

1) The foundation of missionary activity in Korea had already been laid in China, Japan and America.

2) It was by cooperating with one another that Western missionaries could succeed in their task in Korea.

3) Protestant missionary work was carried out by indirect methods such as medical, educational and social welfare projects.

4) The missionary work started with the translation of the Bible in

Korean that was undertaken jointly by various Korean Christian leaders.

5) Koreans took the initiative for the Korean evangelical movement to plant the seeds of faith in Jesus Christ and to plant their churches in Korea.

6) Korean churches were able to stand on their own feet by adhering to the three-self principle of self-support, self-government and self-propagation (Clark 1973:42).

5.2. Contributing Factors to the Rapid Growth of Korean Churches.

According to the Report on Empirical Study of Korean Church Growth and Faith, Korean church growth depends on the Korean church itself more than its environment: Social factors accounting for 9.0%, personal factors 25.7%, and the church factor 64.6% (Kim 1982: 32-37). In this paragraph, I would like to look at the direct contributing factors for Korean church growth to figure out their main activities, almost all for their churches themselves, not for social development (environmental movements) (Kim 1997:156-159).

5.2.1. Prayer Movement.

One of the main factors contributing to Korean church growth is prayer. If anyone asks "What is the key factor for Korean church growth?" most of Korean Christians clearly answer "It's our continual fervent prayer." Korean Christians pray fervently for themselves, churches and country. Pastor, Cho, Y. G. said in a seminar on church growth (Cho 1982:45-46):

If you want your churches to grow, you must pray fervently. The work of the Lord depends upon prayer. How can you have a powerful ministry with a weak human power? So, I have prayed for about two hours in every morning prayer meeting and before preaching on Wednesday and Sunday.

Korean traditional religions and her history of suffering made Korean Christians into prayerful people. Whenever they suffered from the aggression of foreign countries, they prayed with tears day and night, and got the boldness to overcome their hardships through their prayers. They have earnestly been seeking the guidance of the Holy Spirit and the

blessing of God through their prayers. The basic power of church growth in Korea is that Korean churches are founded on prayer. There are several kinds of prayer meetings in Korean Churches:

5.2.1.1. Early Morning Prayer Meeting.

The early morning prayer meeting was initiated by pastor, Kil, Seon-Ju in Pyongyang and gave Korean Churches cause for the Great Revival Movement in 1907 (Min 1982:122-124). When Korean churches were coercively closed by the police of Japan during her colonial period, a lot of Korean Christians prayed early in the morning in front of the closed gates of their churches. Korean Christians have been looking for the origin of the morning prayer meeting in the practical life of Jesus Christ (Mk. 1:35) as the basic power of church growth.

5.2.1.2. Wednesday Evening Prayer Meeting.

All Korean churches have the evening prayer meetings on Wednesday. After the prayer meeting, they make it a rule to study the Bible for an hour. They are sure that the prayer and Bible study make their faith healthy and contribute to rapid church growth in Korea.

5.2.1.3. Friday All-night Prayer Meeting.

Most Korean churches have all-night prayer meetings on Friday. They refresh their faith through remembering the tribulations of Jesus Christ for themselves on the cross. Some Christians are used to fasting for one or two meals on Friday.

5.2.1.4. Mountain Prayer House.

A lot of Korean churches have prayer houses in the mountains for prayer and training of their church members. Some prayer houses are run privately for all Christians. Many Korean Christians go to the mountain prayer houses to pray for three to seven days. For instance, about 3,000 Christians pray every day and 10,000 on weekends in Osanri fasting mountain prayer house, belonging to Yoido Full Gospel Church.

5.2.2. Evangelistic Movement.

Korean churches lay emphasis on evangelism as the best way to accomplish the will of God, and Korean Christians also think that evangelism is their most important task. They have spread the gospel to save the lost through several evangelical methods:

5.2.2.1. Street Evangelism.

Korean Christians have gone out into the streets and market places to preach the gospel and distribute tracts, following the street evangelism of Jesus Christ, since the beginning of Korean mission. It was a famous pastor Choi, Bong-Syuk who cried out "Jesus' Kingdom" on the street of Pyongyang city at five o'clock every morning. His evangelical voice that spread from the street early in the morning became a candle to those who didn't know their spiritual way in the hard times of Japanese colonial rule. Eventually, he was one of the martyrs under the persecution of Japan.

5.2.2.2. Visiting Evangelism.

When a new church starts in Korea, the pastor, evangelist and church leaders visit house to house, talk with the family and preach the gospel. Many people have a good feeling through such visiting evangelism, come to the churches and convert into Christians. Many churches use this evangelical method effectively in the urban areas mainly consisting of apartments, while they visit the Sarang room¹⁾, the Korean guest room, to preach the gospel to the many people gathering from the villages in the rural areas.

1) It is a small room with a heated floor and no furniture, used by the master of the house to receive guests. Sometimes Western missionaries spent two or three hours a day in the Sarang room talking with visitors. Many Korean pastors used the room to preach the gospel to the people of the villages.

5.2.2.3. Special Evangelism.

The military evangelism is a good method to spread the gospel to 600 thousand young men and women in the military services. There are chaplain corps in the army, navy and air force to serve military evangelism, organized by the order of the first president, Dr. Rhee in 1951. After being discharged from their military services, most of the young converts from the services have become members of their native churches.

School evangelism has also significantly contributed to the rapid church growth. There are several groups for school evangelism such as Campus Crusade for Christ (CCC), Inter-Varsity Christian Fellowship (IVF) and Youth for Christ (YFC). In particular, the movement of the CCC that started in 1958 has affected all Korean churches considerably.

There are various kinds of Christian groups in most Korean organizations such as the government, banks, hospitals and so forth, and Korean pastors work in many fields, having various kinds of positions such as hospital pastor, prison pastor, police pastor, school pastor and so on. The companies and factories run by Christians have regular worship services once a month and small groups for Bible study. These movements have provided good opportunities to evangelise friends and colleagues.

5.2.3. Revival Movement.

The great revival movement that occurred in Wonsan city in 1907 spread over the whole nation. A great number of people experienced the work of the Holy Spirit and repented of their sins sincerely as a result of the movement. From the starting point in 1907 Korean churches began to accelerate their growth.

There were two heroes, pastor Kil, Seon-Ju and Kim, Ik-Du in the Korean revival movement. Pastor Kil led more than 7,000 people to conversion and 3,000 to baptism in the revival conference (Kim 1968:74-75). When pastor Kim led the revival conference in Daegu city in 1920, 880 people were converted and a paralytic person was healed and leapt up, through his prayer.

The mass revival conferences were held to evangelize the whole nation. In August 1963, one was held with 10 thousand people under the slogan of "for 50 Million Souls for Christ" at Chan-Chun Gymnasium. From it on, the

mass conferences were on a regular basis held with the concerted efforts to make the slogan a reality, such as the Billy Graham Revival Conference attended by 4.43 million persons in 1973, the Revival Conference of "Explo 74" with 6.55 million persons by Campus Crusade for Christ (CCC) in 1974, and the National Revival Conference for Evangelism with 1.29 million in 1977 (Ju 1982:67).

5.2.4. Bible Study.

One of the important growth factors is the diligent study of the Bible by Koreans, because they are sure that the Scripture is the bread of life (Shearer 1966:196-197). Korean Sunday schools have played an important role in evangelism for children through Bible study, while the small group Bible study for adults meets outside the churches. Women's groups usually gather in the daytime, while men's groups in the night at the home of the member. The seasonal Bible study is held for church leaders for one or two months in summer or winter. Korean Christian faith is strongly built through earnestly studying the Bible and their lovely fellowship is made through the study groups (Wagner 1979:107).

5.2.5. Passion of Pastor.

Korean pastors work hard every day. They think that God endows them with their total life jobs for the glory of God. They work as if they were shepherds and laymen were sheep. So, they work with pleasure under difficult conditions. They must get up early for morning prayer meetings and work until midnight to visit new members and lead many Bible classes. They have regular visiting events at the homes of the church members to exhort them and pray for their family and enterprises in spring and fall. They have good fellowship with each other through regular visits.

They have to prepare several messages for the morning prayer meeting, Sunday morning and evening services, the Wednesday evening service and the Friday all-night prayer meeting every week. Their messages are very evangelical with the emphasis on salvation of sin, victory from sufferings, blessings of earth and heaven, freedom from sin and hope for the second coming of Jesus Christ.

They don't think that the message without Jesus Christ and His Kingdom

is a sermon. According to Empirical Study of Korean Church Growth and Faith, the forgiveness of sin accounted for 34.2% of the total messages, the hope of future life 21.1%, and the stewardship of the church 15.6%, but social development only for 3.3% (Kim 1982: 175-178).

5.2.6. Dedication of Laity.

Korean churches has already practised laity participation in church ministry from the first period of mission in Korea on account of Nevius' Policies (Clark 1973:42). Lay people have changed into dedicated leaders without any rewards through disciple training and seasonal Bible study. The church leaders are elected by the church members as elders and deacons who are ordained for their whole life. Additionally, the pastors appoints temporal deacons with a one year service term to participate in their church ministry.

5.3. Leadership Pathologies in Korean Churches.

Korean churches enjoyed the rapid growth trend and attracted attention among Christians worldwide. In the course of the growth for the last several decades, some leadership pathologies have unfortunately been identified namely, church-centered, secularized, and authoritarian leadership etc. They are nowadays confirmed as primary factors preventing Korean Protestant churches in participating in social development (environmental movements). However, most of the churches' endeavors have ironically concentrated on developing leadership skills, programs and methodology to experience numerical growth again (Kang 2004:250-268).

5.3.1. Secularized Leadership.

The secularized leadership in Korean churches can be understood as leading God's people and performing God's mission with secular values. Behind their apparent promotion of God's glory, secular motifs were involved. These motifs could be described in various ways such as successionism (success-orientation), materialism, megaism and numeralism.

In 1989, Ministry & Theology asked journalists what they thought Korean pastors were most interested in. They answered as portrayed in the

following table 5.3.

Table 5.3: Matters of Most Concern for Korean Pastors.

Concern Matters	Quantitative Growth	Spiritual Growth	Construction of Church Building	Charity	Social Participation
Concerning Rate(%)	75.5	67.2	62.6	43.7	30.4

Source: Gil-Soo Kang and J. Hendriks, "Leadership Pathologies in the Korea Church," *Missionalia* Vol. 32 No2, August 2004, PP251-268.

In 1999, ten years after surveying an enquete from Korean journalists, Ministry & Theology put the same question to 1,000 pastoral candidates, Shockingly, the opinion of the candidates were more critical than those of outsiders as shown in the following table 5.4.

Table 5.4: Matters of Most Concern for Korean Pastors.

Concern Matters	Quantitative Growth	Construction of Church Building	Spiritual Growth	Evangelizing	Charity	Social Participation/Reformation	Others & No Answer
Concerning Rate(%)	63.1	13.0	11.4	9.2	1.2	0.8	1.3

Source: Kang, 2004:251-268.

These tables show that not only do outsiders critically point out that Korean church leadership has been secularized by being too focused on numerical growth and the construction of huge buildings, but pastoral candidates are even more critical of secularized leadership in the Korean churches.

The success-oriented, competitive and secularized leadership obsessed with numerical growth has caused disappointment in church members and has been an obstacle to outsiders. Additionally, in response to the query regarding the most serious factors that Korean churches should deal with in the "Report on Research into Attitudes of Pastors in Seoul," the respondents listed: quality of pastors, materialism, denominationalism, secular blessing, and quality of lay people (Lee 193:379). So, it can be said that many pastors compromise what they want to do (the ideal) with what they cannot help doing (the reality).

5.3.2. Church-centered Leadership.

The church is God's vehicle through which He reaches out to the world to establish His Kingdom. However, the church in the Western Christendom has tried to incarcerate the Kingdom of God in the church by means of the a dichotomous theology that the church is good and the world is evil.

This dichotomy has led to the separation of evangelism and social action, public and private truth, values and facts, faith and reason. Accepting this view of reality, the church has accepted its banishment to the realm of the personal, private and interior, leaving the public and exterior world to the dehumanizing impact of modernity (Myers 1993:21-46).

However, the Korean church has been so influenced by this dichotomous thought that it has become an encapsulated community isolated from its society. This church-centered leadership has brought about either the loss of public confidence or an indifferent and critical attitude of society towards Protestantism and has failed to promote the social responsibility of the church.

In Korea, the social services can mainly be divided into two areas such as charity and structural service. The former conveys the individual or collective activity of charity work in schools, social care, medical aid, relief work. The latter denotes the input to solve society's fundamental problems by reforming social structures (Ro and Nelson 1995:18), which has exclusively been the ministry of the liberal group. The conservative groups, comprising a majority in Korean churches, have deliberately neglected the latter field.

Even though the Korean church has participated in various forms of social service from its beginning, this field has been treated as a secondary ministry so that its annual budget allocates only a small portion (4%) to it compared with evangelism (53%) and worship (33.8%) (Lee 1993:378). As a result, the Korean church has lost much of its credibility in the Korean society.

5.3.3. Authoritarian Leadership.

Authoritarianism is another pathological issue in the Korean church relating to a pastor-centered and hierarchical system in the church administration, androcentric leadership in the church ministry and the like. In 1999, Ministry & Theology surveyed the question on what causes church members to experience hurt from their pastors (Lim 1999:83). The result is

shown in the table 5.5.

Table 5.5: Why Church Member Experience Hurt from their Pastors.

Causes	Losing Credibility	Authoritarian Attitude	Money Problem	Stern Language	Sexual Problem	Political Problem	Others
Causing Rate(%)	42.6	23.8	8.2	6.9	5.7	3.2	4.7

Source: Kang 2004:251-268.

The pastors who have shown a discordance (discrepancy) between word and action have lost their credibility in the eyes of their church members. They tend to control the lay people by their positional and functional powers (authoritarianism), instead of pastoral authority based on legitimacy, spirituality and character in order to maintain their leadership. The stern language of pastors is akin to authoritarianism. Korean Christians should ask themselves where and why these negative images originated and why they are so dominating in the Korean church.

Secularized leadership in Korean churches can be defined as pastors leading God's people and performing God's mission with secular values. Church-centered leadership has brought about either the loss of public confidence or an indifferent and critical attitude of society towards Protestantism and has failed to enhance the social responsibility of the church.

Authoritarian pastors have shown a discordance (discrepancy) between word and action and have lost their credibility in the eyes of their church members. They tend to control lay people by their positional and functional powers (authoritarianism), instead of pastoral authority based on legitimacy, spirituality and character in order to maintain their leadership.

5.4. Environmental Activities of Korean Secular Organizations (NGOs).

In order to figure out the trends of environmental movements in Korea, it is inevitable to understand the serious political situation under the military government. Because the environmental movement was started together with the democratic movement against the Korean military government. In this paragraph, I would, therefore, look at the environmental activities of Korean secular organizations (NGOs) prior to analyzing the environmental movements of Korean churches.

The Anti-pollution Act and Environment protection Act were enacted in 1963 and 1977 respectively. But the former law has not been enforced for a long period of time and the latter law has not been strictly enforced. Besides, the general public were not allowed to participate in the environment-related decision making under the military government. Nor were they allowed to protest against the environmental policies of the government. The main concern of the government was much less the environment than economic growth itself. The extremely low budget for environment (0.24% of the national budget as of 1993) is an obvious sign of the meager efforts of the government in protecting the environment (Kim 1998:44-65).

Under these circumstances, the roles of the non-government organizations (NGOs) have been very important. The roles of NGOs have been highly evaluated, especially in urging the government to be more seriously concerned about the environment and thus to more strictly regulate environment-related crimes. The environmental movements were started as a part of the democratic movements in 1970s and 1980s, quite different from those in other countries freely allowing various kinds of social movements (Kim and Jang 2007:34-39).

Therefore, there is a trend to draw a line between the environmental movements under and after a military government based on the Kwangju Democratic Movement (KDM) broken out in June 1987. Because the KDM became the turning point for changing from the military government to a civil government and allow the environmental movement freedom by virtue of political openings under the civil government.

5.4.1. Environmental Movement under the Military Government.

Korean environmental movements were seriously started in the 1980s under the military government. The economic development projects under the national economic plan resulted in serious pollution so that the civil movements were initiated in spite of the harsh oppression of the government. Even though the movements were peaceful ones, concerned only with environment damage and pollution, the government regarded them as anti-government movements and suppressed them forcefully.

The Korea Institute of Environmental Pollutions (KIEP) was established in 1982 to cope with the serious pollution affected by the heavy and chemical

industries supported by the national economic development plans of the military government. The KIEP was a symbolic group formed to struggle against environmental pollution under the military government.

The Institute was reorganized into the Korea Movement Association for Environmental Damages Banishment (KMAPB) through merging with the Volunteers Movement Association and the Youth Movement Association against Environmental Damages set up by the homemakers and the young people in 1986 and 1987 respectively. The KMAPB had played a vital role in spreading out the environmental movements all over the nation.

The environmental movements in this period were regional and organized sporadic activities against environmental damages and serious industrial pollution as a result of the rapid economic growth policies of the military government in 1960s and 1970s. These remarkable movements resulted in the survival strikes of the residents living in the vicinity of nuclear power plants and compact industrial complexes unilaterally pursued by the government, keeping pace with the democratic movements against the military government.

5.4.2. Environmental Movement after the Military Government.

Korean economic growth has made the people pay more attention to aspects of life quality, which is mostly dependent upon the quality of the surrounding environment. By virtue of the political openings under the civil government after the KDM in 1987, the environmental movements have grown as rapid as environmental destruction and have actively engaged in environmental recovery and protection. The 1992 Rio Declaration marked a turning point for the Korean environmental movements (Park^(b), 2007: 122-123).

The environmental movements have progressed into the resistant activities against the business styles of private companies as well as government policies, through the disclosure of resources abuse, wastes discharge and environmental destruction, and the civic campaign to boycott the products of such behaving companies. The movements were involved in resource- recycling, energy-saving, waste-reducing and alternative policy proposals by means of various methods such as campaigns, seminars, workshops, lectures, public hearings, demonstrations and strikes.

So, Korean companies should pay attention to the social movements

concerned with environmental protection and the change from their old attitudes. They have recently declared business policies for sustainable development in sympathy with their environmental movements, even though those are superficial commercial gestures in order to do their business smoothly. When the government is planning to carry out any great national projects, it cannot avoid some discussion with the environmental organizations.

Some remarkable initiatives were the countermeasure pressing action on the phenol accident in the Nakdong river in 1991, the activities against the nuclear power plants, the fierce anti-action against the nuclear waste place establishment at Wido without discussing it with the residents living in the vicinity of the islands in 2002, the countermeasure action for the polluted products affected by the closed mines in 2006, and the oil spill disasters in the South and West coasts in 1995 and 2007 and the special treatments for health damages from the asbestos mining areas in 2008 and so on.

5.5. Environmental Movements of Korean Churches.

According to the serious caution concerning environmental degradation as the result of the rapid economic growth for the last five decades, Korean churches have sporadically participated in coping with environmental pollution from the 1980s together with secular organizations. But they have not affected public opinion regarding environmental issues very much. Because they did not have Christian practical guidelines in detail different with the directions of the secular organizations (Park 2007:120-126).

Korean churches also started the environmental movements, keeping pace with the Korean democratic movements. The Catholic churches became actively involved in the democratic movements in close cooperation with social organizations in the 1980s, while the Protestant churches mainly initiated the environmental movements as a part of their missionary policy in the 1990s.

After the financial crisis experienced in 1997, environmental issues have gradually been replaced by issues of job creation and economic development. It seems to give a strong persuasion to Korean Churches to strengthen the individual competition for their members to get jobs. Most Korean churches used to sit back from the environmental movements (Kim and Jang 2007:21-22).

When it comes to coping with environmental pollution from mining activities and nuclear plants, Korean churches really have no honorable position. Because there is almost nothing that mentions their activities except for voluntarily participating in the oil-removing activities in the west seacoast polluted by the oil spill disaster in December 2007.

They only sporadically participated in the movements against the establishment of nuclear plants, nuclear waste place, dams and waste incineration places pursued by secular environmental organizations. There is only the Environmental Institute for Taebaek Mining Region (EITM) as a Christian environmental group independently concerned with the mining pollution in Taebaek region.

Due to the recent sequence of serious accidents such as the acute anti-action against the establishment of a nuclear waste place by the residents living in the vicinity of Wido island in 2002, the polluted products affected by the closed mines in 2006, the oil spill disasters in the West coasts in 2007, and the health damage from the asbestos mining areas in 2008 etc., Korean churches usually accept that they should be doing something to prevent this environmental pollution from mining activities and nuclear plants that confronted daily life.

However, Korean churches do not know exactly how to cope with such environmental crises as Christians belonging to the Creator Jesus Christ. They are still of the opinion that environmental issues are only for government and specialized non-government agencies, not for the churches. Their environmental programmes are still far from doing systematic approaches to cope with the environmental pollution from mining activities and nuclear plants. They are still in the initial stage of formulating Christian guidelines for sustainable development in accordance with the will of God.

5.5.1. Environmental Movement of Korean Catholic Churches.

Korean Catholic churches actively participated in environmental movements as well as the democratic movements particularly under the military government. They have actively cooperated more with other religious orders such as Buddhism and Confucianism in comparison with the Protestant churches. From 2000 they have held a Religious Environmental Conference every year. However, they have not played a prophetic role for environmental movements in the light of the affective activities in the

980s.

5.5.1.1. Major Initiatives of the Catholic Churches.

The environmental initiatives of the Catholic churches were mainly directed to the government to ask for proper treatment for the serious environmental pollution on account of national economic plans, in cooperation with secular organizations (NGOs). So, the environmental pioneers of the Catholic churches had sometimes even been treated as a social cancer against Korean economic growth by the military government in the 1970s and 1980s.

In the 1970s, the farmlands and streams were seriously polluted owing to the rapid increasing usage of agricultural chemicals and chemical fertilizers. A lot of farmers lost their health through infection from agricultural chemicals. The consumers avoided buying the agricultural products when the chemical remains were detected in products such as vegetables, fruits and peppers and so on.

The Catholic Farmers Association started the Life Movement in the 1980s to protect agricultural and livestock products through diffusing organic agricultural methods and promoting the benefit to farmers by directly trading safe agricultural products between the producers and consumers.

The Message of "The Peace with the Creator God and the Peace with all the Creatures" declared by the Pope, John Paul II in December 1989 became an initiator to promote the interest of the environment. The Seoul Catholic Parish established the Department of Environmental Preservation to develop a systematic approach to environmental problems in 1989.

The Cardinal, Kim emphasized this in the opening speech for the Conference on Justice, Peace, Integrity of Creation (JPIC) held in Seoul in March 1990 (Park 1990:686-706):

The most serious problem in the current world is the destruction of nature (environment), of which the causes should be found in the minds of human beings. The entity of civilization is the human being. If there are somethings wrong in the environment in civilization, we should try to search for the causes from human beings who made the civilization bad. The destruction of nature means the

destruction of mentality and morality of human beings. Because human beings are a part of nature.

The Catholic churches built environmental groups in the parishes of Daegu, Busan, Kwangju, Suwon, Incheon and so forth. They have organized regional environmental initiatives together with non-governmental organizations (NGOs). Except for Incheon Parish, there is no other parish in the Catholic church who has an "environmental priest" exclusively responsible for environmental ministry. The Incheon Parish set up the Catholic Environment Institute in 1992 and has practised a Christian environmental life through "the Abanada Movement for Spare, Exchange, Share and Reuse."

5.5.1.2. The Environmental Organizations of the Catholic Churches.

Korean Catholic churches established a lot of nominated groups concerned with the environment. But there are only a few organizations to continually carry out the environmental initiatives (Kim and Jang 2007:39-91).

5.5.1.2.1. The Commission on Justice and Peace (CJP).

The CJP was established in August 2001 as an environmental sub-commission to diffuse the teaching materials concerning environmental problems and coordinate the environmental movements direction among the environmental groups of the Catholic church. The CJP has concentrated the environmental movements through developing theological teaching materials for the Catholic churches and coordinating the environmental activities of the Catholic churches.

The CJP has published environmental teaching collections based on the statements of the Pope concerning environmental issues. It has also taught the laity to practise a Christian life for environmental protection through some special events such as lectures and exhibitions under the catch-phrase of "Return to the Nature."

5.5.1.2.2. The Hanmaeum (One Mind) Movement Headquarter (HMH).

The HMH was established to perform environmental conservation in the Seoul Parish in January 1991 through practising a frugal daily life and spreading an environmental attitude of mind. The HMH has regularly opened a market to exchange second hand goods and trade directly agricultural products between rural and urban communities.

In order to promote a frugal daily life, it has annually held some workshops and lectures on how to wisely use electricity and water and recycle waste. In order to promote environmental awareness, it has regularly held "Public Hearings for the Conservation and Completion of the Creation Order" in cooperation with other religious orders under the catch-phrase of "Let's collect the religious powers in confrontation with destructed nature beyond religious orders."

5.5.1.2.3. The Catholic Disciplinant Groups (CDG).

The CDG has jointly held environmental workshops with the Catholic churches and other organizations and developed education programs on creation orders for the children. It has insisted that the churches should train special teachers to teach the children to protect the environment by the will of God.

5.5.1.2.4. The Catholic Farmers Association (CFA).

The CFA has spread organic agricultural methods to farmers and has carried out direct product trading between the farmers and consumers in order to supply clean foods and prevent land pollution.

5.5.1.2.5. The Catholic National Environmental Priest Association (CNEPA).

The CNEPA is a group established in September 1991 to cope with public pollution and nature destruction. The CNEPA consists of priests, nuns, disciplinants and laity interested in environmental protection. It asked strongly to set up a sustainable alternative plan for land reclamation by drainage at Saemangum, Jeonbuk Province in May 2001.

5.5.1.2.6. The Catholic National Creation Conservation Association (CNCCA).

Looking back on the environmental initiatives of the Catholic churches during the last two decades, they have realized that there is no movement of their own practicing creation spirituality and ecological spirituality in Christian lives in accordance with the will of God, although it has sporadically been a part of the activities of other environmental organizations.

Awakening to the responsibility for protecting nature as the children of the Creator and confirming the calling of God to solve the current environmental crisis, they established the Catholic National Creation Conservation Association (CNCCA) on the occasion of Environmental Day in 2002.

The CNCCA declared that its founding purpose was to identify environmental initiatives in the Catholic churches which were different from environmental organizations, overcoming the dichotomy separating human beings from nature, settling the churches as communities harmonizing with all creatures, and practicing creation spirituality in their Christian lives.

The CNCCA has carried out environmental initiatives in close cooperation with the Hanmaeum (One Mind) Movement Headquarter (HMH), the Catholic Ecological Meeting for Women (CEMW), the Environment Priest Commission of Seoul Parish, the Catholic Environmental Coalition of Incheon Parish, the Green Peace Coalition of Daegu Parish, the Catholic Environmental Conference of Daejeon Parish, the Rural Revival Movement Headquarter of Busan Parish, the Environmental Center of Suwon Parish, the Justice and Peace Commission of Wonju Parish, the Life and Environment Coalition of Andong Parish, the Environment Priest Commission of Kwangju Parish, the Saemangum's Tideland Life and Peace Coalition of Jeonju Parish and some other groups such as the Disciplinants Coalitions for Men and Women. However, the Masan, Jeju, Eujungbu, Chungju and Chooncheon Parishes do not take part in these activities yet.

The major activities of the CNCCA have been to participate in an anti-nuclear plant movement in August 2002, declare an anti-statement concerning nuclear energy development in October 2002, hold the Religious Environment Conference in March 2003, publish a pamphlet for movement against nuclear plants in August 2003, hold a Workshop for Religious Environmentalists in September 2004, and publish the Journal of Energy of God's Gift from November 2004.

5.5.2. Environment Movement of Korean Protestant Churches.

Korean Protestant churches have been divided into more than 100 denominations. However, when we nowadays discuss Korean churches concerned with the environment, we can mainly classify them into two groups of progressive churches and conservative churches. The former has been relatively active, while the latter has almost become silent regarding the environment (Park^(b) 2007:126-127).

The National Council of Churches in Korea (KNCC)²⁾ is a representative association of the Korean progressive churches established in September 1924. The KNCC declared that Korean churches should actively perform environmental initiatives to cope with the serious current environmental degradations, and suggested the environmental missionary policy as their coalitional action plan in the beginning of the 1990s.

The KNCC declared "Our Confession to Life Conservation" in April 1991. The KNCC set up the Environment Commission to carry out ① a survey and research on the environment and the setting-up of countermeasures and implementing plans, ② public relations and education on environmental problems, ③ participation in environmental initiatives, ④ cooperating with environmental organizations, and ⑤ management of the environmental groups. The KNCC has carried out its environmental programs in close cooperation with the Christian Environment Movement Association (CEMA), playing a pivotal role in the environmental initiatives of the Korean Protestant churches.

The Christian Council of Korea (CCK)³⁾ is a representative association of the Korean conservative churches set up in 1989, matching the KNCC. The CCK established the Environmental Conservation Commission (ECC) in 1992

2) The members of the KNCC consist of 8 denominations such as the Korean Salvation Army, Korean Gospel Baptist Churches, Korean Evangelical Churches, Jesus Assembly of God, Korean Episcopal Churches, Korean Presbyterian Churches (Tonghap), Korean Presbyterian Churches (Yejang) and The Greek Orthodox Churches in Korea.

3) The members of the CCK are composed of 63 denominations which are almost all the small denominations in the Korean Presbyterian Churches (Hapdong).

and built up the Christian Environment Watching Group under the ECC to lead the Christian environment movement based on the Christian worldview. The CCK sometimes held seminars on "Korean churches and Environmental Conservation" and published a booklet of Christian Environmental Conservation.

5.5.2.1. Major Initiatives of the Protestant Churches.

5.5.2.1.1. The Environmental Week Movement.

It is the environmental week movement that the KNCC has held as a national ecological event every year in cooperation with the CEMA since the KNCC declared the "Environmental Week" on environmental day in 1992. Most of the Korean churches have joined in the weekly movement which was started for practicing "the Environment Declaration of Korean Churches" announced by the KNCC and the CEMA in 1992.

The major programme of the week movement in 2003 was to protect and save water under the subject of "Love God is Love Water," meeting the World Water Year declared by the United Nations. Korean churches announced their viewpoint concerning the national project of land reclamation by drainage in Saemangum as a representative figure destroying the environment through reversing the will of God.

In response to the World Rice Year declared by the United Nations in 2004, Korean churches carried out the Environmental Week Movement under the catch phrase of "Rice of Life and Holy Table" to supply safe foods, decrease the waste and to express thanks for our lives under the protection of the Creator. In 2005, Korean churches initiated "the Green Church Movement" in environmental week to build a sustainable society by the will of God. The practical programme was the Christian Agenda 21 composed of 10 pledges and 30 guidelines in the fields of Kerygma, Didache, Organization, Koinonia and Diakonia to conserve the creation order of the God (Park_(b) 2007:128–133).

In 2006, a joint environmental worship service was held at the Francis Hall of the Seoul Episcopal Church during environmental week under the catch phrase of "Let's practice the sharing spirit for the life table movement" which has 5 purposes such as the faith movement to worship God giving our daily bread, the health movement to take care of the body

and mind with safe edible products, the revival movement to restore all creatures, the economic movement to practice honorable poverty, and the sharing movement to give in charity to the poor and suffering neighbours.

5.5.2.1.2. The Ecological Community Movement.

There are some alternative community movements in South Korea to overcome the inhuman and devastated surroundings of the current capitalistic society as a result of industrialization and urbanization. One of them is the ecological community movement, promoting organic agriculture and practising an environment-friendly lifestyle.

There are several outstanding ecological communities known to Koreans such as Hanmaeum Community at Jangsung started in 1990, Green World at Sangju in 1995, Gongsaeongnong Durae Village at Changnyoung in 1995, Jindori Ecological Village at Muju in 1996, Gandhi Ecological Village at Sanchung in 2000, and Durae Village at Hanyang in 2002.

Korean churches have promoted direct trade of safe products between their churches and ecological communities and strengthened the environmental mind through study and observation of ecological communities. Some churches have directly operated their own ecological communities to kindle a sense of awe, wonder, mystery, and humility by directly contacting nature and standing under the stars during staying several days at the community.

5.5.2.2. The Environmental Organizations of the Protestant Churches.

5.5.2.2.1. The Christian Environment Movement Association (CEMA).

It is the CEMA⁴⁾ that has played a pivotal role in the environmental movements in the Korean Protestant churches. The CEMA was reorganized in 1997 from the Environment Institute of Korean Churches established in 1992 to pursue the environmental movements in close cooperation with Korean churches beyond their nominations and Korean environmental organizations (Park_(b) 2007:151-154).

Environmental activities have mainly been carried out in the three fields of environmental education, church support and environmental initiatives. Education has been given through corresponding programmes, professional

lectures and training courses. The church support has mainly been carried out through keeping environmental week with worship services, sermons, prayers, practices and events such as compositions, drawings and musical festivals concerned with the environment.

The major environmental projects are the prayers for creation order conservation, application of the ten commandments for green Christians and churches, green consuming movement, anti-movement against tideland reclamation, nuclear power plant, great dam construction, gene fabrication and cloning and so on. The CEMA has been implementing these initiatives in cooperation with the seven regional solidarities such as Kwangju, Daegu, Busan, Incheon, Jeonju, Taebaek and Hamyang Christian Environmental Solidarity.

5.5.2.2.2. The Environmental Institute for Taebaek Mining Region (EITM).

The EITM⁵⁾ is a Christian organization concerned about mining pollution, was established in 1994 to cope with the serious pollution from abandoned coal mines closed by the restructuring policy of the government. In particular, the acid drainage from coal mines has polluted the clean water from the mountains so seriously that people could not eat the agricultural products produced in the region of Taebaek. The limestone mines have polluted the clean air so much that all the roofs were covered with mining dust (Park_(b) 2007:156-160).

The EITM has the potential to recover the creation order of the Creator and practise a Christian life harmonized with nature in accordance with the will of God. The major activities required are to solve the current environmental problems such as acid drainages and air pollutions from the coal and limestone mines, consult the residents in Taebaek region about environmental problems, operate the reporting center for environmental

4) The CEMA has 5 directors such as pastor M. J. In who is in charge of Galilee Church, and is located at 35-6, 2Ga, Chungpa-Dong, Yongsan-Ku, Seoul (Tel.: 82-2-711-8905/ www.green Crist.org).

5) The director of the EITM is pastor S. J. Lee who is in charge of Hwangji Central Church, and located at 368-13 Hwangji-Dong, Taebaek city, Kangwon province (Tel.: 82-33-533-7979/ www.tbgreen.net).

problems, run the green shop trading of organic products and regional special goods and open the market exchanging second hand goods. Through education, lectures and events, the EITM has encouraged the residents to develop environmental awareness and participate in environmental movements.

5.5.2.2.3. The Incheon Environmental Mission Association (IEMA).

The IEMA was established in 1994 as a trans-denominational mission organization to do missionary work to restore the creation order of the Creator, support environmental activities, survey and research environmental problems, provide environmental education and publish bulletins concerned with environmental activities.

In its initial stage, it had actively performed significant environmental activities such as piety and moderation life movement, green faith movement, green church movement, environment stewardship meetings, lectures and education. However, there has not been any activities of the IEMA from 2004 onwards.

5.5.2.2.4. The Environmental Groups under the General Assemblies of the Protestant Churches.

There are quite a number of environmental groups under the auspices of the General Assemblies of Korean church denominations. There are some environmental departments in the ranks of the member denominations of the KNCC, while there are a few in the denominations of the CCK. But they exist only in name and not in deed. So, they have generally done some initiatives in cooperation with the KNCC and the CEMA from time to time.

5.5.2.2.4.1. The Environment Conservation Commission of Korean Presbyterian Churches (Tonghap).

The Commission was established in 1991 to undertake the piety and moderation movement through practising a simple, thrifty and sound life. It has actively participated in the environmental movements of the CEMA. It has also managed the College of Environment set up in 2003 to create sensitivity for the environment and carry out a nature conservation

movement. Its director is pastor Y. C. Kwon who is in the Saesungnam Presbyterian Church (Tel.: 82-2-741-4350/ www.pck.or.kr/DeptSocial).

5.5.2.2.4.2. The Environment Mission Commission of Korean Methodist Churches.

The Commission was established in 1990 to carry out environmental missionary work. It drew up a list of 60 rules to encourage environmental conservation in 1991 and sent it to all the members of Korean Methodist churches. In 1993, it prepared for the Social Creed adopted in the General Assembly of the Korean Methodist Church. The creed is to develop a theology on the creation order of conservation and apply it in Christian daily life. In 1995, it adopted a resolution on environmental mission work to cope with the current environmental crisis. It has actively participated in the environmental movements in cooperation with the KNCC. Its director is pastor J. H. Kwon who is in charge of Kungjung Methodist Church (Tel.: 82-2-399-4334/ www.kmcmission.or.kr).

5.5.2.2.4.3. The Church and Society Commission of Korean Presbyterian Churches (Kijang).

The Commission drew up a list of 92 rules for practicing nature conservation and diffusing it to all Korean churches in 1992 and carried out the life recovery movement in 1993. It published a booklet 'the Crisis and Conservation of Creation World' to discuss the tasks confronting the Korean churches in the environmental crisis in 1999. It has actively participated in the environmental week project in cooperation with the KNCC and the CEMA. Its director is pastor J. M. Kim who is in charge of Eunpyung Presbyterian Church (Tel.: 82-2-3499-7600/ www.prok.org).

5.5.2.2.4.4. The Christian Rural Development Institute of Korean Presbyterian Churches (Kijang).

The Institute was established to educate farmers having the mind of the God and foster faith, hope and love for the land through engaging in farming in accordance with the will of God. It does not separate labour from prayer in accordance with Christian tradition that prayer is labour and labour is prayer. Its theological background is the Minjung Shinhak and

Missio Dei theologies which supplied it with the ideological foundation to actively participate in democratic movements in the 1970s and 1980s. Its director is pastor Y. T. Lee and it is located at: 139-1, Limun-Ri, Lisuh-Myun, Wanju-Kun, Jeonbuk Province (Tel.: 82-63-222-9081/ www.cafe.daum.net/kinongwon).

5.6. Environmental Movement Infrastructure of Korean Churches.

In this paragraph the result of a survey that was done twice by the Research Corps for Environmental Culture of Three Korean Religions (RCECTKR) in January and June 2006 to analyze the environmental spirit of the three Korean religions—Catholicism, Protestantism and Buddhism and prepare desirable guidelines and policies to prevent serious environmental degradation will be discussed (Kim and Jang 2007:350-411).

In order to improve the precision and reliance of the survey, the RCECTKR considered the distribution rates of the Korean population and religious statistics when it selected respondents for the survey. It confirmed the standard error range through carrying out some pilot-tests for the survey. The survey analysis was mainly made by the method of Statistical Package for Social Science (SPSS).

5.6.1. The Size and Finances of Religious Environmental Organizations.

The Korean religious environmental organizations have shown quite different trends in their environmental initiatives in comparison with the secular environmental organizations. They have performed their environmental initiatives with low membership fees and modest structures, quite different from the recent trend of secular environmental organizations to increase in size. Of these religious organizations the Protestant churches have received the greatest financial support from the government.

5.6.1.1. The Size of the Religious Environmental Organizations.

Most of the organizations have small membership numbers. 50.9% of the organizations consist of less than 50 persons. 91.4% of the Protestant organizations have small membership numbers of less than 100 persons. There are only two organizations that have more than 1,000 members,

namely in the Catholic churches, in the Incheon and Suwon parishes. They have a few permanent workers so that 72.4% of them have less than 5 persons to undertake their environmental initiatives. There is only one Buddhist organization having more than 30 members.

5.6.1.2. The Finances of the Religious Environmental Organizations.

Most of their members have not paid their fees regularly so that 71.2% of them have payment rates of less than 50%. The Catholic and Buddhist organizations relatively have higher payment rates than the Protestant ones of which 90% have a rate of less than 50%. The numeral results reflect the dwindling interest in the environmental movement, gradually being replaced issues of job creation and economic development after the financial crisis experienced in 1997 (Kim and Jang 2007:21-22).

So, they have undertaken their environmental initiatives under such poor financial conditions that 46.3% of them have self-support rates of less than 50% as shown in the table 6. The Protestant organizations are relatively poorer than the Catholic and Buddhist ones supported by their religious orders.

Table 5.6: The Self-support Rates of the Religious Environmental Organizations Unit: %

Rate Degrees	Protestant	Catholic	Buddhism	Rates
Less than 30%	25.7	-	11.1	18.5
30-49%	40.0	-	11.1	27.8
50-79%	20.0	20.0	33.4	22.2
80-100%	11.4	70.0	33.3	25.9
More than 100%	2.9	10.0	11.1	5.6
Total	100.0	100.0	100.0	100.0

Source: Kim, J. D. et al., The Ecological Crisis and Religious Culture, Life Seed Pub. Co., Seoul, 2007, p. 360.

5.6.2. Environmental Activities of Religious Environmental Organizations.

Comprehensively speaking, Korean religious organizations are in the initial stage of developing environmental projects so that there is not any performing field having more than 5.0 in the value rating of the SPSS as

shown in table 7. They have, in particular, undertaken very few environmental initiatives to cope with environmental pollution as a result of mining activities and nuclear power plants. Such projects are not even part of a typical survey items to check out their environmental activities.

In spite of being at such an initial stage of their environmental activities, we can comparatively analyze their environmental initiatives based in table 7. The protestant organizations outstandingly performed environmental initiatives in the fields of ecological experiences and education, tours of ecological villages and rural areas, ecological food life, and ecological fine arts, literature, movies and construction compared with the Catholic and Buddhist organizations, while the Catholic organizations carried out environmental activities in the areas of ecological food life, publication of teaching materials for environmental education and practices, ecological experience and education, and establishment of environmental days.

The inactive fields in the case of the Protestant organizations are the establishment of environmental education centers, publication of teaching materials for environmental education and practices, investment to foster ecological experts, and job guarantees for environmental activists, while the slump fields of the Catholic organizations are ecological movies, fine arts and literature, and housing with indirect heating systems.

We can conclude that they have still much to do with regard to environmental initiatives in Korea. In particular, they need to undertake the promotion of environmental projects for the sustainable development of energy and mineral resources.

Table 5.7: The Major Activities of Religious Environmental Organizations.

Contents of Environmental Activities	Performance Degrees			
	Protestant	Catholic	Buddhism	Average
Joint networks with other organizations	3.36	3.50	3.46	3.42
Ecological experiences and education	3.67	3.83	3.67	3.69
Ecological food life	3.53	4.17	4.34	3.96
Consultation & diffusion of environmental technology and experiences.	3.22	2.67	3.11	3.10
Tours of ecological villages & rural areas	3.61	2.50	3.08	3.23
Ecological fine arts	2.97	1.67	2.36	2.52
Ecological literature	2.92	2.00	2.56	2.63
Ecological movies	2.94	1.33	2.25	2.42
Ecological construction	3.37	2.00	2.47	2.78
Housing with indirect heating systems	3.03	2.00	2.46	2.63
Investment to foster ecological experts	2.83	3.00	2.81	2.85
Establishment of environmental education center	2.53	2.17	2.64	2.52
Publication of teaching materials for environmental education and practices	2.89	4.00	2.78	3.00
Sustainability evaluation of ecological community	3.19	2.17	2.92	2.93
Job guarantee for environmental activists	2.78	2.83	2.69	2.75
Financial and working guarantee of environmental organizations	2.81	2.67	2.86	2.81
Establishment of environmental days	3.14	3.33	2.20	2.77
Total	3.09	2.68	2.86	2.93

Source: Kim, J. D. et al., The Ecological Crisis and Religious Culture, Life Seed Pub. Co., Seoul, 2007, p. 402.

Chapter VI. A New Concept of Sustainable Development of Energy and Mineral Resources in accordance with the Will of God.

In social science, modernization has been approached in terms of the democratization of politics, the industrialization of the economy, the urbanization of socio-ecological structure, and a transition towards individualism. Through such a way of social development, the concept of sustainable development has emerged in relation to the environmental problem that has arisen as a by-product of industrialization during the last 300 years.

After beginning as an agricultural society and then moving into the industrial age, human society is now being transformed into an information society. The agricultural society can be characterized as low level in terms of convenience of life, efficiency of work, and material and cultural affluence, but as high level in terms of the safety and health of society, and of environmental amenity. Such social profiles were reversed in a industrial society. The industrial society is characterized as a society with high convenience, efficiency, and affluence, but as a risky society, especially in terms of environmental amenity.

In explaining the causes of environmental problems, two primary approaches have been offered in social science. One is the ecological explanation, and the other is the political economy explanation. The two approaches have suggested a wide range of causes of natural environmental problems. These causes include population growth, development of science and technology, overconsumption and overproduction of energy and minerals over the optimum capacity, etc.

In addition, many environmental economists maintain that the market failure of environmental resources in capitalism is the main cause of the environmental problem. These causes of the environmental problems are related to the processes of industrialization and/or their results. Thus, environmental problems are an unexpected by-product of industrialization. This would mean that a contradiction lies between the environment and industrialization.

In relation to the emergence of the contradiction, two opposite arguments were made in the 1970s. As is known, they are 'the limits to growth' and 'the continuing growth through technological optimism.' In accordance with

such concerns with the environment, UN organizations have given attention to the environment on an international and global basis since the 1970s. The major examples include 'One World Only,' 'Eco-Development,' 'Sustainable Development,' and 'Our Common Future' etc.

In 1992, the UN Conference on Environment and Development (UNCED) adapted the ideology of 'environmentally sound and sustainable development' as a common world-wide developmental value for the future. But the ideology of sustainable development is a compromise to solve the contradiction between industrialization and the preservation of the environment.

Even if sustainable development is a useful approach to solve the contradiction between industrialization and the preservation of the environment, it is still faced with some dilemmas particularly in relation to consumerism as sustainable industrialization advances. This is the apparently irresolvable tension between people's drive to consume more and more goods and services in order to improve the quality of life, and the environmental degradation threatened by such consumption.

Therefore, I will firstly analyse the concept of sustainable development, looking at two controversial views of a traditional finite world paradigm and market resource allocation paradigm to examine the ideology and practice of economic growth, fundamentally brought out the concept of sustainable development. Secondly, fundamental roots of environmental degradation and biblical proposition for sustainable development will be discussed to criticise for accusing Christianity of causing an environmental crisis and lay the foundations for biblical sustainable development. And then, I would like to introduce a new concept of sustainable development in accordance with the will of God to show a fundamental approach going beyond discussing only the socio-economic forces encouraging population growth, technological development and production activity on account of anthropocentric greedy values.

6.1. Controversial Concept of Sustainable Development.

The concept of sustainable development has a long and mixed history. It has become a common goal or at least an irresistible slogan in public discourses about the meaning and at the on-going environmental impact of human societies in the last two decades.

However, we should note that the concept relates to a specific theory on economy–environment interactions that contains a large amount of debate about an adequate framework accommodating all the different principles of value determination not only of the current generation but also future generations, hopefully maintaining current lifestyles and economic growth.

6.1.1. Origin of Sustainable Development.

"Silent Spring" written by Rachel Carson was published in 1962. The book's release was considered by many to be a turning point in the understanding of the interconnections among environment, economy and social well-being. Since then, many milestones have marked the journey toward sustainable development.

The linkage between environment and development was globally recognized in 1980, when the International Union for the Conservation of Nature (IUCN) published the "World Conservation Strategy" and used the term "sustainable development" (IUCN 2007).

The concept came into general usage following the publication of "Our Common Future," also known as the Brundtland Report. Set up by the United Nations General Assembly, the Brundtland Commission coined what was to become the most often-quoted definition of sustainable development (WCED 1987:43):

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

It contains within it two key concepts: the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

6.1.2. Scheme of Sustainable Development.

Sustainable development encompasses three general policy areas: economic, environmental and social-cultural (Munasinghe 1993:47-52). In support of this concept, several United Nations texts refer to the "interdependent and mutually reinforcing pillars" of sustainable development as economic development, social development, and environmental protection (UNSD 2005).

The Universal Declaration on Cultural Diversity elaborates further the concept by stating that cultural diversity is as necessary for humankind as biodiversity is for nature (UNESCO 2001). It becomes one of the roots of development understood not simply in terms of economic growth, but also as a means to achieve a more satisfactory intellectual, emotional, moral and spiritual existence. In this vision, cultural diversity is the fourth policy area of sustainable development.

Agenda 21 clearly identified information, integration, and participation as key building blocks to help countries achieve development that recognizes these interdependent pillars. It emphasizes that in sustainable development everyone is a user and provider of information. It stresses the need to change from old sector-centered ways of doing business to new approaches that involve cross-sectoral co-ordination and the integration of environmental and social concerns into all development processes. Furthermore, Agenda 21 emphasizes that broad public participation in decision making is a fundamental prerequisite for achieving sustainable development (UNCED 1992).

Green development is generally differentiated from sustainable development in that green development prioritizes what its proponents consider to be environmental sustainability over economic and cultural considerations. Proponents of sustainable development argue that it provides a context in which to improve overall sustainability where cutting edge green development is unattainable.

For example, a cutting edge treatment plant with extremely high maintenance costs may not be sustainable in regions of the world with less financial resources. An environmentally ideal plant that is shut down due to bankruptcy is obviously less sustainable than one that is maintainable by the indigenous community, even if it is somewhat less effective from an environmental standpoint.

Some research activities start from this definition to argue that the

environment is a combination of nature and culture. The excellent network of "Sustainable Development in a Diverse World" sponsored by the European Union integrates multidisciplinary capacities and interprets cultural diversity as a key element of a new strategy for sustainable development (UNSD 2007).

Still other researchers view environmental and social challenges as opportunities for development action. This is particularly true in the concept of sustainable enterprise that frames these global needs as opportunities for private enterprise to provide innovative and entrepreneurial solutions. This view is now being taught at many business schools including the Center for Sustainable Global Enterprise at Cornell University.

Sustainable development is an ambiguous concept, as a wide array of views fall under its umbrella. The concept has included notions of weak sustainability, strong sustainability and deep ecology. Different conceptions also reveal a strong tension between ecocentrism and anthropocentrism (De Wit 2001:69-82).

6.1.3. Systematic Approach to Sustainable Development.

All definitions of sustainable development require that we see the world as a system that connects space and time. When you think of the world as a system over space, we grow to understand that air pollution from China affects air quality in Korea. And when you think of the world as a system over time, we start to realize that the economic policies we endorse today will have an impact on urban poverty when our children are adults.

We also understand that quality of life is a system. It is good to be physically healthy, but what if you are poor and do not have access to education? It's good to have a secure income, but what if the air in your part of the world is unclean? And it is good to have freedom of religious expression, but what if you can not feed your family?

The concept of sustainable development is rooted in this sort of systems we must consider all the variables involved in our thoughts and activities. It helps us understand ourselves and our world. The problems we face are so complex and serious that we can not address them in the same way we created them.

6.1.4. Carrying Capacity of the Earth.

In the public discourse on "sustainable development" and "the carrying capacity of the earth" these concepts turned out to be universally supported but inherently politicized. The resulting controversy generates different advocacy organizations with different objectives, resources, and political influence. Even among scholars, the notion of the "carrying capacity" are contentious like "sustainable development."

Sociologist William Catton is convinced that the earth has a finite carrying capacity, and that we have already exceeded it (1997:175-78). Others have argued that there is no such thing as sustainable development, being a rhetorical and ideological term for those who wish to continue destructive growth.

Lester Brown and Donella Meadows believe that we may have already exceeded the earth's carrying capacity, but continue to hedge their bets (Brown 1996; Meadows 1992). Economist Julian Simon has for decades been a tireless advocate of the idea that there is no finite carrying capacity, and that development and growth in material consumption should be vigorously promoted to proceed as it has for the last 50 years (1981).

6.1.5. Sustainable Development Timeline.

During the last twenty years, different organizations have tried to measure and monitor the proximity to what they consider sustainability by implementing what has been called sustainability metric and indices. The UNDSO lists the areas coming within the scope of sustainable development (www.menominee/sdi/whatis.htm).

"The Conference on Twenty Years after Brundtland" was held to reflect on the past twenty years of sustainable development since the publication of the Brundtland report in 1987 at Ottawa, Canada in October 2007. Some of the key events have been captured through the "Sustainable Development Timeline" published from 1998 by the International Institute for Sustainable Development (IISD).

6.1.6. Criticism on Sustainable Development.

Many environmentalists have criticized some interpretations of the term "sustainable development" as an oxymoron, claiming that economic policies based on concepts of growth and continued depletion of resources cannot be sustainable, since that term implies that resources remain constant. Recently, the term "developing sustainability" has been used.

Another criticism of the term and its application is that it hurts the developing world. While current first world countries polluted in large quantities during their development, the same countries pressure third world countries to stop polluting, which impedes growth. Many see such policies as hypocritical. Other criticisms of the term include the suggestion that its implementation would mean a reversion to pre-modern lifestyles.

Others have criticized the overuse of the term. They argue that the word "sustainable" has been used in too many situations today, and that "ecological sustainability" is one of those terms that confuse a lot of people. We can hear about sustainable development, sustainable growth, sustainable economies, sustainable societies, sustainable agriculture. Everything is sustainable.

6.2. Competitive Views on Social and Environmental Future.

There are two controversial views on the social and environmental future, which have been around in Western intellectual and political circles since the 1940s. Those are a so-called traditional finite world paradigm and a market resource allocation paradigm. Both have sophisticated intellectual articulation, and both have contemporary defenders to contend for legitimacy and shape policy.

The former is supported by most ecologists, physical scientists and demographers, but the latter is strongly supported by most neoclassical economists, business and industry groups, particularly representing the energy and extractive industries, and the conservative members of the U.S. House of Representatives.

The former view profligates growth as a prelude to disaster, and sees technological innovations as allowing rich nations to make only Faustian bargains.¹⁾ The latter holds that the environmentalists' attempts to dampen

material growth and consumption are the real threats to continued human progress.

Can they do so without devastating the carrying capacity and resource base of the planet in terms of any reasonable criteria for human security and well-being? If the current trends continue, will human beings thereby replicate a global scale outbreak-crash²⁾, familiar to ecologists and population biologists? Or will humans be able to invent and grow our way into a sustainable high-consumption world for large numbers of people?

Can all the people on the earth emulate the consumption habits and lifestyles of contemporary Europeans or North Americans? If we simply let markets operate, the price mechanism will regulate scarcities and stimulate investment in efficiency and innovation. Given human technological ingenuity and elasticities of substitutability, will things work out?

6.2.1. A Future Without Limits: Cornucopia.

Since the 1960s, Herman Kahn (the former director of the Hudson Institute) and his colleagues argued that universal affluence and permanent growth are possible and the most probable long-term outcomes of present trends. They argue that most people in the world can, in fact, live like contemporary Americans and Europeans without devastating the planet. They argued that:

The prospects for achieving eventually a high level of broadly worldwide economic affluence and beneficent technology are bright, and that this is a good and logical goal for mankind ... (Kahn and Phelps 1979: 202).

Taking a very long view, they argued that we are now part of a great transition that began with industrialization in the 1700s:

In much the same way that the agricultural revolution spread round the world, the Industrial Revolution has been spreading and causing a permanent change in the quality of human life. However, instead of lasting 10,000 years, this second diffusion process is likely to be largely completed with a total span of about 400 years or roughly by the late 22nd century (Kahn, Brown, and Martel 1976:20).

Kahn and his colleagues viewed the global inequality as a transitional gap between the living standards of the poor and the rich nations. They think this is inevitable as industrialism spreads and living standards of some parts of the world rise relative to others. But that is analogous to the widespread misery and poverty of early industrialism, which will eventually spread better living conditions to many people in industrial societies.

While they do not ignore the problems of the present, Kahn and his colleagues have little patience with those who view contemporary problems in apocalyptic terms. Reacting to "The Global 2000" (Barney 1980), they responded that:

Global problems due to physical conditions...are always possible, but are likely to be less pressing in the future than in the past. Environmental, resource, and population stresses are diminishing, and with the passage of time will have less influence than now upon the quality of human life on our planet. These stresses have in the past always caused many people to suffer from lack of food, shelter, health, and jobs, but the trend is toward less rather than more of such suffering. Especially important and noteworthy is the dramatic trend toward longer and healthier life throughout all the world. Because of increases in knowledge, the earth's carrying capacity has by now no useful meaning. These trends strongly suggest a progressive improvement and enrichment of the earth's natural resource base, and of mankind's lot on earth (Simon 1981:13).

1) The term "Faustian bargain" derives from the monumental fictional work by German writer Johan Wolfgang von Goethe (1749-1832) about a tragic figure, Faust, who sells his soul to the Devil for pleasure, wealth, and power while he lives, but finds himself condemned to hell for eternity. He bought short-term gain for long-term damnation.

2) The phenomena of outbreak-crash can be illustrated when a bacteria is introduced to a petridish and its exuberant growth follows. But in the limited world of the dish, such growth is not sustainable. Sooner or later, the bacterial populations deplete available resources, and submerge in their own wastes, their initial blossoming replaced by stagnation and collapse (Clark 1990:11).

In a nutshell, this is a cornucopian (optimistic) view of the future, accepting the present trends as basically benign. Kahn and his colleagues have taken a clear human exemptionalist view that humans are essentially exempt from the limits of nature (Dunlap, 1992). With faith in human good will and inventiveness, they see no reason to deflect the course of social development. Many businessmen and politicians are attracted to this view, which posits the possibility of universal affluence and progress (Zey 1994; Simon 1994; Naisbett 1994; Cetron 1994).

6.2.2. A Future with Limits: Outbreak-Crash.

The counterpoint to the cornucopian scenario argues that present trends are putting us on a collision course with the finite carrying capacity of the planet, which we may overshoot. As noted above, some argue that we are already in an overshoot mode. If so, we must dramatically reverse the historic trends of the past 300 years, or inevitably suffer a collapse of human civilization because of a collapse of the resource base on which it depends. The most articulate, influential, and controversial statement of this view was by a 1970s futurist think tank called the Club of Rome.

Rather than rely on the mental and intuitive models of Kahn and his colleagues, the methodology of the Club of Rome used an elaborate computer simulation model called a World System Dynamics (WSD) model developed by scientists, Jay Forrester, Donella Meadows and his colleagues of the Massachusetts Institute of Technology (MIT).

This model started with what was known about current patterns and trends in population growth, economic growth, resource consumption, food supply, and pollution effects, each of which has been growing exponentially. The WSD model then developed an elaborate set of coefficients for how continued growth in each of these areas would impact the others, and attempted to project the sum of these interactions into the future for several hundred years (Meadows et al. 1972).

The resulting projection by the WSD model was a classic outbreak-crash model. The model argues that current exponential growth in population, resource consumption, and food production will produce such enormous stress on the carrying capacity of the planet by 2100, that the resource and capital inputs to support such consumption levels will not be sustainable. Capital investments can no longer keep up with the growing needs. This

prevents increases in fertilizer production, health care, education, and other vital activities. Without food and necessary services, world population and living standards will undergo a steady decline sometime during the twenty-first century (Humphrey and Buttel 1982:97-98).

Thus the Club of Rome research group argued that, on a global basis, the whole of humanity will replicate the more limited ecological crash experience of the Western Roman Empire, and many other preindustrial societies. In their degraded environments they could no longer obtain the investments necessary for social maintenance (Harper 1996). The views of the Club of Rome research group have been forcefully stated in a variety of technical and popular publications (Meadows et al. 1974).

The most recent report by the group using more recent data is significantly entitled "Beyond the Limits," and argues that we have already overshot the earth's carrying capacity and are now living with a dwindling resource base (Meadows et al. 1992).

At some time shortly after the turn of the next century (2100), growth would be unsustainable. The problem was not any single dimension but the cumulative effects of the way that they interact. And the underlying problem is growth itself. Hence MIT researchers emphasized the urgency of global efforts to dampen exponential economic growth itself and move toward a global equilibrium. This is what MIT analysts called their "standard run" reflecting current world conditions.

In this view, it is not enough to simply wait for markets to adjust to scarcity of food and non-renewable resources. By that time irreversible declines in ecological equilibrium and resource availability may have already taken place, and a variety of points of no return may have been passed. Nor can technology save us on an exhausted and polluted planet. All that technological advances can do is delay the inevitable, since dominant cultural patterns and institutional arrangements perpetuate problem-solving-by-growth that are in the end self-defeating. The specter raised by this vision is that, if present trends continue, after 2100 a smaller human population will be eking out a more marginal existence on an exhausted and polluted planet.

This is indeed a sharp counterpoint to the cornucopian view of the future presented by Kahn and his colleagues. It is a darker and more pessimistic scenario about the future, and as we might imagine, has provoked a blizzard of commentary and criticism over the years. The attacks on the

perspectives of the Club of Rome groups have been more political and ideological than scientific. They have been attacked as providing the justification of a planned and rationed world socioeconomic order, an anathema to conservatives and free-market economists, as well as those on the political left as providing justification for halting growth and thus betraying the aspirations of the world's poor.

6.2.3. Evidence for Cornucopian or Finite Future.

Empirical evidence is not irrelevant to this grand-debate about society-environment interaction. But neither is it the sole basis for public policy. The defenders of the cornucopian view note the very great elasticities of substitution, both historic and potential, in industrial and energy resources. They note that many energy and mineral resources are more plentiful and cheaper than they were in the 1970s.

The defenders of the limits view respond that while true, the cost-supply-accounting calculations (prices) about energy and minerals do not include the costs of externalities, and that the most serious problems with industrial minerals have to do not with source but with sink problems (pollutants). They note the on-going pollution of water, declines in biodiversity, and the effect of greenhouse gasses on the climate.

Moreover, the defenders of the limits point not to industrial minerals, but to per capital declines in agricultural resources (arable soil, water) used to produce foods and fishes. Agricultural resources are being seriously over-exploited, and food per capita is becoming less available and more expensive, though that may not be noticed among the affluent classes in rich nations.

6.2.4. Grand-debating Reasons for the Same Future.

How can different analysts disagree so much about the future? How do they do so, even when they look at the same world, and sometimes use the same facts? Which view has the closest approximation to actual world futures? The debate is often sterile and unproductive, with each side grasping a portion of the truth, but not the whole truth.

Part of the answer has to do with differences in the mindsets of the two groups of analysts, who by their training have learned to think about the

world in different ways. They have different paradigms for the way the world works. Another part of the answer to these questions has to do with the selectivity of people's view of the world and its future. No scholars or writers are completely exempt from selectivity.

However, the scenarios emphasizing future limits were created by persons from a variety of scientific backgrounds, including population experts, environmental scientists and ecologists, hydrologists, physical scientists and geologists, mathematics and computer modelers, soil scientists, biologists, climatologists, and some social scientists. But the scenarios emphasizing more optimistic cornucopian futures were created by economists, business people, technical experts in management, and journalists (Brown, 1991:5-9; Harper, 1996:48-58).

Between scenarios written by the emerging consensus within scientific communities and those written by business leaders, economists, and journalists, who do you trust the most to sort through facts and fancies, and to come to grips with objectivity and reality? I definitely have more faith in the official statements by the world's most respected scientific communities than by the industry spokesmen, elected politicians and environmental journalists.

6.3. Fundamental Roots of Environmental Degradation.

When it comes to the roots of environmental degradation, there are some arguments such as Christianity, throwaway worldview, lifestyles of the modern world, different result between the way nature works and the way humans thinks and so forth.

Ecological complaint argues that Christianity is the primary cause of environmental degradation. They accuse Christianity of advocating the human domination and/or domination of the physical world for the sake of material exploitation and spiritual evolution.

Lynn White, Jr. was the first to popularize the idea. His famous essay, called "The Historical Roots of our Ecologic Crisis," is considered by many to be a classic of environmental literature. He argues that the distinctive Western tradition of modern technology and science is deeply conditioned historically by Christian beliefs. He criticizes that Christianity is the most anthropocentric religion the world has seen (White 1967:1203-7).

Ecological complaint against Christianity is pathetically simplistic. Most

complaints often have structured their complaint on a single biblical passage (Gen. 1:28) dealing with domination. However, dangerous modifications of the environment are not necessarily dependent on any philosophical or theological concept like domination.

Tyler Miller refers to "a throwaway worldview" at the root of environmental degradation. This worldview is based on several following beliefs (Miller 1990):

- (1) Humans are apart of nature.
- (2) Humans are superior to non-human creation.
- (3) Human role is to conquer and subdue nature to further their goals by humanizing the surface of earth.
- (4) Resources are unlimited because of human ingenuity in making them available or in finding substitutes.
- (5) The more humans produce and consume, the better off humans are.
- (6) The most important nation is the one that can command and use the largest fraction of the world's resources.
- (7) The ideal person is the self-made individualist who does his or her own thing and hurts no one.

The worldview sees the earth as a place of unlimited room and resources, where ever-increasing production, consumption, and technology inevitably lead to a better life for everyone. This view justifies short-term self-interest to satisfy as much of human unlimited greed as possible. However, this seductive worldview will turn out to be a fatal attraction.

On ecological concerns, the Christian traditions probably affected the various cultural forces at work historically, but they were hardly the historical root of our ecological crisis. There are too many variables to make such a simple assessment. Therefore, I would like to summarize some fundamental roots of environmental degradation to show the proof to the contrary to "the complaints against Christianity" and "throwaway worldview" and find the supporting grounds to define a new concept for sustainable development in accordance with the will of God.

6.3.1. Fall of Man (Gen. 2:1-6).

The serpent (Satan) tempted Eve by getting her to doubt God's goodness. Satan made Eve forget all that God had given her and, instead, focus on the one thing she couldn't have. We also fall into trouble, when we

dwell on the few things we don't have rather than on the countless things God has given us.

Even though Adam and Eve got what they wanted: an intimate knowledge of both good and evil, but the results were disastrous. Sometimes we have the illusion that freedom is doing anything we want. But God says that true freedom comes from obedience and knowing what not to do. The restrictions God gives us are for our good, helping us avoid evil.

Self-exaltation leads to rebellion against God. As soon as we begin to leave God out of our plans, we are placing ourselves above Him. This is exactly what Satan wants us to do. Our sins do not always appear ugly to us, and the pleasant sins are the hardest to avoid. So, we cannot always prevent temptation, but there is always a way of escape (1 Cor. 10:13). Use God's Word, and God help us stand against it.

One of the realities of sin is that its effects spread. After Eve sinned, she involved Adam in her wrongdoing. When we do something wrong, often we try to relieve our guilt by involving someone else. Like toxic waste spilled in a river, sin swiftly spreads. We should recognize and confess our sins to God before we are tempted to pollute those around us.

6.3.2. Human Greed.

The story of Babel is the story of human greed without limit (Gen. 11:1-9). The greedy tower divided all the people and they no longer understand each other. They have lost the ability to feel with each other, imprisoned by their own greed at the expense of others.

Mammon, carrying great wealth on its back, exploits, breaks and kills all creatures in order to possess more wealth. This is the evil spirit who keeps false vested interests without justice. This is the same evil spirit which crucified Jesus Christ. Our Lord Jesus Christ said concerning the greedy acquisitiveness: "No one can serve two masters..... You cannot serve God and mammon" (Matt. 6:24).

6.3.3. Anthropocentrism.

Traditional Christian theology and Western thinking put the human at the center of the created world. That has underpinned the view that human beings have the power to control and dominate creation. Modern science

and development models are based on this assumption. However, we should remember that human beings are a very small part of nature. We affirm that we all come from the earth in the Christian tradition.

6.3.4. Limited Carrying Capacity of the Earth.

We live on a finite, essentially self-contained planet. There are no infinite boundaries or inexhaustible resources. Even though the limits are sometimes extendible by means of human technology, everything is still limited by human overuse and abuse. If our current lavish lifestyles are constant, non-renewal resources will eventually run out; the only question is when, the short or the long term by our greedy over-exploitation?

6.3.5. The second law of thermodynamics³⁾

By the great design principle of the Creator, entropy increases when natural resources are extracted and waste accumulates. Entropy would not be limiting if natural resources and the assimilative capacity were infinite. But there are good indications that both are finite (Daly 1996:33). When these limitations prove to be true, the only plausible way will be to mitigate entropy.

However, post industrial revolution economic systems are heavily dependent on exhaustible fossil fuels which implies that the second law of thermodynamics is essential to the understanding of the current economy. Fossil fuels embody a high level of useful energy, but entropy increases

3) The law of conservation of energy, known as the first law of thermodynamics means that energy is neither created nor destroyed in all physical and chemical changes, but it may be converted from one to another. In other words, we cannot get something for nothing in terms of energy quantity. However, the second law of thermodynamics means that when energy is changed from one form to another, some of the useful energy is always degraded to lower quality, more dispersed, less useful energy. So, we cannot break even in terms of energy quality because energy always goes from a more useful to a less useful form when energy is changed from one form to another.

when it is burnt to release waste energy in the form of heat and emissions. The increased disorder is reflected through the effects of emissions such as greenhouse effect, climate change, etc.

Neoclassical economists tend to ignore the notion of entropy and treat technology as a changing ratio between capital and labour (Mansfield 1988). However, technological advancement can only make throughput more efficient, but cannot mitigate entropy. So, if some fundamental shifts are not made, the earth will ultimately move to a point of no return.

Humans are insecure in their ambiguous situation of finitude and freedom. So, they seek security against the vicissitudes of nature by pretending to have unlimited technological capacities and by exceeding the limits providentially established. Environmental sin is one form of the pride of power through their arrogant sense of independence and greedy efforts beyond natural requirements.

6.3.6. Economic Growth Mania.

Growth-mania is a prime tenet of marketing economic nations today. It is almost an imperative of patriotism in the present. Internationally, economic growth has become for many nations a faith which unites economic ideologies. Allegedly, the perpetual expansion of production and consumption is necessary for progress and prosperity to satisfy the insatiable wants of consumers and to provide employment opportunities for an expanding population. They are used to count even the losses of ecological capital in natural resources as assets rather than deducting them as liabilities, measured quantitatively in GNP (Nash, 1991:197-203).

The capitalistic growth system has some glaring deficiencies. It is not designed to satisfy the needs of the poor and powerless. Wealth is severely maldistributed by the system. The pan of the system agrees that it caters to marketing hedonism responding to and creating every conceivable desire of people, no matter how ignoble in order to provide goods and services. "Born to shop" is the motto of the human product of this process.

However, economic growth is a major factor in destroying the ecosystems on which the well-being of social and economic systems ultimately depends. Unrestrained production and consumption are key factors in the excessive exploitation and toxication of the renewable and non-renewable gifts of nature.

6.3.7. Consumerism (Consuming Paradise).

Why do we take the kind of environmental risks with regard to nuclear plants and mining activities as mentioned in Chapter II and IV? The simple answer is that we are driven by necessity. We need the energy and minerals for our industries and cars and homes. We need them because progress is inevitable and none of us dares stand in its way.

We are victims of our own successes and slaves of our search for consuming paradise affected by western lifestyles. Christians have also come to believe the unspoken maxim: A certain amount of damage to the earth is the cost of the lifestyle we require; we dare not sacrifice this lifestyle, because there is nothing else to give life meaning.

At the heart of consumerism is a basically crooked motivation created by the advertisers: What you see is what you want. What you want is what you deserve. What you deserve is what you must have. After all, we are consumers, and consumers must consume (Badke 1991:131).

6.3.8. Maldistribution.

Economic inequality is a major contributor to environmental problems. Poverty is a driving force behind environmental degradation. Poor people are forced to use their natural resources beyond the point of sustainability to survive in the present. In a vicious cycle, this deterioration reduces the availability of resources and further propels the extension of poverty (Nash 1991:50-54).

Global environmental problems cannot be resolved adequately unless economic maldistribution is remedied. Otherwise, the world's poor are forced to overexploit their natural resources in order to stay alive. So, preferential option for the poor entails a preferential option for ecological integrity.

However, we should make a distinction between pollution from poverty and pollution from prosperity. Because environmental destruction from prosperity contributes to environmental degradation from poverty. The excessive use of the world's finite resources by the overdeveloped world is a significant force in depriving the poor of sufficient resources for their essential needs, and hereby practically compelling them to choose between death and environmental degradation.

6.3.9. Population.

The biblical injunction to increase and multiply (Gen. 1:28) may be the only one that humankind has obeyed faithfully. Now population expansion is a serious problem so that the size of population jeopardizes ecological integrity. Because the human population can exceed the carrying capacity of the earth. We seem to be pressing the limits of natural resources, if we have not already surpassed them (Nash 1991:44-50).

Contrary to the bulk of evidence, some analysts argue that the earth can sustain many times the present population, because of its unlimited resources and the great potential of technological creativity as mentioned at 2.1. However, most demographic interpreters are anxious that the population growth can have serious social and ecological consequences.

Excessive population growth accentuates every environmental problem. The earth has limited resources to sustain and improve the quality of life. While these limits can be extended through human creativity, the potential of extension itself is limited. Overpopulation is a major contributing factor for environmental degradation. So, the population growth should be managed along with the carrying capacity of the earth.

6.3.10. Risks of Nuclear Plants.

The risks of nuclear catastrophes may be as small as optimistic nuclear advocates contend – one in so many thousands of operating hours. But the risk estimates are only educated guesses and hopes. When the risks occur, the potential magnitude of the damage is so severe, as Chernobyl illustrates, that the risk is morally unjustifiable. The rejection of the risk is really the rejection of possible damage.

Plutonium wastes are lethal during the lives of tens of thousands of generations, but they are stored in facilities or containers that will endure for a few decades or at best a few centuries. In the light of the waste problem, nuclear energy is acceptable only so long as the interests of future generations are discounted, only so long as the risks and costs are unjustly postponed to the future.

6.3.11. Marketing Price.

Extracting and processing raw materials to make various kinds of goods depletes non-renewable energy and mineral resources, produces hazardous waste, disturbs land, pollutes the air and water, contributes to global climate change, and reduces biodiversity as mentioned in Chapter II and IV. These harmful effects are external costs passed on to the public, the environment, and in some cases future generations (Miller 2004:24-25).

These harmful costs are not included in the market price, everyone must pay these hidden costs sooner or later, in the form of poorer health, higher costs for health care and health insurance, and higher taxes for pollution control. Thus, the world's current pricing system does not provide consumers with accurate information about the environmental impacts of the products and services they buy in the marketplace.

Therefore, the harmful costs should be included in the market prices of goods and services. However, internalizing the external costs will not occur unless it is required by government action. As long as business receive subsidies and tax breaks for extracting and using virgin resources and are not taxed for the pollutants they produce, few will volunteer to reduce short-term profits by becoming more environmentally responsible.

6.4. Biblically Based Proposition for Sustainable Development.

All the discussions have finally confirmed that human beings cannot devise a fundamental framework for sustainable development with their own technologies, ideologies and systems. It is definitely clear that no morally flawless new human will emerge and no environmental tokenism or half-measures will be fitting responses to the persistent source of environmental problems.

However, if we have gained anything through our study of ecology in the light of Scriptures, it must be to understand that the physical world is not irrelevant to the biblical Christian. The issue of the environment is fundamentally theological and is related to central truths of the Christian faith: creation, sin, salvation, and the proclamation of the gospel (Kinnamon 1991:55-72).

We can find a fundamental concept for sustainable development from the Bible. To lay the foundations for biblical sustainable development, I would like to summarize a number of key propositions to deal with the

environmental crisis.

6.4.1. The Earth is the Lord's.

According to Psalm 24:1-2, the One who made the earth has claimed it for his own. All created things belong to Him, and human beings can lay no claim to any part of the earth to exercise exclusive rights in exploiting its resources. It is important that Christians affirm that ours is a created universe, formed by God who owns it, for without this truth we become a law to ourselves. Such autonomy provides the recipe for environmental disaster. Only when we see ourselves as standing at the throne of God so that we can act under his orders, we can have any hope of living responsibly in the environment (Gnanakan 1999:31-39).

6.4.2. Human Role of Imaging God.

Human understandings of God as Creator, Holy Spirit, and Redeemer implies that all the creatures are valued and loved by God. Divine valuations appear to be cosmocentric and biocentric, not simply anthropocentric. Since loyalty to God entails loyalty to God's values, Christians are called to practice ecological integrity.

All the creatures have intrinsic value, and are to be treated with appropriate care and concern. So, any notion of man's domination over nature must be tempered by two interwoven considerations. First, God created human beings to operate under His lordship. Second, God intended mankind to image Him in the earth, dealing with the environment as representatives of the Creator, as if He Himself were at work.

6.4.3. Relationship between Humans and Nature.

The main cause of environmental problems may fundamentally be a wrong perspective on the relation between humans and nature, in which humans are not a part of nature. Contrary to the will of God, they have tried to competitively study how to control nature and to ruthlessly exploit the resources from nature for their material affluence.

Nature can exist without human beings, but human beings can not exist without nature. Industrialization has been advanced while ignoring this truth.

We should note that material affluence has been achieved under the serious sacrifice of the natural environment such as air and water pollution, depletion of non-renewal resources, climate change etc. So, some scholars define the present world as a risky person walking on thin ice in terms of environment.

6.4.4. The Creation as a Mirror of Human Hearts.

Human beings need concrete reminders of who they are before God. Thus the earth was created as a vast mirror of human experience. In the Garden, the environment said to Adam and Eve, "You are the cherished higher creation of the God whose majesty you see around you. All that you require for life and happiness is easily within your grasp" (Badke 1991:147).

By contrast, we must expect that rebellion against the Creator God in the spiritual realm would bring a corresponding harshness to the environment. Such was indeed the environmental case. So, we should keep in mind in our daily lives that all the creation serves as a mirror of the condition of the human heart, that it is a tangible statement of an intangible reality.

6.4.5. Environmental Crisis from Sinful Hearts.

The mirror images of the inner life of post-fall humanity exist as opposites to the Creator God of glory and nurture. Instead of glory, we find condemnation in the morality of all things, the horrors of natural disasters, and the growing crisis of environmental pollution as mentioned in Chapter II and IV. This is the witness of penalty. Instead of nurture, we discover that the earth no longer supports life without extreme effort, and that death can snuff out in an instant all that we have worked for. This is precariousness.

To pollute deliberately or through carelessness is to make a statement about the condition of one's inner being, for the earth mirrors our hearts. Polluters assume falsely that the earth belongs to man, that greed is good, that economic advancement is the only true goal of humanity, and that sinful human beings can solve their own environmental problems. This complex of self-induced lies is symptomatic of hearts that are in rebellion against the God who made all things.

6.4.6. Lifestyle with the Image of Christ.

Jesus lived a simple life, though He deserved the splendor of the heaven. He sacrificed all, even His very survival, to obey His Father and win our salvation. To image God with the image of Christ is to live in contradiction with a world that scorns self-sacrifice and simplicity. We must be active, as followers of Christ's lifestyle, to do our work on earth.

We need to begin to look at our world through the eyes of God to see what is fitting and what is not as we deal with the physical earth around us. As the follower of Jesus Christ, we must make it our goal to bring a certain kind of beauty to our surroundings, a beauty which harmonizes with nature rather than clashing with it.

6.4.7. Responsibility for Ecological Integrity.

God is the source and sustainer of the whole cosmos. God loves creation, reflecting the glory of its creator. God's work of redemption in Jesus Christ reconciles all things and calls us to the healing work of the Spirit in all creation.

However, today all creation in the world is endangered because humanity has failed to love the earth. The rich and powerful have plundered it as if it were created for selfish purposes. The magnitude of the devastation may well be irreversible and therefore forces us to urgent action.

Biblical statements, such as "to have domination" and "subdue the earth" have been misused through the centuries to justify destructive actions toward the created order. As we repent of this violation, we should accept the biblical teaching that people, created in the image of God, have a special responsibility as servants in reflecting God's creating and sustaining love, to care for creation and to live in harmony with it.

6.5. Biblical Sustainable Development in accordance with the Will of God.

Briefly speaking, the definition of sustainable development by the Brundtland Commission (refer to 6.1.1) is a compromising concept for environmental and economic well-being for today and tomorrow on the basis of continuing economic growth and without changing lifestyle in spite of the limited carrying capacity of the earth. As a result, the goal of sustainable

development is to minimize environmental degradation without damaging economic growth and without considering different economic and political systems around the world.

This lack of clarity has promoted the development of frameworks, management guidelines, and indicator sets in an attempt to operate the concept. Consequently, sustainable development has become a highly ambiguous term, having been made to mean almost anything or almost nothing and interpreted to support a vast array of arguments, strategies and decisions (Cordes and Otto 2000:1). So, although commendable, this definition is not operational and has created much antagonism and cognitive dissonance. Sustainable development has been defined in many ways (Allen 2007:47-65).

However, environmental problems are not only scientific, technical, political or strategic questions, but also fundamentally moral issues. Because environmental pollution is the harmful or fatal effects of human actions, direct or indirect, that places natural and/or synthetic elements in ecosystems where they should not be at all or in amounts that surpass an ecosystem's capacities for normal assimilation. They are human-created problems that adversely affect the good of humans and other creatures in our relationships (Nash 1991:24).

It is therefore necessary to redefine the controversial and ambiguous sustainable development by considering the fundamental roots of environmental degradation and the biblical proposition for sustainable development mentioned in the 6.3. and 6.4.

6.5.1. New Definition of Sustainable Development in accordance with the Will of God.

If the solutions are to be commensurate with environmental problems, they will certainly require fundamental changes in how societies assess and manage economic activities and consumption patterns of human beings to live in harmony with all the other creatures within the carrying capacity of the earth.

Are luxuries and conveniences really significant contributors to human enrichment? What should we be willing to sacrifice now for the sake of social and ecological integrity in the future? How can we reduce or redesign our wants? What is the purpose of the Creator in creating the heavens and the earth (Gen. 1:1)? Why did God make humans in His own image (Gen.

1:27) from the dust of ground (Gen. 2:7)?

Through considering the biblical proposition for sustainable development and the fundamental roots of environmental degradation above-mentioned in the 6.3 and 6.4, I would like to redefine the popular definition of sustainable development by the Brundtland Commission in the following way and call it biblical sustainable development:

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs in harmony with all creation within the carrying capacity of the earth through changing the lavish lifestyle in affluent societies and amending a neoclassical fossil-fuel economic system in accordance with the will of the Creator.

No matter how sophisticated our technology becomes, ecological prudence should be an adaptation to the forces and restraints of nature, recognizing the limitations of human knowledge and technological ingenuity. Humans should avoid overconfidence in human powers to control nature, exaggerations of human authority over nature, and under-valuations of other creatures.

The prevention strategies of environmental degradation would require significant transformation in the patterns of production and consumption in human societies. Life would be less consumptive, more frugal, more restricted, and less convenient, but also safer, more efficient, and ecologically richer. Otherwise, future generations will bear the agonies of our generation's profligacy.

We should use no more than our share of non-renewal resources like fossil fuel and minerals, or provide reparation for jeopardizing the opportunity for future generations coming into being. Excessive depletions of non-renewable resources should be counterbalanced by the devising of new techniques so that succeeding generations have opportunities matching those of their predecessors. The compulsive overuse of fossil fuels in our generation would require not only a new conservation but also the compensatory development of environmental-friendly technologies for energy and mineral resources.

6.5.2. Biblical Sustainable Development in the Mining Context.

In recent years, several concepts have been created to apply to various aspects of environmental management. However, most are highly ambiguous, having been misinterpreted, misused and further redefined over time. It is becoming increasingly challenging to apply environmental management to several sectors of industry.

The most important example is the mining sector. Because mining activities have the ability to cause widespread environmental damage on numerous fronts as mentioned in Chapter II. Moreover, because prospective ore-bodies are geologically fixed, mining management cannot nationally select locations for mine sites. As a result, the management is often criticized for conducting mining operations in environmentally sensitive areas.

The very nature of the mining operation has made the concept of environmental management strictly defined to prevent mining companies from spreading mining pollution and transferring them into future generations in the decision-making and strategic planning processes. Thus to avoid being interpreted generically, a key concept must be defined specifically for the mining industry.

There are three widely adopted environmental management concepts in the mining context, namely "cleaner production" (CP)⁴⁾, "pollution prevention"⁵⁾ and "burden of proof." They are important environmental management concepts to be defined concisely for sustainable development before incorporating them in the mining industry.

The major basis of the debates on mining activities for sustainable development is focusing on the finite nature of mineral resources themselves (Tilton 1996:91-97). Primary examples include sustained mineral assets through conservation and mineral and metal recycling. Others discuss the importance of sustainable development as a guiding principle in mining environmental management in the setting of environmental practicing codes and environmental standards (Carbon 1997:10-13; Miller 1997:14-17).

So, in this light the definition of biblical sustainable development in accordance with the will of God mentioned in the 6.5.1, I would also like to redefine the three concepts as the followings:

6.5.2.1. Cleaner Production (CP) in the Mining Context.

Cleaner production (CP) in the mining context is redefined as a strategy to continuously improve products, services and processes to reduce environmental impact, and to work towards ecological, economical and ethically sustainable development in accordance with the will of God.

6.5.2.2. Pollution Prevention in the Mining Context.

Pollution prevention in the mining context is defined as source reduction and all other practices that reduce or eliminate the creation of pollutants through (1) increased efficiency in the use of raw materials, energy, water,

4) The cleaner production (CP) is used as an overarching environmental management concept, and heralded to be at the pinnacle of the newly emerged preventive paradigm. The origin and introduction of CP into environmental management literature occurred as a result of the work of the United Nations Environmental Programme (UNEP) and United Nations Industrial Development Organization (UNIDO). However, in most cases, UNEP is credited with having first used the concept, initially defining it as a "preventive strategy which promotes waste before it is systematically created, to systematically reduce pollution, and improve the efficiencies of resource use" (UNEP 2001:3). It has been widely adopted and applied throughout Europe, Australia, New Zealand and Asia.

5) After implementing the US Pollution Prevention Act in 1990, advanced countries have developed working definitions of pollution prevention, shifting from conventional pollution control to a preventative approach, with some focussing on the methodologies of product reformation, system modification and equipment redesign and resource recovery changes as key pollution prevention practices in the mining activities. The Pollution Prevention of the Ontario Ministry of Environment (MOE), for example, has defined pollution prevention as activities that "reduce or eliminate pollutants or wastes at the source," (MOE 2001:27). Environment Canada has adopted a similar interpretation, defining pollution prevention as "the use of processes, practices, materials, products or energy that avoid or minimize the creation of pollutants and waste, and reduce overall risk to human health or the environment," (EC 2002).

or other resources within the carrying capacity of the earth, or (2) protection of natural resources by conservation and through changing a lavish lifestyle in affluent societies and amending a neoclassical fossil-fuel economic system.

6.5.2.3. The Burden of Proof in the Mining Context.

In the light of the severe environmental consequences of human ignorance and inevitable error concerning the products made from energy and mineral resources, the burden of proof should rest not on public agencies to prove that new and existing goods are harmful, but on the producers to give reliable evidence that they are safe and not persistent in the environment⁶⁾. Particularly, chemicals are not innocent until proven guilty, but suspect until proven innocent.

6) This means the elements and chemicals which take long time and are difficult to dissolve and/or corrode (decay) like dichloro-diphenyl-trichloro-ethane (DDT).

Chapter VII. A Theological Framework for the Biblical Sustainable Development of Energy and Mineral Resources.

God's project is the earth (cosmos) community, not only the human community. God is acting with justice and mercy to redeem creation, not only human beings. So, it is necessary to reorient our faith and ethics focusing on relations and community, not only on individuals and objects, by the new story of the earth and cosmos bodying forth the power, wisdom and love of God (Hessel 2001:202). It is also necessary to deliberately breach the walls between church and world to show ecclesial authenticity in response to the environmental crisis and to build the biblical sustainable society by the will of God.

Environmental reformation is to re-examine Scripture in the context of the current environmental crisis. All Christians should read and interpret the Bible with more alertness to nature, attending to God's special regard for the poor and oppressed. Particularly, theologians can participate by taking seriously the plight of nature and reflecting on real praxis for biblical sustainable development through reinterpreting the Bible.

Dealing with superficial symptoms will not be sufficient for environmental degradation interlinked with all creation and penetrating into human daily life. Getting to the root issues will turn out to be an absorbing theological discussion because the earth is God's. So, it is an urgent task to overcome the modern Christian habit of divorcing social and ecological stewardship through biblical thought on environmental problems.

In order to do this urgent task, we should firstly recover the biblical doctrine of creation: the heavens and the earth are the Lord's (Gen. 1:1); they are the products of the Creator's ongoing love revealed through creation and through Christ. Secondly, Christians should be awakened, that through the death and resurrection of Christ, He is reclaiming all the creatures for Himself. Thirdly, we should demonstrate through our tangible works that as God is reclaiming human hearts, He has laid claim to the environment in which we live. We have a mandate to image God, not just spiritually but physically, for the physical has always served as a mirror of the human heart.

This demands a new consciousness in the hearts of Christians about the need to care for the earth, to restore it as much as possible, and thus to declare that the earth is the Lord's. This demands a determined effort on

the partake of Christians to heal the earth and to cease contributing to environmental degradation.

Therefore, I will firstly look at theological perspectives in which develop the rudiments of an environmental ethic grounded in the Bible. Secondly, I will suggest practical guidelines to lead this world into the biblical sustainable society based on the theological perspective. This will also be to hint at what criteria can be employed to evaluate the environmental impacts from nuclear plants and mining activities in Korea.

7.1. Theological Perspectives for Biblical Sustainable Development.

A careful look at the Bible will reveal that environmental concerns are very much central to its message. We can seek insights from biblical texts that address the critical issues we encounter in relation to the environment. The issue of the environment is fundamentally theological and is related to central truths of the Christian faith: creation, sin, salvation, and the proclamation of the gospel (Kinnamon 1991:55-72).

The word of God starts with the glorious account of God's creation. God promised the best of created things to the people he made to be his own. The prophets looked forward to a renewed creation. Jesus Christ displayed a very positive attitude to all that was around him. Paul spoke about creation groaning for redemption, just as much as human beings are groaning. The final book, Revelation, concludes with a glowing description of the new heaven and the new earth, a glorious continuity of what God has already done for the world.

However, in the light of the traditional Christian practice to mainly restrict the scope of grace to matters of personal salvation, the church does need new theological and ethical bases for biblical sustainable ecological integrity. This need does not entail abandoning or replacing Christianity's main themes. Rather, it requires extensions and reinterpretations of these main themes in ways that preserve their historic identity and that are also consistent with biblical sustainable development by the will of God. (Nash 1991:92).

7.1.1. Understanding of Creation for Ecological Integrity.

The scriptures reveal the essential truth that God is the Creator of all

creation (Gen. 1:1) and the Spirit of God continually sustains and renews the earth (Ps. 104:30). We confess the Triune God as the source of all life. The Holy Spirit manifests God's energy for life present in all things and reminds us of the dependence of all things on our Lord God. Through Jesus Christ all things have been made, and God's creation comes to its fulfillment in Him. The boundless mystery of the universe, the abundance, beauty and grandeur of creation and of this precious planet manifest the glory of God.

7.1.1.1. Creation of Creation by God.

God is the sole governor and final benefactor, the sovereign source of all being and becoming, the ultimate provider and universal proprietor, the originator and systemic organizer. God is the Creator of all creation (Gen. 1:1), and has declared that it was very good (Gen. 1:31; 1 Tim. 4:4). All elements and inhabitants of every planet and solar system are creations of God and finally dependent on God's providential preservation and parental care.

The God alone is the owner: "The earth is the Lord's and all that is in it, the world and all those who live in it" (Ps. 104). Ancient Israel interpreted as imposing ethical restrictions on the use of the land by its temporary occupants, the human aliens and tenants (Lev. 25:23).

The logic of the doctrine of creation does not permit a nature-grace dichotomy. However, Christian churches used to restrict in practice the scope of grace to matters of personal salvation, and the means of grace (world and sacraments) to ecclesiastical functions. These typical restrictions distort the doctrine of creation. Grace is not only the forgiveness of sins but the givenness of life, a double gratuity of redemption and creation (Sitter 1972:74-78).

God is love. The creative process, therefore, is an act of love, and its creatures are products of love and recipients of ongoing love (Ps. 136:1-9). The whole of nature is an expression of grace, that is God's faithful loving kindness that characterizes God's nature and acts. Through elimination of a nature-grace dichotomy, we should endow all of nature with an intrinsic significance and have an attitude with an understanding of nature as a manifestation and beneficiary of grace.

7.1.1.2. All Creatures with their own Intrinsic Values.

Christian understanding of the world is the affirmation that all the creatures are God's good creation to have their own value and dignity in and of themselves, apart from any usefulness to humans. All creatures have divinely-imparted value independent of human interests. This value exists in a wild and virginal state prior to the taming and technical transformations of human managers. All God's creatures are worthy of moral considerations, as a sign of the worthiness imparted by God as an expression of the worship of God.

The non-human world is a sphere in which God reveals his presence and communicates with humans. The Spirit is present throughout creation. The presence of the Spirit fills the world with the glory of God. The monotheistic doctrine of creation does not desacralize nature: "Nature is still sacred by virtue of having been created by God, declared to be good, and placed under ultimate divine sovereignty" (Heyers 1984:47). We affirm that the universe, as created by God, is good.

However, we should not confuse with nature gods leading to pantheism, animism and/or fetishism. From the theological perspective of monotheism in the doctrine of creation, there are no lesser divinities. In this view, polytheism, animism, astrology, totemism, and other forms of nature worship are not only idolatry, but also vanity and stupidity as the prophets regularly suggested (Isa. 40:12-28; 44:9-20; 46:1-11; Acts 14:15).

Even though the manifestations of the pathetic fallacy are factually found in the Bible, the Old Testament definitely calls all the biotic and abiotic creatures to praise their Maker (Ps. 96; 98; 148). The Creator alone is worthy of worship. Nothing in creation is independent of God, nor identifiable with God. He is the Creator who created all creatures out of nothing (*ex nihilo*).

7.1.1.3. All Creatures Blessed by God.

The universe was not created mainly for human beings, contrary to the humorously arrogant pronouncements in most periods of Christian history. According to Genesis 1, creation and its creatures are declared to be good before the emergence of humans (*homo sapiens*). All animals are blessed with fertility, commanded to "increase and multiply" (Gen. 1:22; 8:17).

God is not only interested in human beings, but also loves all creatures

and is constantly involved in their lives (Psalm 104: 10-14; 145:13). In Job 38-41, the author not only stresses human humility in the presence of divine mystery, but also assumes God's positive evaluations of the whole creation apart from any human utility. God's compassion covers the whole of creation (Ps. 145:9).

The divine sovereignty and universal providence also imply that the Creator is concerned about the whole of creation and all its parts. All the creatures respond in their own ways to the goodness and love of God. This response will reach its climax when all share in the ultimate presence of God amongst His creatures.

7.1.1.4. Relationship among God, Human and Non-human Creation.

In the Old Testament, the creation account begins by showing the threefold relationship between God, human and non-human creation. This relationship is later exemplified in the covenant with Israel, which includes the people of Israel, the gift of the land of Israel and their responsibility for it to God.

If God is the Creator of everything, and if there is a strong bond between God and creation, there ought to be an integral relationship between all creatures as well. Since God is the source of all in the Christian doctrine of creation, all creatures share in a common relationship. Human and non-human creation share a common Creator as well as a common creative process (Gen. 1:1-28; 2:17-19)

On the assumption that one ought to value God's relational design, this theocentric kinship has been interpreted in Christian history as having ethical implications. In this vein, one of the fundamental tasks of Christian ecological ethics is to determine the moral responsibilities entailed by the reality of theocentric and ecological kinship (Nash 1991:98).

Human beings are a part of the world which our Lord God created with the intention of relationship between humans and non-humans.¹⁾ Non-humans can survive without humans, but humans must humbly accept that they cannot survive without non-humans. We should accept the total dependence of our well-being on the well-being of creation. So, a lack of the specific relationship with God in our lives results in a serious distortion of our values and attitudes to the rest of the creatures (Hall 1990:185-215).

The Noachic covenant (Rainbow Covenant) is interpreted as a biblical

symbol for environmental responsibility (Gen. 9:8-17). The ecological covenant, along with the story of Noah's Ark itself, is a symbol of the unbreakable bonds between the Creator and all creatures, not only a sign of the covenant between God and Noah.

While the covenant assumed responsibilities to future generations of humanity, the story provides a symbolic mandate for human responsive loyalty to God's ecological fidelity. The divine promise entails human obligation because faithfulness to God entails loyalty to God's covenants. Similarly, the ecological covenant requires caring and careful responses from humans.

Therefore, environmental degradation is a violation of the ecological covenant and an attack on the created order itself. It is disloyalty to God, other creatures, other humans, future generations, and ourselves, because we are all bound together with common interests in saving the ecological integrity of our home, the earth (McCoy 1992:369-370).

71.1.5. Land of God's Gift and Promise.

The land is God's gracious gift to habitants and God's promise to the landless, demonstrated in the story of the garden of Eden, the grant of fertile Goshen to Joseph and his clan in Egypt, the entrance into Canaan that flows with milk and honey, the return from Babylon to Zion etc. (Conradie and Field 2000:63-67).

So, the people must live in the land in accordance with God's covenant, because the land is God's. The land should be ruled with justice and mercy, providing for an equitable distribution and developing resources in the land by the will of God. The land is not only the object for reckless development for only the current generation, but the subject cared for and used in accordance with the will of God for all the future generations.

In particular, the limited energy and mineral resources deposited in the land should be exploited in accordance with biblical sustainable development by the will of God. They are inevitable resources in the current civilized

1) Douglas J. Hall classified human views about nature into three types such as humanity-over-nature view, humanity-in-nature view, and humanity-with-nature view (Hall 1990:185-215).

society so that we cannot imagine only one day of our lives without energy and mineral resources, as we can not maintain only one minute without pure blood in our lives.

For the legal mind at present, land and its resources are generally something that could be owned. However, ownership poses a serious problem in the light of environmental degradation. The first problem is that little concern has been given to ecological inter-connectedness. The second problem is that the growing disparity between the landed and the landless has caused havoc in many contexts with greed and envy increasing all the time.

Greed and envy demand continuous and unlimited economic growth of a material kind, without proper regard for conservation. The economic growth and unlimited greed have brought the land to the brink of destruction, because this type of growth cannot fit into a finite environment. So, the Bible traces the problems back to the sin of individuals compounded in the sin of society. We should note that the prophets repeatedly warn against the mismanagement of the land through breaking and violating the covenant with God.

7.1.1.6. Creation is waiting.

Paul says that the whole created universe groans in all its parts as if in the pangs of childbirth and waits with eager expectation for God's sons to be revealed (Rom. 8:19-22). The liberation of creation is inextricably linked to the salvation of humans. Creation is waiting for a new community of humans (the new creation) to be formed. Creation is in critical need of a community of people who will again obey God's creational laws and restore justice, peace, love and truth to daily life. Creation is waiting for a community whose lifestyle will comply with care for creation according to the wisdom of the Creator. Creation is waiting for a community that will take bread and wine as a sign of the earth's fidelity to its Creator, the Father of our Lord Jesus Christ (Zink 1985:109).

7.1.2. Christian Faith for Ecological Integrity.

The scriptures teach that human beings were created by God from the earth. In addition, God gave them the breath of life (Gen. 2:7) and created

them in the divine image and likeness (Gen. 1:26-27). So, we have to get rid of our ignorance to the fact that we are part of nature. We should acknowledge that we cannot exist apart from it. Mankind is part of nature and life depends on the uninterrupted functioning of natural systems which ensure the supply of energy and nutrients.

Therefore, it is important to realize that human beings are not the center of the universe, neither is the created order. God should be the focus of our attention. We should more than before proclaim the biblical answer: "The earth is the Lord's, and everything in it" (Ps. 14:1). We should have a unshaken faith that not humankind, not the wonders of nature, but God the Creator is the center of the universe. Without Him nothing else really falls into place (Kritzinger 1991:4-19).

7.1.2.1. Sin against Environment.

Christianity has functionally limited the meaning of sin narrowly such as murder, thief, sexual misdeeds etc. However, the concept of sin is broad and complex in meaning, and is an indispensable element in Christian theology. Particularly, in our time of facing the environmental crisis, the meaning of sin must be properly extended to cover environmental misdeeds and the human condition underlying them.

All human beings are created in the image of God to reflect the character of God and represent God's interest in the world (Gen. 1:27). They should share God's attitude toward all the creatures. They are also part of nature, a species in the community of creation.

However, they have had a tendency to emphasize their unique role among creation for so long. They have lived in the earth as if they were apart from nature. Their arrogance against the rest of creation away from the will of God resulted in a neglect of their responsibility to protect the environment (Gen 6:11-13).

The root of sin is egoism, acting for self-centered lust to arrogantly dominate others and the pretension of self-sufficiency at the expense of other beings. Sin makes the self the center of existence, in defiance of divine intentions and in disregard to the interests of other creation. Sin is turning inward, and thus turning away from God, neighbor, and nature (Gustafson 1981:242-47).

From these points of view, environmental sin is the refusal to act in the

image of God, as responsible representatives who value and love the host of interdependent creatures in their ecosystems, which the Creator values and loves. It is breaking the bonds with God and our comrades in creation. It is acting like the owner of creation with absolute property rights.

Environmental sin is again expressed as the arrogant denial of the creaturely limitations imposed on human ingenuity and technology, a defiant disrespect or a deficient respect for interdependent relationships of all creatures and their environments established in the covenant of creation, and an anthropocentric abuse of what God has made for frugal use.

These dynamics of environmental sin are evident in all dimensions of our environmental crisis. The avarice induced by our economic system resulted in the excesses of capitalistic destruction such as the gutted mines, the wasted forests, and even the construction of nuclear plants without counter-planning for nuclear waste disposal, and sacrificed the future generations to immediate enrichment.

7.1.2.2. Presence of the Holy Spirit.

The Holy Spirit of God is imminent as the life-giver in creation. This vivifying presence reconciles, liberates, enlightens, inspires, guides, counsels, comforts, suffers with, nurtures, strengthens, transforms, renews, sanctifies, empowers, and prods created being in its pilgrimage to its destiny disclosed in Christ. God is intimate with the creation, actively involved in personal, cultural, and natural histories (Nash 1991:111).

This stress on divine immanence breaks down the classical discontinuities between Creator and creation, faith and reason, natural and supernatural, and sacred and secular. It is a revolt against the perception of God as an absentee landlord who enters the premises only for miraculous repairs. Since God dwells in creation and not in deistic isolation, the world is the temple of the Holy Spirit.

Therefore, we can encounter our omnipresent God anywhere as countless Christians have testified. Because God is present not only in the burning bush (Exod. 3:2) but in the nurturing soil and atmosphere, sharing the joys and agonies of all creatures. The intuition of the Spirit's presence in power and love in the physical world have been a potential power in the development of a human appreciation, admiration, and affection for nature, with both spiritual and ethical consequences.

However, creation and its creatures are finite and transient: they are not divine and are, therefore, not to be worshiped. We must not assign natural objects to different deities or divide nature among competing gods like animism and polytheism. Christian sacramentality sacralizes nature but does not divinize nature. Christian monotheism provides an integrated world view: The world is one because God is one.

7.1.2.3. Salvation in Jesus Christ.

Jesus Christ came to the earth in the incarnation of God to enter into solidarity not only with humans but also the world (John 3:16-17). He confers dignity on everything in creation. Christ will redeem the whole creation, liberating all creatures from death and reconciling them for harmonious interactions (Isa. 11:6-9; 65:17; Col. 1:14-20; 1 Cor. 15:28; Eph. 1:10; Rom. 8:19-22).

Every creature is destined for resurrected glory, and Jesus' resurrection is the pledge of that universal salvation. The hope is not for salvation from the human body, but rather the redemption of the whole body of creation (Becker 1980:149-181).

However, the characteristic of Western theological traditions has been the absence of hope for the salvation of creation. Heaven is exclusively for humans who alone have rational and immortal souls, and generally only for a few of them who believe the appropriate doctrine and who behave in the proper manner. There is no room for non-human creatures in the heaven at all (Regan and Singer 1976:179-180).

In this ultimate dualism, redemption is the release from nature, and oblivion is the fate of nature. This exclusive belief has served as a major justification for depreciating the value of creation and destroying its allegedly valueless components. Humans can neglect or abuse what is not redeemable. It can be treated as only an instrumental value without considering its intrinsic value for God to be respected by others.

A non-redemptive God cannot be steadfast with love or justice. Any lover who allows the final annihilation of the beloved fails all the tests of love, including the preservation of the loved one's individuality, potentiality, relationships, and sense of ultimate meaning. There is no ethically sustaining ground in such a situation. Words like love, justice, fidelity, harmony, and reconciliation are all relational terms that have relevance only in relational

contexts.

From this perspective, the resurrection hope is central to the Christian faith. Without this hope, Christian theology and ethics are incoherent. The condition of creation is ultimately tragic and the character of God is ultimately immoral. Only with this hope can the Christian faith maintain its apostolic integrity (Acts 4:2; John 14:2; Rom. 5:10; 8:10-11; 1 Cor. 15:12-16; II Cor. 4:14; Col. 1:18; 1 Thess. 4:14; 1 Pet. 1:3-5; Rev. 1:5).

7.1.2.4. Poverty and Environment.

We should recognize that a fundamental cause of poverty is almost the same as that of environmental degradation as mentioned in 6.4, which is the sinful nature of humankind, manifesting itself through violence, greed and self-interest overriding the God-given mandate to meet the needs of both human and non-human creation, and particularly of a new poor.²⁾ We therefore accept that it is of equal importance when addressing the needs of creation to deal adequately with the needs of the poor (Mcfagu 1999:159-195).

Poverty comes under added scrutiny with an environmental crisis. Wherever there is poverty it is directly or indirectly linked to the perversion of justice. There is injustice against the poor masses and against their environment. There are people who in their poverty are compelled in their desperation to strip their surroundings of all natural resources that could help them survive. However, the poor were sometimes blamed for over-exploitation and consequent degradation of natural resources (Hallman 1994:225-247).

The poor invariably suffer first and most from a degraded environment. In a world intricately interconnected, their struggles are thus a critical and practical starting point for restoration and the well-being of all creation. To overcome the suffering life of those at grassroots as a result of indifference, overconsumption and overdevelopment mainly in the affluent society, people should be persuaded to follow biblical sustainable

2) Eco-feminists tend to consider nature as part of the new poor like maltreated females who suffered in a patriarchal society (Mcfagu 1999:159-195).

development in accordance with the will of God while resisting the pressure of greed and covetousness that pervades humanity.

Our wanton pollution, profligate consumption and human-induced extinctions of creatures are sins from the perspective of the incarnation of Jesus Christ. We should reject anthropocentric valuations by means of spiritual contempt of earthly materials and goods and indifference to other humans and other creatures. Therefore, our Lord Jesus Christ definitely declares that individuals and nations will be judged on the basis of their care for the "have-nots" (Matt. 25:31-46).

7.1.2.5. Christian Hope for Future Glory.

Even though the world is physically decaying and spiritually infected with sin, Christians do not need to be pessimistic. Because we have hope for future glory. In spite of such a disappointing life of human beings, our Lord God has been faithfully carrying out the plans for a new creation to establish the Kingdom of God on earth as it is in heaven (Mat. 6:10).

If Christian salvation is the resurrection of Christian bodies and the new creation of all non-humans, the salvation Spirit of Jesus Christ is the creation Spirit of our Lord God (Col. 1:14-17). All humans and non-humans on earth are the existences of loving solidarity in the hope of salvation (Rom. 8:21-23) waiting for the new heaven and new earth (Rev. 21: 1).

Through Christ's cross and resurrection, we are assured that the entire creation is made new. All things have been reconciled to God in Jesus Christ, and through the Spirit we begin to experience God's future. We look forward to the new heaven and new earth that God has promised, and we wait for God's new order that will free the world of sin, sickness, and evil. This is exemplified in the new messianic era inaugurated through the life, death, and resurrection of Jesus Christ.

7.1.3. Christian Responsibility for Ecological Integrity.

Human beings have the burden to exercise their responsibility along with love and concern for one another within God's creation. We have the responsibility to maintain God-given rights in our dealings with nature. Dictionaries define rights as having to do with justice and moral goodness as well as with entitlement to privileges. Responsible behavior will show

respect for the rights and values of all the parties involved.

The responsibility given to Adam and Eve in the Garden of Eden to name and exercise control over all creation is a good pointer to the fact of such a responsibility (Gen. 2:15). We are quick to interpret it to refer to human authority over the natural world, but ignore a reference to the responsibility entrusted to us to respect and assign rightful place and value to everything by the purpose of God.

7.1.3.1. Divine Image and Human Domination.

According to Genesis 1:26-28, humans are created to be the image of God and to exercise domination in relation to all other creation. The meaning of these two related concepts has been the subject of numerous speculation and debates among theologians in Christian history.

Too frequently and falsely in recent centuries, both the image of God and domination have been interpreted as the divine grant of a special status making humanity the sole bearer of intrinsic value in creation with the divine mandate to pollute, plunder, and prey on creation to the point of exhausting its potential. Domination often became a major pejorative in the environmental complaint against Christianity (White Jr 1967:1203-7).

However, it is surely a distortion of the notion of the image of God and a perversion of domination in their arguments. It is a projection of human greed rather than a revelation of God, since it makes God into the image of arrogant humans. The image and domination in Genesis 1 and 9 are not ground for human abuse of nature (Steffen 1990:1990:18-22). What do these concepts originally mean in the theology of creation?

7.1.3.1.1. Divine Image in Human Beings.

The image of God does not allocate to humans a special status as the sole bearer of intrinsic value or a special sanction to destroy with impunity, but rather a special commission, calling and/or task to serve as responsible representatives of God's interests and values and function as protectors of the ecosphere and self-constrained consumers of the world's goods.

The image is environmentally as much a responsibility as a right. Thus, humanity is both part of the created world and charged to be God's steward of the created world. Human beings are charged to keep the earth and

serve it (Gen. 2:15), in an attitude of that blessed meekness which will inherit the earth with the peculiar rational, moral and creative facilities.

The New Testament understanding of the image of God enhances this sense of environmental responsibility. Christ is the perfection of the image of God and the paradigm of domination over creation so that He is the moral model (II Cor. 4:4; Col. 1:15; Heb. 1:3; John 1:14-18). Christians are to imitate or mirror the love of Christ because love is the essence of the image (Eph. 5:1-2). The mission of Christians is to reflect that love in relationship with all that God loves.

Human worth is not based on possessions, achievements, physical attractiveness, or public acclaim. Instead, it is based on the ability to reflect the character of our Lord Jesus Christ in our love, patience, forgiveness, kindness, and faithfulness. We are persons of worth to help all humans love God, know Him personally, and make a valuable contribution to all other creation around us.

Thus when interpreted in the context of Christ, the realization of the image and the proper expression of domination are not manifestations of exploitation, but rather representations of nurturing and serving love. That is a reason why one of the basic questions for Christian ecological ethics is how to express love, including justice in an ecological context.

7.1.3.1.2. Domination over Creation by Human Beings.

Human domination was neither possible nor necessary until the late development of strong creative and destructive capacities along with the development of science and technology. Our planet thrived under the provision of God without human assistance. Humans have played only very recently destructive roles in the biological and geological history of the planet, our home (*oikos*).

In this context, the idea that the earth was made for humans is not only ludicrous but sinfully arrogant. It is a violation of the integrity of Christian faith. The earth is God's. He has ultimate rule over the earth, and he exercises His authority with loving care. When God delegated some of his authority to human beings, He expected us to take responsibility for the environment and other creatures that share the planet.

Approval for the exercise of unlimited power is alien to Genesis 1 and to the Old Testament as a whole. Humans are creatures, always subject to

divine domination. The land is God's, entrusted to humanity to till and keep in accordance with God's ground rules (Gen. 2:15), which even includes a soil conservation mandate to let the land rest every seven years (Lev. 25:3-5; Exod. 23:10-11).

Therefore, the notion of human domination over nature must be tempered by two interwoven considerations. First, God created human beings to operate under His lordship. Second, God intended mankind to "image" Him on the earth, dealing with the environment as representatives of the Creator, as if He Himself were at work. Our goal as Christians belonging to God is to nurture the environment, not to harm it; to support it, not to destroy it.

We must not be careless and wasteful as we fulfill this charge. God was careful how he made His earth. We must not be careless about how we take care of it. Whenever tendencies are inherent in the world "subduing" for overreaching human boundaries through using up-to-date science and technology should be checked and balanced by the biblical concepts of domination itself, and by other moral constructions in the Bible.

7.1.3.2. Basic Ethic of Jesus's Teaching.

A Christian environmental ethic must focus attention on the life and work of Jesus Christ. The redeemed community of God must develop a redeemed ethic that will demonstrate the redemption message and its impact on all of God's creation. Environmental problems are not accidental, technological, religious or philosophical, but is the problem of sin and sinfulness.

Our Lord God has demonstrated grace that has brought redemption through the cross of Jesus Christ. This encourages us to see environmental concerns as part of our Christian life. Therefore, the permanent solution to environmental degradation will hopefully come through a responsible ethic from a redeemed community.

7.1.3.2.1. Twofold Dynamic of Environmental Ethic.

Jesus Christ summed up the law in a twofold dynamic: love for others as oneself and love for God above all else. A love for God must not only lead us to a deeper dedication to our Creator, but also draw us into a more wholesome relationship with creation. We have thought that love for God

means hatred for the world. On the contrary, we need to discover a more integral link with God's world.

The injunction to love one's neighbour takes us away from any individualistic ethic to a community foundation where we see the needs of others as being as important as ours. Broadened to its fullest implications, this must apply from community to community, and nation to nation. The kind of love that Jesus Christ is teaching is not merely an emotional response but one which calls for heart, mind and will to act. It is a total commitment to others so that equity becomes a natural response rather than a forced demand.

An ethic that is demonstrated through the power of Christ's indwelling presence will have to show in love the central dynamic of Christ's life and ministry. God created and demonstrated Himself as love through the history of the people of God. Election, covenant and redemption were all indicators of the love of God being made available freely through God's grace.

The climax is when "God so loved the world that he gave his only begotten son" (John 3:16). Love is nature, character and outworking of all that God is and does. Therefore, love ought to be the foundation for all that we will do and say as Christians. Love is the center of the gospel, which offers a strong grounding for a Christian ethics. The Christian life is faith working through love (Gal. 5:6).

7.1.3.2.2. Limited Carrying Capacity of the Earth.

Our omniscient and almighty God could create the earth with the unlimited carrying capacity to meet all selfish human greed without relating to ever-increasing population and environmental degradation. What is His purpose not to create it like that for human beings?

We should carefully read His purpose that He wants to teach us to have an attitude of humility, frugality, relationality, solidarity and sustainability in our daily lives and follow the life of our Lord Jesus Christ in the light of the limited carrying capacity of the earth. Thus common affirmation is to love each other (John 15:17), fairly sharing it between the rich and the poor, humans and non-humans, and from generation to generation.

If there is no such thing as an amazing grace from the Creator God, and in particular loving humans and this world, can you imagine what selfish humans will do to meet their unlimited desires?

7.1.3.4. Eco-justice.

Eco-justice is a word which weaves together concepts of ecology and justice, calling us to be responsible and just living to help correct ecological as well as economic imbalances. Christian responses to environmental problems urgently need to be developed in the light of biblical commitment to justice and ecology.

The God portrayed in scripture is a lover of justice (Ps. 99:4; 33:5; 37:28; 11:7; Isa. 30:18; 61:8; Jer. 9:24). Jesus is not only Love but also Justice of God (Haughey 1977:264-290). Jesus clearly was in the prophetic tradition of Isaiah, Amos and Hosea. He denounced those who "pay tithe of mint, dill, and cummin, and have neglected the weightier matters of the law: justice and mercy and faith. It is these you ought to have practiced without neglecting the others" (Matt. 23:23).

Jesus Christ came to us in the form of human need and in the context of a deprivation of rights, soliciting just and compassionate responses. He also took active part in the realities of our sinful world. In doing so, Jesus initiated the transformation of this present earth into a new earth. So, we should affirm that God creates and cares for the earth and wants us to be concerned about the earth, our home. And to neglect the deprived is to reject Christ. Individuals and nations will be judged on the basis of their care for the "have-nots" (Matt. 25:31-46).

The major concerns of ecojustice are today (1) matters relating to our personal relationships, (2) issues relating to countries or communities that exploit the poverty of another country, and (3) matters of a just relationship between humans and creation itself etc (Hessel 1996: 211-222).

People have exploited their laws for their own ends; for their class; for their own nation without considering neighbours and nature. The strong taking advantage of the weak, the luxurious life of a few in the face of misery of many is today leading to environmental catastrophe. The reckless exploitation by the rich North and multilateral corporations in the poor South are to deprive the poor of their natural environment and means of livelihood. Such exploitations lead to uneven distribution and use of the earth's natural resources (Hallman 1994:3-9).

The more sensitive issue is the dumping of toxic waste into developing countries where environmental restrictions have not yet been introduced as

discussed in 2.3.2. This threatens the life of the poor. A nation must not only ensure basic rights for its own people, but must also take care that its neighbours are not deprived because of its policy.

However, today it appears common to blame the South for all environmental problems. It is not often stated that it was the rich North that made some of these countries poor through their reckless exploitation in the name of industrialization. Amos condemned those who, pretending to be religious, participated in rituals to conceal their misdeeds. God confronts all people in every place, in all nations and in all history.

Biblical eco-justice can be defined as a fair treatment of others and full respect for their rights with their own intrinsic values as part of this world by the will of the Creator. So, all things must be treated with respect in accordance with divine valuation, and all creatures must be treated as ends in themselves, not simply as means to human ends. Nothing is any longer valueless or meaningless or irrelevant. Every creature counts for God ultimately.

Eco-justice is not an option for Christians, but a moral imperative. Loyalty to the lover of eco-justice entails a love for eco-justice, especially focusing on securing the needs and rights of poor and oppressed humans and non-humans. The Jubilee principle of Leviticus 25 and Deuteronomy 15 is a good exposition of social and ecological justice. The principle is aimed at protecting the rights of victims of injustice, both humans and nonhumans.

We are summoned to shape the present on the model of God's New Heaven and New earth. That is part of the meaning of the words in the Lord's Prayer: "Your kingdom come, your will be done, on earth as it is in heaven" (Matt. 6:10). God expects his people to demonstrate just and equitable relationships which will bring about integrity in our world today. Christians must reflect God's concern in actions that reflect this relationship.

7.1.3.5. Love, Responsibility and Ethics.

A responsible ethic couched in God's love will result in a practical outworking that will help develop the right ethical perspectives. First, Christians who are called to care for creation will see the need for a recognition of harmony, unity, purity and integrity in creation. our care for creation will show in our love to protect, conserve and bring healing to a wounded earth. Ecology implies inter-relatedness and this will show in our

own hurting for a creation that has been hurt.

Second, we are called to preserve and conserve creation's resources. Preserving could imply abstaining from use, whereas conserving calls for responsible (careful) use. We need to develop the responsibility to preserve some endangered species, and conserve some depleting energy and mineral resources not only for our present needs but also for future generations.

Third, responsible ethics calls for a demonstration in responsible lifestyles. Greed and materialism have caused havoc and disparity which continue unabated with human exploitation. We are called to a life of sharing in the world's community rather than accumulating for ourselves. While this may start interpersonally, it must be realized internationally. In fact, when a nation starts living with integrity, its people will develop a more responsible attitude. Some of the major environmental violations are those that have emerged through international activities.

Fourth, responsible ethics call for an acceptance of the rights of all of God's community and creation. The environmental crisis has brought people to recognize the need to protect the rights of future generations. The rate at which resources are utilized in our world at present is alarming. The question is asked: How much longer will these resources last?

Finally, we have a responsibility towards God to honour Him for the way in which He has honoured us with creation and love. An ethic based on our own human love and responsibility will always be limited by human sin. But knowing that God has honoured us despite our rebellion, we must respond in acts of love, care and responsibility that will in turn honour God. And this will form an integral part of the biblical basis of Christian environmental ethics.

7.1.4. Practical Obstacles for Ecological Integrity.

There are some practical obstacles in realizing the biblical sustainable development in accordance with the will of God. One of the major obstacles lies in ideologies which separate subject from object, mind from matter, and nature from culture. Political economic thinking still sees progress as production and consumption of more goods, because development is equated with growth. But the planet, our home is finite and its capacity to sustain growth already is seriously affected (WCC 1991:60-61).

A second constraint lies in the division of the world into industrialized

and non-industrialized nations. The isolation of wealth from the needs of the poor has resulted in a North-South confrontation which is causing more polarization. Historically with energy and minerals, exploitation of nation by nation and of people by companies has been practiced since the industrial revolution. We enjoy plenty of energy and minerals at the environmental expense of others. We have quality food while our neighbours are hungry. That affects creation very negatively.

Thirdly, we should keep an eye on the potential misuse of technology which is less than perfect. Nuclear plants provide such an example of which we should keep an eye on. Particularly, the disposal of nuclear waste is a preconsideration for the burden of our next generations.

In the end, the main obstacle to the realization of biblical sustainable development lies in our own hearts, in our fear of change, in our lukewarmness, in our lack of spirituality, in apathy and uncritical conformity to the status quo, in our lack of trust in God.

As the world becomes more exploitable, more profligate, more crowded, more unequal, hotter, stormier, less biodiverse, and more violent, the environment of the planet, our home becomes worsened into the brink of total destruction, contrary to the will of the Creator God (Hessel and Rasmussen 2001:186).

Therefore, we need the dynamic power of the Spirit that integrates our faith with our daily lives, our worship with our action, and our justification with our sanctification. When we try to do our best according to the practical guidelines of biblical sustainable development, "no new day will surely begin without having a night to precede it. We contemplate the earth at sunset. Now is the time to make it blaze with glory just once more, before the night falls and a new day shines" (Badke 1991:154).

7.2. Practical Guidelines for Individuals regarding Biblical Sustainable Development.

Humans have natural rights to use physical goods as resources to satisfy human needs and fulfill our cultural potential, but Christians have moral responsibilities as the salt and light of the earth (Mat. 5:13-15) to use these resources frugally, fairly, and prudently in respect for all the belongings of our Lord God.

Christians should not insist only on their rights in accordance with their selfish minds, but they should truly perform their duties to love others and

recover the environment of nature. They must do the best to restore a balance between civilization's ravenous appetite for energy and mineral resources and the fragile equilibrium of the environment by means of a theocentric temperate life in contrast to an anthropocentric extravagant life.

The earth and everything in it are part of God's creation (Ps 24:1) and therefore should be treated appropriately. It is the handiwork of God and therefore qualified as good. We should note that the blessings of God were certainly inclusive of material resources from the world God created.

When we see the earth being destroyed for economic growth, we no longer stand on neutral ground. Environmental exploitation must be resisted by Christians. We should make a determined effort to heal the earth, to cease contributing to environmental degradation, and thus to bear a tangible testimony that God is reclaiming all things lost by the fall. We must repudiate any polluting project, because pollution is a reflection of sin. We must be by all means the scourge of pollution in the world.

Christians have to account for all the rest of creation before God in various ways: as servants, stewards and trustees, as tillers and keepers, as priests of creation, and as nurturers. This requires attitudes of compassion, humility, respect and reverence about nature.

In the Bible, danger and destruction are understood as the signs of the time which calls for repentance and renewal of the relationship with God and the whole of creation. Accordingly, we should return to God and call upon the Spirit to reorient our lives.

7.2.1. Practical Guidelines on Attitude.

We have to begin with basic attitudinal transformations: a recognition that it is proper for a Christian to be involved in the physical realm; willingly believing that the individual is at the heart of any revolution in society, and recognizing that there is nothing we can achieve without people and nature, and we need them as much as they need us.

Even though we cannot relate humans and nature in a biocentric equality, this does not negate a God-intended relationship of respect, care and love in stewardship. We must, therefore, approach solutions to the environmental crisis through a closer look at the inextricable link between humans and nature. In the context of the ecological crisis, we should be reminded that humans and nature belong to one another in an integral relationship within

God's intricate design.

Changing our center from human beings to the Creator God is the first step to practice biblical sustainable development in accordance with the will of God

7.2.1.1. From Anthropocentrism to Theocentrism.

Some environmentalists argue that Christianity should replace its attitude with ecocentric perspectives, because it has an anthropocentric attitude to nonhuman creation. The Bible however upholds a theocentric perspective so clear that the arguments are very far from Christianity.

Ecocentrism is the emerging ecological worldview and advocated as the only hope to save humanity. This new paradigm is the product of the ecological awareness in society, influenced by Eastern philosophies, systems theory, quantum physics, and native cultural insights (Gnanakan 1999:124).

While ecocentrism provides the needed alternative to anthropocentrism, it does not provide the biblically justifiable solution for the Christian. It is a valid corrective for the arrogance that we have been accused of, but these insights need to be placed alongside our strong commitment to God as Creator and one who continues to sustain this creation. It is theocentrism we need to consider.

Paul summed up theocentricity with a total submission to the Creator God: "In him we live and move and have our being" (Acts 17:28). Transposing this to the entirety of God's creation, we affirm that everything finds existence, meaning and purpose in its relationship to our Creator and Redeemer God. Our being stands or falls in relationship to this God. With the environmental degradation we face in our daily lives, we need to clarify the focus of our theocentricity.

Pure ecocentrism tends to defy nature, while pure anthropocentrism will divinize humans. Such an attitude can idolize or romanticize our dealings with nature. It is when we relate to the Creator God that all creation will take its rightful place.

7.2.1.2. From the Dualistic Habit to the Interconnecting Habit.

In many parts of the world, the ways of human life are organized by the assumption of dualism such as our body and soul, emotion and reason, man

and woman, the black and the white, and the rich and the poor etc. The dualism of division in polarity results in a split culture, which breeds people of split personality. In this culture, we are divided against ourselves (Chung 1991:37-47).

We forget that we all come from the same source of life, God, and all the webs of lives are interconnected. When God created the universe, God liked it. It was beautiful because it was in right relationship, no exploitation, and no division. It had its own integrity. All beings in the earth danced with the rhythm of God.

However, when the dualistic habit came into the world in the name of science, philosophy and religion, we began to objectify others as separate from ourselves. In dualistic thinking, others are the objects one can control as one likes. There is no balance, mutuality and interdependence in this objectification. There is only a wall of separation between competitors. If we are to survive, we must learn to live with not dividing dualism but integrating the interconnectedness of all beings.

7.2.1.3. From Self-realization to God-realization.

The Creator God's most important agenda is to have His children share in His authority on earth. We are created so that we may dominate for His purpose, no matter who we are, we have a part to play in His master plan. When His purpose is not understood, our abuse is inevitable.

Many are the plans in a man's heart, but it is the Lord's purpose that prevails (Proverbs 19:21). We have lots of ambitions, dreams and visions which we would like to become and do. But if we are children of God, we should give priority to His plan and His words and fit our plans into His purpose for our lives (Towns 2003 83-87).

There are people who are doing wonderful things today, but God never told them to do such things just to make money. Our society is built on the erroneous concept that wealth is equal to happiness. There are many rich people who have been a waste of God's time because they never did what they were born to do. God is more concerned about obedience than wealth. He is more interested in the fulfillment of his purpose for our lives than that everybody should think we are great through lining up with His plans.

7.2.2. Motivation for Practical Guidelines.

In order to carry out practical guidelines with a strong motivation and without trial and error, it is necessary to consider some propositions (Cho 1997:95-103). Firstly, we are to recognize and avoid common mental traps that lead to denial, indifference, and inaction. These traps include gloom-and-doom pessimism, blind technological optimism, fatalism, extrapolation to infinity. Secondly, we need to keep our empowering feelings of hope slightly ahead of our immobilizing feelings of despair.

Thirdly, we need to begin to look at our world through the eyes of God to see what is fitting and what is not as we deal with the physical earth around us. Fourthly, we are planning to make it our goal to bring a certain kind of beauty to our surroundings which harmonizes with nature. Recognizing that there is no single correct or best solution to the environmental problems we face is also important.

7.2.2.1. Steward as a Representative of God.

In the Old Testament the steward refers to a servant who takes orders and executes them and/or who can make decisions and manage the affairs according to specific instructions. The owner or master, usually a king or ruler, has trust in him such as Joseph and Daniel introduced in Exodus and Daniel (Jang 2006:60-64).

In the New Testament there are plenty of teaching through numerous nuances of the steward's role. For example, the steward and servant are interchangeably used in the parable of the one put in charge of all the possessions (Luke 12:42). We are called to be stewards of the mysteries of God (2 Cor. 4:2), and stewards of God's grace in the household of God (Eph. 3:1-2). Peter adds an eschatological dimension (1 Pet. 4) reinforcing the fact of the "end of all things" and reminds us that we must be "good stewards of God's varied grace."

There is a wide use of the term in the Bible and it carries a whole range of qualities required for responsible leadership. Unfortunately, the motif has been spiritualized in Christian history and recently reduced to refer to people conducting a few manual chores in the church. If rightly developed, the symbol of steward would restore a powerful role to the community of Jesus Christ that would directly impact the world and make a change.

We are stewards on behalf of God who has entrusted creation and its resources for our wise management. This dynamic biblical metaphor must effectively explode into all our dealings with nature, helping us to move from anthropocentricity to theocentricity, from carelessness to concern, and from indolence into diligence.

In accepting the symbol, we need to be reminded that we are not possessors. With free access to the benefits of rich natural resources, we have gotten accustomed to thinking of ourselves as possessors. Furthermore, materialism and consumerism have driven us to more and more self-centered lives.

However, the steward³⁾ is one who administers resources for the benefits of others (Cho 1997:46-52). The concept of stewardship brings into focus a dual responsibility towards someone else who is the owner and to others who are the beneficiaries. If one is a steward, it is others who must benefit. Israel did not see this, but Christians today must.

7.2.2.2. Individual is Significant.

The early church turned the world of its day upside down. Every advance of the gospel in church history was begun by individuals who caught a vision of God's purposes and followed it.

We can change the world by changing the two people next to us. For everything, big or little, that we decide to do to help sustain the earth, try to convince two others to do the same thing and persuade them in turn to convince two others.

Carrying out this doubling or exponential process, only several times would convince everyone in the world. But it is necessary to have about 5% to 10% of the people in a community, state, or country actively involved in order to bring about change. The national and global environmental movement is nearing this critical mass and needs our help.

3) Most Christians understand that the traditional term of "stewardship" adequately describes the task above-mentioned. But others caution that it can convey the mistaken notions that God is an absentee landlord, and that humans may therefore manage creation in any way that they see it (Cho 1997:46-52).

7.2.2.3. Action is a strong witness.

Before we start trying to convert others, we should change our own living patterns. If we as Christians belong to our Lord God, we should correct our own environmental sins in the light of biblical perspectives and participate in healing the scarred earth. Our actions force people to look at what they are doing. People are most influenced by what we do, not by what we say.

We can also join and financially support local and global environmental organizations to amplify or synergize our efforts. In order to influence officials from a biblical perspective, we can work to elect environmental leaders to public office concerned with environmental policy.

7.2.3. Lifestyle-Change is Needed.

Our civilized society will not find a solution to the environmental problem unless it takes a serious look at its lifestyle. In many parts of the world society is given to instant gratification and consumerism while remaining indifferent to the damage which these cause. Simplicity, moderation and discipline must become part of everyday life, lest all creatures suffer the negative consequences of a few careless human habits.

We have natural rights to use physical goods as resources to satisfy human needs and fulfill our cultural potential, but we also have moral responsibilities to use these resources frugally, fairly, and prudently in respect for all the belongings of God. We really need today spiritual sacrifice to change the current lavish lifestyles.

Therefore, we should "not conform any longer to the pattern of this world, but be transformed by the renewing of our minds. Then we will be able to test and approve what God's will is—his good, pleasing and perfect will" (Rom. 12:2).

7.2.3.1. Living more Simply.

Looking for happiness through the pursuit of material things is considered folly by almost every major religion and philosophy. But it is promoted incessantly by modern advertising that encourages us to buy more

and more things. Too many people spend money to buy things they don't need and want.

So, we need some guidelines from Christian ethics for living more simply on earth. God created on earth that can provide enough to satisfy all the creatures but not every person's greed. Jesus Christ himself showed us how to live the simple life along with the limited carrying capacity of the earth.

In order to become followers of Christ's lifestyle, we should question everything we once believed necessary, until we see what is necessary through God's eyes as the Creator who made and wants to preserve His world. If Christians could begin leading the way in stabilizing our own greed masquerading as need, the earth would begin to have some rest from humanity's voracious appetites. We should keep in mind that when we take more than we need, we are taking from each other, borrowing from the future, and destroying the environment.

7.2.3.2. Voluntary Simplicity.

Over-consumption in the North can have a debilitating impact on countries of the South. Particularly, consumption of non-renewal resources in the North should be significantly reduced by changing their lifestyles and industrial patterns. The member countries of OECD have consumed materials and resources ten times more than the carrying capacity of our planet (Sachs et al. 1998). This means that the people in developing countries should reduce their consumption in order for people in advanced countries to maintain their lavish lifestyles.

Therefore, the affluent people in developed countries should adopt a lifestyle of voluntary simplicity, doing and enjoying more with less by learning to live more simply. Voluntary simplicity begins by asking a series of questions before buying anything: Do I really need this? Can I buy secondhand (re-use)? Is the product produced in an environmentally sustainable manner? Did the workers producing it get fair wages under safe working conditions? Is it easy to repair, upgrade, re-use, and recycle?

Through educational programmes and the dissemination of information, individuals can be encouraged to re-examine their values and to alter their behaviour to accord with Christian environmental ethics. It is very useful to hold a workshop and/or exhibition to change lavish lifestyles and introduce a programme to practice a frugal life in the light of the simple lifestyle of

Jesus Christ.

7.2.3.3. New Managing Style of Non-renewal Resources.

Fossil fuels and minerals are originally non-renewal and depleting resources. However, their usefulness for creation can be extended by avoiding overuse or wasteful use, through scientifically recycling and exploiting them, and by developing renewable substitutes where possible.

In order to use them from generation to generation in accordance with the will of God, minerals development policy must be developed attuned to the carrying capacity of the earth, comprehensively managing human numbers and lifestyles together with technologies and management practices. It can be done without rejecting the many benefits that modern technology has brought, provided that technology also works within those limits. This will be a new approach to the future in accordance with the will of God.

7.3. Practical Guidelines for Churches regarding Biblical Sustainable Development.

The church's task is to take part in and give expression to the present and future Kingdom of Christ. When that Kingdom arrives in its fullness, creation will be set free from its bondage to decay. The church should therefore seek to be truly catholic—characterized by wholeness, fullness and universality. The biblical foundations discussed in sections 7.1 and 7.2 compel us in this direction. If we have built up institutions that have totally consumed our time and energies with matters within churches, or have separationist views of the church that keep us away from being involved in the real world, we must thoroughly repent for having such Christian views and practices, based on misinterpretation of Scripture.

Because God's ministry of love is universal and the church is called to represent the comprehensiveness of concern, environmental responsibility is an inherent part of being the church catholic. It is not an option, but a mandate that must be incorporated into the whole. It is one of the signs of a valid Christian ministry. Since God's ultimate goal is the perfection of just and harmonious relationships (shalom) among all creatures, the church's historical mandate includes the pursuit of justice, peace, and ecological integrity.

Therefore, our churches must again take a fresh look at the Lord of the

church, Jesus Christ and the community that he has formed for himself. Paul writing to the Ephesians says:

God placed all things under his feet and appointed him to be head of everything for the church, which is his body, the fullness of him who fills everything in every way (Ephesians 1:22).

If these words are to be taken seriously, there is a tremendous burden on the community of God's people to fulfill God's purpose for all creation. The church must seek to understand this immense responsibility today. A response to the environmental challenge forms part of this challenge today.

7.3.1. The Church's Status in the Environmental Crisis.

The church is not an inward-looking body committed only to worshipping its Lord. The church's ministries are not some set of arbitrary services, but they are a response to God as our Minister. The apostolic church is the community of Christians always being reformed to be in conformity with the divine mission to consummate liberation and reconciliation for the whole creation (Hessel and Rasmussen 2001:118-202).

In the context of the environmental crisis, the church should be a leader to transform a society through practicing social ministry. The Christian community therefore needs to develop practical policy approaches to the environment and environmental issues in the process of analysis-reflection-practice-feedback based on the Biblical perspective (Hessel 1992: 8-15).

The church must be willing to identify and condemn social and institutionalized evil, especially when it becomes embedded in systems. It should propose solutions which both seek to reform and replace creation-harming institutions and practices. It should be a center to exemplify eco-justice through the practical discipline of all its members.

Social analysis is an inevitable proceeding for Christian social ethics as well as social ministry. Theological reflection without social analysis might be an illusive and romantic undertaking. There is no true love without grasping a real circumstance. Preaching and mission based on social analysis will surely be much more effective and powerful (Watkins 1994:114-144).

A dualistic ministry separating individual piety and social behavior, faith and deed, contemplation and commitment, prayer and action, spirit and body, heaven and earth, horizontal relation and vertical relation, etc. should be replaced with a social ministry which also deals with environmental issues. The reason is that environmental degradation is a problem of social justice related to both human and non-human creation.

7.3.1.1. The Church as a Group in which Relationships are restored.

The Christ who was co-creator with God and the Holy Spirit at the beginning, the one who grieved over the fallenness of human beings is now part of God's plan to restore all that was fallen. Humans who were alienated from the Garden, the symbol of God's perfection, are now able to come back to enjoy restored relationships in the Body of Christ, the new garden to be fully revealed in the coming Kingdom (Jung 2006:162-165).

The community that Jesus Christ brings together after his resurrection is the place where his reconciling work is first demonstrated, although only in part. The church is the place where perfect relationships are anticipated, and a group who constantly look to their Lord who is directing them towards perfect relationships. What this means is that the church must become a model of Christ's work, demonstrating such relationships, even though imperfect. The church should be a catalyst for Christ bringing about change in the world.

There is a great eagerness with which creation groans in expectation of the redemption of the people of God, for in that restoration it will also receive its own restoration. If human beings were responsible for the devastation of creation from their fall, creation will be restored through humans who will one day be released from their guilt when Jesus Christ brings about total redemption. The effects of the redemptive work of Jesus Christ are not limited to the body of Christ, the church, but are realized to the fullest extent of all God's creation in the church.

7.3.1.2. The Church as the Image of God.

The church is the community that must become the image of God in the world today. Taking our discussion back to the original creation account, God gave his image to humans in order that they might act responsibly and

care for his creation. It was not something intended merely to set them higher in an ordered hierarchy⁴⁾ over everything else. A renewed image must therefore restore a sense of this responsibility and enable the people of God to demonstrate greater care and concern towards creation (Lee 2006:11-30).

The church, following its head, must exemplify stewardship and begin to care for creation. The community of the disciples of Christ should have been the first to act responsibly, rather than allowing others to become engaged in commendable expressions of environmental action. Rather than merely continuing blindly in material pursuits of the consumer world, the Christian community could help evolve more appropriate means of enjoying God's creation through innovations that will demonstrate God's creativity. The church must become an agent of change.

The image of God could be seen variously as rationality, creativity and moral responsibility. All these characteristics are those that will make the people of God become more involved in environmental conservation and corrective action.

7.3.1.3. The Church as a Resurrection Community

The resurrection is the demonstration of the finality of Jesus Christ's work of the restoration of humanity to God's purposes. The resurrected Lord has brought newness to their community and a renewed hope for the ultimate redemption of humanity and other creation. The church must proclaim this hope as well as demonstrate it anywhere possible (Kim 2006:236-248).

The church is founded on the reality of the resurrection, and is committed to demonstrating and proclaiming this reality. The resurrection made an inward looking group of disciples into a dynamic body turning the then-known world upside down. Today the church similarly needs to look beyond its boundaries, break from over-spiritual interpretation of salvation, even purely human-centered perspectives, and proclaim the complete

4) Eco-feminists criticize the patriarchal hierarchy of Christianity. They classify human domination structures over creation into the three types as hierarchy, heterarchy, and horarchy structure (Lee 2006:13-17).

message of hope to humanity and all other creation.

The church as the resurrection community has a responsibility to get involved in God's programme of renewal for his creation. This is to be shown in practical demonstrations of stewardship that will make known God's Lordship over creation. If the resurrection is a historic reality, the Church as a historic community must get into action in this world.

7.3.1.4. The Church in Worship and in Witness.

The essence of the gospel is the good news of the coming Commonwealth. It is a summons to action, to shape the historical present, as the Lord's Prayer suggests, on the model of God's New Heaven and New Earth. A valid otherworldliness results in a vital worldliness. The church's ethical orientation is eschatopraxis, doing the final future now (You 2006:351-355).

The church's worship, witness and work are not simply present functions; they have ultimate goal, a telos. The church is called to direct its services and design its communal life to be effective expressions of the ultimate goal of God's ministry and the reign of God. The church's ministries are acts of confidence in and commitment to the ethos and ethic of God's reign, which Jesus Christ embodied and proclaimed. A commitment to ecological integrity on the part of the church must be understood in the context of the church's eschatological orientation. In this context, ecological responsibility is a sign of the church's apostolicity and catholicity. It is not an option, but an inherent mandate for the church's ministry. It has been one of the serious omissions in the history of the church and is now one of the critical reforms necessary for the integrity of the church.

7.3.2. The Church in Action for a Biblical Sustainable Society.

The church should be a pilot plant where people can see the congregations and missions showing the substantial healing that God brought about for the alienation which human rebellion has caused. The pilot plant is that which is constructed to show that the full scale plant will work (Shaeffer 1993:80).

The church should therefore seek to develop as creation-awareness

centers in order to exemplify principles of stewardship for their members and communities, and to express both delight in and care for creation in their worship and celebration. The church should be the laity actively engaged in every social sector for justice, peace, and integrity of creation.

The church must demonstrate that "dominion" can be exercised without being "destructive." This calls for some planned efforts to build up our congregation to be the kind of people God wants us to be in our world today. Some of the efforts need to be long-term attitude and awareness building and thus involve a call for teaching programmes. Others may involve a call for immediate action, and hence will require the mobilization of experts with commitment and skills to get involved.

The immediate responsibility of the church should be to educate its community and prepare them for responsible action based on the biblical perspective. In doing so, the community should aim to produce curricula and programmes which encourage knowledge and the care of creation. And the community as a whole will soon recognize the need for joint action in some pressing fields of environmental concern.

7.3.2.1. Christian Liturgy.

In order to build a biblical sustainable society in accordance with the will of God, the church should firstly affirm that God acts with justice and mercy to redeem all creation and that the earth community encompasses not only human cultures, but all the rest of creation.

Secondly, the church's liturgy should link appreciation of nature to explicit concern and care for nature. With this shift, preaching of the Word, administration of the sacraments, and hymns and prayers of the congregations can become more pertinent to the alleviation of the eco-justice crisis and environmental degradation (Hessel 2001:203).

Thirdly, congregations and church-related organizations should be reoriented to develop real relations of solidarity with particular places, people, and life-forms jeopardized by inappropriate development or environmental injustice, particularly considering God's priority concern for the oppressed, including otherkind as well as humankind.

Fourthly, the church should give explicit attention to the environmental aspects of biblical narratives, ethical teachings, confessions of faith, the sacraments of baptism and holy communion, and hymns and prayers.

Environmental reformation can spread when public worship, spiritual development, lay education, and social action focus on the earth community.

Finally, the church has made a sporadic effort to hold some festival days focusing on caring for the earth during liturgical year such as Arbor Day, Rural Sunday, Nature Sunday, Feast Day of Creation, Earth Day, Environmental Sabbath etc. Particularly, the United Nations declared 5 June in 1972 as World Environmental Day. Many churches subsequently started to hold the Sunday close to 5 June as Environmental Sunday (Conradie and Field 2000:91).

There are several other opportunities in the church year for special celebrations such as St. Francis of Assisi Feast Day (4 October), Earth Day (22 April), World Wetland Day (2 February), World Day of Water (22 March), World Meteorological Day (23 March), World Population Day (11 July), World Habitat Day (5 October) and so forth.

7.3.2.2. Environmental Education.

The church must initiate and support the process of education on the Christian approach to environmental ethics. The church's goal should be the growth of earth-keepers, both in the habits of everyday life, and in the provision of leadership for the care of creation. Some planned lessons must be carefully made available ranging from biblical foundations to suggestions for practical action. Practical tips along with biblical teaching will motivate them into action. Some good case studies can also be used to discuss what biblical principle have been, or could have demonstrated.

In particular, Christian colleges and seminaries should provide theological education to cope with eco-justice themes and environmental issues at the individual, institutional, and social policy level. The education aims should be to explore the relationships between ecology, justice, and faith, to foster a theological vision of creation care that affirms the intrinsic worth of all creation, to give visibility to a credible cosmology and a coherent ethical framework for our common future, to strengthen Christian leadership in environmental thought and action, and to develop requisite skills of ministry among clergy and laity (Hessel 2001:200-222).

Theological learning can be enhanced as students participate in the practice of a small learning community that gathers weekly, incorporating worship, education, field trips, service, and recreation around a generative

theme related to eco-justice. The education can effectively be carried out through an internet site.

Education should help students "make the leap from I know" to "I care to do something," understanding and evaluating the environmental worldview and seeing this as a lifelong process. Evaluating and perhaps changing the environmental worldview can set off a cultural mindquake because it involves examining many of the basic beliefs. Once we change our worldview, it no longer makes sense for us to do things in the old ways. If enough people do this and put their beliefs into action, then tremendous cultural change can take place.

Therefore, it is necessary to take the time to escape the cultural and technical body armor we use to insulate ourselves from nature and to experience nature directly. Through kindling a sense of awe, wonder, mystery, and humility by standing under the stars, sitting in a forest, experiencing a stream, lake, coral reef, other parts of nature, we might try to sense how they are a part of us and we are a part of them as interdependent participants in the earth (Miller Jr 2004:40).

7.3.2.3. Joint Activities.

The church should willingly hold a dialogue with all who are concerned with preserving and enhancing our environment. We can get alongside people of other faiths and work together for environmental activities. We should pray that the joint activities may provide a positive contribution towards achieving the goals which we share.

Particularly, where the Christian community is a minority, this will be an excellent way of building bridges into the community. There may be projects that concern injustice to the poor, or actions that cause environmental damage from mining activities. The church could take the lead, but get the community behind them. Such activities will raise the profile of Christian witness particularly in countries where they are looked down upon.

7.4. Initiatives for Biblical Sustainable Development regarding Global Economic System.

We live in a moment of extreme jeopardy. Cumulative human activity threatens destruction not only of regional eco-systems but the planetary

ecology as a whole. The earth warming from CO₂ emissions of fossil fuels poses grave danger to the capacity of all creation to survive and flourish. We are further threatened by environmental degradation from mining activities and nuclear plants. All creation seems broken, wounded and hurt.

It is shocking and frightening for us that human beings have been able to threaten the foundation of life on our planet in only about 300 years of industrialization among the long historic records of the earth. This crisis has deep roots in human greed, exploitation and economic systems which deny the elemental truth that every economic and social system is always a sub-system of the eco-system and is totally dependent on it.

The industrial economic systems treat nature simply as natural resources and abuse it for profit. The future foreshadowed by the present environmental crisis has socially and ecologically cast a gloom over the future of massive suffering of human beings and other creation. The destruction of the environment cries out for urgent repentance and conversion.

Our God is political, blessing the peacemakers, intervening in the affairs of governments and nations, and liberating slaves from the shackles of pharaoh. To be in communion with God is to struggle to deliver the community of earth from all manner of evil—private and public, personal and social, cultural and ecological, spiritual and material. The sovereign God bans all boundaries of benevolence.

Every social and political issue that affects biospheric welfare—whether it be nuclear waste, resource deletion, starvation, pollution from mining activities, racism or extinction—is simultaneously a moral and spiritual concern. That is a challenge of love to the churches in the world. If we are to deal with social causes and not merely individual symptoms, these issues must be items on the agenda of truly catholic, evangelical, and reformed churches.

This challenges the church to study the situation and consider social change. We call for a reordering of personal and corporate lifestyles, relationships and the overall economic system. We are beckoned to rediscover a biblical vision and a new understanding of ourselves and other creation. Accordingly, Churches and Christians should actively participate in policy-making and policy-performance in the specific environmental fields through the influence they bring to bear on the policy issues which comes from Christian insights and biblical perspectives.

7.4.1. Economic Growth in Advanced Countries.

Economic growth is a major factor in destroying the ecosystems on which the well-being of social and economic systems ultimately depends. Unrestrained production and consumption are key factors in the excessive exploitation and toxication of the renewable and non-renewable gifts of nature.

So, there is only one conclusion to be made: the church must have a initiative to curb the economic growth and refrain from extravagant consumption in industrialized countries, while it encourages developing countries to carry out biblical sustainable development to improve the standard of living through promoting transfer of technology working within the limited capacity of the earth.

It is fully accepted that this is a very difficult task to practice this agenda. It is not pleasant to plan a society without economic growth in this world. However, we should look up to the cross of Jesus Christ for us to alleviate environmental degradation and carry out environmental protection in the environmental crisis.

They should also ponder on whether the Christian church has slowly lost its faithful power and holy glory in America and Europe since the middle of 1960s. What are the fundamental reasons for losing them from advanced countries at present? With praying to God to get responsive treatment, would they would volunteer to persuade their governments and citizens to curb their economic growth and refrain from extravagant consumption in their daily lives?

7.4.2. Nuclear Plants without Considering Future Generations.

It is often remarked that establishing a nuclear plant is like building a luxury house without a toilet. For future generations it is a proper treatment to resolute a nuclear power moratorium until developing a perfect technology and/or method to cope with the nuclear waste as discussed in section 3.2. Instead of establishing new nuclear plants, it would be better to concentrate efforts into developing alternative energy resources and

improving the efficiency of the present energy resources.

We should do nothing that could jeopardize the opportunity for future generations and deprive their ecological conditions in order to maintain our current lavish lifestyles. In order to do this, it would be necessary to ban the establishment of further nuclear power plants.

We should keep in mind that nuclear plant always embraces the persisting threat of nuclear accidents, and brings out the unresolved problem of radioactive waste disposal. Additionally, it encourages people to use energy consumption more and more to compensate for the huge cost of its construction, and makes sources for nuclear weapons proliferation associated with continued use of nuclear power.

7.4.3. Mineral Development beyond Planetary Carrying Capacity.

The high quality reserves of mineral resources are disappearing. the extraction of low-graded ores is more energy intensive, thus increasing costs and prices with particularly reverse effects on the poor. Moreover, with increasing scarcity, economic pressures will arise to explore and withdraw minerals from environmentally sensitive areas (Nash 1991:41).

The central point is that the present generation is living beyond planetary carrying capacity. The maximization of current benefits for a minority of the present generation is being achieved by the reduction of potential benefits for future generations. It is therefore necessary to set up a deleting tax of non-renewal natural resources to curb the reckless overdevelopment of mineral resources for future generations.

If humans have responsibilities for future generations, we need an economic system that stresses the virtues of frugality, thinking of the limited carrying capacity of the earth. It goes without saying that the church should counsel human humility and frugality in the light of the ultimate mystery, natural limitation, and biological connection of all creatures on the earth.

7.4.4. Legal Scheme for Mining Industry.

All mining activities are subject to regulations identified in the mining laws of each country. The laws are generally giving preferential treatment

for mining activities over other uses of the land, including agriculture, forestry, and urban development etc. They are firstly made from a technical mining standpoint for the mining industry, but without a comprehensive consideration of the organic and environmental system.

They have few records of collaboration with instructions for environmental protection. This can lead to a decreased environmental oversight over mining activities. Such a legal scheme would directly contradict the organic system of the earth and the purpose of why God created mineral resources.

It is therefore necessary to establish an environmental regulation, administration and monitoring for mining activities in the mining law. According to increasing environmental impacts from mining activities, it is a recent legal trend to enact some provisions for environmental impact assessment (EIA) and environmental protection programme (EPP) in the mining law. However, they are a minimum criteria for getting mining right for a certain mining area.

So, all the churches in the world should try to enact provisions for clear production (CP), pollution prevention and burden of proof in the mining context for biblical sustainable development as discussed in 6.5.2. The provision for a sabbatical year should additionally be enacted to regularly evaluate the environmental impact from mining activities for ecological integrity as discussed in 7.4.12.

7.4.5. Climate Change from GHGs Emissions.

The climate change is just indicator of the threats we face as a rigorous alarm from the Creator, God of grace. It is obviously our urgent duty to heal the climate change caused by human beings.

First of all, it is necessary for us to make it clear that while the earth is killing in the environmental degradation, we are indulging ourselves in overdevelopment and overconsumption so much as discussed in 3.2. Secondly, we should recognize that if we do not act to recover it, the true cost of our failure will be borne by succeeding generations. This is the moral challenge of our generation. We should therefore set up a road-map for a more secure climate future. We cannot rob our children of their future.

Ironically, climate change accompanied with the disasters is more

unfavourable to the socio-economically weak, who are usually less responsible for the advent of climate change and have less ability to cope with the impact of the climate change. Particularly, most of Africa would be hit the hardest if climate change continues on its current course. So, it is necessary to set up an international supporting system for the poor and Africa.

However, Africa's place in the climate agenda was largely neglected in the Copenhagen Conference held in December 2009, even though Africa is central to the global environmental crisis in two important ways, namely possessing the vast natural heritage for the most potent solutions to climate change, but becoming the first victim of major climate disturbances. Sub-Saharan carbon emissions, estimated at only 3% to 4% of the global man-made emissions, are deemed of little interest, even though the responsibility of industrialized countries and emerging economies in the battle against carbon emissions is now well known (Sung 2009:7).

We should therefore ask for an effective, comprehensive and equitable international agreement based on the Will of God to improve the Kyoto Protocol on carbon emissions expiring in 2012. However, no sign of a deal has emerged amid the wide gap between advanced and developing countries over how much the latter should contribute and how or whether their voluntary efforts should be verified.

The accord in the Copenhagen climate talks set a target of limiting global warming to 2 degrees Celsius above pre-industrial times. However, it does not say how this would be accomplished. A \$100 billion in aid annually starting in 2020 to help poor countries deal with climate change is included in the accord. But noticeably absent is where the money will come from (Choi 2009:5).

In order to make a real difference, the only way is to take action together based on loving each other. Instead of saying "you first," we should start by saying "me first."

7.4.6. Free Market System and Social Responsibility.

The free market system places overwhelming emphasis on economic growth or development through free competition. Being based on the belief that the pursuit of private interests automatically leads to an improvement of public interests, the free market system justifies the free pursuit of

private interests without any qualm about the welfare of the whole society. According to the free trade ideology, 'the invisible hand' works to harmonize private interests with public interests.

The self-regulation and market competition are indispensably valuable for economic enterprises in a free market system. But they are not sufficient to provide adequate environmental protection. Because the probability is too high that their economically motivated behaviors will lead to environmental degradations.

In fact, the pressures of competition, which encourage cost-cutting to undersell competitors and maximize profits in market economics, can function as incentives for environmental harm in order to increase competitive advantages.

Considering the severity of the environmental crisis and the role of many economic enterprises in contributing to that crisis, the persistent appeals for the principle of deregulation or minimal regulation of industry is strangely discordant with reality. These appeals are rooted in classical or neoclassical economic theories that regard economic institutions as almost independent of the social matrix of accountability.

With these views, environmental regulations allegedly hinder business in pursuing their objectives. That is none of their business, unless economic incentives are available. The tasks of paying the externalities belong to other social sectors.

In fact, most economic enterprises have enjoyed the privileges to purchase various kinds of materials such as energy, minerals, water, timber etc. at far below market costs. So, the social responsibility of economic enterprises is widely proclaimed today, particularly to control the abuses of multinational corporations in a context of global interdependence.

Economic enterprises can be evaluated economically on the basis of their productivity and profitability, but they should also be evaluated socially and ecologically on the basis of their contributions and harms to the well-being of human and non-human creation in interdependent relationships.

7.4.7. Social Responsibility of Multinational Corporation.

There has been a lot of criticisms about the negligence and wrongdoing of multinational corporations to sacrifice the lives or health of people or the

integrity of environment for the sake of their profits. Particularly in the mining fields through their mobility and flexibility of structure and organization, the examples are discussed in 2.3.2.

Each state is entitled to regulate some aspects of the multinational corporations incorporated or operating within its territory. But many states do not have the resources or political will to do so effectively, giving rise to differences in social and environmental standards between states.

The differences are exploited by multinational corporations for their commercial advantages, investing in the regions in which production costs are lowest because of low regulatory standards and expectations. In return, competition for internal investment is said to put further downward pressure on regulatory standards in those countries, especially the poorer countries of the world, struggling to achieve economic growth.

The international "corporate social responsibility (CSR)" movement has developed in response to these perceived gaps in the regulatory systems. The CSR movement has been described as one of the most important social movements of our time in environmental crisis. As a result of the movement, there has been during the past few years an extraordinary proliferation of "codes of conduct for multinational corporations." But they all struggle to define what corporate social responsibility (CSR) means in practice.

Historically, the role of international law in relation to the multinational corporations has primarily been to define the rights and obligations of states with respect to international investment issues. But there are many possibilities to regulate multinational corporations, despite its fundamental state-centeredness. International law is not a solution itself, but a set of tools.

While international law has its limitations, it is also capable of supporting new regulatory opportunities that have the potential to improve the welfare of people and environments affected by multinational activities, particularly in less developed countries. These new opportunities are emerging as a consequence of developments at two levels: first the growing willingness of home states to consider strategies to regulate the performance of multinational corporations beyond national borders and, second, the intensification of efforts at international level to develop global ethical standards for their business (Zerk 2006:309-310).

It is a time for all the churches with about 2,070 million Christians in

about 1,000 ethnic groups in the world to participate in the CSR movement (Siewert and Valdez 1997:31). The CSR can no longer be dismissed as a passing trend. New international institutions should emerge to promote the CSR standard of multinational corporations. There is much we can do to regulate the multinational corporations, if we work together with our Lord God of justice, reflecting wrongdoing records of the CSR. Multinational corporations must have responsibilities at least as good corporate citizens in the context of the environmental crisis, independent of the regulatory framework within which they operate.

7.4.8. Internalizing of External Costs.

All the churches in the world should strongly ask their governments to deal with the problem of harmful external costs in several ways to build a biblical sustainable society as soon as possible. They can levy taxes, pass laws and develop regulations, provide subsidies, or use other strategies that encourage or force producers to include all or most of these costs in the market prices of their economic goods and services (Miller 2004:25).

Internalizing the external costs of pollution and environmental degradation has some important benefits. It would firstly make preventing pollution more profitable than cleaning it up. Secondly, waste reduction, recycling and re-use would be more profitable than burying or burning most of the waste we produce. Thirdly, it provides consumers with information needed to make informed economic decisions about the effects of their purchases and lifestyles on the planet's support systems and on human health.

When external costs are internalized, the market prices for most goods and services would rise. However, the total price people pay would be about the same because the hidden external costs related to each product would be included in the market price. Governments must reduce taxes on income, payroll and profits and withdraw subsidies formerly used to hide and pay for these external costs. Otherwise, consumers will face higher market prices without tax relief.

Finally, all the costs for goods and services would be less, because internalizing the external costs encourages producers to cut costs by inventing more resource-efficient and less-polluting methods of production and to offer more environmentally beneficial products. If a shift to full-cost pricing took place over several decades, most current environmentally

harmful businesses would have time to transform themselves into profitable environmentally beneficial business.

7.4.9. Economic Injustice

The world's actual and potential resources created by God are sufficient to supply the provisions for the basic and creative needs of all the creatures in the present and future. If justice prevails by the will of God, the biblical sustainable development can be practiced. So, over-possession of necessities is an issue of justice in an interdependent creation and resource-limited planet.

The disparities in income and resources are fundamental features in the modern world. While a minority of less than 20% of the world's population lives in comfort and luxury, consuming and wasting 73% of the world's goods, another minority lives in chronic and desperate poverty. Most environmentalists agree that it would be ecologically disastrous for the rest of the world to reach the current standard of living in the United States (Jeong 2007:67).

Economic justice demands economic systems that supply the material conditions for human dignity and social participation for all, within the limits of the earth's carrying capacity and the integrity of its ecosystems. Global economic justice is an essential good in itself, but it is also an essential condition of ecological integrity (Jeong 2007:85).

On a planet with natural limits, the policy reducing poverty through economic growth is no longer a convincing alternative. The straight policy should be to restrict economic growth in affluent nations in order to provide the materials for essential economic development in poor countries. It does not mean sharing in poverty, but it does mean sharing in solidarity to eliminate poverty, following the sacrifice and love of Jesus Christ.

From a Christian perspective of global solidarity and equality of human value, this situation implies limits to growth for the affluent and economic sharing with the poor.

7.4.10. Population and Consumption.

As long as the population in absolute numbers remains within the earth's

carrying capacity, the actual and potential resources of the earth are sufficient to provide sustainable and adequate goods for all the creatures.

Poverty is not only about overpopulation, but also about the inequitable distribution of resources within and among nations. Current population problems must be understood in relation to patterns of consumption (per capita consumption) and available resources.

In this context, population progression is not only a problem for the third world, but also a problem for the first world. Because the average additional person in affluent nations consumes far more and places greater stress on the world's natural resources. In terms of per capita resource consumption, the United States is probably the most overpopulated nation in the world, leading to excessive exploitation of natural resources.

Therefore, affluent nations have to obey a moral demand for reduced consumption and equitable distribution. There is increasing evidence that the rest of the world cannot afford North American consumption. The United States and other rich nations have some major rethinking to do about morally balancing their reproduction and consumption policies.

The rich must live more simply so that the poor may simply live. The first world should reduce its production, consumption and accumulation in order for the third world to be able to have sufficient production, consumption and accumulation (Birch and Rasmussen 1978:33).

7.4.11. Environmental Justice (Eco-Justice).

The life of Jesus Christ is a clear demonstration of the reign of our Creator of eco-justice. The heart of a harmonious relationship between humans and non-humans on the earth, whether individually, communities or internationally, is the introduction of eco-justice in our daily lives.

The biblical concept of eco-justice recognizes the need for healthy relationships in creation as a whole. This way of viewing eco-justice helps us understand the linkage between poverty, powerlessness, social conflict and environmental degradation. Eco-justice is truly indivisible, and not only a matter of theological conviction but of practice.

Human responsibility requires that we recognize the character of the crisis in our midst: the social justice crisis and the environmental crisis. Pursuing eco-justice requires us to learn new ways of paying attention to all creation. A new vision will integrate our interdependent ecological,

social, economic, political and spiritual needs.

Social justice for all people and eco-justice for all creation must go together, because social justice cannot happen apart from a healthy environment and a sustainable environment will not come about without eco-justice.

Satisfying the demands of eco-justice will be extremely difficult and traumatic. We cannot achieve a different order without a period of wrenching costly change. Our challenge is to find tolerable solutions to the economic-ecology dilemma.

7.4.12. Sabbatical Year for Ecological Integrity.

The institution of sabbath, the sabbatical year and the jubilee year provide a clear vision on economic and ecological reconciliation, social restoration and personal renewal. Sabbath reminds us that time is not just a commodity, but has a quality of holiness, which resist an impulse to control, command and oppress.

In the concepts of the sabbatical and jubilee year, economic effectiveness in the use of scarce resources is joined to environmental stewardship, law to mercy and economic order to eco-justice. We should contemplate and revitalize the biblical concept of sabbath, sabbatical and jubilee year to bring about a global liberation of creation within fifty years.

7.4.13. Global Network for International Alliance.

All nations of the world are interdependent. No nation is economically self-sufficient. No life-supporting systems on the earth respect political boundaries. All nations of the world must act in accord with a biblical sustainable society. It is fallacious to think that either the developed or the developing countries will be able to proceed towards biblical sustainable development without international cooperation in the context of the environmental crisis.

We should act together in defence of creation, and encourage the participation of people against the powers of oppression and destruction. It is therefore necessary to build a network of churches and Christians to facilitate exchange, cooperation, and appropriate collective action in the following fields based on the biblical perspective:

(1) An efficiency revolution that involves not wasting matter and energy resources.

(2) A solar-hydrogen revolution based on decreasing our dependence on carbon-based nonrenewable fossil fuels and increasing our dependence on forms of renewable solar energy and producing hydrogen fuel from water.

(3) A pollution prevention revolution that reduces environmental degradation from harmful chemicals, avoiding their release into the environment by recycling or re-using them within industrial processes, trying to find less polluting substitutes or not producing them at all.

(4) A biodiversity protection revolution that devotes to protecting and sustaining genes, species, natural systems, and chemical and biological processes that make up the earth's biodiversity.

(5) A sufficiency revolution that involves trying to meet the basic needs of all people on the planet and asking how many material things we really need to have a decent and meaningful life within the carrying capacity of the earth.

(6) A demographic revolution based on reducing fertility to bring the size and growth rate of the human population into balance with the earth's ability to support humans and other creatures without serious environmental degradation.

(7) An economic and political revolution in which we use economic systems to reward environmentally beneficial behavior and discourage environmentally harmful behavior.

Chapter VIII: Evaluation of Environmental Initiatives of Korean Churches regarding Biblical Sustainable Development of Energy and Mineral Resources.

The focus of this thesis is on Korea and in particular Korean churches to help prevent environmental impacts from mining activities and nuclear plants through applying a theological framework. But it deals with merely a microcosm of what is happening for securing energy and mineral resources throughout the world as discussed in chapter 2 and 3. We cannot imagine one day of our lives without energy and mineral resources in current civilized societies, just as we cannot exist without pure blood.

Mining cannot be sustainable because the deposit is finite and will eventually be exhausted. Furthermore, the environmental impact from mining activities and nuclear power plants is a major factor contributing to the current environmental crisis. The environmental risks transcend borders. It could even come to jeopardize international peace and security.

Therefore, there is a pressing need in the new century to adopt sustainable energy and mineral options, especially in the face of mounting evidence of global warming linked to fossil fuel use, environmental impact from mining activities and the persisting threat of nuclear accidents, unresolved problems of radioactive waste disposal, and the specter of nuclear weapons proliferation associated with continued use of nuclear power.

In order to eventually evaluate the environmental initiatives of Korean churches and suggest practical guidelines for them concerning the environmental impact from mining activities and nuclear plants, this thesis therefore carried out a factual analysis of energy and mineral resources such as characteristics of energy and mineral resources in chapter 2, the environmental impact from mining activities and nuclear plants in the world and in Korea in chapter 3 and 4 and the environmental involvement of Korean churches in chapter 5. It moved on developing a new concept of sustainable development of energy and mineral resources in accordance with the will of God and biblical sustainable development in the mining context in chapter 6 and finally suggested a theological framework for biblical sustainable development of energy and mineral resources in chapter 7.

South Korea has accomplished a very compressed form of economic growth over the past fifty years. As a result, she has consumed a very high amount of energy and mineral resources to the point that the government is

required to look elsewhere and make deals with other nations in order to compensate for her poor endowment of natural resources. But the rapid economic growth has been accompanied by rapid ecological dilapidation and environmental pollution. The environment was sacrificed by pursuing more economic growth through industrialization as discussed in chapter 4.

However, Korean churches have no an honorable position for the environmental impact from mining activities and nuclear plants. Because most of them have been unconcerned with the serious environmental deterioration as a result of the energy and mineral development projects. They have generally executed their pastoral duties with an indifferent attitude to political and economic programs and structures. They would think that environmental issues are only for government and specialized non-government organizations, not for Christian churches as discussed in chapter 5.

Thus Paul's words to the Romans (12:1-2) remain basic to all actions taken by Christians: "I implore you by God's mercy to offer your very selves to him: a living sacrifice, dedicated and fit for his acceptance, the worship offered by mind and heart. Conform no longer to the pattern of this present world, but be transformed by the renewal of your minds. Then you will be able to discern the will of God, and to know what is good, acceptable and perfect."

Therefore, In this chapter I would firstly like to evaluate the environmental initiatives of the Korean churches in order to clearly identify the challenging tasks which the Korean churches and the Government are now facing. And then I will suggest practical guidelines for the Korean churches based on the theological framework for biblical sustainable development in accordance with the will of God.

Finally, directions for the Korean Government will be suggested through evaluating its energy regime and mining policy in order to offer practical targets for their environmental initiatives in accordance with the will of God.

8.1. Evaluation of Environmental Initiatives of Korean Churches.

The church is a particular kind of caring community, of which the essence is found in the functions of ministry. The ministries are not some set of arbitrary services, but they are a response to the Creator God. The church should experience divine ministries and sense divine beckoning to go

and do likewise to image God (Yang and Son 1998:86).

The divine ministry is a mission of love that creates, sustains, and saves all creation. The divine ministry offers physical sustenance for all creation, comforts the afflicted, promises redemption, generates meaning, builds communion, pursues peace, reconciles the alienated, liberates the oppressed, challenges the oppressors, demands the right, and right the wrong (Yang and Son 1998:88).

From this perspective, the church is called to direct its services and design its communal life for confidence in and commitment to the ethos and ethic of God's Reign, the ultimate goal of God. It is called to be a sign of God's Reign, making its vision visible, reflecting Christ's new creation in personal, social and ecclesiastical transformations. God made the church to act and shape the historical present, as the Lord's Prayer suggests, on the model of God's New Heaven and New Earth (Yang and Son 1998:91-92).

In this context, environmental concern is not an optional matter but an inherent one for the Christian church. The significant environmental implications should be embraced in the proclamations and actions of the church, because environmental integrity is a prominent part of the church's mission as discussed in 7.3.1.

However, that is one of the serious omissions in the history of the Korean church. It is one of the critical matters that the Korean church should overcome as soon as possible through reforming its bad theological habits and ecclesiastical traditions (Koo 2005:12-15).

8.1.1. Bad Theological Habits of Korean Churches.

Most of Korean churches need to acknowledge and abandon several bad theological habits that has malformed the church's understanding and relationship with nature. It is an urgent task for Korean churches to overcome the following alienating factors to recover their understanding of creation with the emphasis on ecological integrity (as mentioned in 7.1.1) in the context of the environmental crisis through decontaminating inherited Christian doctrine and liturgy and reconstructing faith and worship patterns.

8.1.1.1. A Doctrine Separating God from Nature.

The scriptures reveal the essential truth that God is the Creator of all

creation (Gen. 1:1) and the Spirit of God continually sustains and renews the earth (Ps. 104:30). The Holy Spirit manifests God's energy for life present in all things and reminds us of the dependence of all things on our Lord God as discussed in 7.1.1.3 and 7.1.1.4.

However, most of the Korean churches adhere to a doctrine separating God from nature. God is understood to be revealed primarily in human historical events rather than in natural life. God's transcendence is emphasized much more than God's immanence or living presence in creation. They strengthen this habit by the way in which they interpret the sovereignty of God, the authority of Scripture, and the human deputyship to dominate nature (Koo 2005:24-27).

8.1.1.2. A Doctrine Separating Humanity from Nature.

Humans are by nature ecological and political animals, inseparably bound together in a web of biological and communal relationships. But they are enhanced in the earth village due to the development of science and technology, as mentioned in 7.1.1.2.

The non-human world is a sphere in which God reveals his presence and communicates with humans. The Spirit is present throughout creation. All the creatures are God's good creation and have their own value and dignity in and of themselves, apart from any usefulness to humans. All God's creatures are worthy of moral considerations, as a sign of the worthiness imparted by God as an expression of the worship of God, as discussed in 7.1.1.4.

However, Korean churches are used to separating humanity from nature. Humanity alone is said to be made "in the image of God" (Gen. 1:28), set apart from all other kinds, given domination. This translates into devastating the harmonized relationship between humans and nature, as exemplified currently in mining activities and nuclear power plants, which perpetuates human arrogance toward nature (Koo 2005:32-35).

8.1.1.3. A Doctrine Separating Redemption from Creation.

The logic of the doctrine of creation does not permit a nature-grace dichotomy. Grace is not only the forgiveness of sins but givenness of life, a double gratuity of redemption and creation (Sitter 1972:74-78) as discussed

in 7.1.2.3. However, Korean churches are used to restricting in practice the scope of grace to matters of personal salvation, and the means of grace (world and sacraments) to ecclesiastical functions.

There is also an increasing separation of redemption from creation. Nature has become a mere backdrop for the drama of human salvation. Theology, preaching, liturgy, and rituals focus on the doctrine of personal redemption rather than the fulfillment of creation. This is the general trend in the worship and pastoral activities of the Korean churches today. These typical restrictions distort the doctrine of creation (Kim_(b) 2006:107-108).

8.1.1.4. God locked in the Church.

The gospel relates to all creatures and it applies in all situations—personal, ecclesial, social, and ecological. The gospel rejects all forms of moral parochialism. Christ cannot be compartmentalized and locked in some closet as discussed in 7.1.3.2.

The Christian church ought not to make any theologically unacceptable distinctions between personal rebirth and social rebirth. It is called to proclaim and live the whole gospel in loyalty to the Christ who seeks to minister through all humanity and in all contexts to the needs of all creatures.

However, Korean churches are used to drawing a distinction between a personal and social gospel and argue that the role of the church is the conversion of individuals rather than the reformation of society. They are used to implying by their rhetoric and behavior not only that the arena of politics is irrelevant to the concerns of faith but also that the gospel is irrelevant to the decisions of politics (Lee 1993:378-379).

Such an insulation of Christianity from politics is theologically indefensible. It is a functional denial of the sovereignty of God in the church and the ubiquitous involvement of the Holy Spirit. God is central in individual spiritual lives, but is also sovereign over the social, economic, and political realms. This God comforts the afflicted, hears prayers, converts minds, and compels proclamation.

8.1.2. Bad Ecclesiastical Traditions of Korean Churches.

Korean churches made a great contribution to the independence

movement against the colonial regime of Japan and the democratic movement against the military government in Korean modern history. It were Christians who took the lead in the movements for Korean independence and democracy. That is an important motivation for promoting Korean churches through their social credibility from 1960s to 1980s.

However, it is a plain fact that the members of the protestant churches have been decreasing since the first centennial memorial celebration in 1984, while the Catholic church has been increasing strongly since the second centennial celebration in 1984. The reason is well demonstrated by their memorial projects. The Presbyterian churches (Habdong), the greatest denomination of Korean protestant churches, built a centennial memorial building, while the Catholic church supported medical operations for 200 blind people (Noh 1996: 52-73).

There are some bad ecclesiastical habits in Korean protestant churches that should be renewed through criticising themselves. Some church experts indicate that the Korean churches should get rid of such bad ecclesiastical traditions as soon as possible to promote their churches again. They are generally identified as a church-centered ministry, patriarchal and hierarchical traditions and quantitative church growth without social responsibility (Kang and Hendrks 2004:250-268).

8.1.2.1. Church-centered Ministry.

The Korean church has been so influenced by the dichotomous thought of Western Christendom that it has become an encapsulated community isolated from its society (Myers 1993:21-46) as discussed in 7.1.4. The church-centered ministry has brought about either the loss of public confidence or an indifferent and critical attitude of society towards Protestantism. This is nowadays confirmed as a primary factor which has prevented Korean Protestant churches from participating in social development and environmental movements.

In Korea social services can be divided into two areas: charity service and structural service. The former refers to the individual or collective activity of charity work in schools, social care, medical aid and relief work. The latter denotes the input to solve society's fundamental problems by reforming social structures. The area of structural service has been exclusively the ministry of the liberal group because the conservative group,

which comprises of the majority within the Korean church, has deliberately neglected this area (Ro and Nelson 1995:18-19).

Actually both groups have failed to function properly in this area because they lack strong convictions. Even though Protestants have participated in various forms of charity service, it is undeniable that charity service has been recognized as a secondary ministry, for which the church allocates only a small portion (4%) of its annual budget. In other words, the Korean church has also failed to function positively in this area because of their preoccupation in other areas such as evangelism (53%) and worship (33.8%) (Lee 1993:378). As a result, the Korean church has lost much of its credibility in Korean society.

However, instead of trying to participate in social initiatives to recover their social responsibility, most of their endeavors to cope with the crisis have concentrated on developing leadership skills, programs, and methodology through which they believe it will be able once again to experience numerical growth.

8.1.2.2. Male-dominated Church.

Korean churches have a patriarchal tradition accepting domination of men over women inherited from Confucian culture. Man and technology could be identified with the first term in each of the polarities of reason and emotion, mind and body, objectivity and subjectivity, and control and nurture. Women and nature were associated with the second term in each case (Lee 2003:33-51).

Korean eco-feminists have responded effectively with the critique that the oppression of women and the oppression of nature are rooted in a common set of hierarchical, dualistic, and patriarchal assumptions in Korean churches. Their criticism is that the male-centered patriarchal culture has brought violence, victimization, and domination over women and nature. It has brought violence in the form of capitalism, militarism, nuclear weapons and colonialism for natural resources (Jeong 2002:192-196).

In particular, they argue that Korean women have been rendered voiceless by a male-dominated society. They did not have a way of effectively expressing themselves either politically, economically and/or religiously. They still have a small chance of attaining an official position in the church. Their proper place is still considered to be the home. Christian

women often still believe themselves to have very little status, but God uses them in His church.

8.1.2.3. Numerical Growth-oriented Church.

The church is God's vehicle through which He reaches out to the world to establish His Kingdom as discussed in 7.3.1. However, the Korean church has failed to fulfill its social responsibility in comparison with its unprecedented growth from 1960s to 1980s. They have not played an exemplary role regarding social responsibility and environmental initiatives (Lee 2003:73-75).

Some church experts make the diagnosis that Korean churches have gotten so seriously growth-sick that they often disregard even ministry ethics in the effort to increase their members. They further criticize that it seems that their faith in Jesus Christ is one thing and their daily lives are another (Kim_(b) 2006 219-220).

To justify their attitudes, some pastors appeal to the fact that the society itself has been heavily influenced by materialism. Others recognize and criticise the reality of secularized leadership in the Korean church and acknowledge that it has been influenced by materialism, individualism, and successionism as discussed in 5.3.1.

The secularized leadership can be recognized in various forms such as megaism, successionism, materialism and numeralism. Outsiders critically point out that Korean church leadership has been secularized by being too focused on numerical growth and the construction of huge church buildings. This has caused disappointment to church members and has been an obstacle to outsiders (Kang and Hendrks 2004:250-268).

According to the statistics of the Korean Gallup Survey in 2005, it was evaluated that the Korean Protestant church is at the end of its growth rope from the 1990s due to a lack of social responsibility. The Protestant church accounts for 45.5% of the persons convert into other faiths (religions), while the Catholic church and Buddhism account for 14.9% and 24.4% respectively. Most of them are young persons disappointed with the non-ethicity manifested in various forms such as numeralism, successionism, materialism, megaism and authoritarianism in the Protestant church (Kim_(b) 2006:216-220).

The Protestant churches have generally enjoyed quantitative growth,

keeping pace with the rapid economic growth. But they have not taken note of social responsibility particularly regarding environmental degradation from nuclear plants and mining activities. They have not spelt out in clear terms the will of the Creator God to be in harmony with all humans and non-human beings as discussed in 7.1.1.4.

8.1.3. Poor Environmental Activities of Korean Churches.

Korean churches have abundant human and physical resources and wide networks to effectively perform environmental initiatives in comparison with secular environmental organizations. There are various kinds of ecclesial entities that can be involved in environmental activities such as individual churches, regional church associations, denominations, and special environmental organizations etc.

However, we have no alternative but to indicate their poor environmental activities, in the light that their members account for about 25% of the population as shown in table 5.1. Particularly, when it comes to coping with environmental pollutions from mining activities and nuclear plants, there is almost no involvement to evaluate except for voluntarily participating in the oil-removing activities in the west seacoast polluted by the oil spill disaster in December 2007 as discussed in 5.5. There is only the Environmental Institute for Taebaek Mining Region (EITM) as a Christian environmental group independently dealing with the mining pollution in Taebaek region.

8.1.3.1. Sporadic Reactive Motivation for Environmental Initiatives.

Most of Korean Christian organizations are nominally starting to change their attitudes and lifestyles to promote the integrity of creation by the will of God. But their initiatives are sporadic and reactive to special events, not systematic and consistent in practicing biblical sustainable development in accordance with will of God.

They only sporadically participated in the movements against the establishment of nuclear plants, nuclear waste place, dams and waste incineration places pursued by the secular environmental organizations. Their programs are not integrated into their daily lives and their actions are still not mass-based, so that they cannot be mobilized into community movements (You 2006:378-379).

Korean churches still do not supply their congregations with faith-based motivations which are clearly different from the secular motivations of the environmental organizations. This is evidence that they have not developed a systematic approach to the environmental degradations which inter-links all creation and penetrates into our daily lives (Kim and Jang 2007:21-22).

It is therefore necessary to reorient their faith and ethics, focusing on relations and community, not only on individuals and objects, in accordance with the new story of the earth and cosmos embodying forth the power, wisdom and love of God (Hessel 2001:202). They should read and interpret the Bible with more alertness to nature, reflecting on real praxis for biblical sustainable development through reinterpreting the Bible as mentioned in 7.3.1.1.

8.1.3.2. Initiatives without Practical Guidelines.

Korean churches have not affected public opinion regarding environmental issues very much in spite of having sporadically participated in environmental initiatives. This is because they have not had any Christian practical guidelines which could guide their initiatives different from secular organizations (Park^(b) 2007:120-126).

In particular, they have not tried to develop any practical guidelines for environmental movements against mining activities and nuclear plants in spite of the increasing serious environmental impacts from the development projects in Korea as discussed in 4.7 and 4.9.

They are still in the initial stages of formulating Christian guidelines for biblical sustainable development in accordance with the will of God. Their environmental programmes are still far from reflecting a systematic approach to cope with the environmental pollution from mining activities and nuclear plants.

They should therefore develop their own practical guidelines in order to be proactive in protecting the environment from the serious pollution confronting them in their daily life as Christians.

8.1.3.3. Poor Infrastructure for Environmental Initiatives.

Most of the Korean Protestant environmental organizations have undertaken their environmental initiatives under such seriously poor financial

conditions that 46.3% of them have self-support rates of less than 50% as discussed in 5.6.1.

They are mostly sustained by low membership fees without support of their churches. Most of their members have not paid their fees regularly so that 71.2% of them have payment rates of less than 50%.

Particularly, they have such small membership numbers that 91.4% of them have members of less than 100 persons. Furthermore, they have too few permanent workers in order to carry out their own environmental initiatives. This is very far from the church's status which should carry out environmental integrity on behalf of our Lord God as discussed in 7.3.1.2.

8.1.3.3. No Comment on Environmental Problems.

Most of Korean churches have confined themselves to matters of spiritual nature and this spirituality only refers to humans. It excludes the wider scope of God's creation. They are used to just sitting and watching the deteriorating situation of an increasingly weak and vulnerable environment produced by the rapid economic growth during the past five decades.

They have too often been silent in the face of ecological injustice, with an acquiescence which is itself a counter-witness to the Christ who stood up to the powers (Kim^(b) 2006:214–215). They are very far from the church as a resurrection community as mentioned in 7.3.1.3.

While they are alarmed about the environmental crisis in this world, they argue that this will take away from the priority of preaching the gospel. While some Christians got involved in environmental initiatives, they would usually look at it as something good and charitable.

They should have used the catch-phrase: "Let us live straightly by the will of the God." while the government encouraged all citizens to work hard under the slogan: "Let us live well." When the government was proud of "the economic miracle in Han river," the church should have taught its members a Jesus-like life attitude living in the presence of God (Coram Deo).

They should spell out in very clear terms the will of the Creator God who created all human and non-human beings, instead of only being interested in quantitative church growth. The Christian community must dare to proclaim the full truth concerning the environmental crisis in the face of

powerful people, pressures and institutions which profit from concealing the truth. Such recognition of the hard truth is an important step towards the freedom for which creation waits.

8.1.3.4. Indifference of Pastors about Environmental Problems.

Most of Korean pastors have generally executed their pastoral duties with an indifferent attitude regarding the serious environmental deterioration, particularly as a result of energy and mineral development projects. They are of one opinion that environmental issues are only for government and specialized non-government organizations, not for the Christian churches.

That is the result of their church-centered ministries which fail to fulfill their social responsibility and prevent their members from actively participating in the environmental movements as discussed in 5.2. and 5.3.

In order for their congregations to practice environmentally friendly daily lives, they should firstly confirm that their environmental actions are not only for their own sake, but also for the sake of God's Kingdom. Secondly it is necessary for them to act as pioneers in environmental initiatives. Finally they should lead God's people not to commit environmental sins through practicing environmental guidelines for biblical sustainable development in accordance with the will of God (You 2006:381) as discussed in 7.1.2.1.

8.1.3.5. Deficiency of Environmental Education System.

Most of Korean churches do not systematically carry out any environmental education programme in their Bible study and Sunday school. There is no curriculum for environmental studies even in the colleges and seminaries except a few courses concerning the general environmental problems as shown in table 5.7.

Particularly, when it comes to the environmental impact from mining activities and nuclear plants, there is not a seminary or school doing an environmental study based on biblical sustainable development in accordance with the will of the Creator.

Therefore, they must initiate and support the process of education for the growth of earth-keepers, both in the habits of everyday life and in the provision of leadership for the care of creation as discussed in 7.3.2.2.

8.2. Evaluation of Korean Energy Regime and Mining Policy.

The Korean government has persistently justified its heavy reliance on fossil fuels and nuclear plants to promote its growth-oriented economy for several decades, in spite of mounting environmental problems, financial burdens from increasing costs, and complaints against the technocratic system of energy governance as discussed in 4.3.

Korean people have been gradually awakened that energy choices can fundamentally shape the social direction and lifestyle of a certain society for not only the present but also the future. To realize a democratic society, its institutions should be fully open and transparent, and energy systems should also be compatible with democratic governance in scale and function.

In the light of environmental impact from mining activities and nuclear plants in Korea as discussed in 4.7, we cannot help indicating that the Korean energy and nuclear regime was a major pillar in support of its rapid economic growth, but resulted in producing serious social and environmental problems.

This is an adversary policy for eco-justice which raises some serious questions relating to countries or communities that exploit the poverty of another countries or communities and the relationship between humans and non-humans discussed in 7.1.3.4.

If this policy is not immediately checked and changed to suit the biblical sustainable development system in accordance with the will of God, Korea will contribute to bring about inequality in the midst of rising wealth, technocratic governance in lieu of democracy, and widening environmental gradation.

8.2.1. Evaluation of the Energy Policy in Korea.

Although the Korean government launched the restructuring of electric industry in 2000, it has pursued its supply-oriented energy policy for the past half century. It has never performed the national review to carry out a comprehensive energy efficiency scheme and alternative energy development policy which will decrease imports of coal and petroleum, improve industrial competitiveness, increase employment, and reduce pollution (Byrne et al 2004:54).

This is a problematic policy which does not carefully read the purpose of

the Creator who wants to teach us to have a attitude of humility, frugality, relationality, solidarity and sustainability in our daily lives and follow the life of our Lord Jesus Christ in the light of the limited carrying capacity of the earth as discussed in 7.1.3.2.2.

8.2.1.1. High Dependence on Fossil Fuels.

After experiencing the second oil shock in 1979 to 1980, the Korean government made a concerted effort to diversify its energy mix by investing in nuclear power, bituminous coal and natural gas. However, the stable oil prices since 1983 led to increasing oil consumption along with the high economic growth.

The rapidly increasing consumption of fossil fuels stems from expanding its energy-intensive industrial structure, fossil fuel-dominant electric utility and transportation sector. Heavy industry, including those involved with primary metals, petrochemicals and cement, is the major energy consumer in the industrial sector and also the major air and water polluter in the industrial field as discussed in 4.3.1.1.

Particularly, energy consumption in the transportation sector has significantly increased along with the rapidly increasing number of vehicles. Petroleum accounts for more than 99% of total transportation energy consumption in 2008.

The increasing rate in energy consumption has almost outpaced the growth rate of GDP for the last 40 years. Concerning per capita energy consumption, Korea with 4.43 tons of oil equivalents (TOE) exceeded Japan with 4.18 TOE, Germany with 4.22, and most EU countries with 3.91 in 2004 (Yun 2007:4-5).

The increasing demand for electricity has been met by fossil fuels and nuclear power. Particularly, the nuclear power generation enlarged from 18 thousand TOE in 1997 to 30,731 thousand TOE in 2007, producing 80.2% of the total domestic production.

The domestic energy production structure in 2007 was composed of nuclear 80.2% of the total production, anthracite 3.5%, hydro 2.8% and renewals and others 13.5% in 2007 as discussed in 4.3.1.2. This means that Korea is too much dependent to nuclear power to control it in the near future.

This is clear evidence that Korea is an outstanding economic leader who

has played very destructive roles in the biological and geological system of this planet, our home (*oikos*) as discussed in 3.1 and 3.2. This is a violation of the integrity of Christian faith. The earth is our Lord God's and He has ultimate rule over the earth as discussed in 7.1.3.1.2. He did not create the earth for only humans.

8.2.1.2. Environmental Problem.

Fossil fuels are the main source of SO₂, NO_x, CO₂ and TSP emissions in Korea, resulting in climate change. The level of SO_x emissions per unit of GDP is the highest among the OECD member countries. Coal-fired power plants release heavy metals such as mercury, arsenic, lead and cadmium as well as CO₂, SO₂ and NO_x, becoming the major source of acid rain and smog in Korea. Acid deposition and heavy metals are poisoning rivers and lakes as discussed in 4.8.

In particular, the climate change is a warning from our Lord God concerning the unsustainability of a modern industrial society based on fossil fuels and unsound economic wealth orientation. It is not only an environmental issue but also a survival matter for all the creatures created by God. It is not only a scientific issue, but also an ethical matter considering the will of the Creator as discussed in 7.4.5.

Korea has drawn global attention because of her unique situation and rapid growth of greenhouse gases (GHGs) emissions. Korea is the ninth largest emitter of GHGs and its emissions have nearly doubled in the past 15 years. This is the fastest emissions growth among OECD members from 1990 to 2005 (Min 2009:3).

With regard to the absolute amount of CO₂ emission growth, Korea ranks fourth during 1990 to 2002. During the 20th century, the world temperature increased on average by 0.6 Celsius, while in Korea it increased 1.5 Celsius. Korea is very vulnerable to climate change because it is a peninsula with long coastal lines (Son 2009:4).

Korea should actively set up a reduction target of CO₂ emission in 2009 and demonstrate a model to fulfill it before a post Kyoto treaty comes into effect. But it is not a simple matter for Korea to carry out a comprehensive counter-measure for climate change.

Korea should firstly recognize that she is indulging herself in overdevelopment and overconsumption as discussed in 4.3, while strongly

contributing to the environmental degradation. She should secondly keep in mind that if she does not act to recover the environment, the true cost of her failure will be borne by future generations.

8.2.1.3. Economic Problem.

Recognizing that the industrial sector needed a rapidly increasing energy supply, the Korean government placed the emphasis on promoting fossil fuel industries according to its economic development plan. In the light of its export-oriented industrial scheme, the government provided subsidies for fossil fuel industries to keep them competitive in the world markets and controlled energy prices to keep them low (Byrne et al 2004:72).

This policy stimulated energy consumption and resulted in the heavy dependence on imported energy. Its energy imports accounted for 26.6% of the total import amount in 2007. Korea imported crude oil of 872,541 thousand barrels (2,390.1 thousand b/d) in 2007, emerging as the 4th largest crude oil importer in the world. The overseas dependence rate of energy also increased from 65.8% in 1977 to 96.6% in 2007 (KEEI 2008:78–79).

It is generally accepted that the Korean financial crisis in 1997 was closely associated with its energy policy, which contributed an increase of its foreign debt as a result of generous loans to the energy-intensive petrochemical, steel and cement industries, supporting capital-intensive nuclear power projects, and stimulating rapid increasing energy consumption (Byrne et al 2004:73).

This is a defective energy policy in the light of the principle of eco-justice discussed in 7.1.3.4. Korean energy policy gives a good indication that the energy policy of taking advantage of the weak and supporting a few business can be leading to financial crisis as well as environmental degradation.

The gap between the rich and the poor in Korea has increased significantly in the course of her rapid economic growth. In particular, the Korean financial crisis in 1997 resulted in increasing poverty. The fundamental cause of poverty is almost the same as that of environmental degradation as discussed in 6.4. Therefore, eco-justice is nowadays not only an option for the national energy policy, but a moral imperative.

8.2.2. Evaluation of Nuclear Power Policy.

Korea is one of the countries still maintaining a strong nuclear power policy. The nuclear industry argues that nuclear energy is an inevitable option to meet the rapid increasing demand of electricity and complement the poor endowment of domestic energy resources (KEPCO 1997:68). However, it was pointed out that the Korean government started nuclear development not only for electricity generation but also on account of some other motivations (Cho 1990 237-251; Whang 1991: 58-64).

It is generally recognized that the formation of nuclear technocracy and network in Korea was based on the three factors: (1) institutional alliance among the state, the military, conglomerates and scientists; (2) the ideology of economic necessity and national security; (3) client relations between Korea and the U.S.A. (Kim and Byrne 1996:282).

This technocratic base has allowed Korean nuclear power planning to transpire outside normal policy scrutiny, and led to a policy regime decided by an inner expert circle rather than by democratic consent.

Nuclear power and waste disposal have been on the world agenda for many years. In spite of such long research and development for nuclear plants, nuclear waste disposal is still left as a serious environmental problem. However, the avarice induced by the Korean energy regime has resulted in the additional construction of nuclear plants without counter-planning for nuclear waste disposal in a small land of 99,117 km as discussed in 4.5.

This is a sin against the environment which is expressed as the arrogant denial of the creaturely limitations imposed on human ingenuity and technology as discussed in 7.1.2.1. The root of sin is egoism, acting for the self-centered lust to arrogantly dominate others and the pretension of self-sufficiency at the expense of other beings as discussed in 6.3.2.

8.2.2.1. Environmental Problem.

Advocates of nuclear power asserts that this energy source is so clean and CO₂ free that the nuclear option is a viable solution to global environmental problems as well as local pollutions from fossil fuel energy sources (KEPCO 1997:86). However, the assertion definitely fails to notice that nuclear power presents pervasive danger in the form of nuclear

accidents and radioactive contamination which are no less disastrous than global warming.

The most serious problem regarding nuclear power is how to deal with the unresolved problems of radioactive waste disposal. So, the comparison is often made that establishing a nuclear plant is like building a luxury house without a toilet. We should do nothing that could jeopardize the opportunity for future generations and deprive their ecological conditions to maintain our current lavish lifestyles as discussed in 7.4.2.

One of the significant dangers of nuclear power comes from the possibility of a major accident, which could bring about catastrophic consequences for human health and ecosystems for many generations. The Chernobyl accident exemplifies a scenario of a nuclear plant accident. The impact of a nuclear accident in Korea could be amplified by the fact that it is small and densely populated.

According to a computer simulation by the Citizens Nuclear Information Center (CNIC), if a major accident occurs at the Youngkwang nuclear power complex, more than 4 million people would be exposed to radiation exceeding a 1.0 Sivert (Sv) level. About 40 thousand people among them could be expected to die of cancer as a result of an accident (CNIC 1994:54-67).

Even during normal operation, nuclear power plants can release certain toxins such as cesium, tritium and iodine into the air and waterways. The plants also generate substantial amounts of high-temperature wastewater into coastal waters causing serious thermal pollution that destroys sensitive coastal ecosystems.

8.2.2.2. Economic Problem.

The Korea Electric Power Corporation (KEPCO) argues that nuclear power is one of the cheapest energy options available to Korea. However, this analysis ignores or underestimates the costs of nuclear waste disposal and decommissioning as well as the cost of required repairs, safety upgrades and possible accidents. It also neglects to consider the capacity factors elevating the risks of malfunctions and accidents (Byrne et al 2004:92).

Nuclear power inherently has the problem of lumpy investment as a large-scale technology. Heavy investments in nuclear energy forestall the development of genuinely indigenous energy resources such as energy

conservation and renewable resources. Furthermore, nuclear power tends to increase a society's energy dependency by boosting the supply-oriented system and encouraging energy consumption rather than efficient use of energy.

Nevertheless, the Korean Government declared the first national energy plan to build 10 more plants by 2030 in a small land of 99,117 km² without citizen consensus on further plant development. This is a very serious economic and environmental problem which will definitely bring about serious burdens (Cho 2008:3).

8.2.2.3. Social Resistance.

The nuclear energy regime requires centralized planning and tight social control to construct and manage the power plants, which is often at odds with democratic ideals of equity, decentralization and local authority.

The history of the nuclear industry in Korea is one of a nuclear energy regime trying to decrease social resistance by forcing a technocratic mode of governance based on secrecy and coercion under the name of national security or technical requirements for rapid economic growth (Byrne et al 2004:94).

Taking advantage of its monopolistic status and strong support from the government, KEPCO has built a centralized and hierarchically managed energy regime. It exercises significant power regarding social, economic and political issues relating to the construction and operation of nuclear plants.

Most power plants and transmission and distribution facilities were constructed without the consent of local residents. Citizens were excluded from the decision-making processes, and their opposition movements were suppressed violently by the police. This is a far cry from meeting the requirement of eco-justice discussed in 7.1.3.4.

8.2.3. Evaluation of Mining Policy.

South Korea has poor natural resources so that most of the metal and coal mines were shut down due to poor development conditions and environmental impacts, except a number of iron and titanium mines currently in normal operation.

However, Korea has pursued her supply-oriented energy policy to

support her rapid economic growth with mostly overseas energy and mineral resources for the past half century, in spite of her poor endowment of energy and mineral resources as discussed in 4.3 and 4.4.

Korea has resorted to import about 99% of her energy and metals consumption in 2007 as discussed in 4.2. The imports of metallic and non-metallic minerals amounted to 12,292.8 million US\$ in 2007, accounting for 3.4% of the total imports as discussed in 4.4.4. But the non-metal mines are still viable so that their products account for 72.78% of her requirements in 2007 (KIGAM 2008:5-7; KEEI 2008:12-13).

Thus, the Korean government has opted to develop overseas mineral resources instead of its domestic ones to meet the rapidly increasing demand for mineral resources and has avoided environmental problems without adequate consideration of the earth's carrying capacity and the integrity of its ecosystems.

This contravenes the requirements of economic justice that provides the material conditions for human dignity and social participation for all, within the limits of the earth's carrying capacity and the integrity of its ecosystems as discussed in 7.4.9. In order to use energy and mineral resources from generation to generation in accordance with the will of God, mining policy must be developed attuned to the carrying capacity of the earth, comprehensively managing human numbers and lifestyles together with technologies and management practices, as mentioned in 7.2.3.3.

8.2.3.1. Management of Closed Mines.

Korea has developed 2,006 mines since 1930. 1,276 mines among them were abandoned due to the low profits as a result of their scanty reserves, the deepening of mines, and increasing environmental impacts as shown in table 4.2.

The abandoned mines have had a negative impact on many residents in the mining regions as a result of various environmental impacts such as acid mine drainage, soil contamination, health damage and sudden ground collapse etc.

The 1,276 abandoned mines are just the confirmed ones which the Korean government has gotten hold of based on register records in

accordance with the Mining Act. But there remain many unconfirmed closed mines imprudently developed during the colonial period of Japan and left without aftermath management.

The Korean government therefore launched the Mine Reclamation Corporation (MIRECO) in 2005 in accordance with the Mining Damage Prevention and Mine Reclamation Act of 2005, and set up a mine reclamation plan in June 2006 to carry out long-term and systematic projects.

We are stewards on behalf of God who has entrusted creation and its resources for our wise management as discussed in 7.2.2.1. However, most of the Korean churches have not been concerned about an ecological mission regarding mining activities in Korea. They are also unconcerned about the serious pollution from asbestos, limestone and coal mines, oil refining plants, copper and zinc smelting and refinery plants etc. as discussed in 4.7, even though it involves environmental problems that can't be solved by government and specialized agencies alone.

8.2.3.2. Overseas Mineral Development Policy.

Korea regards overseas resource development as one of the effective measures for promoting resource supply security due to its poor endowment of mineral resources and environmental impact from domestic mining activities. The Korean government has increased its investment in this regard aggressively and supported Korean companies by offering overseas developmental assistance (ODA) or by exploiting its diplomatic influence.

The Korean government also set energy and minerals security as one of its high priorities of the national policy in 2008, and planned to achieve a goal for the independent resource development rate of 32% in 2012 from 18.24% in 2007 and then 40% by 2030 for strategic resources such as oil, natural gas, uranium, copper, iron, lead and zinc as mentioned in 4.6.

Korean companies invested 8.9 billion dollars in oil and gas development and 2.5 billion dollars in developing other mineral resources to carry out 286 ongoing resource development projects in 53 countries as of the end of 2007 (Lee 2009:37-43).

However, Korea should have kept in mind that as the world becomes more exploitable and more profligate, the environment of this planet

degenerates unto the brink of total destruction, contrary to the will of God as discussed in 7.1.4. It should have approached more carefully the limited energy and mineral resources and prevented various pollutions from mining activities particularly in developing countries as well as in Korea.

Even though Korea has a poor endowment of natural resources, it should have made a more concerted effort to develop her domestic mineral resources through modernizing the domestic mining industry such as changing from open-pit mining to underground mining, improving its mining technologies for environmental impact etc.

Korean churches should recognize that they are indifferent about where the deposits of energy and mineral resources are, how they are developed, and what environmental damage has already occurred as a result of mining activities. They enjoy using these resources them for their church buildings and convenient facilities rather than playing the role of steward for the earth belonging to our Lord God as discussed in 5.4.

8.3. Guidelines for Biblical Sustainable Society in accordance with the Will of God.

The environmental degradation in Korea is much more serious than we think. The reality of the crises of economic deprivation and environmental degradation has become visible in the everyday life of Korean people as discussed in Chapter IV. That is not only for scientific or economic reasons, but also for moral reasons in that we are already under God's judgement as discussed in Chapter VII.

However, the problems Korea is now facing does not mean that it is impossible to change into a sustainable and democratic energy and mineral future. There are bright alternatives available for Korean society. The biblical sustainable development option in accordance with the will of God is the way to lead Korea into a new society.

In order to work towards this option, institutional mediation is surely needed to promote social changes. But its success ultimately depends on the energy and determination of the Korean people in their different contexts to work for the new order. Therefore, the full support and prayers for solidarity and readiness of Korean churches are truly necessary. It is also necessary for Korean churches to enter into alliances of cooperation with others.

8.3.1. Directions for Individuals regarding Biblical Sustainable Development.

8.3.1.1. Let Us, First of All, Change Ourselves.

Our attitudes and behaviors are the basic elements in practicing biblical sustainable development in accordance with the will of God. So, if we want to change the polluted environment we find ourselves in, we first have to change ourselves. To change ourselves effectively, we first have to change our perceptions of the way things are and of the way things should be. Because the way we act corresponds with the way we see things (Covey 1994:28).

In order to live environmentally sensitive lives, we have to make things happen. We cannot wait for others to do it for us. We have to take the initiative. However, our behavior is the result of the kinds of decisions we make and not of the conditions we live in. Our behavior is the product of our own conscious choices, based on our values to follow our Lord Jesus Christ. Between stimulus and response, we have the freedom of choice for biblical sustainable development.

8.3.1.2. Checking Points for our Daily Lives.

Recognizing that human greed and avarice are root causes of environmental degradation and human debasement, the following queries will help us to examine our spiritual relationship with the natural world and to explore the implications in our daily lives (Koo 2005:73-85):

- 1) Do I live simply, mindful of how my life affects the earth and her resources?
- 2) Do I honour all the creatures in their intrinsic value, the creational order of God, and the richness of the created world?
- 3) Do I seek the holiness which God has placed in His creation?
- 4) What am I doing to teach my children and members of my community to cherish each strand of the interwoven web of creation?
- 5) What actions am I taking to reverse environmental destruction in the planet, our home (*oikos*), and to promote her healing?
- 6) Does my daily life exemplify and reflect my respect for the oneness of creation and my care for the environment?
- 7) Am I willing to consume less myself in order to promote rightful

sharing of the world's limited resources in a manner that reduces environmental degradation? Am I prepared to give up products, services and conveniences, even those I may consider as necessities in order to help preserve non-human creation on earth?

8) Am I aware of what happens to the waste products that I generate? Do I dispose of that waste in ways that are regenerative, or at least that do not harm?

9) Am I careful to avoid spending and investing money in business fields that result in doing harm to the environment?

10) If I own land, do I respect the heritage of the land as a gift of God, exercising sound stewardship over its natural resources, so that they are maintained not just for my use, but for future generations?

11) In my work, do I seek to integrate a concern for the environment into my goals and actions, seeking ways to share with others the values and importance of environmental concerns?

12) Do I seek to avoid destruction of the environment by conserving energy, using energy efficiently and relying on renewable forms of energy?

13) Am I mindful of the extent that the ever-increasing population on the earth contributes to environmental degradation?

14) Do we examine and appreciate cultures and communities whose lives are based on close harmony with the natural world?

15) As friends, do we communicate concerns on environmental issues to local and national legislators in order to encourage environmental regulations and laws?

8.3.1.3. Action for New Biblical Sustainable Development Order.

Our effort to discover and maintain a personal lifestyle should be consistent with God's purpose: ready hospitality; observing a sabbath so as not to get trapped by the world's expectations of exploiting one's own or other people's energies, or to over-use the resources of nature; care over the re-use and recycling of products whenever possible; and tithing of income so as to acknowledge that all economic benefits are God's gifts.

Christian decisions about work and career choices should be consistent with a Christ-like commitment to economic justice for all. Even though the job is humdrum, worthwhile work can be a vocation to care for the earth and the poor. We should try to promote greater economic justice through

personal commitment of some voluntary organization (Lim 2003:71–93).

Where possible, together with people of different backgrounds and lifestyles, we must try to participate in Bible study to learn and identify with God's continuing story with humanity and to break beyond the constricting lenses of understanding that domesticate the Bible into our own culture and expectations.

We must also try to take part in disciplined prayer, public worship, and theological reflection with others to reach out to God and to be directed, energized, refreshed and supported in commitment to God's justice for all.

8.3.1.4. Personal Sacrifice for a Biblical Sustainable Society.

Individual Christians should determine to live responsibly in the environment regardless of the cost, knowing that a few well-placed examples can have a tremendous impact. If personal sacrifice is necessary to reclaim the earth, if we are compelled to give up luxuries and conveniences to which we have become accustomed we can find our inspiration in the sign of the cross.

Jesus Christ left the glory of a place beside His Father to enter poverty and embrace death for the salvation of all creation — human and nonhuman creation. If we are to walk as He walked, surely part of our goal is to make the sacrifices necessary in order to image God on the earth.

In practical terms, the sacrificial life will mean buying fewer luxury goods, living in smaller and more energy-efficient homes, eating foods that are as unprocessed as possible, cooperating with government measures to decrease pollution and increase recycling, and working to put as much into the earth as we take out of it. This will be a total reorientation of lifestyles in an affluent society.

8.3.1.5. Christ-like Life for New Sustainable Society.

The population–consumption–ecology crisis will not be solved by nude rationality, but only by truths that stir the flaccid will by touching the sacral core of human nature. So, we should all practice the Christian ethic in our daily lives to prevent environmental degradation in this world.

The Christian ethic is a Christ-centric ethic characterized by life-giving love which includes incarnation and suffering. Christ-centric ethics means

that (1) Christ is the origin of Christian ethics; (2) Christ is still the model of Christian ethics. His life of incarnation, suffering and crucifixion should remain as the model of our Christian ethics; (3) Christ's mission is the goal of Christian ethics; (4) The specific Christ-centric ethic in this world is the life-giving love or self-giving love in both dying and living; (5) The Holy Spirit regenerates this Christ-centric ethic in Christian life (Cheong 2000:168-173).

At this point, Christians can be identified with Christ in this world. Those who have the Spirit of Christ can become Christ-like persons. We must become Christ-like persons particularly for the earth in the environmental crisis. Therefore, we must live a totally different life from the worldly life. Christians must reject the sinful power, the evil power. Christians must fight against environmental sins (Col. 3:5-9).

When Christians concentrate on Christ, they live a paradoxical life. Our life is not our own. Our life is Christ's. In this otherness of life, Christians should break the wall between the self and the other (humanity and nature). We should live in this world with Christ and in Christ. In the environmental crisis in this world, to live with Christ and in Christ is to live in the life-giving dying or living in and for Christ in order to recover the earth belonging to our Lord God.

8.3.2. Guidelines for Korean Churches regarding Biblical Sustainable Development.

8.3.2.1. Korean Churches are Called to Repentance.

Facing the environmental degradation discussed in Chapter IV, Korean churches as the body of Jesus Christ firstly need to confess that they have failed to recognize and therefore fulfill their human responsibility towards creation. Christian teaching and practice, based on the misinterpretation of scripture, have reinforced systems and structures of power that degraded their environment. These should be examined and clarified (Hessel and Rasmussen 2001:187-188).

The next thing they should do is repent. The only problem is they do not have eyes to see and ears to hear the Spirit, as they are occupied with their greed. Nonetheless, repentance is the first step in any truthful prayer. They should repent their hidden love for mammon and their secret desire for the Babel tower (Chung 1991:41-42).

To prepare the way of the Holy Spirit, they need to be set free from the spell of mammon. They have to turn themselves to the direction which the Holy Spirit empowers them to move in. It is the direction leading to creating, liberating and sustaining all the creatures, not based on the power of domination by capital, weapon or manipulation, but based on the life-giving power of mutuality, inter-dependence and harmony.

With a humble heart and body, they should listen to the cries of creation and the cries of the Holy Spirit with it. They must care for the earth, air, water, energy and mineral resources tortured and exploited by human greed for money. What they need is a wailing wall to weep with the creation which has been groaning in travail (Rom. 8:22).

The Creator God will not abandon them to despair when they repent. He will not allow them to indulge in self-pity as helpless victims. He will call them to come out of their prison of despair, cynicism and oppression. He will empower them to protect the earth. When God's Spirit was upon the Korean people on the day of Pentecost, God confronted their broken hearts and called them into discipleship. Their nightmare of witnessing Jesus' death turned into an apocalyptic vision of a new world. When the life-giving power of the Spirit poured onto the faithful, they saw the vision of a new world.

8.3.2.2. Seriously Awakening to Environmental Degradation.

We face unprecedented environmental changes today such as climate change, land degradation, dwindling of natural resources, nuclear waste treatment, deforestation, air and water pollutions etc. Few global issues are more important than global warming, environmental degradation, and the potential for conflict growing out of competition over dwindling natural resources such as oil, natural gas, water and so on. The rapid environmental change is all around us.

Korean churches must seriously be awakened to such an environmental crisis. In particular they should realize the full extent of what is happening from nuclear plants and mining activities in Korea as discussed in 4.7. The environmental risks transcend borders. It could even come to jeopardize international peace and security.

They should sincerely accept that if they do not act at present, the true cost of their failure will be borne by succeeding generations, starting with

theirs. That would be an unconscionable legacy from generation to generation. Unless they make a conscious effort to preserve their precious natural heritage, they are at grave risk of forever disturbing the delicate ecological balance of nature.

8.3.2.3. Understanding Environmental Issues through the Bible.

In the light of Scripture, Korean churches must firstly understand that the issue of the environment is fundamentally theological and is related to central truths of the Christian faith: creation, sin, salvation, and the proclamation of the gospel.

They must secondly abandon the bad theological habits that malformed the church's understanding of and relationship with nature through decontaminating inherited Christian doctrine and liturgy and reconstructing faith and worship patterns as mentioned in 8.1.1.

They should thirdly discover certain scriptural concepts in order to transform their attitude to the world around them, particularly to solve the environmental problems in Korea as discussed in Chapter IV. Finally, they should prepare a guideline for practicing their daily lives and participating in environmental initiatives (Koo 2005:122-134).

8.3.2.4. Having a Right Relationship with Nature.

Human beings are a part of the world which our Lord God created with the intention of relationship between humans and non-humans. Non-humans can survive without humans, but humans must humbly accept that they cannot survive without non-humans as mentioned in 7.1.1.4. We should accept the total dependence of our well-being on the well-being of creation. So, nature is not a mere backdrop for the drama of human salvation (Hall 1990:185-215).

We can recognize in the Bible that God's interaction with the creatures is never limited to humanity. It always is an interaction with humanity in relation to the rest of creation. God's acts of creation, judgement and redemption embrace the earth and all its creatures. The Spirit is present throughout creation. All the creatures are God's good creation to have their own value and dignity in and of themselves, apart from any usefulness to humans.

Korean churches should therefore discover the need to extend their spirituality to include all of God's creation. Korean churches should not only emphasize a relationship with God through the atoning work of our Lord Jesus Christ, but also spell out in very clear terms the will of the Creator God seeking the well-being of every kind in God's commonwealth.

8.3.2.5. Actively Participating in Environmental Initiatives.

If Korean churches are committed to feeding the hungry, clothing the naked, healing the sick, setting at liberty the oppressed, challenging the powers that be, and exalting those of low degree (Luke 1:46-55; 4:17-19), they dare not ignore the environmental, social, political and economic contexts of these concerns.

They must dare to proclaim the full truth about the environmental crisis in the face of powerful persons, pressures and institutions which profit from concealing the truth. Such recognition of hard truth is an important step towards the freedom for which creation waits. Love demands the pursuit of justice, peace, and ecological integrity in the realm of social systems (Kim 2003:115-123).

They have to make an extra effort to attend ecological meetings, comment loudly and participate effectively in the environmental movements. They should make their voices heard, and they must share their expertise and knowledge to make a contribution to the environmental protection. They can then tell their children that they did try to make a difference for them to take over an integrated environment.

8.3.2.6. Performing Divine Ministry with Social Responsibility.

Korean churches should re-examine the social responsibility placed on them by Scripture to care for God's creation and ensure that they act as responsible stewards of all that God has entrusted to them. In order to perform it, they should dispose of their church-centered ministry as soon as possible. They must go back to their old attitudes toward social ministries which led the independent movement against the Japanese colonial regime and the democratic movement against the military government.

The Korean church needs to recover its original function of ministry which is a response to the divine beckoning to go and do likewise to image God. God made the Korean church to act and shape the historical present

based on the model of God's New Heaven and New Earth (Watkins 1994:68).

In this context, Korean churches should have a strong conviction that the environmental concern is not an optional matter but environmental integrity is a prominent part of the church's mission. They should include significant environmental implications in their proclamations and actions, away from only interest in quantitative church growth (Hessel and Hudnut-Beunler 2001:300).

They should also have a firm belief that this is the best way to set off their revival movement again. The recent member growth trends of both the Catholic and Protestant church are a good witness for the movement. The members of the latter, which is indifferent to social ministry, has decreased more than 10% from the end of the 1980s, while those of the former, often participating in social initiatives, has increased significantly as discussed in 8.1.2.3.

8.3.2.7. Worship Service Oriented to Environmental Concern.

Christian worship needs to become more oriented to seeking the well-being of every kind in God's commonwealth, to ecological concern for the world reconciled in Jesus Christ, and to the eco-justice ethics and praxis that flows from the gospels.

Korean pastors are therefore in charge of instructing the congregation at all times in order to make them more responsible stewards of God's creation. Considering the urgency of solving the environmental crisis, worship patterns should express more the relation between God and nature and encourage members to participate in earthkeeping on a finite planet. Environmental challenges should be issued as often as possible (Koo 2005:157-161).

They should strongly preach that Christians should voluntarily reshape their daily lives in order to highlight God's loving and just relation to the earth, not only humans but all creatures, and join to adopt patterns of production, consumption and reproduction that safeguard the limited carrying capacity of the earth. They should often remind members that Christians are called to be earth-keepers, preventing harm to nature as the best method of environmental protection, and when knowledge is limited, applying a precautionary approach.

8.3.2.8. Christian Community without Sexism and Classism.

If the Korean church truly wants to be the community of Jesus Christ, living in love as one body and seeking the reign of God, the practice of sexism and classism in the church should not be permitted. Instead, the community should be a living witness to a fellowship of sharing, cooperation, and peace among all (Jeong 2002:192-196).

Korean women also need to be free from man-centered instruction and actively develop a spirituality to participate in the environmental initiatives. Korean churches should encourage and support their own activities for environmental issues and prepare some environmental programmes for them. It is never too late for them to become involved in environmental movements.

Additionally, Korean churches are faced with the challenge of Paul's appeal to accept God's preferential option for the poor, because the gap between the rich and the poor in Korea has increased so much in proportion to its rapid economic growth for the past half century. They should recognize that the worth of a society is measured not by its power, wealth or size, but by how it cares for the poorest and weakest members.

8.3.2.9. Revising the Mining Law for Biblical Sustainable Development.

The Bible gives us several commands to obey the political rulers over us (Rom. 13:1; Tit. 3:1). Christians should therefore submit themselves for the Lord's sake to every authority instituted among men (1 Peter 2:13-14). However, when their government leaders violate the power and authority and issue laws contrary to the Scripture, they must not submit but obey God. The examples of this principle can be found in Acts 4:19 and 5:29.

Christians should also support their government leaders by earnestly prayer for them to be filled with divine wisdom to guide them in the affairs of governing the people (1 Tim. 2:1). However, if the leaders are wicked and are acting contrary to God's Word, they should pray for their removal from office and exercise their right as citizens to vote them out of office.

Furthermore, if any law is not identified with biblical sustainable development in accordance with the will of God, Christians should try to revise the law to protect their environment. Our God is political, blessing the peacemakers, intervening in the affairs of governments and nations, and

liberating slaves from the shackles of pharaoh. The sovereign God bans all boundaries on benevolence.

One of the key threats to environmental management in developing countries is the lack of institutional capacity to undertake the complex environmental task. In this regard, Korean mining law also has no clauses concerning clear production (CP), pollution prevention, burden of proof and sabbatical year as discussed in 6.5.2. and 7.4.12.

According to an analysis of the 299 current members of the Korean Parliament in table 1, Christians account for 66.9% (200 members). This means that they can revise the law by themselves if they all joined hands to prevent the environmental degradation through practicing biblical sustainable development in accordance with the will of God. Therefore, Korean churches should put pressure on them to revise the law as soon as possible.

Table 8.1: Religious Share of Members of Korean Parliament.

Religion	Protestant	Catholic	Buddhist	Others	Non-Religios
Share (%)	120 (40.1)	80 (26.8)	47 (15.7)	5 (0.3)	47 (15.7)

Source: Jungyang Sunday, December 15, 2008, p. 7.

8.3.2.10. Educational Approach for Biblical Sustainable Development.

Education is a very useful process to change the environmental worldview which can set off a cultural mindquake, because it involves examining many of the basic beliefs. Once we change our worldview, it no longer makes sense for us to do things in the old ways. If enough people do this and put their beliefs into action, then tremendous cultural change can take place.

The church's educational goal should therefore become the growth of earth-keepers, both in the habits of everyday life, and in the provision of leadership for the care of creation in the environmental crisis. Some planned lessons must be carefully made available ranging from biblical foundations to suggestions for practical action in Bible study, Sunday School and seminary (Kim 2003:123-129).

In particular, Christian colleges and seminaries should provide theological education to cope with eco-justice themes and environmental issues at the individual, institutional, and social policy level based on the biblical

sustainable development in accordance with the will of God.

Korean churches should continually produce consecutive programmes to make the benchmarks for preventing and healing environmental degradation through shifting from current approaches into fundamental approaches in accordance with the will of the God.

8.3.3. Directions for the Korean Government regarding Biblical Sustainable Development.

Human future perspectives depend on energy and mineral resources that are safe, reliable, and environmentally sound, because they are major sources for the current environmental crisis and their deposits are finite and eventually exhausted. However, most countries continue to use energy and minerals that are mostly non-renewable and technologies that pose significant hazards to the environment and human health (Byrne et al 2003:17).

Therefore, it is very necessary to extend them by avoiding overuse or wasteful use, through scientifically recycling and exploiting them, and by developing renewable substitutes where possible. Recent progress in the fields of energy and mineral efficiency, conservation and recycling/ reuse, and alternative substitute development such as solar, hydrogen and wind energy are making possible an energy and mineral transition built on a decentralized, renewable and low-emission technology platform (Byrne et al 2004:98-99).

8.3.3.1. Moratorium on Nuclear Power in Korea.

The Korean Government should make arrangements to stop the establishment of additional nuclear power plants until developing a perfect technology and/or method to cope with the nuclear wastes as discussed in section 3.2. Instead of establishing them, it should make concerted efforts to perform efficiency and conservation schemes for energy and minerals and develop renewal energy and mineral resources.

It is clear that the nuclear plant always embraces the persisting threat of nuclear accidents, and brings out the unresolved problems of radioactive waste disposal. Establishing a nuclear power plant is therefore compared with building a luxury house without a toilet.

Once the huge capital investment is monopolistically committed to the nuclear plant, energy consumers have little choice except to respond to such a significant supply through increasing energy use. It encourages people to overuse energy consumption to make up for the huge cost of its construction, and provides sources for nuclear weapons proliferation. We cannot jeopardize the opportunity for future generations and degrade their ecological conditions to maintain our current lavish lifestyles.

The Joint Institute for Sustainable Energy and Environmental Future (JISEEF)¹⁾ suggests a reasonable initiative focusing on energy efficiency improvement based on a competitive service strategy, while Korean energy policy focuses on nuclear power based on a national monopoly planning approach. The initiative describes a Korean future that could maintain its economic development, significantly lowering CO₂ emissions. It compares environmental and economic effects through improving energy efficiency and conservation with electricity generation increase through additional nuclear plant construction as shown in table 2.

It shows that the cost-effective option for energy efficiency improvement is sufficient to enable Korean society to meet national economic objectives without the construction of additional nuclear power plants. The initiative built on the basis of cost-effective energy use and high-efficiency energy technology clearly justify a nuclear power moratorium.

A main advantage of the moratorium policy would be the release of US\$ 25 billion which can be spent to improve energy efficiency and conservation and developing alternative energy to meet Korean energy requirements in an environmentally responsible manner (Byrne et al 2004:263-264).

1) The Joint Institute for Sustainable Energy and Environmental Future (JISEEF) is designed to play an innovative and creative role in identifying and promoting opportunities for a sustainable future for the Korean peninsula in 2001. JISEEF carries out its goals by linking a highly respected international research team organized by the Center for Energy and Environmental Policy (CEEP) with South Korea's foremost experts in the energy and environmental fields led by the Research Institute for Energy, Environment and Economy (RIEEE) of Kyungpook National University, and including scholars from Seoul National University and researchers from the Citizens' Institute for Environmental Movements.

Table 8.2: Nuclear Power Moratorium through Energy Efficiency Improvement.

Energy Options	100% Commitment	65% Commitment
Additional Nuclear Plant Capacity	30.3 million TOE	30.3 million TOE
Energy Efficiency Improvements	33.6 million TOE	21.8 million TOE

Source: Byrne et al, p. 273.

8.3.3.2. Efficiency and Conservation Policies for Energy and Minerals.

The Korean government introduced a voluntary program²⁾ for energy-intensive industries in 1998 to reduce CO₂ emission by lowering their energy consumption. It launched a energy auditing and consulting program³⁾ for the companies having poor energy management infrastructures in accordance with the Rational Energy Utilization Act (Byrne et al 2003:84-110).

However, the programs are no match for the rapid increasing energy demand and concomitant waste, pollution and social risk that dominates the energy picture. They did not have a great effect on energy conservation in the light of a large amount of investment, because Korean energy policy has mainly sought to assure stable energy supplies from fossil fuels and nuclear power to support its rapid economic growth.

The Korean energy intensity rate remains above the world average. Its energy consumption has grown so dramatically that it records the ninth largest source of carbon dioxide (CO₂) emissions in the world (World Bank, 2008:38).

Fortunately, the JISEEF suggested a scenario (JISEEF initiative)⁴⁾ in 2003 to identify a detailed, practical and economical strategy to reduce Korean energy consumption while improving environmental quality and strengthening

2) The Voluntary Program is a strategy that companies establish their energy conservation targets voluntarily and prepare an agreement with the government to meet these targets. In turn the government pledges to support the companies through various kinds of incentives.

3) Through the Act, the Korean government has provided financial assistance to industrial building, transport, and residential sectors in order to promote energy conservation.

the national economy. In order to supply the initiative with real witness for their prudent selection, the JISEEF team painstakingly examined various options. According to its result after two years examination, the JISEEF supplied Korean people with a environmentally sustainable and economically more practical action agenda: replacing the additional nuclear power plants with an energy service regime that is technologically more diverse and decentralized, environmentally better balanced, socially more equitable, and politically more readily governable by Korean citizens (Byrne et al 2003:24).

The JISEEF initiative offers a future society that reduces CO₂ emission by 589 million tones every year, saves at least US\$ 43.8 billion in net social benefits every year, removes the need for any additional nuclear power plant construction, and restores balance (relationship) between human and non-human creation.

The Korean people stand at a crossroads whether to select their energy policy between monopoly-based nuclear power or market-based energy efficiency. They should check the monopolistic huge capital investment in nuclear plants under the government plan which will preclude her from improving cost-effective energy efficiency.

8.3.3.3. Climate-Sensitive Scheme for Global Warming.

Korea is nowadays required to take notable counter-measures for global warming. It should call for creative measures, mapping out a national comprehensive plan aimed to slow down climate change, reduce energy consumption and invent technologies that can cut down greenhouse gas emissions.

Although Korea is a member of the OECD, it is classified as a non-Annex 1 country which has no obligation to make mandatory cuts of GHGs emissions during the first commitment period of the Kyoto Protocol. Korea still wants to maintain its non-Annex 1 status not to make mandatory

4) The JISEEF initiative was prepared by a team of 38 independent researchers using objective engineering and economic methods to evaluate more than 3,000 technology options for improving energy efficiency in South Korea. These technologies already exist so that breakthroughs through research and development are not needed to implement the scenario.

cuts that can hurt its economic growth.

The Korean Government therefore announced in November 2009 that it will voluntarily cut GHGs emissions by 30% from business as usual (BAU)⁵⁾ level in 2020 compared to 2005. This is the highest figure for non-Annex 1 countries. Its target is equivalent to reducing emissions by 4% from 2005 level, falling to 569 million tons in 2020 from 594 million tons in 2005.

The government also decided to establish the Global Green Growth Institute (GGGI) to develop new technologies to fight global warming and share them with the rest of the world. The institute will act as a global think tank and as a bridge between advanced and developing countries to come up with workable solutions to our problems (Min 2009:3).

However, if Korea really wishes to make any difference in fighting climate change to save ourselves and future generations in the light of its dishonorable record of the fastest emission growth among OECD members, its immediate and comprehensive actions to fulfill the voluntary reduction of GHGs is much more valuable than hopeful messages to reduce GHGs emissions.

8.3.3.4. Scheme for Restricting the Use of Vehicles.

The most rapidly increasing sector during the last three decades was the transportation sector in Korea. A sharp increase took place from 571 thousand vehicles in 1981 to 16,428 thousand in 2007. The consumption came to 36,938 thousand TOE in 2007 as mentioned in 4.3.1.1.2.

The number of vehicles are too many to maintain them in a small territory of 99,117 km . They are a main source of CO₂ emission in Korea. So, the Korean Government should make an arrangement to restrain owners from using vehicles. Driving only odd-registered number vehicles on odd days and driving only even-registered number ones on even days is a good example.

In order to shift to a low-carbon energy system, the Government should

5) "Business as usual (BAU)" is a term used by energy researchers to refer to the likely demand for energy at a future date if there are no significant changes in the society, its economy and its policies.

additionally adopt various kinds of incentive schemes to develop environment-friendly transportation methods and turn to alternative energy to lower the carbon emission rate.

8.3.3.5. Environmental Impact Assessment through the Sabbatical Year Scheme.

The environmental impact assessment (EIA) is usually enacted as a tool of integrating environmental concerns into all major activities throughout each country. That is a procedural minimum guideline for doing business in a country.

In the light of the serious environmental impact as discussed in 4.7., the EIA for mining projects should regularly be performed to evaluate the residual biophysical impact from mining activities. The residual impact should result from a comparison of the "before" and "after" conditions rather than comparing the "before" and "during" situation. The environmental impacts from mining activities should be the total area of land that is affected and water and air consumed as well as some mining waste deposits.

Therefore, it will be a very appropriate arrangement to adopt the sabbatical year scheme discussed in 7.4.12. in mining law to arrive at a true measure of the environmental impact. Thus, the environmental management for mining activities will be fully integrated with mine management which plans, constructs, operates, transports and finally closes down mining operations through applying the sabbatical year.

8.3.3.6. Overseas Mining Policy for Preventing Mining Impact.

In order to promote Korean resource supply security and complement its poor endowment of mineral resources, it is surely accepted that its overseas mining activities is an inevitable option at present.

However, it should try to voluntarily keep clear production (CP), pollution prevention and burden of proof in the mining context of biblical sustainable development as discussed in 6.5.2 as well as adhering to environmental laws and regulations of local developing countries.

Furthermore, it should try to pay the external costs for its overseas mining projects particularly in developing countries as mentioned in 7.4.8 as

well as offering overseas developmental assistance (ODA) supported as its demonstration of benevolence for developing countries.

8.3.3.7. Officials' Attitude to Environmental Integrity.

The Korean Government should engender and stimulate attitudinal change for the integrity of creation through education on topics such as the environment, morals, nature, resources etc. and economic policies such as mining projects, energy efficiency and so forth.

In particular, holders of public offices such as parliament members, cabinet ministers, mayors etc. should fulfill their duty to keep a healthy environment. They must make sure that they are above any criticism that they are using their positions for personal financial advancement. Christians should note to elect those representatives to solve environmental issues.

They should pay attention to treating the environment as an integral part of social and economic development. If they address social and economic issues separately from environmental issues, the ecological and social collapse are inevitable. They should ensure that economic and political reform is carried out with environmental issues.

Chapter IX: Summary, A List of Critical Findings and Recommendations.

9.1. Comprehensive Summary

The objective of this thesis is to provide Korean churches with a theological framework to solve the current environmental impact of energy and mineral development in Korea. But this is merely a microcosm of what is happening in securing energy and mineral resources throughout the world, because we cannot imagine one day of our lives without energy and mineral resources in current civilized societies, just as we cannot exist without pure blood.

In effect, the key question is whether there are Christian insights and theological perspectives which can help prevent complex and dynamic environmental impacts from mining activities and nuclear plants in the environmental crisis.

Chapter 1 provides the rationale for this study by demonstrating the serious environmental impacts from mining activities and nuclear plants as well as the contribution of energy and mineral resources for the economic growth of the world and in particular, South Korea. The environmental pollution from mining activities and nuclear plants is a major factor contributing to the current environmental crisis, which brings about serious harm not only for the present generation but also for future generations.

This is an ethical issue and an urgent mission which needs to be dealt with by the church of Jesus Christ. This thesis therefore argues that all churches throughout the world, as well as in Korea, have an ethical responsibility to be actively and aggressively involved in the saving of the planet not only for the sake of all creation but for the sake of our Lord God who trusted us with His planet.

We have participated in this sinful destruction of the environment by our greed and silence on the issues of the damage caused by the exploiting of energy and mineral resources and the establishment of nuclear plants for economic gain and easy comfortable lifestyles. We do not want to give anything up; we simply wish to increase our wealth and comfort at whatever cost.

Chapter 2 looks at the characteristics and demand-supply of energy and

mineral resources to understand what is going on in the course of mining activities. And then it discusses the demand-supply of energy and mineral resources to analyze the world's dependency on these resources.

There are tables of world trends regarding reserves, demand, production, exports and imports of energy and mineral resources to show the economic impacts of these resources particularly in the rich advanced countries such as the United States of America. It can be clearly seen that the demands of the rich developed nations are much higher than the developing countries.

Particularly, the reserves of fossil fuels such as petroleum are already low, but they provide nearly 90% of the energy which drives industrial society (UGI 2004:2-16). Fossil fuels are responsible for much of the earth's pollution and directly attribute to the global warming.

However, they are still considered to be fairly cheap sources of energy so that there has been very little done to replace these forms of energy. When we discuss these sources as forms of cheap energy, it is because the cost to the environmental degradation (external cost) is not considered into our economic market prices.

World trends in mining policy is finally discussed to manage scarce non-renewable resources in the world. The wealthier Northern countries face new pressures as they depend on the energy and mineral resources of the poorer South, while the South wants to have a say in the management of its own resources. While the divide increases, the crisis intensifies.

Chapter 3 discusses the environmental impact from mining activities and nuclear plants which is not a local issue but pertinent to the whole world and humankind. The discussion begins with the damage caused by the mining industry and goes into greater detail about what happens in the course of mining activities. Then the discussion moves to what happens when a mine closes down.

The complex and dynamic environmental impacts and damages are caused by mining activities in the every where in soil, water, air and human and animal body, which are acid mine drainage, oil leakage, acid rain, GHGs emissions, radioactive waste discharge and deforestation etc. In order to emphasize that we habitually consume energy and minerals without considering such a valuable cost for them, it is worth repeating the statistic that on average of 40 people are killed every day only in mines in the world at the moment.

This chapter takes a serious look at the issue of climate change from GHGs emissions which is just an indicator of the threats we face as a rigorous alarm from our Lord God. We should recognize that while the earth is killed in the environmental degradation, we are indulging ourselves in overdevelopment and overconsumption.

It is obviously our urgent duty to heal the climate change caused by human beings. If we do not act to recover it, the true cost of our failure will be borne by future generations. This is the moral challenge of our generation. We should therefore set up a road-map for a more secure climate future. We cannot rob our children of their future.

The post Kyoto Protocol is also discussed as a concerted effort of not only the richer nations but also all the countries to try and control the damage for the future. In order to make a real difference, the only way is to take action together based on loving each other. Instead of saying "you first," we should start by saying "me first."

Finally, there is a detailed discussion on the environmental impact from nuclear power plants. Nuclear power and waste disposal have been on the world agenda for many years. In spite of such long research and development, the nuclear waste disposal is still left as a serious environmental problem for nuclear power plants. So, it is often remarked that establishing a nuclear plant is like building a luxury house without a toilet.

Chapter 4 focuses on the environmental impacts from mining activities and nuclear plants in Korea. It goes into the detail trends of economic growth which has been accompanied by rapid ecological dilapidation and environmental pollution. The environment was sacrificed by pursuing more economic growth through industrialization in Korea.

The chapter looks at the energy and mineral consumption and supply in the past 30 years: how it has grown with the economic growth of the country, the eventual closing of mines because of their low reserves and poor profits, how Korea has had to look elsewhere and develop an overseas energy mineral development policy to meet and cope with the high demands of the nation.

This chapter goes on to discuss the environmental impact from mining activities in Korea such as acid mine drainage, mine tailings, soil contamination, mine subsidence, oil leakage, and pollutions from asbestos

and coal mines, oil refining plants and copper and zinc smelting and refinery plants etc. Some case studies are introduced to show soil and ground-water contamination from residual mine tailings and acid mine drainage in some mine areas.

Particularly, there is a detailed discussion about how mining companies have dealt with closed mines and the resulting damage done to the land and people of the mine areas. There is also a more detailed discussion on the increasing CO₂ emission which is the most serious environmental problem Korea is now facing.

In the chapter there is also a detailed discussion on the environmental impact from nuclear plants in Korea. This includes a little bit of the history, the amount of plants at present which are in operation and the present as well as the potential damage to the environment. It also discusses the disposal place of nuclear waste building in Korea from 2008 and how inadequate it is going to be in terms of future generations. There are tables to clarify this situation for the reader.

The chapter particularly points out the environmental impact from nuclear waste disposal and plant-building plan which will definitely bring about serious burdens for future generations.

Chapter 5 looks at the environmental involvement of Korean churches in the light of the environmental impacts from mining activities and nuclear plants that are taking place throughout the world and in particular Korea. The discussion focuses on their environmental initiatives in Korea looking at the Protestant church and the Catholic church. There is an outline of each denomination's involvement with some statistics and their financial commitment towards environmental issues.

The discussion analyzes why Korean Protestant churches are not as proactive as they should be in the light of the environmental crisis which is seriously affecting their environment and health. Korean Churches in general have put more emphasis on church growth than anything else, hence the lack of urgency regarding the environmental crisis which looms heavily not only in Korea but throughout the whole world.

This chapter concludes by assessing the major activities of Korean churches pointing out that in Korea this is far too little. There should be so much more environmental initiatives required in this whole area and it should be Korean churches rather than secular organizations leading the

way. Because the earth is our Lord God's. He entrusted to all Christians the care for the earth and all creation.

In order to develop a new concept of sustainable development in accordance with the will of God as a practical matrix for theological framework, Chapter 6 firstly looks at the origin and controversies of sustainable development, two competitive views on the social and environmental future of cornucopia and outbreak crash, fundamental roots of environmental degradation, and biblically based propositions for sustainable development.

As the biblically based propositions for sustainable development, the chapter points out that the earth is the Lords, human role of imagined God, relationship between humans and nature, the creation as a mirror of human hearts, environmental crisis from sinful hearts, lifestyle with the image of Christ, and responsibility for ecological integrity.

This chapter then suggests a new concept of sustainable development in accordance with the will of God which shows a fundamental approach going beyond discussing only the socio-economic forces encouraging population growth, technical development and production activity on account of anthropocentric greedy values. It concludes with a proposal of biblical sustainable development in the mining context as a basic tool to develop a new mining scheme for ecological integrity.

Chapter 7 discusses a theological framework as a practical model from which biblical sustainable development of energy and mineral resources in accordance with the will of God can become a realistic project for the entire world led by Christians everywhere.

This discussion begins with a re-examination of scripture in the light of biblical sustainable development in accordance with the will of God unfolded in previous chapter. This chapter firstly discusses theological perspectives for biblical sustainable development to develop the rudiments of an environmental ethic grounded in the bible. Secondly, it suggests practical guidelines for individuals and churches to lead this world into the biblical sustainable society based on the theological perspectives.

This chapter concludes by discussing the status of the church at present in this environmental crisis and how the Church can lead the way to the biblical sustainable society. All the churches in the world must act

together in defence of creation, and encourage the participation of people against the powers of oppression and destruction through world Christian networks.

Chapter 8 begins with a critical evaluation of the environmental activities of Korean Churches based on the theological framework for biblical sustainable development of energy and mineral resources unfolded in the previous chapter to clearly identify the challenging tasks which they are now facing. This chapter discusses the theological and ecclesiastical weakness of Korean Churches and how much their mission has strayed from the purpose of our Lord God regarding energy and mineral issues in the environmental crisis

The chapter moves on to evaluate the Korean energy regime and mining policy to suggest directions of the Korean government as practical targets for their environmental initiatives in accordance with the will of God.

The discussion points out Korea's high dependency on fossil fuels which results in the severe damage to the environment, especially regarding CO₂ emission causing climate changes. According to the recent statistics, Korea has one of the highest emissions of CO₂ in the world and is in a vulnerable position compounded by her heavy dependence on fossil fuels.

This chapter moves on to a discussion about Korea's nuclear power policy. Korea's nuclear policy is an emotive subject and causes much discussion, protest, intense debate and even violence. This is because there are many unresolved issues surrounding nuclear power plants.

This chapter suggests directions for individuals to build a biblical sustainable society. In order to build the society, Christians must first of all change themselves. A list of checkpoints is offered to assist in doing this. From this point we are in a strong position to tackle a change in society and to live a Christ-like way of life.

The chapter goes on to discuss practical guidelines for Korean churches to practice to be proactive in the environmental initiatives, and then concludes by suggesting directions for the government to offer practical targets for their environmental initiatives.

The Church is arguably the most powerful institution in the world and can literally move mountains because it has its power from God. This power has to be utilized not only in Korea but in the whole world in order that humanity can save this planet before it is too late.

9.2. A List of Critical Findings (Conclusion).

1. The environmental impacts from mining activities and nuclear plants have been taking place throughout the world as well as South Korea, while the contribution of energy and mineral resources for the economic growth has been increasing throughout the world as well as South Korea in the current civilized society.

It is clearly confirmed that the environmental pollution from mining activities and nuclear plants is a major factor of the current environmental crisis, which brings about serious damage not only for the present generation but also for future generations. Particularly, the environmental risks transcend borders. It could even come to jeopardize international peace and security. Furthermore, mining cannot be sustainable because the deposit is finite and is eventually exhausted.

Therefore, there is a pressing need in the new century to adopt sustainable energy and mineral options, especially in the face of mounting evidence of global warming linked to fossil fuel use, the environmental impact from mining activities and the persisting threat of nuclear accidents, unresolved problems of radioactive waste disposal, and the specter of nuclear weapons proliferation associated with continued use of nuclear power.

2. We have participated in this sinful destruction of environment by our greed and silence on the issues of the damage caused by the exploiting of energy and mineral resources and the establishment of nuclear plants for economic gain and easy comfortable lifestyles.

We are indulging ourselves in overdevelopment and overconsumption, while the earth is being killed in the environmental degradation. In particular, the climate change is just an indicator of the threats we face as a rigorous alarm from our Lord God of grace. If we do not act to recover the global warming, the true cost of our failure will be borne by future generations.

Therefore, the environmental problems are not only scientific, technical, political or strategic questions, but also fundamentally moral issues. They are human-created problems that adversely affect the good of humans and other creatures in our relationships.

This involves an urgent mission which needs to be dealt with by the

church of Jesus Christ. This thesis therefore argues that all churches throughout the world as well as Korea have an ethical responsibility to be actively and aggressively involved in the saving of the planet not only for all creation but for our God who entrusted us with His planet.

3. In particular, the giant transnational companies (TNCs) of advanced countries have maximized short term profits, undermine the capacity of poor countries and contribute to the serious degradation of the environment through their control over energy and mineral resources, access to markets, and development of new technologies.

Furthermore, TNCs are using developing countries to dump some of their toxic wastes and exploit their energy and mineral resources. The governments of developing countries are so eager for foreign exchange that they do not have stringent legal conditions in place for the safety of the environment and their people. Therefore, it is urgently necessary to set up conduct codes for TNCs in accordance with the biblical sustainable development to prevent their ruthless business for their profits.

4. The Korean government has justified its heavy reliance on fossil fuels and nuclear plants to promote its growth-oriented economy for several decades, in spite of mounting environmental problems, financial burdens from increasing huge costs, and complaints against the technocratic system of energy governance.

The Korean energy and nuclear regime is a major pillar in support of its rapid economic growth, but resulted in producing serious social and environmental problems. Additionally, Korea has pursued her supply-oriented energy policy with mostly overseas energy and mineral resources for the past half century because of her poor endowment of energy and mineral resources.

In the light of environmental impacts from mining activities and nuclear plants in Korea, it is necessary to check the Korean energy regime and mining policy and change them to operate more in line with the biblical sustainable development system in accordance with the will of God. Particularly, the increasing CO₂ emission in Korea, already exceeding the OECD average, is the most serious environmental problem contributing to global warming. Therefore, it is urgently necessary to alleviate the high dependence on fossil fuels in the Korean economic system.

5. Most of Korean Protestant churches have not taken note of the ecological mission particularly regarding environmental degradation from nuclear plants and mining activities. They have generally enjoyed their quantitative growth, keeping pace with the rapid economic growth.

In spite of the fact that they have abundant human and physical resources and wide networks to effectively perform environmental initiatives, when it comes to coping with environmental pollutions from mining activities and nuclear plants, there is almost nothing to mention regarding their environmental involvement except for voluntarily participating in the oil-removing activities in the west seacoast polluted by the oil spill disaster in December 2007.

The church is God's vehicle through which He reaches out to the world to establish His Kingdom. We are stewards on behalf of God who has entrusted creation and its resources for our wise management. However, the churches have not spelt out in clear terms the will of the Creator God to be in harmony with all human and non-human beings.

6. The church-centered leadership of Korean churches as the result of a dichotomous theology that the church is good and the world is evil is nowadays confirmed as a primary factor preventing them from participating in environmental initiatives (social development).

As a result, they failed to promote their social responsibility and lost much of their credibility in the Korean society. Their total membership has decreased more than 10% during last 15 years. However, most of their endeavors have ironically concentrated on developing leadership skills, programs and methodology to experience numerical growth again.

7. The structural factors which Korean churches have performed poor environmental initiatives, particularly regarding environmental impacts from mining activities and nuclear plants, are pointed out as the following:

- 1) Sporadic reactive motivation for environmental initiatives.
- 2) Environmental initiatives without practical guidelines.
- 3) Poor infrastructure for environmental initiatives.
- 4) No comment on environmental issues.
- 5) Indifference of pastors about environmental problems.
- 6) Deficiency of environmental education system.

In particular, Korean Protestant churches have been divided into more than 100 denominations. When they are nowadays concerned with the environment initiatives, they can mainly be classified into two groups of progressive churches and conservative churches. The former has been relatively active, while the latter has almost become silent regarding the environment.

8. This thesis developed a new concept of sustainable development in accordance with the will of God as a practical matrix for theological framework to help prevent the environmental impacts from mining activities and nuclear plants. That shows a fundamental approach going beyond discussing only the socio-economic forces encouraging population growth, technical development and production activity on account of anthropocentric greedy values as the following:

"Biblical sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs in harmony with all creation within the carrying capacity of the earth through changing the lavish lifestyle in affluent societies and amending a neoclassical fossil-fuel economic system in accordance with the will of the Creator."

A new concept of cleaner production (CP), pollution prevention and burden of proof is also suggested as a basic tool to develop a new mining scheme for biblical sustainable development in the mining context. If we as Christians were to truly practice biblical sustainable development in accordance with will of God, the environmental issues from mining activities and nuclear plants would be an easy task in the current environmental crisis.

In the course of developing biblical sustainable development in accordance with the will of God, it is confirmed that the fundamental roots of environmental degradation are not Christianity as criticized by some environmentalists including Lynn White, Jr., but the fall of man, human greed, anthropocentrism, the limited carrying capacity of the earth, the second law of thermodynamics, the economic growth mania, consumerism, maldistribution, population, risks of nuclear plants, and the marketing price

system.

9. In order to set up a theological framework for individuals regarding biblical sustainable development of energy and mineral resources in accordance with the will of God, it is necessary to look at the whole Biblical doctrine of creation, awakening all Christians to what it teaches and reminding us of our responsibility. Lastly we should demonstrate what the doctrine of creation teaches how we live, our concerns for others and by developing unselfish attitudes proving that God is truly at the center of our lives.

We should keep in mind that God did not create the earth for only humans but for all of creation. Especially, ignoring God's wishes for protecting the environment is ignoring not only our own health and well-being but also opportunities for future generations and all the creatures on the earth.

With God's help we should try to change our lavish lifestyle into a more simplistic lifestyle and replace quantity into quality, material richness into spiritual richness and ruthless development into ecological integrity. We should be doing what is right and just according to the life of our Lord Jesus Christ.

We should recognize that God created the earth with its own properties and limits. Learning how to work with and within the limited carrying capacity of the earth is a major task for Christians in following the will of God, who not only asks us to love each other as humans but also non-humans through practicing ecological virtues such as frugality, solidarity, sustainability etc.

Therefore, we as Christians cannot sit back and watch the environment being abused and say and do nothing about it. We must try to have an attitude of humility, frugality, relationality, solidarity and sustainability in our daily lives and follow the life of our Lord Jesus Christ in the light of the limited carrying capacity of the earth. We should throw away our current anthropocentric lifestyles, giving up selfish intentions to satisfy the insatiable greed through overdevelopment and overconsumption.

10. The church is not an inward-looking body committed only to worshipping its Lord. The church's ministries are not some set of arbitrary services, but they are a response to God as our Minister. Our churches

must again take a fresh look at the Lord of the church, Jesus Christ and the community that He has formed for Himself (Eph. 1:22).

The environmental responsibility is not an option, but a mandate that must be incorporated into the whole. It is one of the signs of a valid Christian ministry. Since God's ultimate goal is the perfection of just and harmonious relationships (shalom) among all creatures, the church's historical mandate includes the pursuit of justice, peace, and ecological integrity.

In the context of the environmental crisis, the church should be a leader to transform a society through practicing social ministry. The Christian community therefore needs to develop practical policy approaches to the environment and environmental issues in the process of social ministry such as analysis–reflection–practice–feedback based on the Biblical perspectives.

The church must be willing to identify and condemn social and institutionalized evil, especially when it becomes embedded in systems. It should propose solutions which both seek to reform and replace creation–harming institutions and practices. It should be a center to exemplify eco–justice through the practical discipline of all its members.

11. The environmental problems Korea is now facing do not mean that it is impossible to change into a sustainable and democratic energy and mineral future. There are bright alternatives available for Korean society. The biblical sustainable development option in accordance with the will of God is the way to lead Korea into a new sustainable society.

In order to work toward this option, institutional mediation is surely needed to promote social changes. But its success ultimately depends on the energy and determination of the Korean people, particularly Korean church members in their different contexts to work for the new biblical sustainable development order. Therefore, the full support and prayers for solidarity and readiness of Korean churches are truly necessary. It is also necessary for Korean churches to enter into alliances of cooperation with others.

However, when it comes to coping with environmental pollution from mining activities and nuclear plants, Korean churches really have no honorable position. Most of them are unconcerned about the serious environmental deterioration from mining activities and nuclear plants. They have generally executed their pastoral duties with an indifferent position

towards political and economic programs and structures. They think that environmental issues are only for government and specialized non-governmental organizations, not for the Christian churches.

They are still in the initial stages of formulating Christian guidelines for biblical sustainable development in accordance with the will of God. Their environmental programmes are still far from reflecting a systematic approach to cope with the environmental pollution from mining activities and nuclear plants.

12. In order to build a biblical sustainable society, Korean churches should take the environmental initiatives into their main mission so that the church leaders constantly preach the message of loving all creation and caring for the environment as well as for our neighbours. This should be reflected in their worship through their liturgies, in their prayers, in their bible studies and as a key factor in their social responsibility as the children of God.

In order to change their attitudes, it is necessary for them to reorient their faith and ethics, focusing on relations and community, not only on individuals and objects, in accordance with the new story of the earth and cosmos embodying forth the power, wisdom and love of God. They should read and interpret the Bible with more alertness to nature, reflecting on real praxis for biblical sustainable development in accordance with the will of the Creator through reinterpreting the Bible.

Their dualistic ministry separating individual piety and social behavior, faith and deed, contemplation and commitment, prayer and action, spirit and body, heaven and earth, horizontal relation and vertical relation, etc. should be replaced with a social ministry which also deals with environmental issues. The reason is that environmental degradation is a problem of social justice related to both human and non-human creation.

They must dare to proclaim the full truth about the environmental crisis in the face of powerful persons, pressures and institutions which profit from concealing the truth. Such recognition of the hard truth is an important step towards the freedom for which creation waits.

In particular, they should have a firm belief that social ministry is the best way to set off their revival movement again. The recent member growth trends of both the Catholic and Protestant church are a good witness for the movement.

13. Korean churches should firstly develop their own practical guidelines in order to be proactive in protecting the environment from the serious pollution confronting them in their daily life as Christians belonging to the Creator Jesus Christ. Secondly, they must establish an infrastructure for environmental initiatives such as manpower, budget, structure etc. Thirdly, they must initiate and support the process of education for the growth of earth-keepers, both in the habits of everyday life and in the provision of leadership for the care of creation.

Korean pastors should firstly confirm that their environmental actions are not only for their own sake, but also for that of God's Kingdom. Secondly it is necessary for them to act as a pioneer in environmental initiatives. Finally they should lead God's people not to commit environmental sins through practicing environmental guidelines for the biblical sustainable development in accordance with the will of God.

14. There are several practical targets for Korean churches to push their government to counter environmental impacts from energy and mineral resources as the following:

1) They should strongly point out the high dependency on fossil fuels which results in severe damage to the environment, especially regarding CO₂ emission causing climate changes. According to the recent statistics, Korea has one of the highest emissions of CO₂ in the world and is in a vulnerable position compounded by her heavy dependence on fossil fuels.

2) Nuclear power is the modern day answer to fossil fuels in that it is clean and does not emit CO₂ into the environment. However, the proponents of nuclear energy omit to tell us of the dangers of accidents causing radioactive contamination, unresolved problems of nuclear waste disposal and nuclear weapons proliferation associated with the nuclear power plants. Additionally, it encourages people to use energy consumption more to make up for the huge costs not only for the construction but also the hidden costs.

Therefore, Korean churches should push the government to proclaim a nuclear power moratorium for additional nuclear plants until developing a perfect technology to cope with the nuclear wastes. Instead of establishing new nuclear plants, she should make concerted efforts to carry out effective energy efficiency improvements and develop other alternative energy

resources such as solar, hydrogen and wind energy and so forth.

3) They should have kept in mind that as the world becomes more exploitable and more profligate, the environment of this planet degenerates unto the brink of total destruction, contrary to the will of God. Therefore, they should push the government and mining companies to develop a more careful approach to the limited energy and mineral resources and prevent various pollutions from mining activities in developing countries as well as in Korea. In order to use energy and mineral resources from generation to generation in accordance with the will of God, mining policy must be developed attuned to the carrying capacity of the earth, comprehensively managing human numbers and lifestyles together with technologies and management practices.

4) The fundamental cause of poverty is almost the same as that of environmental degradation. The gap between the rich and the poor in Korea has increased much in the course of her rapid economic growth. In particular, a lot of the poor were produced as a result of the Korean financial crisis in 1997. Korean churches should keep in mind Paul's appeal to accept God's preferential option for the poor. They should recognize that the worth of a society is measured not by its power, wealth or size, but by how it cares for the poorest and weakest members.

9.3. Recommendations: Further Research.

There are two further research fields, touched upon in this thesis, which I should like to recommend students and theologians to urgently explore to help heal the serious environmental crisis.

9.3.1. Control of GHGs Emission for Climate Change.

Rapid environmental change is all around us. The most obvious example is climate change today. Weather-related disasters are already having dramatic impacts on all the animals and nature as well as human beings. While the earth is being killed in the environmental degradation, we are indulging ourselves in overdevelopment and overconsumption.

Ironically, climate change is more unfavourable to the socio-economically weak, who are usually less responsible for the advent of climate change and have less ability to cope with the impact of climate change. It has turned

out that Africa is the continent suffering most from the impact of climate change. Most of Africa will be hit the hardest if climate change continues on its current course.

The climate change is just an indicator of the threats we face as a rigorous alarm from God of grace. It is obviously our urgent duty to heal the climate change caused by human beings. If we do not act to recover it, the true cost of our failure will be borne by future generations, starting with ours. So, the climate change is not only a political and geological problem, but also an ethical and peace problem for all creatures.

However, no sign of a deal emerged amid the wide gap between advanced and developing countries at the Copenhagen climate talks held in December 2009. They only agreed to set a target of limiting global warming to 2 degrees Celsius above pre-industrial times.

Therefore, it is urgently necessary to do further research on the control of GHGs emission for climate change based on biblical sustainable development in accordance with the will of God. It is difficult to heal the climate change without a fundamental approach going beyond anthropocentric greedy values. Nobody wants to give up anything; we simply wish to increase our wealth and comfort at whatever cost.

9.3.2. Conduct Codes for TNCs based on Biblical Sustainable Development.

There has been a lot of criticisms about the negligence and wrongdoing of giant transnational corporational companies (TNCs) of advanced countries, which sacrifice the lives or health of people as well as the integrity of the environment for the sake of their profits. Particularly, through their control over energy and mineral resources, access to markets, and the development of new technologies, few studies doubt that TNCs have maximized their profits, undermined the capacity of poor countries and contributed to the serious degradation of the environment.

The business differences are exploited by TNCs for their commercial advantages, investing in the regions in which production costs are lowest because of low regulatory standards and expectations. In return, competition for internal investment is said to put further downward pressure on regulatory standards in those countries, especially the poorer countries of the world, struggling to achieve economic growth.

The international "corporate social responsibility (CSR)" movement has

developed in response to these perceived gaps in the regulatory systems. The CSR movement has been described as one of the most important social movements of our time in the environmental crisis. As a result of the movement, there has been during the past few years an extraordinary proliferation of "codes of conduct for TNCs." But they all struggle to define what corporate social responsibility (CSR) means in practice.

Therefore, it is urgently necessary to do further research on conduct codes for TNCs based on biblical sustainable development in accordance with the will of God. Its purpose is to encourage all the churches in the world to participate in the CSR movement. The CSR can no longer be dismissed as a passing trend in order to heal the serious environmental crisis. New international institutions should promote the CSR standard of TNCs according to the biblical sustainable development in accordance with the will of God. TNCs must have responsibilities to enable them to be good corporate citizens in the context of the environmental crisis.

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